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AUTOMATED ENERGY MANAGEMENT SYSTEMS FOR SMALL BUILDINGS

FINAL REPORT

VOLUME II - MARKET ASSESSMENT REPORTS,
PHASE I AND II

August 1978

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for
BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
UPTON, NEW YORK 11973

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Division of Buildings and Community Systems

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Minneapolis, MN 55413

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**AUTOMATED ENERGY MANAGEMENT
SYSTEMS FOR SMALL BUILDINGS**

PHASE ONE: FOCUS GROUP REPORT

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EXECUTIVE SUMMARY

Marketec, Inc., as part of a Honeywell research project sponsored by the Department of Energy (DOE), studied the major marketing influences affecting purchasing decisions for a new product concept--an Automated Energy Management System (AEMS). The first part of this study, designated Phase One, deals with four broad assessments of market need for an AEMS within the market segment generally defined as small buildings (75,000 square feet or less). Thus, determinations were made, using carefully selected focus groups, of the following issues: (1) market perception of the market segment in particular; (2) attitudinal statements concerning the solution of these problems; (3) current and projected energy-saving practices by the respondents from the market segment; and (4) an estimate of market potential of an AEMS from an analysis of the focus groups. The second phase of this investigation will deal with larger national samplings from the same market segments and will use a questionnaire technique.

METHODOLOGY

Three small building sectors were chosen to represent the total small building market: (1) apartments, (2) schools, and (3) offices. In the aggregate, these three sectors represent 50 per cent or more of the energy consumed, square footage, and number of buildings of that total market.

In examining alternative strategies for the market research, a focus group design was selected for the following reasons. First, the qualifications of the respondents would be clear and offer the degree of precision that small sample research requires. Secondly, the "open-ended" format of a focus group would provide new insights into market issues as well as comparable answers to issues already defined. Finally, the information gained from the focus group effort would serve as firm guidance for the breadth required for Phase Two of the program.

Focus group discussions were held in four cities (Minneapolis, Los Angeles, Atlanta, and Boston) with purchasing influences in each of the three sectors. Two criteria were used in inviting the 32 focus group respondents: (1) that they be related to the purchasing process in the energy conservation area, and (2) that they have some technical understanding of energy-saving hardware. Each focus group was 3½ to 4 hours long and required the active involvement of the respondents.

FINDINGS

In general all focus group respondents perceived the energy conservation problem as severe nationally and within their sector. Moreover, most respondents reported considering a number of inter-related factors when determining the best possible ways to solve their energy conservation problems. These factors were grouped into five categories: (a) economic, (b) technical, (c) regulatory, (d) psychological and (e) general.

Economic considerations included the availability of capital and the requirement of a specific payback period related to the purchase of energy-saving equipment. Technical factors generally referred to matching the appropriate energy saving equipment to the specific buildings under consideration and demonstrating that such equipment will actually save energy and money in these buildings. Diverse local regulations and codes (e.g., temperature and ventilation requirements) also were reported to affect purchase decisions. The human elements also were described as considerable, especially the willingness of building tenants to go along with energy-saving programs, their frequently negative reactions to such programs, and the lack of technical sophistication and know-how of building maintenance personnel. Furthermore, a number of general factors were identified as influencing these individuals--for example, a lack of understanding of a wide range of potential solutions to energy conservation problems.

Most focus group respondents reported that aggressive energy-saving practices were currently being employed. These tended to be "first-stage," low-cost practices: the implementation of procedural changes (e.g., turning off lights) and the installation of energy-saving devices (e.g., a night-setback thermostat). Substantial energy and cost savings reportedly have been realized by these practices. Respondents relied on technical and experiential sources of information when planning future energy conservation programs. Technical data comes from trade journals (which provide objective, impartial reports) and manufacturers (who provide the hardware solutions to identified problems). Colleagues and co-workers provide important experiential data based on first-hand experience and knowledge.

The installation of an AEMS was not viewed by most respondents as an effective method of conserving energy at the present time. Although many respondents agreed that an AEMS would be helpful in newer or larger buildings, generally speaking such a system was not viewed as being necessary (given that substantial savings are currently being realized), too costly (given that money is tight), and/or not suited to many of their buildings (given that many buildings are too old and/or too small to efficiently use an AEMS).

Negative economic factors facing these building sectors were identified as the most pressing constraints. The private sector (offices and apartments) differs from the public sector (schools) in how money is obtained and spent; but the overall economic pressures, combined with the perception of other energy-saving practices being effective, militate against an AEMS's being viewed as a desirable or necessary energy conservation step at the present time.

CONCLUSIONS AND RECOMMENDATIONS

The results of this phase of the investigation show that the three building segments can be arrayed from high to low, in terms of market potential, as follows: offices, schools, and apartments.

Offices are knowledgeable regarding the potential effectiveness of such a system, capable of securing the needed monies for the expenditure, and sophisticated regarding investment and purchasing procedures. The school sector, while generally knowledgeable regarding an AEMS, has difficulty in anticipating the need for and actually securing necessary capital. Apartments are characterized by great variability in building age, size, and, therefore, perceived need for an AEMS, as well as a lack of available capital and a thorough understanding of an AEMS and its potential effectiveness.

More broadly, small buildings may represent a viable market for an AEMS--but not right now. Two questions left unanswered are: "When should an attempt be made to market such a system on a broad scale?" and "How should the market be prepared (educated) for acceptance of an AEMS?" It seems reasonable to assume that individuals will continue to conserve energy in the low-cost or no-cost ways previously described until the fullest amount of energy- and cost-savings are realized. It seems equally reasonable to assume that, once this point is reached, energy shortages will still occur and energy costs will still be rising. It is at that time that large-scale marketing of an AEMS may be the most successful, if an antecedent or concurrent market preparation has occurred.

A more immediate question remains, however: "What is the potential AEMS market for the near future?" Marketing strategies need to address the following issues: (1) the lack of public awareness as to the severity of the energy shortage and energy conservation problems in the country and within building sectors; (2) the need for an objective, impartial demonstration that an AEMS will save both money and energy; and (3) the fact that the marketplace is currently faced with severe economic constraints. Federal and State governments as well as manufacturers of energy-saving hardware can assume positions of aggressive leadership in

these areas. Specifically, the following strategies regarding the penetration of the small building market are suggested:

1. Encourage and/or provide an easily administered analytical technique for individual buildings to determine their exact energy conservation and energy management needs and potential solutions.
2. Identify and work with those sources of information on energy conservation deemed by the users to be most influential.
3. Encourage development of an energy management system which requires the lowest possible initial investment.
4. Continue and intensify energy education programs directed to building tenants.
5. Encourage energy management systems design to emphasize operational simplicity.
6. Design energy management systems to address important features, e.g., comfort and lighting controls, and avoid unimportant system features, e.g., fire and burglar alarms.
7. Encourage the development of specific marketing strategies for different market segments.
8. Consider national or regional demonstrations of energy management system effectiveness.

Phase I determined those market issues which were generally agreed upon by the respondents. Pointed purchase-related issues were not agreed upon and required a larger sample survey to more fully understand them. Phase II of the study has been undertaken to answer these questions. A questionnaire has been sent to approximately 5,800 representatives of the three targeted buildings types; a copy of that questionnaire can be found in Appendix D.

INTRODUCTION

The energy problems our country currently faces are well-known and well-documented. The most visible energy-related problem is the shortage--both current and projected--of energy resources. Clearly one way to avert--or at least delay--the onset of a major energy crisis is to better conserve and better manage the resources we currently have. The curtailment of excesses in energy consumption may well be only a short-range solution to the total energy problem, but to experts in the field it is a necessary, if not sufficient, step.

Conventional technology is available to implement a variety of energy conservation functions. One such method is a single system capable of performing several energy-saving functions. In this report we will refer to such a system as an automated energy management system or AEMS. Prior to the final development and sales of AEMS, however, industry needs answers to some key business questions. The largest market for such a system appears to be the small building (under 75,000 square feet) market. The preponderance of this building type and the projected energy savings that could result from AEMS use are primary reasons for the importance of this segment. Yet, relatively little is known about what this market is currently doing to save energy, and there exists a need to determine the nature of energy conservation and energy management practices and problems faced by owners and managers of small buildings and possible ways to solve those problems.

To help provide a greater understanding of these issues, Marketec, Inc. was placed under contract by the Energy Resources Center of Honeywell Inc. to conduct the "Automated Energy Management Systems for Small Buildings Study." The specific problem statement from this contract is reproduced here:

"This study will describe potential market demand characteristics for automated energy management systems in three small

building types: apartment buildings (residential), school buildings (educational), and office buildings (commercial)."

The findings set forth in this report represent the first phase of the overall work to be performed by Marketec, Inc. Data are presented from in-depth focus group discussions involving persons who represent buying influences in each of the targeted small building types in four geographical regions of the United States. The second phase of the study--discussed later in this report--will examine those areas which require further clarification based on the results of Phase I.

RESEARCH METHODOLOGY

Conceptual Framework of the Study

This study was designed to determine (1) the energy conservation and energy management needs of the targeted small building sectors, and (2) the most effective--technically and economically--means by which those needs could be met. Of specific concern was the role an AEMS could or does play in meeting the identified needs. The focus group technique was used so that the investigators could observe the process by which individuals in each building sector make decisions about their energy conservation problems. The investigative team, in conjunction with Honeywell, believed that an important first step was a determination of the respondent's attitude toward the energy crisis. Thus, the decision-making process depends on individual judgments of the severity of the energy conservation problem--throughout the nation and in each respondent's particular building sector.

Once these judgments are known and expressed, the elements of the decision-making process itself can be studied. Four factors comprise this process: general influence factors, economic factors, purchasing factors, and technical factors. By viewing the research problem within this broad context, we may determine the energy conservation problems that prevail in each building sector, how those problems are solved, and why certain solutions are perceived to be better or worse than others. This overall view of the research problem is depicted in Table 1; a detailed description of each element is provided in the following section, "Research Objectives."

Table 1
Conceptual Framework of
The Study

Research Objectives

A number of specific research objectives emerged from the conceptualization of this study. These objectives are presented in Table 2, with a notation of the conceptual element to which each objective is related.

Table 2
Research Objectives

Research Objective

- Determine people's general attitudes toward the energy conservation problem in the nation.
- Determine people's specific attitudes toward the energy conservation problem in their building sector.
- Determine people's perceptions regarding the sources of solution to the energy conservation/management problem(s).
- Determine the accuracy of various sources of information regarding energy conservation/management.
- Determine the degree of influence of various sources of information regarding energy conservation/management.

Related Conceptual Element

Research Objective

- Determine the constraints to solving the energy conservation/management problem(s)/purchasing an automated energy management system.
- Determine the broad financial considerations made in planning to solve their energy conservation/management problem(s).
- Determine the most reasonable payback period regarding the purchase of an automated energy management system.
- Determine how much people are willing to spend regarding the purchase of an automated energy management system.

Related Conceptual Element

- Constraints

Decision-Making Process
to Solve Problems

Economic Factors

- General

- Payback

- Cost

Research Objective

- Determine the decision-making process regarding the purchase of an automated energy management system.
- Determine the decision-makers regarding the purchase of an automated energy management system.
- Determine people's perceptions regarding the methods of solution to the energy conservation/management problem(s).

Related Conceptual Element

Decision-Making Process
to Solve Problems

Purchasing Factors

- How

- Who

Decision-Making Process
to Solve Problems

Technical Factors

- Methods

Research Objective

- Determine people's current energy-saving practices.
- Determine people's projected energy-saving practices.
- Determine the essential elements of an automated energy management system.
- Determine the essential capabilities of an automated energy management system.
- Determine the essential functions of an automated energy management system.
- Determine the tradeoffs associated with the purchase of an automated energy management system.
- Determine the energy conservation/management needs of each building sector.

Related Conceptual Element

- Methods
- Methods
- Elements
- Capabilities
- Functions
- ALL ELEMENTS
- ALL ELEMENTS

Research Design

As noted previously, the total market research study was designed in two phases. Phase I explored energy conservation and energy management issues through focus-group discussions with representatives of the targeted building sectors in four geographic regions. Phase II will examine the identified issues in more depth and will employ a larger sample of respondents.

Samples: The Building Sectors

Prior work* had identified twenty-two different building types which comprise the total small building market. Of these twenty-two, three were chosen to represent that total market--apartment buildings, school buildings and office buildings. When grouped together, these three building sectors represent the majority of square footage, energy consumed, and number of buildings of the targeted market.

Samples: The Geographic Regions

Focus-group discussions were held in four cities across the United States: Minneapolis, Minn.; Los Angeles, Cal.; Atlanta, Ga.; and Boston, Mass. These sites were chosen to broaden the representational quality of the sample and to identify any special energy concerns or attitudes towards AEMS that were regional in origin.

Samples: The Participants

Focus-group participants were chosen based on two primary criteria: (1) that they be related to the purchasing process regarding energy

*Burns, N.M., Foster, S., and Sidley, N.A. National Existing Building Inventory, Minneapolis: Marketec, Inc., 1976.

management/saving devices and (2) that they have some technical knowledge and understanding of energy management/saving devices or systems. It was assumed that, in focus groups, these respondents would comment knowledgeably on marketing-specific issues (e.g., payback period, cost).

Table 3 presents the number of focus-group participants for the total study as broken down by building sector and geographical region. As the table shows, certain "cells" are not represented and in some cases the representation appears unbalanced. These conditions occurred as a result of "no-shows," although in all cases more respondents were invited to the seminar than were needed. The changing schedules of busy people and, in some cases, the weather contributed to the no-show rate.

Table 3
Number of Focus-Group Participants by
Building Sector and Geographical Region

	Apartments	Schools	Offices	Total
Minneapolis	2	4	5	11
Los Angeles	3	2	3	8
Atlanta	-	5	2	7
Boston	2	-	4	6
Total	7	11	14	32

The 32 individuals who did attend the focus-groups fully met the two selection criteria as previously described. A complete listing of the participants--broken down by building sector and geographical region--can be found in Appendix A. This listing gives each participant's name, title, company affiliation, and professional responsibilities and is presented to give the reader an indication of the breadth and depth of the participants.

An important sampling question of this study is: how may we generalize to a broader market segment the data collected from these 32 individuals? It should be noted that the purpose of conducting the focus-groups was to gather a set of data which addressed the inter-relationships of a number of energy-related issues. The energy conservation and energy management problems faced by the targeted building sectors are complex, and the focus-groups sought to refine that complexity, based on the perceptions, opinions and judgments of representatives of those sectors. Phase I was not designed to compile a massive data base on which statistical testing could be drawn. Rather, Phase I was designed to gather in-depth, albeit somewhat preliminary, data that reflected broad small building market concerns and opinions.

The data collected through the focus-group discussions may be generalized to that broad market to the degree that the individuals who attended the sessions are representative of buying influences in each building sector. It is the judgment of the author that the study's sample population is representative of the total population, and the data collected and recommendations set forth accurately reflect those broader market concerns.

Data Collection: The Focus Group Sessions

Each focus-group session was three to four hours long. These discussions were comprised of three separate activities: (1) the administration of the NASA Individual and Group Exercises, (2) the presentation of issue-specific viewgraphs, and (3) the administration of a short-form questionnaire. Copies of each activity's materials are presented in Appendix B.

The focus-groups were designed to have respondents within each building sector work together to solve common problems shared by that sector, where a response to a particular problem or issue would reflect the concerns of that sector as a group, not of each

respondent within that group. The concern was how respondents in the "apartment sector" (for example) felt about a particular issue, not how "Mr. A." in the apartment sector felt.

Participants were seated according to the building sector they represented--apartment sector participants sat together as a group, as did the individuals from the school and office building sectors. Placed before each participant's seat was a packet containing the working materials for the session--the same materials as contained in Appendix B.

After a brief introduction, the project director explained the purpose and structure of the day. The respondents then completed the NASA Individual Exercise, and afterward worked together on the NASA Group Exercise. The combined purpose of these two exercises was to generate group interest and energy and to establish a working structure and tone for the entire session, for the respondents were to work together as a group for most of the day.

After these activities were discussed, people were referred to the "Viewgraph Presentation" materials in their packets. Those materials consisted of fourteen different tasks for the groups to solve; each task had also been produced as a viewgraph transparency for presentation to the total group. Each viewgraph transparency was projected and read to the group, and respondents' questions were answered. Each building sector group was instructed to solve the task that was presented (e.g., for viewgraph slide #1, each group was to rate the severity of the energy conservation problem in the nation). A few minutes were allowed for each group

*It should be noted that viewgraphs #10, #13 and #14--tasks related to the decision-making process, payback period, and cost regarding energy-saving devices or an energy management system--were answered individually, not by each building sector group.

to arrive at a group rating or ranking for each task (except for those few cases where individual respondents were told to solve the task independently). Group consensus was sought; if groups were not able to reach consensus, this was noted and discussed. After each group had completed its rating or ranking, their rating or ranking was written on a flip-chart for all participants to see. The rationale for each group's decision was discussed, both by individual building sector and by all participants together; often the opinions and reasoning of one group spurred a response by another group. Following this discussion, the next viewgraph slide was put on the screen and the same process was followed.

Upon completion of all fourteen tasks, the participants were asked to fill out two paper-and-pencil forms: (1) a questionnaire asking for their current and projected energy-saving practices, and (2) a personal data sheet asking for their name, employment affiliation, and job responsibilities.

A court reporter who was present at each of the four focus-groups recorded all discussions that occurred in the focus group sessions. Conversation held among respondents within their respective building sector groups, in attempting to come up with a response to each task, were not recorded. The verbatim transcripts of each focus-group discussion are contained in Volumes II-V of this report.

THE FINDINGS: INDIVIDUAL SECTORS

Four areas of findings are discussed in the following pages: (1) individual building sectors by geographic region (e.g., the responses of the Minneapolis apartment sector); (2) individual building sectors across geographic regions (e.g., the responses of all apartment sectors); (3) total building sectors across geographical regions (e.g., the responses of all building sectors in all geographic locations); and (4) geographic differences as appropriate. Tabular data is presented with a summary profile relating that data to the information taken from the focus-group discussions. Geographic differences are highlighted in the appropriate summaries.

Individual Building Sector by Geographic Region: Apartment Buildings

Market Research Findings: Minneapolis Apartment Buildings

GENERAL PROBLEM	Severe
SPECIFIC PROBLEM	Severe
DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS	
● TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM	-Scientific Community -Manufacturers
● HIGHLY ACCURATE SOURCES OF INFORMATION	-Trade Journals (#1) -Trade Associations
● ACCURACY RATING OF MANUFACTURERS	-Medium
● LEAST ACCURATE SOURCE OF INFORMATION	-Attorneys

- HIGHLY INFLUENTIAL SOURCES OF INFORMATION
 - Bankers & Investors (#1)
 - Tax Consultants
 - Trade Journals
 - Trade Associations
 - Manufacturers
- INFLUENCE RATING OF MANUFACTURERS
 - High
- LEAST INFLUENTIAL SOURCE OF INFORMATION
 - Attorneys
- CONSTRAINTS
 - Economics
 - Available Capital
 - Investment Practices
 - Human
 - Tenants' Attitudes
 - Staff Efficiency
 - Technical
 - Building Age
 - Building Size
 - General
 - Lack of Product/Solution Awareness

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS
 - Availability of Capital 1
 - Length of Payback Period 2
 - Initial Cost of Devices/Systems 3
 - Tax Incentives 4
- MOST REASONABLE PAYBACK CRITERION
 - 1 Year *N = 1
 - 2 Years
 - 2.5 Years N = 1
 - 3 Years
 - 4 Years
 - 5 Years
 - Other
- AMOUNT WILLING TO SPEND
 - \$30,000+

*Ns refer to the number of individuals responding a certain way and do not represent the responses of the total building sector group.

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Ultimately the Owner Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS
 - Physical Plant Improvements 1
 - Energy-saving Devices 2
 - Procedural Changes 3
 - Energy Management Systems 4
- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEM
 - Payback
- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS
 - Saves Money (#1)
 - Saves Energy
 - Automated Control
 - Ease of Operation
 - Ease of Maintenance
 - Ease of Security
 - Ease of Problem Identification
 - On-site Monitoring
- LEAST IMPORTANT CAPABILITY OF AN AEMS
 - Off-site Monitoring
- TWO MOST IMPORTANT FUNCTIONS OF AN AEMS
 - Heating & Cooling Control
 - Lighting Control
- TWO LEAST IMPORTANT FUNCTIONS OF AN AEMS
 - Fire Alarm
 - Burglar Alarm

Market Research Findings: Minneapolis Apartment Buildings

The Minneapolis apartment focus group respondents described the nation's energy conservation problem as severe. Although respondents said they thought that more could be done to conserve energy and that economic constraints dictate what realis-

tically can be done, they do see some people doing some things to conserve energy.

These respondents have a similar perception regarding the energy conservation problem in their own building sector, noting that while steps are currently being taken to conserve energy, there are substantial personnel problems in implementing conservation. As one respondent described the problem:

"In our sector we try to use or do as much as we can to avoid people, use things that work without people, just because of the people factor. To me, we get a lot of turnover in residential apartment management. Other than training people, we have put in things trying to avoid the personal touch. Things that work automatically."

This sector has a particular set of energy conservation and energy management needs, due primarily to the great variance in the size and age of apartment buildings. When these people explore possible methods to solve their energy conservation problems, they consider physical plant improvements (e.g., insulation) first and the installation of an energy management system last. They feel such a system is not practical for a small building (e.g., not needed, too costly) and that they should "straighten up [their] own ship first"; i.e., make improvements to the existing physical plant or equipment.

When looking at other possible solutions, the respondents look toward the scientific community and manufacturers of energy-saving devices or systems. They see these two sources as identifying the problems apartment buildings face and creating the resources to solve those problems--the scientific community to conduct research and development in the area, manufacturers to implement those solutions.

Another significant problem cited by the Minneapolis apartment sector respondents is the lack of available funds for energy-

saving purchases. In attempting to solve their energy conservation problems, building owners are restrained by restricted capital availability and cautious officials in lending agencies.

Irrespective of the level of influence, respondents indicated that trade journals provide the most accurate information regarding energy conservation. Manufacturers are seen as highly influential (given that they produce the hardware to meet particular apartment needs), but the information they provide is seen as not totally objective.

When these respondents examined ways to solve their energy conservation problems, they reported a number of inter-related constraints, which may be summarized as follows:

- (1) Economic Factors--Needed capital is not available; use of available monies and capital investment practices tend to have short term planning horizons.
- (2) Human Factors--Building tenants are not as cooperative as they should be regarding energy conservation practices. In addition, building (maintenance) personnel are not as efficient as they should be.
- (3) Technical Factors--Variation in the size and age of apartment buildings dictates that each building must be individually analyzed to determine energy conservation needs and solutions.
- (4) General Factors--Lack of awareness regarding possible energy conservation solutions exists in this sector. One respondent suggested,

"Somebody someplace in Hoboken has an energy-saving device that may be the perfect thing for a small building. We don't know about it, so it is unknown. That [source] is something at the present time we don't go out searching for. If the salesman is knocking on the door, we know about it."

