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Nationwide Survey of Energy Conservation in Colleges and Universities: Institutional, Organizational, and Technical Characteristics

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DISCLAIMER

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NATIONWIDE SURVEY OF ENERGY CONSERVATION IN COLLEGES AND UNIVERSITIES: INSTITUTIONAL, ORGANIZATIONAL, AND TECHNICAL CHARACTERISTICS*

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EXECUTIVE SUMMARY

This report summarizes the responses to a mail survey of college and university physical plant directors carried out as part of an evaluation of the U.S. Department of Energy's Institutional Conservation Program (ICP). The overall goal of the evaluation project is to identify the most successful conservation measures (equipment and activities) available to the institutional buildings sector. To accomplish this goal, four specific research objectives were defined:

(1) to determine the impact of the ICP grant program on fostering energy efficiency and saving energy;

(2) to determine key characteristics of institutional conservation efforts outside the federal program;

(3) to determine the technical, organizational, and institutional conditions that create the opportunity for energy conservation measures to be most effective; and

(4) to identify key technology transfer opportunities.

The work conducted as part of this evaluation includes a retrospective evaluation of the ICP grants program to date and recommendations for future conservation efforts in the institutional sector. This report focuses on those characteristics of colleges and universities that might be expected to influence the identification, implementation, operation, and impacts of institutional energy conservation efforts. Information about institutional characteristics was gathered through a mail survey of colleges and universities. Two mailings yielded 773 completed questionnaires out of the population of 3,434 colleges and universities, yielding a response rate of 22%.

Institutional and Locational Characteristics

The responding institutions had a mean physical facility staff size of more than 89 people. The mean number of people supervised by the individual completing the survey was 18; the mean number of engineers supervised was 1, and the mean fraction of supervised staff that were engineers was about 8%.

The Southeastern states were underrepresented relative to the Northern tier of states and to the Southwestern states. There was substantial variation among states in the survey response rate, but careful inspection indicated that nearly all of the Southeastern states showed a depressed response rate. Beyond this, patterns were difficult to identify.

Technical/Physical Characteristics

The average year of construction of all buildings at colleges and universities (C&U) was 1961, and the average age of the oldest building on campus was 66 years. The oldest buildings were found at four-year C&U, private institutions, ICP participants, and

institutions in the Northeast.

The average number of campus buildings was 41, and the average square footage of conditioned building space was 1,336,761 ft^2. The largest institutions were four-year and public C&U and ICP participants.

Most institutions used central and individual boilers to heat their buildings, especially four-year C&U and ICP participants. Little difference was observed across DOE regions in the frequency of use of either central or individual boilers for heating. Natural gas was the most common primary heating source, followed by fuel oil, electricity, coal, and steam/hot water. Two-year C&U and non-ICP participants were more likely to use natural gas as a primary heating source compared with their counterparts. And the Northeast was the only exception to the domination of natural gas: fuel oil and/or electricity were more common in this region.

The most commonly used air-conditioning systems were central or building chillers, followed by window air-conditioners and packaged cooling units, and this was especially true for four-year C&U and ICP participants. There were no strong climate patterns among cooling systems, although in the West, window air-conditioners were less common while evaporative cooling systems were more prevalent. Electricity was the most common primary cooling source and dominated all regions.

Energy Management Activities

Though more than 70% of the survey respondents reported increases in their level of energy conservation effort since 1980, less than 45% reported decreases in energy use, and approximately the same number reported increases. The most commonly reported reasons for changes in energy consumption were (1) changes in building operation, and (2) increases in floor area.

About three-quarters of C&U prepared an energy monitoring or accounting report, which periodically tracked and analyzed energy use and/or costs, and this was especially true for public institutions and ICP participants.

Though most institutions have had several comprehensive technical analyses conducted since 1980 for the purpose of identifying energy conservation measures (ECMs), and most have installed multiple ECMs in recent years, and most have an organized way of monitoring energy use and reporting it to the decisionmaker, only one-third of institutions have formal, written energy plans for controlling energy costs.

Almost three-quarters of all colleges and universities (especially public institutions and ICP participants) had a comprehensive, technical energy analysis of at least one of their buildings since 1980, and most of these audits were performed by private consultants or contractors.

Sponsorship and Financing

By far, the most common source of funds used by institutions to purchase energy-saving capital equipment was internal operating and capital budgets, especially by public institutions and ICP participants. Grants ranked second, with substantially fewer institutions using other financing mechanisms. The financing mechanisms that the institutions planned to use to support future energy conservation efforts were ranked in the same order.

Almost 70% of the sample reported an awareness of the ICP grants program, with the highest level of awareness among public institutions and ICP participants. Nearly 75% of those who were aware of ICP had applied for at least one grant. The most common reason for not applying was the complexity of the grant application and award process, followed by inadequate funding and the ineligibility of the institution.

For institutions participating in the ICP program, the average number of Technical Assistance (TA) grants and Energy Conservation Measure (ECM) grants applied for and received per institution under the Institutional Conservation Program were 9 and 6, respectively. For those colleges and universities participating in the ICP program, the most common reason for not applying for an ECM grant was the problems associated with governmental rules and regulations. The most common reason offered for having an ECM grant denied to an institution was that the grant application was ranked too low in the ICP program.

Over 35% of the respondents participated in energy conservation programs (for financial assistance or energy audits) sponsored by utilities, and private institutions were more likely to have taken advantage of these programs than their public counterparts. Relatively strong regional differences were observed in the level of participation in utility programs, with participation being most likely in the West and Southwest. Across all regions, participation in state and federal programs was common.

Decisionmaking Process

The primary motivations for taking energy conservation actions were reported to be the current high cost of energy, the expectation of further cost increases in the future, and utility demand charges or rate structures. The next three most important reasons were related to the institution and its reaction to energy cost factors: cost-containment programs, availability of outside funds, and the support of administration and staff.

The physical plant director and chief financial officer were reported to be primarily responsible for energy conservation activities in colleges and universities. The director of the physical plant was most often cited as being responsible for setting strategic directions for energy conservation efforts, for selecting specific conservation measures to be installed, and for daily energy management. The chief financial officer was primarily responsible for financing capital energy projects. The governing body (e.g., regents) assumed an important role in setting objectives and determining financing, and the primary administrator (e.g., college president) also played an important role in setting energy conservation objectives.

Sources of Information

The most commonly reported information sources for setting overall objectives were (1) the experience of other institutions and (2) professional associations. A wide range of information sources was used in selecting specific measures, including contacts with other professionals, equipment manufacturers, technical and trade publications, experience of other institutions, conferences, consultants, and professional associations. However, no information source was dominant.

Energy Conservation Measures

In the period between 1973 and 1979, the most common retrofit was the installation of time clock controls, followed closely by caulking and weatherstripping, lighting conversions, HVAC (heating, ventilation, and air conditioning) system adjustments, insulation, and lighting modifications. Between 1980 and 1986, there was a significantly larger number of measures installed, but they were very similar in relative frequency to the previous period. In the future (1987-1990), the level of energy conservation activity is expected to remain high; and emphasis appears to be changing slightly, with substantial increases in the areas of energy management control systems and lighting retrofits. Continuing a trend developed in the previous two periods, four-year C&U are planning to implement more energy conservation measures than are two-year C&U.

The most effective energy-saving measures were reported to be controls for either the HVAC system or for the lighting system. Other ECMs ranking high with respect to energy savings were envelope measures (e.g., insulation and weatherstripping), lighting measures (e.g., delamping and conversion to fluorescent lights), and heating measures (e.g., boiler replacement). All other ECMs, including cooling system measures, ventilation measures, and HVAC system modifications, ranked relatively low. Control measures were more often identified as successful by public institutions, while private institutions were more likely to identify envelope measures as most effective. This difference may reflect the fact that the public institutions were typically larger and operationally more complex than the private colleges and universities.

Energy conservation efforts have not been trouble-free. Over 50% of the respondents indicated that they had experienced technical problems, and about 50% of those indicated that the problem was associated with the ECMs. Institutions also quite commonly experienced problems associated with occupant behavior (e.g., opening windows in the winter) and with occupant comfort.

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1.0 INTRODUCTION

1.1 Overview

Lawrence Berkeley Laboratory (LBL) and Argonne National Laboratory (ANL) conducted a study of energy conservation in schools and hospitals in an evaluation of the U.S. Department of Energy's (DOE) Institutional Conservation Program (ICP). The ICP provides voluntary grants to public and private not-for-profit institutions, including elementary and secondary schools, colleges and universities, and hospitals. The grants support (1) audits or technical analysis directed at identifying appropriate energy conservation measures (ECMs), and (2) design, purchase, and installation of the measures identified. The program requires that the institution provide funds to match the federal grant.[†] Selection of grantees from the applications is based primarily on cost-effectiveness criteria (e.g., payback level). The ICP is implemented through DOE Regional Offices and state energy offices.

The overall goal of the evaluation project is to identify the most successful conservation measures (equipment and activities) available to the institutional buildings sector.* To accomplish this goal, four specific research objectives were defined:

(1) to determine the impact of the ICP grant program on fostering energy efficiency and saving energy;

(2) to determine key characteristics of institutional conservation efforts outside the federal program;

(3) to determine the technical, organizational, and institutional conditions that create the opportunity for energy conservation measures to be most effective; and

(4) to identify key technology transfer opportunities.

These objectives acknowledge two closely related, underlying thrusts of the project. One, related to the first and second objectives, is to accomplish a retrospective evaluation of the ICP grants program to date. The other thrust, related to the third and fourth objectives, is to provide guidance to future conservation efforts in the institutional sector.

1.2 Research Design

The first phase of the project developed and documented the research design (Reference 1). A three-stage model for institutional conservation decisionmaking and implementation was formulated. The first stage, "strategic decisionmaking," addresses the role of

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[†]A 50% match is required except in cases where hardship is demonstrated; in these situations, the federal grant can provide up to 90% of the total cost to the institution.

*There are several measures of success; our measures of success were not limited to energy savings or cost savings.

upper-level institutional managers in the energy conservation decisionmaking process. It includes: (1) awareness of opportunity for energy or energy-cost saving and access to information by key individuals in the organization; and (2) creation of strategic conditions conducive to energy conservation and to decisions to take action.

The second stage, "tactical decisionmaking," carries out the strategy established in the first stage and assumes that the following critical steps occur: (1) obtaining reliable information regarding energy conservation options; (2) understanding how energy conservation relates to the organization's functions and operations; and (3) decisionmaking that results in implementation of the most appropriate equipment measures and activities selected in the decisionmaking process.

The third stage, "decision implementation and impacts," concerns the design, implementation, and operation of the ECMs. The results are measured in terms of energy savings, financial benefits, and other expected or unanticipated, beneficial or detrimental impacts on the functional performance of the institution. The focuses of the evaluation in this stage are: (1) the energy conservation measures themselves, (2) monitoring of results to determine the impacts of the measures, and (3) feedback of results to decisionmakers.

As part of the research design, research issues associated with each stage in the decisionmaking and implementation process were defined. Overall, 52 issues were identified; associated with each issue were relevant facts, assumptions, and hypotheses. The research design identified the technical, institutional, and organizational variables that had to be measured to resolve the individual issues, thereby satisfying project objectives. Existing data sources were examined to determine the extent to which they could contribute to the resolution of the research issues. A data collection plan was developed to provide those data not included in existing data bases.

The research design considered three means to obtain information from institutions:

(1) *Mail survey* of a nationwide, random sample of institutions. Considered as part of the mail survey were telephone calls to nonrespondents, which repeated selected questions from the mailed questionnaire. The sample of nonrespondents that received follow-up phone calls was selected to insure that the full data set (from survey respondents and phone calls to nonrespondents) used in subsequent analysis was representative of the institutional sector being studied.

(2) *Follow-up interviews* by telephone with a subsample of mail survey respondents. The purposes were to obtain clarification or amplification of survey responses, to ascertain the availability of energy use data, and to screen for possible site visit candidates.

(3) *Site visits* of subsamples from both the mail survey respondents and the follow-up interviewees for collecting data on detailed building characteristics, technical actions, and energy data.

Current plans do not include site visits as a source of primary data. However, a few site visits are planned to verify findings from the analysis of survey and interview data.

The research design defined three primary subsectors in the institutional sector: hospitals; colleges and universities; and elementary and secondary schools. Because of the heterogeneity of the institutional sector, it was decided to separate data collection for the three subsectors. The data needed from the three subsectors are identical, so there is a strong relationship between the data collection instruments used. However, because of the varying levels of engineering and decisionmaking expertise that can be expected to exist at the institutions, and because the needed information might come from different elements of the organization, the exact form of the data collection instruments is different for the individual subsectors.

Data collection from the three subsectors has been staggered, with hospitals preceding colleges and universities, and with elementary and secondary schools last. This sequence was chosen to allow the more homogeneous subsector to be attacked first, with the most heterogeneous to be done last. As expected, the data collection plan has evolved and been refined during the course of the project.

1.3 Scope and Purpose of this Report

The purpose of this report is to present the results of the mail survey of colleges and universities. Where appropriate, the responses have been sorted into subsets that allow comparisons of responses from groups of institutions that have common characteristics. The characteristics of interest here are those that might be expected to influence the identification, implementation, operation, and impacts of institutional energy conservation efforts. Examples of these shared characteristics are ownership (e.g., public vs. private institutions) and geographic location (e.g., DOE region). A forthcoming report will incorporate additional information from the colleges and universities followup interviews. It will include results from more in-depth analysis of the data from the three subsectors of interest to the evaluation project (hospitals, colleges and universities, and elementary and secondary schools). The report will focus on decisionmaking issues, analyze technical matters such as ECMs and energy savings, and analyze differences in energy conservation efforts among the three institutional subsectors. The present report is a companion to the survey summary reports for hospitals (Reference 2) and for schools (Reference 3).

The remainder of this report is organized as follows. Section 2 describes the methods and procedures used in the mail survey. Section 3 presents certain demographic characteristics of the individuals who responded to the mail survey and of the institutions they represent. (For convenience, the colleges and universities will frequently be referred to as the respondents.) Section 4 discusses technical characteristics of the respondents, e.g., facility size, building age, HVAC system type, and fuels consumed. Section 5 deals with energy management activities at the institutions, e.g., use of energy plans, energy monitoring reports, and energy audits. Section 6 covers financing of energy conservation activities generally, and, more specifically, the roles of ICP and utilities. Section 7 covers the decisionmaking process and presents information on such topics as motivational factors, the individuals and groups involved in decisionmaking, sources of information, and institutions that have served as models. Section 8 presents information on ECMs: which ECMs have been installed, when they were installed, and what the plans are for future installations; which ECMs are considered successful, which have proven troublesome, and

why. Concluding, Section 9 summarizes the findings. The mail survey instrument and the nonrespondent follow-up instrument, as well as tables detailing the survey response, are given in the appendices.

2.0 MAIL SURVEY METHOD

2.1 The Survey Instrument and its Pretest

Soon after formulation of the research design in early 1986, development of a mail survey instrument began. Data collection from the three subsectors was staggered, with hospitals preceding colleges and universities. Drawing on experience from the hospitals subsector, whose survey was previously implemented, project staff developed the higher education survey instrument. This instrument was refined based on review by staff at LBL, ANL, DOE, professional organizations, and by recognized experts. A final draft version of the instrument was tested in site visits to colleges and universities. In this pretest, teams of two from DOE, LBL, and ANL visited approximately 20 colleges and universities in the Washington, D.C., Chicago, and San Francisco areas. At each site, one or two individuals with responsibility for the physical plant completed the survey instrument; identified flaws in its instructions, questions, and format; and discussed with interviewers how it could be improved. The evaluation project staff used the information and advice obtained in the pretest to refine the content and format of the final survey instrument, which is found in Appendix A. Procedures and results of the higher education pretest are described in a separate report (Reference 4).

The survey instrument used in the mail survey had 64 questions divided into five sections. The six questions in the first section are concerned with how energy is regarded in the institution, what motivates energy conservation efforts, identification and characterization of the people responsible for energy policy and energy decisions, and identification of their sources of information. The second section (14 questions) asks about energy conservation activities, including technical audits and monitoring, and how they are financed. The third section (22 questions) is concerned with characteristics of the college or university campus facility, including its heating and cooling systems and the fuels used. The fourth section (8 questions) concerns participation in energy conservation programs, especially in ICP. The final section (14 questions) asks for information about the person primarily responsible for completing the questionnaire.

2.2 Sampling Procedure

The universe of higher education facilities comprised all institutions in the 50 states, the District of Columbia, and the U.S. territories, a total of 3434 institutions. As discussed in Section 3.1, after considering several sampling schemes, we decided to mail our survey to all 3434 institutions (i.e., the entire universe). Three stratification variables were used to monitor response rates. These variables were (1) two-year or four-year educational program, (2) whether private or public, and (3) whether the institution had or had not participated in ICP. All variables are binary, so eight stratification cells were defined.

Each institution in the universe was "typed" to determine in which stratification cell it belonged. For each cell, the number of responses required to represent the cell's population was determined. Respondents were assigned to their appropriate cell, and the cell population compared with the required responses in that cell. In this way, the respondents and universe were compared on a cell-by-cell basis to determine the

representativeness of the survey respondents relative to the universe.

2.3 Survey Description

Two waves of questionnaires were necessary to obtain the required number of responses. The first wave was mailed in early December 1986, and the second wave in mid-February 1987. In each wave, the questionnaire was mailed to the Director of the Physical Plant, with an accompanying cover letter describing the objectives and importance of the project.

When a completed questionnaire was received, the contractor entered the survey response data into a data base, and the institution was removed from the list of nonrespondents. Approximately five weeks after the first mailing, the remaining nonrespondents were identified and a second wave of mailings took place. Overall, the two mailings yielded 773 completed questionnaires. Because the instruments used in the two waves were not color-coded, it is not possible to assign responses to a specific wave. However, approximately 50% of the 773 responses were received before responses from the second wave could be expected, suggesting that at least half of the responses came from the first wave.

2.4 Nonrespondent Followup

Analysis of the characteristics of the 773 respondents indicated that small institutions (less than 1,000 enrollment) were underrepresented, especially among private colleges and universities. The states were assigned to one of three "climatic" regions: Northern, Southeastern, or Southwestern. The assignments are discussed in more detail in Section 3. Regional disparities in response rates were found: Northern and Southwestern states were overrepresented, while Southeastern states were underrepresented. Therefore, most of the colleges and universities contacted in the nonrespondent followup are small, private, Southeastern institutions.

An abbreviated questionnaire was used to structure a phone survey for nonrespondents. The 19 questions covered ECMs installed or planned, financing arrangements, information about buildings, participation in energy conservation programs, and information about the interviewee. The instrument used is given in Appendix B. Data from the 170 nonrespondent telephone interviews (conducted during May and June 1987) will be included in the final report to follow.

2.5 Data Entry and Analysis

After completed surveys were received, responses to the closed-ended questions were entered into a data file and verified.* The verbal responses to open-ended questions were recorded, but were not included in this report; they will be included as appropriate in the final report to follow.

*A sample of 10% of the responses was manually compared with the corresponding entries in the data base to verify the integrity of the data entry procedures.

Survey responses were sorted by stratification cell for each survey question; the resulting tables are included as Appendix C. These tables are arranged sequentially, according to the order in which they are referenced in Sections 3 through 8 of this report. The introduction to Appendix C cross-references the individual tables to the individual questions in the survey instrument in Appendix A.

3.0 INSTITUTIONAL AND ORGANIZATIONAL CHARACTERISTICS OF RESPONDENTS

3.1 The Universe of Colleges and Universities

According to data obtained from the National Center for Education Statistics (NCES),* there are 3,434 institutions of higher education (colleges and universities) in the U.S. and possessions; these institutions serve a total of 12,693,000 students. The NCES data were used to define and characterize the higher education subsector in preparation for selecting the survey sample.

The NCES data base includes the name, address, and phone number of each institution, and it provides a variety of information on:

- Enrollment
- Ownership (public or private)
- Educational programs
- Accreditation
- Institutional characteristics (e.g., predominance of specific ethnic groups or sex within the institution)
- Cost of attendance
- Population environment of the institution

The population environment for each institution is specified by identifying the community association with Metropolitan Statistical Areas (MSA) where appropriate.† The data base also includes codes for cross-referencing the institutions with other data sources.

In preparation for the survey, the NCES data were merged with selected data from the ICP Grant Tracking System. Based on this combined data base, Table 3.1 summarizes the characteristics of the higher education subsector that are of prime importance to the evaluation project.

As shown in Table 3.1, four-year colleges and universities are more common than two-year institutions, especially at the enrollment extremes. Private institutions dominate the small enrollment category, while public institutions dominate the large enrollments. Overall, institutions of intermediate size are the most common, with substantial numbers of both public and private institutions appearing in this category.

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*The Center for Statistics (formerly the National Center for Education Statistics, or NCES) is a program in the U.S. Department of Education, Office of Educational Research and Improvement.

†The Office of Management and Budget designates Metropolitan Statistical Areas (MSAs); an MSA comprises a large population nucleus and adjacent communities that have a high degree of economic and social integration with the nucleus. In general, an MSA has a population of at least 50,000 and is defined by county boundaries. In some regions of the U.S., the MSA is defined by city and town boundaries.

Table 3.1: Characteristics of the Universe of Colleges and Universities

Institutional Characteristic	Institutions with Enrollment <1000	1,000-10,000	>10,000	Total
Total Institutions	1346	1738	350	3434
Educational Program				
2-Year	466	765	117	1348
4-Year	880	973	233	2086
Ownership				
Public	186	1039	310	1535
Private	1160	699	40	1899
ICP Participation				
Past participant	223	708	218	1149
Not a participant	1123	1030	132	2285
Population Environment				
Not urban (<50,000)	405	572	46	1023
50,000-250,000	119	25	440	413
250,000-500,000	132	208	40	380
500,000-1,000,000	137	204	49	390
1,000,000-2,000,000	136	155	65	356
>2,000,000	352	333	109	794
Undefined	65	12	1	78

As has been reported earlier, ICP penetration in the colleges and universities sector is about 33.5% (Reference 4). Table 3.1 allows the penetration by institution size (enrollment) to be determined. The penetration is 16.6% for institutions with 1,000 or fewer students, 40.7% for institutions with enrollments in the middle category, and 62.3% for institutions with enrollments of greater than 10,000. Thus, there is a strong positive correlation between institution size and ICP penetration. When the population of institutions in each category is accounted for, another penetration figure can be calculated: ICP has provided grants to colleges and universities that represent 54.7% of the total higher education enrollment in the U.S.

About one-third of the colleges and universities in the U.S. are located in nonurban areas with metropolitan populations of less than 50,000. Another one-third are in urban areas with populations between 50,000 and 1,000,000. The final one-third are in urban areas with 1,000,000 or more inhabitants. As the table shows, there is a relatively small number of institutions for which the NCES data base does not identify community population.

In preparation for the mail survey, the merged NCES and GTS data base was analyzed to identify appropriate stratification variables and, for continuous variables, to define the strata. Three binary (yes/no) variables were available that were considered important in characterizing the higher education subsector for the purposes of this project: ownership,

i.e. public vs. private institutions; educational program, i.e. two-year colleges vs. four-year colleges and universities; and past involvement with ICP, i.e. participants vs. non-participants. Other, continuous variables, such as enrollment and location vis-a-vis climate or urban environment, were considered; considerable analysis of enrollment was conducted in an attempt to identify appropriate strata.

In parallel with these analyses, the early results from the hospital survey were offering qualitative confirmation of the expected low response rate for a survey of the scope being used in the evaluation. The hospitals survey experience indicated that a response rate of about 10% per wave was realistic. Since a total of about 750 responses was necessary to achieve a representative sample, the mail survey was sent to the entire universe of colleges and universities in multiple waves of mailings. We monitored the progress of the mail survey by examining the response rates for each of the binary stratification variables discussed above.

3.2 Survey Respondents

Table 3.2 describes the survey respondents and the universe of colleges and universities in terms of the stratification variables. As shown, a total of 773 responses to the survey were received from the two waves of mailings. The overall response rate for the two waves was 22%, with considerable variation in the rate between stratification variables. As shown by the response rate and by comparison of the distribution of responses among strata with that for the universe in Table 3.2, the responses are not representative of the universe of colleges and universities in several important ways. Institutions with two-year educational programs, private institutions, and institutions who have not had ICP grants are noticeably underrepresented.

Table 3.2: Comparison of Respondents with Universe by Stratification Variable

Stratification Variable	Institutions		Respondents		
	Number	% of Total	Number	% of Response	% of Inst.
Educational Program					
4-Year	2086	60.7	529	68.4	25.4
2-Year	1348	39.3	244	31.6	18.1
Ownership					
Public	1535	44.7	431	55.8	28.1
Private	1899	55.3	342	44.2	18.0
ICP Participation					
Past participant	1149	33.5	362	46.8	31.5
Not a participant	2285	66.4	411	53.2	18.0
Total	3434	100.0	773	100.0	22.5

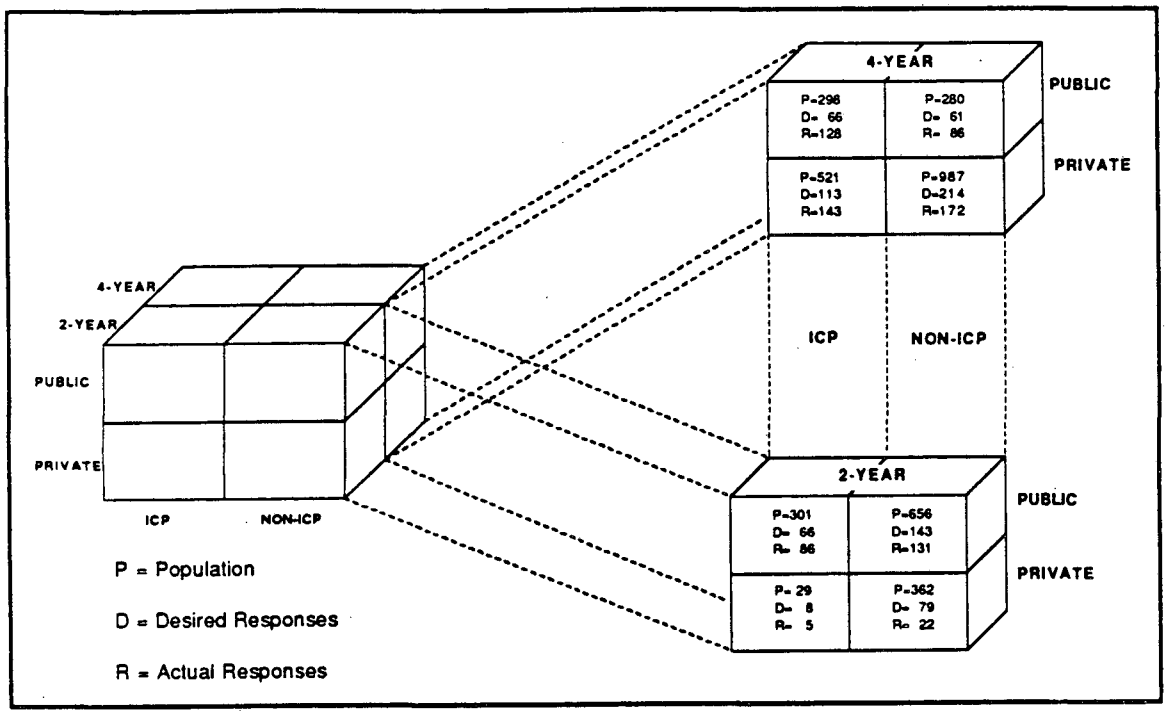

Fig. 3.1: Survey Response by Stratification Cell

Figure 3.1 describes the distribution among eight stratification cells of (1) the universe of colleges and universities, (2) number of survey responses required for statistical analysis, and (3) actual responses. The eight cells represent all combinations of the three binary stratification variables; the figure disaggregates the entries in Table 3.2, showing how the institutions in any one stratum distribute across the other four strata. For example, the 1899 private colleges and universities in the universe identified in Table 3.2 are distributed as follows according to Fig. 3.1: 29 are two-year institutions that have received ICP grants, 362 are two-year institutions that have never received ICP grants, 521 are four-year institutions that have received grants, and 987 are four-year institutions that have not been grant recipients.

Figure 3.1 clearly shows that among colleges and universities that have never received an ICP grant, adequate response was received from only the four-year public institutions—the other three stratification cells representing institutions that have not participated in ICP are underrepresented in the survey response. There is also underrepresentation in the cell corresponding to two-year, private institutions that have participated in ICP in the past. Note that the total number of institutions in this cell is small relative to the other seven cells.

More detailed analysis of the characteristics of the respondents has been carried out to select the nonrespondent followup sample; these analyses imply that the underrepresentation is among private colleges in the Southeastern part of the U.S. and is most severe for institutions with enrollments less than 1000. This group does not fit into a single stratification cell; the impact of the underrepresentation affects all of the strata. It is

perhaps coincidental that these small, private institutions, for which the survey response was smaller than desired, seldom participate in ICP. The nonrespondent followup will concentrate on the small private schools and will provide a final sample that is representative of the universe.

3.3 Characteristics of the Individual Responding to the Survey

Since we did not have available the name of a specific individual, the survey instrument was mailed to the "Director of the Physical Plant" for the institution. At the end of the survey, the respondent's name and title were requested. Thus far, the verbatim* responses to that question have not been entered into the data base. However, the responses to several of the questions in the survey allow general characterization of the individuals in the institutional context. These results are documented in Table C.1 in Appendix C and are highlighted below.

The mean length of association of the individual completing the survey with the institution was 10 years, with little variation among stratification cells. These individuals had been in their current position in the institution for an average of 7 years, again without great differences between cells.

The responding institutions have a mean physical facility staff size of more than 89 people; in this case there are statistically significant differences across the strata. The mean staff size for four-year institutions, public institutions, and for ICP participants is greater than 115, whereas for the other strata, staff size is less than half as large. The mean number of people supervised by the individual completing the survey is 18; the mean number of engineers supervised is one, and the mean fraction of supervised staff that are engineers is about 8%. In terms of all three supervisory responsibility characteristics, institutions in the four-year category, the public category, and the ICP category are comparable with one another. In all three cases, the differences between four-year and two-year institutions, and ICP and non-ICP participants are significant, with a "higher level" of supervisory responsibility residing with the responding individual in the the four-year and ICP institutions. A higher level of responsibility is also evident for the respondents from public institutions compared with respondents at private institutions. However, in this case none of the differences are statistically significant. These results for physical plant staff size and for supervisory responsibility, of course, reflect a bias away from the small, private institutions as discussed in section 3.2. Also, as discussed in section 3.1, ICP penetration is greatest in larger institutions; this is qualitatively consistent with the differences in staff size and supervisory responsibility between ICP and non-ICP respondents.

3.4 Geographic Distribution of Respondents

The state-by-state distribution of responses among stratification cells is shown in Table C.2 in Appendix C. The state data are aggregated by DOE region and by climate region in Tables C.3 and C.4 in the appendix. Tables 3.3, 3.4, and 3.5 below summarize the

*Verbatims are the written responses to open-ended questions in the survey.

responses by climate, DOE region, and state, respectively.

The climate regions used in the aggregation in Table 3.3 are shown in Fig. 3.2a. The assignment of states to the regions was based on quantitative analysis (Reference 6) of climate variables believed to be important in determining the energy performance of non-residential buildings; included were ambient temperature, humidity, and solar resource. The characteristics of the climates are defined in terms of population-weighted mean values for heating degree days (HDD), sensible enthalpy hours (EHS), latent enthalpy hours (EHL), and solar radiation (KbT).* To summarize the key climate distinctions between regions,† as characterized by heating degree days, the Northern region is a more severe climate for heating than the other two regions; both Southern climates are more severe cooling climates, but as indicated by the value for latent enthalpy hours, the Southeast is more severe with respect to moisture removal from ventilation or infiltration air and, as evidenced by KbT, the Southwest is more severe from the perspective of solar gains. The climate region aggregation in Table 3.3 indicates that, in the survey responses, the Southeastern states are underrepresented relative to the Northern tier of states and to the Southwestern states.

Table 3.3: Comparison of Survey Respondents with the Universe by Climate Region

Climate Region	Institutions		Respondents		
	Number	% of Total	Number	% of Response	% of Inst.
Northern Tier	1990	57.9	462	59.7	23.2
Southeast	957	27.9	194	25.1	20.3
Southwest	426	12.4	110	14.2	25.8
Territories	61	1.8	7	0.9	11.4
Total	3431	100.0	773	100.0	22.5

Table 3.4 categorizes the respondents and the universe by DOE region and provides a more detailed breakdown.‡ Figure 3.2b shows the DOE regions. In Table 3.4 it is seen that Region IV is substantially underrepresented. This region has the largest population of institutions and is located entirely in the Southeastern climate region. Regions I and

*Sensible and latent enthalpy hours are indicators of the energy required to cool and dehumidify, respectively, a standard quantity of outside air at ambient conditions in any one hour to interior comfort conditions, accumulated over all hours of the year. KbT is the ratio of the average global horizontal radiation to the average extraterrestrial horizontal radiation.

†For the Northern region, HDD=5704, EHL= 10828, EHS=1529, KbT= 0.466; for the Southeastern region, HDD=2194, EHL=32401, EHS=4732, KbT=0.509; and for the Southwestern region, HDD=2613, EHL=6180, EHS=1844, KbT=0.611.

‡The DOE regions overlap climate regions, making direct comparisons of the two types of region impossible.

Table 3.4: Comparison of Survey Respondents with the Universe by DOE Region

DOE Region	Institutions Number	% of Total	Respondents Number	% of Response	% of Inst.
I	266	7.8	55	7.1	20.7
II	369	10.8	63	8.2	17.1
III	392	11.4	94	12.2	24.0
IV	666	19.4	107	13.8	16.1
V	639	18.6	163	21.1	25.5
VI	261	7.6	63	8.2	24.1
VII	238	6.9	54	7.0	22.7
VIII	137	4.0	44	5.7	32.1
IX	348	10.1	87	11.2	25.0
X	115	3.4	43	5.5	37.4
Total	3431*	100.0	773	100.0	22.5

*For 3 institutions, the NCES data are incomplete; the institutions' addresses (states) have not yet been identified.

II also are underrepresented. Both are entirely within the northern climate region and are relatively small in terms of number of institutions; they are also included with Regions V and VIII in the climate analysis, both of which show overrepresentation. The underrepresentation in Regions I and II, therefore, is not visible in the climate region analysis.

Table 3.5 shows the distribution of respondents by state. There is substantial variation among states in the survey response rate, but careful inspection indicates that nearly all of the Southeastern states show a depressed response rate. Beyond this, patterns are difficult to identify.

