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RESIDENTIAL ENERGY CONSERVATION:

DO FOLLOWUP PROGRAMS MAKE A DIFFERENCE?

By

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CHAPTER I

INTRODUCTION

Field research on the effectiveness of energy conservation programs has often focused on single, or "one-shot", interventions, but has rarely examined programs which integrate deliberate followup components. The present research was designed and implemented to assess whether such deliberate followup components might serve to increase residential energy savings.

In the first section, the problem of diminishing residential energy fuels and the need for improved efficiency in the use of these fuels are discussed. The second section suggests opportunities for positive action and the theoretical basis for interventions which were tested in this study. In the latter pages of this chapter the rationale for the selected program design and the experimental hypotheses are presented.

The Energy Efficiency Challenge

The Problem

Since the turn of the century, the United States has experienced a rapid growth in the use of fossil fuels (coal, natural gas, petroleum) but only recently has it become apparent that these resources are finite and world reserves are being rapidly depleted. The most dramatic signal of this reality came with the Arab Oil Embargo of 1973-74. At this time, our immense dependency on plentiful supplies of these fuels became clear. The shock of limited fuel supplies was particularly acute in the United States since energy intensive life styles were considered normal. It has been estimated that Americans use 30 percent of world energy produced in a year, yet they account for only six percent of world population (Koenig, 1979). Thus, limitations in fuel supplies and increases in price were a sharp departure from previous tends.

A study in Michigan, authored by Gladhart, Zuiches, and Morrison, (1977), documented that in the two years following the Arab Oil Embargo, all household energy prices went up dramatically: 126 percent for fuel oil, 81 percent for natural gas, and 50 percent for electricity. Even without total decontrol of fuel prices, this trend continued. By March, 1981, an average natural gas customer in Michigan could expect to pay in excess of three times the 1975 price (Skwira, 1981). Obviously, these increases had certainly outstripped average increases in family income. A partial result was that families had to spend an increasing proportion of income on utilities. Furthermore, the Public Service Commission of Michigan predicted a 104 percent price increase in natural gas by 1985 (Sharky, 1982): the actual increase between 1980 and 1985 was 48 percent (Energy Information Administration, 1983-85).

One response to the energy problem was to simply attempt to use less energy. Perhaps the most personally compelling reasons for energy conservation were that it represented actions the average person could do, which were ready and reliable (tested and nonexotic), and which yielded immediate energy cost reduction benefits (Seven Reasons, 1981). On a policy level, it represented the least expensive method for combating energy cost increases (Ross, no date).

Even with these seemingly direct incentives only modest energy conservation was realized. During the dramatic price hikes in 1974-76, average homeowners only decreased utility usage by five to ten percent (Morrison, Keith, and Zuiches, 1978, page 9). Research revealed "little evidence that families with higher or more rapidly rising fuel prices have higher rates of reported conservation practice adoption (Gladhart, Zuiches, and Morrison, 1978, page 1)."

Reasons for the lag in conservation actions were suggested by survey research (Olsen and Goodnight, 1977); apparently many people were unaware of what could be done, how it could be accomplished, and which conservation actions would be most cost-effective. While utility bills provide feedback on usage and cost, their deficiency was attributed to the fact that this information was delayed and very general (Carlyle and Geller, 1980, page 9); the billing did not provide information or instruction on specific conservation actions. It was precisely this deficiency in specific information that the program tested in the current research addressed.

Priorities

The cost of residential fuels obviously provided some incentive to homeowners to find ways of conserving, and thereby reduce their fuel bills. Nevertheless, it appeared that without appropriate information on conservation action alternatives, improvement in residential energy efficiency would be delayed. From this perspective, efforts to hasten conservation action would logically involve effective methods of contact, education, and training. The question of the best approach to this task was first reviewed from the standpoint of logistics.

Until 1981, the Federal Department of Energy conducted a myriad of energy conservation programs, but budgetary and policy changes removed the federal government from its previous information and technical assistance role (Conservation: Uncle Sam Bows Out, 1981). As an increasing number of consumers found it difficult to pay rising utility bills, state government, local government, and local organizations were called upon for help. Cutbacks in service at each of these levels placed greater emphasis on coordinating programs at a community level.

This notion of coordinating community based programs was also the topic of applied research. A study of innovative community programs (Pelz, 1981b) indicated that "energy programs succeeded when local organizations took leadership (but department officials took a back seat), when other local governments supplied their experience, and when state agencies established standards" (page 13). It was further found that this kind of coordination was especially important with energy programs since energy issues were relatively heterogeneous, reaching all public and private sectors (Pelz, 1981a).

As various types of intervention were considered, it was argued that developing energy conservation programs at a community level was desirable since the infrastructure of local organizations could be called upon for informal networks of communication and volunteer membership. Local government could offer necessary programmatic support services, and state government could offer specific technical assistance to build local energy conservation competencies. Pelz (1981a, 1981b) emphasized that state agencies best used their resources by (a) providing technical assistance during energy conservation program development and by (b) facilitating the sharing of innovative solutions between communities.

The next question was: Where should a community energy conservation program effort start? At least two well known community energy programs suggested that initial efforts be made in the residential sector. In Springfield, Illinois, Al Casella (Benson, 1981) pointed out that the broadest consensus and support could be gained from helping the homeowner and renter with energy conservation. A similar experience was related by the organizers of the Fon Du Lac county energy program (Lehman, 1981).

Additional support for starting with the residential sector came from detailed research by the Energy Policy Group (1981, page 87). Their basic recommendation for statewide (Michigan) conservation priority was for "retrofit (not new construction) residential conservation." Also, in an analysis of economic sector usage, Stern and Gardner (1980) reported that the estimated percentage of energy use in the residental sector was a very close second, at 32.5 percent, compared to the industrial sector (35.9 percent). Therefore, the residential sector qualified as a worthy initial target for conservation on the basis of percentage of total use.

Thus, it was clear that some good reasons existed for developing energy conservation programs through the organized effort of communities, and for focusing on the residential sector (as a starting point). Further, for residential dwellings, there was little doubt that the biggest target for energy savings was in space heating and cooling. In the northern states the expense of home heating was paramount. Meeks (1981, page 26) as well as Stern and Gardner (1980) confirmed that heating and cooling were the largest energy users in most households. In fact, while residential energy use was increasing between 1960 and 1970, of the increase, 42 percent was in this category (Large, 1973).

Research on residential energy conservation actions also supported this program direction. Survey data collected in Michigan, (Morrison, Keith, and Zuiches, 1978) revealed that the "greatest potential energy reductions were related to space heating" (page 6). Further, an example of one concerted heating-related retrofit effort was documented in Twin Rivers, New Jersey: 67 percent of previous heating costs for a town house built in 1972, was saved from the "simple package of interior window insulation, basement and attic insulation, and plugging air leaks" (Seven Reasons, 1981). The reader will note that all these conservation actions were one-time efficiency actions, apart from any curtailment behavior (Stern and Gardner, 1979).

Clearly, using a community context for residential space heating conservation programming appeared to be an appropriate initial conservation information focus. Research findings therefore suggested the need for effective methods of contact, education and training. By addressing the problem at a community level, effective roles for state and local government could be incorporated. Within communities, the residential sector was identified as a good choice for initial program intervention since it represented potential for infrastructure-building and for major energy savings. Finally, of the various end uses for residential fuels, space heating was identified as a primary target for greater energy efficiency.

Influencing Voluntary Actions

Technical Expertise

Once program priorities were determined, attention turned to the selection of specific initiatives which might be effective in bringing about the desired change of more efficient energy use in the residential setting. In the field of residential energy technology it was commonplace to suggest solutions provided primarily by physical science engineering. These solutions might well have included the offering of energy conservation products such as thermal insulation or special thermostats. It was less frequently recognized that the fields of information transfer (communications and marketing), and the traditional social sciences (sociology and psychology) offered solutions which could facilitate the rapid adoption of the technology provided by the physical sciences. It was considered important that both the physical and social technologies be incorporated in addressing the need for greater residential energy efficiency. From the standpoint of the residential customer (who ultimately must decide what, if anything, will be done about the energy use of their residence) not only was the availability of the energy conservation products important, but the system of information, and sufficient incentives for use of the products were also essential to an affirmative voluntary decision.

While reference will be made to several types of energy conservation actions, many of which suggest the application of the physical products readily available to consumers, most of the discussion in the current report will refer to the application of information and social science technologies in the adoption of these actions and products. It was the application of these two latter technologies to the problem addressed above that was the focus of the present research.

Several researchers familiar with energy conservation (Morrison, 1974; Winett and Neale, in press; Shippee, 1981) readily recognized the necessary interface between the technologies of energy conservation hardware, and social-psychological solutions for designing optimal promotional strategies. Pelz and Munson (1980) articulated this concept quite well:

> The distinction between technological and the embedding content of an innovation makes it hard to discuss the "innovating process" while ignoring the innovation itself. There is a compelling linkage, for example, among the technological complexity of an innovation, the power of the innovation source, and the strategy at design stage (page 17).

Thus, an effective strategy would operationalize a "best mix" of these technologies.

In the formulation of these strategies, the role of the social science practitioner could often be quite varied and far reaching. Five basic roles were suggested by Stern and Gardner, (1979):

1. identifying and implementing direct social strategies
2. enhancing market penetration of new technologies
3. predicting and analyzing barriers to implementation of programs
4. predicting and analyzing social impacts of programs
5. field evaluation of program effectiveness (page 47)

A combination of these roles permitted the social scientist to offer help in very direct and practical ways.

With regard to research on energy conservation programs, where energy conservation was best regarded as a set of product and process technologies, it became clear that these technologies could not be solutions in and of themselves; people needed to know whether or not these solutions were appropriate for their situation, and how they could be applied. Social science, with expertise in social adaptation and learning, could help fill this need (Carlyle and Geller, 1980).

Compound Program Design

Since the general program goal was to activate an entire community around the issue of residential energy conservation, it was important to incorporate and organize resources and strategies which benefited from combination (Stern and Gardner, 1979). One component of such a combination strategy included elements which addressed the decision-making process a community resident might go through in deciding on a personal course of action. According to Burns (1980), the steps in this process might be the following:

1. identifying or recognizing the problem;
2. determining information already available;
3. detailing additional necessary information;
4. defining possible solutions or actions;
5. evaluating such solutions;
6. selecting a strategy for performance;
7. actual performance of an action or actions; and
8. subsequent learning and revision based on the outcomes (page 11).

It was reasoned that an optimal program design would clearly need to include components which provided clear, concise, and personalized information to the individual participant. Because actual decision-making only occasionally follows the above sequence it was important to design a program for voluntary participant actions which offered maximum opportunity for the most accurate line of decisions. Stated another way, a strategy which addressed the multiple barriers to adoption of energy conservation decisions at each step was believed to be more effective than a singular approach (Kelman and Warwick, 1973).

Beyond the organized provision of pertinent information it was also suggested that there was definite merit in making it possible for participants to experience successes resulting from beneficial conservation decisions. Albert Bandura, author of the self-efficacy theory (Bandura, 1977), further pointed out the need to include exposure to performance accomplishments (successful experience), live modeling (to demonstrate necessary skills) and verbal persuasion. His conceptual framework therefore included the cognitive, decision-making components (information) which could lead to action, but it also emphasized skill acquisition (experience).

These concepts provided the theoretical basis for intervention strategies. In order to be operationally valid, Thornton (1976) recommended the importance of project management design which embodied the elements of goal clarity, specific recommended action steps, and the presence of social support for the action.

Although a compound program design was focused on components designed to prompt conservation actions, as Hansen (1976) pointed out, attitudes and beliefs about energy conservation might be part of the decisions to conserve. For this reason the current research included measurement of energy conservation attitudes, and beliefs about the relative salience of certain barriers to conservation actions. Including the measurement of these internal processes made it possible to assess their relationship to program outcomes.

Factual Information

In order to be persuasive, information which could be used in decision-making needed to be clear and unmistakably pertinent to the person's own immediate situation. In the process of providing new, unique, and very personalized information it was obviously desirable to design interventions which captured a person's attention and optimized the likelihood of appropriate reactions.

Since the challenge in program design was to assemble somewhat novel and compelling information for the participant it was necessary to incorporate the best available technology. It was concluded that the ability to show a resident of a community where, on their own residence, actual heat loss (i.e.,thermal inefficiency during winter months) was occurring, would be a rather profound means of persuading a person to take appropriate (heat) conservation actions. This then was the applied physical science technology aspect of the program design and it served as a foundation on which the total energy conservation information package was built. Thus, the physical pictures of residential heat loss were coupled with selected verbal and written information on where, when, and how to complete heat saving energy conservation actions.

Persuasion Approach

A review of recent research on residental energy conservation, innovation diffusion, and learning theory suggested the types of program components best suited for inclusion. Six types of potential design components were analyzed.

Incentives. Cash payments are an obvious way to induce people to conserve. In fact, it was observed that this method might even be the most effective (Leedom, 1980, page 12), yet there were two serious limitations. First, cash payments used for this purpose were, in sum, often considered to be too expensive and too demanding in administration. Second, desirable actions as a result of payment generally stopped when payments were curtailed. Thus, cash payments were ruled out due to both the expense and the short term effectiveness.

Information. Provision of information was a rather broad design category; even so, a wide variety of research had shown that only modest differences in its application had very different effects. It was reported (Olsen and Goodnight, 1977; Heberlein, 1975) that there was little or no relationship between belief in the need for energy conservation and actual energy conservation behaviors. Simply stated, information directed at conservation awareness was insufficient where conservation action was the goal.

Information was identified as an effective motivator when content was simplified and specific. Jacoby, (1977) in research on information load and decision quality, concluded that too much information could actually diminish desired results. Also, Shippee (1980) suggested that if behavior was the goal of information provision, then it should be task or behavior specific.

Another effective design consideration was the concerted effort to make information as personalized as logistically possible (Zuiches, 1977). This was especially necessary for information related to residential energy consumption since these consumption patterns were highly varied (Shippee, 1980, page 1). From another perspective, it was found that when energy conservation was perceived as a problem with personal implications, then actual conservation was realized (Shippee, 1980). Thus, when the information reflected a personal frame of reference, active personal responsibility was more likely (Stern and Gardner, 1979, page 15).

A final note about information provision is in order. In many community settings it was observed that the people who most needed the information were least likely to seek it. This was particularly true of low income and elderly residents who had small or only fixed amounts to spend on their utility bills. Previous research showed not only that personalized information should be used when possible, but face to face presentation could be superior to more impersonal modes (Kushler, 1977). Furthermore, when the recipient of the information perceived personal commonalities with the provider of the information, the message seemed to have more impact (Jeppesen, 1978).

Feedback. Information specific to performance could be termed feedback. Like the cash payment incentives, the effects of feedback on utility usage could deteriorate and, of course, require constant external effort (Slavin and Wodarski, 1977). In fact, Stern and Gardner (1979) summarized their review of the research on feedback with the comment that it worked best when the feedback was immediate, sustained, and in relevant language. It was also important that the feedback use a credible means of report (Becker and Seligman, in press).

The most effective way to use feedback seemed to be in tandem with some form of social commendation (Seaver and Patterson, 1976). This could be as simple as verbal praise or perhaps in the form of a window decal awarded for participation (Shippee, 1980). In fact, social commendation could be thought of as simply another form of feedback (Carlyle and Geller, 1980, page 46) in that it informed one about his/her performance. Thus, it was both possible and desirable to provide multiple forms of feedback, perhaps in sequence with the decision steps which would lead to conservation action.

Specific behavior. Project designs which focused on specific behavior seemed to be more successful. Where there were opportunities for social commendation, feedback, or other information provision, an association to the specific desired behavior offered needed clarity (Carlyle and Geller, 1980). In research on behavioral prompts, such as "shut off the lights," significantly more of the desired behavior was realized from highly specific references to the conservation behavior (Shippee, 1980). Winett and Neale (in press) suggested not only that references be made to specific behavior but that it should be conveyed "at time of opportunity (page 26)"--presumably during the time when the behavior was most likely to occur (e.g., during the heating season).

Small groups/social context. Even as early as 30 years before the current research, Kurt Lewin (1951) demonstrated the influence of groups on individual behavior. It was asserted that amall groups or neighborhoods carried with them the sense of cultural and community characteristics (Nicosia and Mayer, 1976; Glock and Nicosia, 1964) which serve as powerful sources for behavioral norm setting (Burns, 1980). Small groups seemed to create these norms through reciprocal reinforcement (Winett and Neale, in press).

A review by Shippee (1980) suggested that meeting as a group might function to commit residents to the energy conservation content of workshops. In actual practice, Pallack and Cummings (1976) showed that a public (versus private) commitment was more powerful in producing lower rates of utility usage. In all such studies, it was assumed that when discussion among group members was allowed/encouraged these members were more likely to conserve (Pallack and Klienhesselink, 1976; Shippee, 1980). Surely then, when residential energy conservation programs required group meetings or public assemblies, the program design would be well served to make use of these group dynamics in helping persuade individual participants. Also, research on the spread of innovations (Rogers and Shoemaker, 1971; Engel, Blackwell, and Kollatt, 1978) routinely concluded that early adoptors often influenced others through social interaction. Haberlein's (1975) study of apartment dwellers during the oil crisis suggested that interventions which used small groups might well prompt peer monitoring of conservation behaviors.

The nature of energy conservation as a technology and the power of small groups and social context were also considered. To many people, the concepts, skills, and products related to energy conservation were often not understood. Misunderstandings about energy conservation actions had sometimes lead to the conclusion that completing some types of conservation action was perhaps "risky." Hagens (no date) found that members of small cohesive groups were more likely to take the "risk" of doing conservation actions. Thus, the group atmosphere could prompt one to be more venturesome.

Task-orientation. Perhaps one of the most effective ways to help people adopt new behaviors like those required in some types of energy conservation was to have them "learn by doing." The argument usually followed that by using a relevant context for an action which had an instructive result, the person was able to learn not only the concepts important for understanding the actions but also the skills necessary to personally accomplish the actions. For example, a series of environmental educators related positive results from teaching through direct, purposeful experience (Hammerman and Hammerman, 1968; Shomon, 1964; Swan and Stapp, 1974). Howie (1974), reported higher test scores using a supplement of "guided discovery" (a form of task-oriented teaching) to classroom instruction versus classroom instruction alone. Also, Leitenberg (1976) offered the observation that reinforced practice was among the most effective methods for developing new behavioral repertoires.

From Bandura (1977), who helped to integrate many learning theory concepts within his self-efficacy theory, a cornerstone developed on the premise that the experience of mastery (successful action) provided a powerful motive for future action. His studies suggested this experience of mastery was enhanced when external aids were removed (page 202), appropriate skills were selected, and necessary incentives were inherent (page 194). Effects of successful performance were also found to offer a significant supplement to vicarious experience (modeling) (page 197). As Gladhart, Zuiches, and Morrison (1978) noted "people need experiences from which they can discover that life can be good in an energy efficient household and that some sacrifices are opportunities in disguise (page 11)."

Thus, the literature provided strong support for the notion of designing interventions which would have several complementary components. Because factual information, by itself, was often insufficient to prompt action, other design components were added. Feedback, focus on specific behaviors, small groups/social context, and a task orientation had been proven effective in previous research.

Summary

No direct cash incentives were used in the persuasion approaches tested in the current research. Instead, treatments included in the research design involved an emphasis on highly specific, personalized, factual information of heat loss pictures (thermograms) of homes, and the associated conservation action recommendations. This information was provided in special public meetings called Thermogram Meetings. The feedback, on energy conservation action opportunities, provided to attending homeowners was designed to take place immediately, during the meetings. Information was also directed at specific behaviors (recommended conservation actions, relevant to the homeowner's residence). Since the information was provided in a public context, the persuasive impact of the small groups/social context was intended to further encourage the desired conservation actions. Thus, these factors were inherent in the design and conduct of the Thermogram Meetings.

It was further argued that homeowners would be most likely to actually take energy conservation actions when provided with a second phase of intervention, which would follow the Thermogram Meetings. To this end, special followup interventions were designed and implemented which incorporated the offering of a strong task-orientation. By organizing a hands-on learning experience, the high intensity, or strongest, approach actually trained homeowners to complete conservation actions. A lower intensity, or less strong, approach simply provided written documents which illustrated and described the same conservation actions.

The purpose of the program studied in the current research was to activate the whole community around the priority of residential energy conservation. In order to actually persuade residents to invest their time and money on such projects for their own homes it was argued that it would be necessary to incorporate several program features. Not only was it hoped that attention would be drawn to expert, novel and personalized information about the actual areas of heat loss and the associated heat loss remedies, but it was also deemed important to make maximum use of social-psychological solutions in the persuasion strategies.

Thus, basic program design included heat loss pictures of individual residences, interpretations, and associated verbal and written information on appropriate heat loss remedies which a participating resident might complete. The main research question was: to what degree would followup program participation yield more conservation actions and resulting utility bill savings than without this participation?

It was reasoned that the greater the intensity and specificity of the persuasive elements in program design which an individual resident experienced, the greater would be the likelihood of the associated, appropriate residential conservation actions, and resulting utility bill savings. Further, it seemed that effective program followup alternatives would offer a desirable continuity of the information and experience gained during participation in the standard Thermogram Meeting program.

Four treatment conditions, the membership of which differed only in type(s) of program participation, were tested for main effects (OUTCOMES). Those in Condition One (C1) were participants in heat loss picture/information meetings plus a followup hands-on workshop, Condition Two (C2) were participants in heat loss/information meetings plus a followup of mailed information, Condition Three (C3) were participants only in the heat loss/information meetings and Condition Four (C4) were those persons not participating in any of the above.

The treatment condition labels and abbreviations used in subsequent references are given in Table 1.

Table 1. Labels used for Treatment Conditions

Condition	Abbreviated Label	Content Reference
Condition One	C1	Thermogram + Workshop
Condition Two	C2	Thermogram + Mailed Info.
Condition Three	C3	Thermogram Only
Condition Four	C4	No Thermogram (Control)

When 'Thermogram' is used to describe treatment content, the counterpart of energy conservation information is also implied.

Hypotheses

The hypotheses covered five areas of interest: main effects (impacts or outcomes); key process and descriptive variables; relationships between process/descriptive variables and main effects; selected intervention processes; and predictors of main effects. Thus, in addition to the study of the degree to which the treatments had an effect on natural gas and electricity usage, the research also examined important treatment processes.

The primary hypotheses regarded treatment OUTCOMES. The current research was primarily interested in the impact of the treatment conditions on PostTreatment usage of natural gas (heating fuel). Because electricity was the next most common energy source used (primarily for appliances and lighting) in most homes, impacts on this energy use were also examined, but were considered less important. For both types of energy usage, impacts it was assumed that the reductions would be associated with some type of behavioral or structural conservation actions, therefore, they were monitored. Hypotheses 1-4 addressed these issues.

Hypothesis 1: It was predicted that reduced usage of natural gas (the major heating fuel) due to conservation actions would be greatest for Condition One, next for Condition Two, followed by Condition Three and least for Condition Four. Thus greatest effect was predicted for participants with exposure to greatest program intensity, specificity, and continuity. Differences between these experimental conditions were expected to be statistically significant.

Hypothesis 2: Because reduction in usage of electricity was not a major focus for program impacts it was predicted that the four conditions would not have significantly different changes in usage of this utility.

Hypothesis 3: In conjunction with the expected outcomes listed under Hypothesis 1, it was predicted that the number of self reported conservation actions (both those which were completed after program participation and those which were said to be planned) would be statistically different between the four conditions, and that the average number for the respective conditions would be, in order of magnitude: most for Condition One and in descending order for the other three groups (Condition Four having least).

Hypothesis 4: It was predicted that the number of self reported conservation actions (both those which were completed after program participation and those which were said to be planned) would evidence a significant, negative relationship to the amount of natural gas usage, but not to the amount of electrical usage.

Other hypotheses were proposed for various PROCESS and DESCRIPTIVE data to be collected on program delivery records, questionnaires, and a survey. The main purpose of these hypotheses was to provide answers to research questions about the responses and characteristics of participants. These hypotheses were included to provide the potential for more complete interpretation of the main effects results, and a fuller picture of key interventions. Major hypotheses (5-13) for this set of variables follow.

Hypothesis 5: No differences between conditions were anticipated for most participant demographics, characteristics, or residence characteristics, however there were three exceptions. First, those attending the Thermogram Meetings, (C1, C2, and C3), would report greater usage (than C4) of the meeting-promoted services. Second, conditions would differ regarding reported barriers to conservation (least concern in C1 to most concern in C4). Third, treatment conditions would differ on pro-conservation attitudes (such attitudes strongest for C1 to least in C4).

Hypothesis 6: It was hypothesized that for participants in the Thermogram Meetings, (C1, C2, C3), the number of areas showing thermographic heat loss would show a significant, negative relationship to the subsequent amount of natural gas usage, but the relationship with electrical usage would be nonsignificant.

Hypothesis 7: For all treatment conditions studied in this research it was hypothesized that participation in one or more of the information services (i.e., Energy Fair, RCS, or Energy Hotline) would show a significant, negative relationship to the amount of natural gas usage, but the correlation would be nonsignificant for electricity usage.

Hypothesis 8: It was expected that the reported salience of barriers to energy conservation would be significantly, and negatively related to the amount of natural usage, but the relationship to the amount of electricity usage would be nonsignificant.

Hypothesis 9: It was also hypothesized that the reported degree of agreement with pro-conservation statements (energy conservation attitude items) would be significantly and negatively related to the amount of natural gas usage, but not related to the amount of electricity usage.

Hypothesis 10: For Condition One it was predicted that the reported number of actions done during the followup workshop would show a significant, negative relationship to the amount of natural gas savings but not to the savings on electrical usage.

Hypothesis 11: It was expected that for persons in Condition One reported "usefulness" of three workshop content areas would show a significant, positive relationship to the amount of natural gas savings but not to the savings on electrical usage.

Hypothesis 12: For Condition One participants it was predicted that the reported degree of intention to act on information from the three workshop content areas would show a significant, postive relationship to both the number of actions completed after participation and a negative relationship to the amount of natural gas usage, but not to the savings on electrical usage.

Hypothesis 13: Also, for Condition One, it was hypothesized that completion of one or more workshop tasks would be significantly related to the report of one or more like actions being later completed at the participant's home.

Hypothesis 14: The ability of selected PROCESS and DESCRIPTIVE variables (identified in the analyses of Hypotheses 1-13) to predict the natural gas and electricity usage was tested using multiple regression analyses. This series of analyses were exploratory, and were intended to investigate the relationship of key variables to utility usage outcomes.

These fourteen hypotheses formed five basic groups. First, Hypotheses 1-4 addressed tests for main effects. Second, Hypothesis 5 compared treatment conditions on key process and descriptive variables.

Third, Hypotheses 6-9 tested for the relationship between selected process and descriptive variables on natural gas and electricity usage. Fourth, special attention was given to the the most intensive treatment, Condition One (Thermogram + Workshop), in Hypotheses 10-13. Fifth, Hypothesis 14 covered multiple regression analyses which explored potential predictors of the outcomes of natural gas and electricity usage.

CHAPTER II

METHOD

This chapter reviews the design and implementation of the field research used to test the practical application of concepts discussed in Chapter I. Initial comments pertain to the setting in which the research was completed and also the logistical foundation required to organize for the Residential Program. Following this, six sections describe the basic elements of the research method: Participants and Sampling, Experimental Design, Procedures, Instruments, Variable Classification and Reductions, and finally Analyses.

Setting

Research Context

The research design was established in conjunction with program development undertaken by the state agency having the mandate for state energy conservation programs (The Energy Administration, Michigan Department of Commerce). As evaluator for such programs, the author expanded the original pilot program to include special followup treatments. Both the original Thermogram Meeting program and these Followup Treatments were studied using the research design addressed in this study. Thus, program development required for the present research represented an enhancement to basic planned research for a pilot program.

City Selection

The city selected for this research was chosen at random for inclusion in pilot program evaluation research. The pilot program was known as Community Energy Management (CEM). Selection guidelines for this program included an acceptable city size (population between 10 and 50 thousand) and the requirement that the city rank in the middle 50 percent of Michigan cities on a published (economic) Need Index (Department of Commerce, 1981). The Need Index was used since it offered a metric for the economic development CEM was designed to support in the form of energy dollar savings available for local commerce.

City Description

Using the above selection criteria, a small city (population: 11,763; dwelling units: 4,878, 1980 Census) on the eastern shore of Lake Michigan was identified and invited to participate in the CEM program (described below), and its city council accepted. Some basic characteristics of this city may form a useful frame of reference.

Residential utility customers in this city were served by a small natural gas company serving several lower Michigan counties and by a municipal electric company. Natural gas was clearly the most popular heating fuel (97.2 percent of the homes--see Appendix A for source). Average usage per customer was 146 mcf in 1981.

Local people described the housing stock in the city as primarily single family dwellings with very few apartment complexes. Residential rental properties were also primarily single family dwellings.

Organization for the Residential Program

Overall CEM Program

The CEM program was designed to prompt community energy conservation by offering initial program support for rapid implementation action (versus lengthy conservation planning) programs. It was thought that introduction of programs with high visability, rapid development, and relatively rapid benefit realization would hasten the development of community interest in continued conservation efforts. Thus, CEM offered programs in three economic sectors: residential, municipal, and commercial/industrial. Local program development started with the residential sector program during the summer of 1981.

In developing the residential program, the state agency's technical assistance was provided by two liaisons. These liaisons helped the city organize and orient a steering committee of local people who guided program development. The steering committee was charged with guiding programs in all three sectors but started with the residential program and recruited a subcommittee to work on its details. By the end of September, the major part of the residential program was in place and it began offering services to local residents.

Residential Program

State agency liaisons and the local subcommittee used a standardized program model. Liaisons brought three basic program resources from which the subcommittee devised its program: (1) a complete set of land-based thermograms (heat loss pictures described below and pictured in Appendix B) of all residential structures in the city, (2) organizational assistance, and (3) training for volunteer recruits in the interpretation of individual thermograms and the relating of residential conservation information. The local subcommittee used these elements and local resources to structure and conduct their own residential program's initial aspect, a series of (free to the public) Thermogram Meetings.

Before describing the Thermogram Meetings, the state agency's program resource contributions will be discussed: First, the thermograms, then organizational assistance, and finally, a few words on volunteer training.

Thermograms

During the winter of 1980-81 plans were made and executed to complete a heat loss survey of all residential structures in the city. This procedure involved using heat sensitive equipment mounted in a van which scanned building fronts and recorded the heat loss data on magnetic tape. Specialized equipment was later used to decode magnetically stored data into serial black and white images of the scanned building fronts. Various shades of grey showed the locations and relative amounts of radiant heat loss from the houses thus pictured. When catalogued and indexed, this library of pictures represented highly personalized, graphic feedback on heat loss to the residents who were offered the opportunity to see them. Much of the work completed by the residential subcommittee was focused on devising a way to get local residents to come to view their thermograms, starting in September, 1981.

Organization Assistance

Liaisons were trained to organize a series of small, neighborhood specific, (to take advantage of small group dynamics), Thermogram Meetings to be held at public buildings (mostly elementary school building auditoriums). Technical assistance was provided for dividing the city map into meeting areas (about 200 dwelling units each), schedule meeting times, and coordinate publicity. Multiple-source publicity was also employed and it included newspaper, radio, and flyers (which were hand delivered two days before a neighborhood's scheduled Thermogram Meeting).

Volunteer Training

Before the series of Thermogram Meetings were conducted, the steering committee recruited local volunteers. These volunteers were trained to properly interpret the thermograms and to provide the pertinent information on opportunities for residential energy conservation. This instruction was fortified with specific brochure-length publications on energy conservation actions and also information on a Residential Conservation Service (home energy analysis) offered by the natural gas utility company. All the above information was covered in eight hours (four, two hour sessions) of training for the volunteers. With this instruction as the basis for their expertise, volunteers could then offer this information on a neighbor to neighbor basis at scheduled Thermogram Meetings.

Thermogram Meetings

Residents were informed of the Thermogram Meetings through many sources. In contrast to the breadth of the public notices, the information was highly specific in that residents could come only to the meeting scheduled for their neighborhood. This schedule was intended to have at least three beneficial effects. First, the order of the 27 meetings which covered the entire city was randomized so that the schedule would not be biased regarding which neighborhoods would have first access, and it also maximized potential benefits of word of mouth publicity. Second, meetings were planned to be decidedly small gatherings in which residents could receive an unhurried, personalized interpretation of their thermogram and also observe their immediate neighbor's interest in residential conservation (a group dynamics effect). Third, the schedule permitted a sustained (versus momentary) community exposure to the issue of residential conservation. Thus, because the Thermogram Meetings were a public service opportunity which was to be voluntarily attended by residents, these meetings were designed to make good use of the limited exposure.

Meetings were scheduled for Tuesday and Thursday evenings and on Saturday mornings. When residents arrived, they were asked to complete a Thermogram Meeting Registration Form (see Appendix C). Then, they were asked to help a volunteer, stationed near an indexed city map, find the location of their residence and the associated thermogram strip number was recorded on the form. With this in hand, the resident found a volunteer interpreter who located the appropriate thermogram strip. In the conversation which followed, the interpreter asked about the house and then interpreted the thermogram. Thus, the interpreter had an opportunity to point out specific heat loss problems and the variety of remedies which could be taken to reduce them. Possible remedies included referral to specific publications given to the resident before leaving, and also the RCS audit program which could offer a detailed analysis of energy conservation actions specific to his/her house. While the resident was not allowed to take home a copy of his/her thermogram, conservation publications and information on the RCS program could be taken home. If the resident wished to sign up for the RCS audit, this was offered at the same meeting. Thus informed, each resident left the meeting.

A Model for Follow Up

A simple model of residential program goals was devised by the experimenter. The first goal in the intervention process involved promotional efforts which prompted local residents to attend a Thermogram Meeting. Second, while at the meeting these residents would receive specific, personalized information about energy conservation actions. Although these goals seemed necessary, they did not seem sufficient to promote widespread adoption of actual conservation action. As noted in the research discussed in the Chapter I, information alone frequently had a limited effect on subsequent behavior. To promote actual conservation behaviors a third goal was proposed. The graphic representation of this series of three planned goals is depicted in Figure 1.

Program Requirement		Goals (Benefits to Resident)
Promotion	⟶	Attendence
Meetings	⟶	Information
Follow Up	⟶	Conservation Action

Figure 1. Model of Sequential Goals

This model therefore included an additional requirement designed to close the gap between motivated good intentions and completed residential conservation actions. The model also highlighted the need to focus on potential barriers to action, such as the reluctance to invest time and money on unfamiliar, (perhaps even perceptually "risky"), actions. Further, it addressed the possible lack of experience with the manual skills necessary to complete conservation actions or just understand what was really involved in completing them. For these reasons, the experimenter conducted the current research to investigate the relative value of two types of followup. Each type of followup treatment is discribed in the section entitled Procedures. Before this, participants and sampling procedures are discussed.

Participants and Sampling

Of the 3,397 households invited to the Thermogram Meetings 1,035 were represented at the meetings. Thus, 30 percent saw their thermograms when given a specific time and location for their Thermogram Meeting. This massive response was a clear indication of interest in saving on utility bills and the technological novelty of heat loss pictures of personal residences.

The 1,035 participants were considered to be the population from which random selection and assignment to type of followup could be completed. Because procedures and information content of each Thermogram Meeting was routinely standard for all who came, these meetings were considered to be equivalent.

Random selection and assignment to followup treatment invitations was blocked by meeting group. In other words, selection and assignment resulted in representation of households from all meetings in each followup condition, and the number from each meeting was a proportion of the total attendance at the meeting when compared to the attendance across all meetings.