Financial factors are the primary influences in this sector's energy conservation decision-making process. Respondents indicated that if a 1 to 2½ year payback period were demonstrated, \$30,000 would be a reasonable amount to invest in devices or systems. Although availability of capital is the major constraint, respondents said they would try to persuade their building owners to reallocate or borrow necessary monies, provided the need for such a purchase and a 1 to 2½ year payback period can both be demonstrated.

When asked to rate the importance of a number of potential energy management system capabilities, these respondents noted that any energy management system which is purchased must, first and foremost, save money. Other system capabilities ranked as highly important by these respondents were: energy savings, automated control, ease of operation, ease of maintenance, ease of security, ease of problem identification, and on-site monitoring. Off-site monitoring was considered least important by these respondents, since many small apartment buildings in this sector have a person on-site to operate and maintain equipment. The size, number and dispersion of buildings in this sector also makes off-site monitoring of questionable value.

Heating and cooling control and lighting control were considered the two most important functions an energy management system should provide by these respondents. Ventilation and electrical demand controls were considered unimportant because "we don't get into forced air...and the tenants generally pay the electricity."

Market Research Findings:
Los Angeles Apartment Buildings

GENERAL PROBLEM	-Severe
SPECIFIC PROBLEM	-Severe
DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS	
● TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM	-Business Community -Scientific Community
● HIGHLY ACCURATE SOURCES OF INFORMATION	-Trade Journals (#1) -Trade Associations -Department of Energy
● ACCURACY RATING OF MANUFACTURERS	-Medium
● LEAST ACCURATE SOURCE OF INFORMATION	-Attorneys
● HIGHLY INFLUENTIAL SOURCES OF INFORMATION	-Co-workers (#1) -Bankers & Investors -Colleagues -Trade Journals -Trade Associations -Manufacturers -HVAC Contractors
● INFLUENCE RATING OF MANUFACTURERS	-High
● LEAST INFLUENTIAL SOURCE OF INFORMATION	-Attorneys
● CONSTRAINTS	<u>Economic</u> -Available Capital -Energy Costs -Cash-flow Problem <u>Human</u> -Tenants' Attitudes -Owners' Attitudes -Language Problem <u>Technical</u> -Building Size <u>General</u> -Lack of Product/Solution Understanding (Product Line) <u>Regulatory</u> -Tax Situation

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

- Availability of Capital 1
- Length of Payback Period 2
- Initial Cost of Devices/Systems 3
- Tax Incentives 4

- MOST REASONABLE PAYBACK CRITERION

- 1 Year
- 2 Years *N = 2
- 2.5 Years
- 3 Years
- 4 Years
- 5 Years N = 1
- Other

- AMOUNT WILLING TO SPEND

-\$1,000
-Depends on Building Size,
Needs, Owner, Available
Capital

DECISION-MAKING PROCESS: PURCHASING FACTORS

-Depends on Amount of
Purchase
-Ultimately the Owner
Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS

- Physical Plant Improvements 3
- Energy-saving Devices 1
- Procedural Changes 2
- Energy Management Systems 3

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

● MOST IMPORTANT ELEMENT OF
DEVICES/SYSTEM	-Cost
● HIGHLY IMPORTANT CAPABILITIES
OF AN AEMS	-Saves Money (#1)
-Saves Energy
-Automated Control
-Ease of Operation
-Ease of Maintenance
-Ease of Security
-Ease of Problem
Identification
-On-site Monitoring
-Flexibility
● LEAST IMPORTANT CAPABILITY OF
AN AEMS	-Off-site Monitoring
● TWO MOST IMPORTANT FUNCTIONS
OF AN AEMS	-Lighting Control
-Heating & Cooling Control
● TWO LEAST IMPORTANT FUNCTIONS
OF AN AEMS	-Burglar Alarm
-Enthalpy Ventilation
Control

Market Research Findings:
Los Angeles Apartment Buildings

The Los Angeles apartment focus group respondents also perceived the energy conservation problem in the nation to be severe. This group of respondents would have rated the national energy conservation problem as extremely severe if "nobody was doing anything about it."

Collectively, these respondents have the same perception about the energy conservation problem in their own building sector. They noted that many of their current needs are being met, but that more conservation measures should be implemented.

Like other apartment sectors included in this study, the Los Angeles respondents stated that the optimum energy conservation solutions will have to address the issue of size and age of its

buildings. These respondents looked to the installation of energy-saving devices as the most effective way to address this issue and meet their overall energy conservation needs. One respondent said:

"We feel that it is a positive movement to set in, some type of device, such as a time clock or mechanism that is set and doesn't require...to be attended in any way. It's automatic. It's a control."

Although some degree of automatization was sought by this sector, the participants believed that an AEMC would not be necessary in their operations, particularly for small apartment buildings.

This group of respondents expects that the business and scientific communities will be most likely to solve their energy conservation problem, since

"...the business community is going to take the most affirmative action plan, based on dollars, in conservation efforts. That is what is going to save our financial bottom line in conservation efforts."

The scientific community is expected to take the lead regarding the development of technological/hardware solutions to energy-related problems, and will be more "objective" in that they are not driven by a profit motivation that characterizes manufacturers, the other major source of technological solutions.

Continuing this theme of a need to secure reliable, impartial information regarding energy conservation, the respondents rated trade journals as that source which provides the most accurate information and editorial comment. Because these periodicals are viewed as non-commercial, editorial comments on the positive and negative aspects of devices or systems on the market were regarded by respondents as most impartial.

Co-workers were seen as the most influential sources of information regarding energy conservation, owing to their first-hand experience with specific building problems and related solutions. Respondents indicated that such experience results in a high level of credibility.

A number of factors were assessed by the respondents to impede the progress which this sector is making or would like to make in energy conservation. Their comments are summarized below:

- (1) Economic Factors--Needed capital is not available; money is tight, and a cash-flow problem results: apartment building owners need to respond to immediate financial needs, making it difficult to consider a major capital investment like an AEMS; energy costs are rising, and this group has difficulty in absorbing these costs and passing them on to tenants quickly enough.
- (2) Human Factors--Tenants in buildings are not as concerned as they should be regarding energy conservation requirements; an owner's attitude or whim often determines how available money will be spent (e.g., decorating the apartment of a complaining tenant as opposed to making energy-saving expenditures); some owners have difficulty in communicating with non-English speaking tenants regarding energy conservation requirements.
- (3) Technical Factors--As in other building sectors and other geographic locations, an individual building analysis should be conducted to determine the exact needs and solutions; regarding building size, this group feels that the smaller the building, the less need there is for an energy management system.
- (4) General Factors--This group's level of understanding of an energy management system is not high, as one respondent indicated:

"If I had a choice of reducing or eliminating something to save energy or putting in an

energy management system to save energy, I would immediately go to the elimination factor because I understand it."

- (5) Regulatory Factors--Taxes are rapidly rising in Southern California, thereby increasing the magnitude of this sector's capital availability and cash-flow problems.

A fiscal conservatism seems to characterize not only the Los Angeles apartment sector, but other Los Angeles sectors as well, as may be seen in this group's two major financial concerns: (1) the availability of capital and (2) the initial cost of energy-saving devices or an AEMS. Even with a favorable payback period (two of this group's three respondents feel that two years is the most reasonable payback criterion), there still was expressed a need to solve current financial problems.

This theme is also reflected in how much the respondents are willing to spend in order to conserve. Their responses indicated reluctance to commit to a costly purchase at the current time, and the larger the purchase, the more likely that the building owner would make the decision to invest.

Any energy management system which would be purchased would, most importantly, have to save money in these individuals' operations. Like all other sectors included in this study, this group sees an AEMS as an integrated system, and therefore rates many possible system capabilities as highly important: energy saving, automated control, ease of operation, ease of maintenance, ease of security, ease of problem identification, on-site monitoring, and system flexibility; off-site monitoring was identified as the least important capability.

Controls for lighting and heating and cooling are the most important AEMS capabilities. Lighting control would be most important, for

"generally, lighting is the common thing [in an apartment building]." And while "heating is generally separate [and] each individual [apartment] unit has its own heating," such control is still important to this sector.

The Los Angeles apartment sector is faced with basically the same set of constraints as the Minneapolis apartment sector--availability of capital, tenants' attitudes, and variation in individual building needs. Money is reportedly tighter in Los Angeles, however, and the respondents' fiscal conservatism seems to condition all considerations and decisions they made regarding energy conservation.

Market Research Findings:
Boston Apartment Buildings

GENERAL PROBLEM	-Severe
SPECIFIC PROBLEM	-Severe
DECISION-MAKING PROCESS: INFLUENCE FACTORS	
● TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM	-Federal Government -Manufacturers
● HIGHLY ACCURATE SOURCES OF INFORMATION	-Colleagues (#1) -Trade Journals -Co-workers
● ACCURACY RATING OF MANUFACTURERS	-Medium
● LEAST ACCURATE SOURCE OF INFORMATION	-Tax Consultants
● HIGHLY INFLUENTIAL SOURCES OF INFORMATION	-Manufacturers (#1) -Co-workers -Colleagues -HVAC Contractors
● INFLUENCE RATING OF MANUFACTURERS	-High
● LEAST INFLUENTIAL SOURCE OF INFORMATION	-Tax Consultants

- CONSTRAINTS

Economics

- Available Capital
- Energy Costs
- Market Situation

Human

- Tenants' Attitudes
- Staff Efficiency

Technical

- Technology-Product Interface

General

- Lack of Product/Solution Understanding (MFG'S DATA)

Regulatory

- Tax Situation
- Operating Clauses/Leases
- Rent Control
- City Codes
- Potential Time-Of-Day Rates

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

- Availability of Capital	4
- Length of Payback Period	1
- Initial Cost of Devices/Systems	2
- Tax Incentives	3

- MOST REASONABLE PAYBACK CRITERION

- 1 Year	
- 2 Years	
- 2.5 Years	*N = 1
- 3 Years	N = 1
- 4 Years	
- 5 Years	
- Other	

- AMOUNT WILLING TO SPEND

- \$2,500
- \$30,000+
- Depends on Building Needs

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Ultimately the Owner Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS
 - Physical Plant Improvements 2
 - Energy-saving Devices 3
 - Procedural Changes 1
 - Energy Management Systems 4
- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEM
 - Payback
- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS
 - Saves Money (#1)
 - Saves Energy
 - Automated Control
 - Ease of Operation
 - Ease of Maintenance
 - Flexibility
- LEAST IMPORTANT CAPABILITY OF AN AEMS
 - Off-Site Monitoring
- TWO MOST IMPORTANT FUNCTIONS OF AN AEMS
 - Heating & Cooling Control
 - Economizer Ventilation Control
- TWO LEAST IMPORTANT FUNCTIONS OF AN AEMS
 - Ventilation Shut-Off
 - Burglar Alarm

Market Research Findings: Boston Apartment Buildings

Respondents from the Boston apartment sector perceive the nation's energy conservation problem as severe. They note that the problem is not "extremely severe," for the country managed to get through some difficult times (e.g., gasoline shortages, waiting in gas station lines) and the current situation does

not appear to be extreme. On the other hand, the total energy problem--particularly that of energy shortage--is seen as getting worse, and the energy conservation problem--particularly in economic terms--will similarly worsen.

This concern over economics is reflected in the group's rating of the energy conservation problem in their own building sector. Constrained by city codes (regarding ventilation levels) and city regulations (regarding rent control boards and procedures), respondents said they have a difficult time quickly passing on increased costs to their tenants. As one respondent noted:

"We are paying a considerable amount of our collectable dollars today for energy programs, and obviously the only way to control [energy consumption], at this point, is to conserve; but we're limited on what we can do by codes."

This group feels the most effective method to meet its energy conservation and energy management needs is to implement procedural changes within their buildings, to take care of their current operation before adding additional hardware. The installation of an AEMS was rated last, apparently not so much because of doubt about its effectiveness (indeed, one respondent noted that "it may be the most effective means overall"), but because the purchase of such a system would require a prohibitively large capital expenditure. The same individual (as quoted above) said:

"It's the capital outlay, and I could not see, in any way, how you can take that item which is your overall system without first analytically taking care of procedures and buttoning up your shop. And let's do it first."

In a more general sense, this group feels the federal government and manufacturers of energy-saving devices and systems are the two most likely sources of solution to the energy conservation problem. The federal government "is in a position to oversee and override and deal with all facets of the energy

problem." The manufacturers will deliver the hardware that will solve the problem (in conjunction with the scientific community--also rated high--which will conduct research in this area).

Colleagues of these individuals were identified as the most accurate source of information on energy conservation, by their providing information based on personal experience and similarly providing an important "exchange of ideas and data and information pertinent to apartment buildings, through the codes and the regulations and the leasing requirements...."

Manufacturers are seen as the most influential source of information regarding energy conservation. Although this group feels manufacturers provide information of only "medium" accuracy, respondents said they are greatly influenced by them in making energy-related decisions, for manufacturers' data is needed (as is their hardware, as noted above) to make such a decision.

Boston apartment people are faced with a set of inter-related constraints similar to other apartment sectors, but seemed to be more restricted by local codes and regulations. The constraints may be summarized as follows:

- (1) Economic Factors--Needed capital is limited; energy costs are rapidly rising, as are taxes, and this sector faces problems in passing on those increased costs to their tenants ("The market, certainly as far as apartment housing is concerned, has not been able to absorb the increased cost that we have faced."); this market problem also manifests itself in some movement of apartment tenants out of Boston proper to the suburbs, where housing costs are somewhat less.
- (2) Human Factors--Apartment tenants don't cooperate as much as they should regarding energy-saving practices; building maintenance personnel are neither trained

nor efficient in technical areas of energy conservation and related hardware, and, therefore, tend to make mistakes.

- (3) Technical Factors--Technology may exist to solve the energy problems, but one respondent noted that "there's a lot more technology that's been developed that has not been manufactured that we can benefit from."
- (4) General Factors--Although this sector is greatly influenced by and relies on manufacturers' data, some respondents expressed difficulty in understanding such data: "nobody can tell anyone why [a particular energy-saving device] works, or whether it does work."
- (5) Regulatory Factors--Many apartment building operations haven't the necessary clauses or leases which allow for timely compensation for increased energy costs and tax increases; moreover, any proposed rent increase--another way for operators to defray increased costs--must be appealed before local rent control boards, a time-consuming process with no guarantee of rent increase approval; time-of-day rates may be instituted in Boston later in the year, and members of this sector are waiting to see if this occurs before determining the best way(s) to solve their energy conservation problems.

No single factor can be isolated as the most pressing among all these concerns. Broad financial concerns regarding the purchase of energy-saving devices or an AEMS could be addressed by the demonstration of a good payback period--2½ to 3 years for this group. And although there is a problem with lack of available capital (one respondent said he would be willing to spend only \$2,500 on such a purchase because of this availability problem), another respondent noted that, depending on the particular building under consideration, he would be willing to spend \$30,000. A property manager may make the final decision

for a relatively inexpensive purchase, but the building owner--perhaps with recommendations from the property manager--would make the decision on a \$30,000 purchase.

As is true with other apartment sectors, this group feels the most important capability of an AEMS is potential cost savings. Other system capabilities ranked as highly important were energy saving, automated control to reduce errors made by maintenance personnel based on the supposition that the more control is taken "out of people's hands," the better, ease of operation, ease of maintenance, and system flexibility.

Heating and cooling and economizer ventilation controls are the two most important functions of an AEMS. Heating and cooling control were regarded as the more important, because "we're a 24-hour operation...and to us the important factor is to keep a good comfort control station going, which has to do with the heating and the cooling of apartment buildings...." The high ranking of the economizer ventilation control is related to local laws which require some ventilation 24 hours a day and the group's feeling that "...part of our abilities to economize has to do with how much air we're passing over our coils."

Facing substantial economic pressures, pressures made worse by regulatory restrictions, the Boston apartment sector seems limited in its latitude for aggressively addressing and solving energy problems. These constraints seem to inhibit this sector from investing in an AEMS more than any doubt about its potential effectiveness. Respondents seem to perceive that technology and hardware ultimately may solve its energy problems.

TOTAL APARTMENT SECTORS SUMMARY

The respondents from the three apartment sectors surveyed in this study concurred as to the severity of the nation's energy problem. Their general attitude was that, while some people are doing some things to conserve, more needs to be done--especially as the country's energy sources diminish.

Respondents from these sectors also rated the energy conservation problem in the apartment building area as severe. When these respondents examined potential methods to solve their energy-related problems, they generally chose a relatively inexpensive approach (e.g., the implementation of procedural changes, the installation of energy-saving devices). There was a general feeling that one's own operation should be "straightened up" and dealt with before any major hardware additions were made. The installation of an AEMS was consistently ranked low; respondents apparently believe that such a system either does not meet the needs of a small apartment building or would be too expensive.

These two concerns--technical needs and economic considerations--are reflected in the group's ranking of most likely sources of solution to the energy conservation problem. Respondents generally indicated that they are seeking both kinds of solutions--technical answers from the scientific community and manufacturers, and financial leadership from the federal government in cooperation with the business community.

When seeking the most accurate information possible, these respondents tended to rely on those sources of information which provide the most objective, impartial, reliable information--particularly trade journals. Yet, the most accurate

sources were not ranked the most influential. Respondents from the three sectors said they were most influenced by sources which address particular problems of their own operations, ranging from the availability of capital (where bankers and investors are most influential) to sector-specific knowledge (where co-workers are most influential) to specific technical needs (where manufacturers are most influential).

All apartment sectors face similar constraining pressures in trying to meet their energy conservation needs, with some geographic-specific differentiation. The major factors which characterized the total apartment sector were:

- (1) Economic Factors-- Lack of available capital; rising energy costs; rising taxes.
- (2) Human Factors-- Tenants' negative attitudes toward energy-saving practices and programs; untrained, inefficient building personnel.
- (3) Technical Factors--The need to conduct an individual analysis of each apartment building under consideration.
- (4) General Factors--Lack of awareness and understanding of possible solutions to the energy conservation problem, products, and/or manufacturers' data.
- (5) Regulatory Factors--Limiting operating clauses and leases; local codes.

Economic factors appeared to be the major problem the apartment groups faced--money is tight and capital is generally not available for a major energy-saving expenditure. The severity of this problem may be lessened somewhat if a good payback period (2½ years on the average) could be demonstrated. The amount the respondents would be willing to spend on energy-saving devices or an energy management system is not solely dependent on the availability of capital and a favorable payback; it also depends on the needs of a particular building, the owner's attitudes, and other related factors. Regarding

the person(s) making the final decision to make such a purchase, the greater the cost, the higher up the organizational chart one has to go--ultimately to the building owner, utilizing the recommendations of the property managers.

Saving money is the most important capability an automated energy management system should have. Most other possible capabilities were also ranked as highly important, indicating that the participants feel "all [capabilities] relate to each other." Off-site monitoring was ranked as the least important system capability, such a capability generally not being needed in small apartment buildings.

Heating and cooling control and lighting control were the two most important energy management system functions for the total apartment building sector. These functions represented the areas where the most energy- and cost-savings could be realized for apartment buildings.

The total apartment building sector appears to be the poorest potential market for an energy management system of all building sectors examined. This sector faces severe economic problems (particularly with respect to lack of available capital), is more unaware than other building sectors of possible energy conservation solutions, and represents a particular set of building needs which seem not to be best solved by the installation of an AEMS.

Market Research Findings:
Minneapolis School Buildings

GENERAL PROBLEM

-Severe

SPECIFIC PROBLEM

-Severe

DECISION-MAKING PROCESS: GENERAL
INFLUENCE FACTORS

- TWO MOST LIKELY SOURCES OF SOLUTION
TO PROBLEM

-State Governments
-Federal Government

- HIGHLY ACCURATE SOURCES OF
INFORMATION

-Trade Journals (#1)
-Trade Associations
-Co-workers
-Colleagues
-Department of Energy

- ACCURACY RATING OF MANUFACTURERS

-Medium

- LEAST ACCURATE SOURCE OF
INFORMATION

-Attorneys

- HIGHLY INFLUENTIAL SOURCES OF
INFORMATION

-Colleagues (#1)
-Co-workers
-Trade Journals
-Trade Associations
-Department of Energy

- INFLUENCE RATING OF MANUFACTURERS

-Medium

- LEAST INFLUENTIAL SOURCE OF
INFORMATION

-Attorneys

- CONSTRAINTS

Economics
-Tax Revenues

Human
-Staff Morale

Technical
-Building Age
-Individual Building
Analysis

Regulatory
-Buying on Time Restrictions
-Public Works Requirements

DECISION-MAKING PROCESS: ECONOMIC FACTORS

● RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

- Length of Payback Period 1
- Initial Cost of Devices/Systems 2
- Availability of Capital 3
- Tax Incentives 4

● MOST REASONABLE PAYBACK CRITERION

- 1 Year *N = 2
- 2 Years N = 1
- 2.5 Years
- 3 Years
- 4 Years
- 5 Years
- Other

● AMOUNT WILLING TO SPEND

-Good Payback Can Justify
Virtually Any Cost

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Depends on Size of School District
- Ultimately the School Board Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

● RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS

- Energy Management Systems 1
- Energy-saving Devices 2
- Physical Plant Improvements 3
- Procedural Changes 4

● MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS

-Payback

● HIGHLY IMPORTANT CAPABILITIES OF AN AEMS

- Saves Money (#1)
- Saves Energy
- Automated Control
- Ease of Operation
- Ease of Maintenance
- Ease of Security
- Ease of Problem Identification

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

- LEAST IMPORTANT CAPABILITY OF AN AEMS
 - TWO MOST IMPORTANT FUNCTIONS OF AN AEMS
 - TWO LEAST IMPORTANT FUNCTIONS OF AN AEMS
- Flexibility
 - Expandability
 - Over-ride
 - Scheduled Equipment Shutdown
 - Heating & Cooling Control
 - Burglar Alarm
 - Fire Alarm

Market Research Findings:
Minneapolis School Buildings

Respondents from the Minneapolis school sector ranked the energy conservation problem in both the nation and its own building sector as severe. In both areas, these respondents believed that some things were being done, but more remained to be done. "Just about everybody is doing something...there is progress being made," a respondent said when asked about the national energy conservation problem. Referring to school buildings in particular, respondents claimed that some people were doing a good job of conserving energy, while others were doing a poor job.

The energy conservation needs of this sector would be met most effectively by the analysis and implementation of energy management systems. Respondents from this sector defined the energy management system more broadly than other sectors surveyed; Minneapolis school respondents defined the concept in terms of both hardware and software, where such a system would provide both "management and control" functions. "Management" discussions reflected their concern about the reliability of personnel factors associated with energy conservation, while "control" refers to the hardware as a regulatory element.

In a broader sense, respondents from this sector said they would look toward the federal government as the most likely source of solution to the energy conservation problem.

When these respondents look for information on solutions, the focus group results show that they are most influenced by their colleagues. Although other sources are also ranked as highly influential, colleagues are viewed as the most influential because they have the greatest amount of first-hand experience. Colleagues are also seen as providing highly accurate information, but trade journals are seen as being the most accurate and objective source of information.