Table 3.5: Comparison of Survey Respondents with the Universe by State

State	Institutions		Responses		
	Number	% of Total	Number	% of Response	% of Inst.
Alabama	78	2.3	9	1.2	11.5
Alaska	15	0.4	5	0.6	33.3
Arizona	31	0.9	5	0.6	16.1
Arkansas	36	1.0	5	0.6	13.9
California	291	8.5	73	9.4	25.1
Colorado	49	1.4	15	1.9	30.9
Connecticut	49	1.4	4	0.5	8.2
District of Columbia	8	0.2	6	0.8	75.0
Delaware	19	0.5	0	0.0	0.0
Florida	89	2.6	17	2.2	19.1
Georgia	80	2.3	20	2.6	25.0
Hawaii	12	0.3	3	0.4	25.0
Idaho	10	0.3	7	0.9	70.0
Illinois	167	4.9	36	4.7	21.6
Indiana	74	2.2	18	2.3	24.3
Iowa	62	1.8	13	1.7	21.0
Kansas	53	1.5	14	1.8	26.4
Kentucky	59	1.7	9	1.2	15.2
Louisiana	32	0.9	7	0.9	21.9
Maine	31	0.9	5	0.6	16.1
Maryland	57	1.7	14	1.8	24.6
Massachusetts	122	3.6	26	3.4	21.3
Michigan	92	2.7	29	3.8	31.5
Minnesota	69	2.0	15	1.9	21.7
Mississippi	42	1.2	5	0.6	11.9
Missouri	94	2.7	19	2.5	20.2
Montana	17	0.5	2	0.3	11.8
Nebraska	29	0.8	8	1.0	27.6
Nevada	8	0.2	3	0.4	37.5
New Hampshire	28	0.8	7	0.9	25.0
New Jersey	60	1.7	16	2.1	26.7
New Mexico	21	0.6	3	0.4	14.3
New York	306	8.9	47	6.1	15.4
North Carolina	128	3.7	23	3.0	18.0
North Dakota	19	0.6	6	0.8	31.6
Ohio	141	4.1	39	5.0	27.7
Oklahoma	46	1.3	11	1.4	23.9
Oregon	47	1.4	16	2.1	34.0
Pennsylvania	206	6.0	47	6.1	22.8
Rhode Island	13	0.4	3	0.4	23.1
South Carolina	63	1.8	6	0.8	9.5
South Dakota	20	0.6	5	0.6	25.0
Tennessee	81	2.4	14	1.8	17.3
Texas	158	4.6	43	5.6	27.7
Utah	14	0.4	8	1.0	57.1
Vermont	22	0.6	9	1.2	40.9
Virginia	71	2.1	20	2.6	28.2
Washington	53	1.5	22	2.8	41.5
West Virginia	29	0.8	7	0.9	24.1
Wisconsin	64	1.9	20	2.6	31.2
Wyoming	8	0.2	2	0.3	25.0
Territories	61	1.8	7	0.9	11.5
Total	3434	100.0	773	100.0	

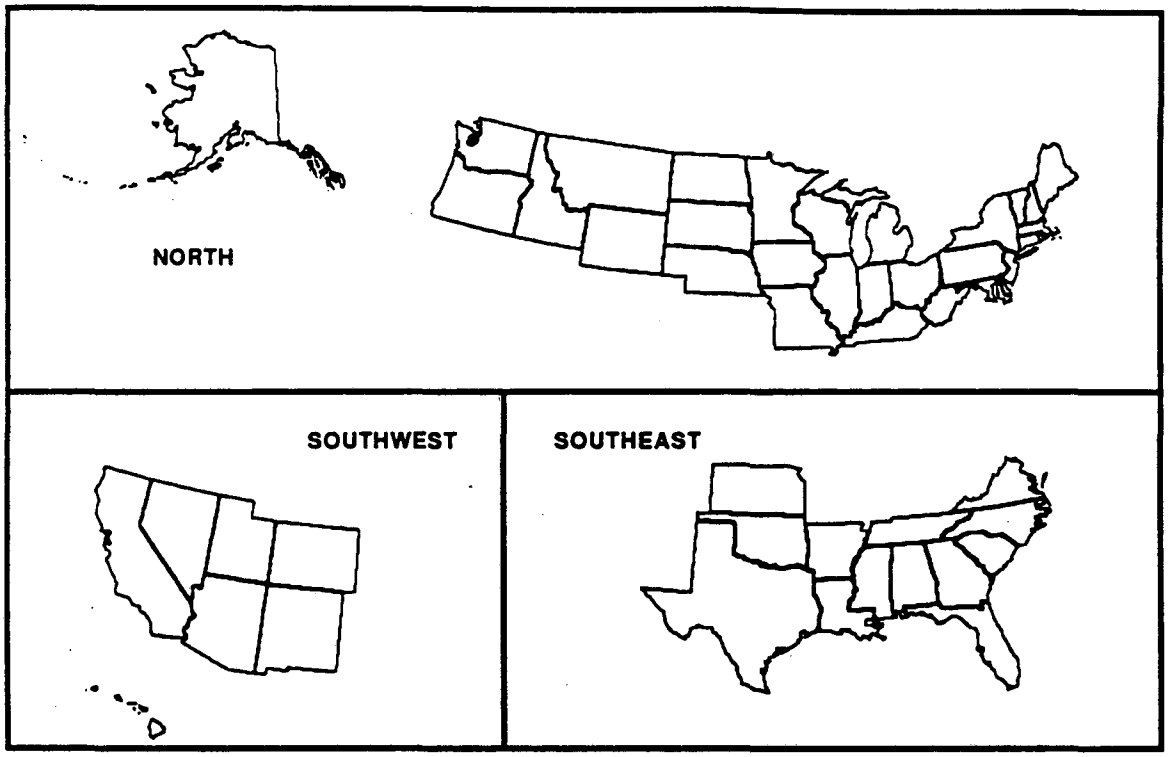

Fig. 3.2a: Climate Regions

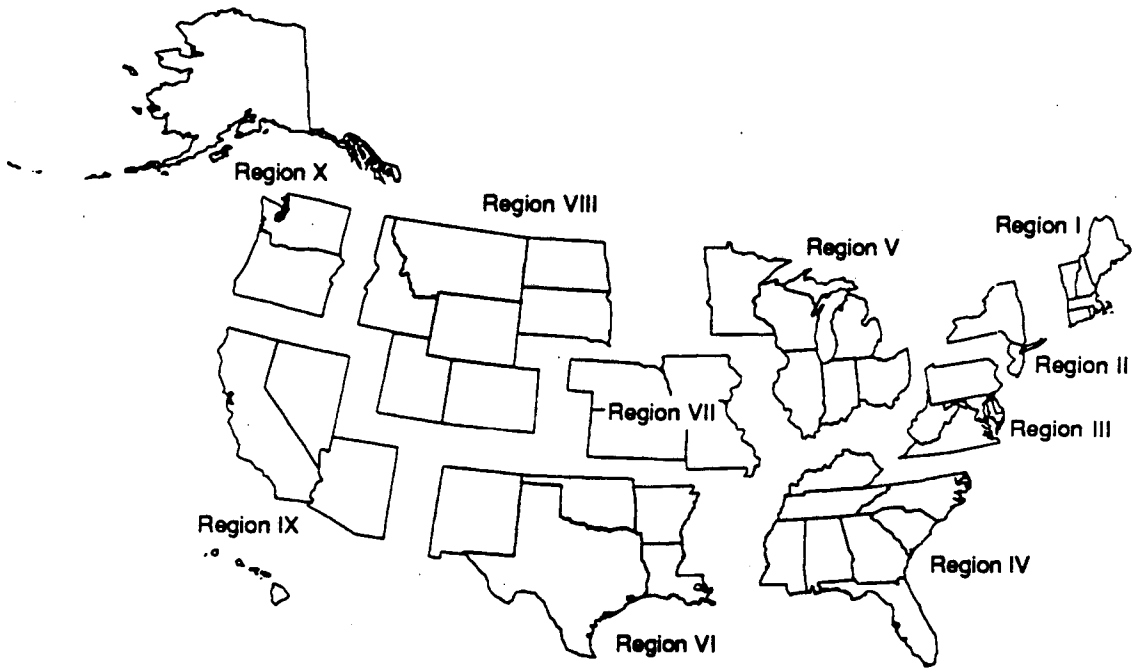

Fig. 3.2b: DOE Regions

3.5 Institutional Characteristics of Respondents

The survey provides information about the enrollment of respondents, distinguishing among full-time students resident on the campus, full-time students living off campus, and part-time students. The results are summarized by stratification variable in Table C.5 in Appendix C. Figure 3.3 reproduces the data in graphical form. The figure shows seven sets of four bars, one set for the entire sample of respondents, and one set for each of the six strata. Each set of four bars includes one bar that represents the total student body, and three bars representing components of the total: (1) full-time students residing on campus; (2) full-time students housed off campus; and (3) part-time students. The height of each bar is the mean enrollment per respondent. For example, for public institutions, the mean enrollment is about 10,500 students; the mean number of resident full-time students is 3000, of nonresident full-time students is nearly 6,000, and of part-time students is about 4,000.

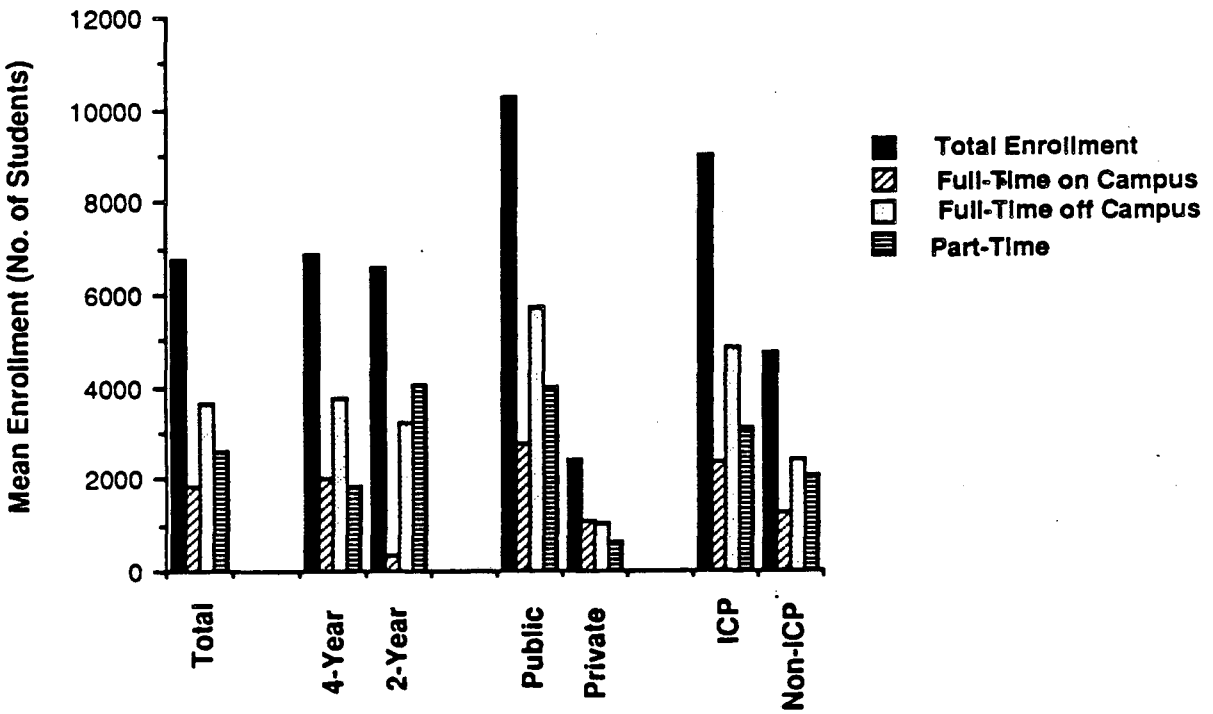

Fig. 3.3: Enrollment

Figure 3.3 shows that the mean total enrollment for two- and four-year institutions is nearly equal for respondents, but that the makeup of the student body is quite different; two-year institutions have a much smaller mean population of full-time resident students and have a much larger mean population of part-time students. The public and private institutions differ dramatically in the mean total enrollment (10,300 vs. 2,500), but the makeup of the student body is similar. The relationship of the mean student population in ICP vs. non-ICP institutions is similar to those for the public and private institutions. We note (again) that the sample of respondents is biased somewhat away from small,

private institutions and, as a result, some of these institutional characterizations may change when the nonrespondent followup data are added to the data set.

The degree of urbanization of the community in which the respondent's physical facility is located has also been examined with data from NCES to investigate the extent to which the sample of responses is representative of the universe of colleges and universities. This examination of the representativeness of the respondents has been performed separately for small institutions (less than 1,000 students), medium institutions (between 1,000 and 10,000 students), and large institutions (more than 10,000 students).* The comparisons are summarized in Figs. 3.4 a, b, and c, for small, medium, and large institutions, respectively.

Figures 3.4 a, b, and c each show three pairs of two bars. Each pair represents a degree of urbanization: rural institutions are those with no MSA designation; suburban institutions are those located in MSAs with populations between 25,000 and 500,000; and urban institutions are located in MSAs with populations greater than 500,000. Within each pair of bars, one represents the universe and the other represents the respondents. The height of the individual bars is the percentage of the total institutions (universe or respondents) in that enrollment category; thus, in each of the figures, the three bars representing the universe, and the three bars representing the respondents must each sum to 100%.

Two features of the data are noteworthy. First, the distribution among urban categories of small and medium institutions in both the universe and in the survey response sample are quite similar, and these two subgroups differ substantially from the large institutions, which more commonly are found in the large urban areas.

The second observation from Figs. 3.4a-c is that, within each figure, the pattern of the bars representing survey respondents is comparable with that for the bars representing the universe of institutions; the response sample is not substantially biased with community population for any of the enrollment categories. As noted earlier however, more in-depth examination of the universe and respondents has indicated that the relatively small biases that are present in the survey response are due largely to underresponse from private institutions; and that these have been corrected by the nonrespondent followup.

*This analysis used enrollment data from the NCES data base rather than the survey respondents' figures.

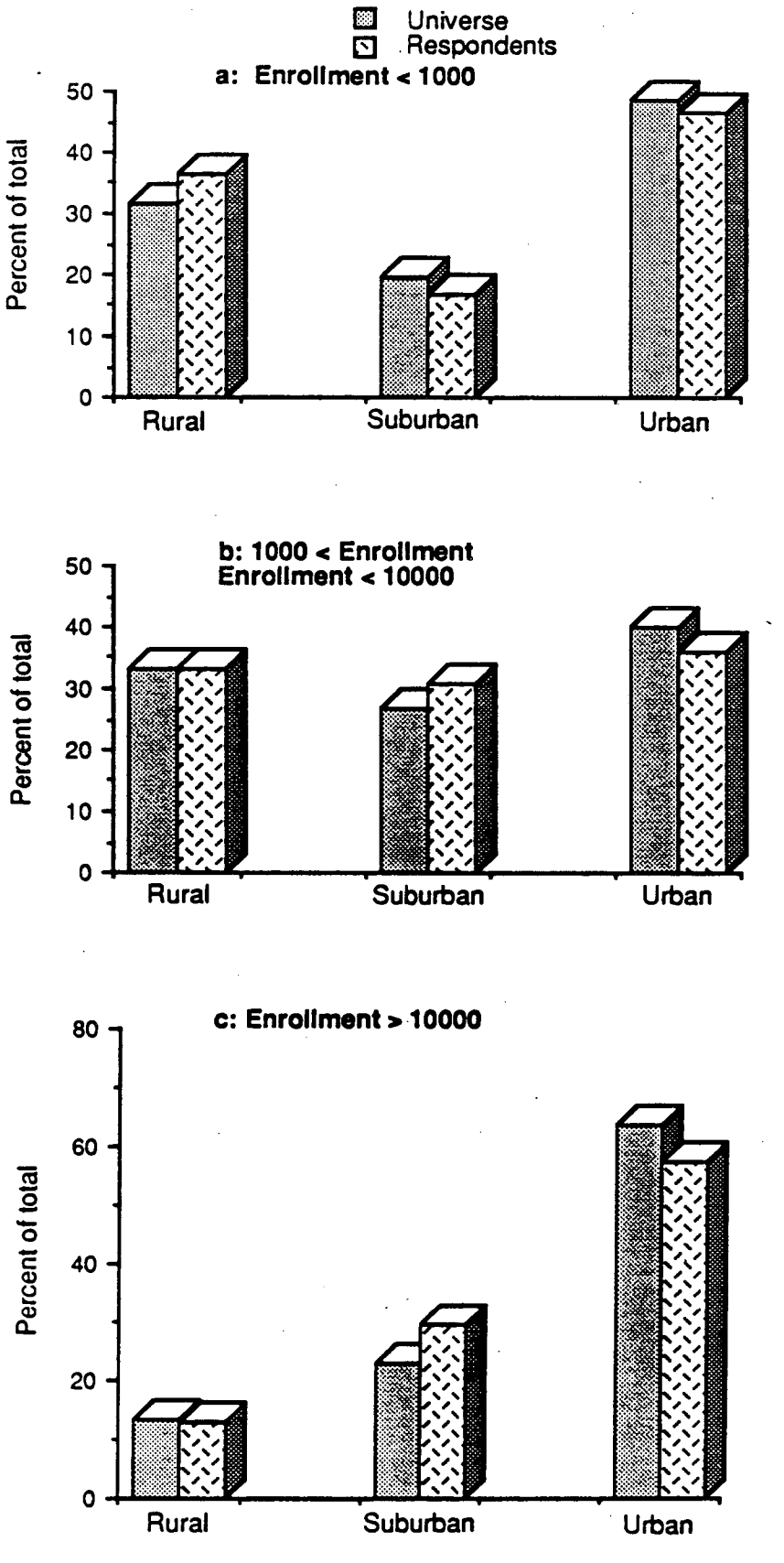

Fig. 3.4: Distribution of Respondents

4.0 TECHNICAL CHARACTERISTICS OF RESPONDENTS

4.1 Building and Functions

The average age of all buildings at these institutions was 26 years, and there were no statistically significant differences between the strata (Table C.6). However, for all institutions, the average age of the oldest building on campus was 66 years old (1921), and there were statistically significant differences between the groups (Table C.6). The oldest buildings at four-year colleges and universities (C&U), private institutions, and ICP participants were older than their counterparts by 12 to 30 years. The average number of buildings built after 1977 was four, and there were statistically significant differences between the groups (Table C.6). Four-year C&U, public institutions, and ICP participants had twice as many of these newer buildings as their counterparts.

The age of survey respondents' physical facilities has also been examined from a geographic perspective; Fig. 4.1 summarizes the results. The mean age of all buildings on campus and the mean age of the oldest building at the institution are shown for each of the ten DOE regions. In terms of both measures of age, colleges and universities in the Northeast (Regions I, II, and III) were the oldest, while institutions in the Sunbelt (Regions IV, VI, and parts of IX) and on the West coast (Regions X and parts of IX) were the youngest.

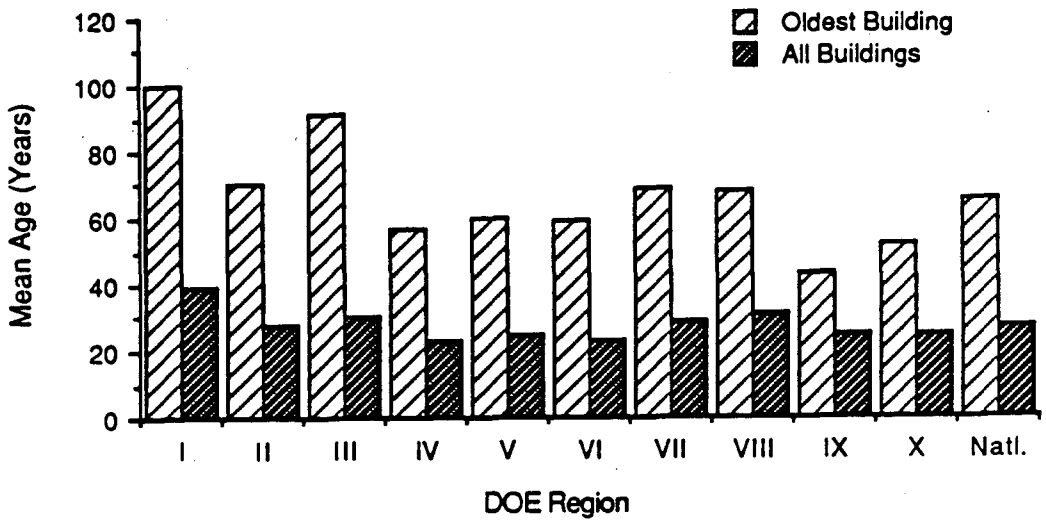

Fig. 4.1: Age of Facility

We examined two indicators of size of institution: number of buildings and square footage (Table C.6). The average number of campus buildings was 41, and there were statistically significant differences between the groups. Four-year C&U, public institutions, and ICP participants were significantly larger than their counterparts. These group differences were also true for square footage of conditioned building space (average of

1,336,761 ft^2 for all buildings). Both of these size indicators are, of course, influenced by underrepresentation of small institutions in the responses, as discussed in Section 3.2.

The geographic distribution of institution size for all survey respondents is summarized in Fig. 4.2. Parts a and b show the mean number of buildings and mean floor area, respectively, by DOE region. With respect to total number of buildings, campuses in Regions III, VI, VIII, and IX were the largest, but in terms of floor area, colleges and universities in Regions II, III, IV, V and VI were significantly larger than in the other regions.

Over 90% of the colleges and universities reporting on the types of uses that occur in their buildings indicated that they had special and general use facilities such as athletic facilities, daycare, devotional facilities, food preparation areas, dining rooms, assembly spaces, museums, and concert halls, and supporting facilities such as storage spaces (Table C.7). There was more divergence among institutions for other facilities: 57% had nonclass laboratory facilities (e.g., research laboratories), 69% had general use facilities such as merchandising, 39% had health care facilities, and 75% had residential facilities such as dormitories. There were several statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to have facilities for nonclass laboratories, special uses, some categories of general use, health care, and residential uses. These same differences held for ICP versus non-ICP participants. Public institutions were more likely than private institutions to have facilities for nonclass laboratories, some categories of general use, health care, and residential uses.

Because instructional use of buildings tends to occur less often during evenings, weekends, and summertime, we asked respondents how their C&U operated during these periods (Table C.8). Almost three-quarters of C&U rarely used their instructional rooms during the weekend; in contrast, they used these rooms more extensively in the evenings and during the summer. There were many statistically significant differences between the stratification groups. Two-year C&U and public institutions were more likely than their counterparts to use instructional rooms in the evening and during the summer. However, four-year C&U and private institutions were more likely than their counterparts to use instructional rooms on the weekends. And ICP participants were more likely than non-ICP participants to use instructional rooms on the weekend. The average number of summer weeks when instructional rooms were used was ten, and there were statistically significant differences for two of the three stratification groups. Public C&U had more summer instructional weeks than private C&U; the differences between ICP and non-ICP participants were based more on variation around the mean than on the mean itself.

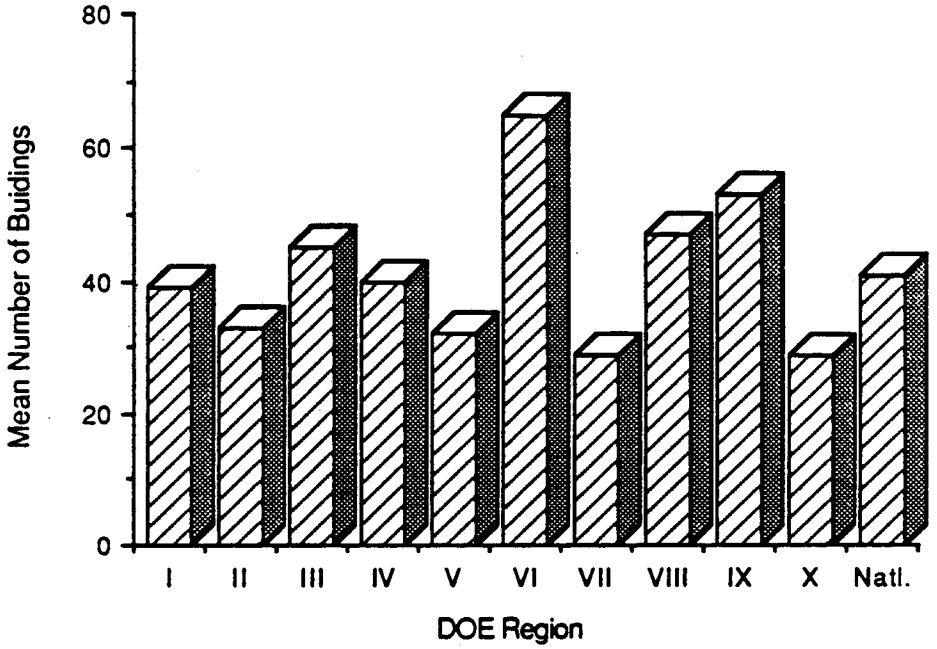

Fig. 4.2a: Size of Institution--Number of Buildings

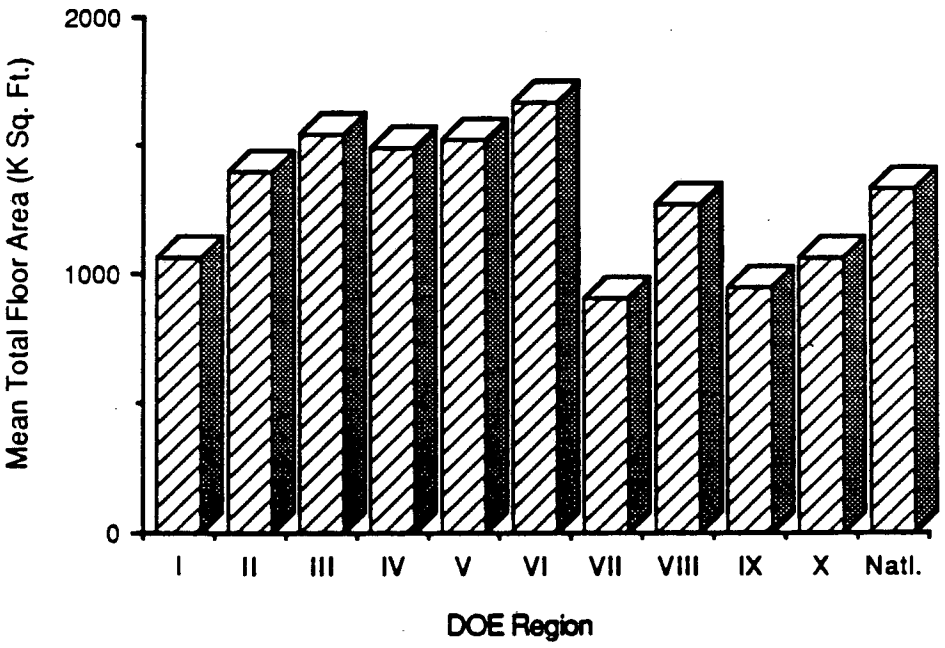

Fig. 4.2b: Size of Institution--Conditioned Floor Area

4.2 Energy Systems and Fuel Sources

4.2a Heating systems

Figure 4.3 shows the frequency of use of types of heating systems by survey respondents. Most institutions used central (66%) and individual (69%) boilers to heat their buildings (Table C.9). The next most common heating systems used were electric resistance heat (48%), gas-fired air heaters (43%), and all-electric heat pumps (29%). Less than 5% of the C&U used solar heating, cogeneration, or district heating. However, as shown in Fig. 4.4, the percentage of floor area heated by these systems gives us a slightly different picture (Table C.10). For example, district heating systems, although used in few institutions, serve almost 80% of the institution's conditioned floor area when they are used. In contrast, electric resistance heat, a more utilized system, typically serves only 15% of floor area. The percentage floor area served by "other" heating systems is approximately 36%. This category includes several heating systems (solar, district heating, etc.) that few respondents reported using. For this category, the figure for percent of floor area served is dominated by district heating.

There were some statistically significant differences between the groups, but no consistent relationship emerged. Four-year C&U and ICP participants were more likely to use central and individual boilers and cogeneration than two-year C&U and non-ICP participants, and public institutions tended to use gas-fired air heaters and solar heating more than private institutions. On the other hand, two-year C&U had a larger percentage of their floor area served by individual boilers, resistance heat, heat pumps, and gas-fired air heaters than four-year C&U. Public institutions had a greater percentage of their floor area served by central boilers, while private institutions had a greater percentage of their floor area served by individual boilers. Non-ICP participants had a larger percentage of their floor area served by individual boilers, resistance heat, and gas-fired air heaters.

Little difference was observed across DOE regions in the frequency of use of either central or individual boilers for heating. Differences are evident in the frequency of use of electric resistance, heat pump, and gas-fired air heating systems; the regional distributions for these three heating systems are shown in Fig. 4.5. Electric resistance heating was common in the Northeast (Regions I and II), East central states (Region III), Southeast (Region IV), and the Northwest (Region X). Gas-fired air heaters were more common in the North central (Regions V, VII, and VIII), South central (Region VI), and Southwest (Region IX). Electric heat pumps were frequently used in the Sunbelt (Regions IV, VI, and IX), and in the more temperate areas in the North (Regions III and X).

4.2b Cooling systems

More than 55% of the respondents indicated that at least part of their floor area was not air conditioned (Table C.11). Uncooled space is significantly more frequent in four-year C&U and ICP participants than in their counterparts. The mean fraction of uncooled space is 36% of the total floor area; the fraction is about the same for four-year and two-year C&U, and it is significantly larger for private institutions and non-ICP participants than for public institutions and ICP participants.

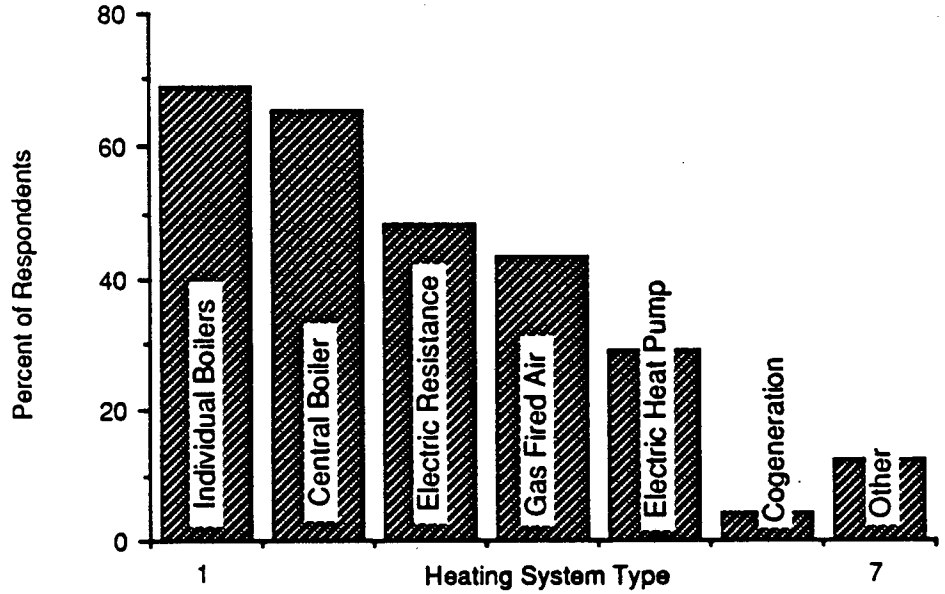

Fig. 4.3: Heating Systems in Colleges and Universities

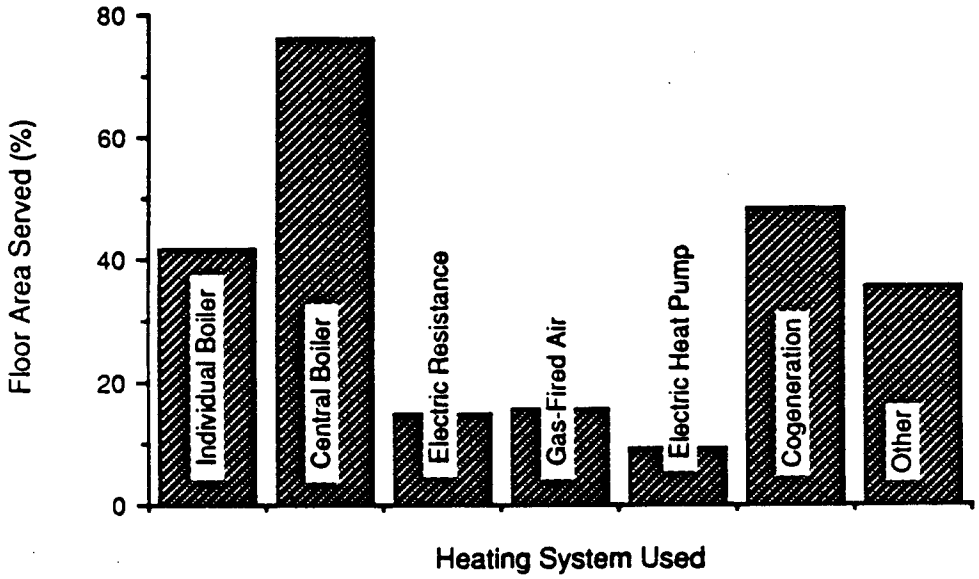

Fig. 4.4: Floor Area Served by Heating System

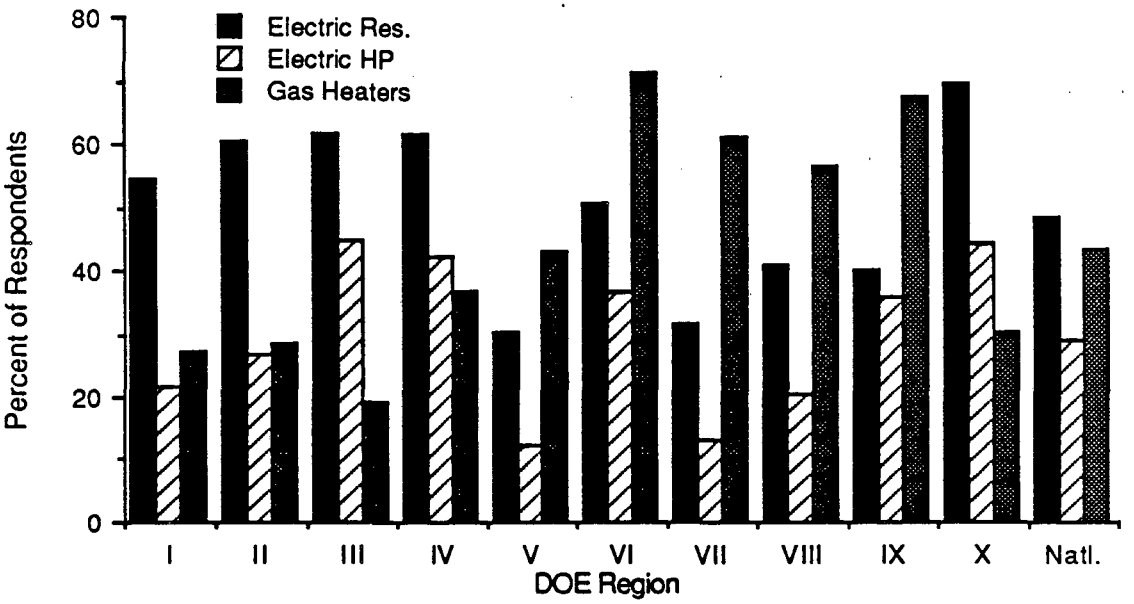

Fig. 4.5: Heating System Use

Regional distributions of cooled and uncooled space are summarized in Figs. 4.6 and 4.7. Figure 4.6 shows the distribution of fully air-conditioned facilities. No consistent climate pattern is evident; that is, there was not a consistently higher fraction of fully air-conditioned facilities in the Southern regions (Region IV, VI, and IX). Figure 4.7 shows the mean percentage of uncooled floor area for those respondents who indicate no air conditioning, or only partial air conditioning. When floor area is accounted for, a climate pattern emerges. Regions IV and VI had a small percentage of uncooled floor area in facilities that were not fully air conditioned (18% and 7%, respectively). For Region I, the mean percentage of floor area that was uncooled (70%) was much larger than in the other regions. Of the other northern climates, Region X had a large mean percentage of uncooled floor space in partially air-conditioned facilities.