Experimental Design

The design for the current research was a nonequivalent control groups design (Cook & Campbell, 1979) with four conditions. The independent variable was type of program treatment and the dependent variables were natural gas usage, electricity usage, and number of conservation actions. Natural gas and electricity usage was measured before and after the program treatments. Number of conservation actions was primarily measured after the program treatments.

The time periods for which the focal natural gas and electricity usage data were collected was arbitrarily defined in terms of the heating season months, October through April; the pre-program period was the 1980-81 heating season, and the post-program period covered the same months in the 1982-83 heating season. The conservation promotion programs took place during the 1981-82 heating season. Reports of conservation actions were analyzed with particular attention to activities completed after the program period.

Procedures

Four program conditions were compared in the research. In the first three conditions all had been participants in the Thermogram Meetings and therefore they had the same exposure to the information resources of these Thermogram Meetings. In the first condition, (C1), participants also received a followup hands-on workshop experience, in the second condition, (C2), participants received a telephone call and subsequent mailing of additional conservation information, and in the third condition, (C3), no follow up was provided. A fourth condition, (C4), included persons from households which had not attended the Thermogram Meetings.

Permission for release of utility data for the above households was primarily secured through a formal, signed release which had been part of Thermogram Meeting Registration Forms (described in the section below entitled Instruments). For those not providing this release in Conditions One, Two, and Three, and for all of Condition Four subjects, the natural gas and electric utility companies provided the same data but without labels identifying the specific customer.

Condition One: Thermogram + Workshop

Invitations to attend a hands on workshop were mailed to 143 households previously represented at Thermogram Meetings. Four workshops were planned, each with a capacity of 25 household representatives, thus a 70 percent acceptance rate was expected. Based on actual response to the invitations only three of the workshops were held with a total of 60 households (42 percent) represented. A copy of the invitation and mail-back reply card are shown in Appendix D.

Participants were instructed to assemble at a public building on a Saturday morning. There, orientation and registration took place prior to bus transport to the workshop site. Then, participants were given a training outline and were given opportunity to ask questions prior to the workshop session.

Each workshop was held at the home of a senior citizen. This arrangement provided the senior with no-cost installation of energy conservation materials in exchange for use of the house as a hands-on training site. The Director of the local senior center provided information on this opportunity to members. After interested seniors were identified, the experimenter and a subcommittee representative visited the senior's home to see if the house needed the items which were to be the object of instruction. After agreements were made with the selected senior hosts, the measurements for materials were completed and the material contributions were solicited from local materials merchants who had indicated interest. (These merchants were pleased to provide these donated materials in view of the increased sales attributable to Thermogram Meetings).

Results from the 1,035 Registration Forms collected at the Thermogram Meetings included indications of which categories of information were most desired by participants. In rank order, they were the following:

34.3 % Foundation Insulation
25.3 % Window/Door Modifications
17.4 % Caulking and Weatherstripping
12.7 % Wall Insulation
8.3 % Attic Insulation
1.5 % Financing Energy Conservation Projects

From these findings the top three categories were selected by the residential subcommittee as the best focus for workshops. These results were also shared with workshop participants during orientation.

Prior to the short trip to the workshop site, the participants were given an overview of the instruction to be covered, learning station rotation pattern, and timetable. Workshop Registration Forms (see Appendix E) were completed at this time and each household representative was assigned a starting learning station.

When participants arrived at the workshop site, they were guided to one of the three learning stations. A total of 25 minutes were allowed at each station before participants rotated to the next station. During each session, each participant was instructed to use the Individual Checklist instrument to record tasks done (see Appendix F). Activity at each station is discussed below:

Station I (Foundation Insulation): At this station, participants were to install paper-faced batt insulation in the box sill area of the of the foundation on the home. Each participant was encouraged to complete two of five tasks:

(1) measure
(2) clean and fill openings
(3) cut batts
(4) insert batts
(5) staple batts

When all participants had the opportunity to complete the two behavior criteria, the station instructor was to lead a discussion and ask for any questions participants might have.

Station II (Window/Door Modifications): At Station II participants constructed two alternative window treatments. The respective tasks for each window treatment follow:

Insider Storm Window	Foam Board Shutter
(1) measure	(1) measure
(2) cut wood	(2) cut foam board
(3) glue/nail	(3) cover (optional)
(4) rough cut plastic	(4) edge tape
(5) staple	(5) foam tape (optional)
(6) trim plastic	(6) install
(7) edge tape	
(8) foam tape	
(9) install	

When all had the opportunity to complete three of the tasks under one of the window treatments, the instructor would proceed to discussion and a question and answer period.

Station III (Caulking and Weatherstripping): Participation at this station involved active location and remediation of areas of unwanted air infiltration. Since these actions involved relatively little time to complete, participants were requested to attempt two tasks under each of the two actions below, and then go directly into a short presentation of types of material which could be used for these jobs. The two categories and associated tasks were:

Caulking	Weatherstripping
(1) load caulk in gun	(1) measure
(2) clean crack or opening to be filled	(2) cut weatherstripping
(3) run bead	(3) install

This presentation included a discussion of the Heat Leak Hit List (see Appendix G) and weatherization information resources (see list in

Appendix H). Any questions participants had were to be addressed during the last portion of the rotation.

When all participants completed the three station rotation, (approximately 1.5 hours, total) they boarded the bus and returned to the public building meeting site. Prior to leaving, participants were given copies of how-to notes for each station activity (see Appendix I) and were given an opportunity to sign up for an RCS home energy analysis. Prior to being dismissed, participants were instructed to complete the Workshop Comments (see Appendix J) questionnaire, and when this was completed, it was collected along with the Individual Checklists.

Condition Two: Thermogram + Mailed Information

For a second group of Thermogram Meeting participants, followup involved provision of: (1) the same written material dispensed in Condition One procedures and (2) an emphasis on brief conversation (see Script, Appendix K) including multiple references to and opportunities for neighbor to neighbor information sharing. During each telephone call the operator indicated that he/she would send a personalized packet of energy conservation information which would exceed material available at the original Thermogram Meetings. This packet included a cover letter (Appendix L) and the same series of how-to notes (Appendix I) used in Condition One workshops.

Emphasis on neighbor to neighbor contact was operationalized both in what was said during the telephone contact and in the cover letter to the packet which was subsequently sent to the participant. During the telephone contact, the participant was referred to by name and the specific community meeting which they attended was also mentioned.

Also, in the cover letter to the information packet, participants were appraised of opportunities to help their neighbors take advantage of project offerings: by indicating willingness to have what they had done to save energy serve as a local case study, and by telling neighbors about a schedule of second-chance thermogram showings. Throughout this packet, personal reference was in evidence, including hand addressing and signatures.

Condition Three: Thermogram Only, (No Follow Up)

Participants in this group were not offered any subsequent followup opportunities. They were, nevertheless, similar to persons in Conditions One and Three in that they had attended a Thermogram Meeting.

Condition Four: No Thermogram, (Control, No Program Contact)

Households represented in this group received no program contact. These households had not been represented at the Thermogram Meetings, and they were not offered followup programs. They were simply randomly selected from the local telephone book, cross-checked against Thermogram Meeting Registration Form records, and assembled as a comparison group.

Summary

Conditions One and Two and the Thermogram Meetings for Conditions One, Two and Three offered three general program features: provision of a noncommercial service which was cost free to the participant, use of community voluntarism, and inclusion of the planned social inducement of seeing neighbors participating. The research design allowed comparison of two types of followup and two control groups. Thus, the research was devised to help assess the degree to which followup was useful and, if so, which of the two kinds was most effective.

The procedures used in all treatment conditions, other than Condition Four, were designed to make the best use of the "physical technology" of the Thermograms by providing program treatments which incorporated important features of "social science technology". The social science features used in Conditions One, Two, and Three were delivered to the participants in a consistent manner by using two control functions of program design and management: organizational assistance and volunteer training. Within the context of these methods of assuring quality control, the highly specific, personalized, factual information of the heat loss pictures (thermograms) could be reliably associated with the verbal feedback on energy conservation opportunities. In other words, since the thermograms indicated specific types of conservation action, the volunteer interpreters could be trained to suggest appropriate, specific behaviors which would have relevance to the individual homeowner. Furthermore, the small groups/social context of the Thermogram Meetings was designed to provide an arena in which local people could experience the encouragement of others as they considered decisions about future energy conservation actions.

In Condition One, the followup hands-on Workshop included an additional "social science technology" feature: learning through task-orientation. This enhancement permitted participants to learn by actually doing selected conservation actions. In contrast to this, Condition Two participants simply received information which was equivalent to that provided in Condition One, but it was in the form of

Mailed Information. Thus, Conditions One (Thermogram + Workshop), Two (Thermogram + Mailed Information), and Three (Thermogram Only) involved procedures which incorporated these social science features, and therefore they were inherent to the treatment design.

Instruments

Data collection occurred at three critical times: the first time (T1) was during the Thermogram Meetings, the second (T2) was during the experimental followup interventions and the third (T3) was about seven months after (T2). References to these time periods are found in the description of the instruments, and Table 2, which follows the discussion of instruments, provides a summary of treatments and data collection dates.

Thermogram Meeting Registration Form

The Thermogram Meeting Registration Form (see Appendix C) was completed by participants in Conditions One, Two and Three during the Thermogram Meetings (at T1). It served to collect participant identification, demographics, responses to publicity methods, a utility data release, and records on the the exchange of information. As the schedule of meetings proceeded, early tallies on this information gave feedback to organizers regarding staffing needs and best information emphasis. The current research required only the information from (1) the checklist of heat loss areas, (2) the checklist of information requests, and (3) the checklist of prior energy conservation actions.

Workshop Registration Form

The Workshop Registration Form (see Appendix E) used at the Condition One workshops (during T2) served to confirm participant identity. When more than one representative of a household came to the workshop, an additional registration form was completed.

Individual Checklist

The Individual Checklist (see Appendix F) served as a self reported behavioral checksheet for the Condition One Workshop participants. The checksheets provided a written statement of behavioral goals for each work station at the workshop. Participants at these workshops were directed to read these recommended behavioral goals and recognize that before the workshop was completed they would be asked to place a check mark next to the tasks they actually helped complete. This instrument was therefore intended to have some incentive value (an implicit request for social compliance), but more importantly it provided a record of actual hands-on activity. Immediately following the on-site workshop activities (T2) participants marked on these checklists which tasks they had actually performed (versus tasks they had only observed).

Workshop Comments

Printed on the back side of the Individual Checklist another series of questions, entitled Workshop Comments (see Appendix J), were introduced to Condition One participants. These questions provided a means for measuring the impact of the workshop experience for these participants. For each of the three "learning stations" referred to in the description of the workshops, the first series of questions requested a rating of workshop usefulness. The second series of questions inquired about the degree to which the person had the intention to act on the conservation actions suggested at each of the respective learning stations. Finally, an open ended question also asked for comments on the workshop experience.

Telephone Checksheet

In the process of inviting participation in Condition Two (during T2) a simple record keeping sheet, called the Telephone Checksheet (see Appendix M), provided space to record progress on the Telephone Script (see Appendix K). The Telephone Checksheet served as a recording mechanism which would document, paragraph by paragraph, the standard verbal delivery of the Telephone Script text.

The procedure for verbal delivery of the Telephone Script was straightforward. After it was confirmed that the person was, in fact, included on the Condition Two sample listing, the text of the Telephone Script was read. The Telephone Script included information about the Condition Two followup service (a special packet of written publications to be mailed to the participant), and the associated plans for later survey contact. Acceptance or rejection of the offer for this service was then recorded.

Residential Telephone Survey

Seven months after T2, (at T3), the Residential Telephone Survey (see Appendix N) was completed by all the available household representatives which had been originally included in the research (all four conditions). While the general content was used with all respondents, some selected questions were presented according to the condition in which the respondent was included.

Seven content areas were included in this survey: confirmation of participation, measurement of conservation knowledge, report of conservation actions, report of residence characteristics, responses referring to "economic multipliers", report on relative salience of barriers to conservation actions, report of energy conservation attitudes, and specification of respondent demographics.

Monthly Utility Data

Monthly utility bill data was obtained from both natural gas and electricity utilities. PreTreatment and PostTreatment comparison periods were for the same span of months for natural gas and electricity usage, (i.e., October-April). Special base (nonheating) load and weather adjustments for the natural gas data are discussed in the following section.

Summary

To clarify the correspondence of time periods, instruments used and participant groups to which they were applied, Table 2 is provided on the following page. Please note that treatment(s) and data collection are listed for each condition.

Table 2. Summary of Treatment and Data Collection for Each Condition

	Time Span
Condition One	
Treatment:	
Thermogram Meeting	September-November 1981
Workshop	February-March 1982
Data Collection:	
Thermogram Meeting Registration Form	September-November 1981
Workshop Registration Form	February-March 1982
Individual Checklist	February-March 1982
Workshop Comments	February-March 1982
Residential Telephone Survey	October-November 1982
Natural Gas Data:	
Base Load Data	June-August 1980 and June-August 1982
Heating Season	October 1980-April 1981 and October 1982-April 1983
Electricity Data:	
Comparison Season	October 1980-April 1981 and October 1982-April 1983
Condition Two	
Treatment:	
Thermogram Meeting	September-November 1981
Mailed Information	February-March 1982
Data Collection:	
Thermogram Meeting Registration Form	September-November 1981
Telephone Checksheet	February-March 1982
Residential Telephone Survey	October-November 1982
Natural Gas Data:	
Base Load Data	June-August 1980 and June-August 1982
Heating Season	October 1980-April 1981 and October 1982-April 1983
Electricity Data:	
Comparison Season	October 1980-April 1981 and October 1982-April 1983

Table 2 (cont'd.)

Condition Three	
Treatment:	
Thermogram Meeting	September-November 1981
Data Collection:	
Thermogram Meeting Registration Form	September-November 1981
Residential Telephone Survey	October-November 1982
Natural Gas Data:	
Base Load Data	June-August 1980 and June-August 1982
Heating Season	October 1980-April 1981 and October 1982-April 1983
Electricity Data:	
Comparison Season	October 1980-April 1981 and October 1982-April 1983
Condition Four	
Treatment:	
(None)	(Not Applicable)
Data Collection:	
Residential Telephone Survey	October-November 1982
Natural Gas Data:	
Base Load Data	June-August 1980 and June-August 1982
Heating Season	October 1980-April 1981 and October 1982-April 1983
Electricity Data:	
Comparison Season	October 1980-April 1981 and October 1982-April 1983

Table 2 also clarifies which months were actually included in the three data collection periods mentioned at the begining of the discussion of instruments. As can be inferred from the forgoing, time periods and respective labels are as follows: September through November of 1981 was T1, February and March of 1982 was T2, and October and November of 1982 was T3. Dates given for the natural gas and electricity data represent the months for which data was collected; this data was necessarily obtained in the months following the tabled time spans.

Variable Classification and Reduction

The instruments designed for the current research provided a broad base of data. The following section of this chapter provides a system of organization for this data, placing emphasis on the practical classifications needed in later discussion of the analyses used to test the hypotheses. Variables included in these analyses are discussed below under three classifications: outcome (dependent) variables, process variables, and descriptive variables.

Outcome Variables

Utility usage. Collection of residential utility use data involved both natural gas and electricity billing statements for all households in the research. For both natural gas and electricity usage data the PreTreatment (heating) season was defined as including the months of October 1980 through April 1981 and the PostTreatment (heating) season was defined as October 1982 through April 1983. Thus, October 1980-April 1981 usage was compared to October 1982-April 1983 usage. For the natural gas data, two adjustments were made to insure comparablity: (1)

the average monthly base load (summer average) was subtracted from each month's usage, thus leaving the heating load usage, and (2) this usage was corrected for weather differences (divided by Heating Degree Days for each season). This computation produced the figure for the hundreds of cubic feet usage per heating degree day (ccf/HDD), corrected for heating load only, a direct index of weather-corrected natural gas heating usage for the heating months.

Monthly electrical usage data was simply summed for the same two comparison periods. RTS survey questions about fuel use confirmed that none of the residences in the research used electricity for the main heating fuel so it was concluded that electrical consumption would not require weather (HDD) correction. The sum of PreTreatment usage was compared directly to PostTreatment usage.

Energy conservation actions. The Residential Telephone Survey (RTS) provided a large data set on energy conservation actions. Some of this data was collected solely for use by the sponsoring agency, the Energy Administration, but all essential components were included in the present research. Responses on the conventional residential items (the first 17 on the list) were considered necessary for this study; the last six items were omitted. The data on the month the action was completed, and relative material quantities were used solely for a separate response validation study.

These 17 residential conservation actions were organized into three logical groupings. Table 3 indicates how the items were grouped.

Table 3. Conservation Action Categories

Category	Actions
Space Heating	Caulking Weatherstripping Turn Down Thermostat Setting Closing Off Unused Rooms Clock Thermostat Tune Up Furnace Derate (BTU) Furnace Automatic Flue Damper Attic Insulation Wall Insulation Foundation Insulation Storm Windows Window Coverings
Water Heating	Reduce Use of Hot Water Turn Down Water Temperature Water Heater Wrap (Insulation)
Lighting	Reduce Use of Lighting
ALL ACTIONS	(All the above)

Clearly, conservation actions related to space heating were most heavily represented. Water heating items were often discussed during thermogram interpretations so the most frequent action recommendations were included. It was decided that only one item under Lighting actions lended itself to a categorical response.

For each of the items in the CONSERVATION ACTIONS section of the survey the respondent was asked whether the action had been done before, or after the program treatment time period, or whether it was planned for the future. The later two response categories were included as outcome variables; as described below, the former (action done 'Before') were analyzed as a separate category, (see Descriptive Variables).

Responses to the RTS actions questions were primarily used to gauge the gross quantity of conservation actions, thus data was reduced to simple tallies of the number of actions in each status category, and combinations of these categories. The resulting action status categories were 'Done', 'Planned', 'Done and Planned', and the combination of 'Done', 'Planned', and 'Done and Planned'.

Process Variables

Beyond the examination of program outcomes, the current research provided extensive data on the processes involved in the delivery of each of the treatment conditions. This was considered important since this body of information would be used to better explain outcomes. Collection of process data took place throughout the research timeline, and as such, discussion of this data was organized by time period. Separate headings are given for PreTreatment, During Treatment, and PostTreatment collections of process data.

PreTreatment. Three months before any of the followup treatments were scheduled, the Thermogram Meetings were offered. During these meetings the Thermogram Meeting Registration Forms were completed by participant homeowners. This data included names and addresses necessary for the sampling for Conditions One, Two, and Three. The local telephone book, cross referenced with the assembled Thermogram Meeting participants list, was then used as a resource in sampling for Condition Four.

In addition to the participant identification data, the Thermogram Registration Form was also used as a means of collecting responses to (1) a checklist of heat loss areas, (2) a checklist of categories of information in which the participant was interested, and (3) a checklist of prior energy conservation actions. For the first two questions the sum of check marks were defined as (1) an index of the need for heat loss remedies (energy conservation), and (2) a measure of interest, respectively. For the checklist of prior actions no data reduction was necessary, each item was retained as an individual variable.

Observation of the process of Thermogram Meetings suggested that although these two checklist items were intended to be separate, they were not treated as separate by the volunteer interpreters who completed the responses. During several of the Thermogram Meetings it was observed that the volunteer interpreters would often record the heat loss shown on the thermogram and then, without actually asking the homeowner about areas of interest, they would just assume parallel check marks for areas of interest. Effectively, this meant that frequently only the first (heat loss) question had face validity, the interest checklist was completed such that it just "mirrored" the heat loss checks. To confirm the extent of this lack of item discrimination, parallel categories under respective items were checked for the percentage of exact agreement. Results showed that when attic heat loss was checked and/or when foundation heat loss was checked, homeowner interest was also checked under these categories (100 percent agreement). Where heat loss from walls, or windows and doors was indicated, homeowner interest was also very frequently checked (80 and 73 percent exact agreement, respectively). Since both observation and statistical analysis indicated this lack of separation between item responses, heat loss data was considered both more important and had higher response rates, therefore homeowner interest responses were dropped from subsequent analysis.

During treatment. Only in Conditions One (Thermogram + Workshop) and Two (Thermogram + Mailed Information) were any followup treatment given. Special data was collected to monitor the followup contacts. For Condition One households, the Workshop Registration Form provided a means of checking that attendees were indeed among those randomly assigned from the Thermogram Meeting Registration Form list. For Condition Two households, the Telephone Checksheet documented that the person contacted, (and which subsequently received the mailed information), had been among those randomly assigned from the Thermogram Meeting Registration Form list. These records were monitored continuously during the treatment procedures; in this way sample composition was confirmed.

The Telephone Checksheet was the only instrument used with Condition Two during this time period, however, for Condition One two other instruments were used. This was considered desireable because the followup treatment offered to Condition One participants was far more complex than the simple information mailings for Condition Two. The first instrument, the Individual Checklist, provided data on the degree to which the intended hands-on feature of the workshop design was actually experienced by participants. Since each participant at the workshops reported activity or observation for each task listed under each workshop station these activities were easily monitored. A count of the number of hands-on tasks planned for each workshop station and the average number of these tasks which were actually completed is given in Table 4.

Table 4. <u>Tally of the Number of Planned and Completed Workshop Tasks</u>

	Number of Planned Tasks	Average Number of Completed Tasks
Station 1 (Foundation Insulation)	5	1.03
Station 2 (Window/Door Modifications)	15	0.15
Station 3 (Caulking/ Weatherstripping)	6	0.25
TOTALS (Stations 1,2, and 3)]	26	1.43

From Table 4 it is clear that although all Condition One participants observed the demonstration of conservation actions at each of the three stations, relatively few participants engaged in the suggested hands-on activity. For each station, the sum of the number of tasks completed was used as an index of workshop involvement.

The second instrument used during the Condition One workshops was the <u>Workshop Comments</u> page. Participants in Condition One were directed to complete the instrument, Workshop Comments, shortly after all participants had rotated through the three workshop stations. The first group of three questions on this page requested a rating of <u>usefulness</u> for each of the respective workshop stations. For this set of questions data was also summarized as the average of the usefulness ratings. The second group of three questions requested a self report of the degree to which the person had the intention to act on the topical information given at each respective workshop station. Here the summary variable was defined as the response "definitely yes", and the sum of "probably yes" and "no". (The latter two response categories were considered similar in that they suggested a lack of strong intention to act).

Comments and suggestions were also collected via an open ended question on the Workshop Comments instrument. The majority of persons attending these workshops did respond to the question and the reader will find all comments reproduced in Appendix O.

PostTreatment. All PostTreatment process data was collected using the Residential Telephone Survey (RTS, see Appendix N). In the first part of the RTS, a series of questions were designed to inquire about which locally available energy information resources had been used by the respondent. If use of an energy information resource was reported, other questions, respective to the particular resource, were asked with regard to the respondent's rating of the resource. As indicated in Appendix N, the RTS included questions not only about specific program treatments intended in this research (the four treatment conditions), but also other energy conservation information services which were known to be available during the same time period. By asking this relatively complete set of questions concerning energy conservation resources which were then available to the public, it was hoped that the process of energy conservation promotion, which happened during the treatment period could be better understood. Thus, for persons in each treatment condition, a few questions were asked which had direct relationship to program treatment (i. e., their respective experimental condition), as well as questions which referred to programs which were concurrently available to the whole community. Table 5 offers a summary of the content of these questions and the experimental condition groups to which they were addressed.

Table 5. Residential Telephone Survey Summary of Questions On Service Recall, and Rated Importance

Category	RTS Question	Question Content	Experimental Condition Groups Asked This Question			
Service Recall	Q1	Thermogram Mtg.	One	Two	Three	Four
	Q3	Energy Fair	One	Two	Three	Four
	Q5	Workshop	One			
	Q7	Information/ Mailing		Two		
	Q9	RCS (sign up)	One	Two	Three	Four
	Q10	RCS	One	Two	Three	Four
	Q13	Hotline	One	Two	Three	Four
Service Importance	Q2	Thermogram Mtg. rating	One	Two	Three	Four
	Q4	Energy Fair rating	One	Two	Three	Four
	Q6	Workshop rating	One			
	Q8	Information/ Mailing rating		Two		
	Q11	RCS rating	One	Two	Three	Four

All RTS respondents were asked if they remembered going to the Thermogram Meetings (Question 1), and the Energy Fair (Question 3), an exhibition of locally available energy conservation products and services. If the respondent recalled taking part in an event they were requested to rate the importance of that event in helping them take conservation actions (Questions 2 and 3, respectively). Condition One respondents were also asked a similar pair of questions about the workshop treatment (Questions 5 and 6); and Condition Two respondents were asked the similar question pair about the additional mailing of energy conservation literature (Questions 7 and 8). A similar question group, Questions 9, 10, and 11), referred to whether or not the household had had an Residential Conservation Service (RCS) audit (a complete on-site residential audit, offered for a fee of ten dollars, through the gas company). Question 13 inquired about use of the state-wide Energy Hotline (a toll-free information service).

For Questions 2, 4, 6, and 8, the importance of services in helping the person to take conservation action were rated by respondents using a Likert-like, five point scale. Coded values ranged from 1 (very important) to 5 (not at all important). Thus, Questions 4, and 11 obtained the ratings respective to the Energy Fair, and the RCS Home Energy Analysis.

Persons surveyed in Condition Four had not, by definition, attended the Thermogram Meetings. For these persons a special version of the RTS included three key questions. In this version of the survey Question 5 inquired as to whether they had heard about the Thermogram Meeting, and if their answer was "yes", Question 6 asked about their sources for this information, and Question 7 inquired about their reason for not attending. Descriptive data collected in this manner provided useful findings on the process of nonparticipation. It was thought that answers to these questions might be used to improve program promotion.

The remainder of process data was obtained through four question categories in the Residential Telephone Survey (RTS): a question about attribution of improved energy conservation knowledge (Question 16), a series of questions related to the "economic multipliers" (impacts of conservation on the local economy, Questions 32-35), a series of questions about barriers to personal conservation actions (Questions 36-46), and a series of questions about specific conservation attitudes (Questions 47-58). The question about improved knowledge (Q16) was addressed only to those who received some form of intervention treatment (Conditions One, Two, and Three). All respondents were asked the questions concerning economic multiplier information, barriers to conservation, and conservation attitudes.

Both the barrier and the attitude questions provided a wealth of process data, consequently they were examined in relatively greater detail. Prior to the RTS survey, but after the Thermogram Meetings, a test-retest pilot evaluation had been completed. This evaluation, performed with a separate series of telephone surveys in April 1982, and again in October 1982, confirmed that these items had very high test-retest reliability. Pearson correlation coefficients averaged .37 and were all significant at $p=.05$ or less.

Only the barrier and attitude items, on the RTS, were subjected to data reduction. For both item sets the strategy was the same. This strategy for scale construction combined empirical (Cronbach, 1970) and rational (Jackson, 1970) methods. First, all items were examined for instances in which 60 percent or more of the participants used only one numeric code category. Items not passing this criteria were dropped from further analysis. Next, remaining items were grouped according to rational similarity, and then were subjected to examinations of item-total correlations and coefficient alpha (Cronbach, ibid.)

until items with greatest relationship were determined. The solutions to these scale construction trials are displayed in Table 6. One barrier item scale, and two attitude item scales were thus formed. Three attitude items proved to be independent, they were retained as single items, termed "singlets".

Table 6. Scale Construction for Barrier and Attitude Items

Item Category	RTS Question	Content	Scale Construction Solution	Statistic Used, Value
Barriers	Q36	cost	Q36 + Q37, (cost/ benefit)	Spearman-Brown coef., .47
	Q37	payback		
	Q38	know what to do first	dropped	NA
	Q39	proper materials selection	dropped	NA
	Q40	know how to complete actions	dropped	NA
	Q41	obtaining a loan	dropped	NA
	Q42	uncertainty about the duration of future residency	dropped	NA
	Q43	comfort of household members	dropped	NA
	Q44	amount of work required	dropped	NA
	Q45	family cooperation	dropped	NA
	Q46	house construction limits	dropped	NA
Attitudes	Q47	individual effort is a significant contribution	dropped	NA
	Q48	favor conservation vs. more power plants	dropped	NA
	Q49	emphasize government spending on conservation	Q49 + Q54 + Q55 (need government involvement)	Cronbach's alpha, .64
	Q54	need stronger government regulations		
	Q55	government should let free market work (item reflected)		
	Q56	energy shortage is real	Q56 + Q57 (energy crisis is real)	Spearman-Brown coef., .62
	Q57	energy crisis is a hoax (item reflected)		
	Q50	favor environmental protection	singlet	NA
	Q51	I am an innovative person	singlet	NA
	Q52	would spend money for conservation even without direct payback benefit	singlet	NA

Descriptive Variables

All of the descriptive variables were obtained from the Residential Telephone Survey (RTS), and were retained as item singlets identified under four categories.

Respondent demographics. The last five questions (Q59-Q63) on the RTS provided data on respondent characteristics. In previous research placement of these questions at the end of the survey seemed to increase the response rate; at this point the respondents were frequently at ease in providing this individual information. These variables, age, education, income, income change, and sex, were considered essential in describing the heads of household in this study.

Residence characteristics. Since experimental conditions were developed to examine relative impacts on household heating requirements it was important to have information on residence characteristics. A considerable series of questions (Q17 - Q31) provided this information. Of these, questions 28 and 29 were included in the survey to help explain possible extremes in utility data.

Energy knowledge rating. The treatment conditions were devised to test effects of specific strategies for promotion of residential energy conservation. One question (Q15) was included in the RTS to record self-rating of knowledge about residential energy conservation. Persons in all conditions were asked this question.

Actions before Thermogram Meetings. All of the conservation actions under the CONSERVATION ACTIONS section of the RTS which were reported as completed before the Thermogram Meetings were designated as a descriptive conservation action profile for the individual household at that time. As with the responses of 'Done' and 'Planned' , which were described as outcome variables, these responses of what was done 'Before' were reduced to simple sums of the number of actions.

Summary

The research plan, which was executed over a three year period, enabled a long term examination of the effects and processes involved in the four treatment conditions compared in this study. Comparisons of main program outcomes were made possible through the collection of energy consumption (natural gas, and electricity) and energy conservation action data. To better explain findings about these main program effects, data on the process of service delivery and the ways in which it was received were also collected. Lastly, the descriptive data provided the means to examine respondent characteristics which might be related to program processes and outcomes.

Analyses

Discussion of the analyses required in the testing of the respective hypotheses (see the last section of Chapter I) are organized by five basic groups. The order in which the analyses are discussed parallels the order in which the results are presented in Chapter III. The only substantial change from the sequence used in the discussion in Chapter I is that Hypothesis 5 is discussed before the main effects hypotheses (1-4). Thus, the order is as follows: (a) comparison of treatment conditions on key process and descriptive variables (Hypothesis 5), (b) main effects analyses (Hypotheses 1-4), (c) relationship of selected process and descriptive variables on natural gas and electricity usage (Hypotheses 6-9), (d) special analyses (Hypotheses 10-13) of the processes essential to the treatment condition, C1 (Thermogram + Workshop), and (e) the multiple regression analyses (Hypothesis 14) used to examine potential predictors of the outcome variables.

The choice of analyses was, of course, directly related to the research design. In the current research random assignment to condition was not possible, therefore a (quasi-experimental) nonequivalent control groups design was employed. As Cook and Campbell (1979) have indicated, with this design, treatment condition participants cannot be assumed to be equivalent since the ideal of random assignment is absent. The alternative then, was to assemble the comparison groups in such a way as to maximize the opportunity for equivalence on key variables, and then collect data which would test for equivalence on the desired dimensions. In the current research, participants were matched by neighborhood prior to invitation to the followup treatments; it was intended that this would improve treatment condition equivalence on residence characteristics (gas and electricity usage) as well as respondent demographics and characteristics.

Comparison of Treatment Conditions on Key Process and Descriptive Variables

This set of analyses, (Hypothesis 5), were studied first in order to better understand any treatment condition differences which might have bearing on the main effects analyses. The key process and descriptive variables included all Respondent Demographics, all Residence Characteristics, the Number of Areas of Heat Loss, and a separate grouping of additional Respondent Characteristics. In all, 35 variables were analyzed for differences between treatment conditions. For the continuous level variables a series of one-way analyses of variance, (ANOVAs), were performed. Discrete level variables were examined using Chi-square analysis.

Main Effects

Foremost among these tests were Hypotheses 1 and 2, which were concerned with main effects for natural gas and electricity, respectively. Since the equivalence of the treatment conditions, prior to treatment, could not be assumed, a simple ANOVA was discarded as a suitable statistical test of condition differences on natural gas and electricity savings. Alternately, an analysis of covariance, ANCOVA (Cook and Campbell, 1979), was considered to be a better choice since it could be used to covary PreTreatment differences in natural gas and electricity usage.

The appropriateness of the ANCOVA approach (for both natural gas and electricity main effects) was investigated in a three part process (Cook and Campbell, idid.). First, the variables which were presumed to be the most likely influences on PostTreatment natural gas and electricity usage were tested for PreTreatment differences between treatment conditions. Three variables were selected: (1) PreTreatment usage level of the respective utilities, (2) Income, and (3) Education. A one-way ANOVA was used to test for PreTreatment differences.

Second, to be considered as viable covariates in an ANCOVA analysis the potential variables also had to be significantly ($p < .05$) related to the PostTreatment usage of the respective utility. These tests used Pearson correlations.

Third, the regression of PreTreatment utility usage on PostTreatment usage had to meet the requirement of approximating a linear function. Scatterplots of these regressions were thus completed for the aggregate of the four treatment conditions and for each treatment condition, separately.

Findings for the natural gas usage ANCOVA. Results of the one-way ANOVA tests for PreTreatment natural gas usage, Income, and Education are shown in Table 7.

Table 7. Analyis Of Variance Findings Used In Choice Of Main Effects Test For Natural Gas

	Group Means					
Variable	C1	C2	C3	C4	F ratio	F probability
PreTreatment Natural Gas Usage (heating load only, in ccf per heating degree day)	.14	.15	.15	.14	1.59	.19
Income	3.00	2.93	3.06	2.43	2.56	.06
Education	3.28	3.22	3.18	2.45	5.57	.00 *

* $p<.05$
Note: The scale for INCOME is 1=under $10000, 2=$10001 to $20000, 3=$20001 to $30000, 4=$30,001 to $40000, 5=$40001 and up. The scale for EDUCATION is 1=grammar school, 2=high school, 3=some college, 4=college graduate, 5=post graduate work or degree.

PreTreatment natural gas usage was computationally adjusted so that only heating load (the amount of natural gas used for heating) was used in the analyses. This was done by substracting the prior summer's average monthly usage (the base load) from each month of heating season usage. The resulting figure was then corrected for weather by computing it in terms of hundreds of cubic feet (ccf) of natural gas per heating degree day (HDD). From Table 7 it was clear that only the variable Education differed significantly between groups. Thus, it was tentatively considered as a covariate in the ANCOVA for natural gas.

Next, correlations with the PostTreatment usage of natural gas were examined. As one would suppose, PreTreatment usage was highly correlated to PostTreatment usage ($r=.80$, $n=238$, $p=.000$). On the other hand Income ($r=.11$, $n=178$, $p=.09$) and Education ($r=.05$, $n=205$, $p=.24$) were not significantly ($p<.05$) related to PostTreatment natural gas usage. Finally, all treatment conditions had linear functions for the regression of PreTreatment natural gas usage on PostTreatment usage. These findings suggested that the data met this major assumption for use of ANCOVA.