Relative to other comparable sectors, the Minneapolis school group is faced with relatively few constraining factors in meeting its energy conservation needs. These factors are described below:

- (1) Economic Factors--This sector is dependent on tax revenues for operating revenue, and apparently requires changes in tax rates or budgetary allocations before new capital expenditures may be seriously considered.
- (2) Human Factors--When energy-saving practices and/or educational programs are instituted in the schools, staff morale appears to be lowered. This reaction occurs, for example, when room temperatures are lowered or classes are combined.
- (3) Technical Factors--An individual building analysis should be conducted to determine optimal energy-conservation methods, systems and solutions. Generally speaking, the older the building, the less need there is for an AEMS and the more likely it is that physical plant improvements or procedural changes would be made.
- (4) Regulatory Factors--One respondent noted that "schools

are prohibited from buying on time; therefore, they have to come up with the necessary money in the front end"; respondents also referred to certain public works requirements, where legally "for public works at the present time, if the cost exceeds \$30,000, a person licensed and registered in that particular field must prepare the plans and specifications for it"; another participant stated that "we get around doing that," but did not elaborate.

These respondents claimed that the payback period was the primary factor regarding the purchase of any energy-saving devices or an AEMS. A good payback period--defined as 1 to 2 years by this group--can justify virtually any cost of hardware, and with a demonstration of a good payback period, the participants could influence their school board or the government to allocate the funds for a purchase or reallocate current funds if a proposed expenditure exceeds current allocations. The greater the purchase price, the more likely that top-level administrators and the school board will make the final purchase decision.

All system capabilities were seen as inter-related, and most were rated as being highly important: energy saving, automated control, ease of operation, maintenance, security, and fault identification, system flexibility and expandability and ease of override from automatic to manual control.

Scheduled equipment shutdown, defined as shutting down "...all equipment, every piece of equipment you have in the system," was ranked as the most important energy management function; heating and cooling control was ranked second.

Respondents recognized that energy management systems (including a software/personnel component) could help solve their conservation problems and saw relatively few constraints regarding the

purchase of such a system. The overriding concern again was that of favorable payback--1 to 2 years. Although there is variation in building age and related building needs and some difficulty in getting needed monies for an energy management system purchase, there appeared to be both a need and desire for these systems in this sector--as long as its payback period requirements are met.

Market Research Findings:
Los Angeles School Buildings

GENERAL PROBLEM

-Extremely Severe

SPECIFIC PROBLEM

-Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

● TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM

-The Public
-Federal Government

● HIGHLY ACCURATE SOURCES OF INFORMATION

-Trade Journals (#1)
-Colleagues
-Manufacturers

● ACCURACY RATING OF MANUFACTURERS

-High

● LEAST ACCURATE SOURCE OF INFORMATION

-Printed Media (e.g.,
Newspaper Advertisements)

● HIGHLY INFLUENTIAL SOURCES OF INFORMATION

-Colleagues (#1)
-Trade Journals
-Trade Associations
-Manufacturers
-HVAC Engineers

● INFLUENCE RATING OF MANUFACTURERS

-High

● LEAST INFLUENTIAL SOURCE OF INFORMATION

-Tax Consultants

● CONSTRAINTS

Economics
-Cash-flow Problem

Human
-Staff Efficiency
-Class Problem

-Language Problem
-Public's Attitudes

Technical

-Current State-of-the-Art

General

-Public Sector Politics
-School Board Politics
-Time Required for
Purchase Approval

Regulatory

-Public Utilities

● RANK ORDER OF IMPORTANCE OF
BROAD FINANCIAL CONSIDERATIONS

- Length of Payback Period	2
- Initial Cost of Devices/Systems	1
- Availability of Capital	3
- Tax Incentives	4

● MOST REASONABLE PAYBACK CRITERION

- 1 Year	-Depends on the Situation --
- 2 Years	Building Age,
- 2.5 Years	Size, Needs, Available
- 3 Years	Capital, etc.
- 4 Years	
- 5 Years	
- Other	

● AMOUNT WILLING TO SPEND

-Depends on Situation --
Building Age, Size,
Needs, Available Capital,
etc.

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Depends on Current or Future Plans
- Ultimately the School Board makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

● RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS

- Energy Management Systems	4
- Energy-saving Devices	2
- Physical Plant Improvements	3
- Procedural Changes	1

● MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS

- Functions

● HIGHLY IMPORTANT CAPABILITIES OF AN AEMS

- Saves Energy (#1)
- Automated Control
- Ease of Operation
- Ease of Maintenance
- Ease of Problem Identification
- Expandability
- Override

● LEAST IMPORTANT CAPABILITY OF AN AEMS

- Off-site Monitoring

● TWO MOST IMPORTANT FUNCTIONS OF AN AEMS

- Heating and Cooling Control
- Lighting Control

● TWO LEAST IMPORTANT FUNCTIONS OF AN AEMS

- Fire Alarm
- Burglar Alarm

Market Research Findings:
Los Angeles School Buildings

Respondents from the Los Angeles school building sector ranked the nation's energy conservation problem as extremely severe. The energy shortage in this sector is perceived as equally severe, a situation which respondents said was compounded by the perception that people are not doing much to save energy.

When these respondents examined various methods of solving their problems, they identified implementing procedural changes as the most effective means, noting they should first "[go] back and [correct] the things that should be corrected and [try] to get as tight a schedule as you [can] on the operation of the equipment in the facilities." This sector is looking for "...the greatest return for the least investment of both dollars and time...", and procedural changes seemed most likely to meet this criterion. Energy management systems are viewed as needing too great a capital expenditure and do not provide a "guaranteed curtailment of consumption."

This concern over financing is reflected in this sector's ranking of the government as the most likely source of solution to the energy conservation problem. "We are a consumer of taxes, not a generator of taxes," one respondent noted, adding that "money is our primary problem [and] the public is the ultimate source of money."

Like each of the other two school groups included in this study, the Los Angeles school participants believed trade journals

provided the most accurate information regarding energy conservation, information which was reliable, impartial, and, "like an editorial," addresses both positive and negative aspects of various energy-saving devices and programs. However, the respondents' colleagues were viewed as the most influential source of information, as their judgments and recommendations were perceived as being based on first-hand experience.

The constraints affecting this sector's activities are described below:

- (1) Economic Factors--This sector faces a cash-flow problem; money is tight--reportedly so tight that it is not unusual for a maintenance program to involve waiting until something breaks down and then fixing it, as opposed to practicing preventive maintenance.
- (2) Human Factors--Respondents reported that building personnel are not well-trained and, in order to protect their own jobs, won't cross labor boundary lines (e.g., a heating, cooling, and ventilation repairman won't train a custodian to perform heating, cooling, and ventilation work); a problem of social class exists in the school system, as described in the following quote:

"...the more affluent the community, the more reluctant they are to curtail their excesses....Our more affluent schools seem to think that each student is entitled to his own particular micro-climatic environment, and it's a problem."

Respondents described a geographic-specific problem of language, stating that some people (e.g., Spanish speaking) "don't understand what [the energy conservation problem] is all about." The attitudes of the general public also were cited as a problem for this sector, where people say there's an energy

problem, but don't do anything about it.

- (3) Technical Factors--Respondents believed that the current state of the art was insufficient to adequately handle energy conservation problems.
- (4) General Factors--Respondents from this sector noted "there are [external] political considerations in the public sector that are frequently yielded to....," where a politically-expedient program (e.g., solar energy) is endorsed without regard to an ideal method of conserving energy. School board political situations were also described, where a particular program is explored, which, again, may not be pertinent to the facilities and problems under consideration. Respondents complained about the amount of time required for the decision-making process to run its full course for a purchase as expensive as an energy management system, a problem compounded by the fact that any monies left unspent after the end of the school system's fiscal year were reported to be unavailable for use the following fiscal year.
- (5) Regulatory Factors--Respondents noted that the Public Works Commission now has a requirement that buildings using over 100,000 cubic feet of gas per day must convert to oil equipment. This mandate requires an immediate focus and spending level from the Los Angeles school building sector to convert the appropriate buildings from gas to oil usage.

Given the facts of a cash-flow/tight money problem and a set amount of money being allocated to the schools for energy conservation every year, this sector was primarily concerned with the initial cost and related payback period of any energy-conservation purchase. They were similarly concerned about the

functions and capabilities of any energy-saving device or system: "what is the device going to do for us and to us [and] what are the capabilities of the device, other than its obvious, intended purpose?" A purchase decision would ultimately be made by the Board of Education, with recommendations from appropriate individuals and departments. Any recommendations on required payback period and cost limitations would be made based on the particular situation and building(s) under consideration.

Unlike other sectors described to this point, the Los Angeles group feels saving energy (not saving money) is the most important capability an energy management system should have; if energy is saved ("...a more altruistic position..."), money will also be saved. Other system capabilities ranked as highly important by this sector were: automated control, ease of operation, ease of maintenance, ease of problem identification, system expandability, and override from automatic to manual control.

Heating and cooling and lighting controls are ranked number one and number two, respectively, regarding important energy management system functions. The reasoning behind this ranking is reflected in the following quote:

"We have many central plant heating facilities, and in our opinion, the conservation of gas in the state of California is more critical for the next four years than the reduction of consumption of electricity. Even though the cost of electricity is higher, ultimately the result of diminishing gas supplies is going to have more economic consequences in this community than the cost of electricity."

So both functions were considered important--heating and cooling control and its relationship to gas consumption, and lighting control and its relationship to electricity usage.

The Los Angeles school building sector may be characterized as facing severe economic constraints, resulting in aggressive,

low-cost, educational and conservation programs. These programs have been generally successful in this sector. In fact, one respondent noted that "we cut the gas consumption by 44 per cent by an expenditure of less than \$500 on an annual basis [by scheduling] the time switches, [by giving] the custodian the capability of turning the system off...." As long as money remains tight in this market, these people will continue to explore relatively inexpensive--and heretofore relatively successful--energy conservation solutions.

Market Research Findings:
Atlanta School Buildings

GENERAL PROBLEM

-Between Severe and
Extremely Severe

SPECIFIC PROBLEM

-Extremely Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

● TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM	-Academic Community
-The Public
● HIGHLY ACCURATE SOURCES OF INFORMATION	-Trade Journals (#1)
-Co-workers
-Colleagues
● ACCURACY RATING OF MANUFACTURERS	-Medium
● LEAST ACCURATE SOURCE OF INFORMATION	-Printed Media (e.g.,
Newspaper Advertisements)
● HIGHLY INFLUENTIAL SOURCES OF INFORMATION	-Co-workers (#1)
-Department of Energy
● INFLUENCE RATING OF MANUFACTURERS	-Medium
● LEAST INFLUENTIAL SOURCE OF INFORMATION	-Attorneys

● CONSTRAINTS

Economics

- Lack of Financial Incentives
- Available Capital
- Tax Revenues

Human

- Public's Attitude
- Staff's Attitudes
- Students' Attitudes

Technical

- Projected State of the Art
- Potential New Energy Sources

General

- Lack of Product/Solution Understanding

DECISION-MAKING PROCESS: ECONOMIC FACTORS

● RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

- Length of Payback Period	2
- Initial Cost of Devices/Systems	3
- Availability of Capital	1
- Tax Incentives	4

● MOST REASONABLE PAYBACK CRITERION

- 1 Year	*N = 1
- 2 Years	
- 2.5 Years	
- 3 Years	
- 4 Years	N = 1
- 5 Years	N = 1
- Other	

● AMOUNT WILLING TO SPEND

- Depends on Payback
- Look at % of Total Operating/Energy Costs

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Ultimately the School Board Makes the Decision

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS
OF METHODS TO MEET NEEDS
 - Energy Management Systems 4
 - Energy-saving Devices 2
 - Physical Plant Improvements 3
 - Procedural Changes 1
- MOST IMPORTANT ELEMENT OF
DEVICES/SYSTEMS -Functions
- HIGHLY IMPORTANT CAPABILITIES
OF AN AEMS
 - Saves Energy (#1)
 - Saves Money
 - Automated Control
 - Ease of Operation
 - Ease of Maintenance
 - Ease of Security
 - Ease of Problem
Identification
 - Flexibility
 - Expandability
 - Off-site Monitoring
- LEAST IMPORTANT CAPABILITY
OF AN AEMS -On-site Monitoring
- TWO MOST IMPORTANT FUNCTIONS
OF AN AEMS
 - Electrical Demand Control
 - Heating & Cooling Control
- TWO LEAST IMPORTANT FUNCTIONS
OF AN AEMS
 - Burglar Alarm
 - Fire Alarm

Market Research Findings: Atlanta School Buildings

Respondents of the Atlanta school building sector ranked the nation's energy conservation problem between severe and extremely severe. These people noted that there currently are no financial incentives for people to conserve and people don't believe the energy conservation problem really exists.

Respondents indicated that in their sector conservation measures-- "policies, guidelines, and...incentive programs"--have been instituted. They described their general progress as slow, however, and rated their overall energy conservation status as severe.

Respondents said they look toward procedural changes as primary avenues of solution first and the installation of an AEMS last. These choices reflect their expressed needs, as highlighted by one respondent's observation:

"Tho Atlanta Public Schools could save more than computers or anything else, if we could cut the equipment off or cut it back, in the case of the wintertime, at the proper time, bring it on at the proper time, and if we could do that we would have accomplished all of our energy conservation goals as far as I am concerned."

The AEMS approach was seen as applicable only to newer buildings, which represent about one-third of all buildings in the sector.

Respondents ranked the academic community and the public as the two sources most likely to solve the energy conservation problem. The academic community was defined as those people who actually work in school (i.e., academic) buildings--students, teachers, and staff--exclusive of college and university academics engaged in energy research and development. As to the public's involvement, "We're going to have to solve our own problems," one respondent stated, "and come up with a solution."

Regarding possible sources of information for dealing with energy conservation, respondents cited trade journals as providing the most accurate information. However, they expressed the conviction that this information does not always reach decision-makers; thus, such journals were regarded as not highly influential in the decision-making process. Co-workers, that is, persons having first-hand experience with conservation measures, were seen as being the most influential.

Energy conservation constraints upon this sector may be summarized as follows:

- (1) Economic Factors--There is a lack of financial incentives at the present time to go into "massive energy conservation," coupled with a shortage of available capital. Respondents said they would "patch the roof rather than replace it," because of limited funds. Like other school sectors, the Atlanta group cited their dependency upon tax revenues for their operating budget as a limiting factor.
- (2) Human Factors--"You can't get anybody to believe that we've got a problem," one respondent noted. Another noted that, when temperatures are cut back in the buildings after regular school hours, employees working in the buildings become upset and their complaints create union problems. Respondents said progress in educating students, teachers and staff is slow.
- (3) Technical Factors--Uncertainty about the future, both in terms of energy resources and energy-saving products, makes a decision difficult as to how to best solve this sector's energy conservation problems now; respondents expressed the fear that today's hardware might be obsolete tomorrow, making a major expenditure difficult to justify; furthermore, new sources of energy may emerge and their development could change this sector's energy conservation and management needs and potential solutions.
- (4) General Factors--Respondents said the Atlanta School Board doesn't fully understand the energy problem, making a difficult process of assessing energy needs and solutions.

These constraints are exacerbated by the group's problem with available capital. As in other school sectors surveyed, Atlanta

is constrained by annualized budgeting procedures; thus, total operating needs must be anticipated and budgeted early. "The way we spend our capital depends upon the payback and cost," one respondent noted, but individual judgments regarding the most reasonable payback period varied from one to five years. A final purchasing decision, made by the Board of Education with recommendations from appropriate committees, would take into account this interaction of available capital, payback and cost.

Besides the most important capabilities of saving both energy and money, this sector rated the following system capabilities as of high importance: automated control, ease of operation, maintenance, security and problem identification, system flexibility and expandability, and off-site monitoring. On-site monitoring was rated the least important system capability; respondents preferred a centralized operation where on-site monitoring is not necessary, especially for larger school buildings.

Electrical demand control and heating and cooling control are the two highest ranked functions of an energy management system. This ranking reflects this sector's concern with the cost of both electricity and gas.

Respondents in the Atlanta school sector noted that an automated energy management system would be appropriate for some of their facilities, especially larger, newer buildings. However, the financial constraints operating within this sector are severe and influence all aspects of the decision-making process regarding energy conservation. And although this sector would rank saving energy as more important than saving money, there was general consensus that ultimately economics will "win," that "in the crunch, we would alter [the opinion that saving energy is more important]."

Total School Sectors Summary

The three school sectors surveyed in this study differed in their rating of the severity of the nation's energy problem, ranging from severe (in Minneapolis) to extremely severe (in Los Angeles). The participants noted that some people were doing some things to save energy, but those efforts were not enough. This problem of people not doing enough is compounded by the nation's diminishing supply of energy resources and the likelihood that this diminution will continue.

This diversity of opinion likewise was reflected in ratings of the severity of the sector-specific energy conservation problem. The Minneapolis and Los Angeles sectors described their own conservation problem as severe, while Atlanta respondents rated their problem as extremely severe. The former two groups of respondents indicated that there has generally been substantial success in their energy conservation programs, but more should be done. Atlanta respondents noted that while they have instituted "policies, guidelines and programs," progress toward conservation is "still slow."

Geographic differences continued to surface when the most effective methods to solve energy conservation problems were explored. Los Angeles and Atlanta respondents said that implementing procedural changes is the most effective method, noting some successes that they have already experienced. The Minneapolis school sector ranked the installation of an energy management system as the most effective method of conservation in their buildings, defining such a system as "management and control"--overall management which included both hardware and software (personnel) components.

When asked to rank a number of possible sources for solving the energy conservation problem, respondents from these sectors noted that a school is "a consumer of taxes, not a generator of taxes," and its directors look toward government (both federal and state) and the public (as taxpayers) as sources.

When looking at various sources of information on energy conservation, all three sectors identified trade journals as providing the most accurate information. However, respondents said they are most influenced by those sources with the most first-hand experience in the area of energy conservation--colleagues and co-workers.

Those constraints which characterize the total school sector are summarized below:

- (1) Economic Factors--Dependency on tax revenues for money; lack of available capital.
- (2) Human Factors--Negative attitudes toward energy-saving practices and programs on the part of students, teachers, and staff; unsupportive attitudes toward the energy conservation problem on the part of the public (e.g., the public doesn't think the problem is real; the public says there is a problem, but doesn't do anything about it).
- (3) Technical Factors--The need to conduct an individual analysis of each school building under consideration; state-of-the-art problems (e.g., current hardware is not sufficient to save needed amounts of energy; current technology is adequate, but future technology might be better).
- (4) General Factors--Political problems, both in the public sector in general (e.g., certain programs--like solar conservation--are "frequently yielded to for political reasons, not necessarily for conservation reasons") and on school boards in particular.

- (5) Regulatory Factors--Budgetary timetable places limitations on expenditures; public works/utilities requirements.

There were geographic differences within the total school sector regarding the most important capability of an energy management system. Minneapolis respondents ranked saving money as the most important capability, while Los Angeles and Atlanta felt saving energy is the most important thing a system should do. Moreover, Minneapolis respondents said the payback period was the most important element to consider in the purchase process, while the other two regions--more concerned with saving energy--were more concerned with the specific functions of a system. All geographic regions ranked many other system capabilities as highly important, noting--like other sectors included in the study--that the possible capabilities were greatly interrelated.

Again, there was not great consistency within the total school sector as to the importance of specific system functions, although each sector did rank heating and cooling control as one of the two most important functions. Observed differences with regard to other highly-ranked functions represent different regional needs as perceived by the respondents.

Market Research Findings:
Minneapolis Office Buildings

GENERAL PROBLEMS

-Severe

SPECIFIC PROBLEMS

-Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

- TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM
 - The Public
 - Operating Staff
- HIGHLY ACCURATE SOURCES OF INFORMATION
 - Manufacturers (#1)
 - Trade Journals
 - Trade Association
 - Colleagues
 - Co-workers
- ACCURACY RATING OF MANUFACTURERS
 - High (#1)
- LEAST ACCURATE SOURCE OF INFORMATION
 - Attorneys
- HIGHLY INFLUENTIAL SOURCES OF INFORMATION
 - Manufacturers (#1)
 - Colleagues
 - Trade Journals
 - Trade Associations
- INFLUENCE RATING OF MANUFACTURERS
 - High (#1)
- LEAST INFLUENTIAL SOURCE OF INFORMATION
 -
- CONSTRAINTS
 - Economics
 - Energy Costs
 - Market Situation
 - Hardware Costs
 - Human
 - Tenants' Attitudes
 - Staff Attitudes
 - Technical
 - Individual Building Analysis

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

- Length of Payback Period 1
- Availability of Capital 2
- Tax Incentives 3
- Initial Cost of Devices/Systems 4

- MOST REASONABLE PAYBACK CRITERION

- 1 Year *N = 1
- 2 Years N = 4
- 2.5 Years
- 3 Years
- 4 Years
- 5 Years
- Other

- AMOUNT WILLING TO SPEND

-Good Payback Can Justify Virtually Any Cost

DECISION-MAKING PROCESS: PURCHASING FACTORS

-Depends on Amount of Purchase
-Ultimately the Owner Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS

Old New
Buildings/Buildings

- Energy Management Systems 1/1
- Energy-Saving Devices 2/2
- Procedural Changes 3/4
- Physical Plant Improvements 4/3

- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS

-Payback

- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS

-Saves Money (#1)
-Saves Energy
-Automated Control
-Ease of Operation
-Ease of Maintenance
-Ease of Security
-Ease of Problem Identification
-Expandability
-Override

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

- LEAST IMPORTANT CAPABILITY
OF AN AEMS

-Manual Control

Market Research Findings:
Minneapolis Office Buildings

Respondents from the Minneapolis office building sector rated the energy conservation problem, both in the nation and their own building sector, as severe, due largely to an expressed concern over implementation of energy-saving practices and the related economic variables. Respondents said they face substantial difficulty in making energy conservation programs operational and cited constraints imposed by the economic implications of energy conservation. Speaking about his own building sector, one respondent noted, "Energy is an overwhelming factor in our operations. We have to conserve to be competitive in our rental rates. That is a severe problem."

Respondents said their energy-related problems can most effectively be met by the installation of energy-saving hardware, with energy management systems perceived as the most effective measure and energy-saving devices the next most effective. The respondents stated a preference for the centralized control functions of an AEMS as being most effective for both newer and older buildings.

However, they expressed a need to educate their tenants and the general public, and took the view that energy conservation problems will not be solved solely by the installation of an energy management system. Moreover, they expressed skepticism over the success of such educational programs, but indicated the opinion that such education should be pursued.

Given their interest in and desire for hardware solutions (e.g., an energy management system), members of this sector noted that manufacturers of such hardware both provide the most accurate information regarding energy conservation and serve as the most influential source of such information. Although the manufacturers' materials are "slanted" (because they're trying to sell a product), they still "have done the most exhaustive research" in the area. This bias means that manufacturers' data must be carefully scrutinized, as reflected in the following remark:

"You have to pick out in your own mind what [the manufacturers] are saying is right and what isn't and it all comes down to the individual judgment on whether you think he is right or wrong."

This group also feels that a prospective buyer of a certain product can verify the manufacturers' claims by speaking with people who have previously used the product.