The most commonly used air-conditioning systems were central or building chillers (70%), window air conditioners (56%), packaged cooling units (52%), and central air conditioners (excluding chillers) at 33%—see Table C.11; frequency of use of these cooling systems is shown in Fig. 4.8. Less popular systems were combination gas heating and electric air-conditioning units (29%), heat pumps (26%), and evaporative coolers (12%). As shown in Fig. 4.9, in terms of percentage of floor area served (Table C.12), chillers served 55%, central air conditioners 29%, and combined gas and electric packages 18%.

Four-year C&U statistically differed from two-year C&U in their use of air-conditioning systems: the former were more likely to use packaged cooling units, window air conditioners, and central chillers. Public institutions statistically differed from private institutions in that public C&U were more likely to use evaporative coolers and chillers, while private institutions tended to use window air conditioners. ICP participants differed from non-ICP participants in their use of air-conditioning systems: the former were

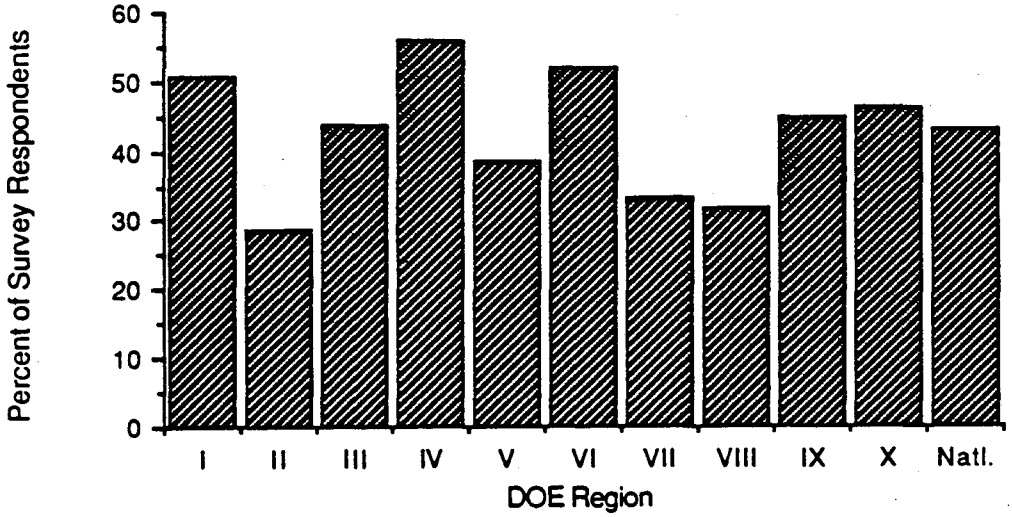

Fig. 4.6: Air Conditioning of Colleges and Universities

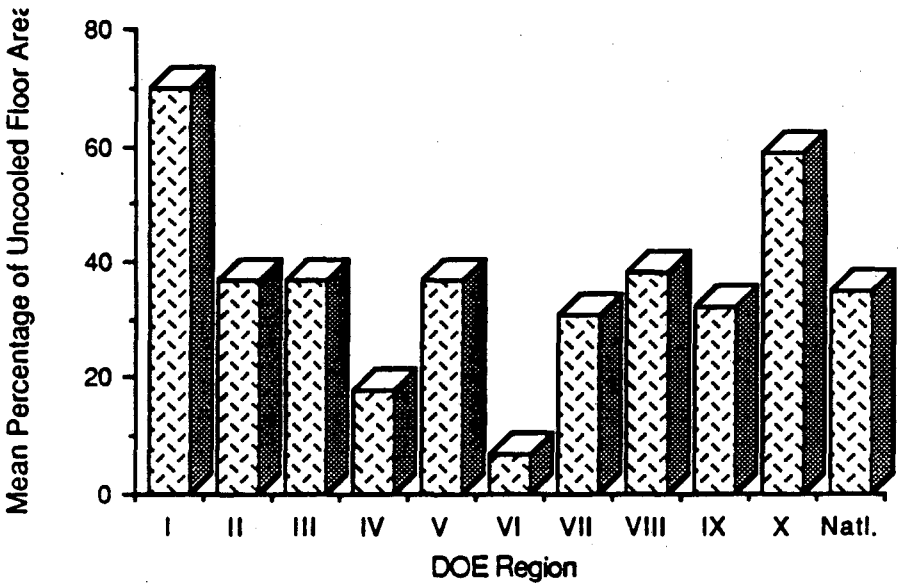

Fig. 4.7: Uncooled Floor Area

more likely to use packaged cooling units, window air conditioners, evaporative coolers, and chillers. Two-year C&U were more likely to have a greater percentage of their floor area served by central air conditioners, gas/electric packages, package cooling units, heat pumps, and chillers than were four-year C&U. The only exception to this trend was for window air conditioners. Public institutions were more likely to have a greater percentage of their floor area served by central air conditioners and chillers than private

institutions, but private C&U were more likely to have a greater percentage of their floor area served by window air conditioners. Non-ICP participants were more likely than ICP participants to have gas/electric cooling packages. The above observations regarding cooling system frequencies may be influenced by biases in the size of responding institutions or in their geographic/climatic distribution. These biases are described in Section 2 and will be corrected for in the nonrespondent followup.

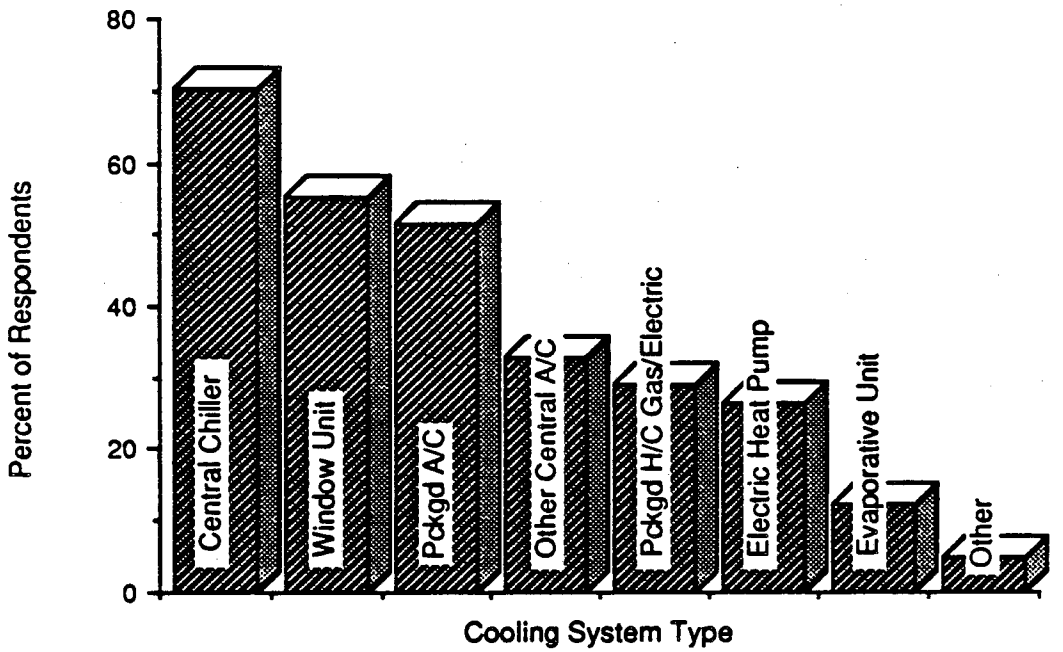

Fig. 4.8: Cooling Systems in Colleges and Universities

Regional distributions of air-conditioning types have been determined for survey respondents and are summarized in Table 4.1. This table shows the percentage of respondents who report use of cooling systems in the individual DOE regions. It is clear that multiple cooling systems were common in colleges and universities, and that there were no strong climate patterns. A few general observations can be made:

- The regional pattern of use of heat pumps for cooling was similar to that for heating—that is, they were most common in Regions III, IV, VI, IX and X.
- Evaporative cooling systems, whose performance is sensitive to climate, were most common in the more arid parts of the U.S. (Regions VIII and IX).
- Window air conditioners were common throughout the U.S. but were less prevalent in the Western areas (Regions IX and X). This is perhaps due to the more moderate climate in Region X, the more common use of heat pumps in Regions IX and X, and the more common use of gas for cooling in Region IX.

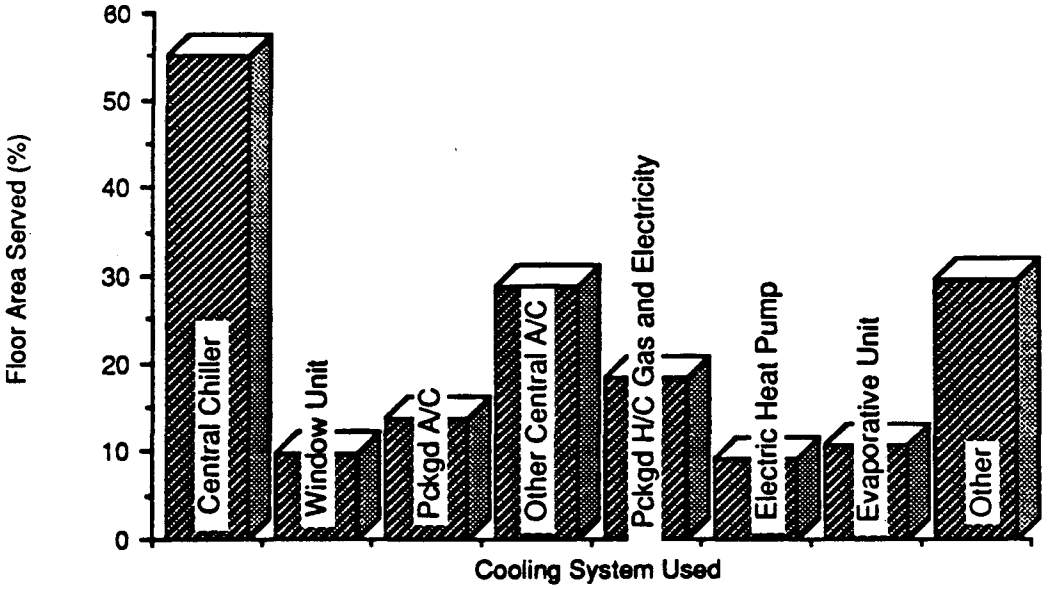

Fig. 4.9: Floor Area Served by Cooling Systems

Table 4.1: Regional Use of Air-Conditioning Systems in Colleges and Universities

System Type	Survey Respondents by DOE Region (%)										Nat'l
	I	II	III	IV	V	VI	VII	VIII	IX	X	
Central Unit (excl. chiller)	30.9	30.2	29.8	45.8	28.8	34.9	50.0	27.3	28.7	18.6	32.9
Pkgd. Elec. A/C w/Gas Heating	9.1	25.4	17.0	33.6	24.5	58.7	40.7	13.6	50.6	7.0	29.1
A/C-only Package	56.4	60.3	51.1	44.9	47.9	49.2	48.1	65.9	54.0	53.5	51.6
Window or Thru-the-Wall Unit	60.0	57.1	60.6	58.9	57.7	57.1	63.0	61.4	36.8	39.5	55.5
Electric Heat Pump	16.4	23.8	43.6	35.5	10.4	34.9	13.0	22.7	34.5	37.2	26.5
Evaporative Cooler	3.6	7.9	2.1	6.5	8.6	17.5	5.6	43.2	28.7	16.3	12.3
Central Chillers	45.5	68.3	76.6	77.6	73.6	76.2	68.5	68.2	67.8	58.1	70.1

Beyond this, patterns are not easily discernible. Central systems had a relatively constant frequency of use across regions, except for in Regions IV and VII, where they were more frequently used. Chillers, too, were used at a relatively constant frequency, except in Region I, where they were less common. Packaged electric air conditioning in concert with gas heating was seldom used in Regions I, III, VIII, and X, and was much more

common in Regions VI, VII, and IX. Air-conditioning-only packages were used with relatively constant frequency across the regions, but were somewhat more common in Regions II and VIII. Understanding these frequencies of use will require more detailed analyses that consider climate, fuel source availability, and institutional characteristics.

4.2c System changes

About one-half of all colleges and universities experienced some changes to their heating, ventilation, and air-conditioning systems since 1980 (Table C.13). Differences were statistically significant only between ICP and non-ICP participants: the former were more likely than the latter to have experienced these changes.

4.2d Service to other buildings

A small percentage (6%) of C&U had heating and/or cooling systems that served other buildings in addition to their own campus(es), and there were statistically significant differences for two of the three stratification cells (Table C.14). Four-year C&U and ICP participants were more likely to have their heating and/or cooling systems serve other buildings than were their counterparts.

4.2e Fuels used

Fuels used for heating in colleges and universities are summarized in Table C.15 and shown in Fig. 4.10. As shown, most colleges and universities used natural gas as their primary **heating** source, followed by fuel oil, electricity, coal, and steam/hot water. One-half of colleges and universities indicated some use of **fuel oil** for heating. One-half of these respondents used fuel oil as a backup heating fuel, 27% used fuel oil as a primary heating fuel, and 19% used it as a secondary fuel. Table C.15 shows statistically significant differences between public and private institutions: the latter were more likely to use fuel oil as a primary heating source, while the former were more likely to use it as a backup source. Over 80% of colleges and universities indicated some use of **natural gas** for heating. Three-quarters of these respondents used natural gas as a primary heating source, 20% used it as a secondary fuel, and a small percentage (6%) used it as a backup source. There were statistically significant differences for two of the three stratification groups, although the differences were slight. Two-year C&U and non-ICP participants were more likely to use natural gas as a primary heating source compared with their counterparts.

Over 40% of colleges and universities indicated some use of **electricity** for heating. About 60% of these respondents used electricity as a secondary heating source, 27% used it as a primary heating source, and 12% used it as a backup source. The only statistically significant difference between groups was between four-year and two-year C&U: the former were more likely to use electricity as a secondary heating source, while the latter were more likely to use it as a primary heating source.

Only 5% of colleges and universities indicated some use of **purchased steam/hot water** for heating, and most of these respondents (86%) used this fuel as a primary

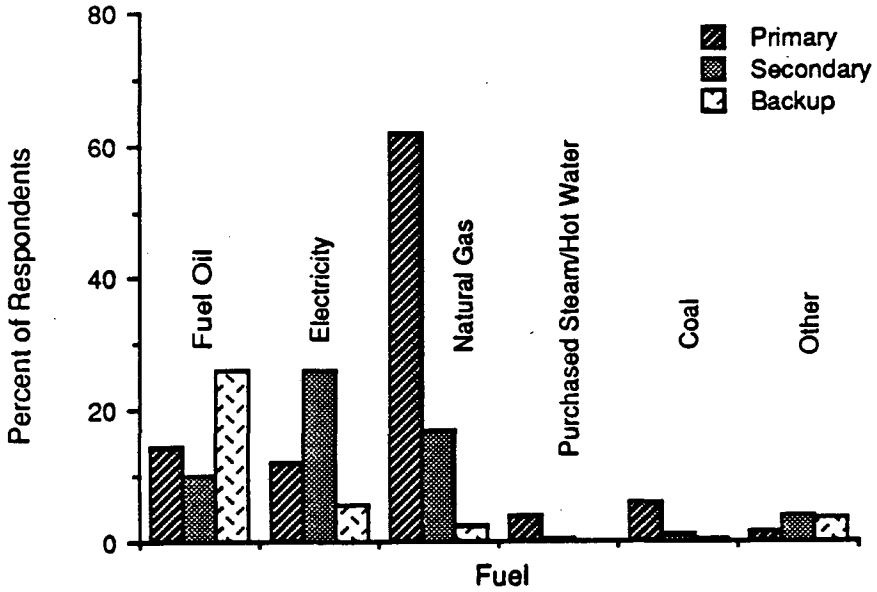

Fig. 4.10: Heating Fuels

heating source. The only statistically significant difference between groups was between ICP and non-ICP participants: the former were more likely to use steam/hot water as a secondary heating source while the latter were more likely to use it as a primary heating source. Only 8% of colleges and universities indicated some use of **coal** for heating. Most of these respondents (75%) used this fuel as a primary heating source, 18% used it as a secondary heating source, and 3% used it as a backup source. There were no statistically significant differences between the stratification groups. Very few institutions used **solid waste, solar energy, or propane** for heating purposes.

Table C.16 shows fuel use for cooling; Fig. 4.11 summarizes the results. Most colleges and universities used electricity as their primary **cooling** source, followed by natural gas. Very few institutions used **fuel oil, coal, purchased steam, solar energy, or propane** for cooling purposes. There were no statistically significant differences between the stratification cells for any of the cooling fuels. Over 80% of colleges and universities indicated some use of **electricity** for cooling. Over 90% of these respondents used electricity as a primary cooling source, and 9% used it as a secondary cooling source. Almost 20% of colleges and universities indicated some use of **natural gas** for cooling, and these respondents used natural gas equally as both a primary and secondary cooling source.

Figures 4.12 and 4.13 show the distribution of fuel sources by DOE region for heating and cooling, respectively. These figures include data for the primary source of fuel only. As shown, natural gas dominated as a heating fuel, except in the Northeast (Regions I, II, and III), where fuel oil or fuel oil and electricity were more common. For cooling, electricity dominated in all regions; however, natural gas was used for cooling across the country, and its use was most appreciable in Region IX.

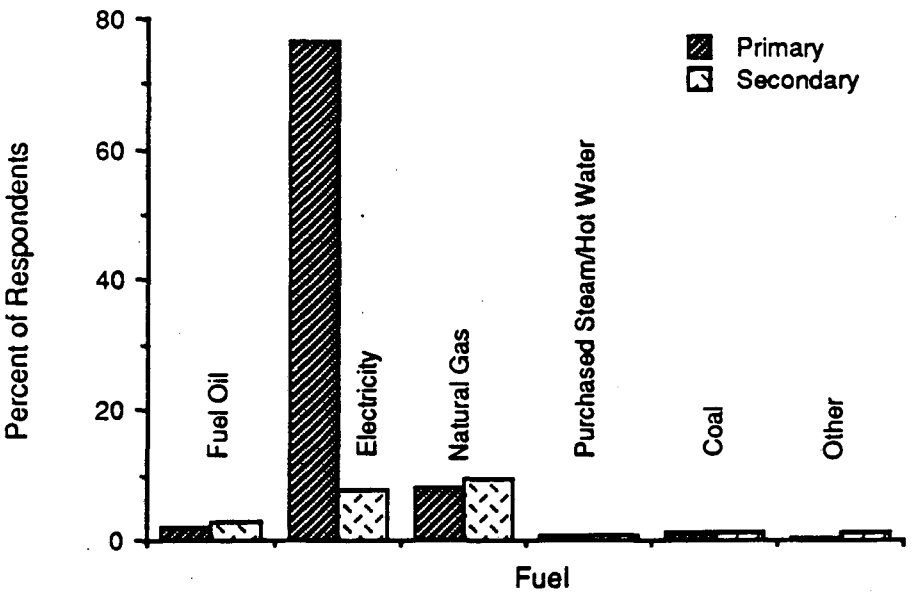

Fig. 4.11: Cooling Fuels

4.2f Metering and changes in metering

The average number of meters measuring electricity was 27 and measuring natural gas was 10 for each institution (Table C.17). The average number of buildings individually metered for electricity use was 19 and for natural gas was 8 for each institution. There was a statistically significant difference between four-year C&U and two-year C&U: the former had more meters and more buildings individually metered than the latter. In the only other case where there was a statistically significant difference, ICP participants had more buildings individually metered for electricity than did non-ICP participants.

4.3 Energy Use

4.3a Changes in energy consumption

Respondents were asked about changes in energy consumption since 1980 and all but 1% responded to this question. As shown in Table C.18 and summarized in Fig. 4.14, about 44% of the respondents reported an increase in their total energy consumption since 1980, 42% reported a decrease, 13% thought their total energy consumption was about the same since 1980, and 2% did not know. There were no statistically significant differences between the stratification groups.

Figure 4.15 shows the regional distribution of changes in energy use. The first two bars for each region represent the fraction of survey respondents reporting increases and decreases, respectively, in energy use since 1980, and the third bar is the fraction that either was unsure or that reported no change. For each region, the three bars sum to 100%. In Regions I, III, IV, VIII, and X, more than 50% of the respondents reported increases in consumption. In the other regions, more institutions reported decreases than increases in energy consumption.

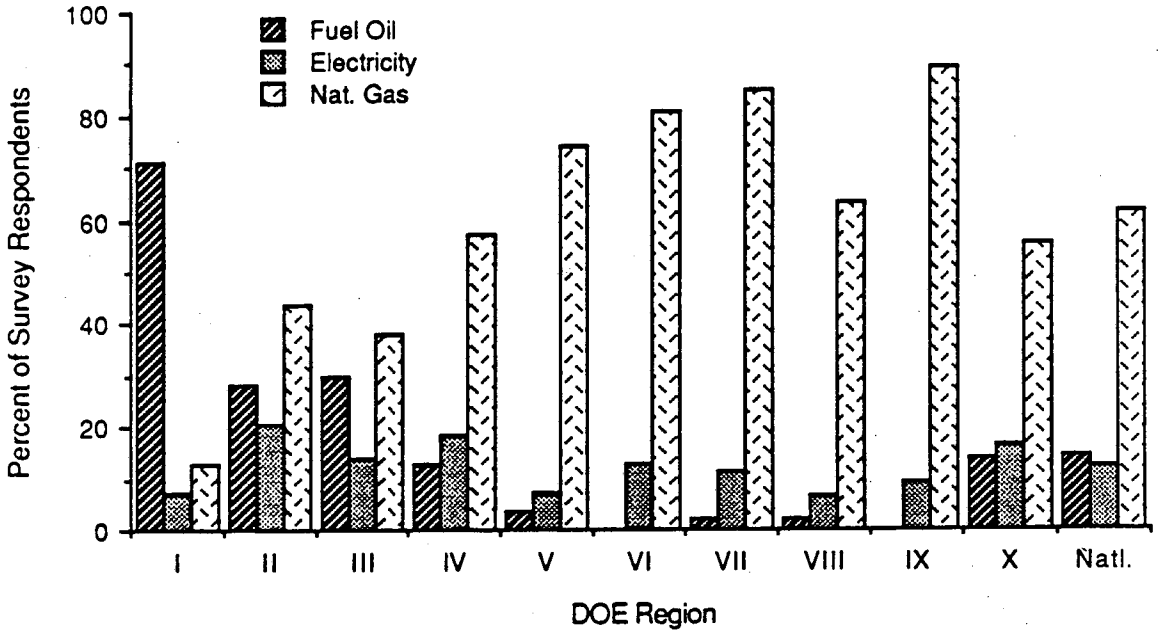

Fig. 4.12: Primary Heating Fuel

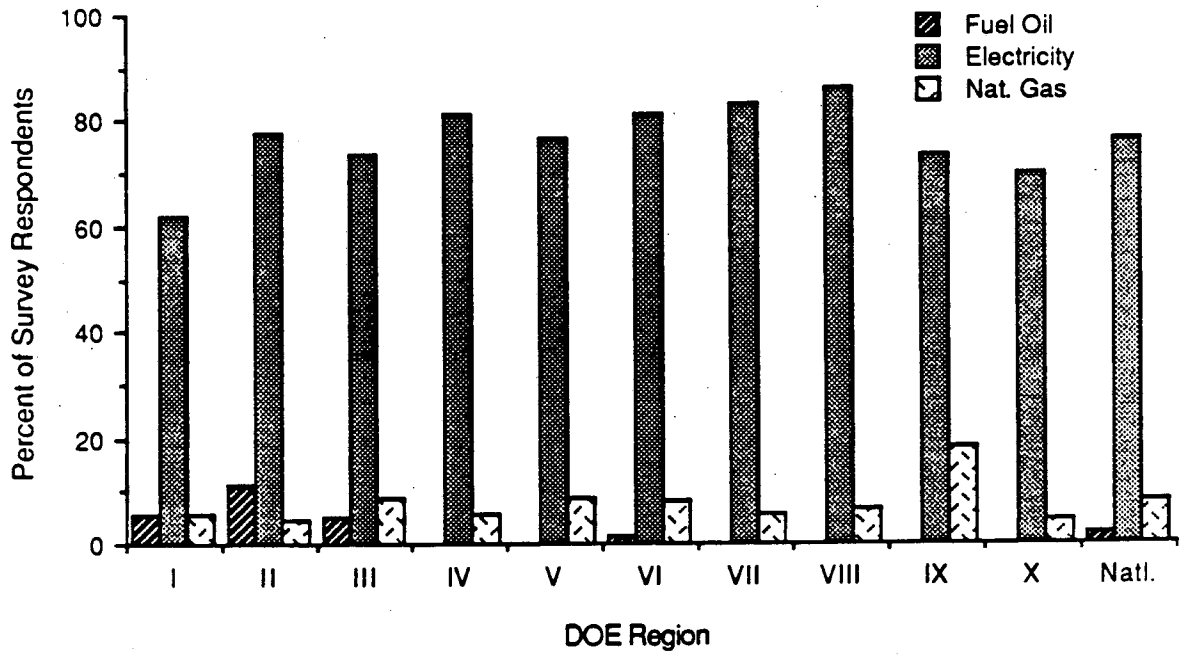

Fig. 4.13: Primary Cooling Fuel

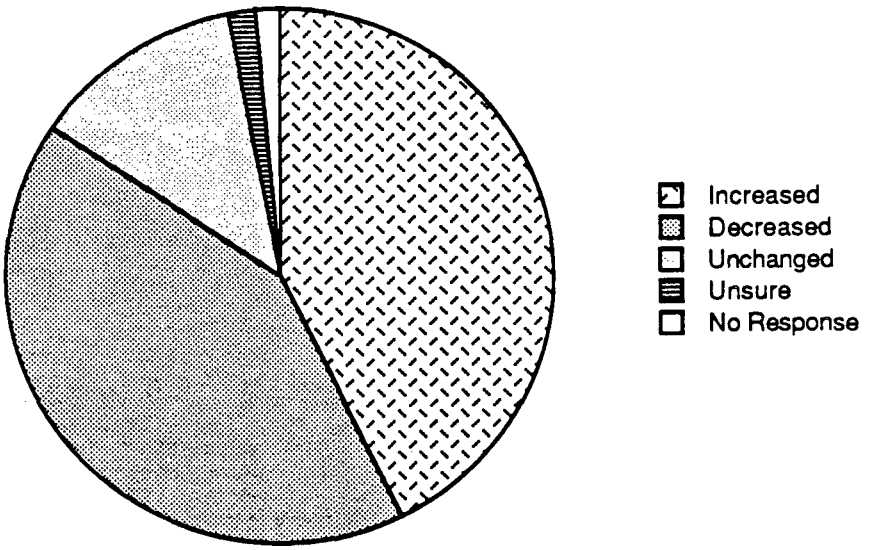

Fig. 4.14: Changes in Energy Use Since 1980

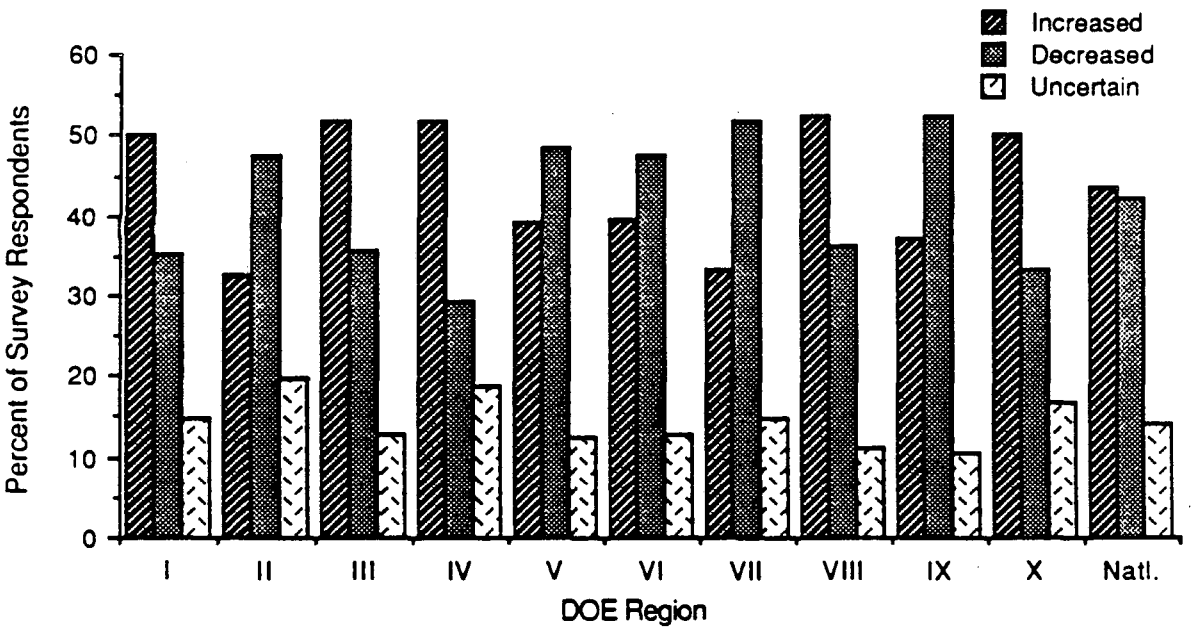

Fig. 4.15: Changes in Energy Use Since 1980 by DOE Region

4.3b Reasons for changes in energy consumption

As mentioned in the previous section, 85% of the colleges and universities indicated that their energy consumption had changed (increased or decreased) since 1980. Institutions reporting a change in energy consumption *not* due to energy conservation measures were asked about possible reasons for the changes. The sample size changed for each of these reasons because some respondents skipped a question if they felt it was inapplicable. Thus, the percentages pertain only to those who answered "yes" or "no" to the specific question. About 70% of the respondents thought the change in energy consumption was due to changes in educational services, 84% to changes in building services, 84% to changes in square footage (building additions), and 58% to changes in the summer schedule (Table C.19). In most cases, these changes led to increased consumption in the buildings. In some cases, there were statistically significant differences between the stratification groups: four-year C&U were more likely to report changes in square footage as responsible for changes in energy use, while two-year C&U and private institutions tended to think that changes in their summer schedule led to a decrease in energy consumption in their buildings, compared with their counterparts. Non-ICP participants were more likely than ICP participants to say that changes in educational services led to a decrease in energy consumption.

5.0 ENERGY MANAGEMENT ACTIVITIES

5.1 Level of Energy Conservation Activity

Table C.20 shows the changes in the level of energy conservation activities in colleges and universities since 1980; the results are summarized in Fig. 5.1. Almost three-quarters of the institutions reported an increase in the number of energy conservation activities on their campus since 1980. About 15% thought that the number of activities remained the same, and 11% reported a decrease in the number of activities. There were no statistically significant differences between the stratification groups.

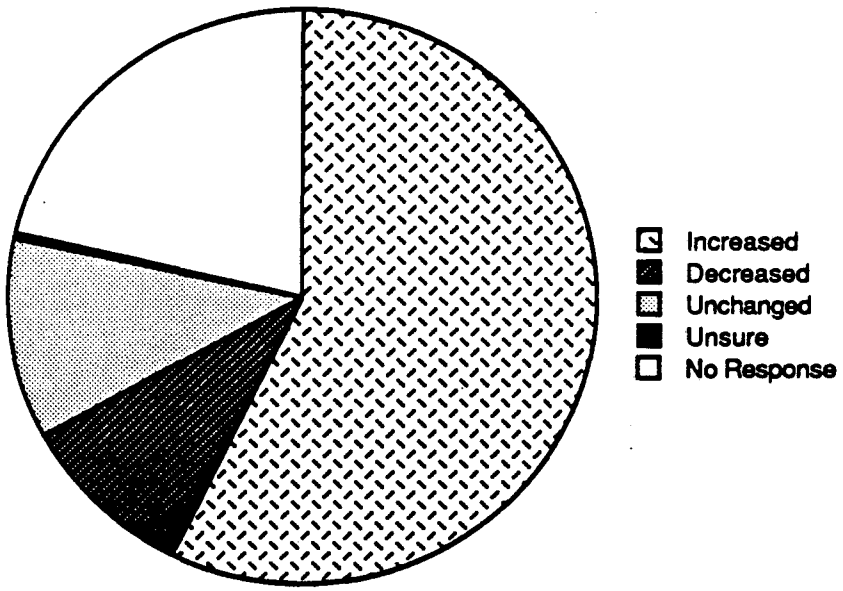

Fig. 5.1: Changes in Conservation Activity Since 1980

Figure 5.2 shows the geographic distribution of changes in the level of energy conservation activity. The first two bars for each region represent the fraction of the respondents reporting increases and decreases, respectively, in the level of activity since 1980; the third bar corresponds to institutions who report no change or who are unsure. The three bars sum to 100% for each region. Although there were increases in all regions, Regions I, III, IV, and VIII showed less increase than the others. Though the differences were small, they are noted here because these were four of the five regions in which a relatively large fraction of colleges and universities reported increases in energy use, as discussed in Section 4.3 and shown in Fig. 4.15.