Thus, on the basis of these preliminary tests, the choice of main effects analyses for natural gas was an ANCOVA with PreTreatment natural gas usage as the only covariate. PreTreatment natural gas usage was retained as a covariate of PostTreatment usage since this ANCOVA would have greater precision in testing main effects than the default, an ANOVA. Although the variable Education showed significant differences between treatment groups, it was not included as a covariate since it was not significantly correlated to PostTreatment natural gas usage.

Findings for the electricity usage ANCOVA. A similar set of analyses guided the decision on an appropriate main effects test for electricity. First, were the results of the one-way ANOVA tests for PreTreatment electricity usage, Income, and Education.

Table 8. Analyis Of Variance Findings Used In Choice Of Main Effects Test For Electricity

	Group Means					
Variable	C1	C2	C3	C4	F ratio	F probability
PreTreatment Electricity Usage	3529	3999	3178	3241	4.46	.01 *
Income	3.07	2.91	3.06	2.43	2.79	.04 *
Education	3.28	3.22	3.18	2.44	5.51	.00 *

* $p<.05$
Note: The scale for INCOME is 1=under $10000, 2=$10001 to $20000, 3=$20001 to $30000, 4=$30,001 to $40000, 5=$40001 and up. The scale for EDUCATION is 1=grammar school, 2=high school, 3=some college, 4=college graduate, 5=post graduate work or degree.

From the results in Table 8, it was concluded that all three variables showed significant differences between groups and were therefore probable candidates as covariates in an ANCOVA on electricity usage.

The question of significant correlation ($p<.05$) of these variables with the PostTreatment usage of electricity was next resolved. As with the natural gas correlations, PreTreatment usage was highly correlated to PostTreatment usage (r=.86, n=232, p=.000). Unlike the natural gas findings, however, both Income ($r=.53$, $n=169$, $p=.00$) and Education ($r=.27$, $n=194$, $p=.00$) were significantly ($p<.05$) related to PostTreatment electricity usage.

These data also passed the final test for ANCOVA appropriateness: treatment conditions had linear functions for the regression of PreTreatment electricity usage on PostTreatment usage. Thus the electricity usage data also met this ANCOVA requirement.

This series of tests suggested that an ANCOVA with PreTreatment electric usage, Income, and Education as covariates was an appropriate choice of analysis. Even though Income and Education were correlated ($r=.50$, $n=177$, $p=.000$) it was still considered useful to include both as covariates since they presumably measured different (and not perfectly related) characteristics, both of which were related to electricity usage.

Hypothesis 3, number of PostTreatment conservation actions. In preparation for the analysis of PostTreatment conservation actions the question of PreTreatment differences on this dimension was addressed. Two independent sources were used: the Thermogram Meeting Registration Form data on prior actions, and the RTS survey data which included information on which conservation actions had been done before the Thermogram Meetings.

Of the thirteen action categories on the Thermogram Meeting Registration Form (C1, C2, and C3 only) none of the Chi-square tests showed significant differences ($p<.05$) between the three conditions which attended these meetings. The RTS, having data for all four treatment conditions, provided more complete analysis of PreTreatment conservation action differences between groups. RTS findings were similar; for all three action categories (i.e., Space Heating Actions, Water Heating Actions, and Lighting Actions) no significant differences were detected between conditions.

Thus, the evidence was convincing that the treatment condition groups did not show any significant differences on PreTreatment conservation actions. With these findings in mind, the main effects test for PostTreatment conservation actions was essentially a post-only examination of treatment condition differences. This involved a series of one-way ANOVAs on the number of self-reported conservation actions in several categories.

Hypothesis 4, relationship between PostTreatment conservation actions and natural gas and electricity usage. The analysis for the degree of relationship between PostTreatment conservation actions and both natural gas and electricity usage outcomes was determined by the choice of analyses (ANCOVA) for both of these two indicators of treatment impact. Partial correlations were used for this hypothesis: For the correlation with PostTreatment natural gas usage, the previously identified covariate of PreTreatment natural gas usage was 'partialed out', or controlled. Similarly, the correlation with PostTreatment electricity usage used a partial correlation with the three covariates, (PreTreatment Electricity Usage, Income, and Education), being controlled.

Relationship of Selected Process and Descriptive Variables to Natural Gas and Electricity Usage

All of the analyses for the hypotheses in this grouping required partial correlations. Partial correlations with PostTreatment natural gas usage controlled for PreTreatment natural gas usage, and partial correlations with PostTreatment electricity usage controlled for

PreTreatment electricity usage, Income, and Education. Process variables included in these correlations with natural gas and electricity usage outcomes included Number of (thermographic) Heat Loss Areas, reported Use of Information Services, and the responses on the survey items for Barriers to Conservation and Pro-Conservation Attitudes. These partial correlations answered the research questions posed by Hypotheses 6-9.

Condition One (Thermogram + Workshop) Process Analyses

For both Hypothesis 10 and 11 the appropriate analyses were partial correlations. Hypothesis 12 required a combination of analyses. First, a Pearson correlation was used for testing the relationship between intention to act on workshop recommendations and subsequent number of actions completed. Second, the relationship between intention to act on workshop recommendations and natural gas and electricity usage was tested with partial correlations. Again, all partial correlations were patterned after those described for Hypothesis 4. Last, Hypothesis 13, the test of relationship between workshop tasks and the later completion of same-category energy conservation actions, required a Chi-square analysis.

Multiple Regression Analyses

The foregoing hypotheses helped identify the groups of variables to be tested as predictors of PostTreatment natural gas and electricity usage. Consistent with the analytical approach in Hypotheses 1-13, the basis for these multiple regression analyses was analysis of covariance, ANCOVA (Nie, Hull, Stienbrenner, and Brent, 1975).

CHAPTER III

RESULTS

Chapter III presents the findings of the current research. The order in which the results are presented is the same as described in the latter part of Chapter II, however three sections have been added. These three sections are Participant Attrition, the findings for Condition Four (No Thermogram) Process, and Individual Cases. Of the eight sections in Chapter III, the first two concern issues of treatment condition equivalence. The section on Participant Attrition is presented first, and is followed by the Comparison of Key Process and Descriptive Variables. A section on Main Effects, and another on the Relationship Between Key Process Variables and Outcome, detail the findings of greatest importance. Next, the results on Condition One (Thermogram + Workshop) Process, and the added section on Condition Four (No Thermogram) Process offer a closer examination of important dynamic features of the treatment conditions which were designed to offer the most intensive intervention (Condition One), and the least (no program contact) intensive condition (Condition Four). Then, a section on Multiple Regression indicates the findings on the study of potential predictors of the PostTreatment indices of natural gas usage, and electricity usage. Finally, to better describe the impacts and processes as they were experienced by individual participants, the last section provides several Individual Cases.

Participant Attrition

The goal of the sampling procedures was to obtain four treatment conditions of approximately 60 participants each. Three steps were necessary in this process: random selection, invitation to followup treatment, and acceptance of followup treatment. Table 9 shows the size and composition of the samples for the four treatment conditions.

Table 9. Patterns of Attrition for Each Condition

	Steps In Establishing Samples			
Condition	Random Selection	Invitation to Follow Up	Acceptance/ Rejection Of Invitation	Final Sample
C1: Thermogram + Workshop,	143	143	60/79	60
C2: Thermogram + Mailed Info.	56	56	56/0	56
C3: Thermogram Only	63	--	--	63
C4: No Thermogram (Control)	67	--	--	67

Note: Of the 143 people invited to C1, four later moved away, prior to data collection.

It was clear that for C2, C3, and C4 participant attrition did not exist. For C1 the situation was different, to obtain the final sample of 60 participants, 143 were randomly selected and invited to a hands-on workshop. Of these, 79 refused the invitation. This raised the question as to whether or not these 79 might be different from the 60 C1 "acceptors" on an important characteristic other than invitation acceptance. The most important criteria was PreTreatment usage of natural gas and electricity, the major outcome variables. In the interest of addressing the concern raised by this question (self-selection differences) a random sample of 35 (the maximum number available from the respective utility companies) out of the 79 refusers was drawn and the necesssary natural gas and electricity data was obtained. Student's T-tests were performed to test for potential differences on PreTreatment utility usage. No significant ($p<.05$) differences were found for natural gas (T-value=-1.0, df=91, p=.32) or for electricity (T-value=-.78, df=82, p=.44).

The next point at which treatment condition participants might differ was whether or not they completed the RTS, the telephone survey which collected the majority of the process and descriptive data. Table 10 provides the breakdown of those who completed the survey versus those who refused it.

Table 10. Tally of the Number of Completers Versus Refusers of the Residential Telephone Survey (RTS), By Condition

Condition	Completers Versus Refusers
C1: Thermogram + Workshop	51/9
C2: Thermogram + Mailed Info.	52/4
C3: Thermogram Only	57/6
C4: No Thermogram (Control)	51/16

Again, a series of Student's T-tests were done for the completers versus the refusers in each treatment condition. Of the four t-tests for PreTreatment natural gas usage, and the four t-tests for PreTreatment electricity usage, none were significant ($p < .05$). This supported the generalizability of the RTS survey findings to RTS nonresponders.

Thus, the data on participant attrition suggested that there were no self-selection biases with regard to natural gas and electricity usage, or the completion of the telephone survey. These findings strengthened the interpretation of main effects for the treatment conditions since this potential source of bias was adequately addressed.

Comparison of Key Process and Descriptive Variables

Prior to testing the treatment conditions for main effects, the analysis plan called for the review of key process and descriptive data with regard to any significant differences between conditions. No differences between conditions were anticipated for most participant demographics and characteristics, or residence characteristics. Specifically, it was intended that the sampling procedures, which matched the condition participants by neighborhood, would improve condition equivalence on these factors. The assessment of group differences on Respondent Characteristics, Residence Characteristics, Number of Areas of Heat Loss, and other self-reported Respondent Characteristics therefore provided the means by which the relative degree of group comparability could be presented. Tables 11 and 12 summarize the findings.

Table 11. Summary of Respondent Demographics, Residence Characteristics, and Number of Areas of Heat Loss Compared Between Conditions

Characteristic	Statistical Procedure	Degrees of Freedom, df	Statistic/ Value
Respondent Demographics:			
Age	ANOVA	3	F ratio/ .66
Education	ANOVA	3	F ratio/ 5.57 **
Income	ANOVA	3	F ratio/ 2.56
Income Change	Chi-Square	6	Chi-Square/ 2.67
Sex	Chi-Square	3	Chi-Square/ 5.52
Residence Characteristics:			
Own/Rent	--	--	(all own)
Billed for Heating Cost	--	--	(all are billed)
Type of Heating Fuel	--	--	(all gas heat)
Type of Water Heating	Chi-Square	3	Chi-Square/ 3.99
Number of Stories	ANOVA	3	F ratio/ .76
Number of Bedrooms	ANOVA	3	F ratio/ 1.46
Square Footage	ANOVA	3	F ratio/ .57
Type of Siding	Chi-Square	12	Chi-Square/ 4.34
Daytime Thermostat Setting	ANOVA	3	F ratio/ 3.11 *
Nighttime Thermostat Setting	ANOVA	3	F ratio/ .72
Change in Heated Space	Chi-Square	3	Chi-Square/ 5.98
Type of Change in Heated Space	Chi-Square	6	Chi-Square/ 19.6 **
Number of Areas of Heat Loss Indicated On Thermogram	ANOVA	2	F ratio/ 6.85 **

* $p < .05$
** $p < .01$

Note: Comparisons for each characteristic include all four experimental conditions. Exceptions exclude Condition Four and therefore show 2 degrees of freedom.

Table 12. Summary of Additional Respondent Characteristics Compared Between Conditions

Characteristic	Statistical Procedure	Degrees of Freedom, df	Statistic/ Value
Self Reported Use of:			
Energy Fair	Chi-Square	3	Chi-Square/ 25.05 **
Residential Conservation Service (RCS)	Chi-Square	3	Chi-Square/ 25.91 **
Energy Hotline	Chi-Square	3	Chi-Square/ 1.96
Self Rated Importance of:			
Energy Fair	ANOVA	3	F ratio/ 1.34
Residential Conservation Service (RCS)	ANOVA	3	F ratio/ .11
Thermogram Meeting	ANOVA	2	F ratio/ 1.89
Self Rated Improvement in Energy Conservation Knowledge	ANOVA	2	F ratio/ .99
Self Rated General Energy Knowledge	ANOVA	3	F ratio/ .33
Percentage of Conservation Materials Purchased Locally	ANOVA	3	F ratio/ 1.24
Dollars Spent on Conservation	ANOVA	3	F ratio/ .82
Loan Taken Out for Conservation	Chi-Square	3	Chi-Square/ 3.17
Barrier to Conservation (Cost)	ANOVA	3	F ratio/ .18
Energy Conservation Attitudes:			
Need Gov't Involvement	ANOVA	3	F ratio/ .31
Energy Crisis Is Real	ANOVA	3	F ratio/ 1.07
Favor Environ. Protection	ANOVA	3	F ratio/ .81
I Am Innovative	ANOVA	3	F ratio/ 3.28 *
Would Conserve Without A Direct Payback	ANOVA	3	F ratio/ .25

* $p < .05$

Note: Comparisons for each characteristic include all four experimental conditions. Exceptions exclude Condition Four and therefore show 2 degrees of freedom.

It was apparent, then, that since treatment conditions were not significantly different on most of these measures, the sampling strategy was largely successful in obtaining equivalent comparison groups. Hypothesis 5 had however predicted three exceptions to the anticipated group equivalence. Findings for these three exceptions (in Table 12) are discussed first.

First, significant group differences were hypothesized for self-reported use of meeting-promoted information services. At the top of Table 12, the results indicate that, in fact, there were treatment group differences on the use of the Energy Fair, and Residential Conservation Service (home energy audit), but not for the Energy Hotline service. Furthermore, the percentages of affirmative answers on use of the Energy Fair and RCS program were generally in the order which had been predicted. For use of the Energy Fair percentage 'yes' responses were, in order from C1 to C4: 51.1 percent, 24.0 percent, 16.4 percent, and 10.2 percent. Similarly, the 'yes' responses for the RCS service were: 51.0 percent, 38.0 percent, 41.1 percent, and 5.9 percent. (A slightly higher percentage of the C3 group used the RCS service than did the C2 group). Although the CEM program promoted use of all these ancillary services, use of the Energy Hotline (toll free energy conservation information) service was minimal: three or fewer participants in each treatment condition used the Hotline.

Second, Hypothesis 5 had predicted treatment group differences on perceived barriers to energy conservation actions. The statistical test of this prediction, on the single scale, COST, did not, however, indicate significant group differences. It appeared that the various treatment combinations inherent in C1, C2 and C3 did not influence an appreciable reassessment of the economic value of conservation investments.

Third, group differences were expected on Energy Conservation Attitudes, yet none of the attitude items except 'I Am Innovative' showed significant differences. Closer examination of this item revealed that on a scale from 1 to 5, (with 1 corresponding to "Strongly Agree"), the group means were 2.84 (C1), 3.20 (C2), 3.33 (C3), and 3.35 (C4). Thus, it seemed that the trend was in the direction of stronger treatment interventions being related to greater agreement on self perceived innovativeness. A posteriori testing (Scheffe' proceedure) of this trend between conditions however indicated no significant ($p<.05$) differences between any pair of treatment groups. The most conservative summary was that differences in energy conservation attitudes did not appear to be associated with type of treatment.

According to Hypothesis 5, other significant differences between groups were not anticipated. Contrary to this prediction, Table 10 shows four significant differences. First on this list was the between-group difference on Education. This variable was a 5 point continuum with 1 equal to grammar school and 5 equal to post graduate work or degree. Mean values for treatment groups were 3.29 (C1), 3.22 (C2), 3.18 (C3), and 2.45 (C4). A posteriori analyses (Scheffe' procedure) confirmed that C4 (No Thermogram), had significantly less formal education than the other groups (C1, C2, and C3). Therefore, it was noteworthy that the control group (C4), which had not attended the Thermogram Meetings, tended to have less formal education than those in the conditions who had elected to participate in the treatments.

Second, Table 11 showed significant differences between treatment conditions on the Daytime Thermostat Setting reported by participants. Group means, in degrees Fahrenheit, were, from C1 to C4, 62 degrees, 64 degrees, 63 degrees, and 65 degrees. A Scheffe' test indicated that C4, the No Thermogram group, was significantly higher than C1 (but not the other two conditions). This suggested an important difference between these two groups, but it was interesting that no significant differences were found for the Nighttime Thermostat Setting. In light of the findings that treatment conditions did not differ on most residence characteristics, it seemed that control group participants, without the benefit of the energy conservation information gained by those in the other conditions, simply chose to keep their thermostats at higher temperature settings.

Third, the Type of Change in Heated Space was also significantly different between groups. Close review of the summary statistics indicated that in C1 16.3 percent of the group had decided to close off rooms which did not need to be heated, whereas in the other three treatment conditions less than 2 percent did this. Originally, this question had been included in the telephone survey (RTS) as a way of detecting reasons for sharp reduction in natural gas (heating) usage level. In retrospect, it appeared that it was best construed as an additional measure of treatment outcome.

Last was the significant between-groups difference for the Number of Areas of Heat Loss Indicated On the Thermograms. Since C4 people did not attend Thermogram Meetings, this variable only referred to C1, C2 and C3. Mean values for this tally of detected heat loss areas were 1.3 (C1), 1.9 (C2), and 1.1 (C3). The a posteriori Scheffe' indicated that

C2 residences showed significantly ($\underline{p}$<.05) more areas of heat loss than either C1 or C3.

At least as important as the significant effects above were the variables for which no significant differences were found. Clearly, the majority of the variables listed in both Tables 11 and 12 were in this category. It was particularly useful to recognize that nearly all of the Residence Characteristics, in Table 11, were not significantly dissimilar. This was further evidence that the sampling strategy was effective in producing initial equivalence across the comparison groups.

Main Effects

This section includes the findings on the three outcome criteria of natural gas usage, electricity usage, and the number of PostTreatment conservation actions. The discussion presents findings for natural gas and electricity first.

Hypothesis 1: Treatment Impact on Natural Gas Usage

Of the two types of utility usage, the treatments were designed to primarily effect a reduction in natural gas (heating) requirements for the participating homeowners. As shown in Table 11, all participants in the current research were homeowners, with obvious responsibility for heating bills, and natural gas was the heating fuel. Findings on the outcome for natural gas usage are shown in Table 13.

Table 13. Analysis of Variance and Covariance of PostTreatment Natural Gas Usage (October-April)

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	.3846	1	.3847	391.39 ***
Main Effects				
Condition	.0042	3	.0014	1.43
Explained	.3889	4	.0972	98.92 ***
Residual	.2290	233	.0010	

*** p<.001

These results indicated that PostTreatment usage of natural gas (which was adjusted for nonheating usage rates [base load], and weather differences [Heating Degree Days]) was determined for the most part by PreTreatment usage. Treatment condition was not a significant factor in affecting PostTreatment usage. Thus, the hypothesis about significant (p<.05) natural gas savings was not realized.

The ANCOVA analysis also provided group means and standard deviations on PostTreatment natural gas usage (base load and weather corrected). Table 14 provides these treatment condition mean values and standard deviations, in base load corrected hundreds of cubic feet of natural gas per degree day (ccf/HDD).

Table 14. Group Means and Standard Deviations On PostTreatment Natural Gas Usage (October-April)

		Statistics, Unadjusted		Statistics, Adjusted for Covariates	
Condition	N	Mean	SD	Mean	SD
C1: Thermogram + Workshop	58	.1136	.0441	.1182	.0326
C2: Thermogram + Mailed Info.	54	.1372	.0506	.1305	.0293
C3: Thermogram Only	62	.1280	.0534	.1231	.0333
C4: No Thermogram (Control)	64	.1177	.0531	.1240	.0292

Grand Mean = .1238
Note: The single covariate was PreTreatment Natural Gas Usage.

The first column of means and standard deviations are for PostTreatment natural gas usage, with no adjustment for the covariate; the second column of means and standard deviations include adjustment for the influence of the covariate. This table indicates that the most intensive treatment combination (Thermogram + Workshop) was associated with the lowest PostTreatment usage of natural gas. Thus, although the differences between conditions were not statistically significant, the mean value for C1 was rank ordered lowest, as predicted.

Although it was anticipated that C2 (Thermogram + Mailed Information) would have had the second lowest PostTreatment usage, followed by C3 (Thermogram Only), the results showed quite a different order of effects (Table 14). On the basis of the adjusted mean values, it appeared that those attending Thermogram Meetings alone (C3) did only slightly better than the control group. The fact that C2 (Thermogram + Mailed Information) had the highest mean value for PostTreatment usage was especially puzzling; however, another finding for C2 suggested an explanation. Participants in Condition Two (C2) had been found to have significantly more Areas of Heat Loss on their Thermograms. This fact suggested that the residences of those in C2 might have been in greater need of conservation actions.

These results were also translated into the dollar equivalents for the heating season. Using the adjusted means (in ccf/HDD) for each condition, a price of $ .519/ccf, and the 5727 Heating Degree Day heating season (PostTreatment), the average heating expenditures for each condition were computed as a simple product. The dollar equivalents for each condition were as follows: $351.33 (C1), $387.89 (C2), $365.89 (C3), and $368.57 (C4). Thus, in comparison to the C4 (control group) average, C1 (Thermogram + Workshop) spent $17.64 less, C2 (Thermogram + Mailed Information) spent $19.32 more, and C3 (No Thermogram) spent $2.68 less. Obviously, the <u>first year</u> net differences from the control group were not substantial. Consideration of other factors such as 1) cumulative natural gas savings over the subsequent years, 2) increasing cost of natural gas, and 3) the potential for additional treatment-motivated conservation actions did, however, suggest that longer term evaluation of natural gas usage impacts may look better over time.

Hypothesis 2: Treatment Impact on Electricity Usage

Hypothesis 2 anticipated no significant main effect for PostTreatment electricity usage. No significant main effect was expected since the treatments were primarily aimed at space heating, where natural gas was the fuel. Results of the ANCOVA for electricity follow, in Table 15.

Table 15. Analysis of Variance and Covariance of PostTreatment Electricity Usage (October-April)

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	171561370	1	171561370	414.77 ***
Income	115312	1	115312	.28
Education	1646227	1	1646227	3.98 *
Main Effects				
Condition	747019	3	249006	.60
Explained	264110760	6	44018461	106.42
Residual	67007784	162	413628	

* $p<.05$
*** $p<.001$

Clearly, Table 15 findings confirmed the expressed expectation. In this instance both PreTreatment Usage and Education were major influences on PostTreatment Usage, but the effect of treatment condition was nonsignificant.

Mean values and standard deviations for PostTreatment Electricity Usage are listed in Table 16. All tabled values are in terms of kilowatt hours (kwh).

Table 16. Group Means and Standard Deviations On PostTreatment Electricity Usage (October-April)

		Statistics, Unadjusted		Statistics, Adjusted for Covariates	
Condition	N	Mean	SD	Mean	SD
C1: Thermogram + Workshop	39	3465.90	1408.74	3403.31	635.16
C2: Thermogram + Mailed Info.	45	3822.47	1312.52	3439.06	643.76
C3: Thermogram Only	48	3159.75	1165.08	3416.46	521.98
C4: No Thermogram (Control)	37	3384.08	1713.15	3583.36	722.40

Grand Mean = 3455.98
Note: Covariates include PreTreatment Electricity Usage, Income, and Education.

As with PostTreatment Natural Gas Usage (Table 14) the most intensive treatment condition, C1, had the lowest (best) average on PostTreatment usage. Unlike the PostTreatment Natural Gas Usage mean values, both C2 and C3 did better than the control group, C4. Thus, although the prediction of nonsignificant group differences on PostTreatment Electricity Usage were supported by the results, the pattern of mean values showed that all the treatment conditions (C1, C2, and C3) had lower mean usage than the control, C4, and C1 had the lowest PostTreatment electricity usage.

The dollar equivalents for the adjusted mean electricity usage (in kilowatt hours, kwh) during the heating season for each condition illustrated the practical meaning of the findings to members of each treatment condition. Based on a price of $.0571/kwh, average dollar equivalents for each condition were: $194.33 for C1 (Thermogram + Workshop), $196.37 for C2 (Thermogram + Mailed Information), $195.08 for C3 (Thermogram Only), and $204.61 for C4 (No Thermogram). In comparison to the average electricity cost to those in C4, C1 participants spent $10.28 less, C2 participants spent $8.24 less, and C3 participants spent $9.53 less. In summary, all three of these groups realized savings, relative to the control group, but these first year net savings were rather small. The addition of these savings over subsequent years, consideration of the increasing cost of electricity, and the potential for additional conservation actions would, however, suggest potential improvement in the overall treatment effects over time.

Hypothesis 3: Treatment Impact on PostTreatment Conservation Actions

It was established, in Chapter II, that treatment conditions did not differ on PreTreatment actions, therefore findings on PostTreatment actions were not biased by prior differences. Having established this PreTreatment equivalence, the question was: Did the conditions differ on the amount of PostTreatment energy conservation actions? Tables 17 and 18 provide the answer. In the process of studying these tables, the reader may wish to refer back to Table 3, in which the contents of each category of action are defined.

Table 17. Summary of One Way ANOVAs of PostTreatment Actions by Condition

PostTreatment Action By Category	Group Means				F ratio
	C1	C2	C3	C4	
Space Heating					
'Done'	1.48	1.57	1.26	1.05	1.42
'Planned'	.64	.63	.50	.28	2.84 *
'Done and Planned'	.33	.31	.10	.03	6.75 ***
'Done', 'Planned' and 'Done and Planned'	2.45	2.52	1.85	1.35	5.70 ***
Water Heating					
'Done'	.90	.63	.73	.25	7.71 ***
'Planned'	.12	.17	.15	.06	1.18
'Done and Planned'	.03	.06	.00	.00	1.52
'Done', 'Planned', and 'Done and Planned'	1.05	.85	.87	.31	8.63 ***
Lighting					
'Done'	.09	.11	.03	.05	1.22
'Planned'	.03	.02	.00	.00	1.34
'Done and Planned'	.02	.04	.00	.00	1.45
'Done', 'Planned', and 'Done and Planned'	.14	.17	.03	.05	3.19 *
ALL ACTIONS					
'Done'	2.47	2.31	2.02	1.34	3.79 **
'Planned'	.79	.81	.65	.34	3.75 **
'Done and Planned'	.38	.41	.10	.03	7.42 ***
'Done', 'Planned', and 'Done and Planned'	3.64	3.54	2.76	1.71	8.77 ***

* $p<.05$ ** $p<.01$ *** $p<.001$

Table 18. Summary of A Posteriori (Scheffe') Tests for Differences Between Conditions on PostTreatment Conservation Actions

Categories	Status of Conservation Actions: 'Done'	'Planned'	'Done, and Planned'	'Done', 'Planned', and 'Done and Planned'
Space Heating	--	no differences	C1,C2>C4	C1,C2>C4
Water Heating	C1,C3>C4	--	--	C1,C2,C3 >C4
Lighting	--	--	--	no differences
ALL ACTIONS	C1>C4	C1,C2>C4	C1,C2> C3,C4	C1,C2>C4

Note: All differences between conditions shown in this table are predicated on the occurrance of one-way ANOVA tests where $p<.05$. Nonsignificant ($p>.05$) differences are noted by (--).

Table 18 reports results of a posteriori (Scheffe') tests which, in parallel with Table 17, complete the picture of these conservation action findings. Entries in Table 18 which indicate 'no differences' refer to instances in which the one-way ANOVA on Table 17 was statistically significant (p<.05), but the rather conservative quality of the associated Scheffe' test suggested that comparison of pairs of treatment conditions were nonsignificant (p<.05).

The combination of Table 17 and Table 18 offer considerable explanation of the actions which are presumed to have resulted from the treatments. First, in all action status groupings under ALL ACTIONS (Table 17) the treatment conditions were significantly different. Group means suggest that the groups which received treatment (C1, C2, and C3) did consistenly better than the control, C4. The associated a posteriori (Scheffe') tests for significant differences between treatment groups (Table 18) revealed that C1 did significantly better than C4, and C2 did similarly well in all action status categories except the one labeled 'Done'.

Each action category could then be considered individually. First, although treatment group means (Table 17) were uniformly higher for Space Heating actions than those for C4, it should be noted that this was true in all action status categories except actions which had been 'Done'. In reference to Table 3 it can be seen that these actions included relatively more expensive actions, a potential reason for deferring action.

The findings were somewhat different for Water Heating. Treatment groups tended to complete these actions ('Done') at a significantly higher rate than the control group, C4.

Lighting action results indicated that only in the combined action status category was the ANOVA significant. The Scheffe' test however suggested no significant differences between treatment condition comparisons. It may be useful to reiterate that the Lighting action category included only one action, reducing the use of lighting. Moreover, reduction in electricity usage was not the goal of the treatments.

Although these results offered the necessary summary statements about the impact of treatments on subsequent conservation actions, one additional series of special analysis was also completed. This analysis simply examined the possibility of treatment condition differences on the action categories which were the specific focus of the followup treatments in C1 (Thermogram + _Workshop_) and C2 (Thermogram + _Mailed Information_). Chi-square results for differences on the three focal conservation actions were as follows. First, PostTreatment _foundation insulation_ showed a significant ($p<.05$) effect, and the percentage of 'yes' responses, by treatment condition, were in the expected order: 42.9 percent (C1), 32.0 percent (C2), 19.6 percent (C3), and 11.8 percent (C4). Second, the PostTreatment combined category of installed of storm doors, storm windows, and other window coverings also showed a significant difference between treatments, and the percentages of 'yes' responses were 30.6 percent (C1), 36.7 percent (C2), 21.4 percent (C3), and 9.8 percent (C4). Thus, C1 and C2 did the most of this set of window and door retrofitting, as one might predict, but C1 did not outperform C2. Third, and last among these special analyses, was a similar test for treatment effects on caulking and weatherstripping. Treatment condition effects were not significant, as is represented by the comparison of percentages of 'yes' responses: 61.2 percent (C1), 56.0 percent (C2), 50.0 percent (C3), and 41.2 percent (C4).

Hypothesis 4: Relationship of Natural Gas and Electricity Usage With PostTreatment Actions

It was predicted that the number of self reported conservation actions would show a significant, negative relationship to PostTreatment natural gas usage, but not for PostTreatment electricity usage. Tables 19 and 20 reflect the results of the appropriate partial correlations.

Table 19. Partial Correlations of Number of PostTreatment Actions With PostTreatment Natural Gas Usage (Controlling for PreTreatment Usage)

	Types of Subsequent Conservation Action			
	Sum of All Space Heating Actions	Sum of All Water Heating Actions	Sum of All Lighting Actions	Grand Total
PostTreatment Natural Gas Usage	-.05	-.03	-.09	-.06

* $p < .05$
Note: Number of cases was 235.

Table 20. Partial Correlations of Number of PostTreatment Actions With PostTreatment Electricity Usage (Controlling for PreTreatment Usage, Income, and Education)

	Types of Subsequent Conservation Action			
	Sum of All Space Heating Actions	Sum of All Water Heating Actions	Sum of All Lighting Actions	Grand Total
PostTreatment Electricity Usage	-.02	-.04	-.04	-.03

* $p < .05$
Note: Number of cases was 164.

All eight partial correlations were in the expected direction (higher number of conservation actions associated with lower utility usage), but these relationships were not significant ($p < .05$). In other words, while the relationship between number of conservation actions and reduced usage of natural gas and electricity were in fact negatively associated, the correlations were not statistically significant. This finding does not necessarily mean the causal link between conservation action and energy savings was not important. The lack of statistical significance for these relationships could also be interpreted as an indication that the number of conservation actions may not be as important as the individualized configuration of specific conservation actions and a home's particular conservation needs.

Relationship Between Key Process Variables and Outcome, Treatment Condition Comparisons

This section concerns the results for Hypotheses 6, 7, 8 and 9. For each of these hypotheses the general question was the degree to which a key process variable was related to PostTreatment natural gas and electricity usage. All of these hypothesis tests required partial correlations; for the correlations with PostTreatment natural gas usage the only variable controlled for was PreTreatment natural gas usage, and the correlations with PostTreatment electricity usage controlled for PreTreatment electricity usage, Income, and Education.

Hypothesis 6: Number of Areas of Heat Loss

Only those in C1, C2 and C3, by definition of treatment condition, had data on the Number of Areas of Heat Loss. (For each of these treatment conditions the Thermogram Meeting Registration Forms served to record the necessary information). Hypothesis 6 predicted a significant, negative relationship with PostTreatment natural gas usage, and a nonsignificant relationship with PostTreatment electricity usage. Results of the correlation with natural gas usage were significant, but the direction was <u>positive</u> ($r=.15$, $df=235$, $p=.01$). This suggested that a higher Number of Areas of Heat Loss was related to subsequent higher usage of natural gas, exactly counter to the prediction. On the other hand, results for correlation with electricity usage were nonsignificant, as predicted ($r=-.01$, $df=164$, $p=.46$).

Hypothesis 7: Participation In Additional Information Services

Hypothesis 7 offered the expectation that participation in one or more of the information services (Energy Fair, RCS, or Energy Hotline), which were promoted in the CEM program, would be inversely related to PostTreatment usage of natural gas, but no significant relationship would exist with PostTreatment usage of electricity. For both natural gas and electricity the correlations were as expected. A significant, inverse relationship was in fact discovered for the natural gas correlation ($r=-.12$, $df=235$, $p=.03$), and for electricity the relationship was nonsignificant ($r=-.07$, $df=164$, $p=.18$). Apparently, use of the recommended information services helped people increase space heating efficiency, and thereby reduce natural gas usage.

Hypothesis 8: Barriers To Energy Conservation

Perceived barriers to energy conservation were also considered to be a potential influence on natural gas usage, but not for electricity usage. The only barrier to be tested for these correlations was the two-item scale, Cost. (Other items had been omitted due to insufficient variance). Partial correlations showed no significant relationship for either natural gas usage ($r=-.04$, $df=200$, $p=.28$) or for electricity usage ($r=-.07$, $df=164$, $p=.20$). Not only was Cost not significantly different between groups (Table 12), but it was also not significantly related to PostTreatment usage of natural gas and electricity.

Hypothesis 9: Pro-Conservation Attitudes

It had been reasoned that Pro-Conservation Attitudes might have some influence on PostTreatment natural gas usage, but they would have no influence on PostTreatment electricity usage. Tables 21 and 22 list the findings which tested these assertions. The first two attitude categories were multiple-item scales and the remaining three were item singlets.

Table 21. Partial Correlations of Pro-Conservation Attitudes With PostTreatment Natural Gas Usage (Controlling for PreTreatment Usage)

Attitude Category	Correlation Coefficient
Need Gov't Involvement	-.05
Energy Crisis Is Real	-.03
Favor Environ. Protection	.05
I Am Innovative	-.08
Would Conserve Without A Direct Payback	.03

* $p < .05$
Note: Degrees of freedom (df) for all correlations was 198.

Table 22. Partial Correlations of Pro-Conservation Attitudes With PostTreatment Electricity Usage (Controlling for PreTreatment Usage, Income, and Educational Level)

Attitude Category	Correlation Coefficient
Need Gov't Involvement	-.08
Energy Crisis Is Real	-.02
Favor Environ. Protection	-.06
I Am Innovative	-.01
Would Conserve Without A Direct Payback	.00

* $p < .05$
Note: Degrees of freedom (df) for all correlations was 163.

The results were unequivocal: none of these correlations were significant. Thus, the assertion that Pro-Conservation Attitudes would be inversely related to PostTreatment natural gas usage was not supported, but the expected nonsignificant relationship for electricity was supported.