Compared generally to other sectors surveyed, the Minneapolis respondents indicated relatively few constraints in meeting their energy conservation needs. These constraints are summarized below:

- (1) Economic Factors--Energy costs are rising, and, as noted previously, "energy is an overwhelming factor in [their] operations"; this sector needs to conserve energy in order to be competitive in their rental rate structures; an energy management system is the most effective way to meet this sector's energy conservation needs, but is costly.
- (2) Human Factors--The human element in energy conservation is crucial for this sector; educating tenants was identified as the largest problem; the quality of an energy conservation program is a function of the quality and dedication of the persons involved in it.

- (3) Technical Factors--The need exists to individually analyze each building before a determination of the problems and solutions to those problems can be made.

While respondents acknowledged that the most effective method of solving the energy conservation problem is also the most expensive, cost becomes less important when a favorable payback period is realized. Respondents rated 2 to 2½ years as favorable. As one respondent commented, "If the thing is a good enough...deal, you'll find the money. It doesn't make a difference what it costs." While relatively inexpensive purchasing decisions (for example, between \$1,000 and \$2,000) are made at the discretion of building managers, the owner would make the final decision on a higher costing energy management system.

When determining the relative importance of various energy management system capabilities, respondents seemed to regard all capabilities as inter-related and view the system as a total, "complex package." Saving money is the most important system capability, with saving energy, automated control, ease of operation, maintenance, and, security problem identification, system expandability, and manual override rated as highly important. Respondents identified enthalpy and economizer ventilation controls as the two most important functions.

Faced with apparently few constraints to solving its energy conservation problems, the Minneapolis office building sector is both knowledgeable about and desirous of utilizing AEMSS. Although respondents described substantial personnel problems, their understanding of hardware solutions to energy-related problems seems clear. As one respondent commented:

"If you want to pay the bill, the technology is there to do it. There is enough talent and enough hardware and programs and so forth. They do exist to do an out-of-sight job of energy conservation if you are willing to pay the bill."

Market Research Findings:
Los Angeles Office Buildings

GENERAL PROBLEMS

-Severe

SPECIFIC PROBLEMS

-Somewhat Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

- TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM

-Business Community
-Scientific Community

- HIGHLY ACCURATE SOURCES OF INFORMATION

-Colleagues (#1)
-Co-workers
-Trade Associations

- ACCURACY RATING OF MANUFACTURERS

-Medium

- LEAST ACCURATE SOURCE OF INFORMATION

-Attorneys

- HIGHLY INFLUENTIAL SOURCES OF INFORMATION

-Co-workers (#1)
-Colleagues
-Manufacturers

- INFLUENCE RATING OF MANUFACTURERS

-High

- LEAST INFLUENTIAL SOURCE OF INFORMATION

-Attorneys

- CONSTRAINTS

Economics

-Available Capital
-Cash-flow Problem

Human

-Tenants' Attitudes

Technical

-Individual Building Analysis
-Building Age
-Building Size

Regulatory

-Potential Time-of-Day Rates

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS
 - Length of Payback Period 3
 - Availability of Capital 1
 - Tax Incentives 4
 - Initial Cost of Devices/Systems 2
- MOST REASONABLE PAYBACK CRITERION
 - 1 Year *N = 1
 - 2 Years
 - 2.5 Years
 - 3 Years
 - 4 Years
 - 5 Years N = 1
 - Other N = 1 (Cost More Important)
- AMOUNT WILLING TO SPEND
 - Depends on Building Needs, Available Capital

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Ultimately the Owner/ Board of Directors Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS
 - Energy Management Systems 2
 - Energy-saving Devices 3
 - Procedural Changes 1
 - Physical Plant Improvements 4
- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS
 - Functions
- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS
 - Saves Money (#1)
 - Saves Energy
 - Automated Control
 - Manual Control
 - Ease of Operation
 - Ease of Maintenance
 - Ease of Security
 - Ease of Problem Identification
 - Flexibility

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

- LEAST IMPORTANT CAPABILITY
OF AN AEMS

- TWO MOST IMPORTANT FUNCTIONS
OF AN AEMS

- TWO LEAST IMPORTANT FUNCTIONS
OF AN AEMS

- Over-ride
- On-site Monitoring

- Off-site Monitoring

- Electrical Demand Control
- Lighting Control

- Fire Alarm
- Burglar Alarm

Market Research Findings:
Los Angeles Office Buildings

Representatives of the Los Angeles office sector rated the nation's energy conservation problem as severe, although they indicated that they thought some things are being done. Respondents assessed their own energy conservation problem as only somewhat severe. One respondent said that "...people in [our] industry...have made pretty good strides in conservation already" by "turning things off, shutting equipment down, [using] time clocks, and so on."

This group reported general success by means of these procedural changes, and identified this approach as the most effective method of solving energy conservation problems. Respondents claimed to have realized 50 to 60 per cent savings by instituting operational changes, and cited similar success in the educational programs and training sessions involving their building tenants.

In a broader sense, sector representatives said that the business and scientific communities seemed to be the two most likely sources to solve the energy conservation problem. One respondent said that tenants "are concerned about conserving dollars

in the business end, because the more they can conserve and the more we can conserve, the less their lease is going to go up." The scientific community would provide technological solutions to energy conservation problems. This apparent reliance on the sector's "own people"--tenants and owners--is further demonstrated by widely expressed opinion that sector colleagues provide the most accurate information regarding energy conservation and is the most influential source of information on the subject.

The Los Angeles respondents cited a number of constraints and these may be summarized as follows:

- (1) Economic Factors--Respondents described a major problem with available capital, which they indicated may be the most important financial consideration, possibly outranking the payback period or the initial purchase price.
- (2) Human Factors--Although respondents described some success in educating tenants on energy conservation, a problem seems to exist among top executives in office buildings. One respondent described the situation as follows:

"...top executives are there in that building and they will walk through and say: 'I don't like the lighting here since we have cut down--I want more'; then their people below will go along with that trend. [If] we get [the top executives] on [our] side, we have got no problem."

- (3) Technical Factors--Respondents said analyses should be conducted to determine the exact energy conservation needs of each building, stating that owners are less willing to spend money on smaller, older buildings.
- (4) Regulatory Factors--Respondents noted that time-of-day rates may be enacted in Los Angeles, which could

affect their needs assessment.

The general problem of tight money seems to be reflected in other management considerations that affect planning for energy conservation. The payback criterion -- varying among respondents from 2½ to 5 years -- is the next most important financial consideration. A final decision to purchase energy-saving devices or an energy management system would be made by building owners or boards of directors.

The view that all energy management system capabilities are related to one another emerged in this sector's discussion. One respondent stated that "everything mentioned...is important in reaching your decision." All but one of the suggested capabilities were rated as highly important, with "saves money" ranking most important. Rated least important was off-site monitoring.

This sector is currently being charged for electricity on demand, and therefore electrical demand and lighting control were listed as the two most important energy management functions. If time-of-day rates are instituted, this ranking would probably change.

In the abstract, energy management systems would be useful for the Los Angeles office sector; however, the respondents saw their energy conservation problems being solved largely by internal means and as inexpensively as possible. They have conducted successful educational programs with their tenants and made relatively inexpensive purchases which have realized substantial energy and cost savings. Certainly this sector's capital situation indicates a need for a lower front-end investment. A favorable change in the regional money supply or a subsidized long-term financing plan are possible solutions to this economic roadblock.

Market Research Findings:
Atlanta Office Buildings

GENERAL PROBLEM

-Severe

SPECIFIC PROBLEM

-Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

- TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM
 - Scientific Community
 - Academic Community
- HIGHLY ACCURATE SOURCES OF INFORMATION
 - Colleagues (#1)
- ACCURACY RATING OF MANUFACTURERS
 - Medium
- LEAST ACCURATE SOURCE OF INFORMATION
 - Attorneys
- HIGHLY INFLUENTIAL SOURCES OF INFORMATION
 - Co-workers (#1)
 - Colleagues
- INFLUENCE RATING OF MANUFACTURERS
 - Medium
- LEAST INFLUENTIAL SOURCE OF INFORMATION
 - Attorneys
- CONSTRAINTS
 - Economic
 - Cash-flow Problem
 - Market Situation
 - Human
 - Tenants' Attitudes
 - Technical
 - Individual Building Analysis
 - Projected State-of-the-Art
 - Regulatory
 - Potential Time-of-day Rates
 - Operating Clauses/Leases

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS

	Old Buildings	New Buildings
- Length of Payback Period	2/1	
- Availability of Capital	1/2	
- Tax Incentives	3/4	
- Initial Cost of Devices/Systems	4/2	

- MOST REASONABLE PAYBACK CRITERION

- 1 Year	*N = 1
- 2 Years	
- 2.5 Years	N = 1
- 3 Years	
- 4 Years	
- 5 Years	
- Other	

- AMOUNT WILLING TO SPEND

-Look at % of Total Operating/Energy Costs
--

DECISION-MAKING PROCESS: PURCHASING FACTORS

- Depends on Amount of Purchase
- Ultimately the Owner Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS

- Energy Management Systems	3
- Energy-saving Devices	2/1
- Procedural Changes	1/2
- Physical Plant Improvements	4

- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS

-Payback

- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS

-Saves Money (#1)
-Saves Energy
-Automated Control
-Ease of Operation
-Ease of Maintenance
-Ease of Security

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

● LEAST IMPORTANT CAPABILITY
OF AN AEMS	-Off-site Monitoring
● TWO MOST IMPORTANT FUNCTIONS
OF AN AEMS	-Electrical Demand Control
-Heating and Cooling
Control
● TWO LEAST IMPORTANT FUNCTIONS
OF AN AEMS	-Scheduled Equipment
Shutdown
-Burglar Alarm

Market Research Findings:
Atlanta Office Buildings

Representatives of the Atlanta office sector rated the nation's energy conservation problem as severe. They saw the nation as having the technological capabilities needed to solve the energy problem, and expressed the opinion that new energy resources, a "combination of nuclear and solar," will emerge. However, one respondent indicated the prevalence of an information gap in this sector:

"The reason [we rated the problem as severe] is that we don't have enough reliable data on which to base an absolute decision, because we're only able to base it upon the news media's supply of information to us, which is, of course, not necessarily the true facts."

Respondents also rated their sector's energy conservation problem as severe, noting specific problems of economics (property owners' need to provide competitive rental rates for their tenants) and attitudes (building tenants feel they are entitled to their own "comfort level").

Respondents were not able to reach consensus regarding the most effective methods to meet their building sector needs.

One respondent said that implementing procedural changes seemed to be the best approach -- "very energy conscious" -- but antiquated lease provisions which entitle tenants to specified comfort levels hinder implementation. One respondent said the installation of energy-saving devices (e.g., time clocks) would be most effective, and said he thought such devices would yield some 35 per cent in energy savings.

Respondents identified the scientific and academic communities as the most likely sources of solution to energy conservation problems. One respondent commented that "these were the places or sources I would look toward to solve the question of where is our next energy source or how will we provide energy to live and work twenty or thirty years from now "

Otherwise, respondents said they tend to seek out sources having first-hand experience and information on the subject. Colleagues were seen as providing the most accurate information, and both colleagues and co-workers are highly influential.

Constraints on this sector may be summarized as follows:

- (1) Economic Factors--Generally involve the overriding need to remain competitive in their marketplace; some facilities operate on marginal or negative cash flow, making costly energy saving measures infeasible.
- (2) Human Factors--Respondents said some building tenants express negative attitudes about energy conservation efforts, arguing that by paying their rent, they are entitled to a specified comfort level, usually somewhat above the conservation level.
- (3) Technical Factors--Respondents said extensive individual building analyses are needed to measure problems

and identify solutions; respondents expressed concern over the current state-of-the-art, as characterized by one respondent's comment that "while there are techniques on the market, perhaps there are better ones to come yet."

- (4) Regulatory Factors--Antiquated operating clauses in leases tend to thwart energy conservation efforts; time-of-day rates may replace demand billing in the sector, which may improve the prospect of effective conservation.

As to energy management cost recovery, one respondent said a one-year payback would seem most feasible, and indicated that payback is the most important financial factor. Another respondent was willing to consider a longer payback period (2½ years), but indicated that a lack of available capital would be the more important consideration. Building owners would make the final purchasing decision.

Saving money was rated as the most important energy management system capability. One respondent noted that "if you save money, you save energy [so] it's really the same thing." Automated control and ease of operation, maintenance, and security also rated as highly important. Off-site monitoring, while important for large office buildings, was regarded as not important for small buildings and was ranked the least important capability. Electrical demand control and heating and cooling were ranked number one and two, respectively.

While the need to place themselves competitively in the marketplace was of great concern to the individuals in the Atlanta

office building sector, these respondents face basically the same kinds of concerns as office sectors elsewhere -- economic and attitudinal problems. And although an automated energy management system could potentially solve some of those problems, such a determination cannot be made without first conducting careful individual analyses of the appropriate buildings.

Market Research Findings:
Boston Office Buildings

GENERAL PROBLEMS

-Severe

SPECIFIC PROBLEMS

-Severe

DECISION-MAKING PROCESS: GENERAL INFLUENCE FACTORS

- TWO MOST LIKELY SOURCES OF SOLUTION TO PROBLEM
 - Scientific Community
 - Business Community
- HIGHLY ACCURATE SOURCES OF INFORMATION
 - Manufacturers (#1)
 - Trade Journals
 - Colleagues
 - Department of Energy
- ACCURACY RATING OF MANUFACTURERS
 - High (#1)
- LEAST ACCURATE SOURCE OF INFORMATION
 - Attorneys
- HIGHLY INFLUENTIAL SOURCE OF INFORMATION
 - Manufacturers (#1)
 - Co-workers
 - Colleagues
 - Department of Energy
- INFLUENCE RATING OF MANUFACTURERS
 - High (#1)
- LEAST INFLUENTIAL SOURCE OF INFORMATION
 - Printed Media (e.g., Newspaper Advertisements)
- CONSTRAINTS
 - Economics
 - Energy Costs
 - Hardware Costs
 - Human
 - Public's Attitudes
 - Staff Efficiency

Regulatory
 -Tax Situation
 -Operating Clauses/Leases
 -Potential Time-of-day
 Rates

DECISION-MAKING PROCESS: ECONOMIC FACTORS

- RANK ORDER OF IMPORTANCE OF BROAD FINANCIAL CONSIDERATIONS
 - Length of Payback Period 1
 - Availability of Capital 3
 - Tax Incentives 2
 - Initial Cost of Devices/Systems 4
- MOST REASONABLE PAYBACK CRITERION
 - 1 Year
 - 2 Years
 - 2.5 Years *N = 3
 - 3 Years N = 1
 - 4 years
 - 5 Years
 - Other
- AMOUNT WILLING TO SPEND -\$30,000+

DECISION-MAKING PROCESS: PURCHASING FACTORS

-Depends on Amount of Purchase
 -Ultimately the Owner Makes the Decision

DECISION-MAKING PROCESS: TECHNICAL FACTORS

- RANK ORDER OF EFFECTIVENESS OF METHODS TO MEET NEEDS
 - Energy Management Systems 4
 - Energy-saving Devices 2
 - Procedural Changes 1
 - Physical Plant Improvements 2
- MOST IMPORTANT ELEMENT OF DEVICES/SYSTEMS -Payback

*N refers to the number of individuals responding a certain way and does not represent the responses of the total building sector group.

- HIGHLY IMPORTANT CAPABILITIES OF AN AEMS
 - Saves Money (#1)
 - Saves Energy (#1)
 - Automated Control
 - Manual Control
 - Ease of Operation
 - Ease of Maintenance
 - Ease of Security
 - Ease of Problem Identification
 - Flexibility
 - Over-ride
 - On-site Monitoring
- LEAST IMPORTANT CAPABILITY OF AN AEMS
 - Off-site Monitoring
- TWO MOST IMPORTANT FUNCTIONS OF AN AEMS
 - Electrical Demand Control
 - Heating & Cooling Control
- TWO LEAST IMPORTANT FUNCTIONS OF AN AEMS
 - Fire Alarm
 - Burglar Alarm

Market Research Findings:
Boston Office Buildings

Respondents from the Boston office sector rated the nation's energy conservation problem as severe, commenting that while some measures are being taken and untapped sources of energy exist, much remains to be done. Respondents also rated their own sector problem as severe. As one respondent commented:

"We feel that perhaps 75 to 80 per cent of the ability to conserve [energy] within the buildings has already been accomplished, so that we really have a very short distance to go to conserve further; [however, there is a problem in] policing the conservation program[s] we already put into effect and will continue to apply..."

The success that this sector has already experienced is due

to the most effective energy conservation method: the implementation of procedural changes. Respondents said that, although energy management systems might be valuable in some cases, they typically were deferring any decision until the public utilities decide whether or not to adopt time-of-day billing, currently under official consideration.

Respondents identified the scientific and business communities as the two most likely sources of solution to the energy conservation problem: The scientific community would provide the needed technological breakthroughs, and the business community would offer financial support--particularly for the scientific community to conduct its work. A "chicken-or-egg" issue was raised as sector members questioned whether financial incentives are needed to spur the production of needed technologies, or the technological development itself will increase the likelihood of financial incentives being provided.

Sector respondents indicated that manufacturers of energy-saving devices and energy management systems were regarded as the most accurate and influential source of energy conservation information. The respondents rated manufacturers' data as generally reliable (given that they have their own standards), but indicated that a knowledgeable person who understands that data is needed to analyze and verify the manufacturers' claims.

Constraints on this group in making energy conservation decisions are similar to those of other office building sectors and are summarized below:

- (1) Economic Factors--With energy costs continuing to rise, respondents expressed concern over finding additional avenues of saving after current practices have reached optimal effect; the cost of an energy management system was seen as being too high at the

current time, and one respondent noted that "...there may not be a system right now that we can afford [and] if we can't afford it, even though it exists, it really isn't going to meet the needs of our buildings."

- (2) Human Factors--The public was described as "very difficult to get moving" on energy conservation; also, respondents said building staffs are indifferent in policing existing energy conservation efforts.
- (3) Regulatory Factors--Respondents said a problem exists with current leases, which make it difficult to pass on increased operating costs to building tenants; proposed time-of-day utility rates could change current energy use habits and affect energy conservation/management problems and solutions.

Respondents generally agreed that they would be willing to pay \$30,000 or more for energy-saving devices or an energy management system, if it involves a short enough payback period. Respondents' general payback criterion was 2½ to 3 years. An expenditure of this magnitude would be made by the owner of a particular building, with the recommendation of the property manager.

All but one of the listed energy management system capabilities were rated as highly important, with off-site monitoring being ranked as the least important (although still of medium importance) capability.

Electrical demand and heating and cooling controls were ranked as the two most important functions an energy management system should have.

A general sector uncertainty about the future of energy conservation was epitomized in one respondent's comment:

"...the real issue...is what do we do for an encore?
What do we do when we've used up all the possible conservation approaches and we still have a problem...
...from that point on, we have to either start using less of it by making lower temperatures, or a whole bunch of other problems, or get different sources."

Total Office Sectors Summary

In all four regions of the country tested, the respondents from the office sectors rated the energy conservation problem in the nation as severe. The general consensus of these groups was that, while the problem is clearly a pressing one, some things are being done in the nation to save energy.

The energy conservation problem in this building sector is likewise generally severe. Respondents from the office sectors in each geographic region reported that they were vigorously addressing the problem and in some cases had achieved substantial success. They indicated that energy cost remains a problem, and tenants' attitudes towards the current conservation programs are frequently unfavorable.

Respondents from three of the four office sectors surveyed noted that the implementation of procedural changes in their buildings is the most effective method of energy conservation and energy management. This technical approach has met with reasonable success in the past and these three groups will continue to use it in the future. Respondents from the sector saw value in the installation of an energy management system (the Minneapolis group ranked it the most effective energy conservation method), although a variety of economic and technical constraints make this currently a less attractive approach to solving their energy-related problems.

These two areas of constraint--economic and technical--are reflected in respondents' ranking of possible sources of solution to the energy conservation problem. The scientific community (to provide technological answers) and the business community (to provide financial support) were the two sources of solution listed most often.

There were geographical differences when the importance of sources of information on energy conservation were explored. Minneapolis and Boston respondents reported that manufacturers both provide the most accurate information on energy conservation and are the most influential source of such information. The respondents from the Los Angeles and Atlanta sectors, however, look for more experiential sources, stating that co-workers provide the most accurate information and colleagues are the most influential information source.

Although many of the constraints faced by office buildings are similar to those faced by apartment and school buildings, it faces some specific operational limitations. These may be summarized as follows:

- (1) Economic Factors--Rising energy costs, cash-flow problems; lack of available capital; need to be competitive in the office building marketplace; expensive energy-saving hardware.
- (2) Human Factors--Tenants' negative attitudes toward energy-saving practices and programs; building personnel sometimes uncooperative with regard to energy conservation practices and programs.
- (3) Technical Factors--Need to conduct an individual analysis of each office building under consideration.
- (4) Regulatory Factors--Limiting operating clauses and leases; local codes.

Relative to the other building sectors included in this study--residential and educational--the office sector faces fewer constraints in meeting its energy conservation needs. Economics is the major area of concern, but its severity and impact could be reduced if a favorable payback period was demonstrated for an energy-saving purchase. The length of that payback period consistently was identified as the most important element of energy management systems. A payback period as short as 2½ years

for the total sector would ease the problem of convincing building owners that an energy management purchase should be made, even if the total price was \$30,000 or more. That final decision would be made by the owner of a particular office building.

Financial considerations entered strongly into respondents' rankings of important energy management system capabilities. Each of the four geographic regions ranked "saves money" as the most important system capability. Most other capabilities were also rated as being highly important. One Los Angeles respondent commented: "Everything mentioned there [i.e., each capability] is important in reaching your decision; it would be difficult to pick out anything, say, that's medium." Respondents typically saw an energy management system as a total, "complex package," and rated the system capabilities as such. They generally saw monitoring of such a system as occurring "right there at the building," particularly in a small office building; thus, off-site monitoring was ranked as the least important capability.

Electrical demand control was ranked as one of the two most important functions of an energy management system by three of the four office sectors, and heating and cooling control by two of those four. Other highly important functions varied by geographic region.

The office building sector appears to be the best potential market for an automated energy management system. As noted previously, this sector is faced with fewer constraints--in terms of both quantity and severity--than the other two sectors. Driven largely by financial considerations, this sector is generally sophisticated in its procurement, expenditure, and investment of capital. If a favorable payback period can be demonstrated regarding the purchase of an automated energy management system, this sector is more likely--and more able--than the other sectors to make such a purchase.

The Findings: All Sectors

Previous sections have detailed the findings for each individual building sector surveyed; further, a separate summary section has been presented outlining the findings for each of the three total building sectors--apartments, schools, and offices. This section represents the aggregation of all data for all sectors and allows the reader to look at differences between and similarities among the responses from the targeted building types.