5.2 Institutional Programs

5.2a Written energy plans and energy-savings retained

One-third of the colleges and universities had a written energy plan for controlling energy costs, and almost all of them reported that they currently used their plan. The

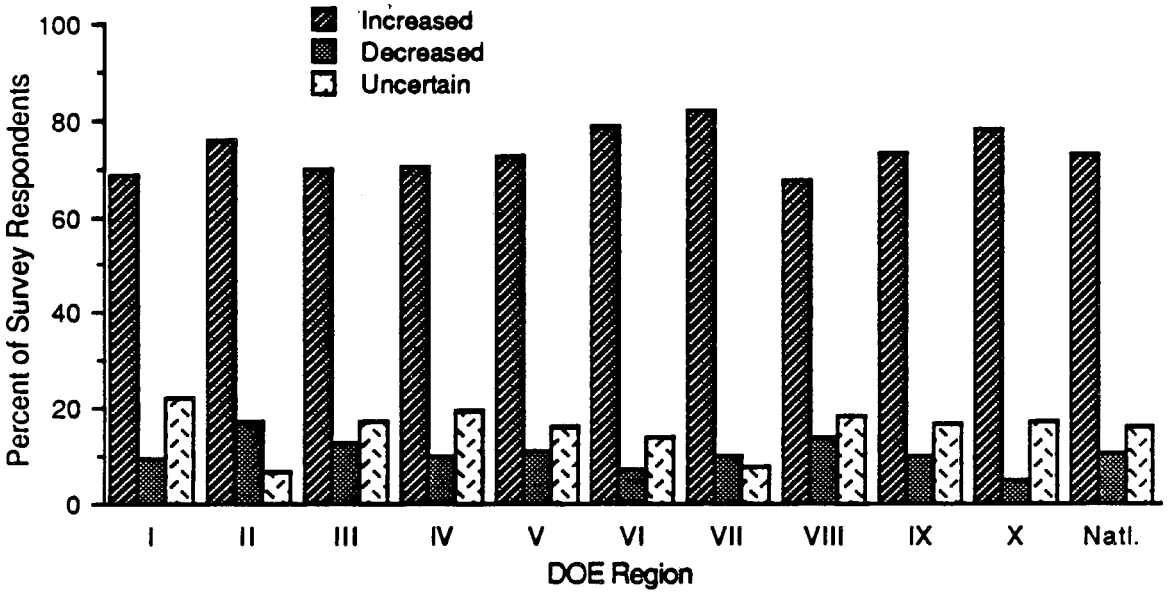

Fig. 5.2: Energy Conservation Effort

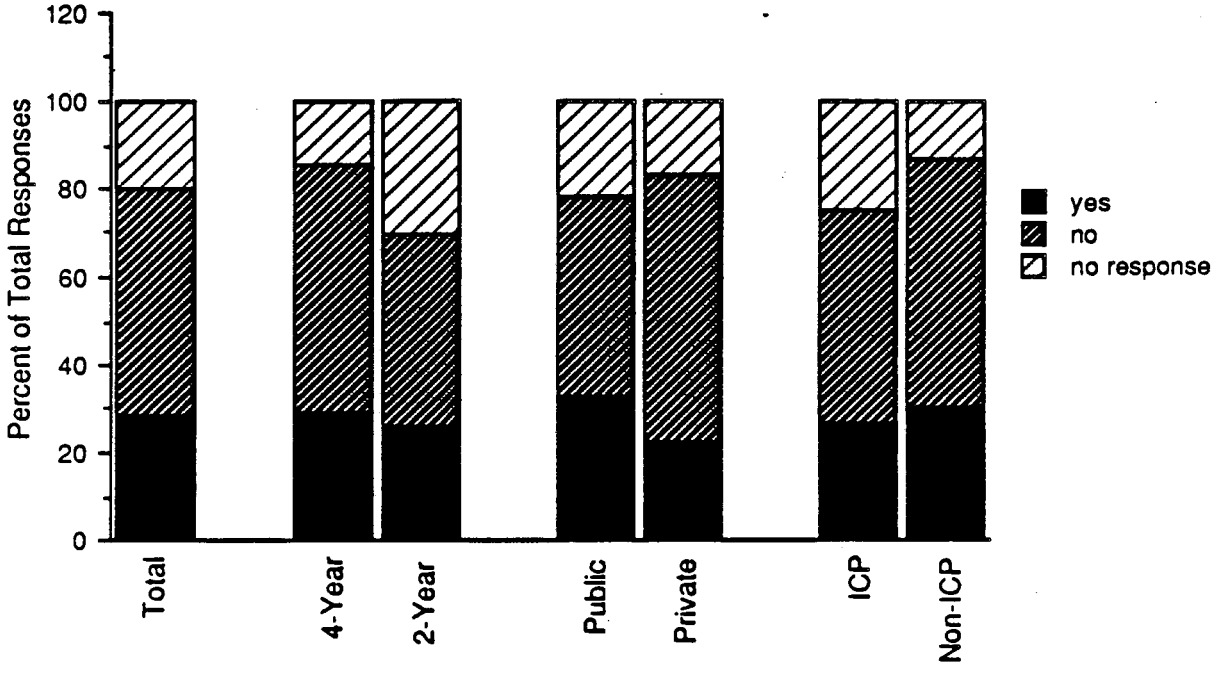

Fig. 5.3: Written Energy Plans (by variable)

breakdown by stratification variable is shown in Table C.21 and summarized in Fig. 5.3. Public institutions differed statistically from private institutions in this matter: public colleges and universities were more likely than private institutions to have a written energy plan.

Figure 5.4 shows by DOE region the frequency of written energy plans for institutions responding to the survey. The three bars for each region correspond, respectively, to institutions where (1) energy plans do exist, (2) energy plans do not exist, and (3) where the individual responding either was uncertain as to the existence of a plan or did not answer the survey question. The three bars for each region sum to 100%. Two regions differed substantially from the norm. In Region VI written energy plans were considerably more common than in the other regions, and in Region X they were considerably less common. Perhaps coincidentally, Region X was one of the regions where a substantial number of institutions reported increases in energy use since 1980, as discussed in Section 4.3 and shown in Fig. 4.15.

A recent, innovative mechanism for encouraging institutions to conserve energy is the ability of institutions or departments to retain in their budgets a portion of the cost savings after investing in energy conservation measures (rather than having budgets reduced by the amount of energy cost savings). The average percentage of savings retained by colleges and universities in our sample was 57%; however, the average percentage of savings retained by a department at the institution—usually the Physical Plant Department—was 13% (Table C.21). There was considerable variation in the savings retained by the institution and the department. Private institutions and ICP participants differed statistically from their counterparts: private institutions and ICP participants were more likely than public institutions and non-ICP participants to retain a greater proportion of cost savings.

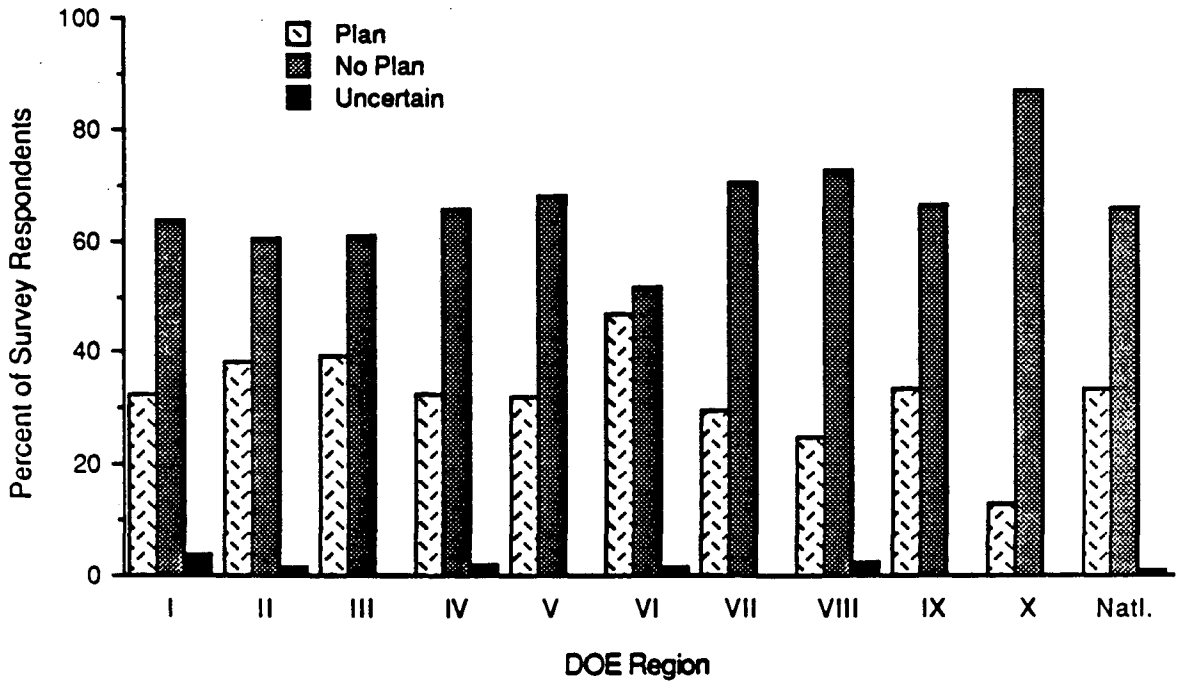

Fig. 5.4: Written Energy Plans (by region)

5.2b Audits, consultants, expertise, and mechanical work

Table C.22 summarizes responses to survey questions relating to technical audits (defined as an onsite examination of a building and its energy systems, performed for the purpose of recommending ways to save energy). Figure 5.5 summarizes the results as they relate to the frequency of audits and to identification of the auditor. Almost three-quarters of all respondents reported that a comprehensive, technical energy audit had been conducted on their campus since 1980. Table C.22 indicates that public institutions and ICP participants differed statistically from their counterparts: public institutions and ICP participants were more likely than private institutions and non-ICP participants to have had an audit. The most common way the results of the audit were reported to the institution was by a detailed written report (59%), followed by a brief report and/or oral briefing (16%), and/or simply a computer printout (10%). The only statistically significant difference between the stratification groups occurred in the use of detailed written reports: public institutions and ICP participants were more likely than their counterparts to use this medium.

Most recent audits were performed by private consultants or contractors (53%) and college or university employees (12%). A small percentage of audits was performed by utility company personnel (8%), state government personnel (4%), or local government personnel (0.1%). Table C.22 indicates that public institutions were more likely than private institutions to have audits performed by private consultants or contractors or by state personnel. ICP participants were also more likely than non-ICP participants to have had private consultants or contractors perform the audit.

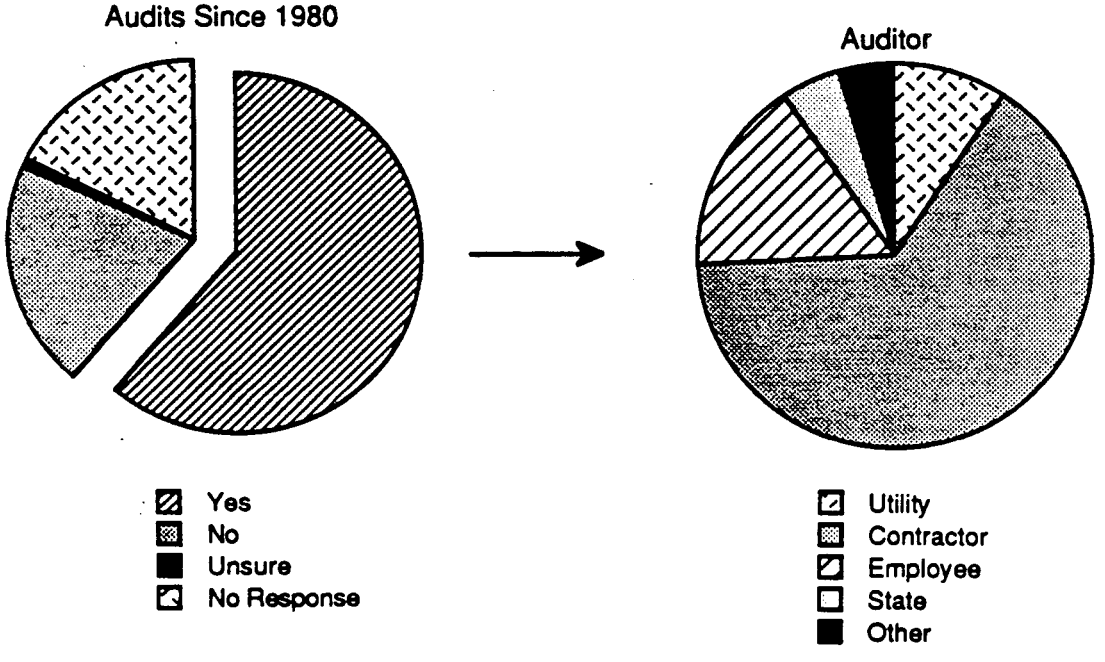

Fig. 5.5: Energy Audit Activities

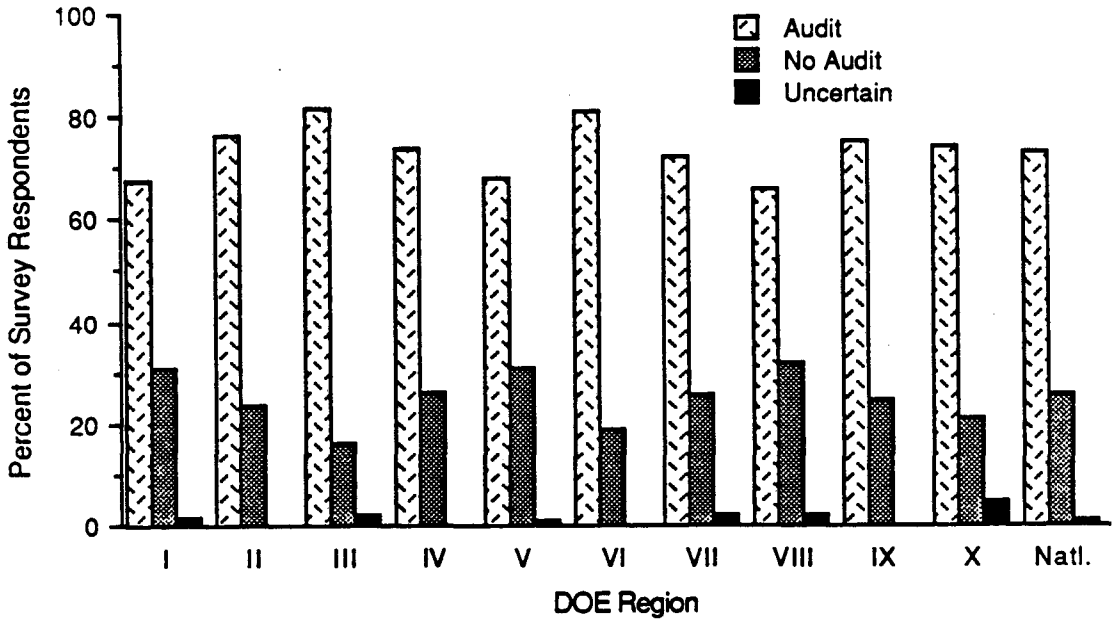

Fig. 5.6: Technical Audits

Figure 5.6 summarizes audit activity among survey respondents by DOE region. The three bars for each region correspond to respondents who had audits between 1980 and 1986, those who did not have audits in this period, and those for which the individual completing the survey was unsure or did not answer the question. Audit activity was high throughout the country. Regions I, V, and VIII had somewhat less audit activity than the other regions, and Regions III and VI somewhat more activity.

Nationally, the average number of buildings audited since 1980 was 15, and there were statistically significant differences between four-year and two-year C&U and between ICP and non-ICP participants. Four-year C&U and ICP participants had more audits than their counterparts. The most recent audit was performed, on average, in 1984, and this was true for all stratification groups (Table C.22).

Most of the mechanical work on respondents' facilities was conducted by college and university staff (96%). However, colleges and universities also contracted out considerable mechanical work; more than 80% of those responding to this question, or about 68% of the total number of respondents, indicated that they contract out at least part of the work. As shown in Table C.23, there were no statistically significant differences between the stratification groups.

5.3 Occupant Problems

Information was also requested regarding problems associated with building occupants; the results are summarized in Fig. 5.7 and, in more detail, in Tables C.24 and C.25. It is important to note that these problems are often associated with the performance of the building (heating, cooling, and lighting) or with the way the building is managed.

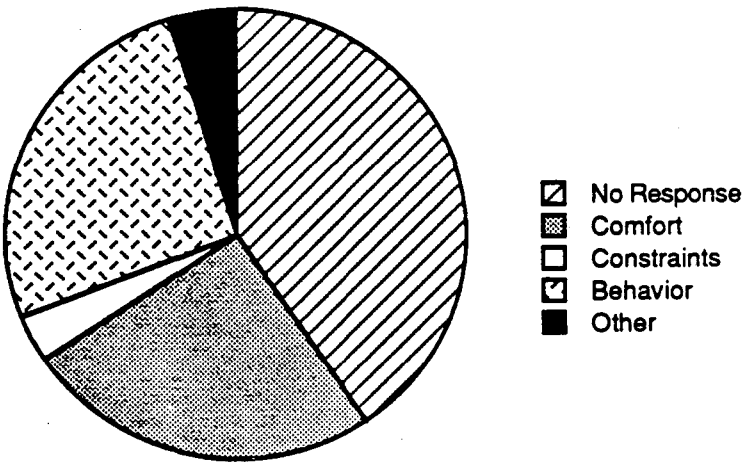

Fig. 5.7: Occupant Problems

Almost 60% of the colleges and universities indicated that they had occupant-related problems in implementing energy conservation measures. Almost one-quarter of the sample cited problems with occupant behavior: what occupants do (e.g., leave windows open), what occupants want (e.g., control of their environment), the level of occupant interest (e.g., they don't care, they resist change, or they are indifferent), or occupants' likes and dislikes. Another quarter of the sample specifically mentioned comfort problems, and a very small percentage (3%) cited constraints (e.g., special requirements resulting from the education or research functions provided). There were statistically significant differences in two of the three stratification groups. Two-year institutions and non-ICP participants were more likely to indicate a lack of occupant problems than their counterparts.

6.0 SPONSORSHIP AND FINANCING

6.1 Sources of Financing

Survey respondents were asked about the financial arrangements they've taken since 1980 (or which they plan to take) to enable their college or university to purchase energy-saving capital equipment. The responses are summarized for the nation in Fig. 6.1. The data used in this figure are from Table C.26. As shown in Fig. 6.1, the most common source of funds was general operating and capital funds (81%), followed by grants (46%), savings-based financing (13%), lease/lease purchase financing (8%), tax-exempt bonds (6%), and commercial loans (4%). For the future, the most common source of funds planned was in the same order: general operating and capital funds (48%), grants (32%), savings-based financing (13%), lease/lease purchase financing (6%), tax-exempt bonds (6%), and commercial loans (3%). The only statistically significant difference between four-year and two-year C&U was for tax-exempt bonds: the former were more likely than the latter to have used this source of funds. There were several statistically significant differences between public and private institutions: public colleges and universities were more likely to use grants or to plan for the use of general operating and capital funds, while private institutions tended to use commercial loans and lease/lease purchase financing. There were consistently significant differences between ICP and non-ICP participants: the former were more likely than the latter to use tax-exempt bonds and grants and to plan for the use of general operating and capital funds, savings-based financing, and grants.

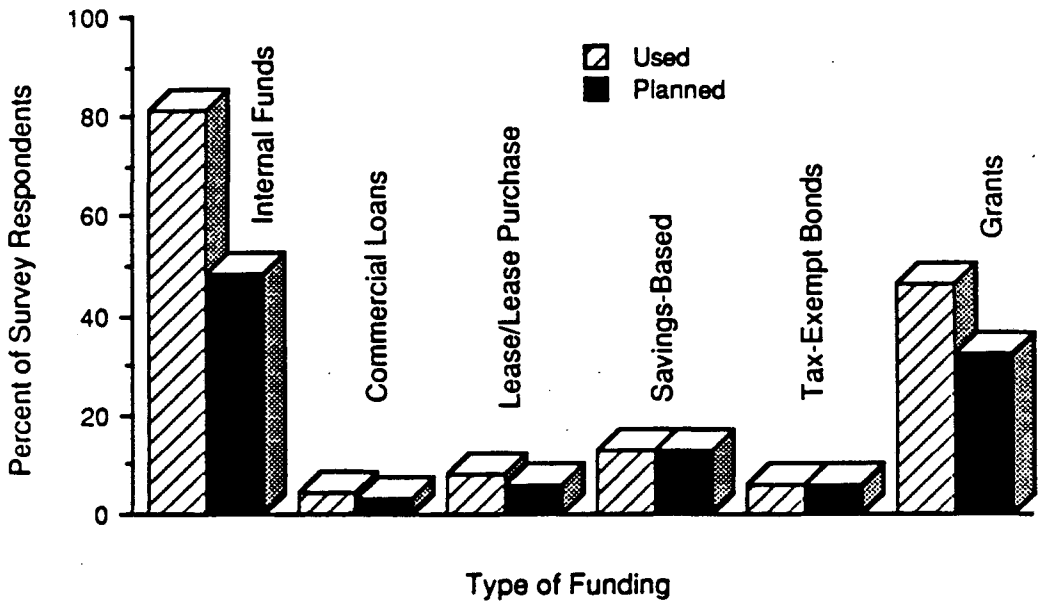

Fig. 6.1: Energy Conservation Funding

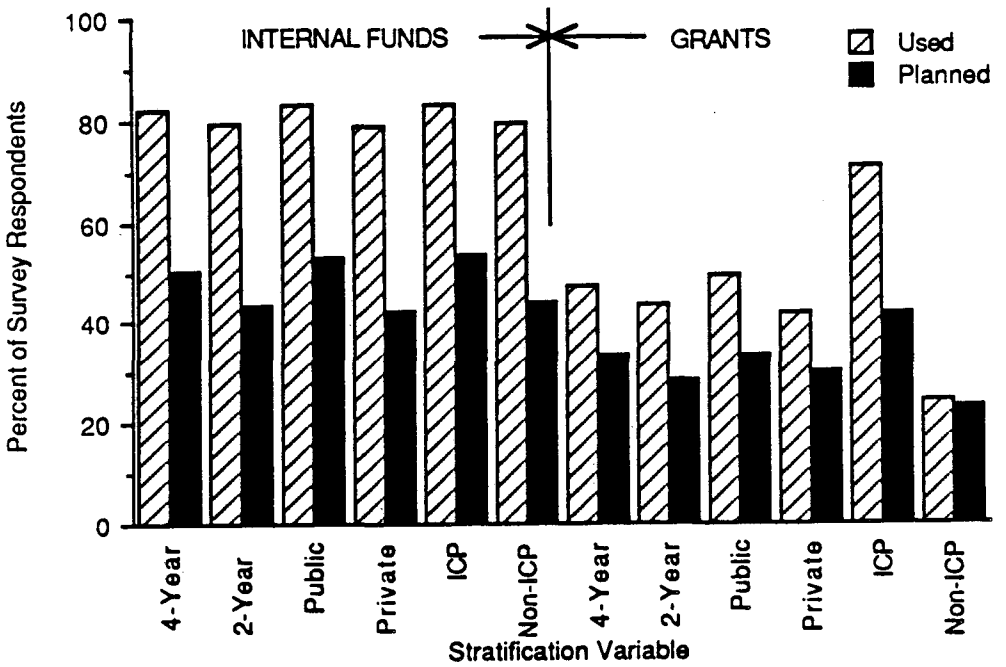

Fig. 6.2: Internal Funds vs. Grants for Energy Conservation Measures

It is noted that, in most cases, the frequency with which institutions plan to use funding sources in the future is less than—and in several cases, substantially less than—the frequency with which these sources have been used in the past. This is especially true for the two leading funding sources, internal operating and capital funds, and grants. For these two sources, the comparison of frequency of past use and planned future use is provided in Fig. 6.2. Across all stratification variables, internal operating and capital funds are expected to be used to support future energy conservation activities by 30% to 40% fewer institutions than in the past. Expectations for use of grants are also lower by about the same percentage for all stratification variables—except for past grant recipients, where an even larger decrease is evident. The lack of forward planning is consistent with two other observations from the survey. First, as discussed in Section 5.2a, most institutions do not have written energy plans. And second, as will be discussed in Section 8, the number of energy conservation measures installed in the future is not expected to increase.

6.2 The Role of ICP

6.2a Awareness of ICP

As shown in Table C.27, almost 70% of the survey respondents were aware of the Institutional Conservation Program, and there were statistically significant differences in two of the three stratification cells. Public C&U and ICP participants were more aware of ICP than their counterparts. It is noted that of the individuals at institutions that

received ICP grants, about 84% were aware of the program. This is qualitatively consistent with another finding: only 71% of the individuals responding to the survey from institutions that received ICP grants were aware that a grant had been received. Figure 6.3 shows the percentage of survey respondents from each DOE region who indicated awareness of ICP. There is substantial variation, with a relatively high level of awareness in Region II, and a low level of awareness in Regions I, VII, and VIII.

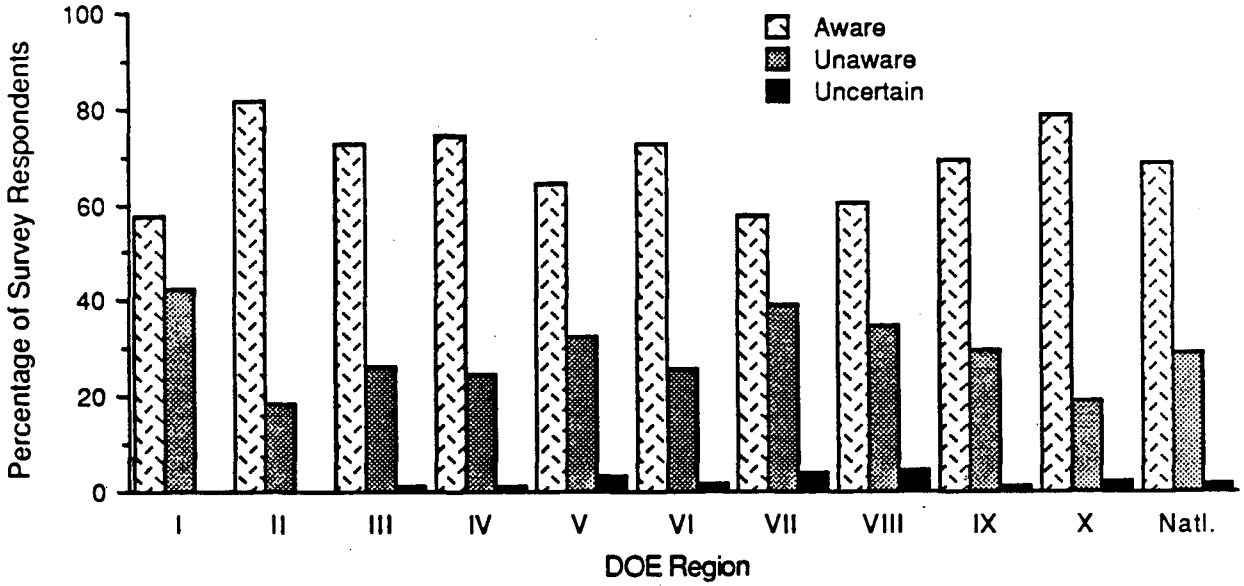

Fig. 6.3: Awareness of ICP

6.2b ICP grant applications

Table C.28 indicates that almost three-quarters of the C&U that were aware of ICP applied for an ICP grant, and the ICP participants were more likely than non-ICP participants to have applied for such a grant. Also as shown in Table C.28, the reasons given for not applying for an ICP grant, in decreasing popularity, were the complexity of the ICP process (22%), inadequate funding (16%), ineligibility of the institution (12%), the absence of a need for ICP or other assistance (11%), lack of information about the program (8%), and the reputation of the program (4%). There were no statistically significant differences between the stratification groups. After receiving a Technical Assistance (TA) grant, the most common reasons given for not applying for an Energy Conservation Measure (ECM) grant were government rules and regulations (36%) and the lack of a need for federal support (6%).

The geographic distribution of ICP grant applications among survey respondents is shown in Fig. 6.4. The regional pattern is somewhat different from that for ICP awareness in Fig. 6.3. In both cases, Region I was considerably below the national average. However, with respect to awareness, Regions VII and VIII were low and Regions VI, IX,

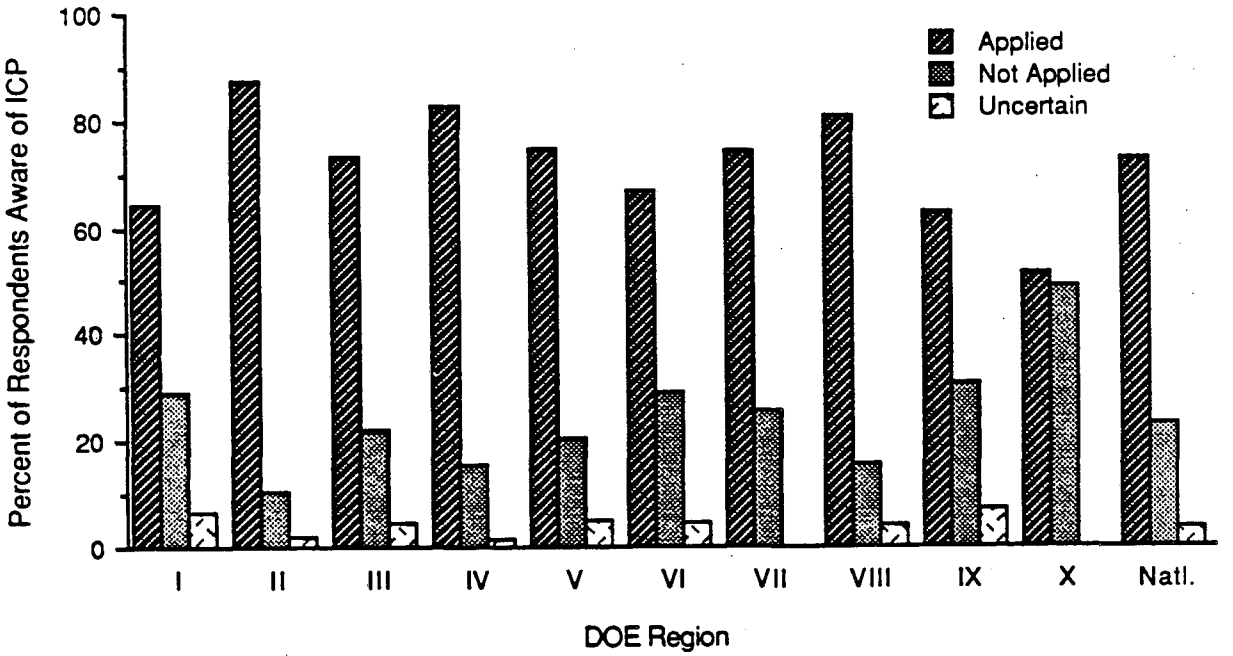

Fig. 6.4: ICP Grant Applications

and X were relatively high. For these five regions, the pattern reverses for the percentage of institutions who have applied for grants. Two issues should be noted in comparing Figs. 6.3 and 6.4. First, only those respondents who indicated awareness of ICP were asked if they had applied. The respondents are, therefore, normalized to different totals, so that, for example, the percentage of respondents who indicate that they have applied to ICP can be larger than the percentage that indicated awareness of ICP. Second, since only those who were aware of ICP were asked if they had applied for a grant, the results are not biased by grant recipients who are unaware of the grant.

6.2c ICP grants received and denied

Table C.29 indicates that the average number of TA grants applied for and received were 9 and 6, respectively. The average number of ECM grants applied for and received were also 9 and 6, respectively. The only statistically significant difference in the TA and ECM applications occurred for the number of TA grants applied for: four-year and private C&U were more likely to have applied for more TA grants than their counterparts. The respondents reported that the major reason that the ECM grant was denied (after receiving a TA grant) was the ICP grant ranking process (78%). In a few cases (4%), the institution was ineligible for an ECM grant.

6.3 Other External Energy Conservation Funding Sources

Survey respondents were asked about participation in energy conservation programs sponsored by organizations other than ICP. The responses are summarized by

stratification variable in Table C.30, and the national summary is shown in Fig. 6.5. In Fig. 6.5, the responses are normalized to the total number (773) of survey respondents, so the percentages in the figure differ slightly from those in the table in Appendix C. Over one-third of colleges and universities have participated in energy conservation programs for financial assistance or energy audits sponsored by utility companies. Public and private institutions statistically differed in this respect: private colleges and universities were more likely than their counterparts to participate in programs sponsored by utility companies.

Colleges and universities also participated in energy conservation programs for financial assistance or energy audits sponsored by state agencies (55%), federal agencies (44%), parent organizations such as state college or church (19%), associations (9%), and local agencies (4%). Public institutions statistically differed from private institutions in that public colleges and universities tended to participate in programs sponsored by federal and state agencies and parent organizations, while private institutions tended to participate in programs sponsored by utility companies (see above). ICP participants statistically differed from non-ICP participants in that past ICP grant recipients tended to participate in programs sponsored by federal and state agencies. It is important to note that some of these federal and state agencies are associated with the implementation of ICP.

Table C.31 shows that for those colleges and universities with a parent organization (such as state college system or church), about 30% found them helpful in reducing their institution's energy use. Two-year and public C&U statistically differed from their counterparts in that two-year and public colleges and universities were more likely than their counterparts to find their parent organization helpful in this area.

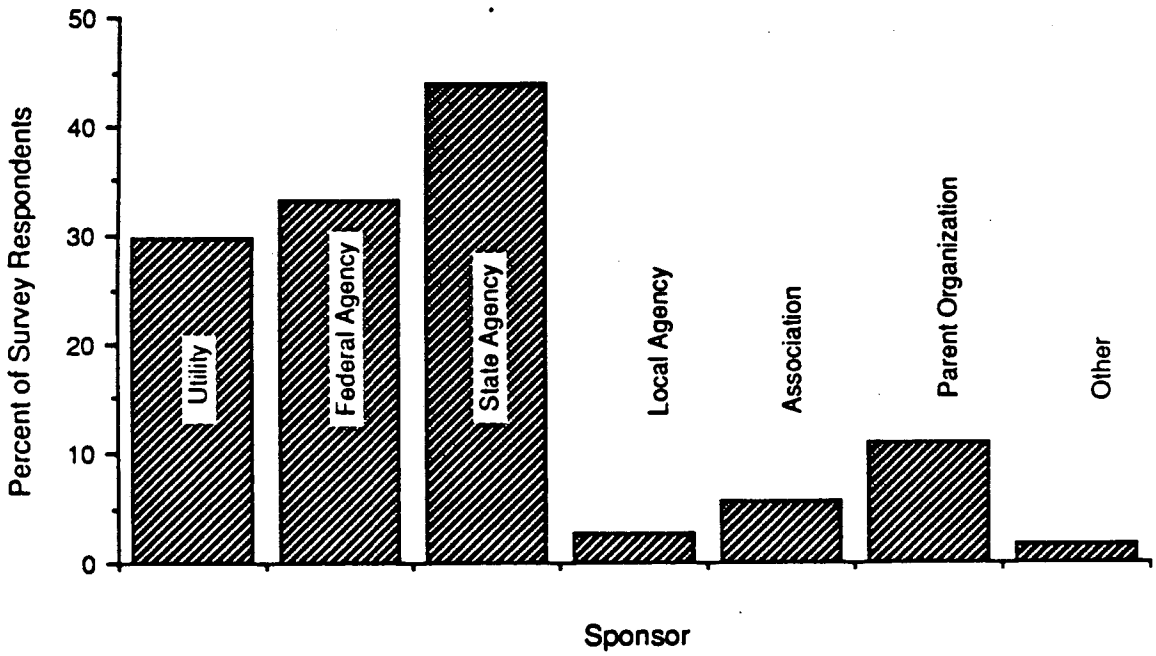

Fig. 6.5: External Sponsorship and Financing

Figure 6.6 shows the regional distribution of energy conservation activity sponsorship. Only the three leading sponsorship options at the national level (utilities, federal agencies, and state agencies) are included. Utilities played a major role in Region IX, and a relatively minor role in Regions VII and VIII. State agencies played an especially important role in Regions II and VIII. Sponsorship from all sources (including "other") was low in Regions I, III, and VII. Across all regions, state and federal sponsorship was of major importance, and, as mentioned above, some of these agencies are associated with ICP.