Condition One (Thermogram + Workshop) Process

Condition One (Thermogram + Workshop) was intended to be the most intensive treatment combination. In addition to the information provided at the Thermogram Meetings the followup intervention was designed to encourage participants to get involved in the completion of specific conservation actions at the hands-on workshop. Thus, before discussing the relationships between workshop characteristics and specific outcome indices (Hypotheses 10-13) the first part of this section will address the degree to which the workshop sessions (3 groups of participants, on three separate days) were delivered as planned. With the knowledge of the degree of conformity of the workshop treatment to the intended plan, the interpretation of the relationships of its essential processes to the desired outcomes could become more meaningful.

Treatment Integrity

The issues of how consistent and complete the delivery of each intervention (in this case, hands-on workshops) was has been presented by Sechrest and Redner (1979). This is an issue of treatment integrity. Integrity of treatment may be especially important when interpreting treatment outcomes which are statistically nonsignificant; that is, information on the experienced treatment may be helpful in guiding later improvements. The current research had been designed so that information on treatment integrity could accompany other major findings, and thus increase interpretability of the results.

The Individual Checklist and Workshop Comments instruments provided data on (1)the number of hands-on tasks actually completed during the workshops, (2) ratings of the usefulness of the workshop, and (3) statements of intention to act on workshop recommendations. This was collected for each of the three content-specific workshop stations. Table 23 displays the mean values.

Table 23. Workshop Process Variable Means, For Each Workshop Station

Station	Workshop Process Variables		
	Number of Hands On Task	Usefulness Rating	Plan To Take Action
	(tallied number)	(1=very useful to 5=not useful)	(1=not planned 2=planned)
#1. Foundation Insulation	.98	1.38	1.50
#2. Window/Door Modifications	.16	1.63	1.56
#3. Caulking and Weatherstripping	.26	1.64	1.63
OVERALL	1.40 (sum)	1.55 (average)	1.56 (average)

Note: Number of cases was 58 for "Tasks", 56 for "Ratings", and 54 for "Plan".

Several features of this table are noteworthy. First, it is apparent that relatively few hands-on tasks were completed, and between the three workshop stations the Foundation Insulation station showed greatest activity. Second, ratings of the workshop station content was generally quite high, and the Foundation Insulation station was most highly rated. Third, results were about evenly divided on planned versus nonplanned action. The lower the mean values on this dichotomous variable indicated the tendency for rejection of the recommended actions. Thus, workshop participants seemed least inclined to report the intention to take Foundation Insulation actions, and were relatively more inclined to plan actions on Window/Door Modifications and Caulking and Weatherstripping. Nevertheless it is important to remember that these were responses collected immediately following the workshop station rotations; it was entirely reasonable to expect that some participants later reconsidered these plans for conservation actions.

Next, the issue of consistency between workshop sessions was considered. Table 24 indicates the findings for these comparisons.

Table 24. Workshop Process Variables Compared Between Workshop Sessions

Process Variable	F ratio	F probability
Number of Hands On Tasks		
Foundation Insulation	18.22	.00 *
Window/Door Modifications	0.13	.88
Caulking and Weatherstripping	4.18	.02 *
OVERALL	4.53	.02 *
Usefulness Rating		
Foundation Insulation	1.42	.25
Window/Door Modifications	1.43	.25
Caulking and Weatherstripping	1.78	.18
OVERALL	1.75	.18
Plan To Take Action		
Foundation Insulation	.02	.98
Window/Door Modifications	.27	.76
Caulking and Weatherstripping	.94	.40
OVERALL	.27	.77

* $p < .05$

Note: All one-way analyses of variance were computed with 2 degrees of freedom.

For both the Usefulness Ratings and Plan To Take Action findings no significant differences were found, but for Number of Hands On Tasks there were significant differences. When the three workshop sessions were compared, hands-on activity for Foundation Insulation and Caulking/Weatherstripping were different between sessions. A Scheffe' test indicated that, for the Foundation Insulation station, participants in the first session did significantly ($p < .05$) more than those in subsequent sessions. For the Caulking/Weatherstripping station those in the first workshop session did significantly more hands-on tasks than did those in the second session.

In summary, these findings suggested that although the workshops were well received, the available indicators revealed less hands on activity than planned and some important variation between sessions. This is further discussed in Chapter IV.

Hypotheses 10-13

All hypotheses under this heading dealt with the relationship of the hands-on workshop process data with the outcome data. Thus, the treatment integrity issues addressed in the foregoing section provided some useful insights about the workshop process, and therefore helped explain results in this section. Hypotheses 10-12 centered on natural gas and electricity outcomes whereas Hypothesis 13 concerned specific categories of PostTreatment conservation action. Significant relationships were predicted for all tests except those with the electricity outcomes.

Because of the similarities in Hypotheses 10-13, tabled results have been consolidated. For each workshop process variable (i.e., Number of Hands On Tasks, Usefulness Rating, and Plan To Take Action) the correlations with PostTreatment usage are given separately for each workshop station. For example, the first entry in Table 25 indicates a partial correlation coefficient of -.15 for the relationship between PostTreatment natural gas usage and the Number of Hands On Tasks reported for the Foundation Insulation workshop station. Table 25 displays the partial correlations regarding natural gas outcomes, and Table 26 shows these correlations for electricity outcomes.

Table 25. Partial Correlations With PostTreatment Natural Gas Usage (Controlling for PreTreatment Usage)

Station	Workshop Process Variables		
	Number of Hands On Tasks	Usefulness Rating	Plan To Take Action
	(tallied number)	(1=very useful to 5=not useful)	(1=not planned 2=planned)
#1. Foundation Insulation	-.15	.24 *	-.09
#2. Window/Door Modifications	.19	.17	-.22
#3. Caulking and Weatherstripping	-.14	.12	.03
OVERALL	-.11 (sum)	.22 (average)	-.13 (average)

* $p < .05$

Note: Number of cases was 55 for "Tasks", 53 for "Ratings", and 51 for "Plan".

Table 26. Partial Correlations With PostTreatment Electric Usage (Controlling for PreTreatment Usage, Income, and Educational Level)

Station	Workshop Process Variables		
	Number of Hands On Tasks	Usefulness Rating	Plan To Take Action
	(tallied number)	(1=very useful to 5=not useful)	(1=not planned 2=planned)
#1. Foundation Insulation	.14	-.04	.14
#2. Window/Door Modifications	.03	-.08	.03
#3. Caulking and Weatherstripping	-.44 **	-.15	.21
OVERALL	.04 (sum)	-.12 (average)	.17 (average)

** $p < .01$

Note: Number of cases was 34 for "Tasks", 33 for "Ratings", and 31 for "Plan".

Table 25 findings will be reviewed first. The predicted direction of these correlations were negative for columns 1 and 3, and positive for column 2. The results generally showed the expected direction of these relationships. The only significant ($p < .05$) relationship suggested that high ratings of the Foundation Insulation workshop station were related to low PostTreatment natural gas usage.

Table 26 shows the correlations for electricity usage outcomes. Although the hypotheses anticipated no significant correlations for PostTreatment electricity usage, one relationship was significant. This correlation suggested that a higher number of hands-on tasks at the Caulking/Weatherstripping workshop station was related to lower PostTreatment electricity usage. Since this did not appear to represent a direct, logical relationship, it was suggested that this finding was either spurious, or some unknown moderator variable may have been responsible.

Last in this series was Hypothesis 13. Here the prediction was that completion of one or more workshop tasks would be significantly related to the report of one or more PostTreatment actions in the same category. Since the workshop focused on teaching conservation actions related to residential space heating, this was where subsequent actions were expected. Table 27 indicates the correlations with space heating actions, as well as two other action categories.

Table 27. Pearson Correlations of the Reported Intention To Act With Number of PostTreatment Actions

Reported Area of Intended Action (1=not planned, 2=planned)	Types of PostTreament Conservation Action			
	Sum of All Space Heating Actions	Sum of All Water Heating Actions	Sum of All Lighting Actions	Grand Total
#1. Foundation Insulation	.14	-.14	-.11	-.07
#2. Window/Door Modifications	.04	-.04	-.15	-.11
#3. Caulking and Weatherstripping	.22 *	.18	.12	.11
OVERALL	.18	-.01	-.07	-.03

* $p < .05$

Note: Number of cases was 55 for row 1; 56 for rows 2 and 3; and 54 for row 4.

As one would predict, all correlations with PostTreatment Space Heating Actions were positive. Based on the only significant correlation in this table, it appeared that when participants indicated an intention to do caulking and weatherstripping at home, it was associated with a report of more PostTreatment Space Heating Actions.

Condition Four (No Thermogram) Process

Although not directly related to the research questions of the current study it was considered useful to ask a series of questions on the telephone survey (RTS) which were addressed only to those in Condition Four. The first question was simply: if they had heard of the Thermogram Meetings, how had they heard about them?

Table 28. Distribution Of Responses On How NonParticipants Heard Of The Thermogram Meetings

How Heard	Count	Relative Frequency (Percent)
Newspaper	18	27.7
Flyer	1	1.5
Friends	1	1.5
Neighbors	3	4.6
Relatives	2	3.1
School	1	1.5
Energy Fair	1	1.5
Businessmen	1	1.5
Newspaper + Radio	3	4.6
Newspaper + Television	2	3.1
Newspaper + Flyer	1	1.5
Newspaper + Flyer + Relatives	1	1.5
(No Data)	30	46.1
TOTAL	65	100.0

From this table, it should be emphasized that 53.9 percent did hear about the meetings. Obviously, the local newspaper was the most important source by which nonparticipants had heard about the Thermogram Meetings, but it was also noteworthy that the total of multiple source responses (such as Newspaper + Radio) represented a category with the next highest percentage, 10.7 percent. Apparently, Thermogram Meeting publicity had reached the majority of nonparticipants.

The other question was: why didn't you attend the Thermogram Meeting? A relatively high percentage said they didn't recall the reason for not going (46.1 percent); this seemed reasonable since it was roughly one year after the Thermogram Meetings that this survey question was asked. For the remainder of those surveyed the responses were, in rank order, 18.5 percent 'bad timing', 16.9 percent (miscellaneous), 10.8 percent 'not interested', and 7.7 percent 'conflict with work schedule'. Thus, relatively few people who had not attended the Thermogram Meetings were disinterested.

Multiple Regression

The final series of analyses (Hypothesis 14) explored potential predictor variables for the PostTreatment natural gas and electricity usage outcomes. Since these main effects had been tested within an ANCOVA framework (Nie, et al.,1975), where PreTreatment usage and other key covariates (Income and Education) were essential elements, the exploration of potential predictor variables, in addition to the previously selected covariates, also involved an ANCOVA approach to the tested multiple regression solutions. In short, variables which had been identified as potential predictors in Hypotheses 1-13 were included with previously identified covariates in a stepwise regression with no entry criteria; covariates and other potential predictors were entered into the regression analysis simultaneously. Thus, the 'other potential predictors' were placed in direct competition with prior covariates.

To be selected as potential predictors, variables had to meet the following criteria: (1) be a continuous level variable, (2) show significant ($p<.05$) difference between treatment conditions, and (3) have a significant ($p<.05$) correlation to the respective PostTreatment natural gas or electricity usage level. For each set of analyses the list of potential predictor variables (in addition to those previously identified as covariates in the main effects analyses) included four possiblities: Daytime Thermostat Setting, Information Services Use, Total Number of ('Done' or 'Planned') Conservation Actions, and (for C1, C2, and C3 only) Number of Areas of Heat Loss.

Both dependent variables (PostTreatment Natural Gas Usage, and PostTreatment Electricity Usage) had two multiple regressions. One multiple regression was done including the latter variable, Number of Areas of Heat Loss, and this was for participants from C1, C2, and C3. The other multiple regression excluded this variable and was completed for all participants (C1, C2, C3, and C4).

Results are presented first for the prediction of PostTreatment natural gas usage. Variables which met the three part criteria for inclusion were Daytime Thermostat Setting, and Number of Areas of Heat Loss. The ANCOVA multiple regression solution for the three-group analysis is revealed in Table 29.

Table 29. Analysis of Variance and Covariance of PostTreatment Natural Gas Usage (October-April), First Regression Solution

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	.23	1	.23	220.28 ***
Daytime Thermostat Setting	.00	1	.00	.19
Number of Areas of Heat Loss	.01	1	.01	5.27 *
Main Effects				
Condition	.00	2	.00	1.08
Explained	.25	5	.05	49.17 ***
Residual	.15	149	.00	

* $p<.05$
*** $p<.001$

For those who attended Thermogram Meetings (C1, C2, and C3) the number of areas of heat loss which were identified to the participant seemed to be a significant predictor of PostTreatment natural gas usage. The raw regression coefficients for the series were .81, .00, and .01, for the respective covariates above. The .01 regression coefficient is postive, however, when one would predict it to be negative (i.e., higher number of areas of heat loss associated with subsequent lower gas usage, due to conservation).

A similar multiple regression, which omitted Number of Areas of Heat Loss, was completed for participants from all four treatment conditions.

Table 30. Analysis of Variance and Covariance of PostTreatment Natural Gas Usage (October-April), Second Regression Solution

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	.33	1	.33	324.06 ***
Daytime Thermostat Setting	.00	1	.00	.23
Main Effects				
Condition	.00	3	.00	1.31
Explained	.37	5	.07	71.52 ***
Residual	.20	198	.00	

*** $p<.001$

Here the only added covariate, Daytime Thermostat Setting, showed no significant contribution to prediction. The raw regression coefficents for the two covariates were .84 and .00, respectively.

For PostTreatment electricity usage the list of potential predictors included five variables. The varaiable Income was dropped since, in Table 15, its contribution to the main effects ANCOVA had been nonsignificant. The other two original covariates were retained, and three variables which had met the three part criteria for inclusion (i.e., Information Services Use, Number of Conservation Actions, and Number of Areas of Heat Loss) were also added. Table 31 reports the resulting multiple regression solution.

Table 31. Analysis of Variance and Covariance of PostTreatment Electricity Usage (October-April), First Regression Solution

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	155958150	1	155958150	345.68 ***
Education	3012277	1	3012277	6.68 **
Information Services Use	867	1	867	.00
Number of Conservation Actions	34571	1	34571	.08
Number of Areas of Heat Loss	833672	1	833672	1.85
Main Effects				
Condition	50537	2	25268	.06
Explained	191537120	7	27362445	60.65 ***
Residual	63163772	140	451170	

** $p<.01$
*** $p<.001$

Clearly, of the three added covariates none were significant predictors of PostTreatment electricity usage. Raw regression coefficients were .79, 129.17, -5.43, 5.54, and 69.22.

The final multiple regression was completed for participants from all four treatment conditions, and therefore the variable Number of Areas of Heat Loss was omitted from the list of covariates. As in Table 31, none of the added covariates showed a significant ability to predict PostTreatment electricity usage.

Table 32. Analysis of Variance and Covariance of PostTreatment Electricity Usage (October-April), Second Regression Solution

Source of Variation	Sum of Squares	DF	Mean Squares	F
Covariates				
PreTreatment Usage	240815920	1	240815920	520.16 ***
Education	3609634	1	3609634	7.80 **
Information Services Use	36579	1	36579	.08
Number of Conservation Actions	96192	1	96192	.21
Main Effects				
Condition	615830	3	205277	.44
Explained	285705120	7	40815018	88.16 ***
Residual	86110840	186	462962	

** $p<.01$
*** $p<.001$

Thus, for the multiple regression analyses little new information was learned. The only exception involved the regression analysis for PostTreatment natural gas usage, in which Number of Areas of Heat Loss was indicated as an important predictor, but the sign of the regression coefficient was opposite of what had been predicted. One possible interpretation was that this was an artifact of some other important participant or residence characteristics (perhaps lower income residences showing more heat loss).

Individual Cases

Thus far in this chapter, the results were obviously based on data gathered for treatment condition statistics. As a brief departure from type of content, this section provides a review of selected case studies which illustrate the dynamics and effects of the treatments on individual participants. Three examples of energy savings outcomes are provided: the first example was selected to depict an "average" participant, the second indicates an instance in which energy usage appeared to increase dramatically, and the third example describes a case in which a substantial energy usage decrease resulted. All energy savings were calculated as a difference between PreTreatment and PostTreatment usage; natural gas savings reflected the base load corrected (heating only) totals. In each case, actual participant data is quoted.

An "Average" Participant

A participant in the C1 (Thermogram + Workshop) treatment was selected to describe a typical participant, and average conservation activity and results. He was a retired male, over 55 years of age, with an annual income of between $10,001 and $20,000. He and his wife lived in a three bedroom house (1750 square feet).

During the Thermogram Meeting the thermogram of this man's house showed noticable heat loss from the walls and foundation. Survey (RTS) data indicated that prior to the Thermogram Meeting, a fair amount of weatherization had already taken place. The home already had some wall insulation, storm doors and windows, caulking and weatherstripping, and it was reported that the residents turned down the thermostat at night, had a furnace tune-up, and had closed off rooms which did not require heating.

After attending the Thermogram Meeting and the Workshop, additional home energy conservation actions were also completed. To reduce space heating requirements, they decided to install a solar space heating module, reduced nighttime thermostat settings below previous levels, and did some additional caulking and weatherstripping. Water heating conservation actions included a reduction of hot water usage, reduction of hot water temperature, and insulation of the water heater. All of these actions were intended to reduce natural gas usage. Among these actions, only the caulking and weatherstripping had been recommended at the Workshop.

Actual savings of natural gas was 107 ccf or about $56 and the electricity savings was 422 kwh or $24. Taken together, the total energy bill savings was $80 during the first year following the Thermogram Meeting and Workshop. While these results were fairly typical, not all participants in the research had energy savings performance within this general range.

An Example of Major Increase In Usage

The second example was taken from data collected for a participant in condition C3 (Thermogram Only). In this instance however, utility usage actually increased. This example showed how some changes in natural gas and electricity usage were unexplained, even with the availability of extensive descriptive and process data.

The respondent selected for this case study was a male, over 55 years of age, retired, with an annual income of $20,001-$30,000. He and his wife were the only occupants of their house (three bedrooms).

Before attending the Thermogram Meeting this homeowner had done several energy conservation projects. All the projects he mentioned in the RTS survey which were done beforehand were related to space heating. He had completed several simple actions including turning down the thermostat temperature setting, closing off unheated rooms, and weatherstripping. Furthermore, the walls and attic had been insulated. When he and his wife looked at their thermogram at the Thermogram Meeting it indicated considerable heat loss from the foundation and doors.

Following the Thermogram Meeting and Workshop this homeowner completed both space heating and water heating actions. Four of these actions should have logically contributed to lower demand for natural gas heating fuel: they caulked, added a storm door, installed some inside window coverings, and insulated the foundation. The only other action was for water heating, it involved reducing the water temperature.

With these conservation actions being completed after the Thermogram Meeting and Workshop one would expect energy savings to result, but this was not the case. Natural gas and electricity usage increased. For natural gas the increase was 280 ccf or $145, and for electricity it was 1452 kwh or $83. Thus, the total increase in utility bills, due to increased usage, was $228. None of the survey data suggested any reason for this anomaly; in particular the respondent did not mention any long vacations or periods of illness which might suggest a partial reason for a relative increase in usage. In past studies the researcher had, however, occasionally noted dramatic effects from unreported actions. For example, some residents confessed to turning up the thermostat after weatherizing their home, since they felt they "could afford it now". Also, while it might not explain all of the increase in electricity usage, the addition of major appliances such as arc welders, large space heaters, or deep freezers could account for some of the increase. In sum, without more intensive data collection, (perhaps even on-site inspections), some changes in natural gas and electricity usage may not be adequately explained.

An Example of Major Decrease In Usage

The last case study provided an example of a large reduction in utility usage. This household had participated in the C2 (Thermogram + Mailed Information) treatment. In this instance the respondent was a male, over 55, retired, and had an income of less than $10,000. He lived in a two bedroom house (1120 square feet) with his wife.

Prior to going to the Thermogram Meeting, and receiving the Mailed Information, the attic and walls of the house had been insulated, and they had done some weatherstripping. Their thermogram showed heat loss problems around the foundation and windows.

After the C2 treatment, the residents apparently resolved to reduce their natural gas bills. They reduced their usual thermostat setting, had a furnace tune-up, installed an automatic flue damper on the furnace, installed new windows and doors, and caulked. All these items reduced heating fuel (natural gas) use, and among them it was noted that the latter two items had been recommended in the Mailed Information packet. Beyond this, two actions reduced natural gas usage for water heating: a reduction in hot water temperature, and an automatic flue damper for the water heater. In sum, all these actions should have reduced natural gas usage.

The natural gas usage reduction realized by this couple was 415 ccf or $215, and electricity usage was only slightly more than before, 13 kwh or $1 worth. Total utility savings were therefore $214.

These case studies provided an additional perspective to the reported findings. While most participants experienced changes in their natural gas and electricity bills, these examples illustrated the great diversity of homeowners with regard to combinations of conservation actions taken before and after the planned treatments. Because of this great diversity, large sample research, such as the one described here, is very desireable. Also, these case studies suggest that policy about conservation program design may do best to focus on individual needs (versus average needs) where it is feasible.

Summary

Results presented in this chapter have covered issues of treatment group comparability, main effects for the treatments, and the investigation of important treatment processes, and their relationship to main effects. Also, the discussion of case studies highlighted the importance of attention to program needs of the individual. Chapter IV offers a discussion of these results presented in this chapter.

CHAPTER IV

DISCUSSION

Chapter IV reviews and discusses the major findings of Chapter III. Thus, the six sections cover treatment group equivalence, main effects, correlation of treatment processes with outcome, Condition One processes, predictor variables, and a summary.

Treatment Group Equivalence

It was particularly useful, in the current research, to determine the degree to which treatment groups had parity on important indices. The research design was, of necessity, a nonequivalent control groups design, that is, participants could not be randomly assigned to treatment. Thus, comparison groups were matched on geographic neighborhood with the intent of improving comparability on important characteristics, both on the residents and the residences.

Participant attrition was found to be a factor only for C1 (Thermogram + Workshop), and this was due to the fact that some of those invited to the hands on workshop refused the invitation. Also, each treatment condition had some participants who did not complete the Residential Telephone Survey. Because these subgroups represented the object of questions about potential self selection biases they were compared with those who did participate. These comparisons, on PreTreatment natural gas and electricity usage showed no significant differences. This finding suggested that although self selection represented a possible threat to the interpretation of participant group differences the data showed that this was not an issue in the current research.

Treatment groups were also compared on key process and descriptive data. Of the 35 variables, including the categories of Respondent Characteristics, Respondent Demographics, Residence Characteristics, and Number of Areas of Heat Loss, 28 showed no significant difference between treatment conditions. For the seven variables for which there were significant treatment condition differences, three were predicted (Hypothesis 5). Specifically, the results showed that those who participated in Thermogram Meetings did make greater use of the Energy Fair and RCS information services than did the control group, C4. The between-groups comparison on the conservation attitude 'I Am An Innovative Person' was also significant, but a Scheffe' test indicated no significant differences between treatment condition pairs.

Four variables which had not been expected to be different between conditions were, in fact, significantly different. Since it was desireable that the treatment conditions be equivalent, these differences were worthy of attention. Discussion of the findings for each follow.

For the variable Education it was found that C4 participants had significantly less formal education than C1, C2, and C3 participants. During the choice of analyses this variable had already been selected as a logical choice for a covariate.

The Daytime Thermostat Setting was also different between groups. An a posteriori Scheffe' test indicated C4 people had significantly higher settings than did C1. Since this data was collected months after the Thermogram Meetings, one explanation could be that C1 people responded to the thermogram by reducing the thermostat setting. Thus, it was not clear for how long the thermostat setting had been at the reported temperature, and no data was collected on the associated dates of initiating this setting. The appropriate variable for testing a causal effect of the treatments was an item on the CONSERVATION ACTIONS portion of the RTS, 'Turn Down Thermostat Setting', which was included in the Space Heating actions category (Table 2). Thus, the result for Daytime Thermostat Setting was somewhat ambiguous, but the 'Turn Down Thermostat Setting' item, which was included in the main effects tests (Hypothesis 3), was designed to test the relationship between condition treatment and subsequent thermostat setting behavior.

Next among the list of items with significant differences for treatment condition was Type of Change in Heated Space. In this comparison C1 participants apparently closed off more unheated rooms in their home than did other groups. Again, this could be construed as an outcome of the treatment condition (in this case, the most intensive treatment combination, Thermogram + Workshop). It should be noted that this same group, C1, also had the least PostTreatment usage of natural gas; the fact that they closed off more unheated rooms than did those in other treatment conditions suggests that this action may have contributed to lower natural gas usage. The possibility that this was influenced by the treatment condition was nevertheless better tested by the CONSERVATION ACTION item on the RTS, 'Close Off Unused Rooms'.

The last of these variables was the Number of Areas of Heat Loss, where the significant treatment condition differences were, by definition of treatment, limited to C1, C2, and C3. Here, C2 (Thermogram + Mailed Information) had shown significantly more areas of heat loss than C1 or C2. One could infer from this that C2 might have greater motivation to take conservation actions than the other two groups, but the main effects analyses (see Table 14), did not show lower usage of natural gas (heating fuel) for C1 over C2 and C3.

In sum, nearly all of the analyses which tested for important between-group differences supported the goal in the research design of group equivalence. The main effects analyses were chosen and configured to address other concerns about between-group covariance with the utility data.

Main Effects

The primary focus of the treatments tested in the current research was to educate and persuade the residential community to take conservation actions which would reduce the use of the main heating fuel, natural gas. The Thermograms, information, and follow-up treatments centered on heat loss remedies. The results did not however indicate that the treatments made a statistically significant difference in PostTreatment natural gas usage. Group means for the four treatment conditions (adjusted for PreTreatment natural gas usage) nevertheless showed that Condition One (Thermogram + Workshop) did do better than both C3 (Thermogram Only) and C4 (No Thermogram, Control). C2 had the highest mean value for PostTreatment usage, a fact which was puzzling since this condition had the highest Number of Areas of Heat Loss on the thermograms.

Initially, it seemed logical that more perceived heat loss would motivate greater conservation actions, and the resulting reduction in natural gas usage. Further, the between group comparisons on Income (Table 11) and the perceived barrier of Cost (Table 12) were not significant. From this perspective, the reason for the C2 mean PostTreatment natural gas usage being higher than C2 and C3 was unexplained. An alternative hypothesis asserted that C2 homes had more Areas of Heat Loss and this simply suggested that these residences needed more significant work done to remedy heat loss problems. Because space heating actions are frequently more expensive than water heating or lighting actions, C2 participants may have deferred taking Space Heating actions to a later date, when the necessary money for these actions might be available.

The PostTreatment electricity usage had not been predicted to be significantly different between conditions. Since all participants heated with natural gas, electricity conservation actions were considered to be effected only by association to a general willingness to take energy conservation actions. The results simply confirmed the expectation of no effect. Even so, the group means (adusted for the covariates) showed that all the participants in Thermogram Meetings (C1, C2, and C3) did better than the control, C4. It was interesting that C1 had the lowest PostTreatment electricity usage, the same rank order as for natural gas.

The theory behind the design of the treatments had suggested that attendance at the Thermogram Meetings was a necessary, but not sufficient motivator toward appropriate energy conservation actions. Obviously, without these actions fuel usage would be expected to stay the same. Therefore, the followup treatments were introduced to see if the addition to Thermogram Meetings would result in the desired target behaviors, space heating conservation actions. Based on the Scheffe' tests for significant differences between pairs of treatment conditions several significant and important effects on conservation actions were revealed. For the composite of positive action status categories ('Done', 'Planned', and 'Done and Planned') there were significant differences for both Space Heating Actions and Water Heating Actions. For Space Heating Actions C1 and C2 did significantly more actions than did C4 (No Thermogram, Control). For Water Heating Actions C1, C2, and C3 did significantly more than C4. Thus, the general finding was that the order of effects in terms of conservation actions were realized as had been expected.

An examination of the component action status categories (Table 17) showed that the 'Done' category had higher representation with the Water Heating Actions than was true for the Space Heating Actions. Conversely, Space Heating Actions were more likely to be represented in the categories where the actions were planned, but not yet completed. Comparison of the two categories of action (Space Heating versus Water Heating, Table 3) suggested that the possible reason that more Space Heating Actions were not yet done was because they are generally more expensive.

Both C1 (Thermogram + Workshop) and C2 (Thermogram + Mailed Information) had followup treatments which emphasized three special sets of space heating conservation actions, namely, Foundation Insulation, Window and Door Modifications, and Caulking and Weatherstripping. It was intended that this focused emphasis on certain highly effective residential heat loss remedies would result in more action in these areas following the respective treatment interventions. The special series of analyses which tested for between-group differences on the desired results revealed that significant treatment condition differences were found for Foundation Insulation and Window and Door Modifications, and for both of these action categories C1 and C2 did, in fact, do better than C3 and C4. No significant treatment effects were realized for Caulking and Weatherstripping actions. These findings support the conclusion that the followup treatments prompted the desired conservation actions in two of the three focal categories. One interpretation for the lack of effect in the Caulking and Weatherstripping category might be that this category of conservation action is very common, therefore many people may not have considered it novel enough to be considered or remembered. Because the other two areas included do-it-yourself actions frequently not already known by homeowners, the novelty may have attracted their attention, and subsequent action. It should be remembered that treatment conditions were found to have no significant differences on PreTreatment conservation actions, and this finding was consistent for data from two independent sources.

In general, the treatments had good success in prompting appropriate energy conservation actions, but the actual natural gas and electricity usage was not significantly affected. Interestingly, Number of PostTreatment Conservation Actions was not significantly related to PostTreatment usage of either natural gas nor electricity. Mean values for natural gas and electricity usage did nevertheless suggest that effects were in the expected direction, especially for the most intensive treatment combination, C1 (Thermogram + Workshop). (Potential reasons for the lack of more significant effects on PostTreatment natural gas usage for C1 are more thouroughly discussed under Condition One Processes).

Correlation of Treatment Processes With Outcome

Four treatment processes were considered to be importantly related to PostTreatment natural gas usage, but nonsignificant as regarded PostTreatment electricity usage. For all four of the processes, which are discussed in this section, the results did show no significant relationship with electricity usage. Correlations with natural gas usage provided some interesting results.

For both the perceived barrier to conservation of Cost, and for the series of five Pro-Conservation Attitude items the relationship with PostTreatment natural gas usage was nonsignificant. Thus, perceived cost of conservation and important attitudes about energy conservation had little to do with natural gas usage. The lack of association with perceived Cost was particularly surprising since it is often cited as a key barrier to conservation. It may be that perceived Cost would be a significant decision factor if the question were to have asked about specific conservation actions.

The other two treatment process variables, Number of Areas of Heat Loss and Participation in Additional Information Services did have a significant relationship to PostTreatment natural gas usage. The correlation with Number of Areas of Heat Loss (C1, C2, and C3 only) indicated a significant relationship but the correlation was positive (i.e., a greater number of areas of heat loss was associated with higher PostTreatment natural gas usage!). One possible interpretation was that when a residence requires a lot of energy conservation retrofitting it simply takes longer to get the job done.

The correlation between use of Additional Information Services and PostTreatment natural gas usage was significant and negative. When people used one or more of these services (including the Energy Fair, RCS audit, and Energy Hotline), as had been promoted in the CEM program, the subsequent natural gas usage was less. Thus, it appeared that promotion of these services may have contributed to some of the natural gas savings. This variable was included in the multiple regression analyses to test for its relative importance in predicting natural gas usage.

Condition One Processes

Condition One (Thermogram + Workshop) was considered to be the treatment combination with the most intensive or persuasive impact on participants. The workshops had been designed so that local people could conduct it, and to the extent that the workshops could be judged successful this field setting pilot test might suggest its readiness for more general application in other CEM cities. Because it was hoped that the workshops would provide a significant contribution to increased energy conservation actions and subsequent reduction in natural gas usage, the current research investigated the dynamics of the workshop and the relationship of these dynamics to the desired outcomes.

Two types of investigation were included: tests of treatment integrity and tests of relationship of key workshop processes to outcomes.

The findings related to the treatment integrity issue suggested that the workshop treatment was not perfectly administered. Participants did indicate generally high ratings on the usefulness of workshop content, and they also reported a modest amount of intended conservation action in the areas covered during the workshop. But the number of hands-on tasks completed was both much less than had been planned and the amount of hands-on activity was significantly different between the three separate sessions. The author's observation was that participants felt a little shy of being one of the few to actually aid in the demonstrations (do some of the hands-on tasks). Also, it became clear that time was inadequate for everyone to complete hands-on actions at each workshop station.

The parts of the workshop which were relatively more successful did however, suggest some potential mainstays to the overall followup treatment design. The Foundation Insulation station achieved the highest number of hands-on tasks, and it was most highly rated among the three stations.

The tests for the relationship of key workshop processes to the desired outcomes further emphasized strong features of the workshop design. High ratings (usefulness) of the Foundation Insulation workshop station were significantly related to lower PostTreatment natural gas usage. The correlations of the reported Intention to Act on workshop recommendations with PostTreatment conservation actions in the Space Heating area showed a consistent positive relationship. Even so, only one correlation was statistically significant: when participants indicated intentions to do the Caulking/Weatherstripping actions, this tended to be related to significantly more PostTreatment conservation actions in the targeted category of Space Heating.

Thus, the strongest features of the workshops tended to be the Foundation Insulation station, and in some respects, the Caulking/Weatherstripping station. It was observed that participants in the Thermogram Meetings were consistently surprised to see substantial heat loss from foundation areas, and relatively few homes had insulation in this area, therefore this seems to be a logical focus for future followup workshops. It would seem to further improve the participation rates in coming to such followup workshops if this followup activity were offered only to homeowners which had substantial foundation heat loss. Also, with a single content area (Foundation Insulation) the opportunities for more uniform hands-on activities would be less constrained by available time. With these improvements the impacts on PostTreatment natural gas usage might show statistical significance.

Predictor Variables

It had been considered useful to explore the possibility that selected variables might prove to be significant predictors of PostTreatment natural gas and electricity usage. If identified as significant predictors potential implications for treatment design might be recognized. Unfortunately, the multiple regression solutions provided little new information about predictors of natural gas and electricity outcome.

Summary

This research succeeded in testing the relative effectiveness of two forms of followup treatment. In combination with Thermogram Meeting information, the Hands-On Workshop and Mailed Information followup treatments did prompt significantly more of the targeted conservation actions. As anticipated, results for PostTreatment electricity usage were not significantly affected by the treatments. The lack of significant treatment effects was also indicated for PostTreatment natural gas usage outcomes, but the *order* of effects suggested that the treatments had some of the desired impact.

The investigation of the strength and integrity of the followup treatment designed to be most intensive suggested that, with some improvements, the Hands-On Workshops might effect significant reductions in natural gas usage. It was considered useful that the content of the workshop be narrowed to exclusive attention on Foundation Insulation, and that the promotion of these workshops could be emphasized for groups with identified need for this information. Furthermore, hands-on workshops might be designed for improved access and more immediate continuity with the Thermogram Meetings. Although the logistics would be more demanding, these workshops might be more successful if they were offered immediately following the standard Thermogram Meetings. If demonstration models were available in adequate numbers, many more people might take advantage of this second phase of the Thermogram Meeting. This would also eliminate a separate invitation process for workshops and would take place while the interest in the Thermogram information was at its peak.

The fact that C2 (Thermogram + Mailed Information) participants had significantly more areas of heat loss indicated on their Thermograms seemed to suggest that these residences simply had much more need for space heating conservation actions. In spite of the fact that the graphic demonstration of major heat loss might have been motivating toward the most effective conservation actions, it might also have influenced the resident to defer action on many of the major heat loss remedies. Thus, one programmatic change might be to integrate attractive financing alternatives. Because C2 participants were different from C1 and C3 with regard to Number of Areas of Heat Loss the need for improvements in research design controls was also suggested. If future research included matching of conditions on generic categories of heat loss, comparison groups would achieve greater comparaability. This would then allow a better test of treatment differences on outcomes.