MARKET RESEARCH FINDINGS: ALL SECTORS

APARTMENTS

SCHOOLS

OFFICES

GENERAL PROBLEM

SEVERE

BETWEEN
SEVERE AND
EXTREMELY
SEVERE

SEVERE

SPECIFIC PROBLEM

SEVERE

BETWEEN
SEVERE AND
EXTREMELY
SEVERE

SEVERE

DECISION-MAKING PROCESS:
GENERAL INFLUENCE FACTORS

• TWO MOST LIKELY
SOURCES OF SOLUTION
TO PROBLEM

-SCIENTIFIC
COMMUNITY
-MANUFAC-
TURERS

-FEDERAL
GOVERNMENT
-THE PUBLIC

-SCIENTIFIC
COMMUNITY
-BUSINESS
COMMUNITY

MARKET RESEARCH FINDINGS: ALL SECTORS

	<u>APARTMENTS</u>	<u>SCHOOLS</u>	<u>OFFICES</u>
● <u>MOST ACCURATE SOURCES OF INFORMATION</u>	-TRADE JOURNALS -COLLEAGUES	-TRADE JOURNALS	-MANUFACTURERS -COLLEAGUES
● <u>ACCURACY RATINGS OF MANUFACTURERS</u>	-HIGH	-HIGH -MEDIUM	-HIGH -MEDIUM
● <u>LEAST ACCURATE SOURCES OF INFORMATION</u>	-ATTORNEYS -TAX CONSULTANTS	-PRINTED MEDIA -ATTORNEYS	-ATTORNEYS
● <u>MOST INFLUENTIAL SOURCES OF INFORMATION</u>	-MANUFACTURERS -CO-WORKERS -BANKERS & INVESTORS	-COLLEAGUES -CO-WORKERS	-MANUFACTURERS -CO-WORKERS
● <u>INFLUENCE RATINGS OF MANUFACTURERS</u>	-HIGH	-HIGH -MEDIUM	-HIGH -MEDIUM
● <u>LEAST INFLUENTIAL SOURCES OF INFORMATION</u>	-ATTORNEYS -TAX CONSULTANTS	-ATTORNEYS -TAX CONSULTANTS	-ATTORNEYS -PRINTED MEDIA

MARKET RESEARCH FINDINGS: ALL SECTORS

	<u>APARTMENTS</u>	<u>SCHOOLS</u>	<u>OFFICES</u>
● <u>CONSTRAINTS</u>	<u>ECONOMICS</u>	<u>ECONOMICS</u>	<u>ECONOMICS</u>
	-AVAILABLE CAPITAL	-AVAILABLE CAPITAL	-AVAILABLE CAPITAL
	-ENERGY COSTS	-TAX REVENUES	-ENERGY COSTS
	-CASH-FLOW PROBLEM	-CASH-FLOW PROBLEM	-CASH-FLOW PROBLEM
	-MARKET SITUATION	-LACK OF INCENTIVES	-MARKET SITUATION
	-INVESTMENT PRACTICES		-HARDWARE COSTS
	<u>HUMAN</u>	<u>HUMAN</u>	<u>HUMAN</u>
	-TENANTS' ATTITUDES	-STUDENTS' ATTITUDES	-TENANTS' ATTITUDES
	-OWNERS' ATTITUDES	-STAFF'S ATTITUDES	-STAFF'S ATTITUDES
	-STAFF'S EFFICIENCY	-STAFF'S EFFICIENCY	-STAFF'S EFFICIENCY
	-LANGUAGE PROBLEM	-PUBLIC'S ATTITUDE	-PUBLIC'S ATTITUDE
		-LANGUAGE PROBLEM	
		-CLASS PROBLEM	

MARKET RESEARCH FINDINGS: ALL SECTORS

● CONSTRAINTS
(CONT.)

APARTMENTS

SCHOOLS

OFFICES

TECHNICAL

TECHNICAL

TECHNICAL

-BLDG. AGE

-INDIVIDUAL
BLDG. ANA-
LYSIS

INDIVIDUAL
BLDG. ANA-
LYSIS

-BLDG. SIZE

-BLDG. AGE

-BLDG. AGE

-TECHNOLOGY-
PRODUCT IN-
TERFACE

*-CURRENT
STATE-OF-
THE-ART

-BLDG. SIZE

-PROJECTED
STATE-OF-
THE-ART

-PROJECTED
STATE-OF-
THE-ART

-POTENTIAL
NEW ENERGY
SOURCES

GENERAL

GENERAL

GENERAL

-LACK OF
PRODUCT/
SOLUTION
UNDERSTANDING

-LACK OF
PRODUCT/
SOLUTION
UNDERSTANDING

-LACK OF
PRODUCT/
SOLUTION
AWARENESS

-PUBLIC
SECTOR
POLITICS

-SCHOOL BOARD
POLITICS

-TIME REQUIRED
FOR PURCHASE
APPROVAL

MARKET RESEARCH FINDINGS: ALL SECTORS

	<u>APARTMENTS</u>	<u>SCHOOLS</u>	<u>OFFICES</u>
● <u>CONSTRAINTS</u> (CONT.)	<u>REGULATORY</u>	<u>REGULATORY</u>	<u>REGULATORY</u>
	-TAX SITU- ATION	-BUYING-ON- TIME RE- STRICTIONS	-TAX SITU- ATION
	-OPERATING CLAUSES/ LEASES	-PUBLIC WORK/ UTILITIES REQUIRE- MENTS	-OPERATING CLAUSES LEASES
	-RENT CONTROL		-CITY CODES
	-CITY CODES		-POTENTIAL TIME-OF-DAY RATES
	-POTENTIAL TIME-OF-DAY RATES		

MARKET RESEARCH FINDINGS: ALL SECTORS

APARTMENTS

SCHOOLS

OFFICES

DECISION-MAKING PROCESS:

ECONOMIC FACTORS

● TWO MOST IMPORTANT
BROAD FINANCIAL
CONSIDERATIONS

-AVAILABILITY
OF CAPITAL

-LENGTH OF
PAYBACK
PERIOD

-LENGTH OF
PAYBACK
PERIOD

-LENGTH OF
PAYBACK
PERIOD

-INITIAL COST
OF DEVICES/
SYSTEMS

-AVAILABILITY
OF CAPITAL

● MOST REASONABLE
PAYBACK CRITERION

- 1 YEAR

*N = 1

N = 3

N = 1

- 2 YEARS

N = 2

N = 1

N = 1

- 2.5 YEARS

N = 2

N = 9

- 3 YEARS

N = 1

N = 1

- 4 YEARS

N = 1

- 5 YEARS

N = 1

N = 1

N = 1

- DEPENDS ON
SITUATION

N = 3

- COST MORE
IMPORTANT

N = 1

*Ns refer to the number of individuals responding a certain way and do not represent the responses of the total building sector group.

MARKET RESEARCH FINDINGS: ALL SECTORS

APARTMENTS

SCHOOLS

OFFICES

● AMOUNT WILLING TO SPEND

-NO CONSISTENCY; DEPENDENT ON A WIDE
 RANGE OF INTER-RELATED FACTORS --
 BUILDING SPECIFICATIONS AND NEEDS,
 PAYBACK PERIOD, AVAILABLE CAPITAL,
 TOTAL OPERATING/ENERGY COSTS, ETC.

DECISION-MAKING PROCESS: PURCHASING FACTORS
--

-DEPENDS ON
 AMOUNT OF
 PURCHASE

-DEPENDS ON
 AMOUNT OF
 PURCHASE

-DEPENDS ON
 AMOUNT OF
 PURCHASE

-ULTIMATELY
 THE OWNER

-ULTIMATELY
 THE SCHOOL
 BOARD

-ULTIMATELY
 THE OWNER

MARKET RESEARCH FINDINGS: ALL SECTORS

APARTMENTS

SCHOOLS

OFFICES

DECISION-MAKING PROCESS:
TECHNICAL FACTORS

● MOST EFFECTIVE METHODS
TO MEET NEEDS

-PROCEDURAL
CHANGES

-PROCEDURAL
CHANGES

-PROCEDURAL
CHANGES

-ENERGY-
SAVING
DEVICES

-ENERGY-
SAVING
DEVICES

-ENERGY-
SAVING
DEVICES

-PHYSICAL
PLANT
IMPROVEMENTS

● MOST IMPORTANT ELEMENT
OF DEVICES/SYSTEMS

-PAYBACK

-FUNCTIONS

-PAYBACK

MARKET RESEARCH FINDINGS: ALL SECTORS

	<u>APARTMENTS</u>	<u>SCHOOLS</u>	<u>OFFICES</u>
● <u>MOST IMPORTANT CAPABILITY OF AN AEMS</u>	-SAVES MONEY	-SAVES ENERGY -SAVES MONEY	-SAVES MONEY -SAVES MONEY AND ENERGY
● <u>LEAST IMPORTANT CAPABILITY OF AN AEMS</u>	-OFF-SITE MONITORING	-OFF-SITE MONITORING -ON-SITE MONITORING	-OFF-SITE MONITORING

MARKET RESEARCH FINDINGS: ALL SECTORS

	<u>APARTMENTS</u>	<u>SCHOOLS</u>	<u>OFFICES</u>
● <u>MOST IMPORTANT FUNCTIONS OF AN AEMS</u>	-HEATING & COOLING CONTROL -LIGHTING CONTROL -ECONOMIZER VENTILATION CONTROL	-HEATING & COOLING CONTROL -LIGHTING CONTROL -ELECTRICAL DEMAND CONTROL -SCHEDULED EQUIPMENT SHUTDOWN	-ELECTRICAL DEMAND CONTROL -HEATING AND COOLING CONTROL -LIGHTING CONTROL -ECONOMIZER VENTILATION CONTROL -ENTHALPY VENTILATION CONTROL
● <u>LEAST IMPORTANT FUNCTIONS OF AN AEMS</u>	-BURGLAR ALARM -FIRE ALARM -ENTHALPY VENTILATION CONTROL -VENTILATION SHUTOFF	-BURGLAR ALARM -FIRE ALARM	-BURGLAR ALARM -FIRE ALARM -SCHEDULED EQUIPMENT SHUTDOWN

Market Research Findings:

All Sectors

Respondents from the three building sectors included in this study believed that the energy conservation problem--both in the country as a whole and in their own particular building sectors--is severe. Respondents noted that while some things were being done to conserve energy, much more needed to be done to attain improvement of energy conservation.

These sectors are at a relatively early stage of development regarding programs and procedures to save energy in their operations. Respondents identified the implementation of procedural changes and the installation of energy-saving devices as the two most effective methods currently used or anticipated. Not only were these methods ranked as the most effective, but they also represent the smallest capital outlay for the respondents. As will be discussed in the final chapter of this report, it should not be inferred from the data that the installation of an energy management system would not aid sector members in meeting their energy conservation needs. Rather, the sectors' stage of development and ability to pay for such an energy management system tend to be limiting factors when such purchases are considered. Respondents have generally been able to realize substantial savings by utilizing the two approaches they rated as most effective, and will continue to use these approaches until the fullest amount of cost and energy savings are realized.

When more general sources of solution to the energy conservation problem are explored, a split between the sectors begins to surface. This split may be described as a private-public split.

Private sector respondents believed that solutions to their energy conservation problems would lie in the areas of technical research and development from the scientific community, and implementation and commercialization from the manufacturers of energy-saving devices. The public sector looks toward the federal government and the public (i.e., taxpayers) as the two most likely sources of solution to their problems.

This split is less evident when the various sources of information regarding energy conservation are explored. It is important to note, however, that with one exception those sources which are seen as providing the most accurate information are not those sources which are most influential to these sectors. There are two distinct dimensions that are reflected in the respondents' ratings of both the most accurate and the most influential sources of information. The first such dimension is one of technical understanding and knowledge, as reflected by the importance of trade journals and manufacturers to these sectors as accurate sources of energy-related information. The same two dimensions appear in the respondents' rankings of the most influential sources of energy-related information. Manufacturers are seen as that source which will provide the equipment to meet the particular building needs of these sectors, and co-workers--defined as those people with whom an individual works on a day-to-day basis--are seen as providing important information based on first-hand activities.

Tax consultants and attorneys are lumped together as being both the least accurate and least influential source of information on the subject, a group judged as knowing very little about energy-related issues. Manufacturers were rated either as medium or high in terms of their accuracy and their level of influence; some respondents expressed a feeling that the data provided by a manufacturer was slanted in favor of his own

product and therefore should be carefully scrutinized.

When the constraints faced by these sectors are carefully examined, the complexity of the marketplace becomes clear. Economics is the most pressing problem faced by all building sectors. Each sector noted that the lack of available capital was a problem in their operation. Beyond this commonly shared problem, other economic constraints are defined along the private-public split mentioned previously. The private sector complained of rising energy costs and a difficulty in passing them on to tenants. This sector also faces a problem with the marketplace in that both residential and commercial tenants seek the best rental rate structure for their own operations. In some situations this means that a tenant will move out of an apartment building or office building in order to secure that better rate. The public sector, while faced with the same problem of lack of available capital and the related negative cash-flow problem, is different from the private sector in that they are totally dependent upon the tax revenues for their yearly allocations. This sector cannot raise taxes the same way the private sector can raise rents, and the amount of money available for energy-related expenditures for schools is frequently fixed on an annual budget.

Each of the three sectors face substantial problems regarding the attitudes of the people in their buildings--tenants in the private sector and the students, teachers, and staff in the school building sector. While these programs have met with general success regarding energy saved, they have also been met with a lack of cooperation and negative response on the part of the tenants. It was noted by the respondents that many people really don't feel the energy problem is real and are not willing to make sufficient sacrifices in order to lessen the severity of that problem. Respondents also reported that some tenants feel that while some sacrifices need to be made in order to conserve energy,

the managers and owners of the buildings are moving either too quickly or too aggressively. Another problem shared by all three sectors is one of the efficiency of the maintenance personnel in the buildings themselves. These people are generally unsophisticated, untrained individuals and any energy-saving devices or system that would be installed in these buildings would have to account for this factor.

From a technical point of view, there was agreement among all three sectors that an individual analysis of each building under consideration must be conducted in order to determine differing needs. A number of state-of-the-art concerns were also expressed by the respondents. In one case it was noted that while the technology currently exists to solve the energy conservation needs, the products that translate that technology into real life solutions do not exist. Some respondents also expressed a concern about the projected state of the art in energy conservation, noting that energy-saving hardware may well be both more effective and cheaper in the future. As long as people have these concerns in mind, they tend to put off the decision to purchase an energy-saving system.

Respondents from both sectors also perceived legal or legislative constraints as interfering with the introduction of energy conservation measures. In the private sector, rising tax costs are passed on to their tenants in the same fashion as tenants bear the costs of more expensive energy: their rent goes up. Respondents from this sector complained of antiquated operating clauses and leases that made it difficult to institute the kind of energy-saving practices that the property managers and owners would like. For example, a clause may read that a certain temperature level should be maintained, where an optimal energy conserving level would be two to four degrees lower than that. Respondents from this sector also criticized restrictive city codes regarding ventilation and temperature requirements. The public sector respondents also face certain constraints

that may impede the adoption of energy conservation techniques. School boards set an annual fixed budget, and school systems have that fixed amount of money that they can spend in energy conservation areas. If a particular need arises during the course of a year, respondents claimed, the school board would have to be solicited in order to reallocate that fixed budget. (Ideally, the school systems would be able to anticipate their energy conservation needs a year or two in advance so that the yearly allocations reflect those needs; respondents stated that this is often difficult or impossible to do.)

Some general constraints were also voiced by the respondents. Some people are not aware of the devices or systems currently on the market that could meet their needs; others are aware of that hardware, but the data provided by the manufacturers on the operation of those devices or systems is not clearly understood. The school sector again faces a situation of making an energy-related purchase decision within a potentially political arena. A school board member, for example, may have a particular program that he or she would like to see pursued. If this is the case, the appropriate committees within the school system have to be concerned about that individual's request as well as the technical aspects of such a purchase decision. Finally, school systems require a lengthy lead time for the approval of a major capital expenditure.

In either sector, the length of the payback period is crucial. Given a good payback period--generally speaking, 2½ years--most respondents felt that they could make a stronger argument to their building owners or school boards to make an energy-related purchase.

There was no consistency, however, either within or between the building sectors, on how much should reasonably be spent on such a purchase. Such a decision would depend on a range of factors--building specifications and needs, payback period, availability of capital, total operating and energy costs, and

so forth. Some respondents indicated that they would be willing to spend more than \$30,000 on such a purchase, given an attractive payback period and available credit. Others surveyed noted that they would spend only \$1,000 to \$3,000 on such a purchase.

The final decision to make such a purchase would depend on the price. A purchase of an expensive energy management system would ultimately be made by the owners of apartment and office buildings or by the school board.

The private sector, driven by a strong profit motive, ranked the length of the payback period as the most important element. School respondents, however, identified the functions of the hardware as the most important consideration. Each of the three sectors surveyed indicated that the manufacturer's brand name was not an important consideration as long as the device or system paid itself back in a reasonable amount of time and performed those functions which were important to the particular building needs.

Saving money was identified as the most important capability of an automated energy management system. Some individuals noted that saving energy was equally important; however, these people understood that if the system served the former need, it would also serve the latter. Most other system capabilities were also ranked as highly important. The general notion was that those capabilities could not be split apart, that an energy management system was a total, "complex package." Most respondents ranked off-site monitoring as the least important energy management system capability. In the small buildings surveyed in this study, most buildings had a person on-site to monitor the equipment. (It was noted that off-site monitoring is an important capability for a larger operation, but not really needed in the small building sectors.)

Comfort and lighting control functions were rated the two most important functions of an AEMS. There was some differentiation

among geographic locations and building types as to other important functions, as has been described in previous tables and profiles. There was general consensus that the fire alarm and burglar alarm functions were least important.

What now can be said about all the participants of these focus-group discussions? A number of conclusions seem warranted. First, all the sectors surveyed appear to be at a rudimentary stage of development with regard to meeting their energy conservation needs. All sectors seem to have attempted generally successful educational programs in their operations. As long as the participants are able to realize energy and cost savings through conservation, it is likely that they will continue along the same lines. The real question for this study is: what will these people do when the fullest possible amount of savings are realized? Some of the respondents noted that whenever this occurs, energy costs will still be rising and the sources of energy will still be largely untapped. What these sectors will do at that time is still unknown. Some of the respondents did note, however, that an energy management system would help their energy conservation practices. Exactly when the marketplace will be more receptive to such a system is unclear. There will be some time in the future, however, when these sectors will need to conserve more energy and save more money than they are able to do through their current practices.

Secondly, there was strong consensus among all sectors that individual analysis of each building under consideration should be conducted in order to determine the exact energy conservation needs and energy conservation solutions for those buildings.

Thirdly, respondents said that they wanted a demonstration and a guarantee that the system would both function effectively and offer a favorable payback period. This concern is related to the problem mentioned previously, namely, that the information

provided by manufacturers is often seen as slanted towards the sale of that particular system. If such a guarantee did exist, some of the wariness to purchase such a system would be removed and the likelihood that such a system would be purchased would be increased. A demonstration project would ideally come from a credible source such as an independent testing laboratory or agency.

Implications for Market Research Strategies

A number of practical market research implications emerge from this study.

1. DOE should encourage and/or provide an easily administered analytical technique for individual buildings to determine their exact energy conservation and energy management needs and potential solutions.

The relevant factors include the age and size of the building, the required payback, purchase price and the methods deemed most effective to solve those energy conservation problems. Given the demonstrated need to provide impartial, objective data on energy conservation and management, the analytical technique could be a "self-administered" form that would be available from lending institutions, professional associations, testing laboratories, independent agencies, and both federal and state governments. Such techniques should have, as part of their output, estimates of payback and financial benefit.

2. DOE and its major contractors should identify and work with those sources of information on energy conservation deemed by the users to be most influential.

A demonstration of the effectiveness of an AEMS should be provided by those sources of information which were viewed as accurate and influential. Such a demonstration might occur by manufacturers cooperating with trade journals to develop informative articles in trade journals, as manufacturers regarded as influential in developing hardware solutions to energy problems and trade journals are viewed as providing impartial, unbiased information. Another strategy might involve

users of energy management systems being interviewed on the effectiveness of their systems for a trade journal article. A relationship might also be developed between an outside, independent expert in the area and one or more visible, influential users of such a system.

3. DOE and its contractors should encourage development of an energy management system which requires the lowest possible initial investment.

As noted throughout this report, the economic problems facing all three sectors are the major constraints towards purchasing an automated energy management system. One of the most pressing problems is the lack of available capital to make such a purchase. If such a system were offered under specific leasing arrangements or an installment plan, the likelihood may well increase that these people would purchase such a system. Governmental leadership should also occur in this area, for example in establishing mortgaging policies and tax breaks which would make the purchase of an energy management system more attractive to the potential purchaser.

4. DOE and its contractors should continue and intensify energy educational programs directed to building tenants.

The problem of building tenants' negative response to aggressive energy conservation programs was noted in all building sectors. To overcome this problem, it is suggested governments assume an aggressive leadership position regarding the establishment of model education programs. Such programs would address the public

apathy problem by objectively detailing the national energy conservation situation; the public must be convinced that this problem is real. Any educational program which is developed should address market-specific problems, for example the language problem (particularly with Spanish-speaking people) observed in California.

5. DOE should encourage energy management system design to emphasize operational simplicity.

All sectors interviewed demand operational simplicity. Training manuals should be developed for all levels of AEMS users, which describe the functions of the particular equipment as well as the management needs of operating such a system.

6. DOE and its contractors should design energy management systems to address important features, e.g., comfort and lighting controls, and avoid unimportant system features, e.g., fire and burglar alarms.

Comfort and lighting control were rated the two most important system functions. There was also general consensus that the inclusion of a burglar alarm and fire alarm in an automated energy management system was simply not needed; these functions are often fulfilled by independent systems in the respondents' operation.

7. DOE should encourage the development of specific marketing strategies for different market segments.

Although both geographic and building type differences were observed, sector concerns dominate geographic ones. For example, the school sector appears to be

able to tolerate a longer payback period than the private sector. Payback and tax incentives may also operate differentially among various sectors. Similarly a number of geographic considerations must be included in the marketing plan; for example, the issue of diminishing gas supplies is particularly important in California but less so in other markets. Each market faces its own local codes and restrictions (for example, in the areas of ventilation and temperature levels required) and these restrictions should be known before trying to make a sale.

8. DOE and its contractors should consider national or regional demonstrations of energy management system effectiveness.

A strategy should be developed whereby a credible and legitimate installation of an automated energy management system will be accepted by the market as being the optimal solution to those particular markets' energy conservation problems. Timing is particularly important here. Given the relatively early stage of development regarding energy conservation practices, today may not be the best time to try to convince potential purchasers that an AEMS is truly needed. It does appear, however, that some time in the future such an argument can be strongly and accurately made.

Recommendations for Further Research

The economic issues related to the purchase of an automated energy management system are the most pressing problems regarding the marketability of an AEMS. Many of the design-related questions have been answered; the features to be included in a basic automated energy management system are known. Phase Two of this study will examine more closely those economic factors, focusing particularly on payback and cost requirements for the purchase of this system. Both the design and specific questionnaire to be used in this second phase have been presented to Honeywell Inc. and can be found in Appendix D of this report.