6.4 Financing Problems

While one-third of colleges and universities reported that they did not have any financial problems in implementing energy conservation measures (ECMs), about one-half of the respondents cited the availability of funding as an important problem affecting their ability to invest in energy conservation (Tables C.32 and C.33). Another 14% indicated financial problems associated with investment criteria (e.g., payback level, rate of return, and return on investment). There were no statistically significant differences between the stratification groups.

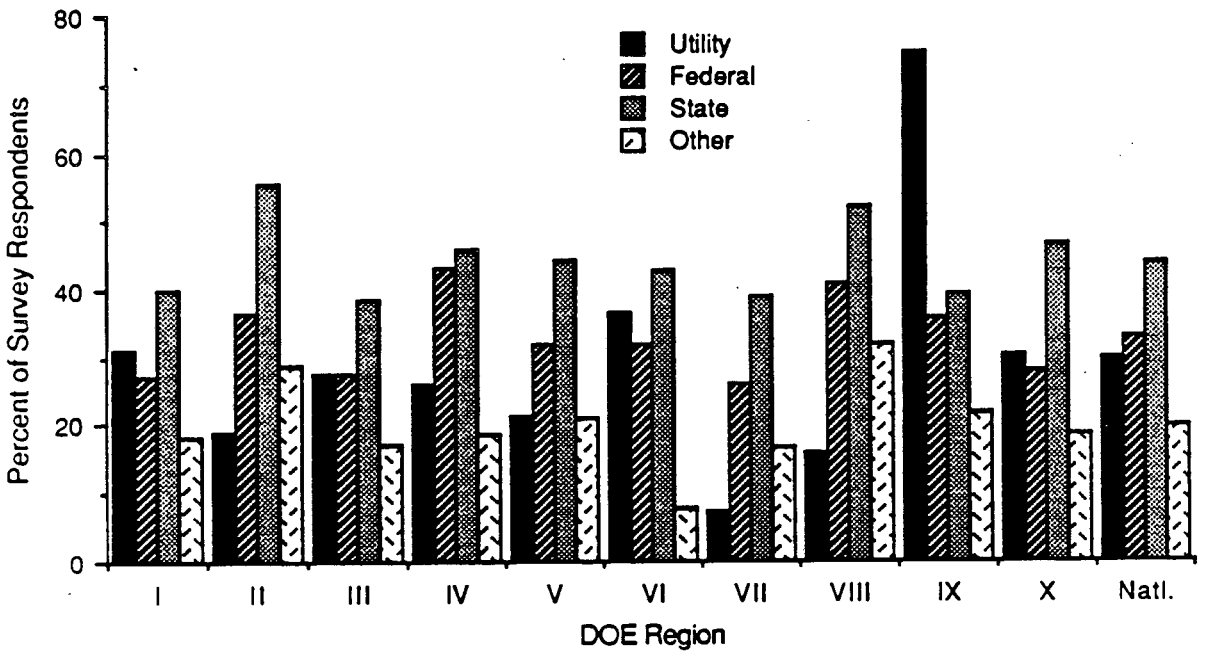

Fig. 6.6: Energy Conservation Sponsors (by region)

7.0 DECISIONMAKING PROCESS

7.1 Motivation

Respondents were asked about the importance of 12 factors for motivating current energy conservation activities in their college or university (Table C.34). Where applicable, each factor was rated on a scale of 1 (highly important) to 4 (not at all important). Factors were not compared with one another, so that it was possible for a respondent to rate all factors as highly important. In order of importance (from most to least), the factors were ordered* in the following way.

High energy costs	1.3
Expectations of rising energy prices	1.7
Utility demand charges or rate structures	1.9
Support of administration and staff	2.0
Cost-containment program within college or university	2.0
Availability of outside funds—grants, private capital, etc.	2.2
Energy projects' cost savings retained by institution and/or maintenance department	2.3
Availability of information on building energy costs	2.4
Awareness of successful experiences of similar institutions	2.6
Exposure to marketing of energy conservation products	2.7
Utility company conservation programs	2.8
Tax incentives (credits)	3.4

There were a few statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to rank as more important utility demand charges or rate structures and utility company conservation programs. Private institutions were more likely than public institutions to rank as more important energy projects' cost savings retained in the budget of the institution and/or maintenance department. ICP participants were more likely than non-ICP participants to rank as more important exposure to marketing of energy conservation products and utility company programs. On the other hand, non-ICP participants tended to rank the availability of outside funds as more important, compared with ICP participants.

Figure 7.1 shows the regional distribution of the importance of the six motivational factors that were judged most significant by survey respondents. Three of the six leading factors relate directly to energy costs (high costs, rising prices, and utility rate structures), and the other three relate to the institution and its "reaction" to energy cost factors; these two classes of motivational factors are the topics of Figs. 7.1a and b, respectively. Note that the two parts of the figure have different vertical scales.

*The number following each motivational factor is the numerical mean rating assigned to that factor by all respondents.

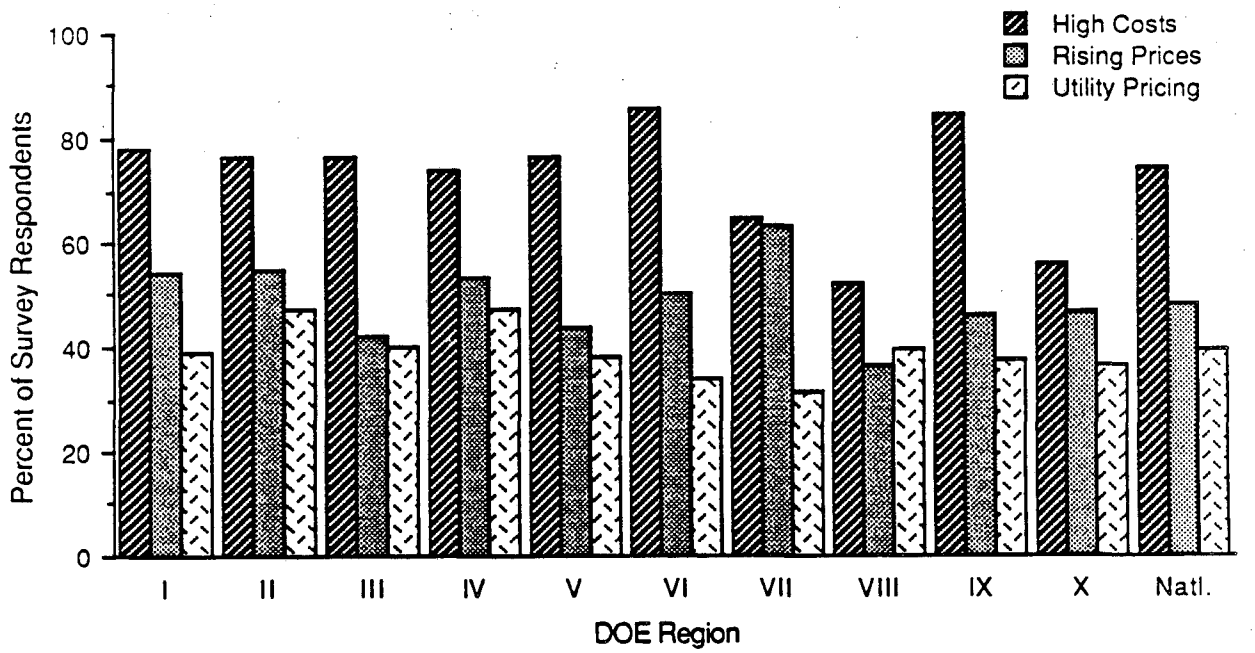

Fig. 7.1a: Energy Conservation Motivation--Energy Cost

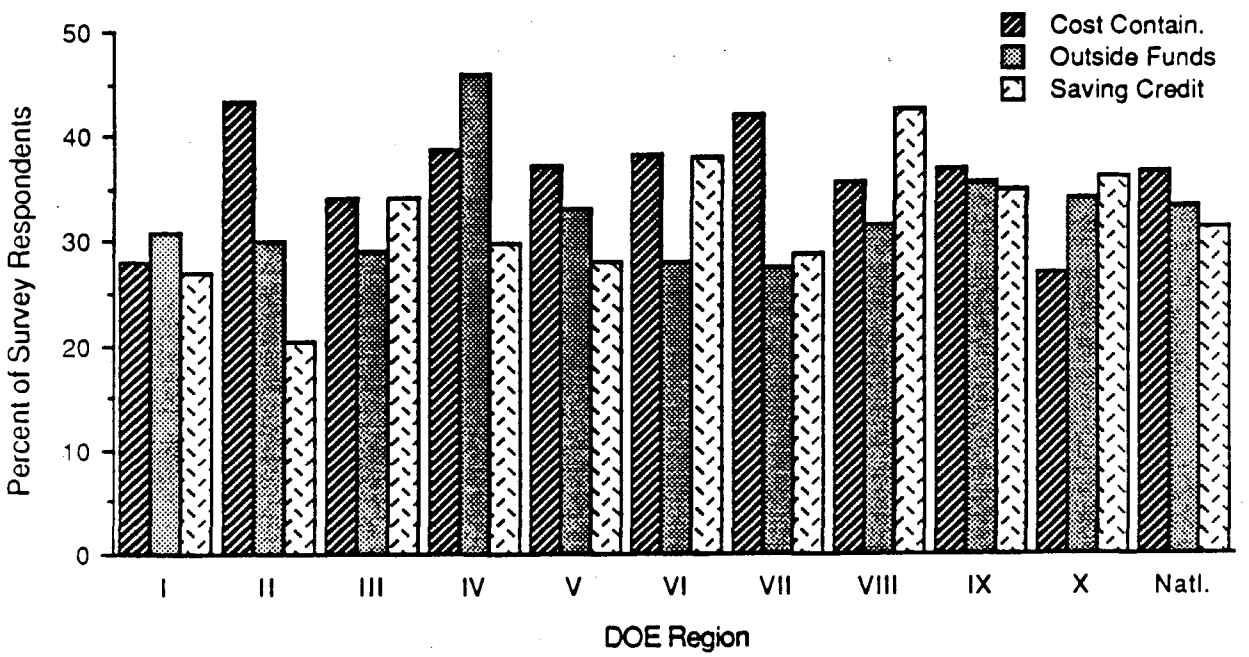

Fig. 7.1b: Energy Conservation Motivation--Institutional Motives

Across all regions, the high cost of energy was the most important motivation for energy conservation activities, though it was less important in Regions VII, VIII, and X. In Region VI, rising energy prices were nearly as important as current high costs, but in Regions VIII and X, factors related to energy cost were simply less important motivations than in the rest of the country. With respect to institutional motives, cost containment was especially important in Regions II, IV, and VII; it was significantly less important in Regions I and X. Availability of outside funds was especially important in Region IV; and crediting of energy cost savings to the institution or individual departments was important in Regions VI and VIII and significantly less important in Region II.

7.2 Responsibilities

Respondents were asked to indicate who was primarily responsible for setting general objectives, selecting specific actions to reduce energy use, financing capital projects, and managing (on a daily basis) energy conservation activities in their college or university. A list of persons was provided, and the respondent could select as many as applied. The results are summarized by stratification variable in Tables C.35 to C.38, and the national results are summarized in Fig. 7.2. For most respondents, the physical plant director and chief financial officer bore the bulk of the responsibility for all energy conservation activities. The governing body (e.g., regents) played an important role in setting objectives and determining financing, and the primary administrator (e.g., college president) also played an important role in setting energy conservation objectives. Interestingly, administrators and financial officers played as large a role in selecting specific actions as did staff engineers or consultants.

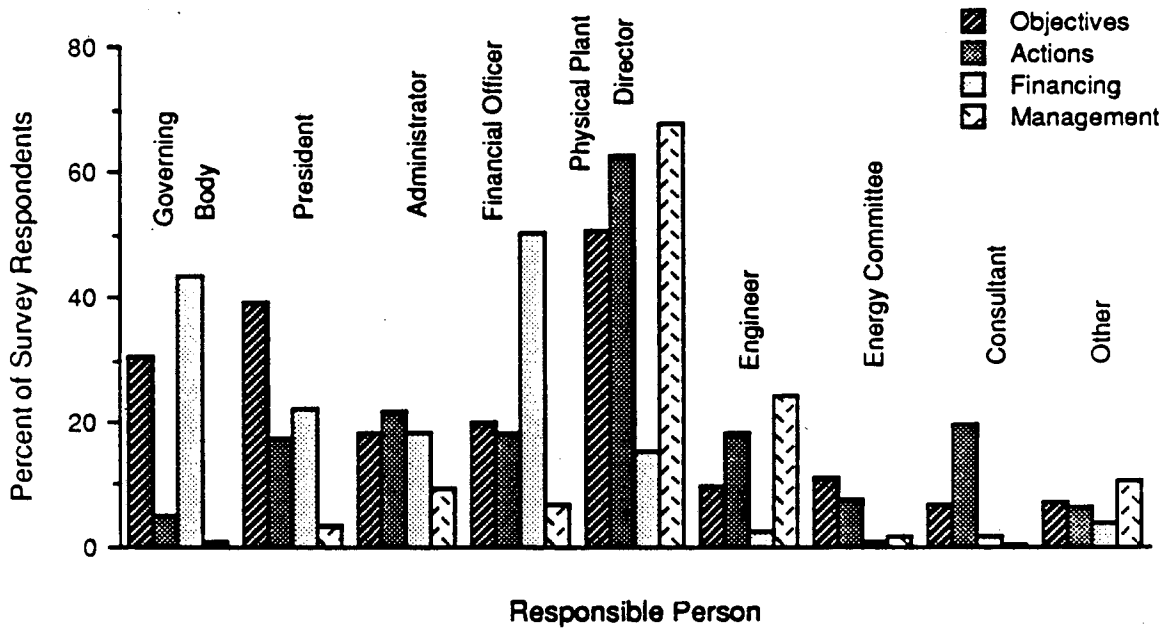

Fig. 7.2: Responsibility in Conservation Program

The following four subsections discuss the survey results concerning responsibility in more detail, based on Tables C.35 through C.38.

7.2a Setting general objectives

Over one-half of the respondents indicated that the director of the physical plant was primarily responsible for setting general objectives regarding energy matters. The college or university administrator (president) and the governing body (board of trustees or regents) were chosen as primarily responsible by 39% and 31% of the respondents, respectively. Two other persons were selected with less frequency, the chief financial officer (20%) and an administrator (18%), and an energy committee was selected by about 10% of the sample. The college or university engineer, private consultant, and academic department were selected by less than 10% of the respondents. There were a few statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to have a college or university engineer or an energy committee primarily responsible. Public institutions were more likely than private institutions to have a governing body, an administrator, or energy committee primarily responsible.

7.2b Selecting specific actions

Over 60% of the respondents indicated that the director of the physical plant was primarily responsible for selecting specific actions to reduce energy use. A number of people were grouped closely to one another as being primarily responsible: an administrator other than the president of the college or university (22%), private consultant (20%), chief financial officer (18%), college or university engineer (18%), and the college or university administrator (18%). The governing body, energy committee, and academic department were selected by less than 10% of the respondents. There were a few statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to have an engineer primarily responsible for selecting specific actions; however, two-year institutions were more likely to have the college or university administrator primarily responsible. Public institutions were more likely than private institutions to have an administrator or an energy committee primarily responsible. ICP participants were more likely than non-ICP participants to have an engineer or private consultant primarily responsible.

7.2c Financing capital projects

One-half of the respondents indicated that the chief financial officer was primarily responsible for financing capital energy projects, followed closely by the C&U's governing body (43%). The next most likely persons primarily responsible were the college or university administrator (22%), an administrator other than the president (18%), and the director of the physical plant (16%). The college/university engineer, an energy committee, academic department, and private consultant were selected by less than 4% of the respondents. There were very few statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to have the chief financial officer primarily responsible. Private institutions were more likely than

public institutions to have the chief financial officer primarily responsible; however, public colleges and universities were more likely than private colleges and universities to have an administrator primarily responsible. ICP participants were more likely than non-ICP participants to have the chief financial officer primarily responsible.

7.2d Daily energy management

Almost 70% of the respondents indicated that the director of the physical plant was primarily responsible for the daily management of energy conservation activities in their college or university. The next most likely person was the college or university engineer (24%), and all others were selected by less than 10% of the respondents. There were a few statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to have the director of the physical plant primarily responsible for daily management; however, the latter were more likely than the former to have the C&U administrator and the director of the physical plant primarily responsible. Non-ICP participants were more likely than ICP participants to have the C&U President or another administrator primarily responsible.

7.3 Information Sources

Respondents were asked to indicate which information sources they used in setting general objectives, selecting specific actions to reduce energy use, financing capital projects, and the daily management of energy conservation activities in their college or university. A list of sources was provided, and the respondent could select as many as applied. The results are summarized by stratification variable in Tables C.39 through C.42, and the national results are summarized in Fig. 7.3. There were no dominant information sources relating to setting energy conservation objectives, selecting actions, or daily management of energy conservation efforts. The financial condition of the institution, not surprisingly, was a key source of information regarding financing of energy conservation activities and also was important in setting objectives and selecting actions. The experience of others, conferences, publications, professional societies, and other individuals were all important in providing information regarding objectives, actions, and management.

Based on the survey responses documented in Tables C.39 to C.42, the following four subsections discuss information sources for each of the four elements of energy conservation efforts in more detail, including differences among respondents from different strata.

7.3a Setting general objectives

About one-half of the respondents indicated that the experience of other colleges or universities was a source of information for setting general objectives regarding energy matters, followed closely by professional societies such as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the National Association of College and University Business Officials (NACUBO), and the Association of Physical Plant Administrators (APPA) (43%) and by conferences (42%). Several other sources of information were also used by at least 20% of the respondents: technical and trade publications such as *Energy User News* (37%), contacts with other professionals such as

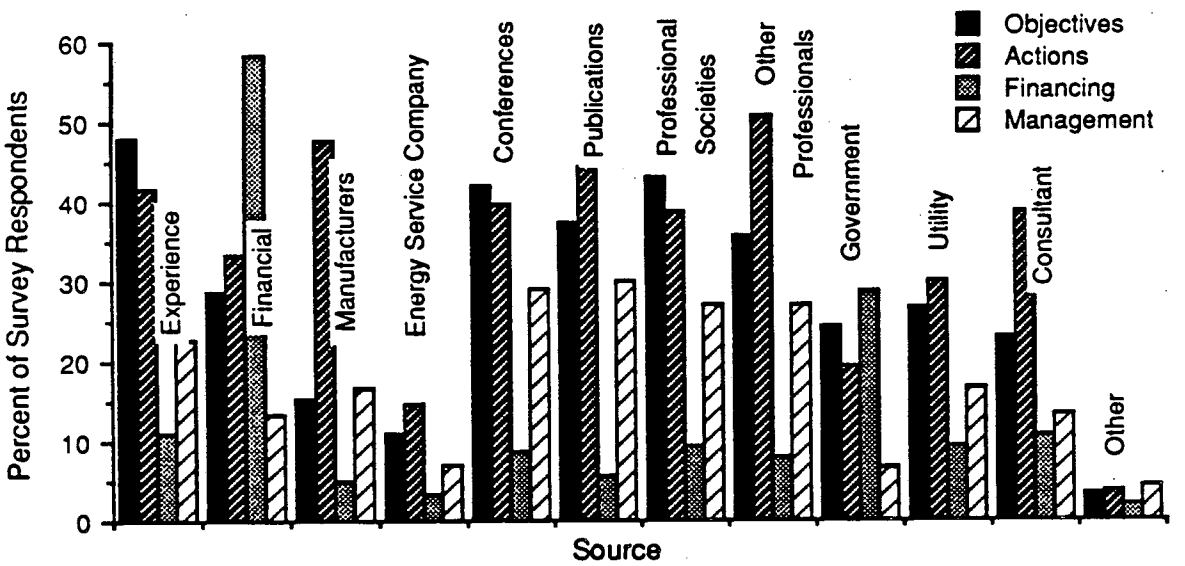

Fig. 7.3: Information Sources

engineers (36%), the financial status of the college or university (29%), utility companies (27%), personnel in state or federal energy offices (24%), and consultants and auditors (23%). Manufacturers (16%) and energy service companies (11%) were also cited by a number of respondents. There were a few statistically significant differences between the stratification groups. Public C&U were more likely than private C&U to rely on conferences and state and federal energy office personnel for information; however, private institutions were more likely than their counterparts to obtain information from energy service companies. ICP participants were more likely than non-ICP participants to rely on conferences for information.

7.3b Selecting specific actions

One-half of colleges and universities obtained information from contacts with other professionals for selecting specific actions to reduce energy use. A number of other information sources were also highly used by the respondents: manufacturers of energy conservation products (48%), technical and trade publications (44%), experience of other colleges or universities (42%), attending conferences (40%), consultants and auditors (39%), and professional societies (39%). About one-third of the respondents relied on utility companies and on the financial status of the college or university, and 20% obtained their information from personnel in state and federal energy offices. Energy service companies were used by 15% of the respondents for selecting specific actions. There were several statistically significant differences between the stratification groups. Four-year C&U were more likely than two-year C&U to use the financial status of their college or university and their contacts with other professionals for information. Public institutions were more likely than private institutions to use the experience of other colleges or

universities, conferences, publications, state and federal personnel, and consultants and auditors for information. ICP participants were more likely than non-ICP participants to use professional societies and consultants and auditors for information.

7.3c Financing capital projects

Over one-half of the respondents indicated that the financial status of the college or university was a source of information used in financing capital projects. The next most used information sources were contacts with state or federal personnel (29%), the experience of other colleges or universities (11%), and consultants and auditors (11%). Less than 10% of the respondents used manufacturers of energy conservation products, energy service companies, conferences, technical and trade publications, professional societies, contacts with other professionals, and utility companies as sources of information. There were a few statistically significant differences between the stratification groups. Four-year C&U were more likely than their counterparts to rely on the financial status of their institution for information; however, two-year colleges and universities were more likely to rely on utility companies for information. Public institutions were more likely than private institutions to rely on utility companies and state or federal personnel for information. ICP participants were more likely than non-ICP participants to use the financial status of their institution and state or federal personnel for information.

7.3d Daily energy management

Several information sources were used for daily management of energy conservation activities with equivalent frequency: publications (30%), attending conferences (29%), professional societies (27%), and contacts with other professionals (27%). With slightly less occurrence, respondents used the experience of other colleges or universities (23%), manufacturers of energy conservation products (17%), utility companies (17%), the financial status of their institution (13%), and consultants and auditors (13%) as sources. Energy service companies (7%), and state or federal personnel (7%) were rarely used by the respondents as information sources for daily management. There were only two statistically significant differences between the stratification groups. Four-year C&U and ICP participants were more likely to rely on professional societies for information, compared with their counterparts.

7.4 Models

Colleges and universities were asked whether any colleges or universities served as models or had been helpful to them in making energy-related decisions (Table C.43). About 65% of the respondents gave no response, 15% listed one institution, 9% two institutions, and 8% three or more institutions. There were no statistically significant differences between the stratification groups.

7.5 Energy Use Reporting/Feedback

As indicated in Fig. 7.4, almost 75% of the colleges and universities prepared an energy monitoring or accounting report, which periodically tracked and analyzed energy use

and/or energy costs (e.g., monthly, quarterly, or annually). The figure is based on the survey response summary in Table C.44, which also shows the results sorted by stratification variable. Public institutions and ICP participants were more likely to prepare an energy report than their counterparts (significant difference). As indicated in both Fig. 7.4 and Table C.44, the monitoring results were usually reported to the director of the physical plant (30% of responses), the chief financial officer (20%), and the college/university administrator. Results were reported less often (less than 10%) to an energy committee, college/university engineer, the governing body, maintenance/custodial staff, or an administrator. Because this question allowed for multiple responses, statistical analysis of the results could not be performed.

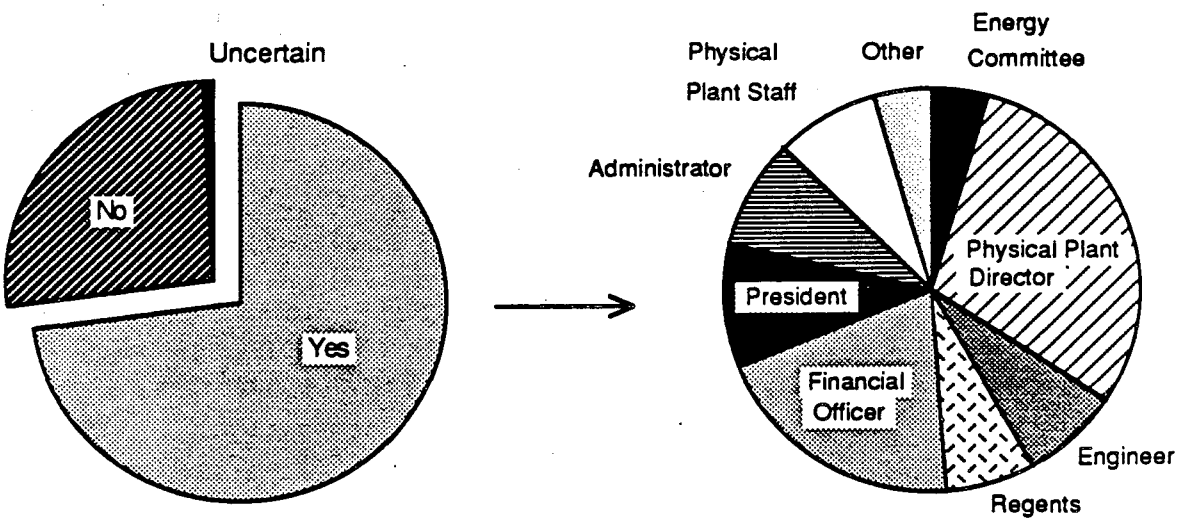

Fig. 7.4: Energy Use Reporting

7.6 Management Problems

The survey requested information regarding management problems associated with energy conservation efforts. The results are summarized in Fig. 7.5 and are further broken down by stratification variable in Tables C.45 and C.46. Over 60% of colleges and universities reported that they did not have any management problems in implementing energy conservation measures. However, a number of respondents cited the lack of adequate staff (21%), unreceptive management who, for example, lacked interest or were unaware of benefits (8%), and the approval process (8%) as management problems. There were no statistically significant differences between the stratification groups.

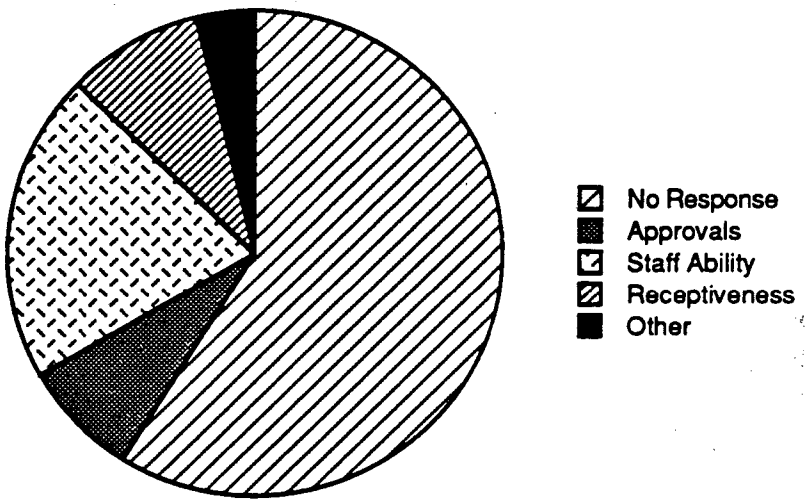

Fig. 7.5: Management Problems

8.0 ENERGY CONSERVATION MEASURES

8.1 Relative Frequencies

Respondents were asked what energy conservation measures (ECMs), including low-cost/no-cost measures, they have undertaken since 1973 or have planned for in the near future. They were given a table containing the names of 36 measures and three time periods (1973–79, 1980–86, and 1987–90); a set of definitions explaining the measures was attached to the questionnaire (see Appendix A). The responses, sorted by stratification variable, are documented in Table C.47; a national summary of the 31 measures that were most often mentioned is in Fig. 8.1.

Figure 8.1 shows the frequency with which measures were reported as being installed in the three time periods; a measure could be installed in more than one time period. For example, in one period an institution may convert from incandescent to fluorescent lighting in one building, and in another period the same (or a different) conversion can be installed in another building. As a result, the number of times a particular measure is indicated by the respondents can exceed the number of respondents. The relative frequency axis is the percent of total respondents, and for several measures, 100% (relative frequency = 100) is exceeded. Note also that for the same reason, a relative frequency of, for example, 80 does not imply that 80% of the respondents have installed or will install the measure. The relative frequency scale is meaningful only in comparing the measures with each other. The time periods used here are not of equal length; the two periods covering past retrofits are each six years long, while the one covering the future is only three years long.

The most common retrofits are those to the opaque envelope (insulation, caulking, and weatherstripping), mechanical system controls (time clocks and energy management systems), and lighting conversions (e.g., incandescent to fluorescent) and lighting modifications (e.g., delamping) (Fig. 8.1). There has also been significant activity in the retrofit of mechanical systems (heating, cooling, and distribution systems), electrical controls (generally for lighting), window replacement, and domestic hot water systems. The relative frequency of ECM installations by time period and by stratification variable is discussed below, based on the survey responses as summarized in Table C.47.

8.1a Measures installed 1973–79

For 1973-79, at least one-third of all colleges and universities installed time clocks controlling heating, ventilation, and air-conditioning (HVAC) systems or electrical and lighting systems. About one-quarter of the sample caulked and weatherstripped buildings, converted lighting systems, manually adjusted HVAC systems, insulated building envelopes (walls, ceilings, or roofs), or modified their lighting systems. One-fifth of all C&U insulated pipes or ducts, installed HVAC energy management systems, made manual adjustments to the building envelope or electrical/lighting systems, and improved the energy efficiency of domestic hot water systems. At least 10% of the sample installed steam traps or valves, improved the energy efficiency of air-conditioning systems, replaced windows, placed reflective film on windows, replaced burners, converted

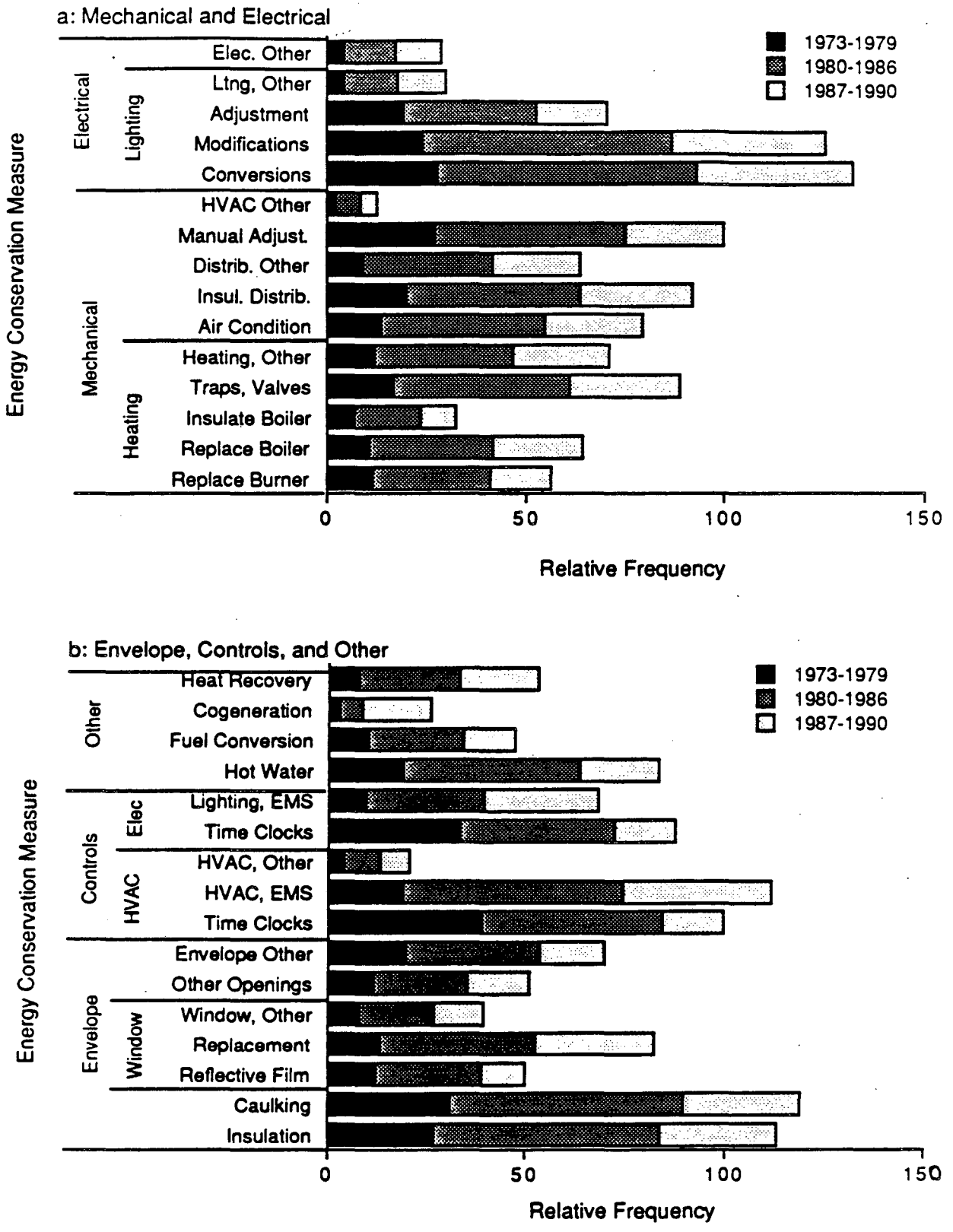

Fig. 8.1: Most Common Conservation Measures

fuels (excluding renewables), or made other modifications to heating systems or building envelopes. Less than 10% of colleges and universities implemented electrical/lighting energy management systems, made other changes to distribution systems, installed other window-related ECMs, insulated boilers, installed HVAC energy recovery devices, implemented other HVAC or electrical/lighting controls, installed other electrical applications or HVAC modifications, put in cogeneration, installed active or passive solar systems, or converted to renewable fuels.