The current research also demonstrated the value of monitoring intervention processes. This category of data not only permitted the monitoring of treatment integrity (a factor which is commonly ignored), but it also provided valuable information for insight on ways to improve both the treatment and future research. Equally important were the tests for treatment condition equivalence. These findings were useful in addressing questions about self-selection differences and also shaped the content of exploratory analyses.

While the treatments discussed in this manuscript had been explicitly designed to operationalize and incorporate "social science technology", which was coupled to the "physical technology" of the Thermograms, future program designs could involve even more social science technology, especially in the area of community dynamics. In the current research, the components of social science technology of factual information were available from the interpretation of the individual Thermograms, verbal feedback on energy conservation opportunities was part of the interpretation process, and specific behaviors were recommended by the volunteer interpreters. Because the Thermogram Meeting logistics always involved small groups of local residents who talked with volunteer interpreters and each other, it was assumed that the small groups/social context of this environment would enhance the likelihood of social support for decisions to take appropriate residential energy conservation actions. Thermogram Meetings were even held during the winter, when heating bill issues would be most salient to homeowners. The quality and consistency of these program design features were perhaps best exemplified in the C1 (Thermogram + Workshop) condition, where participants were to benefit from the small group setting and the special opportunity to learn energy conservation skills by participating in them (task-orientation) at the Workshop. Nevertheless, as shown by the very low rate of actual hands-on activity at the Workshops, even very carefully considered program design can have shortcomings in practice.

It was considered important that the current research include measures of key program processes. In particular, the Workshop process data was used to examine treatment integrity issues. That which had not been included, however, were procedures and measures which could examine the relative importance of the community context and the small group dynamics which were supposed to be an inherent, operationalized part of the program design. Subsequent research (Jeppesen, 1985), which had been initiated during the writing of this manuscript, broached these issues. An example of findings from this research was that Thermogram Meeting participants tended to spread the word of the meetings to an average of four other people. While these findings are preliminary, they suggested the value of having more information about the importance of community dynamics and social processes.

Research which emphasizes the salience of the community context, and the relevance of local neighborhood dynamics, can make major contributions. It may often identify those program components which are suitable for direct intervention by program staff, and those components which can rely on a participant's decision to take appropriate actions. For example, a program could provide full service attic insulation (no paperwork or installation work required of the resident), but might require that the resident do a complete job of exterior caulking as a prerequisite for the attic insulation. To the extent that the social mores of a neighborhood permit this combination of efforts to weatherize a home, it could then become an improved program strategy.

APPENDICES

Appendix A

Thermogram Meeting Registration Form, With Response Statistics

REGISTRATION FORM

Please answer as fully as you can. This will help us to give you information which fits your situation.

DATE ______________________________

NAME ______________________________

ADDRESS ______________________________

PHONE NUMBER ______________________________

1. Type of residence? (Circle one)

   Single family residence   Duplex   Apartment   Mobile home

2. Own or rent? (Circle one)   Own   Rent

3. If you rent do you pay heating bills? (Circle one)   Yes   No

4. Main heating fuel? (Circle one)

   Natural Gas   Fuel Oil   Wood   Coal

   Electric   Propane   Solar   Don't know

5. What kinds of things have you already done to save on energy costs? (Check all that apply.)

   ____Installed ceiling insulation
   ____Installed wall insulation
   ____Installed storm windows/doors
   ____Weatherstripped/caulked
   ____Set back thermostat
   ____Reduced home lighting
   ____Closed off unused rooms
   ____Reduced the amount of hot water used
   ____Turned down hot water temperature
   ____Had a furnace tune-up
   ____Insulated heat ducts
   ____Heated with wood
   ____Heated with solar
   ____Changed driving habits
   ____Switched to economy car
   ____Used carpool/mass transit
   ____Other (Explain briefly)______

6. How did you hear about this program? (Check all that apply.)

   ____Newspaper
   ____Television
   ____Radio
   ____Poster
   ____Flyer
   ____Friends
   ____Neighbors
   ____Relatives
   ____School
   ____Booth at a public event
   ____Speaker
   ____Church

7. REQUEST: As the Grand Haven Energy Conservation Organization (ECO) Project develops we would like to know if we are actually helping people save on energy bills. To help us answer this question we need your written permission to obtain a copy of your energy bills. If you are willing to help us in this way please complete the following and sign your name below where it says "Your Signature."

   Which utility company or companies provide energy to your home? (Please write the name of the company or dealer in the appropriate place below.)

   Natural Gas ______________________________

   Electric ______________________________

   Fuel Oil ______________________________

   Propane ______________________________

   I authorize the release of information on the amount and cost of energy purchased from the above companies and/or dealers from January 1978 to January 1984. I understand this information will be used by the Grand Haven ECO Project to see if it is helping people save on energy bills.

   Your Signature ______________________________

IF YOU WANT TO WRITE DOWN YOUR COMMENTS OR IDEAS USE SPACE LABELED "YOUR COMMENTS" ON THE BACK OF THIS FORM.

YOUR COMMENTS

Your ideas and comments are important. If you would like to share them please write them down on the blank lines below.

____
____
____
____

HELPER'S WORKSPACE

(To be filled out by volunteer helpers at this meeting.)

RECORD:

Thermogram of structure shows heat loss from:(Check all that apply.)

____Attic ____Foundation Other (explain) ____________
____Walls ____Windows ____________
____Kneewalls ____Doors ____________

ASK:

1. What kind of information interests you most? (Check all that apply.)

____Attic insulation ____Other (explain) ____________
____Wall insulation
____Foundation insulation
____Window/door modifications
____ Caulking and weatherstripping
____Financing energy conservation projects

2. If we could develop a free demonstration workshop on the information you are interested in would you like us to let you know about it? (Circle one.)

Yes No

3. Would you be interested in volunteering some of your time to help with this Energy Conservation Organization project? (Circle one.)

Yes No

4. Before coming to this meeting had you signed up for a Michigan Gas Utilities RCS (Residential Conservation Service) Energy Analysis? (Show the person a copy of the RCS brochure and the MGU sign-up card, then circle one of the responses below).

Yes No

RECORD:

If the person answered "no" to #4 and if they are interested in signing-up:

1. Help them fill out the request card, keep it and indicate that we will mail it for them. Then check one below.

OR

2. If they want to think about it, give them the RCS brochure and sign-up card. Then, check one below.

____person took information
____person filed out request and left it to be mailed

Appendix B

Sample Thermogram

Figure 2. Sample Thermogram

Appendix C

Sample Thermogram Meeting Registration Form

Appendix D

Condition One Invitation Letter and Response Card

YOU ARE INVITED . . .

To attend a free "hands-on" workshop on home weatherization on Saturday, ______________ at ______________ o'clock.

This workshop will give you an opportunity to ask questions, get instruction and practice installation of weatherization materials. We hope this workshop will help people learn how to complete these actions with a minimum of cost and effort.

Currently, the Grand Haven Energy Conservation Organization (ECO) is offering this workshop on a trial basis to a small number of people who registered at the ECO, "thermogram", meetings. Part of the project will be to see how much interest there is in such workshops and how helpful we can make them. So, next summer we plan to call people who come to the workshop and ask them questions which will give us some idea about how helpful the workshop was. This telephone survey will be brief and confidential. And if you'd like to know what the survey showed we will gladly send you the results.

If you want to attend this workshop, please return the enclosed pre-addressed and post-paid reservation card. Transportation will be available from the Senior Citizens Center, Columbus and Fifth Street. Please plan to be at this location 15 minutes before the above scheduled time.

Mark us down on your calendar.

☐ YES, I plan to attend the workshop on home weatherization on Saturday,

_______________ at ________ o'clock.

I will be at the Senior Citizen Center fifteen minutes prior to above time when transportation will be available.

______________________ (Signature)

ENERGY CONSERVATION ORGANIZATION
CITY HALL
GRAND HAVEN, MI 49417

WANT TO SEE YOUR

THERMOGRAM ?

Although you may have missed the opportunity to see the heat-loss picture (thermogram) of your home last Fall, you can still see it.

Schedule of dates, times, and location

January 26 7:30 pm .... Loutit Library (lower level)

February 23 7:30 pm ...... Loutit Library (lower level)

March 23 7:30 pm .... Loutit Library (lower level)

April 27 7:30 pm .... Loutit Library (lower level)

May 25 7:30 pm .... Loutit Library (lower level)

We hope to see you there!

GRAND HAVEN ENERGY CONSERVATION ORGANIZATION

Appendix E

Workshop Registration Form

GRAND HAVEN ENERGY
CONSERVATION
ORGANIZATION
HANDS-ON ENERGY
CONSERVATION
WORKSHOP

REGISTRATION FORM

____

____

Instructions: Welcome to our hands-on (learn by doing) energy conservation workshop for home weatherization!

Please print your name, address, and telephone number in the space provided below. If you came with another resident of your home please ask for one of these registration forms for them too. When you have it filled out hang on to it until the workshop is completed.

Name: ____

Address: ______________________________________

Phone Number: _________________________________

Appendix F

Individual Checklist

INDIVIDUAL CHECKLIST

NAME: ________________________________

INSTRUCTIONS: As you have seen there were three training stations at the workshop site. Each station offered different activities for stopping heat loss. We hope you had a chance to practice some of these actions at each station.

Please fill out this checklist, indicating which actions you personally did and which actions you observed. When tallied these checks will give us an idea of which actions people tend to do most.

STATION 1 : FOUNDATION INSULATION

Actions	Goal	Check (✓) did or observed	
Measure		__did	__observed
Clean and fill openings		__did	__observed
Cut Batts	do at	__did	__observed
Insert Batts	least	__did	__observed
Staple Batts	two	__did	__observed

STATION 2 : WINDOW AND DOOR MODIFICATIONS

Insider Storm Window

Actions	Goal	Check (✓)	
Measure		__did	__observed
Cut wood		__did	__observed
Glue/nail		__did	__observed
Rough cut plastic		__did	__observed
Staple	do at	__did	__observed
Trim plastic	least	__did	__observed
Edge tape	three	__did	__observed
Foam tape		__did	__observed
Insert		__did	__observed

Foam Board Shutter

Actions	Goal	Check (✓)	
Measure		__did	__observed
Cut foam board	do at	__did	__observed
Cover	least	__did	__observed
Edge tape	three	__did	__observed
Foam tape		__did	__observed
Install		__did	__observed

STATION 3 : CAULKING AND WEATHERSTRIPPING

Caulking

Actions	Goal	Check (✓)	
Load caulk in gun		__did	__observed
Clean and fill opening	do at least	__did	__observed
Run bead	two	__did	__observed

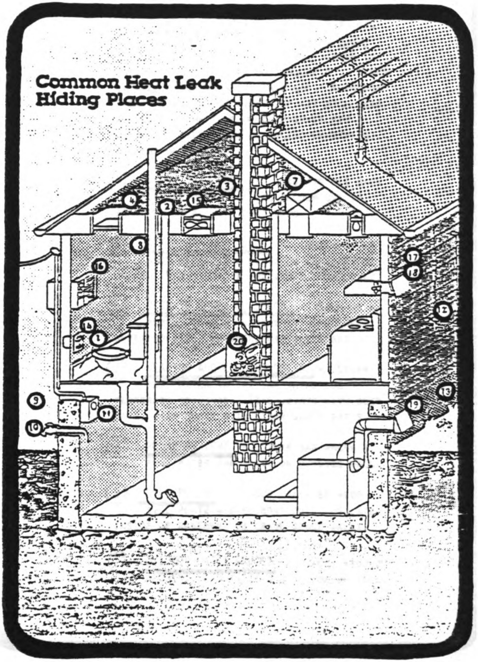
Weatherstripping

Actions	Goal	Check (✓)	
Measure		__did	__observed
Cut weather-stripping	do at least	__did	__observed
Install	two	__did	__observed

Appendix G

Heat Leak Hit List

THE HEAT LEAK HIT LIST



1. BASEBOARDS - Push thin strips of unfaced fiber glass insulation under baseboards.

2. ATTIC - If there is not a top plate over exterior walls, stuff unfaced fiber glass down between the studs, staple polyethylene over the top.

3. CHIMNEY OR FURNACE FLUE - The wood framing of the attic floor is boxed out around the flue or chimney. There is usually a gap that is not insulated. Stuff unfaced fiber glass in this gap. Although fiber glass is not fireproof (it will char at 800°F.) the flue or chimney is not likely to exceed 250°F. unless something is terribly wrong.

4. ATTIC TRAP DOOR - Insulate the back of the door. If you seldom use it, seal the edges with duct tape.

5. ATTIC STAIRWAY DOOR - Insulate the back with fiber glass or insulation board. Weatherstrip the sides thoroughly.

6. DOOR TO UNHEATED SPACE - Such as a porch, garage, basement. Insulate unheated side, weatherstrip all edges.

7. HEATING AND COOLING DUCTS - Stuff insulation in the gap where ducts penetrate ceilings. Seal joints with duct tape, wrap ducts with fiber glass batts.

8. PLUMBING VENT - Stuff gap where it penetrates the attic or outside wall.

9. SILL PLATE - Caulk crack between sill plate and foundation. Insulate inside of basement or crawl space walls.

10. OUTDOOR WATER FAUCET - Caulk around opening on outside and inside of wall.

(11) ELECTRICAL CABLE - CAULK WHERE CABLE ENTERS HOUSE, ON INSIDE AND OUTSIDE, NEAR THE FUSE BOX, NOT INSIDE THE FUSE BOX.

(12) ANTENNA CABLE - CAULK HOLE WHERE ANTENNA CABLE ENTERS THE HOME. STUFF FIBER GLASS ON THE INSIDE OF THE HOLE.

(13) TELEPHONE CABLE - CAULK WHERE THE THIN WHITE CABLE ENTERS THE HOUSE.

(14) ELECTRICAL SWITCH/SOCKETS - ON OUTSIDE WALLS, LITTLE OR NO INSULATION IS BEHIND BOXES. INSTALL INSULATING GASKETS (AVAILABLE FROM HARDWARES) BEHIND THE COVER PLATE.

(15) WHOLE HOUSE FAN - IN SUMMER IT IS GREAT, IN WINTER COVER OPENING BY MAKING A PLUG FROM INSULATION BOARD, SEAL EDGES WITH TAPE.

(16) ROOM AIR CONDITIONER - CAULK EDGES, COVER IT INSIDE, OUTSIDE, OR BOTH WITH SIX-MIL POLYETHYLENE, SEAL WITH TAPE.

(17) BATH EXHAUST FAN - MAKE SURE THE OPENING CLOSES TIGHT WHEN NOT IN USE.

(18) KITCHEN AND STOVE FAN - COVER OPENING FROM INSIDE WHEN FAN IS NOT IN USE.

(19) CLOTHES DRYER VENT - CAULK AROUND EDGES. MAKE SURE IT CLOSES TIGHTLY, PUT ON A MAGNETIC CLOSURE. VENT WARM AIR TO THE INSIDE.

(20) FIREPLACE - WHEN THERE IS A FIRE, WARM AIR IS SUCKED UP THE CHIMNEY. INSTALL TIGHT FITTING GLASS DOORS TO PREVENT THIS. MAKE SURE THE DAMPER FITS TIGHT. IF THERE ISN'T A DAMPER, MAKE ONE OUT OF NON-FLAMMABLE MATERIAL SUCH AS CEMENT ASBESTOS.

Appendix H

Weatherization Information Resources

Appendix I

How To Notes for Conditions One and Two

INFORMATION PACKET CONTENTS

Information on <u>FOUNDATION INSULATION</u>

Insulate Your Basement Walls
Solving Moisture Problems with Vapor Barriers and Ventilation

Information on <u>WINDOW AND DOOR MODIFICATIONS</u>

It's Curtains for Heat Loss
Calculating Energy Savings from Window Modifications
How to Build An Insider Storm Window
How to Build A Foam Board Insulated Window Shutter

Information on <u>CAULKING AND WEATHERSTRIPPING</u>

Weatherstrip Your Doors And Windows
The Heat Leak Hit List

Information on other ways to save on utility bills

Common Sense Energy Tips
65 Ways to Save Natural Gas

Where to get more information

Energy Extension Service: Who We Are and What We Do

What else can you do?

1. Share a schedule of ongoing thermogram meetings with neighbors (<u>two</u> copies are enclosed)

2. Mail in the Grand Haven ECO INTEREST CARD (<u>one</u> enclosed)

INSULATE YOUR BASEMENT WALLS

A MODERATELY EASY DO-IT-YOURSELF PROJECT

Install 2" X 3" studs along the walls to be insulated. Add glass fiber blanket insulation between the furring strips and finish with wallboard or panelling.

NOTE: The method of insulation shown here should not be used by residents of Alaska, Minnesota, and northern Maine. The extreme frost penetration in these areas can cause heaving of the foundation if the insulation method shown here is used. Residents of these areas should contact local HUD/FHA field offices for advice.

Tools

1. Saw
2. Hammer, nails
3. Heavy duty staple gun, or hammer and tacks 
4. Tape measure 
5. Linoleum knife or heavy duty shears 
6. Level 
7. Small sledge hammer, masonry nails 

Safety

1. Provide adequate temporary lighting
2. If you use glass fiber or rock wool, wear gloves and a breathing mask, and keep the material wrapped until you are ready to use it

Materials

What you'll need

1. R7 (2-2½ inch) Batt or blanket insulation, glass fiber or rockwool, with a vapor barrier (buy polyethylene if you can't get batts or blankets with a vapor barrier)

2. 2" X 3" studs 
3. Drywall or panelling 
4. Waterproof paint, if necessary 

How much

1. Find the average height above the ground of the walls you intend to insulate and add two feet. Then measure the length of the walls you intend to insulate. Multiply the two figures to determine how many square feet of insulation is needed.

   (height) X (length) = area

   ______ X ______ = ______

2. Find the linear feet of studs you'll need by multiplying the length of the walls you intend to insulate by (6).

   (6) X (length) = (linear ft.)

   (6) X ______ = ______

3. The area of wall covering equals the basement wall height times the length of wall you intend to finish.

   (height) X (length) = area

   ______ X ______ = ______

Installation

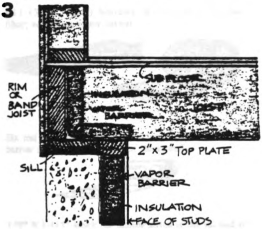
Preparation

Check to see whether or not moisture is coming through your basement walls from the ground outside. If it is and your walls are damp, you should eliminate the cause of the dampness to prevent the insulation you're going to install from becoming wet and ineffective.

Nail the bottom plate to the floor at the base of the wall with a hammer and concrete nails. Install studs 16 or 24 inches apart after the top plate is nailed to the joists above. (Where the wall runs parallel to the joists, nail the top plate to the tops of the studs, and fasten the studs to the wall.)

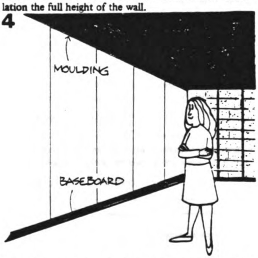
Cut blankets into sections long enough to extend from the top plate to 2 feet below the ground line. Staple them into place between the studs, with the vapor barrier towards the living space. NOTE: in northern climates there will be added benefit to installing the insulation the full height of the wall.

3



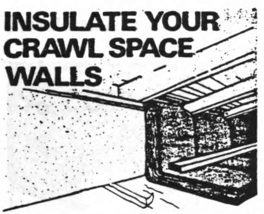
Install another small piece of insulation above the furring and against the sill to insulate the sill and band joist.

4



Install finish wall board or panelling over insulation and furring.

INSULATE YOUR CRAWL SPACE WALLS



Tools

1. Hammer and nails

2. Heavy duty shears or linoleum knife

3. Temporary lighting
4. Portable fan or blower to provide ventilation

5. Tape measure

6. Duct or Masking Tape (2" wide)

TWO OPTIONS AVAILABLE

(1) **Do-It-Yourself:** Install batt or blanket insulation around the walls and perimeter of your crawl space. Lay a plastic vapor barrier down on the crawl space earth.

(2) **Contractor Installed:** If your crawl space presents access or working space problems, you may want to consider having a contractor do the work for you. The contractor will probably follow a method similar to the do-it-yourself method described below. But if he suggests something different, have him price both methods and show you which is better. See page 64 for advice on how to select a contractor.

NOTE: The method of insulation shown here should not be used by residents of Alaska, Minnesota, and northern Maine. The extreme frost penetration in these areas can cause heaving of the foundation if the insulation method shown here is used. Residents of these areas should contact local HUD/FHA field offices for advice.

Safety

1. Provide adequate temporary lighting
2. Wear gloves and a breathing mask when working with glass fiber or rock wool
3. Provide adequate ventilation
4. Keep lights, fan, and all wires well off wet ground

Materials

What you'll need

1. R11 (3-3½" thick) blankets of rock wool or glass fiber; without a vapor barrier

2. Six mil polyethylene plastic to lay on earth for vapor barrier (mil's are a measure of thickness)

3. 1/2" X 1-1/2" stock for nailing strips at the sill and at the band joist.

How much

1. Determine area to be insulated; measure the length and average height of the wall to be insulated; add 3' to the height (for perimeter insulation) and multiply the two to find total insulation area

   (length) X (height + 3') = area

   ______ X ______ + 3' = ______

2. Determine the area to be covered by the vapor barrier by finding the area of your crawl space

   (length) X (width) = area

   ______ X ______ = ______

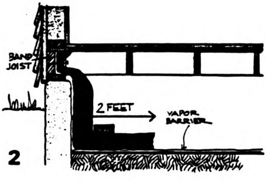
You may have to divide your crawl space into several rectangles — measure them and add up the areas.

(length)	X	(width)	=	
______	X	______	=	______
______	X	______	=	______
______	X	______	+=	______
		TOTAL	=	

3. The total length of nailing strips required equals the length of wall to be insulated

Installation

Drawing 1: Where the joists run at right angles to the wall, press short pieces of insulation against the Header – they should fit snugly. Then install the wall and perimeter insulation by nailing the top of each strip to the Sill using the 1/2" X 1-1/2" nailers. Make sure the batts fit snugly against each other, and that you cut them long enough to cover 2 feet of floor as in Drawing 2.



Drawing 2: Where the joists run parallel to the wall, you don't need the short pieces of insulation, just install the wall and perimeter insulation by nailing the top of each strip to the Band Joist, using the 1/2" X 1-1/2" nailers.

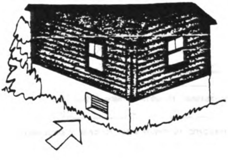
When all batts have been installed, lay down the polyethylene vapor barrier, tucking it under the batts all the way to the foundation wall. Tape the joints of the vapor barrier or lap them at least 6". Finally lay 2 X 4 lumber along the wall on top of the batts to weight the batts in place. (Rocks work well, too.) Plan your work to minimize stepping or crawling on the vapor barrier.

VENTILATING YOUR CRAWL SPACE

Even with a plastic vapor barrier on the floor, the air in your crawl space will be too damp if fresh air doesn't get in there from time to time. This will mean your new insulation will be wet, and it won't keep your house as warm. It will also mean that wooden members that hold up your house will be wet, and they'll rot. Proper ventilation will prevent both of these problems:

1. **If your crawl space is part of your forced-air heating system** (in other words, if air from your furnace moves through it), seal your crawl space as tightly as possible—the air moving through it from your furnace is enough ventilation in winter. If you have crawl space vents, keep them shut in winter, open in summer. If there are no vents, run the blower on your furnace 3 or 4 times during the summer to keep the air in the crawl space from getting too damp.

2. **All other crawl spaces** should have vents in them that can be opened in summer (to clear out the damp air), and closed **tightly** in winter to make the most of your new insulation. You can make a cover for them to install in winter. Note: Your furnace may get its combustion air from the crawl space. If so, some of the vents should be left open. Check with your local HUD/FHA office.



INSULATE YOUR FLOOR

TWO OPTIONS AVAILABLE

1. DO-IT-YOURSELF

Install batts or blankets between the floor joists by stapling wire mesh or chicken wire to the bottom of the joists and sliding the batts or blankets in on top of the wire. Place vapor barrier up.

The job is quite easy to do in most cases. If you are insulating over a crawl space there may be some problems with access or working room, but careful planning can make things go much more smoothly and easily.

Check your floor joist spacing – this method will work best with standard 16" or 24" joist spacing. If you have non-standard or irregular spacing there will be more cutting and fitting and some waste of material.

2. CONTRACTOR INSTALLED

See page 6.

DO-IT-YOURSELF

Tools

1. Heavy duty shears or linoleum knife
2. Temporary lighting with waterproof wiring and connectors
3. Portable fan or blower to provide ventilation
4. Tape measure
5. Heavy duty staple gun and staples




Safety

1. Provide adequate temporary lighting
2. Wear gloves and breathing mask when working with glass fiber or rock wool
3. Provide adequate ventilation
4. Keep lights and all wires off wet ground

Materials

What you'll need

1. R11 (3"-3½") batts or blankets or rock wool or glass fiber, preferably with foil facing (See Installation).

2. Wire mesh or chicken wire of convenient width for handling in tight space.

How much

Determine the area to be insulated by measuring the length and width and multiplying to get the area.

(length) X (width) = area

(____) X (____) = ______

You may find it necessary to divide the floor into smaller areas and add them.

(length) X (width) = area

(____) X (____) = ______

(____) X (____) = ______

(____) X (____) = ______ +

total area = ______

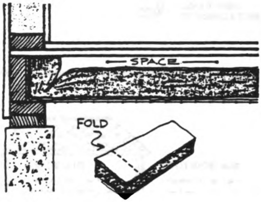
(.9)(total area) = area of insulation

(.9)(______) = ______

total area = area of wire mesh or chicken wire

Installation

Start at a wall at one end of the joists and work out. Staple the wire to the bottom of the joists, and at right angles to them. Slide batts in on top of the wire. Work with short sections of wire and batts so that it won't be too difficult to get the insulation in place. Plan sections to begin and end at obstructions such as cross bracing.



Buy insulation with a vapor barrier, and install the vapor barrier facing up (next to the warm side) leaving an air space between the vapor barrier and the floor. Get foil-faced insulation if you can; it will make the air space insulate better. Be sure that ends of batts fit snugly up against the bottom of the floor to prevent loss of heat up end. Don't block combustion air openings for furnaces.

State of Michigan
William G. Milliken
Governor
Michigan Department
of Commerce

AFS - 2 - 3 - 4

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE

ENERGY CONSERVATION IN THE RURAL HOME

SOLVING MOISTURE PROBLEMS WITH VAPOR BARRIERS AND VENTILATION

When you install insulation—or "weatherize" your home in other ways—you may alter the movement of moisture through the walls, ceilings, and floors. Signs of undesirable moisture movement are: peeling paint, water stains in the attic, or an extremely damp crawl space. Trapped moisture invites decay and insects.

Moisture which gets into insulation also increases the rate of heat loss; therefore, you should control moisture as an essential part of your own energy conservation plan.

During the heating season, warm indoor air holds more moisture than cold outdoor air (fig. 1). This creates vapor pressure inside, which constantly forces water vapor out through walls and ceilings as it seeks lower moisture levels outside. When moisture levels within walls, attics, or crawl spaces become high, the water vapor tends to condense on cold surfaces. In most structures moisture can escape to the outside, but if moisture moves into the walls, ceiling, or crawl space faster then it can escape to outside air, the moisture will build up.

Here are three things you can do to control moisture buildup: (1) control humidity in the house; (2) install vapor barriers in walls, floors, and ceilings; and (3) ventilate attics and crawl spaces.

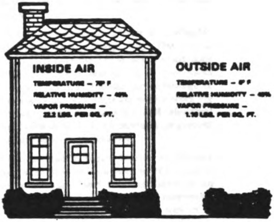


Figure 1. Vapor pressure difference between indoors and outdoors causes the movement of moisture into the walls.

CONTROL HOUSEHOLD HUMIDITY

In cold climates, set your indoor controls for relative humidity in the winter no higher than 35 to 40 percent. When outdoor temperatures are 20° F or lower, reduce the humidity to less than 35 percent. Although a higher humidity might be healthier and might improve the performance of your heating system, it could cause serious condensation problems in your home. When condensation develops on insulated glass windows, you know that the relative humidity is definitely too high.

You add to the moisture level inside your home by bathing, cooking, and doing laundry. These activities can raise the humidity level too high. Exhaust fans in baths and kitchens will help eliminate this moisture before it spreads through the house. Clothes dryers should be vented to the outdoors. If high humidity persists, you might consider using a dehumidifier, even in winter. This, however, would be necessary only in an exceptional situation.

If your home is too dry, use a humidifier. Set the controls no higher than the humidity that is recommended for your climatic zone. Watch the windows and cut back the humidifier if you see excessive condensation forming on them. Major humidifier manufacturers provide a schedule of settings that are appropriate for outdoor temperature levels.

VAPOR BARRIERS

A vapor barrier is any material that effectively slows the movement of moisture from a point of high vapor pressure to one of lower vapor pressure—such as from the inside of a warm home toward the outside cold air. Vapor barriers should always be placed near the warm side of the wall, ceiling, or floor. Materials near the cold side should permit moisture to escape out of the wall or ceiling to the outside. A vapor barrier that is placed on both the inside and outside of a wall will trap moisture and invite decay.

Small vents installed near the top and bottom of stud spaces will allow moisture to escape where no vapor barrier is used. In some instances, however, these vents may result in higher moisture in the insulation because cold air entering the cavity moves the dew point (the temperature at which condensation occurs) toward the warm or house side of the cavity. The vents do reduce moisture levels near the siding or outside wall. This may help prevent peeling of paint, even though there is a greater heat loss.

Blanket insulation with a vapor barrier backing is frequently used in new walls. Tabs of the backing should always be attached over the edge of studs with tabs lapped. Additional strips should be used over uninsulated areas such as window framing. Without this lap, moisture can enter the walls between adjoining insulation blankets. This is something to discuss with the builder.

Another commonly used vapor barrier in new buildings is polyethylene film in large rolls. The film is applied continuously over the inside face of studs, over the bottom of ceiling joists, and on top of floor joists over a crawl space. Such a film has the advantage of being continuous so the only gaps are where holes are cut for openings such as windows and electrical outlets. These holes should be cut carefully to prevent as much moisture leakage as possible.

It is difficult to add a vapor barrier to existing construction. Often older homes have several coats of oil-based paint on walls, and this may serve as an adequate vapor barrier if you maintain reasonable household humidities. However, the only way to be certain of an adequate barrier is to add a vapor barrier to the walls and apply new paneling or other drywall over the barrier. Attics and crawl spaces can generally be vented enough to carry moisture out, so barriers in floors and ceilings are not as critical as barriers on walls.

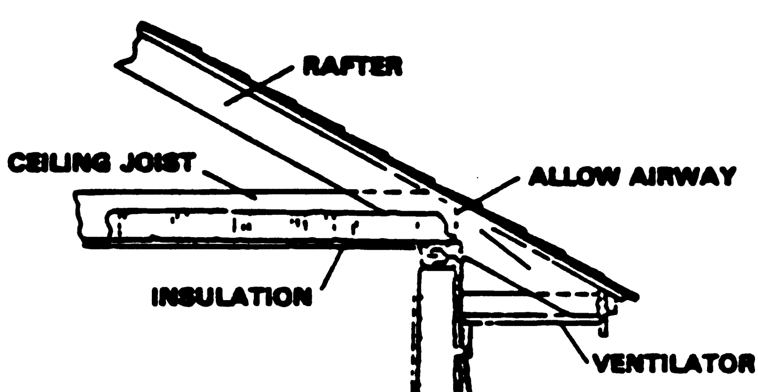


Figure 2. Airway at eave must not be blocked by insulation.

A major source of moisture in houses can be eliminated almost completely by placing a vapor barrier over the soil in a crawl space. This prevents deterioration of floor framing because of high moisture levels, and keeps moisture from moving up through walls and to living areas.

VENTILATION

The main areas requiring ventilation are attics and crawl spaces. In both instances it is necessary to have a good distribution of air movement over the entire area. Attic ventilation is essential. Without it, moisture that moves through the ceiling will be trapped in the attic because most roofing materials prevent moisture from escaping. Flat roofs or cathedral ceilings also must provide for ventilation between the insulation and the roofing.

You can provide attic ventilation with inlet vents distributed along the eave, and with outlet vents near the ridge. Eave vents must not be blocked by ceiling ventilation (fig. 2). Warm air in the attic rises and escapes through the ridge vents; cooler outside air enters at the eaves (fig. 3). Thus, the ventilation is continuous and does not depend on the wind. This ventilation also slows the melting of snow from the roof in cold climates, reducing the possibility of ice dam problems. In the summer, such ventilation reduces buildup of heat in the attic which, otherwise, would cause uncomfortably high temperatures in the house or, at least, higher air conditioning costs. For adequate ventilation, the area of inlet vents each should be at least 1/900th of the ceiling area. Outlet vents also should be at least 1/900th of the ceiling area. Where vents are provided at only one level, such as at gable ends, the total of all the vent areas should be at least 1/300th of the ceiling area.

Crawl spaces should be vented to the outdoors. If the vents are located near each corner, the vents will permit good air movement through the crawl space. The total of all the vent areas where there is no vapor barrier as a ground cover should be at least 1 square foot for each 150 square feet of floor area. Where such a vapor barrier is used, the vent area may be reduced to 1/1500th of the floor area.

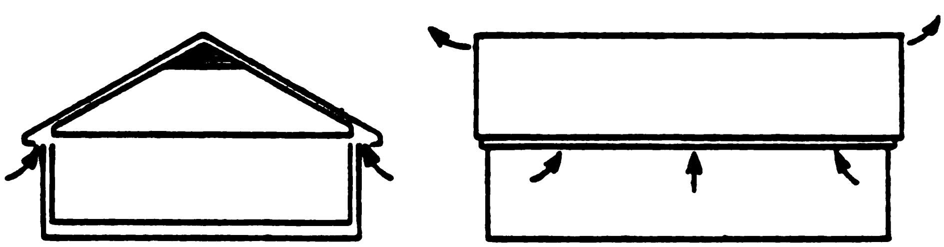


Figure 3. Inlets at eave, outlets at ridge for good ventilation.

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IT'S CURTAINS FOR HEAT LOSS

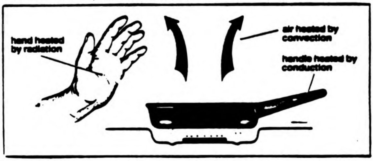
Windows can account for up to one-third of a home's heat loss, depending on the percentage of window space and how adequately the home is insulated. To understand how heat loss occurs through windows and ways to reduce window heat loss, an understanding of the following terms is necessary: convection, radiation and conduction.

Convection is the transfer of heat by currents of air of different densities. Warm air molecules expand, become lighter, and move upward while the cooler ones become heavier and sink downward creating an air flow. Infiltration means cold air coming into the home through air leaks around window frames and sashes creating a draft. This causes convection currents around window areas. (A three by four foot window with 1/16-inch leak around it is like having a hole in your wall the size of a grapefruit!) You can test for infiltration around windows using one of the following methods:

1. Hold a lighted match or candle up to the suspected drafty area. If the flame flickers or is blown out, you are losing valuable energy. (Be very careful holding a flame near curtains, shades, or plastic. These materials may be flammable.)
2. Make a draft guage by attaching a piece of tissue or cellophane to a clothes hanger with tape or pins. Hold it up to the suspected drafty area and watch for it to blow.