APPENDIX A

FOCUS-GROUP PARTICIPANTS BY
BUILDING SECTOR AND GEOGRAPHICAL REGION

APARTMENTS: MINNEAPOLIS

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
T. BACKSTROM	ASST. V.P.	EBERHARDT COMPANY	MANAGER, RESIDENTIAL PROPERTY MANAGEMENT DIVISION
R. WILLIAMS	VICE PRESIDENT	MARIL MANAGEMENT	PROPERTY MANAGEMENT

APARTMENTS: LOS ANGELES

C. FREMED	PROPERTY MANAGER	CORLISS & ASSOCIATES	SUPERVISE MAINTENANCE/ REPAIR OPERATIONS: APARTMENT PREPARATION AND RENTAL
R. SANDLIN	ENERGY COORDINATOR	R & B DEVELOPMENT	DEVISE, ACQUIRE, IMPLEMENT, AND MAINTAIN ALL ENERGY CONSERVATION DEVICES/ SYSTEMS
R.S. TUCKER	PROPERTY MANAGER	ROQUE & MARK COMPANY	MAINTAIN APARTMENT BUILDINGS AND TENANTS

APARTMENTS: BOSTON

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
G. LEWIS	VICE PRESIDENT	NILES COMPANY, INC.	PROPERTY MANAGEMENT
M. ROTENBERG	PRESIDENT	REDMART ASSOCIATES	PROPERTY MANAGEMENT

SCHOOLS: MINNEAPOLIS

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
S. CHASNEY	PRESIDENT	CHASNEY ASSOCIATES, INC.	CONSULTANT--DESIGN OF NEW MECHANICAL AND ELECTRICAL SYSTEMS, ENERGY STUDIES, ETC.
F. CHRISTIANSEN	DIRECTOR OF SCHOOL MANAGEMENT SERVICE	DEPARTMENT OF EDUCATION (STATE)	SCHOOL DISTRICT ORGAN- IZATION, PLANNING, AND OPERATION
E. EVERETTS	ASSOC. V. CHANCELLOR FACILITY PLANNING & MANAGEMENT	MINNESOTA COMMUNITY COLLEGE SYSTEM	COORDINATE PLANNING, CON- STRUCTION, MAINTENANCE OF FACILITIES
D. PRYOR	ASSISTANT SUPER. FOR BUSINESS SERVICES	INDEPENDENT SCHOOL DISTRICT #273	TOTAL RESPONSIBILITY FOR BUILDINGS AND GROUNDS

SCHOOLS: LOS ANGELES

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
L.G. BURLESON	ENERGY MANAGEMENT & UTILIZATION COOR- DINATOR	LOS ANGELES UNIFIED SCHOOL DISTRICT	DEVELOP, IMPLEMENT, EVALUATE ENERGY MANAGEMENT CONCEPTS
J.P. ROSE	H/AC TECHNICAL SUPERVISOR	LOS ANGELES UNIFIED SCHOOL DISTRICT	COORDINATE EFFORTS OF SEVERAL MAINTENANCE AREAS; ASSIST IN PLANNING/EVALUATION OF ENERGY CONSER- VATION EFFORTS

SCHOOLS: ATLANTA

J.O. KNUCKLES	DIRECTOR, BUREAU OF ENERGY MANAGEMENT	ATLANTA PUBLIC SCHOOLS	CREATE AWARENESS OF ENERGY CRISIS WITH STUDENTS, STAFF, COMMUNITY; PROMOTE ENERGY CONSERVATION CAMPAIGNS
J.E. LAROWE	COORDINATOR: SCHOOL PLANT PLANNING	ATLANTA PUBLIC SCHOOLS	COORDINATE DESIGN OF SCHOOLS BETWEEN OWNER/USER AND ARCHITECT; LONG- RANGE PLANNING

SCHOOLS: ATLANTA (CONT.)

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
J.A. MARTIN	MECHANICAL ENGINEER	ATLANTA PUBLIC SCHOOLS	ELECTRICAL AND MECHANICAL EQUIPMENT SPECIFI- CATIONS; REVIEW INSTALLATIONS
C.A. NAHSE	SCHOOL ARCHITECT	ATLANTA PUBLIC SCHOOLS	DESIGN AND CONSTRUCTION OF SCHOOL FACILITIES
D.W. WOMACK	ASST. SUPER., FACILITIES SERVICE	ATLANTA PUBLIC SCHOOLS	FACILITY PLANNING AND CONSTRUCTION; BUILDING OPERATION AND HOUSEKEEPING; ENERGY CONSERVATION; REAL ESTATE MANAGE- MENT

OFFICE BUILDINGS: MINNEAPOLIS

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
G. CIRKS	MAINTENANCE SUPER- VISOR	SHELARD COMPANIES, INC.	OVERSEES ALL MAINTENANCE FOR OFFICE COMPLEX
M. HUGHES	V.P. & MANAGER COMMERCIAL PROPERTY MANAGEMENT & LEASING	EBERHARDT COMPANY	MANAGER OF COMMERCIAL DEPARTMENT
N.D. JOHNSON	VICE PRESIDENT	L G S CONCORD CORP.	IN CHARGE OF RENTAL OF COMMERCIAL PROPERTIES
G. MARHOUN	CHIEF ENGINEER	TOWLE REAL ESTATE CO.	OVERSEES ALL MAINTENANCE OF MECHANICAL/ ENERGY EQUIPMENT
M. MILES	VICE PRESIDENT, PROPERTY MANAGEMENT	SHELARD COMPANIES, INC.	LEASING; HANDLES ALL NEGOTIATIONS WITH TENANTS

OFFICE BUILDINGS: LOS ANGELES

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
V. BURROLA	PROJECT COORDINATOR	CONTINENTAL SERVICE COMPANY	COORDINATION OF BUILDING PROJECTS FOR BANK OF AMERICA
N.L.F. GULLETT	SUPER. OF BLDG. OPERATIONS: SO. CALIFORNIA	CONTINENTAL INSURANCE COMPANY	IN CHARGE OF ALL BUILDING OPERATIONS/PROCEDURES
J. TANNER	ASSISTANT V.P.	CALIFORNIA FEDERAL SAVINGS	PROPERTY MANAGEMENT AND CONSTRUCTION

OFFICE BUILDINGS: ATLANTA

L.J. BURDULIS	PROJECT MANAGER	ADAMS CATES	TOTAL RESPONSIBILITY FOR OPERATION OF OFFICE BUILDINGS/ PARKS
R.W. FREEL	GENERAL MANAGER PROPERTIES	AFCO REALTY ASSOCIATES	PROPERTY MANAGEMENT; MANAGE SMALL OFFICE BUILDINGS/PARKS

OFFICE BUILDINGS: BOSTON

<u>NAME</u>	<u>TITLE</u>	<u>COMPANY</u>	<u>RESPONSIBILITIES</u>
I. KLOCZKOWSKI	PLANT SUPERVISOR	PEMBERTON MANAGEMENT COMPANY	HVAC MAINTENANCE
D.W. NORDBECK	VICE PRESIDENT	MEREDITH & GREW	IN CHARGE OF MANAGEMENT DEPARTMENT
G. POTTER	PROPERTY MANAGER	C.W. WHITTIER & BROTHERS	LEASING-TENANT LIAISON
J.D. WHITE	BUILDING MANAGER	PEMBERTON MANAGEMENT COMPANY	BUILDING MANAGEMENT

APPENDIX B

FOCUS GROUP MATERIALS

FOCUS-GROUP ACTIVITY #1

NASA INDIVIDUAL AND GROUP EXERCISES

NASA EXERCISE INDIVIDUAL WORKSHEET

INSTRUCTIONS:

You are a member of a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. Due to mechanical difficulties, however, your ship was forced to land at a spot some 200 miles from the rendezvous point. During landing, much of the equipment aboard was damaged, and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200-mile trip. Below are listed the 15 items left intact and undamaged after landing. Your task is to rank order them in terms of their importance to your crew in allowing them to reach the rendezvous point. Place the number 1 by the most important item, the number 2 by the second most important, and so on, through number 15, the least important. You have 5 minutes to complete this phase of the exercise.

- _____ Box of Matches
- _____ Food Concentrate
- _____ 50 Feet of Nylon Rope
- _____ Parachute Silk
- _____ Portable Heating Unit
- _____ Two .45 Calibre Pistols
- _____ One Case Dehydrated Pet Milk
- _____ Two 100-lb Tanks of Oxygen
- _____ Stellar Map (of Moon's Constellation)
- _____ Life Raft
- _____ Magnetic Compass
- _____ 5 Gallons of Water
- _____ Signal Flares
- _____ First Aid Kit containing Injection Needles
- _____ Solar-powered FM Receiver-Transmitter

NASA EXERCISE GROUP WORKSHEET

This is an exercise in group decision-making. Your group is to employ the method of Group Consensus in reaching its decision. This means that the prediction for each of the 15 survival items must be agreed upon by each group member before it becomes a part of the group decision. Consensus is difficult to reach. Therefore, not every ranking will meet with everyone's complete approval. Try as a group to make each ranking one with which all group members can at least partially agree. Here are some guides to use in reaching consensus:

1. Avoid arguing for your own individual judgements. Approach and avoid conflict. Support only solutions with which you are able to agree somewhat, at least.
2. Avoid changing your mind only in order to reach agreement and avoid conflict.
3. Avoid 'conflict-reducing' techniques such as majority vote, averaging, or trading in reaching your decision.
4. View differences of opinion as helpful rather than as a hinderance in decision-making.

_____	Box of Matches
_____	Food Concentrate
_____	50 Feet of Nylon Rope
_____	Parachute Silk
_____	Portable Heating Unit
_____	Two .45 Calibre Pistols
_____	One Case Dehydrated Pet Milk
_____	Two 100-lb Tanks of Oxygen
_____	Stellar Map (of Moon's Constellation)
_____	Life Raft
_____	Magnetic Compass
_____	5 Gallons of Water
_____	Signal Flares
_____	First Aid Kit Containing Injection Needles
_____	Solar-powered FM Receiver-Transmitter

FOCUS-GROUP ACTIVITY #2

VIEWGRAPH PRESENTATION

1.

IN THE OPINION OF YOUR GROUP, HOW SEVERE IS
THE NATION'S ENERGY CONSERVATION PROBLEM?

4 = EXTREMELY SEVERE

3 = SEVERE

2 = SOMEWHAT SEVERE

1 = NOT SEVERE

2.

IN THE OPINION OF YOUR GROUP, HOW SEVERE IS THE
ENERGY CONSERVATION PROBLEM IN YOUR BUILDING SECTOR?

4 = EXTREMELY SEVERE

3 = SEVERE

2 = SOMEWHAT SEVERE

1 = NOT SEVERE

3.

LISTED BELOW ARE SOME SOURCES WHICH COULD SOLVE ENERGY CONSERVATION PROBLEMS IN YOUR BUILDING SECTOR. RANK ORDER THESE SOURCES ACCORDING TO THE LIKELIHOOD THAT EACH WILL SOLVE YOUR ENERGY CONSERVATION PROBLEMS. PLACE THE NUMBER 1 NEXT TO THE SOURCE WHICH YOUR GROUP FEELS IS THE MOST LIKELY TO SOLVE YOUR ENERGY CONSERVATION PROBLEMS, FOLLOWED BY THE NEXT MOST LIKELY SOURCE, AND SO ON:

- _____ FEDERAL GOVERNMENT
- _____ STATE GOVERNMENTS
- _____ SCIENTIFIC COMMUNITY
- _____ ACADEMIC COMMUNITY
- _____ BUSINESS COMMUNITY
- _____ MANUFACTURERS OF ENERGY-SAVING DEVICES/
SYSTEMS
- _____ CONSUMER-ADVOCACY GROUPS
- _____ THE PUBLIC

LISTED BELOW ARE FOUR BASIC METHODS OF CONSERVING ENERGY IN SMALL BUILDINGS. RANK ORDER THESE METHODS ACCORDING TO THE EFFECTIVENESS EACH WOULD HAVE IN MEETING YOUR ENERGY CONSERVATION NEEDS. PLACE THE NUMBER 1 NEXT TO THE METHOD WHICH YOUR GROUP FEELS WOULD BE THE MOST EFFECTIVE, FOLLOWED BY THE NEXT MOST EFFECTIVE METHOD, AND SO ON:

- _____ IMPLEMENT PROCEDURAL CHANGES (E.G.,
TURNING OFF UNUSED LIGHTS)
- _____ INSTALL ENERGY-SAVING DEVICES (E.G.,
NIGHT SET-BACK THERMOSTAT)
- _____ INSTALL ENERGY MANAGEMENT SYSTEMS
- _____ MAKE PHYSICAL PLANT IMPROVEMENTS
(E.G., INSULATION)

5.

LISTED BELOW ARE A NUMBER OF STATEMENTS REGARDING ENERGY CONSERVATION AND ENERGY MANAGEMENT. ARE THESE STATEMENTS YOUR GROUP WOULD CONSIDER IN PLANNING TO MEET THE ENERGY CONSERVATION AND ENERGY MANAGEMENT NEEDS OF YOUR BUILDING(S)?

ANSWER YES OR NO FOR EACH STATEMENT.

STATEMENT #1: CURRENT ENERGY-SAVING TECHNIQUES ARE SUFFICIENT TO MEET MY ENERGY CONSERVATION AND ENERGY MANAGEMENT NEEDS. _____

STATEMENT #2: AT THE PRESENT TIME, THERE ARE TOO MANY UNKNOWNS ABOUT ENERGY MANAGEMENT SYSTEMS FOR ME TO BUY SUCH A SYSTEM. _____

STATEMENT #3: ENERGY MANAGEMENT SYSTEMS WILL BE MORE EFFECTIVE IN THE FUTURE THAN THEY ARE TODAY. _____

STATEMENT #4: ENERGY MANAGEMENT SYSTEMS WILL BE CHEAPER IN THE FUTURE THAN THEY ARE TODAY. _____

STATEMENT #5: THERE IS NO NEED FOR AN ENERGY MANAGEMENT SYSTEM IN MY BUILDING. _____

STATEMENT #6: PEOPLE ARE NOT WILLING TO MAKE SACRIFICES IN ORDER TO CONSERVE ENERGY. _____

STATEMENT #7: PEOPLE DON'T FEEL THE ENERGY CONSERVATION PROBLEM IS REAL. _____

STATEMENT #8: ENERGY MANAGEMENT SYSTEMS WHICH COULD MEET THE ENERGY CONSERVATION NEEDS OF MY BUILDING(S) ARE NOT ON THE MARKET TODAY. _____

6.

LISTED BELOW ARE A NUMBER OF ELEMENTS OF ENERGY-SAVING DEVICES OR SYSTEMS. RANK ORDER THESE ELEMENTS ACCORDING TO HOW IMPORTANT EACH IS IN PLANNING TO MEET YOUR ENERGY CONSERVATION NEEDS. PLACE THE NUMBER 1 NEXT TO THE ELEMENT YOUR GROUP FEELS IS MOST IMPORTANT, FOLLOWED BY THE NEXT MOST IMPORTANT ELEMENT, AND SO ON:

- _____ FUNCTIONS OF SUCH DEVICES/SYSTEMS
(E.G., NIGHT SETBACK)
- _____ CAPABILITIES OF SUCH DEVICES/SYSTEMS
(E.G., OFF-SITE MONITORING)
- _____ QUALITY OF SUCH DEVICES/SYSTEMS
- _____ COST OF SUCH DEVICES/SYSTEMS
- _____ PAYBACK PERIOD OF SUCH DEVICES/SYSTEMS
- _____ MANUFACTURER OF SUCH DEVICES/SYSTEMS

7.

LISTED BELOW ARE SOME FINANCIAL CONSIDERATIONS WHICH MIGHT
EFFECT HOW YOU PLAN TO MEET YOUR ENERGY CONSERVATION NEEDS.
RANK ORDER THESE CONSIDERATIONS ACCORDING TO THEIR IMPORTANCE
TO YOU IN PLANNING TO MEET YOUR ENERGY CONSERVATION NEEDS.
PLACE THE NUMBER 1 NEXT TO THE CONSIDERATION YOUR GROUP
FEELS IS MOST IMPORTANT, FOLLOWED BY THE NEXT MOST IMPORTANT,
CONSIDERATION, AND SO ON:

_____ TAX INCENTIVES

_____ LENGTH OF PAYBACK PERIOD

INITIAL COST OF ENERGY SAVING DEVICES
OR SYSTEMS

_____ AVAILABILITY OF CAPITAL

8.

LISTED BELOW ARE SOME SOURCES OF INFORMATION ON ENERGY CONSERVATION. RANK ORDER THESE SOURCES ACCORDING TO THE ACCURACY OF THE INFORMATION WHICH THEY PROVIDE. PLACE THE NUMBER 1 NEXT TO THE SOURCE YOUR GROUP FEELS PROVIDES THE MOST ACCURATE INFORMATION, FOLLOWED BY THE NEXT MOST ACCURATE SOURCE, AND SO ON:

- _____ CO-WORKERS
- _____ COLLEAGUES IN MY FIELD
- _____ PRINTED MEDIA (E.G., NEWSPAPER ADVERTISEMENTS)
- _____ DEPARTMENT OF ENERGY
- _____ TRADE ASSOCIATIONS
- _____ TRADE JOURNALS
- _____ MANUFACTURERS OF ENERGY-SAVING DEVICES
OR SYSTEMS
- _____ LOCAL HVAC CONTRACTORS
- _____ TAX CONSULTANTS
- _____ ATTORNEYS
- _____ BANKERS AND INVESTORS

LISTED BELOW ARE SOME SOURCES OF INFORMATION ON ENERGY CONSERVATION. RANK ORDER THESE SOURCES ACCORDING TO HOW INFLUENTIAL EACH WILL BE IN PLANNING TO MEET YOUR ENERGY CONSERVATION NEEDS. PLACE THE NUMBER 1 NEXT TO THE SOURCE YOUR GROUP FEELS IS MOST INFLUENTIAL, FOLLOWED BY THE NEXT MOST INFLUENTIAL SOURCE, AND SO ON:

- _____ CO-WORKERS
- _____ COLLEAGUES IN MY FIELD
- _____ PRINTED MEDIA (E.G., NEWSPAPER ADVERTISEMENTS)
- _____ DEPARTMENT OF ENERGY
- _____ TRADE ASSOCIATIONS
- _____ TRADE JOURNALS
- _____ MANUFACTURERS OF ENERGY-SAVING DEVICES
OR SYSTEMS
- _____ LOCAL HVAC CONTRACTORS
- _____ TAX CONSULTANTS
- _____ ATTORNEYS
- _____ BANKERS AND INVESTORS

10.

ASSUME YOUR ORGANIZATION IS AT THE POINT OF DECIDING
TO BUY OR NOT TO BUY ENERGY-SAVING DEVICES OR AN ENERGY
MANAGEMENT SYSTEM.

WHO WILL MAKE THAT DECISION?

11.

ASSUME YOU HAVE MADE THE DECISION TO PURCHASE ENERGY-SAVING DEVICES OR AN ENERGY MANAGEMENT SYSTEM. LISTED BELOW ARE SOME CAPABILITIES SUCH DEVICES AND SYSTEMS MIGHT PROVIDE. RANK ORDER THESE CAPABILITIES ACCORDING TO HOW IMPORTANT EACH IS TO YOUR PARTICULAR SITUATION. PLACE THE NUMBER 1 NEXT TO THE CAPABILITY YOUR GROUP FEELS IS MOST IMPORTANT, FOLLOWED BY THE NEXT MOST IMPORTANT CAPABILITY, AND SO ON:

- _____ AUTOMATED CONTROL
- _____ MANUAL CONTROL
- _____ EASE OF PROBLEM IDENTIFICATION
- _____ SAVES MONEY
- _____ SAVES ENERGY
- _____ OVER-RIDE FROM AUTOMATED CONTROL TO MANUAL CONTROL
- _____ FLEXIBILITY TO MEET PARTICULAR BUILDING NEEDS
- _____ ON-SITE MONITORING
- _____ OFF-SITE MONITORING
- _____ EXPANDABILITY TO MEET FUTURE NEEDS
- _____ EASE OF OPERATION
- _____ EASE OF MAINTENANCE
- _____ EASE OF SECURITY

12.

ASSUME YOU HAVE MADE THE DECISION TO PURCHASE ENERGY-SAVING DEVICES OR AN ENERGY MANAGEMENT SYSTEM. LISTED BELOW ARE SOME FUNCTIONS SUCH DEVICES AND SYSTEMS MIGHT PROVIDE. RANK ORDER THESE FUNCTIONS ACCORDING TO HOW IMPORTANT EACH IS TO YOUR PARTICULAR SITUATION. PLACE THE NUMBER 1 NEXT TO THE FUNCTION YOUR GROUP FEELS IS MOST IMPORTANT, FOLLOWED BY THE NEXT MOST IMPORTANT FUNCTION, AND SO ON:

- _____ BURGLAR ALARM
- _____ FIRE ALARM
- _____ SCHEDULED EQUIPMENT SHUTDOWN
- _____ ENTHALPY VENTILATION CONTROL
- _____ ECONOMIZER VENTILATION CONTROL
- _____ ELECTRICAL DEMAND CONTROL
- _____ VENTILATION SHUT-OFF
- _____ LIGHTING CONTROL
- _____ HEATING AND COOLING CONTROL (E.G., OPTIMAL START AND STOP TIME)

13.

ASSUME YOU HAVE MADE THE DECISION TO PURCHASE ENERGY-SAVING DEVICES OR AN ENERGY MANAGEMENT SYSTEM. WHAT IS THE MOST REASONABLE PAYBACK CRITERION FOR PURCHASING SUCH DEVICES OR A SYSTEM?

- 1 YEAR
- 2.5 YEARS
- 4 YEARS
- 5 YEARS
- OTHER PERIOD OF TIME

ASSUME YOU HAVE MADE THE DECISION TO PURCHASE ENERGY-SAVING DEVICES OR AN ENERGY MANAGEMENT SYSTEM. HOW MUCH WOULD YOU BE WILLING TO PAY FOR SUCH DEVICES OR A SYSTEM?

- \$1,000
- \$2,500
- \$5,000
- \$7,500
- \$10,000
- \$15,000
- \$20,000
- \$25,000
- \$30,000
- MORE THAN \$30,000

FOCUS-GROUP ACTIVITY #3

CURRENT AND PROJECTED ENERGY-SAVING PRACTICES

Name: _____

Sector: _____

45 possible steps to save energy are listed on the attached sheets. Consider for a moment the various steps you currently use to save energy in your building(s). Read through the list and place a "C" in the left-hand margin next to each step you currently use. If there are steps you currently use which are not listed, please list those steps in the spaces provided and place a "C" next to them.

Then, consider the various steps you plan to use in the future to save energy in your building(s). Read through the list and place a "P" in the left-hand margin next to each step you plan to use. Again, if there are steps you plan to use which are not listed, list those steps in the spaces provided and place a "P" next to them.