There were many statistically significant differences between the stratification groups, especially between four-year and two-year colleges and universities. In general, four-year C&U implemented more energy conservation measures than two-year C&U, and these differences covered most of the measures mentioned above. There was less consistency for public and private institutions: in some cases, public colleges and universities implemented more measures, and in other cases, the reverse was true. There were a few statistically significant differences between ICP and non-ICP participants: ICP participants were more likely than their counterparts to have insulated buildings, placed reflective film on windows, installed HVAC time clocks or energy management systems, replaced boilers, installed steam traps or valves, and converted or modified lighting systems.

8.1b Measures installed 1980–86

For 1980-86, colleges and universities were much more active in implementing energy conservation measures than during the previous period. One-half of the sample converted or modified lighting systems, caulked and weatherstripped, insulated buildings, installed HVAC energy management systems, made manual adjustments to HVAC systems, or installed HVAC time clocks. At least one-third of C&U added steam traps or valves, insulated pipes or ducts, made improvements to domestic hot water systems, improved the energy efficiency of air-conditioning systems, installed electrical/lighting time clocks, replaced windows, made manual adjustments to building envelopes or to electrical/lighting systems, or implemented other measures affecting distribution or heating systems. One-fifth of the sample replaced boilers or burners, installed electrical/lighting energy management systems, placed reflective film on windows, installed HVAC energy recovery devices, converted fuels (excluding renewables), implemented other energy conservation measures to openings in the building envelope (e.g., storm doors), or implemented other window-related energy conservation measures. At least 10% of C&U insulated boilers, implemented other electrical/lighting measures, installed electrical/lighting applications, or implemented HVAC controls. Less than 10% of the sample installed active or passive solar systems, put in cogeneration, converted to renewable fuels, or made other changes to HVAC systems.

As in the previous period, there were many statistically significant differences between the stratification groups, especially between four-year and two-year colleges and universities. In general, four-year C&U implemented more energy conservation measures than two-year C&U, and these differences covered most of the measures mentioned above. There was less consistency and there were fewer statistically significant differences between public and private institutions: in some cases, the former implemented more measures, and in other cases, the reverse was true. ICP participants were more likely than non-ICP participants to have installed HVAC or electrical/lighting energy

management systems, converted fuels, improved the energy efficiency of air-conditioning systems, insulated boilers, added steam traps or valves, insulated pipes or ducts, installed HVAC energy recovery devices, converted lighting systems, or implemented other energy conservation measures related to windows, openings in the building envelope, and heating or distribution systems.

8.1c Measures planned for 1987–90

For the future, 1987-90, many colleges and universities are planning to implement a number of energy conservation measures, with a slightly different emphasis than in the previous two periods. One-third of the sample intend to modify or convert their lighting systems or to install an HVAC energy management system. At least one-quarter of C&U expect to replace windows, insulate buildings, install an electrical/lighting energy management system, caulk and weatherstrip buildings, insulate pipes or ducts, install steam traps or valves, improve the energy-efficiency of air-conditioning systems, make manual adjustments to HVAC systems, or implement other heating measures. At least 10% of the sample plan to replace boilers, improve domestic hot water systems, implement other energy conservation measures related to distribution systems, install HVAC energy recovery devices, make adjustments to electrical/lighting systems, put in cogeneration, make manual adjustments to the building envelope, implement measures for other openings in the building envelope, install HVAC or electrical time clocks, replace burners, convert fuels, implement other window-related ECMs, install reflective film on windows, or implement other electrical/lighting measures or other electrical applications. Less than 10% of C&U intend to insulate boilers, install other HVAC controls, implement other HVAC measures, install passive or active solar systems, or convert to renewable fuels.

Except for four-year and two-year colleges and universities, there were fewer statistically significant differences between the stratification groups than in the previous analyses. As before, four-year C&U plan to implement more energy conservation measures than two-year C&U, and these differences covered most of the measures mentioned above. Public institutions were more likely than private institutions to plan to insulate buildings, install HVAC energy management systems, and implement other measures affecting distribution systems. ICP participants were more likely than non-ICP participants to plan to install HVAC or electrical/lighting energy management systems, convert fuels (excluding renewables), install steam traps or valves, implement other heating or distribution system measures, improve the energy efficiency of domestic hot water systems, put in cogeneration, and convert or modify lighting systems.

Figures 8.2a-f summarize the frequency of installation by DOE region for six classes of measures. In all cases (all classes of measures and all regions), the frequency of installation is greatest in the most recent past (1980 to 1986), and the expected frequency in the 1987 to 1990 period is significantly lower. It is noted that, as discussed in section 5.2a, written energy plans are not common, so one might expect ECM installation plans to be somewhat indefinite.

The regional distributions do not show any substantial structure, though several observations can be made. Envelope retrofits (Fig. 8.2a) were somewhat less frequent in

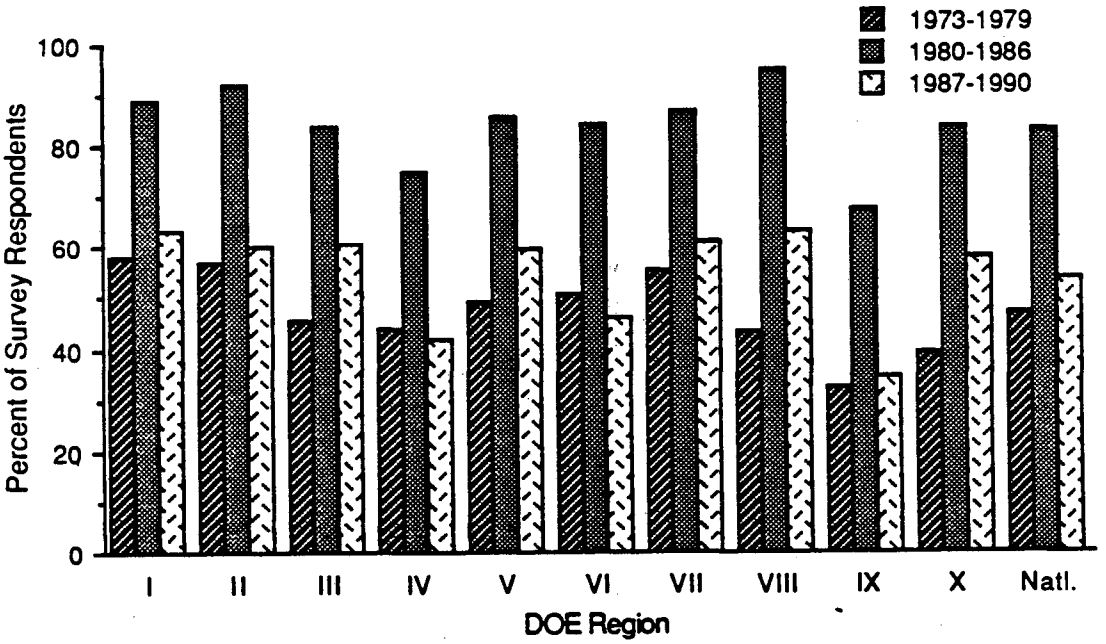

Fig. 8.2a Conservation Measures--Envelope

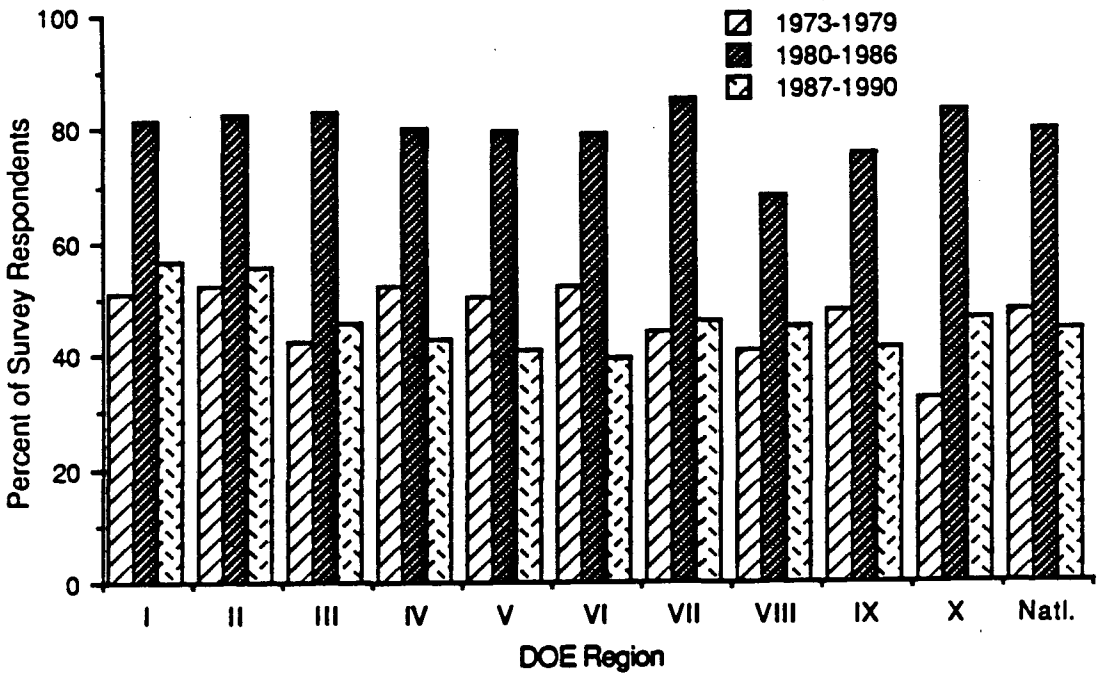

Fig. 8.2b: Conservation Measures--HVAC Controls

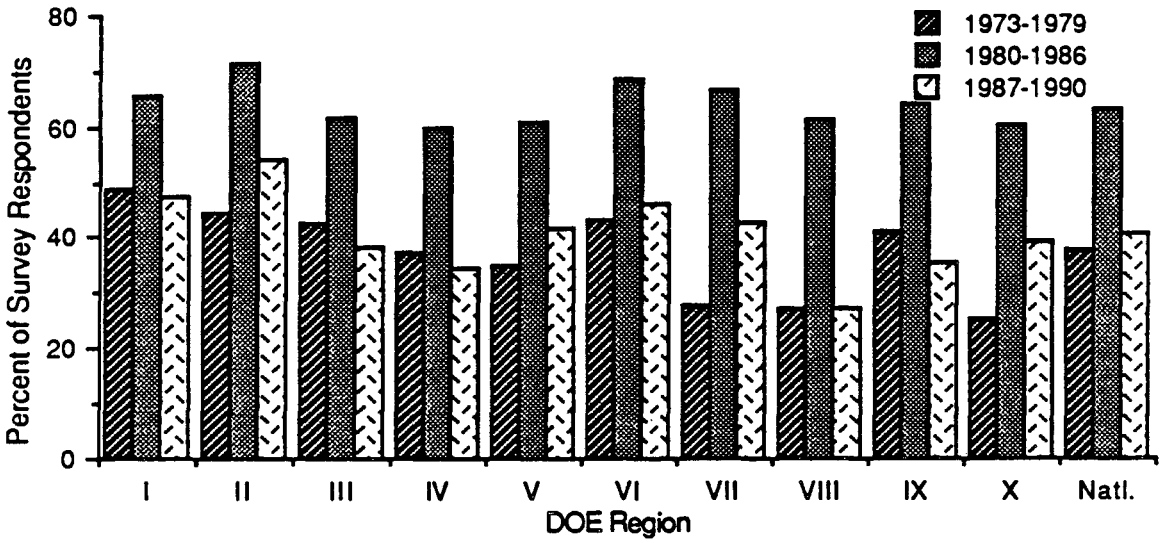

Fig. 8.2c: Conservation Measures--Lighting Controls

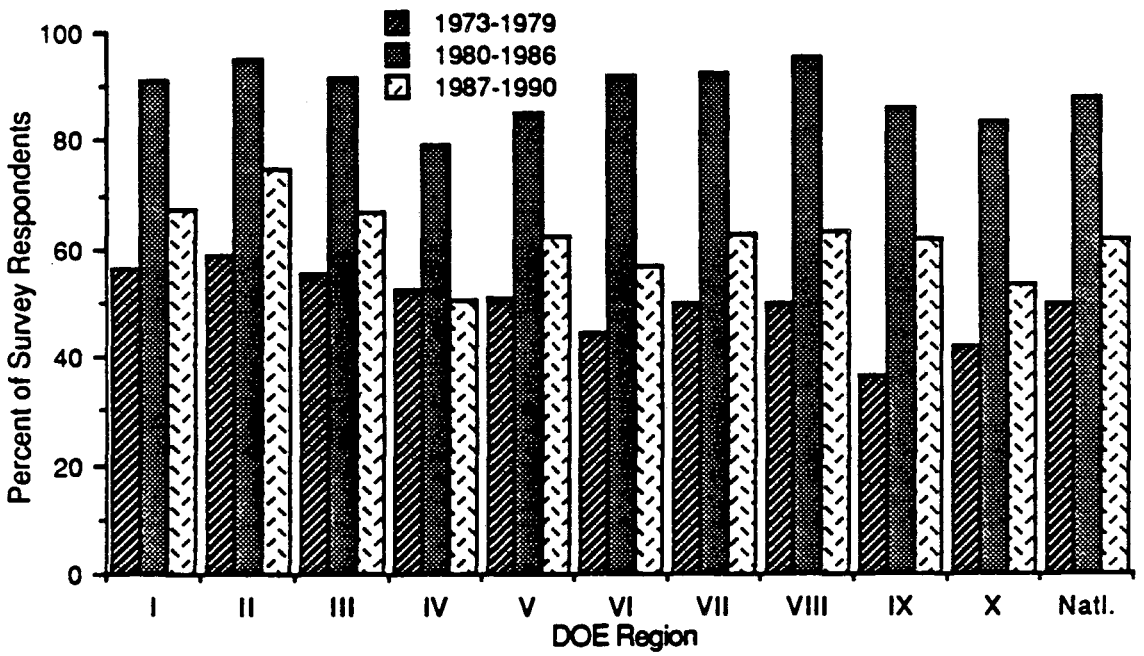

Fig. 8.2d: Conservation Measures--Heating, Ventilating, Air Conditioning

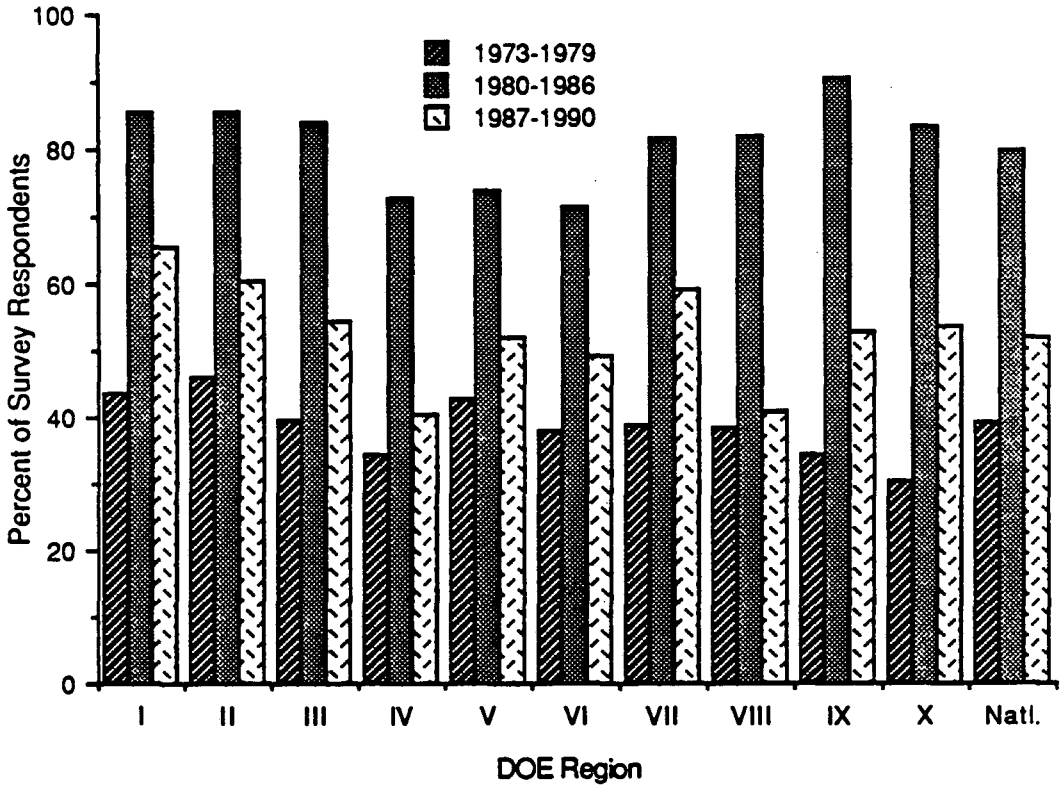

Fig. 8.2e: Conservation Measures--Lighting

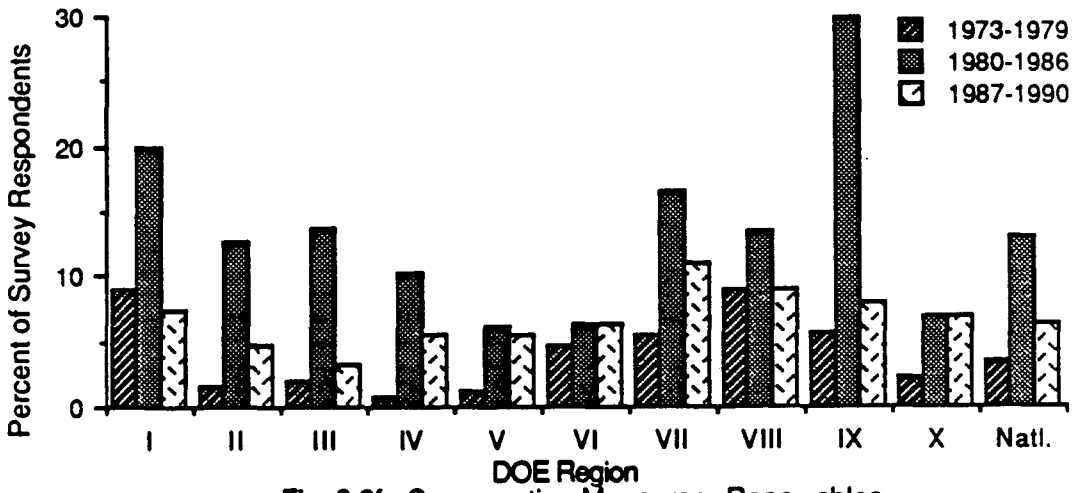

Fig. 8.2f: Conservation Measures--Renewables

Regions IV and IX, both of which are in the Southern tier of states. However, Region VI is also located in the South, and there was substantial attention to envelope measures. HVAC and lighting control measures (Figs. 8.2b and c) were somewhat less frequent in Region VIII, and lighting controls were also slightly less frequent in Regions III, IV, V, and X. Mechanical system measures (Fig. 8.2d) were less common in Region IV. Lighting measures were least common in Regions IV, V, and VI.

8.2 Successful Measures

Respondents were asked which energy conservation measures saved the most amount of energy (British thermal units, or Btu) for their college or university, based on the list of energy conservation measures previously presented to them. They were given two choices: most effective and second most effective. We do not know whether or how colleges and universities measured the amount of energy saved by these measures.

The results are summarized in Fig. 8.3, and Table C.48 shows the responses sorted by stratification variable. The most effective measures were *reported* to be HVAC and/or electrical/lighting controls (including time clocks and energy management systems), as indicated by 48% of the sample of 740. The next most effective measures were building envelope measures (e.g., insulation and caulking and weatherstripping) at 15% and heating measures (e.g., replacement of burners and boilers) at 12%. No other measures were regarded by more than 10% of the sample as most effective. Public institutions did significantly differ from private institutions: for example, more public colleges and universities thought control measures were most effective, while more of the private institutions thought envelope measures were most effective. The second most effective measures were lighting measures (e.g., lighting conversions and modifications) at 22%, followed by control and envelope measures at 19%. Again, public institutions significantly differed from private institutions in their response to this question, with the same emphases.

8.3 Technical Problems

The survey requested information regarding technical problems encountered in the respondents' energy conservation activities. As shown in Fig. 8.4, over one-half of the colleges and universities experienced technical problems. One-quarter of all C&U had problems directly related to a piece of equipment or system, and 10% indicated problems related to the need for staff training to operate the equipment adequately. Another 10% noted problems with the capabilities of the consultants (e.g., for conducting energy audits and technical analysis). A small percentage (3%) reported a problem with the lack of available staff. These results are broken down by stratification variable in Tables C.49 and C.50. There were statistically significant differences for two of the three stratification groups. Four-year C&U were more likely than two-year C&U to indicate problems with staff availability and consultant capabilities. In contrast, two-year C&U were more likely than four-year C&U to indicate problems with energy conservation measures. ICP participants were more likely than non-ICP participants to indicate problems with specific energy conservation measures.

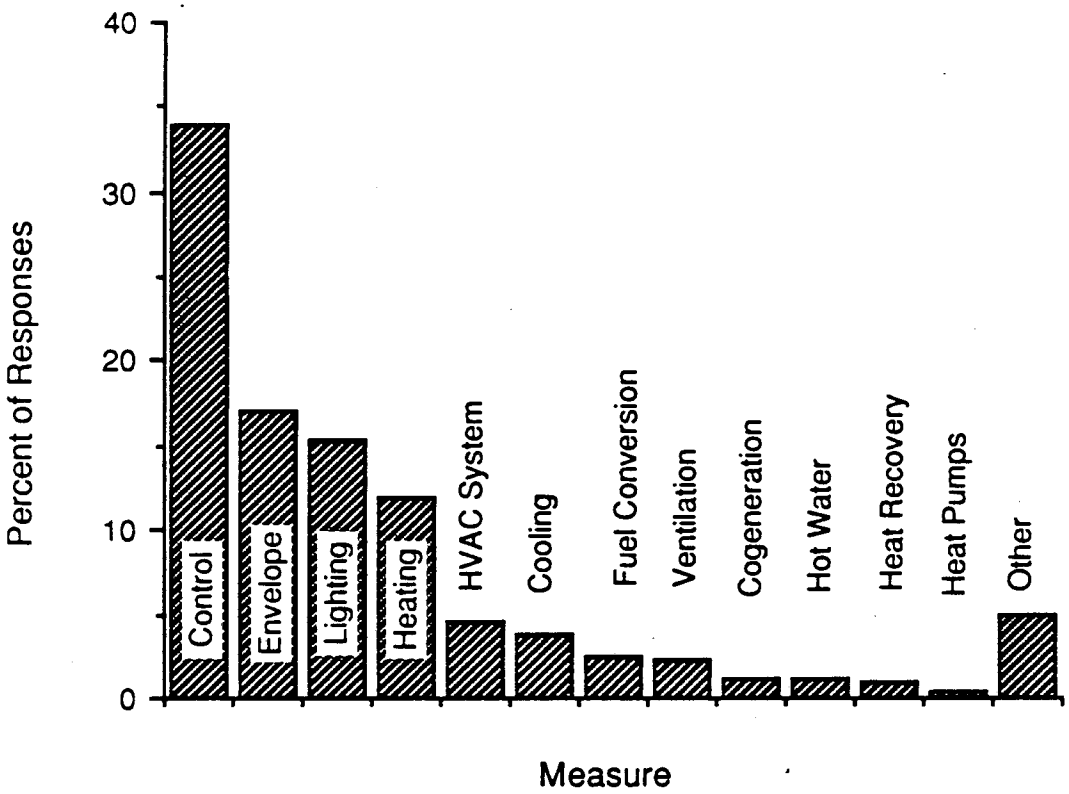

Fig. 8.3: Successful Measures

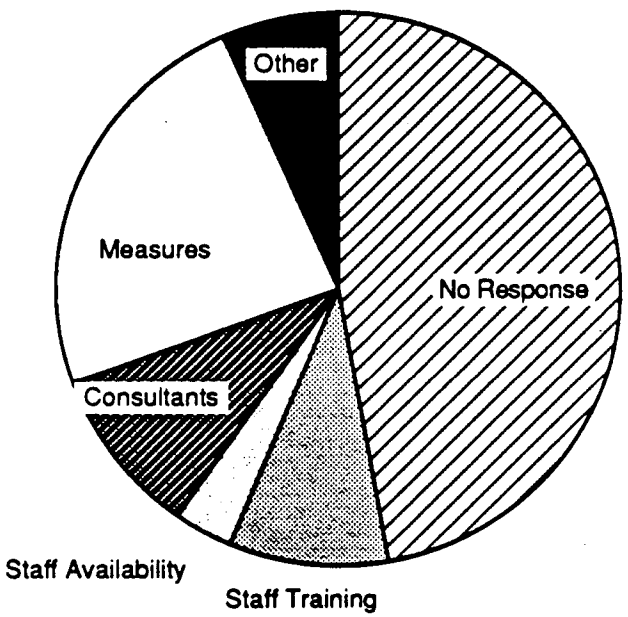

Fig. 8.4: Technical Problems

9.0 SUMMARY OF FINDINGS

The purpose of this report is to summarize the responses to a mail survey of college and university physical plant directors carried out as part of an evaluation of the Department of Energy's Institutional Conservation Program (ICP). We have focused on those characteristics of institutions that might be expected to influence the identification, implementation, operation, and impacts of institutional energy conservation efforts. Information about institutional characteristics was gathered through a mail survey of colleges and universities. Two mailings yielded 773 completed questionnaires out of the population of 3,434 colleges and universities, yielding a response rate of 22%. The rest of this section summarizes many of the findings in the same order as they were presented in the report.

9.1 Technical/Physical Characteristics

The average year of construction of all buildings at colleges and universities (C&U) was 1961, and the average age of the oldest building on campus was 66 years. The oldest buildings were found at four-year C&U, private institutions, ICP participants, and institutions in the Northeast.

The average number of campus buildings was 41, and the average square footage of conditioned building space was 1,336,761 ft^2. The largest institutions were four-year and public C&U and ICP participants.

Most institutions used central and individual boilers to heat their buildings, especially four-year C&U and ICP participants. Little difference was observed across DOE regions in the frequency of use of either central or individual boilers for heating. Natural gas was the most common primary heating source, followed by fuel oil, electricity, coal, and steam/hot water. Two-year C&U and non-ICP participants were more likely to use natural gas as a primary heating source compared with their counterparts. And the Northeast was the only exception to the domination of natural gas: fuel oil and/or electricity were more common in this region.

The most commonly used air-conditioning systems were central or building chillers, followed by window air conditioners and packaged cooling units, and this was especially true for four-year C&U and ICP participants. There were no strong climate patterns among cooling systems, although in the West, window air conditioners were less common while evaporative cooling systems were more prevalent. Electricity was the most common primary cooling source and dominated all regions.

9.2 Energy Management Activities

Though more than 70% of the survey respondents reported increases in their level of energy conservation effort since 1980, less than 45% reported decreases in energy use, and approximately the same number reported increases. The most commonly reported reasons for changes in energy consumption were (1) changes in building operation, and (2) increases in floor area.

About three-quarters of C&U prepared an energy monitoring or accounting report, which periodically tracked and analyzed energy use and/or costs, and this was especially true for public institutions and ICP participants.

Though most institutions have had several comprehensive technical analyses conducted since 1980 for the purpose of identifying energy conservation measures (ECMs), and most have installed multiple ECMs in recent years, and most have an organized way of monitoring energy use and reporting it to the decisionmaker, only one-third of institutions have formal, written energy plans for controlling energy costs.

Almost three-quarters of all colleges and universities (especially public institutions and ICP participants) had a comprehensive, technical energy analysis of at least one of their buildings since 1980, and most of these audits were performed by private consultants or contractors.

9.3 Sponsorship and Financing

By far, the most common source of funds used by institutions to purchase energy saving capital equipment was internal operating and capital budgets, especially by public institutions and ICP participants. Grants ranked second, with substantially fewer institutions using other financing mechanisms. The financing mechanisms that the institutions planned to use to support future energy conservation efforts were ranked in the same order.

Almost 70% of the sample reported an awareness of the ICP grants program, with the highest level of awareness among public institutions and ICP participants. Nearly 75% of those who were aware of ICP had applied for at least one grant. The most common reason for not applying was the complexity of the grant application and award process, followed by inadequate funding and the ineligibility of the institution.

For institutions participating in the ICP program, the average number of Technical Assistance (TA) grants and Energy Conservation Measure (ECM) grants applied for and received per institution under the Institutional Conservation Program were 9 and 6, respectively. For those colleges and universities participating in the ICP program, the most common reason for not applying for an ECM grant was the problems associated with governmental rules and regulations. The most common reason offered for having an ECM grant denied to an institution was that the grant application was ranked too low in the ICP program.

Over 35% of the respondents participated in energy conservation programs (for financial assistance or energy audits) sponsored by utilities, and private institutions were more likely to have taken advantage of these programs than their public counterparts. Relatively strong regional differences were observed in the level of participation in utility programs, with participation being most likely in the West and Southwest. Across all regions, participation in state and federal programs was common.

9.4 Decisionmaking Process

The primary motivations for taking energy conservation actions were reported to be the current high cost of energy, the expectation of further cost increases, and utility demand charges or rate structures. The next three most important reasons were related to the institution and its reaction to energy cost factors: cost-containment programs, availability of outside funds, and the support of administration and staff.

The physical plant director and chief financial officer were reported to be primarily responsible for energy conservation activities in colleges and universities. The director of the physical plant was most often cited as being responsible for setting strategic directions for energy conservation efforts, for selecting specific conservation measures to be installed, and for daily energy management. The chief financial officer was primarily responsible for financing capital energy projects. The governing body (e.g., regents) assumed an important role in setting objectives and determining financing, and the primary administrator (e.g., college president) also played an important role in setting energy conservation objectives.

The most commonly reported information sources for setting overall objectives were (1) the experience of other institutions and (2) professional associations. A wide range of information sources was used in selecting specific measures, including contacts with other professionals, equipment manufacturers, technical and trade publications, experience of other institutions, conferences, consultants, and professional associations. However, no information source was dominant.

9.5 Energy Conservation Measures

In the period between 1973 and 1979, the most common retrofit was the installation of time clock controls, followed closely by caulking and weatherstripping; lighting conversions; heating, ventilation, and air-conditioning (HVAC) system adjustments; insulation; and lighting modifications. Between 1980 and 1986, there was a significantly larger number of measures installed, but they were very similar in relative frequency to the previous period. In the future (1987-1990), the level of energy conservation activity is expected to remain high; and emphasis appears to be changing slightly, with substantial increases in the areas of energy management control systems and lighting retrofits. Continuing a trend developed in the previous two periods, four-year C&U are planning to implement more energy conservation measures than two-year C&U.

The most effective energy-saving measures were reported to be controls for either the HVAC system or for the lighting system. Other ECMs ranking high with respect to energy savings were envelope measures (e.g., insulation and weatherstripping), lighting measures (e.g., delamping and conversion to fluorescent lights), and heating measures (e.g., boiler replacement). All other ECMs, including cooling system measures, ventilation measures, and HVAC system modifications, ranked relatively low. Control measures were more often identified as successful by public institutions while private institutions were more likely to identify envelope measures as most effective. This difference may reflect the fact that the public institutions were typically larger and operationally more complex than the private colleges and universities.

Energy conservation efforts have not been trouble free. Over 50% of the respondents indicated that they had experienced technical problems, and about 50% of those indicated that the problem was associated with the ECMs. Institutions also quite commonly experienced problems associated with occupant behavior (e.g., opening windows in the winter) and with occupant comfort.

REFERENCES

1. Argonne National Laboratory and Lawrence Berkeley Laboratory, "Evaluation Design Document for the Institutional Conservation Program." February 1986.

2. Nancy E. Collins, Linda Gaines, Philip H. Kier, and Kenneth L. Miller, "Nationwide Survey of Energy Conservation in Hospitals: Institutional, Organizational, and Technical Characteristics." Argonne National Laboratory, Draft Report, May 1987.

3. Argonne National Laboratory and Lawrence Berkeley Laboratory. Report on the results of the school district and private school survey. To be published Fall 1987.

4. Nancy E. Collins and Ronald C. Kammerud, "Institutional Conservation Program Evaluation Project: Review of Existing Data." October

5. Argonne National Laboratory and Lawrence Berkeley Laboratory, "Higher Education Survey Pretest Results." Winter 1987.

6. Brandt Andersson, William L. Carroll, and Marlo Martin, "Aggregation of U.S. Population Centers Using Climate Parameters Related to Building Energy Use," *ASHRAE Transactions,* vol. 91, part 2B (1985); presented at the ASHRAE Semi-Annual Meeting, June 1985, Honolulu. Also in *Journal of Climate and Applied Meteorology,* vol. 25 (1985): pp. 596–614. Also published as Lawrence Berkeley Laboratory Report LBL-15230.

APPENDIX A: COVER LETTER AND MAIL SURVEY INSTRUMENT

Lawrence Berkeley Laboratory
Berkeley, California 94720

December 1, 1986

Dear Director of Physical Plant:

The amount of money spent on energy by colleges and universities remains a serious problem despite the recent drop in oil prices, internal cost-containment efforts, and improved energy efficiency of equipment. Many opportunities remain for physical plant directors to reduce energy consumption, but many barriers also remain before these opportunities can be realized.

The U.S. Department of Energy (DOE) is sponsoring a study to determine the most successful energy conservation activities taken by colleges and universities during the past 10 years and how these institutions decide to undertake these activities. Two of DOE's national energy laboratories are conducting this study: Lawrence Berkeley Laboratory in California and Argonne National Laboratory, just outside Chicago.

We need your help! We would greatly appreciate your completing and returning the enclosed questionnaire. By doing so, you will help us identify the most popular and successful energy conservation activities and technical measures used by colleges and universities, the types of information needed to choose and implement activities and measures, and the best ways to transfer information and technologies to college and university engineers and administrators.

You are one of 3000 college and university physical plant directors receiving the questionnaire. Answering it will take 25 minutes of your time. A self-addressed envelope is enclosed for your convenience. The questionnaire will be returned to Elrick and Lavidge, Inc., the company handling the mailing of the survey.

Please read the instructions carefully as you move through the survey so that we can avoid taking more of your time by telephoning for clarification. Answer the questions only for the campus named on the envelope sent to you (also on the first page of the questionnaire) even though you may be responsible for other campuses as well. If you are unable to answer a question, please obtain the missing information from the person who can best answer the question. If you have additional comments, feel free to write them down in the margin of the questionnaire. Your identity (and that of your college or university) will be kept in strictest confidence, and your responses will be used only for aggregated statistical analyses.