Radiation is the transfer of heat in waves which are emitted by all warm objects; carpet, furniture, walls, and people. This radiant heat flows to windows, is conducted by the glass and window frame, and radiates outside.

Conduction is the transfer of heat through solid objects. For example, heat is conducted through a spoon in a hot cup of coffee. Heat is conducted at different rates through different materials. For energy savings, the best window frames and sashes should be poor heat conductors.



HEAT TRANSFER: Heat can be transferred in three different ways. Convection is what is meant by saying "hot air rises." Conduction means that heat is transferred through materials themselves. Radiation means heat waves, which always travel from warmer objects to cooler ones in a space.

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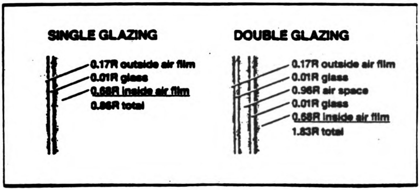
R-Values

R-Values measure the resistance of a material to heat flow. The higher the R-Value, the better the thermal protection against heat loss or gain. A well-insulated wall has a heat retaining ability around R-17 (depending on wall thickness and insulation quality). A window with double-glazing and loose drapery has an R-Value of only 1.9. For the total R-Value of a particular window, add R-Values of all materials: panes of glass, window treatments, and dead air spaces created. (U-Values measure the amount of energy transmitted, a reciprocal of the R-Value: $U = 1/R$ or $R = 1/U$.)



R-VALUES measure the resistance of building materials to the flow of heat by conduction. The higher the R-Value, the less heat transfer. Complete window R-Value information is available from Michigan's Energy Administration Clearinghouse. Ask for "Calculating Energy Savings from Window Modifications," publication #201.

Reduce Heat Loss...

The primary considerations to reducing heat loss from windows are caulking and weatherstripping to reduce infiltration, and adding window panes to help reduce conduction, radiation, and convection. Adding air-tight thermal treatments or improving your existing drapes or shades can also vastly increase energy savings.

Caulk around immovable parts of the exterior window frame. Do not caulk the bottom of storm windows because condensation escapes there. Caulking is the most important and least expensive window treatment.

Weatherstrip around the movable window parts. Weatherstripping products range from self-sticking adhesive-backed vinyls to higher-priced spring metal strips that need to be nailed into place. There are durable easy-to-apply plastic types now on the market, too. Installing a lock on the window will make the seal even tighter.

Add at least one window pane if you have only a single pane. Double-glazing is sometimes preferred over triple-glazing because it allows more solar heat gain, especially on south-facing windows. (The most widely recommended window treatment is a combination of double-glazing and movable window insulation.)

Exterior storm windows used to be the most common glass addition, but insulated (thermal) glass is also becoming popular. Insulated glass is comprised of two or three panes of glass welded or sealed together with caulk. A dead air space or vacuum is created between the glass panes adding to the insulation value. The seals can deteriorate, resulting in condensation between the panes. The higher quality seal that is used, the longer the guarantee of the insulated glass. Plastic can be used as an exterior storm window, either by tacking the plastic to the window frame or by building a wood frame for the plastic.

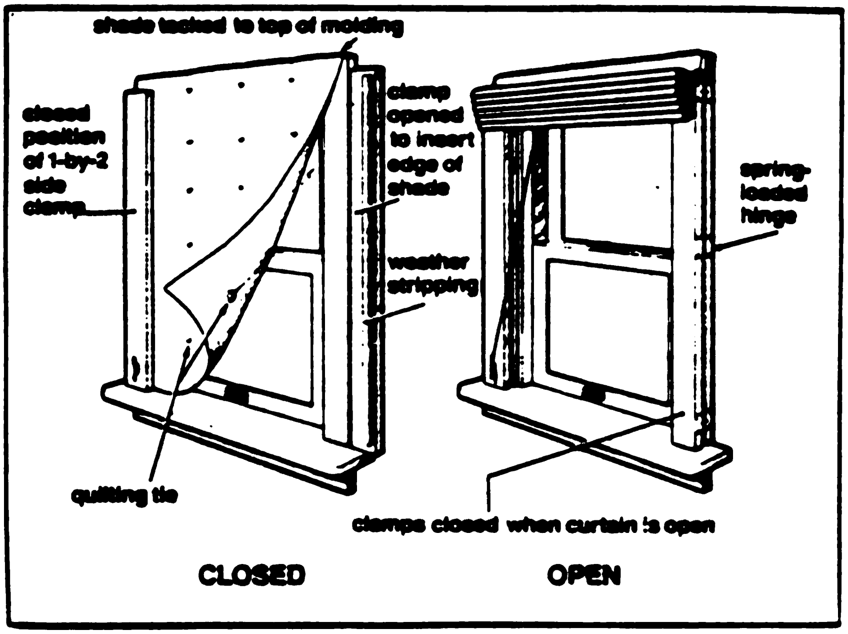
Interior storm windows are available from several manufacturers. Some are permanently installed and others snap on and off. You may wish to build a plastic covered wood frame interior storm window which can be easily removed. The most useful and inexpensive way to add a pane is simply to tape plastic over the interior of windows that are not opened during the heating season. When doing this, you may want to leave the bottom untaped, with plastic overlapping the window sill: Then the plastic can be ripped off in a hurry in case of an emergency such as fire.

In-between plastic storm windows are another possibility to reduce heat loss. A frame covered with plastic can be used on the upper portion of a double-hung window, or a full sheet of plastic may be applied.

When purchasing new windows, consider the material of the window frame for its conduction rate. Since metals are good heat conductors, some new metal-framed windows are being made with a vinyl gasket between inside and outside metal sections. This is called "thermal-break" construction.

Thermal window treatments or window insulation should fit properly. If there are air leaks, their effectiveness as insulators will be drastically reduced. Leaks may allow condensation to form on the window. When considering window insulation, think about the practicality of each window treated. For example, north- and west-facing windows would be top priority: Their orientation towards sun and wind make them lose more heat than east- or south-facing windows. South-facing windows can actually gain heat from the sun on a winter day. Types of window insulation include the following:

Shades include Roman shades, quilted shades, and roll-up shades. The shades are usually comprised of layers of thermal material such as fiberfill, plastic, or reflective plastic acting as a vapor barrier, and outer layers of fabric. The Roman shades have quilting rings tied to the back where strings are attached to fold or roll up the shade. Quilted shades roll up into a valance and usually have a tight-fitting frame. Roll-up shades are tied up by ties attached to the top of the window frame and the bottom of the shade. The shades can also be fitted with velcro attached to the shade and window frame or a hinged frame clamp made of wood for a tight seal.



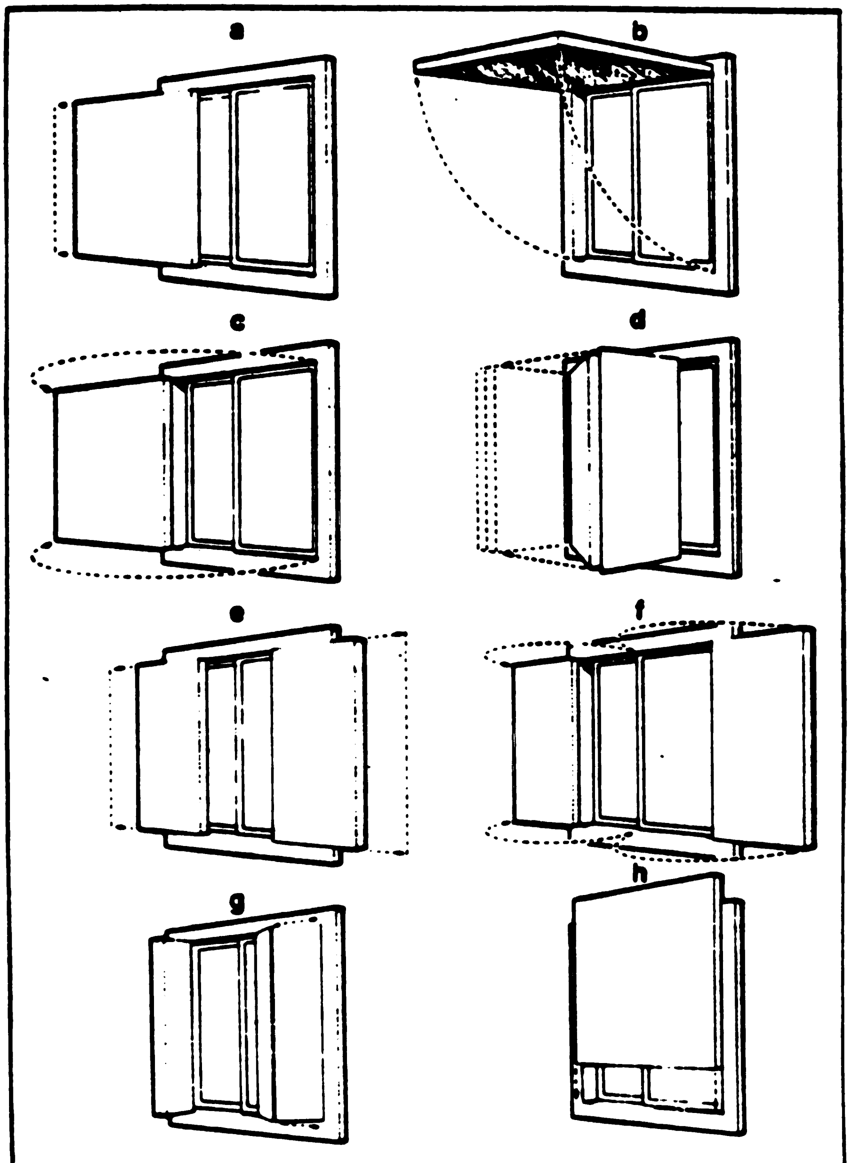
ROMAN SHADES: This diagram shows one design for Roman Shades. Notice the weatherstripped side clamps to create a tight seal between the shade and window frame. Quilting rings attached to the back of the shade allow it to be raised or lowered with a pull cord. See the Energy Administration Clearinghouse Windows Bibliography for more designs for window shades. A good, tight-fitting shade can vastly increase window energy savings if closed at night.

Multiple-layer shades and multiple shade systems are also on the market. Multiple-layer shades are constructed with four or five layers of reflective materials separated by spacers that flatten as the shade rolls up. A motor is available from at least one manufacturer that will raise and lower the shade, but the motor's cost makes it practical only for large window areas. Multiple shade systems have three plastic roll-up shades mounted in the same frame. One shade is transparent, one is reflective, and one is heat-absorbing with perforations to allow viewing. The shade can provide insulation, reduce infiltration, allow summer sun control, or allow winter passive solar gain.

One shade made of fiberglass can be used on the interior or exterior of the window. The exterior version can be protected from wind damage by a wind sensor which automatically rolls up the shade during heavy winds.

<u>Interior shutters</u> include sliding thermal shutters, hinged thermal shutters, and pop-in shutters. Sliding thermal shutters are attached to an overhead dowel and slide over the window when in use. They are constructed with insulation board or filled with fiberfill, fiberglass, or cellulose, and they include a plastic vapor barrier within a wooden frame. Pop-in shutters can be constructed with a high density cardboard covered with foil, and separated by a wood frame to create an insulating air space. The wood frame is edged with weatherstripping to insure a tight fit within the window frame.

Interior folding shutters are also available. They are made of a rigid polyurethane foam core between birch plywood panels

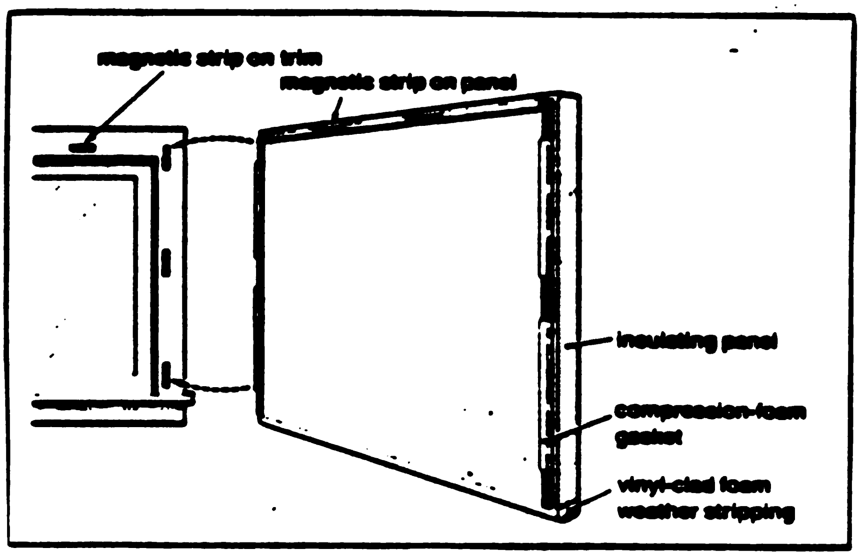


There are many different options for shutter designs.

and come with a wood frame weatherstripped with flexible foam for a tight fit.

Exterior shutters are either hinged or roll shutters. Hinged shutters are constructed with insulation sandwiched between plywood and sheet metal. They can be hinged on the top, sides or bottom of the shutter with the inside facing covered with a reflective material to maximize your home's solar heat gain when the shutters are opened. The outside of the shutter can be either stained or painted to match the house. A cable connected to the shutter will allow operation from inside the home. There are two different types of roll shutters: one is constructed with numerous horizontal slats and the other has only a few sections hinged like a garage door.

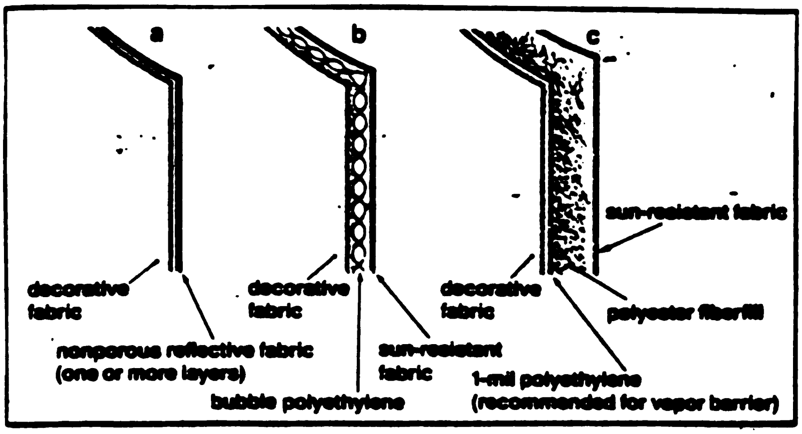
Pop-in panels are comprised of a single piece of insulation board held in place by metal or magnetic clips; or fiberglass or fiberfill in a wood frame, locked in place by four bullet catches. They can be covered with decorative fabric or posters for use as wall hangings, or they can be covered with burlap for use as bulletin boards. That way they can hang on the wall when not in use, rather than having to find storage space for them. Another type of pop-in panel is a translucent sandwich panel made of two sheets of translucent fiberglass bonded to an aluminum grid core structure.



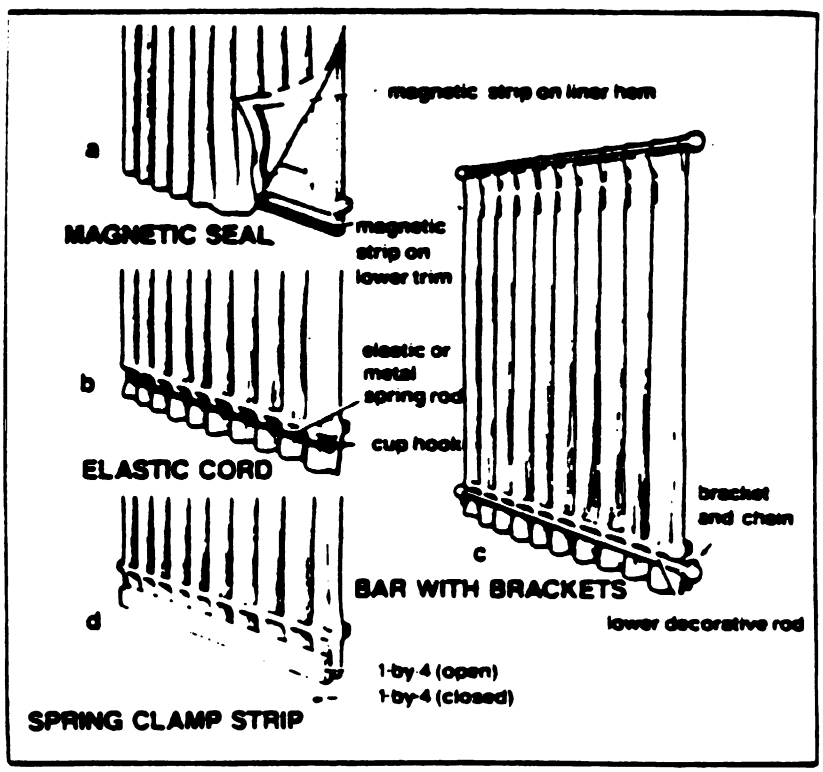
POP-IN PANELS are made to fit over the inside window frame. They are held in place with weatherstripping or, like in this example, with magnetic stripe like a refrigerator door. Several options are available for pop-in panel design. They can be made with a wood frame filled with insulating materials and covered with a poster on the inside, or covered with burlap and used as a bulletin board.

Another window insulation method is a product which blows polystyrene beads between multi-paned windows. The beads are stored in a storage bin and can be controlled automatically by a thermostat or manually by pushing a button. A pump and motor blow the beads into place or vacuum them into the storage bin when not in use. The same concept can be used by manually pouring packing beads between window panes.

<u>Window blankets</u> and <u>thermal curtains</u> contain insulation quilted to or sandwiched between layers of fabric. They are either hung on a track and folded to one side when not in use, or they can hang on a conventional curtain rod. Reflective fabrics may be used on the outside to reduce solar heat gain in summer. They can be sealed in the same manner as existing curtains.



Draperies and shades can be greatly increased in effectiveness by sealing the top, bottom, and sides to reduce convective air flow. The top can be sealed by attaching a piece of insulating fabric or a valance can enclose the rod or dowel. The sides can be sealed with snaps or velcro attached to the drapery or shade and the window frame. Draperies can also be sealed at the bottom, using a valance or by weighting them to fit snug on the sill or floor. Sealing drapery gaskets are available for purchase as well as drapery liners made of aluminized polyester to help control summer heat gain.



DRAPERIES can create a flow of cold air near the window if they are not sealed at the top or bottom. On a cold day, hold your hand near the bottom of your drapes. Can you feel cold air sinking into the room? These bottom seal options, pictured, can help cut down on unwanted air circulation next to your windows. Similar treatments are possible for the curtains' top. Making a good seal between the curtain and window frame will save a lot on heating and cooling bills. A valence can be used at curtain tops to prevent air from convecting around the curtain, past the window, and into your room.

Insulating window films are another method of insulating windows. These plastic films are glued to windows and reflect radiation from room temperature surfaces back into the room. Some films are absorptive allowing some of the absorbed solar energy into the room and others reflect most of the solar radiation. Heat mirror films are still being developed and are not yet widely available. These films reflect radiant heat back inside through the glass while at the same time allowing solar radiation to enter. They are applied to the outer side of the interior glass to prevent wear and tear from the inside.

Avoid condensation problems...

Condensation can be a problem with window treatments. If fog or frost forms on your window, it could damage the window frame and window insulation. If you make sure that the window insulation fits properly and includes a vapor barrier, and provide adequate ventilation for your bathroom and kitchen, condensation is unlikely to form. If it does, you may have too much humidity in your home.

Summer Savings...

It costs more in electricity to extract a unit of heat in the summer than it costs in gas or oil to add a unit of heat in winter. Windows collect the sun's heat, adding to the cooling burden. Methods of controlling solar heat gain include reflective films and shading devices. Reflective film that can be removed and reused is more feasible in climates like ours where it is advantageous to use solar heat gain during colder seasons. Adjustable canvas awnings, shade screens, and metal louvered screens are on the market, too. They can be folded or removed when solar heat gain is desired. You may wish to construct a wooden support frame to hold boards for shading. They can also be removed to let the sun shine in.

Caution...

Many of the materials that can be used for making window treatments are flammable. Plastics, insulating materials, and fabrics are often flammable, and may release toxic fumes into the air in the event of a fire. Please use caution when using any combustible materials in your home. You may want to plan to use non-combustible materials for windows near your range or oven, or other heat sources.

For more information...

This publication is intended to familiarize you with the many types of window treatments presently available. For product and manufacturers' information as well as directions to make your own window insulation treatments, some excellent sources are Movable Insulation by William K. Langdon (Rodale Press, Emmaus, PA 18049; $14.95), or Thermal Shutters and Shades by William Shurcliff (Brick House Publishing Company, 34 Essex Street, Andover, MA 01810; $12.95).

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CALCULATING ENERGY SAVINGS FROM WINDOW MODIFICATIONS

If you are planning to modify your windows to save energy, or to estimate savings for new windows, you can use this publication to check how much energy you might save.

The amount of heat energy conducted through windows is measured in units of heat flow, and these values for different window types are reported in "U-factors." The U-factor measures the transmittance of heat in BTU* per square foot of window area, per hour, per degree Fahrenheit--representing the temperature difference between inside and outside conditions [written BTU/ft² (hour) (F°)].

Since heat always flows from the warmer side of a window toward the cooler side, windows can be considered to be heat-losers or heat-gainers depending on their location in the home and their orientation toward the sun during different months of the year. This publication is not intended to answer questions about passive solar heating (i.e., the use of windows to gain heat during cold months), but it will provide useful information for considering heat loss from windows--disregarding their solar orientation.** In general, though, the better your windows fight heat loss in the winter months the better they will fight heat gain during the summer. The following calculations will provide close estimates for the energy-saving potential of various window modifications.

BTU-per-year represents savings...

U-factors for different window types are measured in experimental conditions where the inside and outside temperatures can be closely monitored. Once you know the U-factor for a given window type you can estimate the total annual heat loss via conduction using this formula:

U-value x 24 hours x d.d. x window area = BTU heat loss per year.

The "d.d." stands for annual degree days--a value representing average climatic conditions for different locations. Window area should be expressed in square feet. To find the U-value for various window types, consult the following chart, or ask a window manufacturer or distributor for test results from an independent testing laboratory. (Page 3 of this publication lists average annual degree-days for each Michigan county; page 2 shows average U-values for many window types.)

*BTU is short for British Thermal Unit. One BTU is the amount of heat energy required to raise the temperature of one pound of water one degree Fahrenheit--or approximately one kitchen match worth of heat energy.

**For more information about passive solar energy, contact the Energy Hotline.

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To estimate...

To calculate the savings likely to result from window modifications, apply the formula once to calculate annual fuel use (in BTU/year) for your present windows. Then apply the formula again using U-values based on planned window alterations. If you are planning to add shades, shutters, or insulated blinds, then you will have to consider the average number of hours per day they might be in place. To include shutters, shades, etc. in your calculations, just make a fraction--in hours per day/24--and add that factor in the formula (see example on page 4).

If you find an "R" value for shades, curtains, etc. instead of a U-factor, then use the reciprocal of the R-factor to calculate the U (i.e., R = 1/U or U = 1/R).

Figuring infiltration...

The U-value formula, above, is to calculate savings based on heat losses due to conduction of heat through the window materials themselves. Another important energy conservation consideration is the heat loss due to infiltration of cold air into your home. Some window infiltration occurs around the window frame itself, and this is where weatherstripping is applied. That kind of infiltration is measured in cubic feet per minute of air per linear foot of window frame (cfm/ft), and that's information that you should be able to get from window manufacturers or distributors for new windows. For your present windows, you can reduce infiltration by applying weatherstripping to seal the joints where window frames meet, and at the bottom and top of double-hung windows. Caulking can be applied to seal windows which will not be opened.

Coefficients of Transmission (*U*) of Windows, Skylights, and Light Transmitting Partitions

These values are for heat transfer from air to air, Btu/(hr • ft² • F).

Part A — Vertical Panels (Exterior Windows, Sliding Patio Doors, and Partitions) — Flat Glass, Glass Block, and Plastic Sheet

Description	Winter	Description	Winter	Description	Winter
Flat Glass		insulating glass — triple		insulating unit — double	
single glass	1.10	0.25-in. air spaces	0.39	0.25-in. air space	0.55
insulating glass — double		0.5-in. air spaces	0.31	0.5-in. air space	0.43
0.1875-in. air space	0.62	storm windows			
0.25-in. air space	0.58	1-in. to 4-in. air space	0.50	Glass Block	
0.5-in. air space	0.49			6 x 6 x 4 in. thick	0.60
0.5-in. air space, low		Plastic Sheet		8 x 8 x 4 in. thick	0.56
emittance coating		single glazed		—with cavity divider	0.48
e = 0.20	0.32	0.125-in. thick	1.06	12 x 12 x 4 in. thick	0.52
e = 0.40	0.38	0.25-in. thick	0.96	—with cavity divider	0.44
e = 0.60	0.43	0.5-in. thick	0.81	12 x 12 x 2 in. thick	0.60

Part B — Horizontal Panels (Skylights) — Flat Glass, Glass Block, and Plastic Domes

Description	Winter
Flat Glass	
single glass	1.23
insulating glass — double	
0.1875-in. air space	0.70
0.25-in. air space	0.65
0.5-in. air space	0.59
0.5-in. air space low emittance coating	
e = 0.20	0.48
e = 0.40	0.52
e = 0.60	0.56
Glass Block	
11 x 11 x 3 in. thick with cavity divider	0.53
12 x 12 x 4 in. thick with cavity divider	0.51
Plastic Domes	
single-walled	1.15
double-walled	0.70

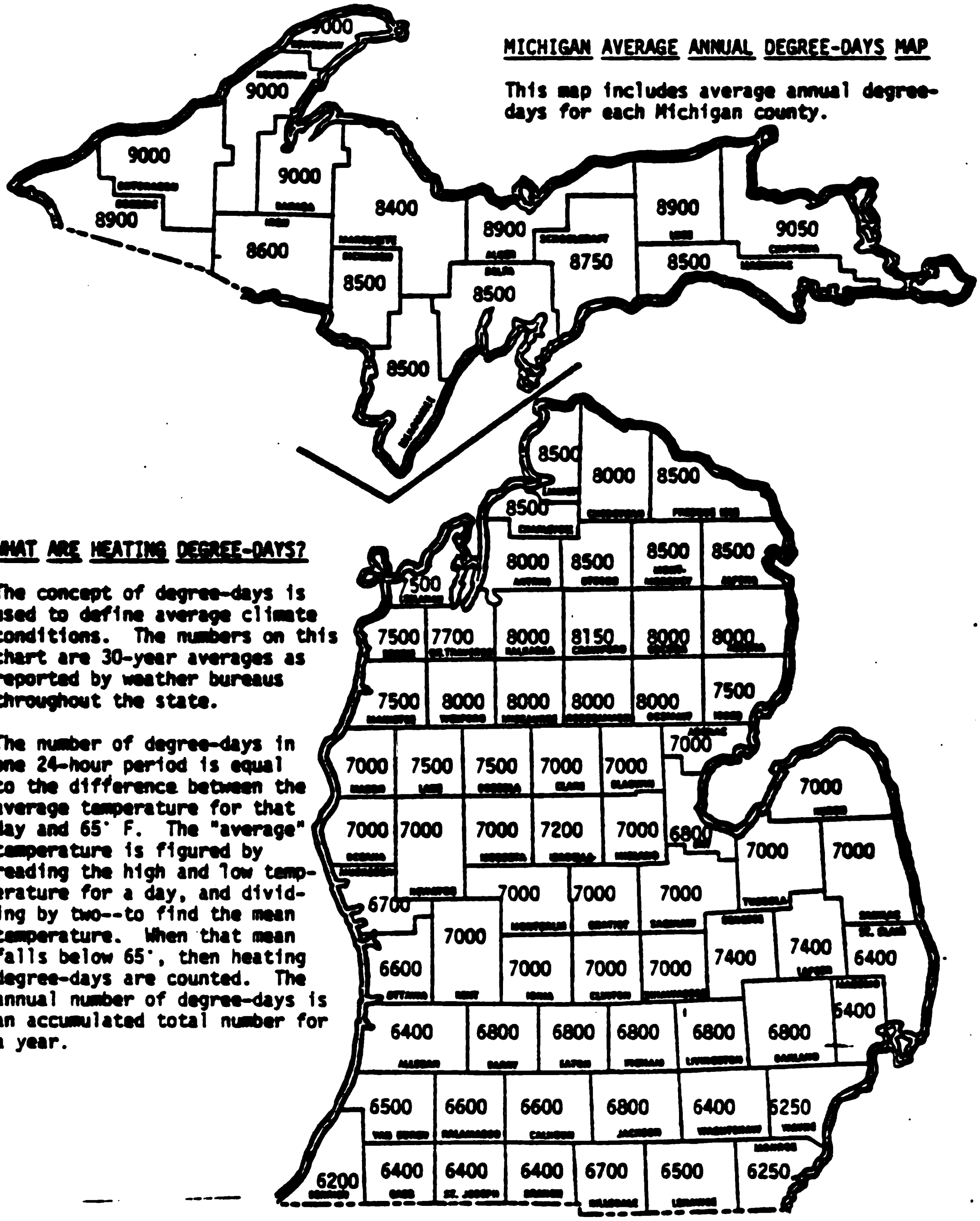
Part C — Adjustment Factors For Various Window and Sliding Patio Door Types (Multiply *U* Values in Parts A And B By These Factors)

Description	Single Glass	Double or Triple Glass	Storm Windows
Windows			
All Glass	1.00	1.00	1.00
Wood Sash — 80% Glass	0.90	0.95	0.90
Wood Sash — 60% Glass	0.80	0.85	0.80
Metal Sash — 80% Glass	1.00	1.20	1.20
Sliding Patio Doors			
Wood Frame	0.95	1.00	–
Metal Frame	1.00	1.10	–

This information is copied from the Michigan Energy Code workbook, page 28. Data compiled by the American Society of Heating, Refrigeration, and Air Conditioning Engineers.

MICHIGAN AVERAGE ANNUAL DEGREE-DAYS MAP

This map includes average annual degree-days for each Michigan county.



WHAT ARE HEATING DEGREE-DAYS?

The concept of degree-days is used to define average climate conditions. The numbers on this chart are 30-year averages as reported by weather bureaus throughout the state.

The number of degree-days in one 24-hour period is equal to the difference between the average temperature for that day and 65° F. The "average" temperature is figured by reading the high and low temperature for a day, and dividing by two--to find the mean temperature. When that mean falls below 65°, then heating degree-days are counted. The annual number of degree-days is an accumulated total number for a year.

A greater share of infiltration around windows occurs between the rough-frame and the finished window frame. For the best protection against infiltration, you should caulk all around the outside of the window frame, and insulate any open spaces in the rough frame, if possible. (See diagram on page 5.)

For example...

Suppose my home is in Kalkaska County and I have 240 square feet of window area. Forty square feet already has storm windows, but I want to estimate the savings from adding storms to the rest of the windows, and I want to check the potential savings from using shutters on half my windows on winter nights. First I want to calculate the present heat loss in BTU/year. From the chart on page two, I find that the single-pane windows' U-value is 1.10 (part A of chart). I'm adjusting that factor for wood sash windows that are 80% glass (part C), multiplying by .90. For the windows with storms, I'll use .50 (from part A) and .95 (from part C). Annual degree-days for Kalkaska County--from the map in page 3--equals 8000. Applying the formula for my present situation I have:

U-value for single glass = 1.10 x .90 = .99; window area = 200 ft^2
U-value for storm windows = .50 x .95 = .475; window area = 40 ft^2.

(Remember, the formula for annual heat loss in BTU/year is: U-value x 24 hours x degree-days x window area (in ft^2) = BTU heat loss/year).

Heat loss from single glass = .99 x 24 x 8000 x 200 = 38,016,000 BTU/year.
Heat loss from storm windows = .475 x 24 x 8000 x 40 = 3,648,000 BTU/year.
Present total for house (add each segment's heat loss) = 41,664,000 BTU/year.

If I add storm windows to the remaining 200 square feet, I'll have 240 square feet, all with U-value of .475, or:

Heat loss for all storm windows = .475 x 24 x 8000 x 240 = 21,888,000 BTU/year.
Savings (present total minus all storm windows total) = 19,776,000 BTU/year.

Now I want to calculate the savings from using shutters** on half the windows, eight hours per day (in addition to the storm windows). The shutters have an R-value of 5. R-value for the storm windows is 1/U, or 1/.475 = 2.105. Adding the R-values, I find the total R-value will be 7.105 when the shutters are in place. The total U-value will be 1/7.105 or .1407. The heat loss for 8 hours per day for my shuttered windows (120 ft^2) will be:*

"Shutters on" 120 ft^2 = .1407 x (8/24) x 24 x 8000 x 120 = 1,080,576 BTU/year.

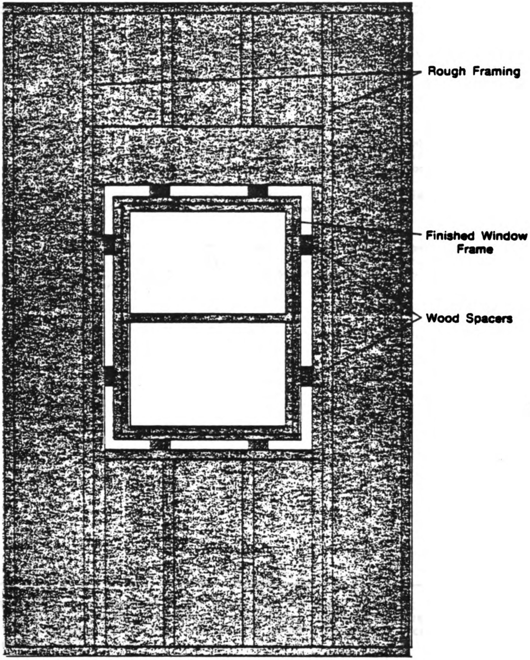
For the other 16 hours each day the heat loss will be:

(Continued on page 6)

*Actually, since the shutters will be in place at night, when it's coldest, the actual savings will be greater than the formula shows. Remember that these figures are estimates. Your actual savings will vary depending on local weather conditions, on the location and orientation of your home toward the sun and wind, and on the condition and operation of your heating system.

**Shades, blinds, etc. would be calculated in the same manner. Add R-values to find the total for the window system.

If possible, insulate the space between the finished window frame and rough frame (white space in drawing). That's where most infiltrating air will enter the house. Also, apply caulking outside, around the edge of window frames where they meet the siding materials. (For more information about caulking and weatherstripping, ask for EES Publication #19: *Weatherstrip Your Doors and Windows.)*



"Shutters off" 120 ft^2 = .475 x (16/24) x 24 x 8000 x 120 = 7,295,999 BTU/year.

The rest of my windows will be "shutters off" for 24 hours, or:

Windows with no shutters = .475 x 24 x 8000 x 120 = 10,944,000 BTU/year.

The total for the house using shutters is (adding subtotals): 19,320,575 BTU/year.

Savings from the shutters is the difference between the heat loss for all storm windows and the heat loss for the house with shutters, or 2,567,425 BTU/year. Compared to the way the house is now, the savings would be 22,343,425 BTU/year. In order to calculate the dollar savings these BTU represent, check EES Publication #93: Which Fuel to Choose.

About frames...

Steel, aluminum, wood, and vinyl are the most common materials used to make window frames. Steel and aluminum will conduct much more heat than wood or vinyl, but you shouldn't let the heat loss of the frame material be your only consideration when buying new windows. Also think about how long the frames will last, how much maintenance they will require, and how they will look. For example, wooden frames will conduct less heat than aluminum, but the wooden ones will require regular painting while aluminum will not.