45 Steps to Save Energy

1. Reduce lighting.
2. Reduce room temperatures in winter; increase room temperatures in summer.
3. Schedule operations during non-peak times (early morning or evening hours).
4. Lower hot water temperatures.
5. Lower water pressure.
6. Keep boilers, furnaces and air conditioning units on even settings.
7. Keep windows closed when heater or air conditioner is being used.
8. Turn off all electrically powered units when not in use.
9. Replace incandescent bulbs with flourescent bulbs.
10. Clean lights.
11. Clean heater.
12. Increase use of photoelectric cells (e.g. for parking lots, advertisements, etc.).
13. Shut off all mechanical equipment not essential to maintaining minimum night setback space temperatures.
14. Reduce elevator service.
15. Check dampers to see if operating properly.
16. Periodically check entire temperature control system.
17. Reduce use of heating and cooling systems in spaces which are used infrequently or only for short periods of time.
18. Turn heat and air conditioning off during last hours of occupancy.

19. Reduce heat in garages.
20. Consider closing outside air dampers during the first and last hours of occupancy and during peak loads.
21. Reduce air volume to meet minimum requirements; therefore, reducing fan power input requirements.
22. Raise supply air temperatures during the cooling season and reduce them during the heating season.
23. Lower hot deck temperature and raise cold deck temperature.
24. Utilize revolving doors for the front entrance.
25. Make delivery entrances smaller.
26. Install adjustable outdoor shading devices, such as sunshades.
27. Reglaze with double or triple-glazing, or with heat absorbent and/or reflective glazing materials.
28. Add reflective materials to the window side of draperies.
29. Use opaque or translucent insulating materials to block off and thermally seal all unused windows.
30. Install storm windows and storm doors where practical.
31. Insulate.
32. Test, adjust and balance entire air distribution system.
33. Add additional shut-off valves for more efficient zone control.
34. Update and modernize control systems.
35. Add controls to shut-down air and water to unoccupied space.
36. Limit use of reheat to areas where humidity control is needed.
37. Install thermostats for control of all heating equipment.
38. Install night set-back and morning start-up controls so heating and cooling of each zone can be scheduled based upon occupancy patterns.

39. Install program clocks and manual overall timers in control circuits.
40. Modify piping so cooling coil is used for both heating and cooling.
41. Install demand reset controls to regulate hot and cold deck temperatures.
42. Reduce air flow.
43. Use time control lighting for areas of building used infrequently.
44. Apply caulking.
45. Apply weatherstripping.
- 46.
- 47.
- 48.
- 49.
- 50.

FOCUS-GROUP ACTIVITY #4

PERSONAL DATA SHEET

NAME: _____

SECTOR REPRESENTING: _____

FIRM: _____

TITLE: _____

RESPONSIBILITIES: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

TELEPHONE: _____

APPENDIX C

RAW DATA: CURRENT AND
PROJECTED ENERGY-SAVING PRACTICES

Note: Each "C" represents one individual who is using a specific practice at the current time.

Each "P" represents one individual who is planning to use a specific practice in the future.

Initials	Date
Prepared By	
Approved By	

LINE NO.	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
	APTS. MPS	APTS. LA	APTS. ATL	APTS. BOS	SCH. MPS	SCH. LA	SCH. ATL	SCH. BOS	OFF. MPS	OFF. LA	OFF. ATL	OFF. BOS					
1		1. Reduce lighting.	C	CCC		CC			CC	CCCCC			CCC	CC	CCCC		
2																	
3																	
4		2. Reduce room temperatures in winter;	C	CC		CC			CC	CCCCC			CCC	CC	CCCC		
5		increase room temperatures in summer.															
6																	
7																	
8		3. Schedule operations during non-peak		CC		C			C		C		CC	CC	CC		
9		times (early morning or evening hours).	P						P								
10																	
11																	
12		4. Lower hot water temperatures.	C	CCC		CC			CC	CC			CC	CC	CCCC		
13																	
14																	
15		5. Lower water pressure.	C	CC													
16																	
17																	
18		6. Keep boilers, furnaces and air	C	CC		C			CC	CC			CC	CC	CCC		
19	151	conditioning units on even settings.	P						P								
20																	
21																	
22																	
23																	
24		7. Keep windows closed when heater or		C		C			CC	CCCCC			CCC	CC	CCCC		
25		air conditioner is being used.				P											
26																	
27																	
28																	
29		8. Turn off all electrically powered	C	CC		C			CC	CCCCC			CCC	CC	CCCC		
30		units when not in use.	P			P											
31																	
32																	
33																	
34		9. Replace incandescent bulbs with		C		C			CC	CCCC			CC	CC	CC		
35		flourescent bulbs.		P		P									P		
36																	
37																	
38																	
39		10. Clean lights.	CC	CC					C	CCCCC			CCC	CC	C		
40									P								
41																	
42		11. Clean heater.	CC	CC		CC			C	CCCC			CCC	CC	CC		
43									P								

[illegible]

	Initials	Date
Prepared By		
Approved By		

[illegible]

	APT. MPS	APT. LA	APT. ATL	APT. BOS	SCH. MPS	SCH. LA	SCH. ATL	SCH. BOS	OFF. MPS	OFF. LA	OFF. ATL	OFF. BOS
30. Install storm windows and storm doors where practical.	C P	C		C			P				P	
31. Insulate.	C P	CC		C P		P	C PPP			CC	C P	C P
32. Test, adjust and balance entire air distribution system.	C P	CC		P		C	CC P			CCC	CC	C P
33. Add additional shut-off valves for more efficient zone control.	C P	C		C		P	C PPP			C	CC	CC
Update and modernize control systems.	C P	CC		CC PP		C P	PPPP			CC P	C P	C
35. Add controls to shut-down air and water to unoccupied space.	C	P				C P	PP			P	C P	C P
36. Limit use of reheat to areas where humidity control is needed.							P			C	P	CC
37. Install thermostats for control of all heating equipment.	C P	CC P		C P		C	C PPP			CC	C P	CC
38. Install night set-back and morning start-up controls so heating and cooling of each zone can be scheduled based upon occupancy patterns.	C	CC		C P			CC PP			C P	CC	CCC

APPENDIX D

PHASE TWO DESIGN AND QUESTIONNAIRE

PHASE TWO DESIGN

The questionnaire was sent to representatives of apartments, schools, and offices as well as the original 32 focus-group respondents.

The apartment and office building sample was chosen from the membership directory of the Institute of Real Estate Management (IREM). School representatives were chosen from the membership list of the Association of School Business Officials (ASBO). IREM members received two (2) questionnaires to cover the possibility that one individual managed both apartments and offices.

The number of individuals to whom questionnaires were sent is presented in Table D-1.

TABLE D-1
PHASE TWO SAMPLING

	<u>Number of Individuals to whom Questionnaires Were Sent</u>	<u>Number of Questionnaires Sent</u>
IREM	3,436	6,872
ASBO	2,326	2,326
Original Focus- Group Respondents	<u>32</u>	<u>32</u>
TOTALS	5,794	9,230

PHASE TWO QUESTIONNAIRE

INTRODUCTION

The Department of Energy has sponsored a national research project examining the energy conservation problems facing three building types: (1) apartments, (2) schools, and (3) offices. This questionnaire focuses on an automated energy management system as one possible way of solving small building energy conservation problems.

INSTRUCTIONS

Read each of the following sections carefully and answer the questions before moving on to the next section. This form has been pre-tested with people like yourself and should take no longer than 10 minutes to complete. Please take these few minutes to complete the questionnaire TODAY and return it in the enclosed return envelope.

I. Individual Information

Name: _____ Title: _____

Organization: _____

Responsibilities: _____

- Your Building Sector would be called (Check one):

- ☐ Apartment Buildings
- ☐ School Classroom Buildings
- ☐ Office Buildings - Owner Occupied
- ☐ Office Buildings - Tenant Occupied

How many total buildings are you responsible for? _____ Bldgs.

How many buildings of that total are 75,000 sq. ft. or less? _____ Bldgs.

II. Building Information

Of all the small buildings (i.e., 75,000 sq. feet or less) in your current total operation, choose that building which is typical of the total and describe that building along the following dimensions. If you are responsible for both apartments and offices, please fill out one questionnaire for each building type.

- Building Age (Check one):

- ☐ 1-10 years
- ☐ 11-20 years
- ☐ 21-30 years
- ☐ 31-40 years
- ☐ 41-50 years
- ☐ 51 years or older

- Building Size (Check one):

- ☐ 10,000 sq. feet or less
- ☐ 10,001 - 25,000 square feet
- ☐ 25,001 - 50,000 square feet
- ☐ 50,001 - 75,000 square feet

- HVAC System Type (Check one):

- ☐ Single Zone
- ☐ Variable Volume Re-Heat
- ☐ Dual Duct Mixing Boxes
- ☐ Through the Wall Units

- ☐ Terminal Re-Heat
- ☐ Multizone
- ☐ Induction Units
- ☐ Other (Please specify) _____

For each utility type used, what were your energy bills for the "typical" building for the calendar year 1977?

● Utility Type

Electricity	\$ _____
Natural Gas	\$ _____
Liquefied Petroleum Gas	\$ _____
Distillate (#2) Fuel Oil	\$ _____
Residual (#6) Fuel Oil	\$ _____
Coal	\$ _____
Steam	\$ _____

Are these energy bill figures ☐ actual data, or ☐ an estimate? Check one).

III. Basic Automated Energy Management System

One of the ways being considered today to meet the energy conservation needs of a small building is to install an automated energy management system. When considering such an installation, it is assumed that no-cost and low-cost energy saving procedures and equipment are already in operation. The installation of an automated energy management system is assumed to provide a higher level of control by offering functions not normally used and adding improvements over current operations or equipment. The specific features of such a system will vary according to each individual building. However, for the purposes of this questionnaire, assume that the BASIC SYSTEM will, on the average, save 20% of your current energy bill.

ASSUME:

- (1) Your organization is going to purchase the BASIC SYSTEM as described above to be used in your "typical" building; and
- (2) the energy rates for that building will be those projected for your State by the Federal Energy Administration as shown in the table on the back page of this questionnaire.

GIVEN THESE ASSUMPTIONS, please answer the following questions by filling in the appropriate blanks or checking the appropriate boxes.

1. Based on my "typical" building, the Federal Energy Administration rate projections, and the assumed performance of the BASIC SYSTEM, I would be willing to pay \$ _____ (total installed price) for that system.
2. Based on the price above, my preferred purchase method would be:

☐ outright cash purchase
☐ installment purchase
3. (Answer only if you checked "installment purchase" above.)
 Under an installment plan, I would be willing to pay
 \$ _____ down and \$ _____ per month for the BASIC SYSTEM.

- 4 I would rather lease or rent the BASIC SYSTEM than purchase it outright:
- ☐ yes
☐ no
5. I would rather lease or rent the BASIC SYSTEM than purchase it on an installment plan:
- ☐ yes
☐ no
6. (Answer only if you answered YES to #4 or #5 above.)
I would be willing to pay \$ _____ per month to lease or rent the BASIC SYSTEM.
7. An energy monitoring and control service which provided all the energy savings of the BASIC SYSTEM but was operated off-site (off my premises) by a building maintenance or control company would be (Check one):
- ☐ less desirable than the purchase of the BASIC SYSTEM.
☐ as desirable as the purchase of the BASIC SYSTEM.
☐ more desirable than the purchase of the BASIC SYSTEM.
8. I would be willing to pay \$ _____ per month for such a service.
9. I would most likely purchase the BASIC SYSTEM from:
- ☐ Local HVAC Contractor
☐ Manufacturer of the system
☐ Other (please specify) _____

10. For purchases of systems or services of the type described, I would generally expect that they would pay for themselves, through savings, in about _____ months.

PROJECTED TOTAL PERCENTAGE CHANGE IN ENERGY RATES FROM 1977 TO 1990

FEA REGION # STATES UTILITY TYPE	I	II	III	IV	V	VI	VII	VIII	IX	X
	ME, NH VT, RI CT, MA	NY, NJ	PA, DE MD, VA WV, DC	NC, SC GA, FL KY, TN AL, MS	MI, OH IN, WI MN, IL	AR, LA OK, TX NM	IA, MO NE, KS	ND, SD MT, WY CO, UT	NV, AZ CA, HI	ID, WA OR, AK
Electricity	+ 4%	(-1%)	+ 8%	+ 9%	+12%	+32%	+12%	+11%	+15%	+28%
Natural Gas	+53%	+56%	+65%	+97%	+105%	+131%	+150%	+140%	+89%	+68%
Liquified Petroleum Gas (LPG)	+10%	+24%	+36%	+43%	+40%	+39%	+37%	+31%	+28%	+30%
Distillate (#2) Fuel Oil	-15%	+21%	+24%	+25%	+25%	+24%	+24%	+22%	+17%	+19%
Residual (#6) Fuel Oil	+18%	+21%	+27%	+28%	+19%	+25%	+15%	+15%	+ 5%	+ 5%
Coal	+30%	+38%	+52%	+47%	+38%	(-5%)	+17%	+33%	+ 2%	+59%

Note: The above figures are projections based on averaging individual Federal Energy Administration projections. Projections for Steam were not available. Computations were made in constant (Base Year 1977) dollars.

**AUTOMATED ENERGY MANAGEMENT
SYSTEMS FOR SMALL BUILDINGS**

**PHASE TWO: PRICING AND RELATED
VARIABLES FOR MARKETING AN AEMS
(A MAIL SURVEY)**

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Introduction

As energy prices rise, energy resources dwindle, and the cost impact on all segments of the building market becomes increasingly severe, more attention is being paid to the benefits of energy-saving systems. The large building market segment -- both commercial and residential -- has received most of the attention of companies with such energy-saving offerings. Only recently have these suppliers begun to focus on energy management systems for smaller buildings -- here defined as 75,000 square feet or less. An important question currently facing these suppliers addresses the feasibility, within the small building market, of successfully marketing such an energy-saving system.

Based on current technical plans and computer-simulated engineering estimates, an automated energy management system (AEMS) can be designed and installed in small buildings with resultant 20 per cent or more savings in energy costs. Although such substantial savings are possible, sales of these systems are not sufficiently large to have attracted the traditional control systems houses such as Honeywell, Johnson and Powers to announce a small building offering. Is there a wide-spread lack of product awareness on the part of potential users? Have suppliers not yet determined the most effective means of entering and penetrating the market? Are economic constraints within users' operations so severe that the required capital outlay is impossible to secure?

It is within the context of such questions that a two-part market research study was undertaken. Examining the energy conservation and energy management operations of apartment,² school, and office buildings,¹ the first phase of the study highlighted those factors which constrain individuals from purchasing an AEMS and presented marketing strategies which could increase the likelihood that such a purchase would be made.

Although comprehensive in its coverage of many aspects of the AEMS marketing problem, first-phase data which related to the

¹In the aggregate, these three building types represent the majority of square footage, energy consumed, and total number of buildings of the small building market.

²Jolosky, T. Automated Energy Management Systems for Small Buildings, Phase I: Focus Group Final Report. Vols. I-V. Marketec, Inc.: Minneapolis, MN, 1978.

most appropriate pricing strategies for entering the small building marketplace proved inconclusive. The need to determine such strategies forms the basis of this study.

Research Objectives

The objectives of this study are listed below:

- (1) Determine how much potential purchasers are willing to pay for an automated energy management system which would save 20 per cent of their current energy use.
- (2) Determine potential purchasers' payback criteria for the purchase of an automated energy management system.
- (3) Determine potential purchasers' preferred method of obtaining an automated energy management system.
- (4) Determine those variables which are related to how much potential purchasers are willing to pay for an automated energy management system.

Research Methodology

Research Design and the Samples

A questionnaire (see Appendix A) drawing on Phase I findings and tapping the dimensions of the Phase II research objectives was designed and mailed to a sample of 5,794 individuals from the apartment, school, and office building sectors. There were three distinct sample segments: (1) members of the Institute of Real Estate Management (IREM); (2) members of the Association of School Business Officials (ASBO); and (3) participants of the first-phase focus groups.

The entire 3,400-plus membership of IREM was mailed two questionnaires -- one for apartment buildings and one for office buildings. In the aggregate, these individuals manage one-fourth of all apartments and one-fifth of all office space in the United States.³ Over 2,300 school business officials received questionnaires. Business managers, directors of physical plant, and

³Institute of Real Estate Management 1978 Membership Directory.
Institute of Real Estate Management, Chicago: 1978.

superintendents comprised the primary grouping of school representatives sampled. All 32 individuals who participated in Phase I focus-group discussions also received questionnaires.

Appendix B illustrates the number of individuals to whom questionnaires were sent and the total number of questionnaires which were mailed out as broken out by sample category.

The Returns

Some 542 questionnaires were returned, of which 524 contained sufficient information for inclusion in the study (a 9 per cent return rate). Approximately one-half of the 524 responses came from respondents within the school building sector; the remaining questionnaires were almost evenly distributed between respondents from apartment and office buildings.

Appendix C sets forth the number of individuals who returned questionnaires and the number of questionnaires returned as broken out by sample category. Appendix D depicts the number of questionnaires returned for each building sector.

The Findings

Descriptors of the Respondents

Because there were rather severe limitations in both time and budget, the sample in this study could not be constructed to represent building representatives chosen at random in the U.S. Rather, the sample on which this report is based probably tends to be more sophisticated than a random sample since it was drawn from building management "professionals."

A number of characteristics descriptive of the respondents and their "typical" buildings were examined in this study. Most importantly, the respondents were directly involved in small building management and operation. On the average, the individuals sampled were each responsible for 30 buildings which are 75,000 square feet or less. It seems reasonable to conclude that the information provided by the respondents is therefore based on extensive first-hand knowledge of and experience with small building operations.

Further, individuals generally chose new, mid-sized buildings as a frame of reference for their marketing-oriented responses. About two-thirds of the people sampled chose buildings less than 20 years old and 10,000 to 50,000 square feet in size as most typical of the buildings they manage. The age distribution of buildings described in this study closely parallels the age distribution of all buildings in the United States as inventoried

TABLE I

Average Total Utility Costs and Cost Per Square Foot (in Dollars)
By Building Sector and Building Size

	<u>Apartment Buildings</u>		<u>School Buildings</u>		<u>Office Buildings</u>		<u>Total Sample</u>	
	Total Cost	Cost/ ft. ²	Total Cost	Cost/ ft. ²	Total Cost	Cost/ ft. ²	Total Cost	Cost/ ft. ²
Buildings ^a 10,000 sq. ft. or less	\$ 7,394	\$.98	\$ 7,182	\$.95	\$ 4,897	\$.65	\$ 6,643	\$.88
Buildings ^b 10,001 - 25,000 sq. ft.	\$15,923	\$.90	\$66,893	\$3.82	\$30,127	\$1.72	\$41,160	\$2.35
Buildings ^c 25,001 - 50,000 sq. ft.	\$11,989	\$.31	\$40,041	\$1.06	\$40,140	\$1.07	\$36,412	\$.97
Buildings ^d 50,001 - 75,000 sq. ft.	\$66,211	\$1.05	\$76,788	\$1.22	\$60,401	\$.96	\$71,092	\$1.13

^a 7,500 ft.² was used as an "average" building in this size range.

^b 17,500 ft.² was used as an "average" building in this size range.

^c 37,500 ft.² was used as an "average" building in this size range.

^d 62,500 ft.² was used as an "average" building in this size range.

in previous work.⁴

Table I presents total utility costs and utility costs per square foot for each building sector and building size. Figures 1 and 2 graphically illustrates the same findings. This data demonstrates the generally expected linear relationship between total utility costs and building size -- as the former increases, so does the latter. Further, most buildings fall within the expected range of \$.40 to \$1.65 utility costs per square foot.⁵ Some exceptions to this pattern were observed, however. The reasons for these exceptions are unclear, but are most likely explained by variables not explored in this study (e.g., certain school buildings might operate at night and on weekends or might have instituted very few energy- and cost-saving procedures).⁶

A complete description of the total sample as broken out by building sector -- including geographic distribution, HVAC system type, and average costs of each individual utility type -- is presented in Appendix E.

Penetration Into and Placement Within
the Marketecplace: Cost

Aggregating the data across all the building types represented, the average value that the total sample reported being willing to spend was \$11,499 for an automated energy management system with the capabilities as described in the questionnaire. Table II presents the spending data for both the total sample and each building sector.

TABLE II

Average Amount Willing to Spend for an AEMS:
By Total Sample and Building Sector

	<u>Apartment Buildings</u>	<u>School Buildings</u>	<u>Office Buildings</u>	<u>Total Sample</u>
Average Amount Willing to Spend	\$6,978	\$11,758	\$14,538	\$11,499
Number of Respondents*	72	177	92	341

*On the average, each of the respondents manages 30 buildings.

⁴Burns, N.M., Foster, S., and Sidley, N.A. National Existing Building Inventory. Marketec, Inc.: Minneapolis, 1976.

⁵As per Downtown and Suburban Office Building Experience Exchange Report, Building Owners and Managers International, 1977 and personal correspondence with Mr. Louis G. Burleson, Energy Management and Utilization Coordinator, Los Angeles Unified School District, Los Angeles, California, July, 1978.

⁶The age and geographic distribution of specific building categories (particularly schools 10,001 - 25,000 square feet) closely parallels the distributions of the total sample and appear not to explain the observed variation.

Figure 1

Average Annual Total Utility Costs(1977):
By Building Sector and Building Size

FIGURE 2

Average Annual Utility Costs Per Square Foot (1977)
By Building Sector and Building Size

Average
Annual Utility
Costs 'Per
Square Foot
(\$)

KEY:

A = Apartment Buildings

S = School Buildings

O = Office Buildings

T = Total Sample

Building Size (Square Feet)

These findings closely parallel the patterns observed in Phase I of the study and may well reflect the sector differences regarding the amount of available disposable capital and level of investment sophistication described in that work.⁷

A further differentiation was observed within the office building sector as reflected in Table III.

TABLE III

Average Amount Willing to Spend for an AEMS:
By Office Building Segments

	Office Bldgs. Owner Occupied	Office Bldgs. Tenant Occupied	Office Bldgs. Owner and Tenant Occupied	Total Office Bldgs.
Average Amount Willing to Spend	\$8,276	\$15,614	\$20,397	\$14,538
Number of Respondents*	20	62	10	92

More detailed research exploring these differences between office groupings is planned for the near future.

Table IV presents data on amount willing to spend broken out further -- by building sector and building size.

TABLE IV

Average Amount Willing to Pay for an AFMS (in Dollars):
By Building Sector and Building Size

	<u>Apartment Buildings</u>	<u>School Buildings</u>	<u>Office Buildings</u>	<u>Total Sample</u>
Buildings 10,000 ft. ² or less	\$ 3,489	\$ 5,100	\$ 2,258	\$ 3,519
Buildings 10,001-25,000 ft. ²	\$ 5,692	\$ 8,557	\$ 9,452	\$ 8,191
Buildings 25,001-50,000 ft. ²	\$ 8,408	\$13,286	\$10,334	\$12,083
Buildings 50,001-75,000 ft. ²	\$12,919	\$12,147	\$27,835	\$17,808

*On the average, each of the respondents manages 30 buildings.

⁷Jolosky, T. op. cit.