We encourage you to complete this questionnaire immediately. The results from this study will be made available to all interested participants.

If you have questions, please call Edward Vine of Lawrence Berkeley Laboratory at (415) 486-6047, or Philip Kier at Argonne National Laboratory at (312) 972-3989.

Thank you very much for your cooperation.

ENERGY USE IN COLLEGES AND UNIVERSITIES

Please CIRCLE THE APPROPRIATE NUMBER(S) that correctly answers the questions, or write in your response where indicated. Please do not estimate. If you are unable to answer a question, please obtain the missing information from the person who can best answer the question. Please indicate if the information is not available by writing in "not available."

****

In this first section, we are interested in how energy is regarded by your college or university and by the people who are responsible for energy policy and energy decisions.

****

1. Overall, has the number of energy-conserving activities in your college or university increased, decreased, or remained the same since 1980?

1 Increased overall
2 Decreased overall
3 Remained the same
4 Don't know

2. On a scale of 1 (highly important) to 4 (not at all important), how would you rate the importance of each of the following factors for motivating current energy conservation activities in your college or university? Please circle a number as your response for each factor; the same rating can be given to two or more factors.

Motivating Factors	Importance				Not Applicable
	Highly			Not at all	
High energy costs	1	2	3	4	9
Expectations of rising energy prices	1	2	3	4	9
Utility demand charges or rate structures	1	2	3	4	9
Cost-containment program within college or university	1	2	3	4	9
Tax incentives (credits)	1	2	3	4	9
Awareness of successful experiences of similar institutions	1	2	3	4	9
Availability of information on building energy costs	1	2	3	4	9
Availability of outside funds (grants, private capital, etc.)	1	2	3	4	9
Exposure to marketing of energy conservation products	1	2	3	4	9
Utility company conservation programs	1	2	3	4	9
Energy projects' cost savings credited to institution and/or maintenance department	1	2	3	4	9
Support of administration and staff	1	2	3	4	9
Other (Please specify:)	1	2	3	4	9

3. Do you have a written energy plan (excluding audits) for controlling energy costs in your college or university?

1 Yes
2 No (*GO TO QUESTION 5*)
3 Don't know (*GO TO QUESTION 5*)

4. Do you currently use your energy plan?

1 Yes
2 No
3 Don't know

5. For energy matters, who is PRIMARILY RESPONSIBLE for setting general objectives, selecting specific actions to reduce energy use, financing capital projects, and the daily management of energy conservation activities in your college or university? (Circle all that apply)

Responsible Person(s)	Setting General Objectives	Selecting Specific Actions	Financing Capital Projects	Daily Management
Governing body (Board of Trustees/Regents)	1	1	1	1
College or university administrator (President)	1	1	1	1
Other administrator (Please specify title:)	1	1	1	1
Chief financial officer	1	1	1	1
Director of physical plant	1	1	1	1
College or university engineer	1	1	1	1
Energy committee	1	1	1	1
Private consultant	1	1	1	1
Academic department (Please specify:)	1	1	1	1
Other (Please specify:)	1	1	1	1
No designated individual	1	1	1	1

6. For energy matters, what INFORMATION SOURCES do you use in setting general objectives, selecting specific actions to reduce energy use, financing capital projects, and in daily management of energy conservation activities in your college or university? (Circle all that apply)

Information Source	Setting General Objectives	Selecting Specific Actions	Financing Capital Projects	Daily Management
Experience of other colleges or universities	1	1	1	1
Financial status of college or university	1	1	1	1
Manufacturers of energy conservation products	1	1	1	1
Energy Service Companies (ESCo)	1	1	1	1
Attending conferences	1	1	1	1
Technical and trade publications (e.g., *Energy User News*)	1	1	1	1
Professional societies (e.g., *ASHRAE, NACUBO, APPA*)	1	1	1	1
Contacts with other professionals (e.g., engineers)	1	1	1	1
Personnel in state/federal energy offices	1	1	1	1
Utility companies	1	1	1	1
Consultants and auditors	1	1	1	1
Other (Please specify:)	1	1	1	1

****

The next section asks about energy conservation activities conducted by your college or university.

****

7. Overall, has total energy consumption (NOT COSTS) changed in your college or university since 1980? (If more than one fuel is used by your institution, answer for the NET change.)

1 Increased overall
2 Decreased overall
3 About the same (*GO TO QUESTION 9*)
4 Don't know (*GO TO QUESTION 9*)

8. If there has been a change in total energy consumption NOT DUE to energy conservation measures, why do you think it has occurred? (Circle a response for each item)

Reason	Yes	No	Direction of change	
			Up(+)	Down(-)
Change in educational services	1	2	+	-
Change in building operations	1	2	+	-
Change in square footage	1	2	+	-
Change in summer schedule	1	2	+	-

9. Has anyone performed a comprehensive, technical energy audit (on-site examination of a building and its energy systems, performed for the purpose of recommending ways to save energy) on your campus since 1980?

1 Yes
2 No (*GO TO QUESTION 14*)
3 Don't know (*GO TO QUESTION 14*)

10. How many buildings have been audited? _____

11. When was the MOST RECENT audit performed? _____ (year)

12. Who performed the MOST RECENT energy audit? (Circle one) (If more than one person, choose the party responsible for preparing the audit report)

1 Utility company
2 Private consultant/contractor
3 A college or university employee
4 State government employee
5 Local government employee
6 Other (Please specify: _____)
7 Don't know

13. How were the results of the most recent audit reported to you? (Circle all that apply)

1 Received a computer printout
2 Received a detailed written report
3 Received a brief report and/or oral briefing
4 Don't know

14. We are interested in finding out what energy conservation measures (including low-cost/no-cost measures) you have undertaken since 1973 or have planned for the near future. Please remove the last page and refer to the definitions of energy conservation measures. Please circle all that apply.

Energy Conservation Measures (ECMs)	Date of Installation 1973-1979	Date of Installation 1980-1986	Planned 1987-1990
BUILDING ENVELOPE			
Insulation (walls, ceilings, roof)	1	1	1
Caulking and weatherstripping	1	1	1
Windows (reflective film)	1	1	1
Windows (replacement)	1	1	1
Windows (all other ECMs)	1	1	1
Other openings	1	1	1
Manual adjustments	1	1	1
CONTROLS - HVAC			
Time clocks	1	1	1
Computer-based energy management systems (EMS)	1	1	1
Other	1	1	1
CONTROLS - ELECTRICAL/LIGHTING			
Time clocks	1	1	1
Computer-based energy management systems (EMS)	1	1	1
Other	1	1	1
MECHANICAL (HVAC)			
Fuel conversions	1	1	1
Air conditioning	1	1	1
Heating modifications (replace burner)	1	1	1
Heating modifications (replace or add boilers)	1	1	1
Heating modifications (insulate boiler)	1	1	1
Heating modifications (steam traps; valves)	1	1	1
Heating modifications (all other ECMs)	1	1	1
Distribution system (insulate pipes/ducts)	1	1	1
Distribution system modifications (all other ECMs)	1	1	1
Domestic hot water	1	1	1
Cogeneration	1	1	1
Manual adjustments	1	1	1
Energy recovery devices	1	1	1
Other	1	1	1
ELECTRICAL/LIGHTING			
Lighting conversion	1	1	1
Lighting modifications	1	1	1
Manual adjustments	1	1	1
Other electrical applications	1	1	1
RENEWABLES			
Solar (passive)	1	1	1
Solar (active)	1	1	1
Solar (all other)	1	1	1
Conversion to renewables	1	1	1
Other	1	1	1

15. **Based on the list of energy conservation measures (ECMs) shown on the preceding page, which TWO ECMs have saved the most amount of energy (BTUs) for your college or university?**

Most effective: _____

_____

Second most effective: _____

_____

16. **Please describe the following kinds of problems (technical, financial, managerial, and building occupant) you have had in implementing energy conservation measures:**

Technical (e.g., equipment, operations and maintenance, installation): _____

_____

_____

Financial (e.g., funding, payback, budget): _____

_____

_____

Managerial (e.g., staffing, approvals): _____

_____

_____

Building occupants (e.g., perceptions of comfort, schedules): _____

_____

_____

17. **Is an energy monitoring or accounting report, which periodically tracks and analyzes energy use and/or energy costs (e.g., monthly, quarterly, annually), prepared by or for your institution?**

1 Yes

If yes, to whom are the results reported? (Circle all that apply)

1 Energy committee
2 Director of physical plant
3 College or university engineer
4 Governing body (Board of Trustees/Regents)
5 Chief financial officer
6 College or university administrator (President)
7 Other administrator (Please specify title: _____)
8 Maintenance/custodial staff
9 Other (Please specify: _____)

2 No
3 Don't know

18. **What financing arrangements have enabled your college or university to purchase energy-saving capital equipment since 1980, and which financial arrangements are you considering for any planned energy investment? (Circle all that apply)**

Source	Used	Planned
General operating and capital funds	1	1
Commercial loans	1	1
Lease/lease purchase	1	1
Savings-based financing	1	1
Tax exempt bonds	1	1
Grants	1	1

19. **What percent of energy cost-savings is returned to your institution's budget?** ____%

20. **What percent of energy cost-savings is returned to your department's budget?** ____%

****

In the following section, we ask some questions about your college or university. Where there is more than one building, the questions concern the entire facility. If there is more than one campus, the questions concern your particular campus.

****

21. **How many buildings are on your campus (excluding unconditioned storage and related buildings)?** _____

22. **When was the oldest building built?** _____ (year)

23. **How many buildings were built after 1977?** _____

24. **What is the average age of your buildings?** _____

25. **What is the approximate total square footage of all conditioned (heated and/or air-conditioned) building space on your campus (excluding unconditioned storage and related buildings)?** _____ (square feet)

26. **Do you have a central physical plant?**

    1 Yes
    2 No (*GO TO QUESTION 28*)

27. **How many buildings does the central physical plant serve?** _____

28. **Please indicate the types of use that occur in buildings on your campus. (Circle all that apply)**

Building use	Yes	No
Nonclass laboratory facilities (e.g., research laboratories)	1	2
Special use facilities (e.g., athletic facilities, daycare, & devotional)	1	2
General use facilities #1 (e.g., food preparation & dining rooms)	1	2
General use facilities #2 (e.g., assembly, museums, & concert halls)	1	2
General use facilities #3 (e.g., merchandising)	1	2
Supporting facilities (e.g., storage)	1	2
Health care facilities (e.g., hospital)	1	2
Residential facilities (e.g., dormitories)	1	2

29. **Is the mechanical work done on your buildings conducted by your institution's staff or is it contracted out? (Circle all that apply)**

Mechanical work	Yes	No
Conducted by staff	1	2
Contracted out	1	2

30. Please circle the boxes below which best describe the SPACE HEATING systems used and estimate as closely as possible the percent of institutional floor area each system serves. (Responses may add to more than 100%)

Heating system	Used	Percent of institutional floor area served
Central boiler (steam or hot water)	1	%
Individual boilers (steam or hot water)	1	%
Electric resistance heat	1	%
All-electric heat pump	1	%
Gas-fired air heaters	1	%
Solar heating with collector panels	1	%
Cogeneration	1	%
Purchase from district heating system	1	%
Other (Please specify:)	1	%

31. Please circle the boxes which best describe the AIR-CONDITIONING systems used and estimate as closely as possible the percent of institutional floor area each system serves. (Responses may add to more than 100%)

Air-conditioning system	Used	Percent of institutional floor area served
No air-conditioning	1	%
Central unit (excluding chillers)	1	%
Combination gas heating & electric air-conditioning in a packaged unit	1	%
Air-conditioning only in a packaged unit	1	%
Electric through-the-wall or window unit	1	%
All-electric heat pump	1	%
Evaporative (swamp) cooler	1	%
Central or building chillers (Type:)	1	%
Other (Please specify:)	1	%

32. What are the fuels most used in your institution's space heating and cooling systems? (Circle all that apply)

Fuel	Heating			Cooling	
	Most used	Second most used	Backup	Most used	Second most used
Fuel oil (#)	1	2	3	1	2
Electricity	1	2	3	1	2
Natural gas	1	2	3	1	2
Purchased steam/hot water	1	2	3	1	2
Coal	1	2	3	1	2
Solid waste	1	2	3	1	2
Solar	1	2	3	1	2
Propane/butane (Bottled gas)	1	2	3	1	2
Other (Specify:)	1	2	3	1	2

33. Please indicate the number of meters your institution has for measuring consumption of electricity, natural gas, and other fuels. Also, please indicate the number of buildings individually metered for each of these energy sources.

	Energy sources		
	Electricity	Natural gas	Other fuels
Number of meters			
Number of buildings individually metered			

34. Are energy costs broken down and charged to individual cost centers, or is there no breakdown?

1 Individual cost centers
2 No breakdown
3 Some breakdown
4 Don't know

35. Do your college or university's heating and/or cooling systems serve other buildings in addition to your campus(es)?

1 Yes
2 No
3 Don't know

36. Do you have any specific types of equipment or facilities that use a lot of energy (e.g., large computers, experimental equipment, medical training equipment)?

1 Yes
If yes, what types of equipment? _____
_____
_____
_____
2 No

37. Have any major system changes (e.g., changes in heating, ventilation, and air conditioning systems) occurred in your college or university since 1980?

1 Yes
If yes, what changes and when did they occur? _____
_____
_____
_____
2 No

38. How many full-time students lived ON campus during 1985-86? _____ (students)

39. How many full-time students lived OFF campus during 1985-86? _____ (students)

40. How many students attended part-time during 1985-86? _____ (students)

41. **What percentage of instructional rooms are used during the following times of the year? (Circle one percentage level for each time period)**

	Percentage of instructional rooms in use				
Time period	0-25%	26-50%	51-75%	76-100%	Don't know
Evenings, academic year	1	2	3	4	5
Weekends, academic year	1	2	3	4	5
Weekdays, summer	1	2	3	4	5

42. **How many weeks during the summer are instructional rooms used?** _____ (weeks)

****

The next section asks about your participation in energy conservation programs.

****

43. **Are you aware of the U.S. Department of Energy's Institutional Conservation Program (ICP), sometimes called the Schools and Hospitals Program?**

1 Yes
2 No (*GO TO QUESTION 48*)
3 Don't know (*GO TO QUESTION 48*)

44. **Has your college or university ever applied for a grant award under the ICP program?**

1 Yes (*GO TO QUESTION 45*)
2 No

If no, why not?_____

_____

_____

(*IF NO, GO TO QUESTION 48*)

3 Don't know (*GO TO QUESTION 48*)

45. **Please indicate the number of Technical Assistance (TA) audit grants and Energy Conservation Measure (ECM) grants your college or university has applied for and the number you have received:**

	# Applied for	# Received
TA grants		
ECM grants		

46. **If you received a TA grant but did not apply for an ECM grant, please indicate your reasons for not applying:** _____

_____

_____

_____

47. **If you were denied (or you rejected) an ECM grant, please indicate the reasons for the denial (or rejection), if you know them:** _____

_____

_____

_____

48. **List the names and locations of other colleges or universities which have served as models or have been helpful to you in making energy-related decisions:** _____

_____

_____

49. **If you have a parent organization (e.g., state college system or church), has it been helpful in reducing your institution's energy use?**
    1 Yes
    2 No
    3 Don't know

50. **Have you participated in energy conservation programs for financial assistance or energy audits sponsored by the following organizations? (Circle a response for each organization)**

	Yes	No	Don't know	If yes, name of organization
Utility companies	1	2	3	
Federal agencies	1	2	3	
State agencies	1	2	3	
Local agencies	1	2	3	
Associations	1	2	3	
Parent organization (e.g., state college or church)	1	2	3	
Other	1	2	3	

****

For the person primarily responsible for completing this survey, please answer the following questions.

****

51. **How long have you worked at this college or university?** _____ (years)

52. **How long have you held your current position?** _____ (years)

53. **What degrees and certificates (including energy-related ones), if any, have you earned?**

_____

_____

54. **What other positions have you held at this college or university?**

_____

_____

55. **Where did you work immediately prior to coming to this college or university?**

_____

_____

56. **How large is the physical facility staff?** _____

57. **How many people do you directly supervise?** _____

58. **How many of these people are engineers?** _____

59. What is the title (position) of your immediate supervisor? _____

60. If we have any questions, whom should we contact for clarification of responses in this questionnaire?

Contact Person: _____

Title: _____

College or university: _____

Address: _____

_____

City _____ State _____ Zip _____

Phone: _____

61. Is the Contact Person yourself?

1 Yes (*GO TO QUESTION 63*)
2 No

62. What is your title? _____

63. If you would like to receive information regarding the findings of this survey, please check the line below, and we will arrange to send you the survey results in about two months:

___ I would like to receive summary results of the survey.

64. Is there anything else you would like to comment on in regard to this questionnaire or energy use in general?

COMMENTS:

THANK YOU FOR YOUR HELP!
WE APPRECIATE THE TIME YOU SPENT HELPING US.

We provided an envelope with an address label for returning this questionnaire. If you do not have the label, please send the questionnaire to the company handling the mailing of the survey: Elrick and Lavidge, Inc., 111 Maiden Lane, San Francisco, Ca. 94108.

****

USE THESE DEFINITIONS TO ANSWER QUESTIONS 14 AND 18

****

GENERAL DEFINITIONS

Cogeneration - Cogeneration is the sequential production of heat and power, usually electricity and steam.

District Heating - District heating systems are thermal energy systems which produce heat in the form of steam or hot water, and convey it from one or more central energy production stations to service the thermal energy needs of commercial, residential, institutional, and industrial users.

Energy Audit - An energy audit is an on-site examination of a building and its energy systems, performed for the purpose of recommending ways to save energy.

Energy Service Company - Energy Service Companies arrange "utility service agreements" in which the firm often takes responsibility for paying utility bills in exchange for a portion of the savings attributable to conservation measures installed and sometimes financed by the energy service company.

Lease Purchase Programs - Lease purchase programs require no initial capital investment. At the end of the lease, the building operator acquires ownership of the leased equipment. Under these arrangements you assume the risk of continued lease payments even if there are no energy savings. These programs include "bargain purchases."

Savings-based financing - In these arrangements, a contractor agrees to finance, install and maintain energy-saving equipment in exchange for a portion of the energy savings. As part of savings-based financing, the contractor may provide "turnkey" services such as building energy audits, project design, installation, maintenance and repairs.

DEFINITIONS OF ENERGY CONSERVATION MEASURES (ECMs)

BUILDING ENVELOPE

Insulation

Roof/ceiling insulation (e.g., crawl space), wall insulation, combination of roof/ceiling/wall insulation, or other insulation measures (e.g., berming, soffit, vent caps).

Infiltration control

Caulking and weatherstripping (e.g., tuckpoint).

Windows

Storm windows (inside or outside), double- or triple-glazed windows, replace glass with insulated panel (includes partial panel and glass), reflective window film, wall up or close off windows, or other window measures (e.g., skylight modification).

Other openings

Storm doors, air locks or vestibules (e.g., air curtains, strips), wall up or close off doors, or other door/miscellaneous measures (e.g., insulate, replace with higher R-value, automatic closures, thresholds, sweeps).

Manual adjustments (e.g., pulling shades, screens, opening and closing windows/doors).

CONTROLS - HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

Time clocks

Computer-based energy management systems (EMS)

Other (e.g., temperature reset devices and enthalpy control).

CONTROLS - ELECTRICAL/LIGHTING

Time clocks

Computer-based energy management systems (EMS)

Other (e.g., additional/selective switching and motion detectors).

MECHANICAL HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

Fuel conversions

Convert to oil, natural gas, electricity, coal or another nonrenewable fuel.

Air conditioning

Chiller conversion/efficiency improvement, package unit application, install economizer, adiabatic cooling, or other air conditioning measures (e.g., cross-connect system).

Heating modifications

Replace burner, replace boiler (e.g., more efficient), add smaller boiler, downsize system (e.g., special use), automatic flue damper, install automatic ignition device, preheat heat combustion air/make-up water, turbulators, stack economizer, humidification device, district heating, or other heating modifications (e.g., steam traps/valves, insulate boiler, radiator control valves, oxygen trim).

Distribution system modifications

Reduce air volume, prevent air stratification (e.g., ceiling fans, deflectors), convert to variable air volume, insulate pipes/ductwork, damper modifications (e.g., automatic dampers, seals, controls), zoning modifications (e.g., close off areas, add ductwork), motors (e.g., high efficiency, motor controllers), or other distribution systems measures.

Water

Flow restrictors (e.g., automatic faucet shutoffs, low-flow showerheads), insulate tanks, decentralized hot water heater (e.g., seasonal/booster heater), or other water measures (e.g., flue damper, interconnect system, filter system, pool cover).

Cogeneration

The sequential production of heat and power, usually electricity and steam.

Manual adjustments (e.g., shut off equipment, motors, temperature adjustments).

Energy recovery devices (e.g., boiler blowdown, heat wheel, heat exchanger, heat pipe, runaround system, boiler flue gas, laundry heat).

Other (e.g., humidifiers and dehumidifiers).

ELECTRICAL/LIGHTING

Lighting conversion

Convert to fluorescent lights, high intensity discharge lights (e.g., mercury, metal halide, HP sodium), or other high efficiency lights.

Lighting modifications

Modify fixture (e.g., lenses, reflectors, lower height), reduce number of fixtures, ballast modifications (e.g., electronic ballast, power reducers), or other lighting modifications.

Manual adjustments (e.g., shutting off lights, dimming)

RENEWABLES

Solar

Active solar hot water, active solar heating, passive solar heating (e.g., trombe wall, greenhouse), photovoltaic application, or daylighting.

Conversions

Conversion to wood (e.g., wood chips), biomass (e.g., vegetation, animal waste, agricultural), refuse (e.g., residues), and other renewables.

Other (e.g., wind, tidal, hydro, geothermal, and thermal storage).

APPENDIX B: TELEPHONE SURVEY INSTRUMENT FOR NONRESPONDENT FOLLOWUP

Elrick and Lavidge, inc.
111 Maiden Lane
San Francisco, CA 94108

Project: #82-1332
Final: 5/28/87

COLLEGE AND UNIVERSITY
NON-RESPONDENT SURVEY

Group#_____

ID | | | | | | |

SWITCHBOARD INTRO

A. Hello I'm _____ calling about a Department of Energy survey being conducted by Lawrence Berkeley Laboratory.

B. I'd like to speak with the Director of your Physical Plant.

(IF "NO SUCH TITLE" ASK FOR THE PERSON IN CHARGE OF BUILDINGS.)

RESPONDENT INTRO

Hello I'm _____ calling about a Department of Energy survey being conducted by Lawrence Berkeley Laboratory.

1. Do you recall receiving a survey in the mail about energy conservation several months ago?

Yes
No

IF YES: Our records show we didn't receive your response so we'd like to ask you just a few questions now . . .

IF NO: Perhaps the questionnaire was incorrectly addressed or it may have gone to someone else at your institution. Since we don't have a record of any response from your university (or college) we'd like to ask you just a few quesitons now . . .

IF RESPONDENT REFUSES

Why is it you don't wish to participate in this survey?

Don't have time	-1
Recalled mail questionnaire as being too long	-2
Recalled mail questionnaire and didn't know answers	-3
Not interested in subject	-4
Other: _____	
_____	

I'm going to ask you about energy conservation activities conducted by your institution. Where there is more than one building, the questions concern the entire facility. If there is more than one campus, the questions concern the campus where your main office is located.

First, we would like some general information about energy conservation efforts at your university (or college).

1. Overall, has the number of energy-conserving activities in your college or university increased, decreased, or remained the same since 1980?

   1 Increased overall
   2 Decreased overall
   3 Remained the same
   4 Don't' know

7. Overall, has total energy consumption (**NOT COSTS**) changed in your college or university since 1980? (If more than one fuel is used by your institution, answer for the **NET** change.)

   1 Increased overall
   2 Decreased overall
   3 Remained the same
   4 Don't' know

9. Has anyone performed a comprehensive, technical energy audit (on-site examination of a building and its energy systems, performed for the purpose of recommending ways to save energy) on your campus since 1980?

   1 Yes
   2 No
   3 Don't know

14. We are interested in finding out what types of energy conservation measures, including any low-cost/no-cost measures) you have undertaken since 1973, or have planned for the near future.

Since 1973, have you made any energy conservation changes in your building envelope such as insulation, weatherstripping, window treatments, etc.?

1 Yes -1
2 No -2

IF YES: Were those changes made between 1973 and 1979 . . . or between 1980 and 1986? **RECORD**

IF NO: Do you plan to make any energy conservation changes in your building envelope between now and 1990? **IF YES, RECORD**

REPEAT SEQUENCE FOR:

- o Mechanical (HVAC) equipment including boilers, air conditioning, heating or hot water equipment or changes?
- o Electrical/lighting equipment
- o Renewable energy . . . such as solar or other forms of renewable energy?

Energy Conservation Measures (ECMs)	Date of Installation		Planned
	1973-1979	1980-1986	1987-1990
BUILDING ENVELOPE	1	1	1
MECHANICAL(HVAC)	1	1	1
ELECTRICAL/LIGHTING	1	1	1
RENEWABLES	1	1	1

IF MORE THAN TWO CONSERVATION MEASURES INSTALLED SINCE 1973

15. Based on the energy conservation measures we have talked about, which TWO have saved the most energy for your university (or college).

1 _____

_____

2 _____

_____

16. Now I'll mention some types of problems you may have had in implementing energy conservation measures . . . as I name each one please tell me if you've had that problem and if so please describe what the problem was.

a. Technical problems such as equipment, operations and maintenance, installation — Yes ( ) No ( )

_____

_____

_____

b. Financial problems such as funding, payback, budget — Yes ( ) No ( )

_____

_____

_____

c. Managerial problems such as staffing, approvals — Yes ( ) No ( )

_____

_____

_____

d. Building occupant problems such as perceptions of comfort, schedules — Yes ( ) No ( )

_____

_____

_____

IF ANY INSTALLED 1980-1986

18a. What financing arrangements have been used by your university (or college) to purchase energy-saving capital equipment since 1980? For example, have you used . . . **READ.**

Source	Used	Planned
Internal funds	1	2
Commercial loans	1	2
Lease/lease purchase	1	2
Savings-based financing	1	2
Tax exempt bonds	1	2
Grants	1	2

b. Which financial arangements are you consdering for any planned energy investment? For instance . . . **READ AND RECORD ABOVE**

The following questions are about your university (or college). Where there is more than one building, the questions concern the entire facility.

21. How many buildings are on your campus? _____

25. What is the total square footage of all conditioned space on your campus? _____

22. When was the oldest building built? _____ (year)

23. How many buildings were built after 1977? _____

The next few questions are about your participation in energy conservation programs.

43. Are you aware of the U.S. Department of Energy's Institutional Conservation Program (ICP), sometimes called the Schools and Hospitals Program?

1 Yes -1
2 No -2 **(GO TO QUESTION 50)**

44a. Has your university (or college) ever applied for a grant award under the ICP program?

1 Yes -1 **(GO TO QUESTION 50)**
2 No -2

b. If no, why not? _____

_____

_____

3 Don't know

50. We're interested in whether you have participated in any energy conservation programs such as financial assistance or energy audits sponsored by various organizations. How about utility company programs?

REPEAT FOR ALL OTHERS

IF YES: What utility sponsored that?

	Yes	No	Don't know	If yes, name of organization
Utility companies	1	2	3	
Federal agencies	1	2	3	
State agencies	1	2	3	
Local agencies	1	2	3	
Associations	1	2	3	
Parent Organizations	1	2	3	
Any others?	1	2	3	

Now a couple of final questions about you and your job.

51. How long have you worked at this university (or college)? _____ (years)

52. How long have you held your current position? _____ (years)

53. What degrees and certificates have you earned? _____

_____

59. What is the title (position) of your immediate supervisor?

_____

63. Would you like to receive information regarding the findings of this survey?

Yes -1 ------> **SAY:** We will arrange to send you the survey
No -2 results in about two months:

THANK YOU FOR YOUR HELP!
WE APPRECIATE THE TIME YOU SPENT HELPING US.

APPENDIX C: STATISTICAL TABLES SUMMARIZING THE COLLEGES AND UNIVERSITIES SURVEY

APPENDIX C: STATISTICAL TABLES SUMMARIZING THE COLLEGES AND UNIVERSITIES SURVEY

Cross-referencing of Tables with Survey Questions

Table	Survey	Table	Survey	Table	Survey
C.1	51–52,56–58	C.18	7	C.35	5
C.2	60	C.19	8	C.36	5
C.3	60	C.20	1	C.37	5
C.4	60	C.21	3–4,19–20	C.38	5
C.5	38–40	C.22	9–13	C.39	6
C.6	21–25	C.23	29	C.40	6
C.7	28	C.24	16	C.41	6
C.8	41–42	C.25	16	C.42	6
C.9	30	C.26	18	C.43	48
C.10	30	C.27	43	C.44	17
C.11	31	C.28	44,46	C.45	16
C.12	31	C.29	45,47	C.46	16
C.13	37	C.30	50	C.47	14
C.14	35	C.31	49	C.48	15
C.15	32	C.32	16	C.49	16
C.16	32	C.33	16	C.50	16
C.17	33	C.34	2		

Cross-referencing of Survey Questions with Tables

Survey	Table	Survey	Table	Survey	Table		
1	C.20	17	C.44	33	C.17	49	C.31
2	C.34	18	C.26	34	None	50	C.30
3	C.21	19	C.21	35	C.14	51	C.1
4	C.21	20	C.21	36	None	52	C.1
5	C.35–38	21	C.6	37	C.13	53	None
6	C.39–42	22	C.6	38	C.5	54	None
7	C.18	23	C.6	39	C.5	55	None
8	C.19	24	C.6	40	C.5	56	C.1
9	C.22	25	C.6	41	C.8	57	C.1
10	C.22	26	None	42	C.8	58	C.1
11	C.22	27	None	43	C.27	59	None
12	C.22	28	C.7	44	C.28	60	C.2–4
13	C.22	29	C.23	45	C.29	61	None
14	C.47	30	C.9–10	46	C.28	62	None
15	C.48	31	C.11–12	47	C.29	63	None
16	C.24,25,32,33, 45,46,49,50	32	C.15–16	48	C.43	64	None

Table C.1: Characteristics of Individuals Filling Out Survey

	4-Year	2-Year	Public	Private	ICP	Non-ICP
Length of Association with University						
Mean	9.34	10.38	10.34*	8.64	9.97*	9.56
Standard Deviation	8.29	7.37	7.71	8.33	7.98	8.07
Sample Size	526	243	429	393	306	409
How Long at Current Position						
Mean	5.63*	7.07	6.58	5.47	5.83	6.31
Standard Deviation	5.46	7.07	5.54	5.70	5.27	5.93
Sample Size	525	243	427	340	359	409
Size of Physical Facility Staff						
Mean	117.10*	30.11	116.61*	53.74	120.38*	61.59
Standard Deviation	170.37	37.21	175.90	88.35	171.75	115.78
Sample Size	510	242	423	329	352	400
Number of People Supervised						
Mean	19.17*	13.98	18.79	15.90	20.73*	14.69
Standard Deviation	33.60	16.00	32.76	24.02	37.20	19.36
Sample Size	517	240	426	331	356	401
Number of Engineers Supervised						
Mean	0.86*	0.26	0.75	0.57	0.83*	0.52
Standard Deviation	1.67	0.90	1.63	1.30	1.68	1.29
Sample Size	483	231	393	321	334	380
Percentage of Supervised Staff that are Engineers						
Mean	10.83*	2.55	8.63	7.56	9.75*	6.75
Standard Deviation	22.65	10.80	20.90	18.83	21.26	18.71
Sample Size	483	231	340	321	334	380

*Analysis of variance F probability significant at $p < .05$.