You may not be able to find out accurately how long each window type is expected to last, but the manufacturer or distributor might provide you with names and addresses of satisfied customers you could talk with. A guarantee or warranty is another good assurance of product durability.

"This material was prepared with the support of the U.S. Department of Energy (DOE) Grant No. EC-77-G-01-5902. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of DOE."

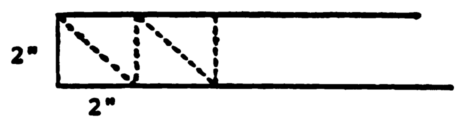
HOW TO BUILD AN INSIDER STORM WINDOW

An Insider Storm Window is a simple wood frame and plastic film window treatment. It helps to seal off drafts of cold air coming from the window and in addition to offering some window insulation its design does not restrict sunlight from entering your home.

MATERIALS AND TOOLS YOU WILL NEED

MATERIALS

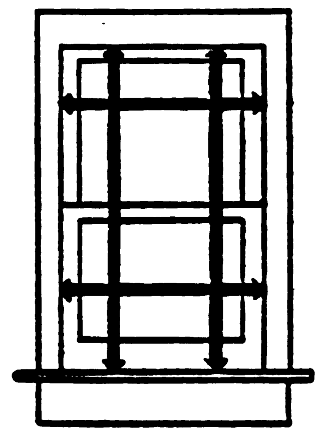
- **3/4 inch wood ripped to 1 inch wide from wood a bit longer than window height**
- **wood glue**
- **#6 finish nails**
- **staples for staple gun**
- **duct tape**
- **foam tape weather-stripping**
- **flexible plastic film (comes in a roll, should be a little wider than window frame opening)**
- **wooden corner supports (3/4 inch wood ripped to 2 inches wide, then cut into triangular pieces, as shown to the right)**



TOOLS

- **wood saw (a miter box and saw set up is nice but not absolutely necessary)**
- **yard stick or measuring tape**
- **pencil**
- **knife**
- **hammer**
- **staple gun**

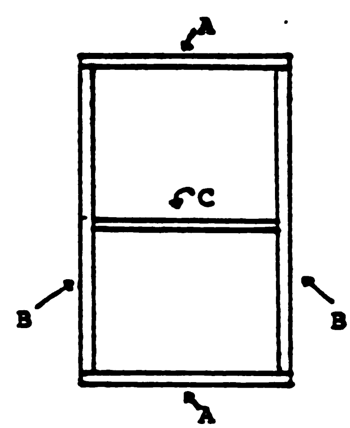
READ THROUGH ALL INSTRUCTIONS BEFORE STARTING THE PROJECT. THIS WILL HELP SAVE TIME AND HELP YOU AVOID MISTAKES.



STEP ONE : MEASURE

Measure the width and height of the window frame opening where the insider can fit against a flat surface on top, bottom and sides.

Tips: Measure the window frame opening at more than one place along the flat surfaces for both width and height dimensions. This is a good idea since some window frames may be warped or irregular. Remember to subtract about one half of the thickness of the foam tape weatherstripping from width and height measurements (see Tips under STEP EIGHT).



STEP TWO : CUT WOOD

Cut wood in lengths needed for the overall dimensions determined in STEP ONE, but take into account the way the wood pieces will be fitted together as shown here.

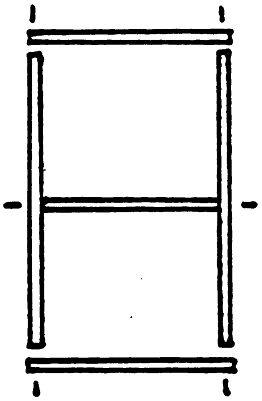
In this example, top and bottom pieces (A) are full width measure, side pieces (B) are each two inches shorter than full height measure, and the support piece (C) is two inches shorter than top and bottom pieces.

Then cut wooden corner supports as shown on page one.

Tips: Make sure yours cuts are square so joints fit without gaps. Assemble wood pieces on the floor to double check that assembled measurements add up to needed overall width and height.

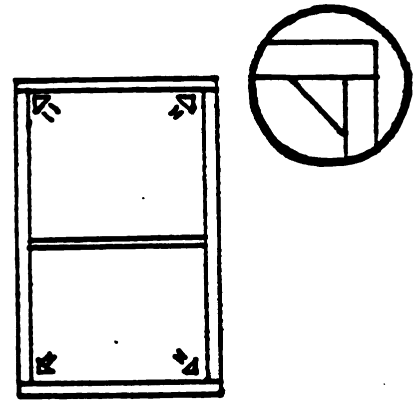
STEP THREE : GLUE AND NAIL

Assemble wood pieces by gluing where wood surfaces meet, then nail joints as shown:



glue and nail main pieces

then



glue and nail wooden corner supports

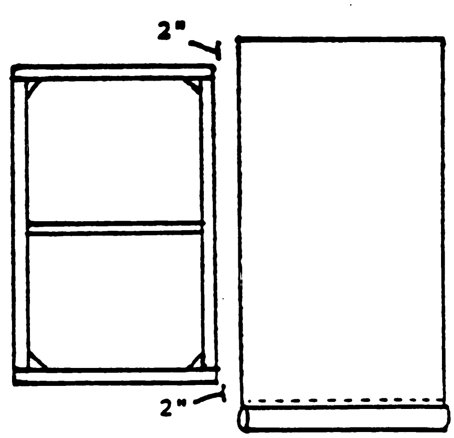
Tips: Determine where you want the support piece (C in STEP TWO) before gluing and nailing - you may want it to parallel a cross piece in the existing window.

STEP FOUR : ROUGH CUT PLASTIC

Lay assembled wood frame on the floor, roll out plastic next to the frame, then cut plastic four inches longer than the frame height. This will give you a two inch border on top and bottom.

Then, if plastic is folded as it comes off the roll, unfold it and cut it so you have a two inch border on each side of the frame.

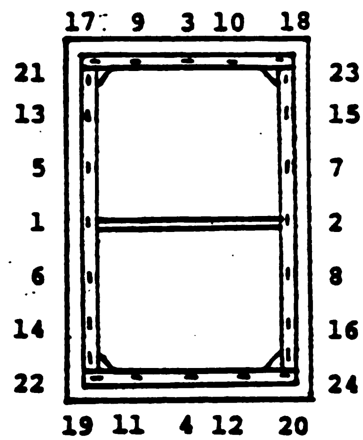
Cut two pieces of plastic with these dimensions.



Tips: Think about the dimensions of the plastic as it comes off the roll; you may be able to find a way to cut out the pieces you need with less waste than you would have if you did it as suggested above.

STEP FIVE : STAPLE

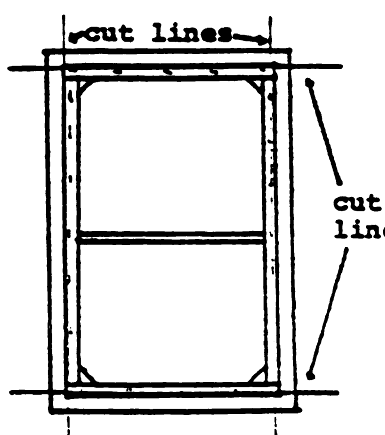
With frame flat on the floor, or on a sturdy work surface, staple one sheet of plastic to each side of the frame.



Tips: Work in a well lighted, clean area. Light reflecting on the plastic will help you see how much and where to stretch the plastic over the frame before stapling. A clean area will insure that lint and other unwanted debris will not be trapped between the plastic surfaces. Staple from the center of opposing sides outward (this is illustrated by the series of numbered staples in the drawing above). Complete stapling plastic on one side before stapling plastic on the other side.

STEP SIX : TRIM PLASTIC

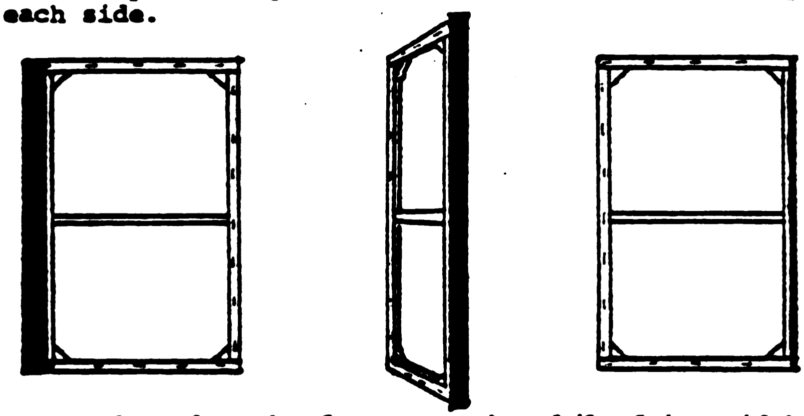
Trim off excess plastic about 1/8 inch in from the edge of the frame. Do this on all edges of each side of the frame.



Tips: Make cuts with a knife against a straight edge as a guide. By cutting 1/8 inch in from edges the plastic will not pucker as the duct tape is applied to the edges of the frame (STEP SEVEN).

STEP SEVEN : TAPE EDGES

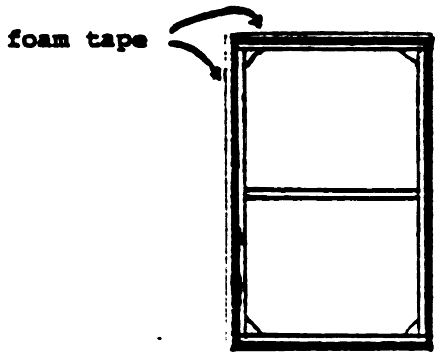
Seal the exposed wooden edges of the frame with duct tape such that the tape overlaps onto the trimmed edges of the plastic on each side.



Tips: Apply a length of tape so that 1/3 of its width is stuck to the front side. Next, fold and press the second 1/3 of the tape's width against the outside edge. Finally, press the remaining 1/3 of the tape's width against the back side edge. Repeat this taping process on the other three edges. When taped on all edges the inside air space (between plastic surfaces) will be air tight, creating a 3/4 inch "dead air" space.

STEP EIGHT : APPLY FOAM TAPE

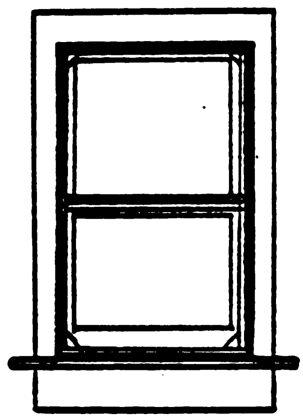
Apply self adhesive foam-backed tape on two outside, adjacent edges.



Tips: As stated in STEP ONE wood frame measurements must leave enough room for about one half of the thickness of the foam tape when it is applied to one side and either the top or bottom edge. The foam tape helps the insider to fit snugly within the window frame.

STEP NINE : INSERT

Insert the finished insider storm window into the window frame opening.



Tips: When fitting the insider into the window frame opening push the side with foam tape on it in first. This will help the foam tape stay in place while you swing the opposite side into position. Some type of pull knob or tape tab can be secured to the front of the frame to aid in easy removal.

THE FINISHED PRODUCT

When finished the insider will, by itself, have an R value of 1 but you can add another R1 to its overall installed R-value for the space of trapped air between the insider and the window glass (if this distance is 3/4 inch or more). In sum you will have a window with added insulation value without sacrificing natural day lighting or the view outside.

HOW TO BUILD A FOAM BOARD
INSULATED WINDOW SHUTTER

A foam board, pop-in window shutter is a very simple way to reduce heat loss from windows. In addition to helping to seal off cold drafts coming from windows, it has a fairly high R-factor. The most common use of these shutters is as a supplement to closing drapes at night, although they can also be left in place during the daytime.

When considering use of foam board for shutters you should also know that covering them with some type of fireproof material is a necessity; if the foam board should catch fire toxic fumes would be released. A fireproof covering helps prevent this possibility.

MATERIALS AND TOOLS YOU WILL NEED

MATERIALS

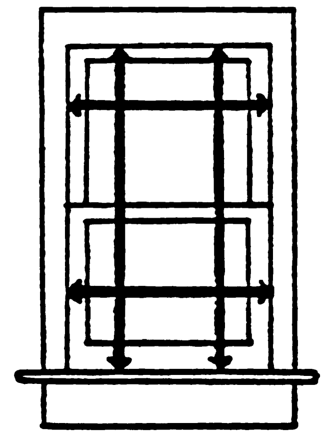
- 4 foot by 8 foot insulating foam board, 3/4 inch thick
- duct tape
- fireproof covering
- decorative covering
- glue (if needed for coverings)
- foam tape weatherstripping

TOOLS

- utility knife
- yard stick or measuring tape
- pencil

READ THROUGH ALL INSTRUCTIONS BEFORE STARTING THE PROJECT. THIS WILL HELP SAVE TIME AND HELP YOU AVOID MISTAKES.

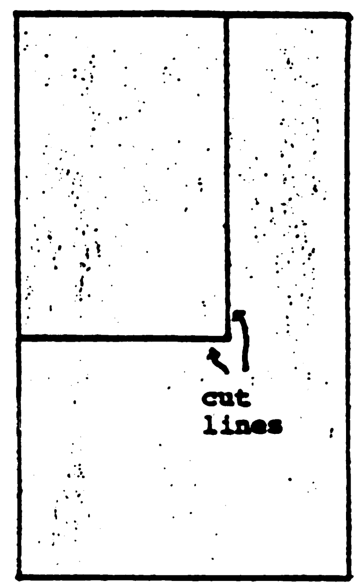
STEP ONE : MEASURE



Measure the width and height of the window frame opening where the shutter can fit against a flat surface on top, bottom and sides.

Tips: Measure the window frame opening at more than one place along the flat surfaces for both width and height dimensions. This is a good idea since some window frames may be warped or irregular. Remember to subtract about one half of the thickness of the foam tape weatherstripping from width and height measurements (see Tips under STEP FIVE). Also, allow for the thickness of any coverings.

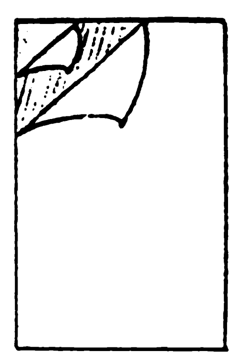
STEP TWO : CUT FOAM BOARD



Cut out the piece of foam board based on the measurements made in STEP ONE.

Tips: Place and old board or some type of work surface protection under the foam board where you will be cutting through. Use a sharp knife blade and make cuts clean and square. Measure in from the edge of the 4 by 8 sheet of foam board, pencil in cut lines, then with the knife against a straight edge as a guide, make the cuts.

STEP THREE : COVER

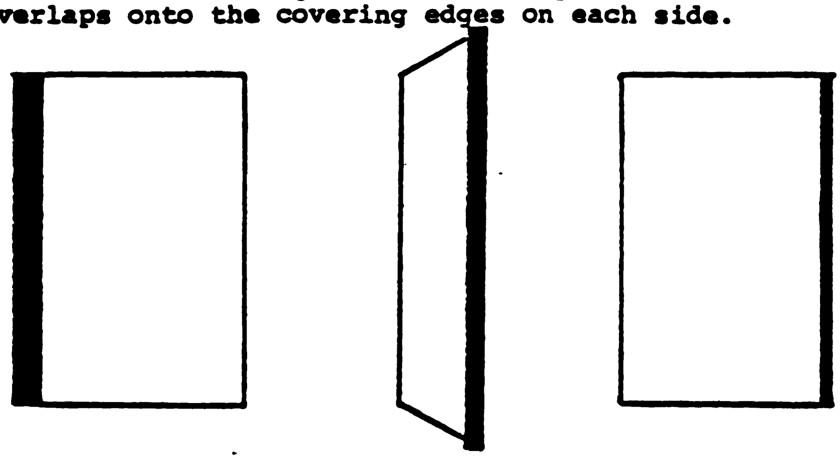


Glue or tape shutter coverings in place.

Tips: You may want to do STEP FOUR before this step, depending on your choice of coverings and whether or not you mind having a taped border around the shutter.

STEP FOUR : TAPE EDGES

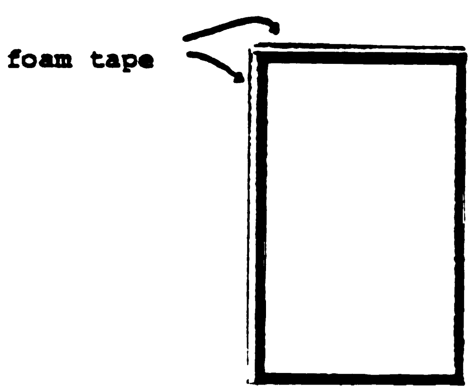
Seal the shutter edges with duct tape such that the tape overlaps onto the covering edges on each side.



Tips: Apply a length of tape so that 1/3 of its width is stuck to the front side. Next, fold and press the second 1/3 of the tape's width against the outside edge. Finally, press the remaining 1/3 of the tape's width against the back side edge. Repeat this taping process on the other three edges.

STEP FIVE : APPLY FOAM TAPE

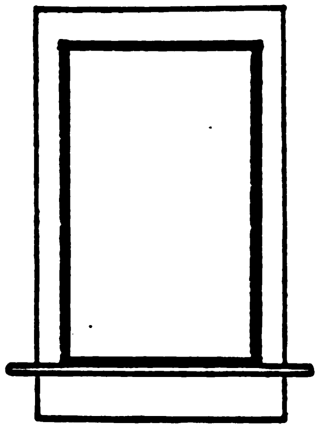
Apply self adhesive foam-backed tape on two outside, adjacent edges.



Tips: As stated in STEP ONE shutter measurements must leave enough room for about one half of the thickness of the foam tape when it is applied to one side and either the top or bottom edge. The foam tape helps the shutter to fit snugly within the window frame.

STEP SIX : INSERT

Insert the finished shutter into the window frame opening.



Tips: When fitting the shutter into the window frame opening push the side with foam tape on it in first. This will help the foam tape stay in place while you swing the opposite side into position. Some type of pull knob or tape tab can be secured to the front of the frame to aid in easy removal.

THE FINISHED PRODUCT

When finished the shutter will, by itself, have an R value equal to that indicated on the foam board packaging. To this you can figure another R1 for the space of trapped air between the shutter and the window glass (if this distance is 3/4 inch or more). In sum, you will have a very effective and attractive means of saving on window heat loss.

Extension Bulletin 1104: In the Bank or Up the Chimney?

WEATHERSTRIP YOUR DOORS AND WINDOWS

AN EASY DO-IT-YOURSELF PROJECT

You can weatherstrip your doors even if you're not an experienced handyman. There are several types of weatherstripping for doors, each with its own level of effectiveness, durability and degree of installation difficulty. Select among the options given the one you feel is best for you. The installations are the same for the two sides and top of a door, with a different, more durable one for the threshold.

The Alternative Methods and Materials

1. Adhesive backed foam:

Tools

Knife or shears,
Tape measure

Evaluation – extremely easy to install, invisible when installed, not very durable, more effective on doors than windows.

Installation – stick foam to inside face of jamb.

2. Rolled vinyl with aluminum channel backing:

Tools

Hammer, nails,
Tin snips
Tape measure

Evaluation – easy to install, visible when installed, durable.

Installation – nail strip snugly against door on the casing

3. Foam rubber with wood backing:

Tools

Hammer, nails,
Hand saw,
Tape measure

Evaluation – easy to install, visible when installed, not very durable.

Installation – nail strip snugly against the closed door. Space nails 8 to 12 inches apart.

4. Spring metal:

Tools

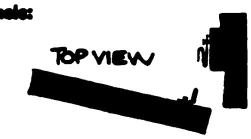
Tin snips
Hammer, nails,
Tape measure

Evaluation – easy to install, invisible when installed, extremely durable.

Installation – cut to length and tack in place. Lift outer edge of strip with screwdriver after tacking, for better seal.

Note: These methods are harder than 1 through 4.

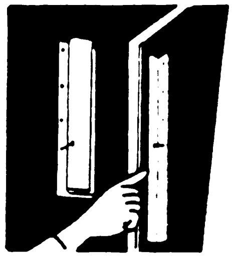
5. Interlocking metal channels:



Tools

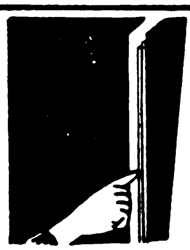
Hack saw,
Hammer, nails,
Tape measure

Evaluation – difficult to install (alignment is critical), visible when installed, durable but subject to damage, because they're exposed, excellent seal.



Installation – cut and fit strips to head of door first: male strip on door, female on head; then hinge side of door: male strip on jamb, female on door; finally lock side on door, female on jamb.

6. Fitted interlocking metal channels: (J-Strips)



Evaluation – very difficult to install, exceptionally good weather seal, invisible when installed, not exposed to possible damage.

Installation – should be installed by a carpenter. Not appropriate for do-it-yourself installation unless done by an accomplished handyman.

7. Sweeps:

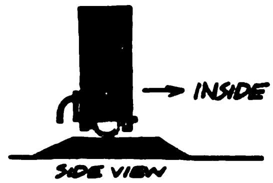
Tools

Screwdriver,
Hack saw,
Tape measure

Evaluation – useful for flat threshholds, may drag on carpet or rug.

Installation – cut sweep to fit 1/16 inch in from the edges of the door. Some sweeps are installed on the inside and some outside. Check instructions for your particular type.

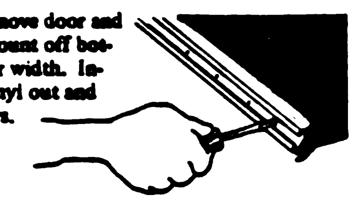
8. Door Shoes:



Tools

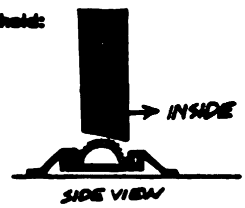
Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation – useful with wooden threshhold that is not worn, very durable, difficult to install (must remove door).



Installation – remove door and trim required amount off bottom. Cut to door width. Install by sliding vinyl out and fasten with screws.

9. Vinyl bulb threshold:



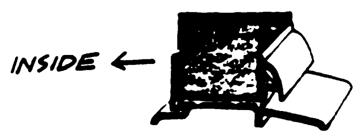
Tools

Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation – useful where there is no threshhold or wooden one is worn out, difficult to install, vinyl will wear but replacements are available.

Installation – remove door and trim required amount off bottom. Bottom should have about 1/8" bevel to seal against vinyl. Be sure bevel is cut in right direction for opening.

10. Interlocking threshold:

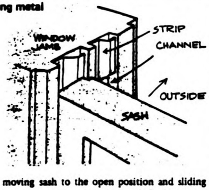


Evaluation – very difficult to install, exceptionally good weather seal.

Installation – should be installed by a skilled carpenter.

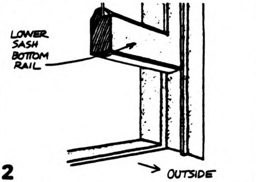
Weatherstrip Windows

Thin spring metal



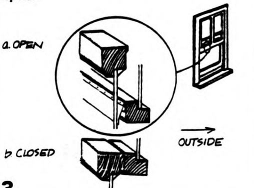
1

Install by moving sash to the open position and sliding strip in between the sash and the channel. Tack in place into the casing. Do not cover the pulleys in the upper channels.



2

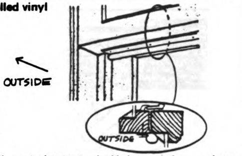
Install strips the full width of the sash on the bottom of the lower sash bottom rail and the top of the upper sash top rail.



3

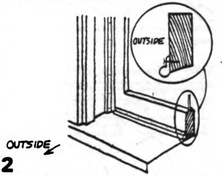
Then attach a strip the full width of the window to the upper sash bottom rail. Countersink the nails slightly so they won't catch on the lower sash top rail.

Rolled vinyl



1

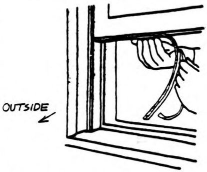
Nail on vinyl strips on double-hung windows as shown. A sliding window is much the same and can be treated as a double-hung window turned on its side. Casement and



2

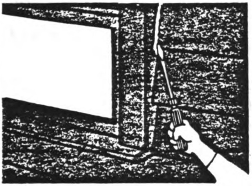
tilting windows should be weatherstripped with the vinyl nailed to the window casing so that, as the window shuts, it compresses the roll.

Adhesive-backed foam strip

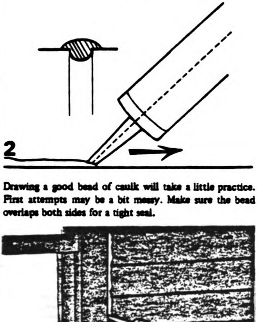


Install adhesive backed foam, on all types of windows, only where there is no friction. On double-hung windows, this is only on the bottom (as shown) and top rails. Other types of windows can use foam strips in many more places.

Installation of Caulking



Before applying caulking compound, clean area of paint build-up, dirt, or deteriorated caulk with solvent and putty knife or large screwdriver.



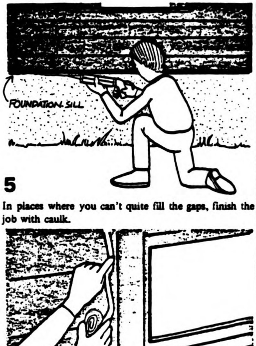
2

Drawing a good bead of caulk will take a little practice. First attempts may be a bit messy. Make sure the bead overlaps both sides for a tight seal.

A wide bead may be necessary to make sure caulk adheres to both sides.

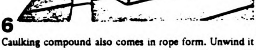
4

Fill extra wide cracks like those at the sills (where the house meets the foundation) with oakum, glass fiber insulation strips, etc.)



5

In places where you can't quite fill the gaps, finish the job with caulk.



6

Caulking compound also comes in rope form. Unwind it and force it into cracks with your fingers. You can fill extra long cracks easily this way.

INSTALL COMBINATION STORM WINDOWS

CONTRACTOR INSTALLED

Triple track, combination (windows and screen) storm windows are designed for installation over double hung windows. They are permanently installed and can be opened any time with a screen slid into place for ventilation.

Double-track combination units are also available and they cost less. Both kinds are sold almost everywhere, and can be bought with or without the cost of installation.

Installation

You can save a few dollars (10% to 15% of the purchase price) by installing the windows yourself. But you'll need some tools: caulking gun, drill, and screw driver. In most cases it will be easier to have the supplier install your windows for you, although it will cost more.

The supplier will first measure all the windows where you want storm windows installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them.

Installation should take less than one day, depending on how many windows are involved. Two very important items should be checked to make sure the installation is properly done.

Make sure that both the window sashes and screen sash move smoothly and seal tightly when closed after installation. Poor installation can cause misalignment.

Be sure there is a *tightly* caulked seal around the edge of the storm windows. Leaks can hurt the performance of storm windows a lot.

NOTE: Most combination units will come with two or three 1/4" dia. holes (or other types of vents) drilled through the frame where it meets the window sill. This is to keep winter condensation from collecting on the sill and causing rot. Keep these holes clear, and drill them yourself if your combination units don't already have them.

Selection: Judging Quality

Frame finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and performance of storm windows. Corners are a good place to check construction. They should be strong and air tight. Normally overlapped corner joints are better than mitered. If you can see through the joints, they will leak air.

Sash tracks and weatherstripping: Storm windows are supposed to reduce air leakage around windows. The depth of the metal grooves (sash tracks) at the sides of the window and the weatherstripping quality makes a big difference in how well storm windows can do this. Compare several types before deciding.

Hardware quality: The quality of locks and catches has a direct effect on durability and is a good indicator of overall construction quality.

INSTALL COMBINATION STORM DOORS

NORMALLY CONTRACTOR INSTALLED

Combination (windows and screen) storm doors are designed for installation over exterior doors. They are sold almost everywhere, with or without the cost of installation.

Installation

You can save a few dollars (10% to 15% of the purchase price) by installing doors yourself. But you'll need some tools: hammer, drill, screw driver, and weatherstripping. In most cases, it will be easier to have the supplier install your doors himself.

The supplier will first measure all the doors where you want storm doors installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them. Installation should take less than one-half day.

Before the installer leaves, be sure the doors operate smoothly and close tightly. Check for cracks around the jamb and make sure the seal is as air-tight as possible. Also, remove and replace the exchangeable panels (window and screen) to make sure they fit properly and with a weather tight seal.

Selection: Judging Quality

Door finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and effectiveness of storm doors. Corners are a good place to check construction. They should be strong and air tight. If you can see through the joints, they will leak air.

Weatherstripping: Storm doors are supposed to reduce air leakage around your doors. Weatherstripping quality makes a big difference in how well storm doors can do this. Compare several types before deciding.

Hardware quality: The quality of locks, hinges and catches should be evaluated since it can have a direct effect on durability and is a good indicator of overall construction quality.

Construction material: Storm doors of wood or steel can also be purchased within the same price range as the aluminum variety. They have the same quality differences and should be similarly evaluated. The choice between doors of similar quality but different material is primarily up to your own personal taste.

State of Michigan
William G. Milliken
Governor
Michigan Department
of Commerce

common sense energy tips

To cut your utility costs and help conserve Michigan's energy supply

Energy Extension Service

Energy Administration
Michigan Department of Commerce

The following energy conservation measures are designed to provide Michigan residents with quick and common-sense ways to save energy in the home.

how to save HEATING energy

- Lower your thermostat to 65 degrees during the day and 55 degrees at night.
- Keep windows near your thermostat tightly closed. Otherwise your furnace will keep working after the rest of the room has reached a comfortable temperature.
- If you do not have storm windows, cover windows with clear plastic sheeting. You'll seal out the cold and reduce heat loss.
- Dust or vacuum radiator surfaces. Dust and grime impede the flow of heat.
- Make sure there are no obstructions, such as furniture or draperies, around heating air vents inside the house.
- Open draperies or shades on the sunny side of the house and let the sunshine in. Otherwise, keep draperies and shades closed to help keep warm air in. Always close draperies and shades at night.
- Close off unoccupied rooms. Bedrooms or other rooms which are unoccupied for long periods need not be heated to people-comfort levels.
- Keep your fireplace damper closed unless you have a fire going. An open damper in a 48-inch square fireplace can let up to 8% of your heat out the chimney.
- To lessen heat loss when a fireplace is in use and the furnace is on:
    - Lower thermostat setting to 50-55 degrees.
    - In the room where the fireplace is located, close all doors and warm air ducts.
- For comfort in cooler indoor temperatures, use the best insulation of all—warm clothing. Dressing wisely can help you retain natural heat.
    - Wear closely woven fabrics. They add at least a half a degree in warmth.
    - For women. Slacks are at least a degree warmer than skirts.
    - For men and women. A light long-sleeved sweater equals almost 2 degrees in added warmth; a heavy long-sleeved sweater adds about 3.7 degrees.

saving AIR-CONDITIONING energy

- Keep thermostat at 78°F or above when you are home, and set it substantially higher if you are going to be away for a large part of the day. Turn off the air-conditioner if you are going to be away from home for more than 24 hours.

- Keep windows and outside doors closed. Remind your family not to hold doors open and allow warm air to rush inside. Be sure to turn off lights not in use - the heat produced by lighting must be removed by your air-conditioner.

- Don't position heat-producing devices such as lamps and TV sets beneath a wall-mounted thermostat for a central cooling system.

- Clean or replace filters. Clogged filters make your system work harder and less efficiently.

- Ventilate high moisture areas such as bathroom, laundry room and kitchen. Humid air makes you feel warmer than dry air.

- Turn off window air-conditioners in unused rooms. Keep doors to unused rooms closed.

- Keep draperies closed on the sunny side of your home.

- Restrict the use of dryers, ovens and other heat-producing equipmer Whenever possible, use this equipment during the cooler hours of morning and evening.

- Vent your clothes dryer outside. Otherwise it pumps heat and moisture into your home. Don't forget your "solar clothes dryer." Sun-dried clothes smell great and cost nothing to dry.

- Wear light-weight and light-colored clothing. Natural fibers like cotton and linen are generally cooler than synthetics.

- On extremely hot days, serve salads or cold cuts rather than hot meals.

- Drink plenty of cool liquids. They really do help cool you.

without air-conditioning....

- Be sure to keep windows and outside doors closed during the hottest hours of the day.

- Use window fans to cool the house when it's cool outside.

HOT WATER energy savers

- Check the temperature on your water heater. Most water heaters are set for 140°F, or higher, but you may not need water that hot, unless you have a dishwasher. A setting of 120°F can provide adequate hot water for most families. (If you are uncertain about the tank water temperature, draw some water from the heater through the faucet near the bottom and test it with a thermometer.)

- Don't let sediment build up in the bottom of your hot water heater. Sediment lowers the heater's efficiency and wastes energy. About once a month, flush the sediment out by drawing several buckets of water from the tank through the water heater drain faucet.

- Limit the length of your showers. Showers can use less hot water than baths, but take care not to "soak" under the shower head.

- Always use cold water when it will do the job as well as hot.

- Replace worn washers on leaky faucets. A dripping hot water faucet leaking at the rate that would fill a 4-ounce teacup in ten minutes can waste over 1600 gallons of hot water per year.

- Do not leave water running while shaving, brushing teeth, etc.

- Turn off faucets promptly after use.

- Do not waste hot water on a garbage disposal. Most operate better with cool water.

- Use hot water during off-peak hours when possible. Off-peak hours are 10 p.m. to 6 a.m.

KITCHEN energy savers

Cooking

- Preheat your oven only for baked goods. It is generally not necessary to preheat the oven for meats, casseroles, etc. Load immediately when pre-heating temperature has been achieved.

- Preheating is unnecessary for broiling. The broiler of your range does not require preheating, no matter what you've heard.

- Make use of night or early morning baking or roasting and separate this electrical load demand from that of other cooking equipment.

- Start baking with products needing the lowest temperature.

- When possible, use low temperature roasting.

- Never use your oven to heat your kitchen. This is expensive and unsafe because ovens are not designed for space heating.

- Don't "peek." Instead, cook by time and temperature. Use a meat thermometer when roasting to prevent over or under cooking and excess shrinkage. Use a timer to time all precise cooking operations. Timing prevents loss of heat through repeated openings of the oven door or by "peeking under the lid" during surface cooking.

- Place utensil on the proper size surface unit. If the unit is too big for a small pan, heat is wasted.

- In the preparation of vegetables, rice, pasta or puddings, use steam cookers (if you have them). They are speedier and need only enough power to maintain the steam up to pressure.

- Never line your oven with aluminum foil. It can interfere with cooking and fuse to the heating element of an electric oven, thereby reducing oven efficiency. Do not place foil on the same rack as your food, but on the separate rack below. Leave an inch or more of space on all sides for proper air circulation.

- Never boil water in an open pan. Water will come to a boil faster and use less energy in a kettle or covered pan.

- Use high heat setting to bring water to a boil or to start cooking foods with water, then reduce the heat to desired lower setting. But don't set an electric surface unit on "high" if you're just warming an item.

- When cooking with electricity, get in the habit of turning off burners several minutes before the alloted cooking time. The heating element will stay hot long enough to finish the cooking without using more electricity.

- Use small electric pans or ovens (if you have them) for small meals rather than the kitchen range or oven. They use less energy.

- Use pressure cookers and microwave ovens (if you have them). They can save energy by reducing cooking time.

- Keep range-top burners and reflectors clean. They will reflect heat better.

- Expand the family menus to include stews and other single-dish meals that can be prepared in a slow cooker or crock pot (if you have one).

- Eat cold foods and sandwiches more often.