For the purpose of pricing an AEMS, the average value the sample would be willing to spend is perhaps not as useful as the distribution of responses. Figure 3 shows the percentage of the sample who would be willing to pay specific amounts for an automated energy management system. This figure allows a determination of the portion of potential markets which could be captured by pricing an energy-saving system at a specific value. For example, pricing an AEMS at \$11,500 (the average figure for the total sample) will capture only 28 per cent of the total market. Further, such a pricing decision would capture 41 per cent of the office market, but only 18 per cent of the apartment group. Different purchasing patterns between sectors are clearly demonstrated, and the data presented in Figure 3 strongly suggest different pricing strategies for different market segments.

A following section of this report will demonstrate that building size is the primary demographic characteristic which is closely related to how much people are willing to spend for an AEMS. Figure 4 illustrates a general pattern: the larger the building an individual operates, the more money the individual is willing to spend for such a system.

Penetration Into and Placement Within the Marketplace: Payback

A second factor which strongly influences an individual's purchasing decision is the length of time the product will pay for itself through increased operational efficiency and cost savings.

A 2½-year payback criterion is often suggested in professional journals and forums. Further, the first phase of this study provided general support for this criterion being employed by individuals in the field. Second-phase data painted a different picture, demonstrating that a substantial number of respondents are willing to go with a longer payback period. The average payback period for the total sample is 42 months (3½ years); the average sector responses were: 37 months for offices, 38 months for apartments, and 46 months for schools.

Table V and Figures 5 and 6 present the payback data, examining differences between building sectors and building sizes. As Figure 5 indicates, a 2½ year payback period would capture 63 per cent of the total market; increasing that period to 39 months would still result in a favorable response from 50 per cent of the total sample. Again, some sector differences were observed. The first-phase assertion that schools are willing to go along with a longer payback period is supported by these Phase II findings. Size differences in required payback criteria are presented in Figure 6, indicating a general pattern of longer payback being acceptable as buildings increase to 50,000

FIGURE 3

Cumulative Percentage of Respondents Willing to
Spend at Least the Amount Shown for an AEMS:
By Building Sector

FIGURE 4

Average Amount Willing to Spend for an AEMS
By Building Sector and Building Size

FIGURE 5

Cumulative Percentage of Respondents Willing to
Accept at least the Payback Period Shown for an AEMS:
By Building Sector

FIGURE 6

Average Payback Period for an AEMS.
By Building Sector and Building Size

square feet and decreasing for buildings ranging from 50,000 to 75,000 square feet in size. As was true with the pricing data, payback findings suggest different strategies for different sectors and different sized buildings.

TABLE V

Average Payback Period (in Months):
By Building Sector and Building Size

	<u>Apartment Buildings</u>	<u>School Buildings</u>	<u>Office Buildings</u>	<u>Total Sample</u>
Buildings 10,000 ft. ² or less	38	33	32	35
Buildings 10,001-25,000 ft. ²	35	45	37	40
Buildings 25,001-50,000 ft. ²	41	50	39	47
Buildings 50,001-75,000 ft. ²	38	40	39	39

Procurement Within the Marketplace

Phase II findings indicate that different sectors have different preferred methods of securing an AEMS. The previously-mentioned problem of lack of available capital within the apartment sector is further highlighted by a hesitation to purchase an AEMS outright. Only 43 per cent of the apartment respondents indicated such a preference, while 79 per cent of the school respondents and 59 per cent of the office building sample stated they would rather purchase the system outright than buy it on an installment plan.

All respondents, however, preferred one of these two purchase methods to renting or leasing an automated energy management system. Only 21 per cent of the total sample said they would prefer leasing or renting the system over either purchasing it outright or purchasing it on an installment plan; consistency across building sectors was also observed. Appendix F presents the detailed findings related to preferred procurement methods, including how much individuals would be willing to pay for each possible method.

A final procurement question is: from whom will an AEMS be purchased once it is placed in the marketplace? Table VI presents the answers to these questions for the total sample and for each targeted building sector.

TABLE VI

Source of AEMS Purchase:
By Total Sample and Building Sector

	<u>Apartment Buildings</u>		<u>School Buildings</u>		<u>Office Buildings</u>		<u>Total Sample</u>	
	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>
Local HVAC Contractor	55%	52	46%	99	64%	67	53%	218
Manufacturer of the System	40%	38	41%	88	33%	34	39%	160
Other	5%	5	13%	29	3%	3	9%	37

Processes Within the Marketplace

Decisions to purchase a system such as the AEMS occur within a broad context; a number of variables may influence the potential user in making a decision. Amount of available capital, general market conditions, previous energy conservation programs, and building demographics (size, age, utility costs) may all be considered. Some of these elements are quantifiable and easily recognizable as important, while the influence of others may be more subtle; all factors are equally powerful in the decision-making process.

Two statistical tests were used to determine the relationship of a set of variables to the amount respondents were willing to pay for an AEMS. A correlational matrix was developed which illustrated the relationships of all variables to one another. Table VII presents the correlations (relationships) of selected variables which have a correlation of .5 or greater.⁸ A direct interrelationship among building size, total utilities, payback period and amount willing to spend is clearly demonstrated.

The second procedure used was a stepwise multiple regression test, a statistical method which determines a set of variables which are the best predictors of one specific variable (in this case, how much individuals are willing to spend for an AEMS). A regression test examining the influence of building descrip-

⁸ Positive correlations indicate that as one variable increases in value, so does the other; a negative correlation indicates that as one variable increases, the other variable decreases. Further, the .5 level of correlation is a generally conservative measure. Variables with a .5 correlation or greater can be said to be highly related.

TABLE VII

Correlation Matrix of Selected Variables

	Total Bldgs.	Buildings 75,000 ft. or less ²	Bldg. Age	Bldg. Size	Amount Willing To Pay	Payback Period	Total Utility Costs	Derived Payback/ Price
TOTAL BUILDINGS	1.000							
Buildings 75,000 ft. ² or less	.995	1.000						
Building Age			1.000					
Building Size				1.000				
Amount Willing to Pay					1.000			
Payback Period					.639	1.000		
Total Utility Costs				.661	.625		1.000	
Derived Payback/Price					.638	.997		1.000

tors (geographic region; building sector, age, and size; and total utility costs) demonstrated that building size (also highly correlated with total utility costs, as shown in Table VII) was the best predictor of how much respondents would be willing to spend.

Combining the results of the correlational and regression tests, it becomes evident that the price of an automated energy management system is based largely on the size of the building being considered, the relationship between building size and total utility costs, and the potential purchaser's payback criterion. Further, the regression analysis also demonstrated the influence of building sector (as described in previous sections of this report) on how much individuals would spend for the system.

Positioning Within the Marketplace

A final question remains to be answered: is there truly a market for an automated energy management system? The first-phase final report strongly suggested that such a market does not exist at the current time, but would emerge in the future -- when money was not as tight and all possible methods of energy conservation currently being used were exhausted. This study suggests that carefully-determined pricing and payback strategies could overcome some of these constraints and allow suppliers to firmly position themselves within the marketplace. These strategies should address the cost and payback criteria reported by the respondents as well as incorporate an understanding of the process variables previously described.

There is no question that economic factors greatly influence potential users' energy conservation and energy management decisions. And although financial constraints may be substantial, respondents preferred to purchase an AEMS (either outright or on an installment plan) than lease or rent it. Respondents also preferred to purchase the system rather than pay for an off-site service which provided all the functions and savings of the AEMS. Only 17 per cent of the total sample (with very little difference between building sectors) stated that such a service was more desirable than purchasing an AEMS.

The 20 per cent savings figure must also be considered in market-positioning plans. Respondents were told to assume that the AEMS as described would, on the average, save 20 per cent of individuals' current energy bills. It appears this direction was taken seriously by the respondents; an internal validity check demonstrated a high positive correlation between how much people would spend for an AEMS and the calculations they used to determine that amount. Assuming that individuals would calculate 20 per cent of their most recent annual utility bills, and then multiply that amount by their payback criteria in order to determine the amount they are willing to pay, we anticipated a strong

correlation between the amount calculated in this way (derived payback/price) and the amount stated. As indicated in Table VII, this correlation was quite high (.638). As actual cost savings vary from the 20 per cent figure (given the wide variation in building types, sizes, ages, savings already realized and savings possible yet to realize), so, too, will the amount individuals are willing to spend for the system vary.

This report has presented data which reflect current market conditions, preferences, and decision-making criteria. Whether suppliers of an automated energy management system can profitably design, manufacture, and market the system based on these guidelines which take into account broader, perhaps more subtle, complex issues (e.g., the need for demonstration and educational programs, advertising and promotional campaigns targeted to different market segments) remains to be seen. Theoretically, statements regarding how much people are willing to pay for an AEEMS are closely related to their actual ability to pay. The true test of this assumption will come when the marketplace is entered.

APPENDIX A
RESEARCH STUDY QUESTIONNAIRE

INTRODUCTION

The Department of Energy has sponsored a national research project examining the energy conservation problems facing three building types: (1) apartments (2) schools, and (3) offices. This questionnaire focuses on an automated energy management system as one possible way of solving small building energy conservation problems.

INSTRUCTIONS

Read each of the following sections carefully and answer the questions before moving on to the next section. This form has been pre-tested with people like yourself and should take no longer than 10 minutes to complete. Please take these few minutes to complete the questionnaire TODAY and return it in the enclosed return envelope.

I. Individual Information

Name: _____ Title: _____

Organization: _____

Responsibilities: _____

- Your Building Sector would be called (Check one):

- ☐ Apartment Buildings
- ☐ School Classroom Buildings
- ☐ Office Buildings - Owner Occupied
- ☐ Office Buildings - Tenant Occupied

How many total buildings are you responsible for? _____ Bldgs.

How many buildings of that total are 75,000 sq. ft. or less? _____ Bldgs.

II. Building Information

Of all the small buildings (i.e., 75,000 sq. feet or less) in your current total operation, choose that building which is typical of the total and describe that building along the following dimensions. If you are responsible for both apartments and offices, please fill out one questionnaire for each building type.

- Building Age (Check one):

- ☐ 1-10 years
- ☐ 11-20 years
- ☐ 21-30 years
- ☐ 31-40 years
- ☐ 41-50 years
- ☐ 51 years or older

- Building Size (Check one):

- ☐ 10,000 sq. feet or less
- ☐ 10,001 - 25,000 square feet
- ☐ 25,001 - 50,000 square feet
- ☐ 50,001 - 75,000 square feet

- HVAC System Type (Check one):

- ☐ Single Zone
- ☐ Variable Volume Re-Heat
- ☐ Dual Duct Mixing Boxes
- ☐ Through the Wall Units

- ☐ Terminal Re-Heat
- ☐ Multizone
- ☐ Induction Units
- ☐ Other (Please specify) _____

For each utility type used, what were your energy bills for the "typical" building for the calendar year 1977?

● Utility Type

Electricity	\$ _____
Natural Gas	\$ _____
Liquefied Petroleum Gas	\$ _____
Distillate (#2) Fuel Oil	\$ _____
Residual (#6) Fuel Oil	\$ _____
Coal	\$ _____
Steam	\$ _____

Are these energy bill figures ☐ actual data, or ☐ an estimate? Check one).

III. Basic Automated Energy Management System

One of the ways being considered today to meet the energy conservation needs of a small building is to install an automated energy management system. When considering such an installation, it is assumed that no-cost and low-cost energy saving procedures and equipment are already in operation. The installation of an automated energy management system is assumed to provide a higher level of control by offering functions not normally used and adding improvements over current operations or equipment. The specific features of such a system will vary according to each individual building. However, for the purposes of this questionnaire, assume that the BASIC SYSTEM will, on the average, save 20% of your current energy bill.

ASSUME:

- (1) Your organization is going to purchase the BASIC SYSTEM as described above to be used in your "typical" building; and
- (2) the energy rates for that building will be those projected for your State by the Federal Energy Administration as shown in the table on the back page of this questionnaire.

GIVEN THESE ASSUMPTIONS, please answer the following questions by filling in the appropriate blanks or checking the appropriate boxes.

1. Based on my "typical" building, the Federal Energy Administration rate projections, and the assumed performance of the BASIC SYSTEM, I would be willing to pay \$ _____ (total installed price) for that system.
2. Based on the price above, my preferred purchase method would be:

☐ outright cash purchase
☐ installment purchase
3. (Answer only if you checked "installment purchase" above.) Under an installment plan, I would be willing to pay \$ _____ down and \$ _____ per month for the BASIC SYSTEM.

4. I would rather lease or rent the BASIC SYSTEM than purchase it outright:

☐ yes
☐ no

5. I would rather lease or rent the BASIC SYSTEM than purchase it on an installment plan:

☐ yes
☐ no

6. (Answer only if you answered YES to #4 or #5 above.)
I would be willing to pay \$ _____ per month to lease or rent the BASIC SYSTEM.

7. An energy monitoring and control service which provided all the energy savings of the BASIC SYSTEM but was operated off-site (off my premises) by a building maintenance or control company would be (Check one):

☐ less desirable than the purchase of the BASIC SYSTEM.
☐ as desirable as the purchase of the BASIC SYSTEM.
☐ more desirable than the purchase of the BASIC SYSTEM.

8. I would be willing to pay \$ _____ per month for such a service.

9. I would most likely purchase the BASIC SYSTEM from:

☐ Local HVAC Contractor
☐ Manufacturer of the system
☐ Other (please specify) _____

10. For purchases of systems or services of the type described, I would generally expect that they would pay for themselves, through savings, in about _____ months.

PROJECTED TOTAL PERCENTAGE CHANGE IN ENERGY RATES FROM 1977 TO 1990

FEA REGION # STATES UTILITY TYPE	I	II	III	IV	V	VI	VII	VIII	IX	X
	ME, NH VT, RI CT, MA	NY, NJ	PA, DE MD, VA WV, DC	NC, SC GA, FL KY, TN AL, MS	MI, OH IN, WI MN, IL	AR, LA OK, TX NM	IA, MO NE, KS	ND, SD MT, WY CO, UT	NV, AZ CA, HI	ID, WA OR, AK
Electricity	+ 4%	(-1%)	+ 8%	+ 9%	+12%	+32%	+12%	+11%	+15%	+28%
Natural Gas	+53%	+56%	+65%	+97%	+105%	+131%	+150%	+140%	+89%	+68%
Liquified Petroleum Gas (LPG)	+10%	+24%	+36%	+43%	+40%	+39%	+37%	+31%	+28%	+30%
Distillate (#2) Fuel Oil	+15%	+21%	+24%	+25%	+25%	+24%	+24%	+22%	+17%	+19%
Residual (#6) Fuel Oil	+18%	+21%	+27%	+28%	+19%	+25%	+15%	+15%	+ 5%	+ 5%
Coal	+30%	+38%	+52%	+47%	+38%	(-5%)	+17%	+33%	+ 2%	+59%

Note: The above figures are projections based on averaging individual Federal Energy Administration projections. Projections for Steam were not available. Computations were made in constant (Base Year 1977) dollars.

APPENDIX B

NUMBER OF INDIVIDUALS TO WHOM QUESTIONNAIRES WERE SENT
AND NUMBER OF QUESTIONNAIRES SENT: BY SAMPLE CATEGORY

<u>SAMPLE CATEGORY:</u>	<u>IREM MEMBERS</u>	<u>ASBO MEMBERS</u>	<u>FOCUS-GROUP PARTICIPANTS</u>	<u>TOTALS</u>
Number of individuals to whom Question- naires were sent:	3,436	2,326	32	5,794
Number of Question- naires sent out:	6,872	2,326	32	9,230

APPENDIX C

NUMBER OF INDIVIDUALS WHO RETURNED QUESTIONNAIRES

AND NUMBER OF QUESTIONNAIRES RETURNED: BY SAMPLE CATEGORY

<u>SAMPLE CATEGORY</u>	<u>IREM MEMBERS</u>	<u>ASBO MEMBERS</u>	<u>FOCUS-GROUP PARTICIPANTS</u>	<u>TOTALS</u>
Number of individuals who returned Question- naires:	235	273	3	511
Number of Questionnaires returned:	248	273	3	524
Return Rate ^a	7%	12%	9%	9%

^a The number of individuals who returned Questionnaires as a percentage of all individuals to whom Questionnaires were sent.

APPENDIX D

NUMBER OF QUESTIONNAIRES RETURNED: BY BUILDING SECTOR

<u>BUILDING SECTOR:</u>	<u>APARTMENT BUILDINGS</u>	<u>SCHOOL BUILDINGS</u>	<u>OFFICE BUILDINGS</u>	<u>TOTALS</u>
Number of Questionnaires returned:	119	268	123	510 ^a
Percentage of total:	23%	53%	25%	100%

^a This figure is less than the "524 Questionnaires returned" figure presented in Appendix C because not all respondents noted which sector they represented.

APPENDIX E

DESCRIPTORS OF THE TOTAL SAMPLE: BY BUILDING SECTOR

GEOGRAPHIC REGION		<u>APARTMENT BUILDINGS</u>		<u>SCHOOL BUILDINGS</u>		<u>OFFICE BUILDINGS</u>		<u>TOTAL SAMPLE</u>	
		<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
I.	(ME, NH, VT, RI, CT, MA)	9%	11	11%	27	5%	5	9%	43
II.	(NY, NJ)	6%	7	11%	26	6%	6	8%	39
III.	(PA, DE, MD, VA, WV, DC)	15%	18	8%	19	10%	11	10%	48
IV.	(NC, SC, GA, FL, KY, TN, AL, MS)	10%	12	4%	11	20%	22	9%	45
V.	(MI, OH, IN, WI, MN, IL)	22%	26	34%	85	21%	25	29%	136
VI.	(AR, LA, OK, TX, NM)	7%	8	4%	11	10%	11	6%	30
VII.	(IA, MO, NE, KS)	2%	2	10%	24	4%	4	6%	30
VIII.	(ND, SD, MT, WY, CO, VT)	3%	4	9%	23	6%	6	7%	33
IX.	(NV, AZ, CA, HI)	21%	25	4%	9	13%	14	10%	48
X.	(ID, WA, OR, AK)	4%	5	5%	12	5%	5	5%	22

BUILDING SECTOR		<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
Apartment Buildings		100%	119					23%	119
School Buildings				100%	268			53%	268
Office Buildings						100%	123	25%	123

		APARIMENT BUILDINGS		SCHOOL BUILDINGS		OFFICE BUILDINGS		TOTAL SAMPLE	
NUMBER OF TOTAL BUILDINGS		<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
		60	118	32	261	21	122	36	501
NUMBER OF BUILDINGS 75,000 SQUARE FEET OR LESS		<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
		55	113	25	253	16	118	30	484
BUILDING AGE		<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
861	1 - 10 Years	46%	54	20%	54	45%	55	32%	163
	11 - 20 Years	26%	31	38%	99	23%	28	31%	158
	21 - 30 Years	7%	8	25%	65	11%	14	17%	87
	31 - 40 Years	5%	6	6%	15	7%	9	6%	30
	41 - 50 Years	5%	6	5%	13	2%	3	4%	22
	51 years or older	11%	13	7%	18	11%	13	9%	44
BUILDING SIZE		<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
10,000 sq. ft. or less		29%	34	4%	12	15%	19	13%	65
10,001 - 25,000 sq. ft.		31%	37	19%	51	30%	37	25%	125
25,001 - 50,000 sq. ft.		22%	26	50%	134	28%	34	38%	194
50,001 - 75,000 sq. ft.		18%	22	26%	71	27%	33	25%	126

	<u>APARTMENT BUILDINGS</u>		<u>SCHOOL BUILDINGS</u>		<u>OFFICE BUILDINGS</u>		<u>TOTAL SAMPLE</u>	
HVAC SYSTEM TYPE	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
Single Zone	32%	36	20%	49	21%	25	23%	110
Variable Volume Re-Heat	2%	2	4%	9	12%	14	5%	25
Dual Duct Mixing Boxes	3%	3	4%	11	5%	6	4%	20
Through the Wall Units	17%	19	18%	46	2%	2	14%	67
Terminal Re-Heat	1%	1	2%	6	3%	4	2%	11
Multizone	21%	24	36%	89	42%	51	34%	164
Induction Units	-	-	2%	6	2%	3	2%	9
Other	25%	29	13%	33	13%	16	16%	78
ANNUAL UTILITY COSTS	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
Electricity	\$17,257	79	\$39,323	223	\$32,456	110	\$33,259	412
Natural Gas	7,363	72	25,579	178	6,567	61	17,466	311
Liquefied Petroleum Gas	6,800	1	2,480	18	7,052	3	3,299	22
Distillate (#2) Fuel Oil	12,644	12	14,139	83	33,349	7	15,281	102
Residual (#4) Fuel Oil	12,262	3	28,682	27	2,328	1	26,243	31
Coal	-	-	22,666	2	-	-	22,666	2
Steam	13,039	2	197,811	4	9,026	9	59,896	15
Total Utility Costs	\$21,429	97	\$53,517	249	\$40,340	111	\$43,506	457
ARE THESE UTILITY FIGURES:	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
Actual Data	58%	57	66%	164	57%	62	62%	283
An Estimate	42%	42	34%	84	43%	47	38%	173

APPENDIX F

PROCUREMENT METHODS OF THE TOTAL SAMPLE: BY BUILDING SECTOR

FOR THOSE WHO PREFER TO PURCHASE AN AEMS ON AN INSTALLMENT PLAN:

	APARTMENT BUILDINGS		SCHOOL BUILDINGS		OFFICE BUILDINGS		TOTAL SAMPLE	
	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
<u>Amount Willing to Pay Down:</u>	\$1,496	38	\$2,923	32	\$1,992	38	\$2,093	108
<u>Amount Willing to Pay per Month:</u>	\$ 210	42	\$ 362	33	\$ 364	35	\$ 305	110

FOR ALL RESPONDENTS:

	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
<u>Rather Lease or Rent an AEMS than Purchase it Outright:</u>								
Yes:	32%	29	15%	32	25%	25	21%	86
No:	68%	63	85%	178	75%	77	79%	318

Rather Lease or Rent an AEMS
Than Purchase it on an
Installment Plan:

Yes:	19%	17	19%	38	25%	24	21%	79
No:	81%	72	81%	158	75%	73	79%	303

FOR THOSE WHO PREFER TO LEASE OR RENT AN AEMS:

	APARTMENT BUILDINGS		SCHOOL BUILDINGS		OFFICE BUILDINGS		TOTAL SAMPLE	
	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
<u>Amount Willing to Pay per</u> <u>Month:</u>	\$ 122	22	\$ 353	34	\$ 308	23	\$ 276	79

FOR ALL RESPONDENTS:

	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>	<u>Percent</u>	<u>N</u>
<u>Compared to Purchasing an AEMS,</u> <u>an Off-site Energy Monitoring</u> <u>and Control Service would be:</u>								
Less Desirable:	58%	57	61%	136	64%	65	61%	258
As Desirable:	20%	20	22%	49	22%	22	22%	91
More Desirable:	21%	21	17%	38	14%	14	17%	73
	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>	<u>Average</u>	<u>N</u>
<u>Amount Willing to Pay Per</u> <u>Month for an Off-Site Service:</u>	\$ 102	38	\$ 226	70	\$ 449	41	\$ 223	149