Refrigeration and Food Freezing

- Don't keep your refrigerator or freezer too cold. Recommended temperatures: 38 to 40 degrees for fresh food compartment of the refrigerator; 5 degrees for the freezer section. (If you have a separate freezer for long-term storage, it should be kept at $0^{o}F$, however.)
- Make sure your refrigerator door seals are airtight. Test them by closing the door over a piece of paper or a dollar bill so it is half in and half out of the refrigerator. If you can pull the paper or bill out easily, the latch may need adjustment or the seal may need replacing.
- If possible, locate your refrigerator or freezer away from heat-producing equipment, such as the range, and out of direct sunlight.
- Assure proper ventilation. Maintain adequate clearance, as recommended by the manufacturer, from walls and/or cabinets.
- Keep condenser coils clean. If dust or dirt is allowed to accumulate, operation will be impaired.
- Defrost freezer when 1/4 inch of frost has accumulated (on a manual-defrost model). The frost buildup causes the cooling system to work harder.
- Cool very hot foods for a short time at room temperature before placing in the refrigerator. But don't let food stand for too long--bacterial growth can make it unsafe.
- Label all food cleanly and legibly. This eliminates confusion and facilitates quick removal of food.
- Place more frequently used food items in the front.
- Store products loosely to allow good air circulation.
- Proper wrapping of foods helps prevent excess frost formation on sides and coils.
- Make a mental list of the things you need before you open the refrigerator or freezer door, then take out as many items as you can at one time.

Dishwashing

Studies show that a dishwasher uses less hot water than washing dishes by hand. However, further savings can be made in the way you operate it.

- Always wait until you have a full load before running your dishwasher.

- Use the "short cycle" or "light wash" if your dishwasher is equipped with one.
- Use only dishwasher detergent. Other cleaning agents can block the washing action, causing overflow and possible damage to the appliance.
- Remove excess food before placing dishes in the dishwasher.
- Check the filter frequently to be sure it's not clogged with food.
- Turn off the drying cycle. After the rinse cycle is completed, turn off your dishwasher and open the door so your dishes can air-dry. They will dry quickly and you save electric energy used by the heating element.
- Do not use your dishwasher to warm plates.
- If your dishwasher has a filter screen, clean it often.
- Use dishwashers during off-peak hours when possible. Off-peak hours are 10 p.m. to 6 a.m. daily.

Washing Dishes by Hand

- Don't leave hot water running while washing dishes.
- Rinse with warm water.

tips that save energy in the LAUNDRY

Washing

- Wash clothes in warm or cold water, rinse in cold.
- Fill washers (unless they have small-load attachments or variable water levels), but do not overload them.
- Use the suds saver if you have one. It will allow you to use one tub full of hot water for several loads.
- Don't use too much detergent. Oversudsing makes your machine work harder and use more energy.
- Pre-soak or use a soak cycle when washing heavily soiled garments. You'll avoid two washings and save energy.
- Wash during off-peak hours (10 p.m. to 6 a.m.) when possible.

Clothes Drying

- If you have space and weather permits, hang clothes to dry in the sunshine or air.
- Fill clothes dryer, but do not overload.
- Keep the lint screen in the dryer clean. Lint impedes the flow of air in the dryer and requires the machine to use more energy.
- Dry your clothes in consecutive loads. Stop-and-start drying uses more energy since the dryer must reach the desired temperature each time you begin.
- Separate drying loads into heavy and lightweight items. Since the lighter ones take less drying time, the dryer doesn't have to be on as long for these loads.
- If drying the family wash takes more than one load, leave small lightweight items until last. You may be able to dry them, after you turn the power off, with the heat retained by earlier loads.
- Use heated water only in the washing cycle.
- Avoid over drying in the dryer.
- Remove items when dryer stops to avoid unnecessary wrinkling which may require pressing to remove.
- Dry during off-peak hours (10 p.m. to 6 a.m.) when possible.

Ironing

- Remove clothes that will need ironing from the dryer while they are still damp. There's no point in wasting energy to dry them thoroughly if they only have to be dampened again.
- First iron those fabrics that require lower temperatures and work up to those requiring higher heat. An iron heats faster than it cools.
- Turn off iron five minutes or so before all clothes have been ironed, and finish ironing with the heat stored in the soleplate.
- Always turn off the iron when work is interrupted by telephone or doorbell.
- Do all your weekly ironing at one time.

conserving energy in the BATHROOM

- Take showers rather than tub baths. It takes about 30 gallons of water to fill the average tub. A shower with a flow of 4 gallons of water a minute uses only 20 gallons in 5 minutes.

- Consider installing a flow restrictor in the pipe at the shower head. These inexpensive, easy-to-install devices, restrict the flow of water to an adequate 3 to 4 gallons per minute.

saving energy in your HOME LIGHTING

Indoor Lighting

- Spend more time in the same room with other family members. You can share the use of the same lighting and entertainment.

- "Light-zone" your home and save electricity. Concentrate lighting in reading and working areas and where it's needed for safety (stairwells, for example). Reduce lighting in other areas, but avoid very sharp contrasts.

- Reduce overall lighting in non-working spaces by removing one bulb out of three in multiple light fixtures and replacing it with a burned-out bulb for safety. Replace other bulbs throughout the house with bulbs of the next lower wattage.

- Use one large bulb instead of several small ones in areas where bright light is needed.

- Need new lamps? Consider the advantages of those with three-way switches. They make it easy to keep lighting levels low when intense light is not necessary. Use the brightest setting only for reading or activities that require more intense light.

- Always turn three-way bulbs down to the lowest lighting level when watching television. You'll reduce the glare and use less energy.

- Use fluorescent lights whenever you can; they give out more lumens per watt. For example, a 40-watt fluorescent lamp would save about 140 watts of electricity over a seven-hour period. These savings, over a period of time, could more than pay for the fixtures you would need to use fluorescent lighting.

- Consider fluorescent lighting for the kitchen sink and counter-top areas.

- Consider installing solid state dimmers or hi-low switches. They make it easy to reduce lighting intensity in a room and thus save energy.

- Contrary to popular opinion, you will use less energy by turning an incandescent light off and then on again, even a few minutes later, than you will by leaving it on continually.

- Keep bulbs and fixtures clean. Accumulation of dust can lower lighting levels.

- Control window brightness to your best advantage. Use daylight when possible. At night, cover windows with light colored draperies or shades to reflect artificial light back into the room.

- Install time switches. Leaving lights on day and night while you're away from home is wasteful and expensive.

Outdoor Lighting

- Outdoor safety/security lighting that is normally turned on at night can be put on a photo cell or timer so lights will go off automatically and not waste power if someone forgets to turn them off during the day.

- To reduce power usage, use small-sized mercury vapor bulbs or fluorescent tubes.

SMALL APPLIANCES and ENTERTAINMENT SYSTEMS

Even though these items are small energy users individually, you can save considerable energy through care in their use and operation.

- Don't leave your appliances running when they're not in use.

- Keep appliances in good working order so they will last longer, work more efficiently and use less energy.

- Use appliances wisely; use the one that takes the least amount of energy for the job. For example: Toasting bread in the oven uses three times more energy than toasting it in a toaster. A popcorn popper uses less energy than a unit of your range.

- Portable electric heaters should be thermostatically controlled. Limit their use to temporary heating. These units are not designed for full-time heating operation. When the extra heat is not needed or no one is in the house, turn them off or unplug them.

- Rechargeable appliances generally use more energy than those that operate directly from the electrical outlet.

energy dispatch

Energy Extension Service

Energy Administration
Michigan Department of Commerce
P.O. Box 30228
Lansing, Michigan 48909
(517) 373-0480

65 WAYS TO SAVE NATURAL GAS

THE HARSH WINTER OF 1979-80 ACCENTED THE NATION'S DEPENDENCE ON NATURAL GAS, A CLEAN-BURNING FUEL THAT IS IN INCREASINGLY SHORT SUPPLY.

IN MANY PARTS OF THE COUNTRY, NATURAL GAS IS USED IN PRODUCING ANOTHER FORM OF ENERGY—ELECTRICITY. SO, WHEN YOU SAVE ELECTRICITY, YOU ARE ALSO SAVING NATURAL GAS.

ONE WAY TO STRETCH THE SHRINKING SUPPLIES OF NATURAL GAS IS TO REDUCE THE AMOUNT YOU USE IN YOUR HOME BY USING IT IN A MORE EFFICIENT WAY. YOU CAN BEGIN BY ADJUSTING YOUR THERMOSTAT TO 65°F DURING THE DAY AND 55°F AT NIGHT IN THE WINTER AND 73°F OR HIGHER IN THE SUMMER.

THESE ARE ONLY TWO OF 65 WAYS TO SAVE NATURAL GAS PRESENTED HERE (AND THERE IS SOME SPACE AT THE BACK OF THIS BOOKLET FOR YOU TO ADD YOUR OWN, TOO). TRY THEM AND SEE HOW USING LESS GAS AFFECTS YOUR UTILITY BILL.

NATURALLY, IF PRICES FOR NATURAL GAS INCREASE, ONE WAY TO SAVE MONEY ON YOUR GAS BILL IS TO USE LESS GAS. YOUR UTILITY BILLS MAY NOT GET SMALLER, BUT THEY WILL NOT BE AS LARGE AS IF YOU DID NOT CONSERVE.

EVEN IF PRICES INCREASE, YOU CAN SEE THE EFFECT OF CONSERVATION MEASURES ON YOUR GAS BILL BY COMPARING THE NUMBER OF "THERMS" YOU USE NOW TO THE NUMBER YOU USED LAST YEAR.

BE CREATIVE AND PERSEVERE, BECAUSE YOUR CONSERVATION MEASURES WILL SAVE YOU MONEY IN THE LONG RUN AND HELP THE COUNTRY STRETCH OUT ITS SUPPLIES OF NATURAL GAS.

Energy Hotline . . . 1-800-292-4704

HEATING

1. Check your attic to see if your home needs insulation.
2. Contact an insulation dealer, your local building inspector, or your county extension service agent if you need advice about insulation.
3. Buy attic insulation by R-value, not by thickness. Recommended R-values are R-26 to R-38, regardless of the type.
4. Insulate floors over unheated spaces, such as garages and crawl spaces.
5. Insulate, or increase the insulation, in your attic or top floor ceiling to at least R-26.
6. Insulate your exterior walls if you live in a very hot or very cold climate. Call in a contractor for this service.
7. Caulk and weatherstrip doors and windows to reduce fuel use.
8. Install storm windows: combination screen and storm, single-pane storm, or clear plastic film taped or stapled to the window frame.
9. Add storm doors to your house if you live in a very hot or very cold climate.
10. Lower thermostat settings to 65°F during the day and 55°F at night. Dress warmly if you are cold.
11. Let the sun shine in during the day to warm the house; close draperies and shades at night to hold in the heat.
12. Ask your gas utility or Michigan's Energy Clearinghouse about the savings potential of conservation devices for gas furnace.
13. Have your furnace checked once a year to make sure it is as efficient as possible.
14. Ask your gas utility how to turn off the furnace pilot light during the summer; make sure you turn it back on when cold weather comes.
15. If you are buying as gas furnace, look for one that has an automatic flue damper to reduce heat loss when the furnace is off.
16. Do not set the thermostat at a warmer setting than normal when you first turn the heat up; the house will not warm up faster.
17. Clean and replace the filter in your forced-air heating system about once a month for better system efficiency.
18. Check the ductwork for a forced-air system, especially at connection points. Fix leaks with duct tape or caulking.

HEATING (CON'T.)

19. Do not heat rooms that you are not using; close them off and save energy.

20. Close your fireplace damper when you are not using the fireplace so that warm room air does not escape up the chimney.

21. Install glass doors on your fireplace to reduce heat loss up the chimney. You can still enjoy the fire's warmth.

HEATING WATER

22. Do not waste hot water by letting faucets drip or by running water needlessly.

23. Install flow restrictors in your showers to reduce hot water flow to about three gallons per minute.

24. Install aerators or spray heads in hot water taps to reduce the flow.

25. Do as much household cleaning as possible with cold water.

26. Use cold water rather than hot to operate your sink garbage disposer.

27. Make sure the temperature in your gas water heater is no more than 120°F (140°F if you have a dishwasher).

28. Buy a water heater that has thick insulation on the shell, or...add insulation to the outside of your present water heater.

29. Insulate your hot water pipes if they are not adequately insulated where they pass through unheated areas.

30. Flush out the bottom of your water heater about once a month to reduce sediment build-up that lowers heating efficiency.

31. Be sure your dishwasher and washing machine are full (but not overloaded) when you turn them on.

32. Do not use the rinse-hold feature if you have one on your dishwasher.

33. Buy a dishwasher that has an air-power or overnight-dry setting or both.

34. Let the dishes in your dishwasher air dry by turning it off and by opening the doors at the beginning of the drying cycle.

35. Wash clothes in warm or cold water as much as possible and rinse them in cold water.

HOMES APPLIANCES

36. Remove clothes from your clothes dryer as soon as they are dry; fill, but do not overload your dryer.

37. Keep your refrigerator at 38°--40°F for the fresh food compartment, 5°F for the freezer compartment.

38. Keep the temperature in a separate freezer at 0°F for long-term storage of food.

39. Make sure the seals on the refigerator and the freezer are airtight. If they are not, replace the gaskets.

40. Defrost manual-defrost refrigerators and freezers before the frost builds up to more than one-quarter of an inch.

41. If you buy a self-defrosting refrigerator or freezer, buy one that has a power saver switch to turn off the defroster's heating element.

42. Turn off decorative gaslights or replace them with electric ones.

COOKING

43. Buy energy-efficient appliances and keep them in good working order. Do not leave them running when they are not in use.

44. If you are buying a new gas oven or range, look for one that has an electronic igniter instead of a pilot light.

45. Make sure the pilot lights burn with a blue flame for maximum efficiency. A yellow flame means an adjustment is needed.

46. Use lids on pots and pans for faster cooking time and less energy use.

47. Adjust burner flames to the pan size so that you do not heat the air around the pan.

48. Plan your meals so that your oven is filled every time you use it.

49. Keep top range burners and heat reflectors clean.

COOLING

50. Install a whole-house ventilating fan in your attic or upstairs window to draw cool air from the outside through your home.

51. Use a ventilating fan when the temperature is 82°F or below to cut down on air-conditioning use.

COOLING (CON'T.)

52. Set the thermostat for your air-conditioner at 78°F or higher and dress for the warmer temperature.

53. Do not set the thermostat at a cooler setting than normal when you first turn your air-conditioner on; it will not cool faster.

54. In humid weather, the "low" fan speed on your window air-conditioner removes moisture more efficiently than the "high" setting.

55. Turn off your room air-conditioner when you leave a room for several hours.

56. Keep lights low or off during the day to keep heat build-up at a minimum.

57. Place lamps and TV sets away from air-conditioner thermostat. Their warmth triggers more cooling than necessary.

58. Buy the smallest, least powerful air-conditioner you need to cool the space you have for the climate in which you live.

59. Clean or replace the air-conditioner filters at least once a month so that cool air can flow better through your home.

60. Insulate ductwork in your air-conditioning system, especially ducts passing through the attic or uncooled areas, to prevent cooling loss.

61. Draw shades or draperies during the day to keep the house cool naturally; use awnings for the same reason.

62. Cook and use other heat-generating appliances in the early morning or late evening to help keep the house cooler.

63. Close off rooms that are not in use to avoid wasting energy to cool them.

64. Never run the air-conditioner when windows or outside doors are open.

65. Use the kitchen, bath, and other ventilating fans sparingly if your air-conditioner is on so that cooled air is not blown away.

DID YOU KNOW . . .

If 10 million gas-heated homes with inadequate insulation were properly upgraded, we would save about 300 billion cubic feet of natural gas each year, or about 8% of the total demand for natural gas for home heating.

If every gas-heated home were properly caulked and weatherstripped, we would save enough natural gas each year to heat almost 4 million homes.

If you reduce the setting on your gas hot water heater from high (140°F) to normal (120°F), you could reduce the gas it uses by 18%.

If you buy a gas oven or range having an electronic igniter system, you could cut the amount of gas used by your oven by 47% and the gas used by the top burners by about 53%.

If storm windows and doors were added to 10 million of the gas-heated homes that need them, we would save enough natural gas to heat another 1.6 million homes.

If heating temperatures in every gas-heated home were lowered 6 degrees, the gas saved could be used to heat an additional 4 million homes in winter.

If you do not use the rinse-hold feature on your dishwasher, you could save 3 to 7 gallons of hot water every time you wash dishes.

If you turn off just one decorative gaslight, you could save $40--$50 a year.

Eight gaslights burning all the time use as much gas as it takes to heat a whole house for a winter heating season.

If you fix a faucet that is leaking a drop every second, you could save as much as 60 gallons of hot (or cold) water a week.

If you insulate in your attic or top floor ceiling to at least R-26, you could save 5 to 30% a year on heating and cooling.

If you insulate floors over unheated spaces, you could save about 8% on heating and cooling costs.

If you live in a very hot or very cold climate and you insulate your exterior walls, you could save 16 to 20% a year on heating and cooling.

If you lower thermostat settings to 65°F during the day and 55°F at night, you could save about 3% of your fuel costs for every degree you reduce the average temperature in your home for a 24-hour period, or about 1% for each eight hour, one-degree set back.

If you have your gas furnace properly adjusted, you could save up to 14% in heating fuel use.

If you raise the average temperature in your home by 6°F, you could save between 12 and 47 percent in cooling costs, depending on the length of your cooling season and the air-tightness of your home.

The Energy Administration Clearinghouse has more than 250 free Publications about energy conservation and renewable resources. If you need further information or have additional questions, please contact the Energy Clearinghouse.

Thank you for your interest and concern for Michigan's Energy Future.

Energy Extension Service

ENERGY ADMINISTRATION
MICHIGAN DEPARTMENT OF COMMERCE

WHO WE ARE . . . AND WHAT WE DO

The Energy Extension Service Clearinghouse operates an information service which is available to all Michigan residents — a toll-free ENERGY HOTLINE.

A division of the Energy Administration/Michigan Department of Commerce, the Energy Extension Service is supported by a grant from the U.S. Department of Energy. The EES Clearinghouse has a variety of energy information and materials about conservation, renewable resources (solar, wind, water, etc.), new technologies, and community and financial assistance.

The EES Clearinghouse staff is 'on-call' to help Michigan residents with many kinds of energy questions. For example, we currently have over 200 different publications available to interested citizens, including:

- Which Fuel to Choose (#93)
- Conservation Dollars (#229)
- The Energy-wise Home-buyer (#55)
- Do-It-Yourself Insulation Packet (#32)
- Wood Packet (#42)
- Conservation Packet (#41)
- Solar Energy Packet (#33)

Single copies of these items and a complete list of energy information can be requested by calling the . . .

energy hotline 1-800-292-4704

or by writing the . . .

Energy Extension Service Clearinghouse
Energy Administration/
Michigan Department of Commerce
P.O. Box 30228
Lansing, MI 48909

Please feel free to call or write the EES Clearinghouse staff with any energy questions, requests, or ideas that you may have. We look forward to hearing from you.

WANT TO SEE YOUR

THERMOGRAM ?

Although you may have missed the opportunity to see the heat-loss picture (thermogram) of your home last Fall, you can still see it.

Schedule of dates, times, and location

January 26 7:30 pm .... Loutit Library (lower level)

February 23 7:30 pm ...... Loutit Library (lower level)

March 23 7:30 pm .... Loutit Library (lower level)

April 27 7:30 pm .... Loutit Library (lower level)

May 25 7:30 pm .... Loutit Library (lower level)

We hope to see you there!

GRAND HAVEN ENERGY CONSERVATION ORGANIZATION

Appendix J

Workshop Comments

WORKSHOP COMMENTS

Your comments on this workshop will help us improve it. Please rate the usefulness of each workshop station shown below. Indicate your rating by circling one of the five numbers.

	VERY USEFUL		SOMEWHAT USEFUL		NOT USEFUL
1. The station on FOUNDATION INSULATION:	1	2	3	4	5
2. The station on WINDOW AND DOOR MODIFICATIONS:	1	2	3	4	5
3. The station on CAULKING AND WEATHERSTRIPPING:	1	2	3	4	5

During the next six (6) months do you think you will do some of the actions shown at the workshop stations? Please circle one answer for each of the areas listed. Any other comments are also welcomed.

4. Are you planning to do some FOUNDATION INSULATION?

   Definitely Yes   Probably Yes   No   Comments: ______________________

5. Are you planning to do some WINDOW AND DOOR MODIFICATIONS?

   Definitely Yes   Probably Yes   No   Comments: ______________________

6. Are you planning to do some CAULKING AND WEATHERSTRIPPING?

   Definitely Yes   Probably Yes   No   Comments: ______________________

If you have any other comments or ideas you would like to share please do so in the space provided below:

____

____

____

____

____

____

____

Thank you.

Appendix K

Telephone Script

TELEPHONE SCRIPT

A Hello, this is_____________. I am calling to let you know that the Grand Haven Energy Conservation Organization (the group that put on the "thermogram" meetings) is mailing out additional energy conservation information to a few of the people who attended the meetings back in September, October, and November last year. Do you recall the meeting you went to? I see from our list that you went to the meeting at ___________ school. (Brief discussion).

B Anyway, I will send you this packet of additional information including short publications on different things you can do with window treatments, foundation insulation and how to find and fix places where home heat can leak out. These are all pretty low cost options. And, all the publications are free.

C We also thought you might like to know that 30 percent of the city turned out to those meetings. There was a lot of interest but not everybody had a chance to see the thermogram of their house. In case you know somebody who would like to see their thermogram, I'll include a couple of cards showing when they can come in to see them over at the Loutit Library.

D Well, I'll send you that information today. We are sending out a sample of this type of information to just a few people who attended the thermogram meetings to see how useful it is. Next summer we plan to call people who receive this additional information and ask them about the usefulness of it. This telephone call will be brief and confidential.

E Oh yes, if you want to know how useful the information was to others who get these additional items, we will be glad to send you a copy of the results.

F Well, I guess that's it -- if you have any questions, our number is 842-3210. I hope the information will be helpful.

Thank you.

Bye.

Appendix L

Condition Two Cover Letter

February 6, 1982

Dear Energy Conscious Resident:

Enclosed is the information packet which we promised to send you, as well as a schedule of ECO thermogram meetings. Please share the schedule with friends and neighbors who would still like to see infrared pictures of their homes.

The enclosed postage prepaid card will give ECO permission to release written information concerning how you saved energy. If you would be willing to share this kind of information or if you could help with some aspect of Grand Haven's ECO program, please sign this card, make a note and put it in the return mail.

Sincerely,

Jerry Brochu, Chairman

Enclosure

WANT TO SEE YOUR

THERMOGRAM ?

Although you may have missed the opportunity to see the heat-loss picture (thermogram) of your home last Fall, you can still see it.

Schedule of dates, times, and location

January 26 7:30 pm .... Loutit Library (lower level)

February 23 7:30 pm ...... Loutit Library (lower level)

March 23 7:30 pm .... Loutit Library (lower level)

April 27 7:30 pm .... Loutit Library (lower level)

May 25 7:30 pm .... Loutit Library (lower level)

We hope to see you there!

GRAND HAVEN ENERGY CONSERVATION ORGANIZATION

Appendix M

Telephone Checksheet

TELEPHONE CHECKSHEET

Page _____ of ______

Contact No.	Date	Time	Paragraph Covered						Notes/Comments
			A	B	C	D	E	F	

Appendix N

Residential Telephone Survey

DO NOT WRITE IN THIS AREA

NAME:

SURVEY NUMBER:

(enter survey number)

(MANIPULATION CHECK AND IMPORTANCE)

There were quite a few energy related events last ( ). I would like to ask you about your participation in them and also ask you how important each was in helping you to take conservation actions. The rating scale for importance of each event to you is from 1 to 5 with 1 being "very important" to 5 being "not at all important."

1\. Page number

1\. Do you remember going to one of the thermogram meetings last ( )? YES=1 NO=2

2\. (If "yes") How important was that thermogram meeting in helping you to take conservation actions?
1=very impt 2=important 3=not sure 4=not impt 5=not at all impt

3\. Did you go to the Energy Fair at the ( ) last ( )? YES = 1 NO = 2

4\. (If "yes") How important was the Energy Fair in helping you to take conservation actions?
1=very impt 2=important 3=not sure 4=not impt 5=not at all impt

(C.1 ONLY) 5. Do you recall going to a home weatherization workshop in February or March of this year? YES = 1 NO =2

6\. (If "yes") How important was that workshop in helping you to take conservation actions?
1=very impt 2=important 3=not sure 4=not impt 5=not at all impt

(C.2 ONLY) 7. Do you recall getting an additional mailing of energy conservation literature in February or March of this year? YES = 1 NO = 2

8\. (If "yes") How important was that extra energy conservation literature in helping you to take conservation actions?
1=very impt 2=important 3=not sure 4=not impt 5=not at all impt

9\. Have you signed up for a ( ) RCS (Residential Conservation Service) Home Energy Analysis? YES = 1 NO = 2

10\. (If "yes") Has the Home Energy Analysis been done on your residence? YES = 1 NO = 2

11\. (If "yes") How important was the Home Energy Analysis in helping you to take energy conservation actions?
1=very impt 2=important 3=not sure 4=not impt 5=not at all impt

12\. (If "yes") Which month did they do the Home Energy Analysis? (PROMPT: Was it before or after Thanksgiving, Xmas, Easter, etc.)
Month_____ Year_____ ENTER 2 DIGIT CODE

DO NOT WRITE IN THIS AREA

13. Have you ever called the toll-free Energy Hotline number?
YES = 1 NO =2

14. (If "yes") Which month did you call?_______ MONTH
(PROMPT: Was it before or after Thanksgiving, 4th of July, Easter, etc.?) Use 2 digit month/yr. code

(KNOWLEDGE)

15. On a scale of 1 to 10, with 10 being the highest, how would you rate your own knowledge of how to save energy?
_____ rating

16. Do you feel your knowledge in this area has improved as a result of the thermogram meeting? ALLOW OPEN-ENDED RESPONSE, DO NOT PROMPT.
1=Yes, a great deal 2=Yes, somewhat 3=Not sure 4=No

(CONSERVATION ACTIONS)

Next, I will ask about some of the things which you may have done to conserve on energy costs in your residence or in your driving habits. If any of these actions have been done or you plan to do them, I will ask a brief question or two about each of them. This will help us estimate how much energy might be saved. REFER TO ACTION MATRIX BASIC SCRIPT.

	BEFORE THERMOGRAM		AFTER THERMOGRAM		PLAN TO DO	
Date of meeting	date mo/yr	amount	date mo/yr	amount	date mo/yr	amount
Insulated Attic		___ inches		___ inches		___ inches
Insulated walls (above ground)						
Insulated Foundation (above ground)						
Installed storm windows and doors		___ number		___ number		___ number
Install Insulated window coverings		___ number		___ number		___ number
Caulked and sealed Outside cracks						

DO NOT WRITE IN THIS AREA

NAME: ______________________________

SURVEY NUMBER: ____________________

(enter survey number)

(Action Matrix Cont.)	BEFORE THERMOGRAM		AFTER THERMOGRAM		PLAN TO DO	
Date of meeting	date mo/yr	amount	date mo/yr	amount	date mo/yr	amount
Weatherstripped Doors and Windows		number		number		number
Set Back Thermostat		to		to		to
Installed Clock Thermostat		sets back to		sets back to		sets back to
Reduced Home Lighting						
Closed Off Unused Rooms		of rms		of rms		of rms
Reduced Hot Water Usage						
Turned Down Hot Water Temp.		to		to		to
Insulated Water Heater						
Had Furnace Tune-Up						
Derated (downsized) Furnace						
Installed Flue Damper						

DO NOT WRITE IN THIS AREA

(ACTION MATRIX CONT.)

	BEFORE THERMOGRAM		AFTER THERMOGRAM		PLAN TO DO	
Date of meeting	date mo/yr	amount	date mo/yr	amount	date mo/yr	amount
Switched to main wood heat		___%		___%		___%
Installed solar space heat		sq.ft of panels		sq.ft. of panels		sq.ft. of panels
Reduced use of car						
Switched to economy car						
Used carpool/ mass transit						
Other						

(RESIDENCE CHARACTERISTICS)

The next few questions are some basics on the type of residence you have. Your answers will help us estimate about how much energy you may be saving

17. Do you own or rent your residence?

← 1=Rent 2=Own

18. Do you pay heating bills?

← 1=Yes 2=No

19. What is your main space heating fuel?

← 1=Natural Gas 2=Fuel oil 3=Wood 4=Coal 5=Electric 6=Propane 7=Solar 8=Don't know

20. Is your water heater gas or electric?

← 1=Natural Gas 2=Electric 3=Other

DO NOT WRITE IN THIS AREA

NAME: ____________________

SURVEY NUMBER: ____________________

(enter survey number)

Page number 3 3

(RESIDENCE CHARACTERISTICS CONT.)

21. How many stories does your residence have_____?
1=1-1.5 stories 2=2-2.5 stories 3=3-3.5 stories
4=4-4.5 stories

22. What type of siding material is installed on your residence?
1=wood 2=masonary 3=aluminum 4=vinyl 5=other

23. In the winter what thermostat setting do you use during the day?
_____degrees farenheit (f)

24. In the winter what thermostat setting do you use during the night?
_____degrees farenheit (f)

25. How many bedrooms are there in your residence
_____(number)

26. If you know it, what is the approximate heated square footage of your residence?
_____don't know = 9999 _____square feet

27. Have you added to or removed any heated space at your residence in the last two years?

1=added 2=removed 3=nothing added or removed

28. (IF added or removed) About what month was the change made?

________(PROMPT: Was it before or after Thanksgiving,
(month)(year) Xmas, Easter?)

(NOTE: Use same 2 digit code as for item 12)

DO NOT WRITE IN THIS AREA

29. Can you recall any events, such as long vacations or illness which might have changed how much you heated your house? (Write response verbatim, including approximate date (month/year or season/year).

____

____

____

____

_______________________ Yes, Response=1 No Response=2

30. Including yourself how many people live in your residence?

_______________ (number)

31. How many members of your household, including yourself, work outside the home 30 hours or more per week?

_______________ (number).

(MULTIPLIERS)

The next four questions are about energy conservation business in ( ) during the last year ( ).

32. About what percentage of the materials and services you purchased to do energy conservation at home were purchased in ( )?

_______________ Percent

33. Roughly, how much did you spend this last year on the conservation measures you mentioned?

_______________ Dollars

34. Have you taken out a loan for any of the energy conservation projects since ( )?

1=Yes 2=No

35. (If "yes") Where?

1=Local bank/financial institution 3=Utility company

2=Nonlocal financial institution 4=Investment source

5=Assistance program

DO NOT WRITE IN THIS AREA

NAME: ____________________

SURVEY NUMBER: ______________

(enter survey number)

(BARRIERS TO CONSERVATION) Page number 4

Now, I'm going to read a list of reasons which may have kept you from taking conservation actions. Please answer by telling me if you strongly agree, agree, are undecided, disagree or strongly disagree with each statement.

36. The cost of energy saving measures has kept me from taking conservation actions.
1 2 3 4 5
SA A U D SD

37. The amount of time a conservation action will take to pay for itself in energy savings has kept me from taking conservation actions.
SA A U D SD

38. Not knowing what to do first has kept me from taking conservation actions. SA A U D SD

39. The difficulty in selecting or buying the right conservation materials has kept me from taking conservation actions.
SA A U D SD

40. Not knowing how to do the conservation actions myself has kept me from taking conservation actions.
SA A U D SD

41. Problems with obtaining a loan has kept me from taking conservation actions. SA A U D SD

42. Uncertainty about how long I will stay at my present residence has kept me from taking conservation action.
SA A U D SD

43. Concern for the comfort of household members has kept me from taking conservation actions.
SA A U D SD

44. The amount of work required has kept me from taking conservation actions.
SA A U D SD

45. The cooperation required from family members has kept me from taking conservation actions.
SA A U D SD

46. The way the house is built has kept me from taking conservation actions.
SA A U D SD

DO NOT WRITE IN THIS AREA

(ENERGY CONSERVATION ATTITUDES)

Now I would like to ask your opinion about several statements please answer by telling me if you STRONGLY AGREE, AGREE, ARE UNDECIDED, DISAGREE OR STRONGLY DISAGREE with each statement.

47. The effort made by individuals to conserve energy can have a major impact on our energy problems 1 2 3 4 5
SA A U D SD

48. I favor conserving energy rather than building more power plants SA A U D SD

49. The government should spend a larger portion of their present budget on energy conservation
SA A U D SD

50. I am more favorable toward environmental protection than the average person SA A U D SD

51. I am the type of person who tries out a new product or activity before my friends or neighbors do.
SA A U D SD

52. Even if I knew I would never recover all of the money I spent on home energy conservation, I would still spend it
SA A U D SD

53. I encourage other persons to do more home energy conservation.
SA A U D SD

54. The government needs to promote stronger regulations to encourage energy conservation. SA A U D SD

55. Government should stay out of the picture and let the free market find the best solution to our energy problem.
SA A U D SD

56. The world wide energy shortage is real.
SA A U D SD

57. The energy crisis is more of an oil company hoax than anything else SA A U D SD

58. Long term adjustments must be made by Americans to adopt an energy efficient lifestyle
SA A U D SD

(DEMOGRAPHICS) TURN TO LAST PAGE - RECORD ANSWERS AFTER INTERVIEW IN APPROPRIATE SPACE BELOW.

59. Age__________

60. Education__________

61. Income__________

62. Income Change__________

63. Sex__________

Appendix O

Comments and Ideas, As Solicited on Workshop Comments

Appendix O

Comments and Ideas, As Solicited on the Workshop Comments Instrument

*I am building a system for solar hot water. After this change, in about 4 to 6 months, I plan to start other things.

*Would like more information.

*I would have liked to see installation of weatherproofing fully exposed basement walls (walkouts) and remodeling ideas as far as insulation of existing upstairs walls (plastered, etc.). Excellent demo--Thank You!!

*Well run. --Like to see more of these workshops and similar things done by the community.

*I used 1/8 inch plexiglass sheets for basement storm windows.

*Would like more information on older home with crawl space.

*Excellent idea! I'd like to attend another workshop!

*Article in Detroit Free Press stated that you shouldn't leave your storm window up on a south facing storm door because if the inside door is completely sealed and the widow is up, moisture can form in between and warp both door frames.

*This was really worthwhile.

*Thank you!

*Thanks, hope more people can do this.

*Didn't show how to weatherstrip or caulk windows, just did doors.

*Very good--in areas covered.

*Would like to have observed caulking and window weatherstripping.

*This program is excellent. My major concern has been basement and bedroom windows.

*Fine workshop!

*Good ideas--Some I wouldn't have thought of.

*Excellent program. Persons were knowledgable and willing to assist.

*(The presentor) did not know prices or availability of materials needed for doing the job.

*More time would be needed at each stop to actually do the work, even in a group of only eight people.

*Workshop very good.

*Best result was when placed an extra insulation blanket in the attic.

*I thought the workshop was very useful for me because I have a very old house and am just learning how to accomplish some of the things I want to do.

*Would like information on weatherstripping large double entrance doors--between doors.

*Thank You.

*Very helpful in my future plans.

*Good ideas. Informative. Helpful suggestions.

*I feel it was very worthwhile and although there wasn't enough time to get involved with everything, your prepared displays assisted in making the demonstrations more meaningful. A real fine program.

*Workshop where, for the cost of material plus fee, would actually supervise the making of window panels, quilts etc. would be helpful (and pop in frames for basement). I hope I can follow the instructions. I can't always. Very worthwhile experience!

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