Table C.2: Geographic Distribution of Respondents by State

State	4-Year	2-Year	Public	Private	ICP	Non-ICP
Alabama	6 1.1%	4 1.6%	9 2.1%	1 0.3%	5 1.4%	5 1.2%
Alaska	2 0.4%	3 1.2%	4 0.9%	1 0.3%	0 0.0%	5 1.2%
Arizona	2 0.4%	3 1.2%	4 0.9%	1 0.3%	3 0.8%	2 0.5%
Arkansas	4 0.8%	1 0.4%	4 0.9%	1 0.3%	4 1.1%	1 0.2%
California	41 7.8%	34 13.9%	47 10.9%	28 8.2%	23 6.4%	52 12.7%
Colorado	8 1.5%	7 2.9%	10 2.3%	5 1.5%	8 2.2%	7 1.7%
Connecticut	4 0.8%	1 0.4%	5 1.2%	0 0.0%	3 0.8%	2 0.5%
Delaware	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
District of Columbia	6 1.1%	0 0.0%	0 0.0%	6 1.8%	4 1.1%	2 0.5%
Florida	7 1.3%	10 4.1%	15 0.5%	2 0.6%	10 2.8%	7 1.7%
Georgia	17 3.2%	3 1.2%	11 2.6%	9 2.6%	12 3.3%	8 1.9%
Hawaii	4 0.8%	0 0.0%	1 0.2%	3 0.9%	3 0.8%	1 0.2%
Idaho	4 0.8%	3 1.2%	5 1.2%	2 0.6%	4 1.1%	3 0.7%

State	4-Year	2-Year	Public	Private	ICP	Non-ICP
Illinois	19 3.6%	17 7.0%	20 4.6%	16 4.7%	17 4.7%	19 4.6%
Indiana	17 3.2%	1 0.4%	6 1.4%	12 3.5%	11 3.0%	7 1.7%
Iowa	10 1.9%	3 1.2%	4 1.2%	9 0.6%	4 1.1%	9 2.2%
Kansas	7 1.3%	7 2.9%	11 2.6%	3 0.9%	6 1.7%	8 1.9%
Kentucky	6 1.1%	3 1.2%	6 1.4%	3 0.9%	6 0.8%	3 1.5%
Louisiana	7 1.3%	0 0.0%	6 1.4%	1 0.3%	1 0.3%	6 1.5%
Maine	4 0.8%	1 0.4%	1 0.2%	4 1.2%	4 1.1%	1 0.2%
Maryland	10 1.9%	4 1.6%	11 2.6%	3 0.9%	11 3.0%	3 0.7%
Massachusetts	21 4.0%	5 2.0%	2 0.5%	24 7.0%	9 2.5%	17 4.1%
Michigan	16 3.0%	13 5.3%	21 4.9%	8 2.3%	17 4.7%	12 2.9%
Minnesota	11 2.1%	4 1.6%	4 0.9%	11 3.2%	5 1.4%	10 2.4%
Mississippi	4 0.8%	1 0.4%	5 1.2%	0 0.0%	3 0.8%	2 0.5%
Missouri	15 2.8%	4 1.6%	4 0.9%	15 4.4%	7 1.9%	12 2.9%

Table C.2 continued: Geographic Distribution of Respondents by State

State	4-Year	2-Year	Public	Private	ICP	Non-ICP
Montana	2 0.4%	0 0.0%	2 0.5%	0 0.0%	0 0.0%	2 0.5%
Nebraska	5 0.9%	3 1.2%	4 0.9%	4 1.2%	5 1.4%	3 0.7%
Nevada	2 0.4%	1 0.4%	2 0.5%	1 0.3%	1 0.3%	2 0.5%
New Hampshire	5 0.9%	2 0.8%	3 0.7%	4 1.2%	0 0.0%	7 1.7%
New Jersey	11 2.1%	5 2.0%	8 1.9%	8 2.3%	14 3.9%	2 0.5%
New Mexico	3 0.6%	1 0.4%	3 0.7%	1 0.3%	4 1.1%	0 0.0%
New York	33 6.2%	14 5.7%	22 5.1%	25 7.3%	32 8.8%	15 3.6%
North Carolina	13 2.5%	10 4.1%	15 3.5%	8 2.3%	10 2.8%	13 3.2%
North Dakota	3 0.6%	3 1.2%	5 1.2%	1 0.3%	1 0.3%	5 1.2%
Ohio	28 5.3%	10 4.1%	21 4.9%	17 5.0%	17 4.7%	21 5.1%
Oklahoma	9 1.7%	2 0.8%	8 1.9%	3 0.9%	5 1.4%	6 1.5%
Oregon	11 2.1%	5 2.0%	9 2.1%	7 2.0%	9 2.5%	7 1.7%
Pennsylvania	40 7.6%	7 2.9%	15 3.5%	32 9.4%	14 3.9%	33 8.0%
Puerto Rico	1 0.2%	2 0.8%	1 0.2%	2 0.6%	2 0.6%	1 0.2%
Rhode Island	3 0.6%	0 0.0%	1 0.2%	2 0.6%	2 0.6%	1 0.2%
South Carolina	3 0.6%	3 1.2%	4 0.9%	2 0.6%	3 0.8%	3 0.7%
South Dakota	5 0.9%	0 0.0%	3 0.7%	2 0.6%	4 1.1%	1 0.2%
Tennessee	7 1.3%	7 2.9%	9 2.1%	5 1.5%	8 2.2%	6 1.5%
Texas	36 6.8%	7 2.9%	26 6.0%	17 5.0%	20 5.5%	23 5.6%
Utah	3 0.6%	4 1.6%	6 1.4%	1 0.3%	4 1.1%	3 0.7%
Vermont	7 1.3%	2 0.8%	1 0.2%	8 2.3%	5 1.4%	4 1.0%
Virginia	15 2.8%	5 2.0%	13 3.0%	7 2.0%	11 3.0%	9 2.2%
Washington	12 2.3%	10 4.1%	15 3.5%	7 2.0%	7 1.9%	15 3.6%
West Virginia	7 1.3%	0 0.0%	5 1.2%	2 0.6%	4 1.1%	3 0.7%
Wisconsin	13 2.5%	7 2.9%	12 2.8%	8 2.3%	3 0.8%	17 4.1%
Wyoming	0 0.0%	2 0.8%	2 0.5%	0 0.0%	0 0.0%	2 0.5%
Column Total	529 68.4%	244 31.6%	431 55.8%	342 44.2%	362 46.8%	411 53.2%

Table C.3: Geographic Distribution of Respondents by DOE Region

Region	4-Year	2-Year	Public	Private	ICP	Non-ICP
1	44 8.3%	11 4.5%	13 3.0%	42 12.3%	23 6.4%	32 7.8%
2	44 8.3%	19 7.8%	30 7.0%	33 9.6%	46 12.7%	17 4.1%
3	78 14.7%	16 6.6%	44 10.2%	50 14.6%	44 12.2%	50 12.2%
4	64 12.1%	43 17.6%	75 17.4%	32 9.4%	56 15.5%	51 12.4%
5	111 21.0%	52 21.3%	90 20.9%	73 21.3%	71 19.6%	92 22.4%
6	52 9.8%	11 4.5%	41 9.5%	22 6.4%	33 9.1%	30 7.3%
7	37 7.0%	17 7.0%	23 5.3%	31 9.1%	22 6.1%	32 7.8%
8	25 4.7%	19 7.8%	33 7.7%	11 3.2%	21 5.8%	23 5.6%
9	49 9.3%	38 15.6%	54 12.5%	33 9.6%	30 8.3%	57 13.9%
10	25 4.7%	18 7.4%	28 6.5%	15 4.4%	16 4.4%	27 6.6%
Column Total	529 68.4%	244 31.6%	431 55.8%	342 44.2%	362 46.8%	411 53.2%

Table C.4. Geographic Distribution of Respondents by Climate

Climate Zone	4-Year	2-Year	Public	Private	ICP	Non-ICP
Northern	315 59.5%	126 51.6%	213 49.4%	228 66.7%	207 57.2%	234 56.9%
Southeastern	146 27.6%	65 26.6%	141 32.7%	70 20.5%	104 28.7%	107 26.5%
Southwestern	68 12.9%	53 21.7%	77 17.9%	44 12.9%	51 14.1%	70 17.0%
Column Total	529 68.4%	244 31.6%	431 55.8%	342 44.2%	362 46.8%	411 53.2%

Table C.5: Institutional Characteristics of Respondents

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Full-Time Students Resident 1985-86							
Mean	1842	2016*	347	2794*	1119	2383*	1268
Standard Deviation	2369	2443	384	3005	1351	2674	1835
Sample Size	496	444	52	214	285	255	241
Full-Time Students Off-Campus 1985-86							
Mean	3607	3761*	3232	5719*	1041	4852*	2432
Standard Deviation	6092	6751	4055	7385	1999	7445	4136
Sample Size	680	482	198	373	307	330	350
Part-Time Students 1985-86							
Mean	2596	1862*	4035	3997*	622	3139*	2081
Standard Deviation	4427	3617	5422	5274	1181	4701	4093
Sample Size	557	369	188	326	231	271	286
Total Number of Students 1985-1986							
Mean	6778	6874	6559	10289*	2450	9026*	4724
Standard Deviation	9700	10514	7533	11501	3642	11556	7032
Sample Size	710	494	216	392	318	339	371

*Analysis of variance F probability significant at $p < .05$.

Table C.6: Characteristics of Buildings

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Average Age of Buildings (years)							
Mean	26	29	20	22	33	26	27
Standard Deviation	15.6	15.0	15.0	12.2	17.2	16.9	14.0
Sample Size	742	502	240	413	329	344	398
Year of Oldest Building							
Mean	1921	1909*	1949	1934*	1905	1915*	1927
Standard Deviation	44.0	42.3	34.2	38.9	45.0	44.5	42.9
Sample Size	759	520	239	425	334	357	402
Number of Buildings After 1977							
Mean	4	4*	2	5*	2	5*	3
Standard Deviation	7.0	8.0	3.6	8.7	3.5	9.1	4.1
Sample Size	764	522	242	424	340	356	408
Number of Campus Buildings							
Mean	41	52*	17	50*	30	53*	31
Standard Deviation	77.2	84.3	51.8	97.0	37.5	82.4	70.9
Sample Size	763	522	241	424	340	356	408
Total Conditioned Building Space (ft^2)							
Mean	1,336,761	1,805,578*	332,745	1,666,554*	893,772	1,818,282*	884,184
Standard Deviation	2,141,531	2,450,003	284,205	2,509,473	1,399,018	2,564,973	1,572,234
Sample Size	710	484	226	413	329	344	398

*Analysis of variance F probability significant at $p < .05$.

Table C.7: Uses of Buildings

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Nonclass Laboratory Facilities		*	*	*	*	*	*
Yes	384 56.8%	314 65.3%	70 35.9%	226 60.8%	158 52.0%	206 63.4%	178 50.7%
No	292 43.2%	167 34.7%	125 64.1%	146 39.2%	146 48.0%	119 36.6%	173 49.3%
Special Use Facilities (Athletic, Daycare, etc.)		*	*			*	*
Yes	670 90.0%	481 93.2%	189 85.5%	378 92.0%	292 89.6%	342 97.4%	328 85.0%
No	67 9.1%	35 6.8%	32 14.5%	33 8.0%	34 10.4%	9 2.6%	58 15.0%
General Use Facilities #1—Food Preparation, e.g.				*	*	*	*
Yes	708 95.2%	495 95.9%	213 93.4%	403 96.9%	305 93.0%	352 99.7%	356 91.0%
No	36 4.8%	21 4.1%	15 6.6%	36 3.1%	13 7.0%	23 0.3%	1 9.0%
#2— Assembly, Concert Halls, etc.							
Yes	669 91.6%	486 94.4%	183 85.1%	369 91.3%	300 92.0%	326 93.7%	343 89.8%
No	61 8.4%	29 5.6%	32 14.9%	35 8.7%	26 8.0%	22 6.3%	39 10.2%
#3—Merchandising, etc.				*	*		
Yes	456 68.8%	324 69.2%	132 67.7%	280 75.3%	176 60.5%	229 72.0%	227 65.8%
No	207 31.2%	144 30.8%	63 32.3%	92 24.7%	115 39.5%	89 28.0%	118 34.2%
Supporting Facilities (e.g. storage)							
Yes	629 90.5%	445 91.2%	184 88.9%	361 92.3%	268 88.2%	312 92.9%	317 88.3%
No	66 9.5%	43 8.8%	23 11.1%	30 7.7%	336 11.8%	24 7.1%	42 11.7%

*Chi-square significant at $p < .05$.

Table C.7continued: Uses of Buildings

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Health Care Facilities		*	*	*	*	*	*
Yes	232 38.6%	202 47.2%	30 17.3%	147 43.5%	85 32.3%	127 43.6%	105 33.9%
No	369 61.4%	226 52.8%	143 82.7%	191 56.5%	178 67.7%	164 56.4%	205 66.1%
Residential Facilities		*	*	*	*	*	*
Yes	519 75.1%	465 90.6%	54 30.3%	223 61.4%	296 90.2%	265 79.3%	254 71.1%
No	172 24.9%	48 9.4%	124 69.7%	140 38.6%	32 9.8%	69 20.7%	103 28.9%

*Chi-square significant at $p < .05$.

Table C.8: Time of Instructional Use for Buildings

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Evenings		*	*	*	*		
0-25%	210 28.2%	181 35.8%	29 12.1%	86 20.5%	124 38.3%	88 25.4%	122 30.7%
26-50%	185 24.9%	145 28.7%	40 16.7%	96 22.9%	89 27.5%	86 24.9%	99 24.9%
51-75%	157 21.1%	93 18.4%	64 26.8%	98 23.3%	59 18.2%	83 24.0%	74 18.6%
76-100%	175 23.5%	71 14.1%	104 43.5%	130 31.0%	45 13.9%	79 22.8%	96 24.1%
Don't Know	17 2.3%	15 3.0%	2 0.8%	10 2.4%	7 2.2%	10 2.9%	7 1.8%
Weekends		*	*	*	*	*	*
0-25%	514 70.4%	347 70.1%	167 71.1%	302 72.9%	212 67.1%	220 64.1%	294 76.0%
26-50%	119 16.3%	72 14.5%	47 20.0%	72 17.4%	47 14.9%	66 19.2%	53 13.7%
51-75%	39 5.3%	26 5.3%	13 5.5%	17 4.1%	22 7.0%	27 7.9%	12 3.1%
76-100%	34 4.7%	28 5.7%	6 2.6%	12 2.9%	22 7.0%	16 4.7%	18 4.7%
Don't Know	24 3.3%	22 4.4%	2 0.9%	11 2.7%	13 4.1%	14 4.1%	10 2.6%
Summer		*	*	*	*		
0-25%	163 21.9%	121 24.0%	42 17.6%	58 13.8%	105 32.4%	66 19.1%	97 24.4%
26-50%	256 34.5%	185 36.6%	71 29.8%	151 36.0%	105 32.4%	124 35.9%	132 33.2%
51-75%	181 24.4%	105 20.8%	76 31.9%	123 29.4%	58 17.9%	94 27.2%	87 21.9%
76-100%	122 16.4%	76 15.0%	46 19.3%	75 17.9%	47 14.5%	51 14.8%	71 17.8%
Don't Know	21 2.8%	18 3.6%	3 1.3%	12 2.9%	9 2.8%	10 2.9%	11 2.8%

*Chi-square significant at $p < .05$.

Table C.8 continued: Time of Instructional Use for Buildings

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
% of Rooms Used—Evening							
Mean	2.4	2.1†	3.0	2.7†	2.1	2.5	2.4
Standard Deviation	1.1	1.1	1.1	1.1	1.1	1.1	1.2
Sample Size	727	490	237	410	317	336	391
% of Rooms Used—Weekend							
Mean	1.4	1.4	1.4	1.4†	1.5	1.5†	1.3
Standard Deviation	0.8	0.8	0.7	0.7	0.9	0.8	0.8
Sample Size	706	473	233	403	303	329	377
% of Rooms Used—Summer							
Mean	2.4	2.3†	2.5	2.5†	2.1	2.4	2.3
Standard Deviation	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sample Size	722	487	235	407	315	335	387
Number of Summer Weeks Instructional Rooms Used							
Mean	10	10	10	11†	9	10†	10
Standard Deviation	3.9	3.9	3.9	3.5	4.2	3.5	4.2
Sample Size	742	505	237	414	328	347	395

*Chi-square significant at $p < .05$.

†Analysis of variance F probability significant at $p < .05$.

Table C.9: Heating Systems Used

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Central Boiler	506 65.5%	366* 69.2%	140 57.4%	291 67.5%	215 62.9%	255* 70.4%	251 61.1%
Individual Boilers	532 68.8%	397* 75.0%	135 55.3%	287 66.6%	245 71.6%	273* 75.4%	259 63.0%
Electric Resistance Heat	373 48.3%	272 51.4%	101 41.4%	215 49.9%	158 46.2%	180 49.7%	193 47.0%
All-Electric Heat Pump	225 29.1%	161 30.4%	64 26.2%	132 30.6%	93 27.2%	115 31.8%	10 26.8%
Gas-Fired Air Heaters	335 43.3%	221 41.8%	114 46.7%	206* 47.8%	129 37.7%	151 41.7%	184 44.8%
Solar Heating w/Collector Panels	36 4.7%	24 4.5%	12 4.9%	29* 6.7%	7 2.0%	19 5.2%	17 4.1%
Cogeneration	30 3.9%	27* 5.1%	3 1.2%	20 4.6%	10 2.9%	21* 5.8%	9 2.2%
District Heating System	27 3.5%	21 4.0%	6 2.5%	13 3.0%	14 4.1%	13 3.6%	14 3.4%
Other	33 4.3%	20 3.8%	13 5.3%	20 4.6%	13 3.8%	21 5.8%	12 2.9%

*Chi-square significant at $p < .05$.

Table C.10: Percent of Floor Area Served by Heating Systems

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Central Boiler							
Mean	76.2	76.5	75.4	78.5*	73.2	77.0	75.5
Standard Deviation	24.3	23.6	26.3	22.6	26.2	24.5	24.2
Sample Size	479	348	131	273	206	240	239
Individual Boilers							
Mean	41.7	38.9*	50.0	37.2*	47.0	38.5*	45.1
Standard Deviation	35.6	35.2	35.6	35.6	34.934.7	36.2	
Sample Size	509	382	127	277	232	246	263
Electric Resistance Heat							
Mean	14.9	13.0*	21.4	14.4	15.5	9.6*	19.9
Standard Deviation	23.4	19.8	30.2	24.4	21.9	16.9	27.3
Sample Size	359	263	96	207	152	176	183
All-Electric Heat Pump							
Mean	9.3	6.8*	15.4	8.4	10.6	9.0	9.6
Standard Deviation	16.3	1.3	22.3	18.3	14.9	16.0	16.8
Sample Size	217	153	64	130	87	112	105
Gas-Fired Air Heaters							
Mean	15.6	11.2*	24.2	16.0	14.8	11.7*	18.8
Standard Deviation	23.5	18.6	29.3	24.9	21.4	19.2	26.4
Sample Size	321	213	108	195	126	173	148
Solar w/Collector Panels							
Mean	3.5	3.5	3.5	2.7	6.0	3.3	3.8
Standard Deviation	4.2	4.7	3.5	2.7	7.2	5.1	3.1
Sample Size	25	17	8	19	6	14	11
Cogeneration							
Mean	48.2	51.9	6.0	49.0	46.5	58.5	43.4
Standard Deviation	36.9	36.1	5.7	38.5	35.8	39.4	35.9
Sample Size	25	23	2	17	8	17	8
Purchase from District Heating System							
Mean	78.7	79.4	76.3	77.2	80.2	80.5	77.1
Standard Deviation	23.2	25.7	23.1	29.2	16.8	27.4	19.4
Sample Size	27	21	6	13	14	13	14
Other Heating							
Mean	24.3	19.7	30.6	24.4	24.2	17.8	38.0
Standard Deviation	30.1	30.6	19.7	27.7	34.4	19.7	43.1
Sample Size	31	18	13	18	13	21	10

*Analysis of variance F probability significant at $p < .05$.

Table C.11: Air-Conditioning Systems Used

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Air Conditioning	439 56.8%	327* 61.8%	112 45.9%	251 58.2%	188 55.0%	234* 64.6%	205 49.9%
Central Unit (Excluding Chillers)	254 32.9%	179 33.8%	75 30.7%	144 33.4%	110 32.2%	131 36.2%	123 29.9%
Combination Gas Heating & Electric A/C Package	225 29.1%	153 28.9%	72 29.5%	134 31.1%	91 26.6%	110 30.4%	115 28.0%
A/C Only Packaged	399 51.6%	293* 55.4%	106 43.4%	223 51.7%	176 51.5%	203* 56.1%	196 47.7%
Electric Wall Unit	429 55.5%	339* 64.1%	90 36.9%	217* 50.3%	212 62.0%	215* 59.4%	214 52.1%
All Electric Heat Pump	205 26.5%	148 28.0%	57 23.4%	119 27.6%	86 25.1%	103 28.5%	102 24.8%
Evaporative Cooler	95 12.3%	59 11.2%	36 14.8%	72* 16.7%	23 6.7%	54* 14.9%	41 10.0%
Central or Building Chillers	542 70.1%	387* 73.2%	155 63.5%	333* 77.3%	209 61.1%	281* 77.6%	261 63.5%
Other	36 4.7%	23 4.3%	13 5.3%	24 5.6%	12 3.5%	11 3.0%	25 6.1%

*Chi-square significant at $p < .05$.

Table C.12: Percent of Floor Area Served by Cooling Systems

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Air Conditioning							
Mean	36.4	37.9	32.2	29.6*	45.7	31.4*	42.3
Standard Deviation	30.0	29.2	31.6	27.5	30.7	27.3	31.9
Sample Size	423	312	111	244	179	227	196
Central Unit							
Mean	28.7	24.7*	38.7	33.8*	21.9	27.3	30.3
Standard Deviation	30.2	26.9	35.5	33.6	23.4	29.9	30.6
Sample Size	238	169	69	137	101	115	123
Gas/Electric Package							
Mean	18.3	14.7*	25.8	16.9	20.4	13.9*	22.6
Standard Deviation	26.5	23.7	30.3	25.8	27.6	20.9	30.4
Sample Size	217	146	71	129	88	106	111
A/C Only, Packaged Unit							
Mean	13.9	12.3*	18.4	13.0	15.0	12.4	15.5
Standard Deviation	19.5	16.3	26.3	19.6	19.4	17.8	21.2
Sample Size	380	281	99	211	169	185	195
Electric Window Unit							
Mean	9.7	10.4*	7.0	7.1*	12.3	9.9	9.5
Standard Deviation	11.3	11.7	9.2	8.2	13.4	11.1	11.6
Sample Size	409	324	85	206	203	207	202
All Electric Heat Pump							
Mean	9.2	6.7*	15.3	9.0	9.5	8.6	9.8
Standard Deviation	16.8	13.7	21.6	16.4	17.5	16.6	17.1
Sample Size	196	139	57	116	80	98	98
Evaporative (Swamp) Cooler							
Mean	10.7	7.8	1.3	10.9	10.0	9.3	12.3
Standard Deviation	20.3	16.6	24.7	20.3	20.7	18.4	22.4
Sample Size	89	5	34	68	21	49	40
Chillers							
Mean	55.0	51.7*	63.4	59.8*	47.3	55.0	55.0
Standard Deviation	30.6	29.9	30.7	29.6	30.7	30.0	31.4
Sample Size	520	371	149	320	200	276	244
Other Air Conditioning							
Mean	29.8	29.1	31.0	34.5	20.5	13.0	37.2
Standard Deviation	35.5	36.4	35.4	38.9	26.6	18.2	39.0
Sample Size	36	23	13	24	12	11	25

*Analysis of variance F probability significant at $p < .05$.

Table C.13: Changes to Energy System Since 1980

	Total	4-Year	2-Year	Public	Private	ICP*	Non-ICP*
Yes	385 50.7%	270 52.2%	115 47.5%	228 53.4%	157 47.3%	199 55.9%	186 46.2%
No	373 49.1%	246 47.6%	127 52.5%	199 46.4%	174 52.4%	157 44.1%	216 53.6%
Don't Know	1 0.1%	1 0.2%	0 0.0%	0 0.0%	1 0.3%	0 0.0%	1 0.2%

*Chi-square significant at $p < .05$.

Table C.14: Services to Noncampus Buildings

	Total	4-Year*	2-Year*	Public	Private	ICP*	Non-ICP*
Yes	47 6.1%	43 8.2%	4 1.6%	23 5.3%	24 7.1%	30 8.3%	17 4.2%
No	721 93.9%	481 91.8%	240 98.4%	407 94.7%	314 92.9%	330 91.7%	391 95.8%

*Chi-square significant at $p < .05$.

Table C.15: Fuels Used for Heating

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Fuel Oil				*	*		
Most Used	113 26.9%	89 28.6%	24 22.0%	42 18.3%	71 37.4%	62 27.1%	51 26.7%
Second Most Used	78 18.6%	56 18.0%	22 20.2%	43 18.7%	35 18.4%	40 17.5%	38 19.9%
Backup	201 47.9%	145 46.6%	56 51.4%	130 56.5%	71 37.4%	201 48.5%	111 47.1%
Most Used and Backup	1 0.2%	0 0.0%	1 0.9%	0 0.0%	1 0.5%	0 0.0%	1 0.5%
Second Most Used and Backup	23 1.0%	17 1.3%	6 0.0%	13 0.9%	10 1.1%	12 1.7%	11 0.0%
Most Used and Second Most Used	4 1.0%	4 1.3%	0 0.0%	2 0.9%	2 1.1%	4 1.7%	0 0.0%
Electricity		*	*				
Most Used	94 27.4%	46 20.4%	48 41.0%	58 30.2%	36 23.8%	31 21.7%	63 31.5%
Second Most Used	201 58.6%	142 62.8%	59 50.4%	107 55.7%	94 62.3%	90 62.9%	111 55.5%
Backup	43 12.5%	33 14.6%	10 8.5%	25 13.0%	18 11.9%	20 14.0%	23 11.5%
Most Used and Backup	1 0.3%	1 0.4%	0 0.0%	0 0.0%	1 0.7%	0 0.0%	1 0.5%
Second Most Used	3 0.9%	3 1.3%	0 0.0%	1 0.5%	2 1.3%	1 0.7%	2 1.0%
Most Used and Second Most Used	1 0.3%	1 0.4%	0 0.0%	1 0.5%	0 0.0%	1 0.7%	0 0.0%

*Chi-square significant at $p < .05$.

Table C.15 continued: Fuels Used for Heating

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Natural Gas		*	*			*	*
Most Used	480 75.0%	319 72.2%	161 81.3%	273 75.8%	207 73.9%	223 73.6%	257 76.3%
Second Most Used	131 20.5%	100 22.6%	31 15.7%	71 19.7%	60 21.4%	58 19.1%	73 21.7%
Backup	20 3.1%	18 4.1%	2 1.0%	11 3.1%	9 3.2%	16 5.3%	4 1.2%
Most Used and Backup	4 0.6%	2 0.5%	2 1.0%	2 0.6%	2 0.7%	2 0.7%	2 0.6%
Second Most Used and Backup	2 0.3%	0 0.0%	2 1.0%	1 0.3%	1 0.4%	1 0.3%	1 0.3%
Most Used and Second Most Used	3 0.5%	3 0.7%	0 0.0%	2 0.6%	1 0.4%	3 1.0%	0 0.0%
Purchased Steam/ Hot Water						*	*
Most Used	31 86.1%	25 89.3%	6 75.0%	13 76.5%	18 94.7%	12 75.0%	19 95.0%
Second Most Used	4 11.1%	3 10.7%	1 12.5%	3 17.6%	1 5.3%	4 25.0%	0 0.0%
Most Used and Backup	1 2.8%	0 0.0%	1 12.5%	1 5.9%	0 0.0%	0 0.0%	1 5.0%
Coal							
Most Used	47 74.6%	44 75.9%	3 60.0%	37 80.4%	10 58.8%	25 67.8%	22 84.6%
Second Most Used	11 17.5%	10 17.2%	1 20.0%	6 13.0%	5 29.4%	8 21.6%	3 11.5%
Backup	4 6.3%	3 5.2%	1 20.0%	2 4.3%	2 11.8%	3 8.1%	1 3.8%
Most Used and Second Most Used	1 1.6%	1 1.7%	0 0.0%	1 2.2%	0 0.0%	1 2.7%	0 0.0%

*Chi-square significant at $p < .05$.

Table C.15 continued: Fuels Used for Heating

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Solid Waste							
Most Used	1 25.0%	1 25.0%	0 0.0%	1 33.3%	0 0.0%	0 0.0%	1 33.3%
Second Most Used	2 50.0%	2 50.0%	0 0.0%	1 33.3%	1 100.0%	1 100.0%	1 33.3%
Backup	1 25.0%	1 25.0%	0 0.0%	1 33.3%	0 0.0%	0 0.0%	1 3.3%
Solar Energy							
Second Most Used	5 33.3%	3 33.3%	2 33.3%	2 22.2%	3 50.0%	3 37.5%	2 28.6%
Backup	10 66.7%	6 66.7%	4 66.7%	7 77.8%	3 50.0%	5 62.5%	5 71.4%
Propane/Butane							
Most Used	2 5.7%	1 5.9%	1 5.6%	1 4.2%	1 9.1%	2 13.3%	0 0.0%
Second Most Used	18 51.4%	7 41.2%	11 61.1%	13 54.2%	5 45.5%	7 46.7%	11 55.5%
Backup	15 42.9%	9 52.9%	6 33.3%	10 41.7%	5 45.5%	6 40.0%	9 45.0%
Other							
Most Used	10 43.5%	9 42.9%	1 50.0%	6 54.5%	4 33.3%	6 37.5%	4 57.1%
Second Most Used	8 34.8%	7 33.3%	1 50.0%	4 36.4%	4 33.3%	6 37.5%	2 28.6%
Backup	3 13.0%	3 14.3%	0 0.0%	0 0.0%	3 25.0%	2 12.5%	1 14.3%
Second Most Used and Backup	2 8.7%	2 9.5%	0 0.0%	1 9.1%	1 8.3%	2 12.5%	0 0.0%

Table C.16: Fuels Used for Cooling

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Fuel Oil							
Most Used	16 41.2%	14 45.2%	2 28.6%	8 42.1%	8 42.1%	10 41.7%	6 42.9%
Second Most Used	21 55.3%	16 51.6%	5 71.4%	10 52.6%	11 57.9%	13 54.2%	8 57.1%
Most Used and Second Most Used	21 55.3%	16 51.6%	5 71.4%	10 52.6%	11 57.9%	13 54.2%	8 57.1%
Electricity							
Most Used	592 90.7%	404 89.4%	188 93.5%	327 89.3%	265 92.3%	284 89.0%	308 92.2%
Second Most Used	59 9.0%	46 10.2%	13 6.5%	39 10.7%	20 7.0%	34 10.7%	25 7.5%
Most Used and Second Most Used	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.7%	1 0.3%	1 0.3%
Natural Gas							
Most Used	63 45.7%	42 42.4%	21 53.8%	42 47.2%	21 42.9%	30 35.7%	33 61.1%
Second Most Used	74 53.6%	56 56.6%	18 46.2%	46 51.7%	28 57.1%	53 63.1%	21 38.9%
Most Used and Second Most Used	1 0.7%	1 1.0%	0 0.0%	1 1.1%	0 0.0%	1 1.2%	0 0.0%
Purchased Steam							
Most Used	6 46.2%	6 46.2%	0 0.0%	1 20.0%	5 62.5%	4 40.0%	2 66.7%
Second Most Used	7 53.8%	7 53.8%	0 0.0%	4 80.0%	3 37.5%	6 60.0%	1 33.3%
Coal							
Most Used	11 50.0%	11 50.0%	0 0.0%	9 47.4%	2 66.7%	8 57.1%	3 37.5%
Second Most Used	11 50.0%	11 50.0%	0 0.0%	10 52.6%	1 33.3%	6 52.9%	5 62.5%

Table C.16 continued: Fuels Used for Cooling

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Solar Energy							
Second Most Used	2 100.0%	1 100.0%	1 100.0%	2 100.0%	0 0.0%	1 100.0%	1 100.0%
Propane/Butane							
Second Most Used and Backup	1 100.0%	1 100.0%	0 0.0%	0 0.0%	1 100.0%	1 100.0%	0 0.0%
Other							
Most Used	5 41.7%	4 40.0%	1 50.0%	5 50.0%	0 0.0%	3 60.0%	2 28.6%
Second Most Used	7 58.3%	6 60.0%	1 50.0%	5 50.0%	2 100.0%	2 40.0%	5 71.4%

Table C.17: Use of Meters

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Number of Meters for:							
Electricity							
Mean	27	34*	13	31	23	33	22
Standard Deviation	81	74	91	89	69	81	80
Sample Size	747	508	239	419	328	350	397
Natural Gas							
Mean	10	13*	6	11	9	12	9
Standard Deviation	30	21	44	11	9	37	21
Sample Size	746	507	239	417	329	349	397
Other Fuels							
Mean	4	5*	0	7	4	5	3
Standard Deviation	24	29	1	21	27	17	30
Sample Size	742	506	236	413	329	348	394
Number of Buildings Metered:							
Electricity							
Mean	19	24*	7	221	15	24*	14
Standard Deviation	48	46	50	59	29	49	47
Sample Size	746	508	238	416	330	352	394
Natural Gas							
Mean	8	10*	5	9	8	9	8
Standard Deviation	8	10	5	9	8	36	16
Sample Size	745	507	238	414	331	351	394
Other Fuels							
Mean	2	3*	0	2	2	2	2
Standard Deviation	12	14	2	13	19	12	12
Sample Size	741	505	236	411	330	351	390

*Analysis of variance F probability significant at $p < .05$.

Table C.18: Changes in Consumption Since 1980

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Increased Overall	332	238	94	193	139	156	176
	43.5%	45.8%	38.5%	45.1%	41.4%	43.7%	43.2%
Decreased Overall	323	212	111	174	149	160	163
	42.3%	40.8%	45.5%	40.7%	44.3%	44.8%	40.0%
About the Same	97	62	35	58	39	36	61
	12.7%	11.9%	14.3%	13.6%	11.6%	10.1%	15.0%
Don't Know	12	8	4	3	9	5	7
	1.6%	1.5%	1.6%	0.7%	2.7%	1.4%	1.7%

Table C.19: Reasons for Change in Consumption (Other than Conservation)

Change In:	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Educational Services							
Yes	250 72.0%	172 70.8%	78 75.0%	152 74.5%	98 68.5%	116 71.2%	134 72.8%
No	97 28.0%	71 29.2%	26 25.0%	52 25.5%	45 31.5%	47 28.8%	50 27.2%
Direction of Change						*	*
Up	223 94.5%	156 95.7%	67 91.8%	137 95.1%	86 93.5%	104 98.1%	119 91.5%
Down	13 5.5%	7 4.3%	6 8.2%	7 4.9%	6 6.5%	2 1.9%	11 8.5%
Building Operations							
Yes	333 84.3%	232 84.7%	101 83.5%	191 84.5%	142 84.0%	159 84.6%	174 84.1%
No	62 15.7%	42 15.3%	20 16.5%	35 15.5%	27 16.0%	29 15.4%	33 15.9%
Direction of Change							
Up	200 64.7%	141 65.9%	59 62.1%	115 64.6%	85 64.9%	93 64.6%	107 64.8%
Down	109 35.3%	73 34.1%	36 37.9%	63 35.4%	46 35.1%	51 35.4%	58 35.2%
Square Footage		*	*				
Yes	354 83.9%	266 88.1%	88 73.3%	212 84.8%	142 82.6%	174 85.7%	180 82.2%
No	68 16.1%	36 11.9%	32 26.7%	38 15.2%	30 17.4%	29 14.3%	39 17.8%
Direction of Change							
Up	330 97.3%	250 97.7%	80 96.4%	199 98.0%	131 96.3%	162 98.2%	168 96.9%
Down	9 2.7%	6 2.3%	3 3.6%	4 2.0%	5 3.7%	3 1.8%	6 3.4%
Summer Schedule							
Yes	182 58.0%	121 55.5%	61 63.5%	103 57.5%	79 58.5%	91 61.9%	91 54.5%
No	132 42.0%	97 44.5%	35 36.5%	76 42.5%	56 41.5%	56 38.1%	76 45.5%
Direction of Change		*	*	*	*		
Up	125 72.7%	90 77.6%	35 62.5%	64 64.6%	61 83.6%	60 71.4%	65 73.9%
Down	47 27.3%	26 22.4%	21 37.5%	35 35.4%	12 16.4%	24 28.6%	23 26.1%

Chi-square significant at $p < .05$.

Table C.20: Change in Level of Conservation Activity Since 1980

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Increased Overall	533 73.1%	357 71.5%	176 76.5%	297 72.6%	236 73.8%	263 76.5%	270 70.1%
Decreased Overall	79 10.8%	62 12.4%	17 7.4%	45 11.0%	34 10.6%	36 10.5%	43 11.2%
Remained the Same	112 15.4%	76 15.2%	36 15.7%	65 15.9%	47 14.7%	43 12.5%	69 17.9%
Don't Know	2 0.3%	2 0.5%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.3%

Table C.21: Energy Plans and Savings Returns

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Written Energy Plan				*	*		
Yes	251 33.3%	171 33.1%	80 33.6%	168 39.9%	83 24.9%	123 35.2%	128 31.6%
No	496 65.8%	340 65.9%	156 65.5%	249 59.1%	247 74.2%	222 63.6%	274 67.7%
Don't Know	7 0.9%	5 1.0%	2 0.8%	4 1.0%	3 0.9%	4 1.1%	3 0.7%
Currently Use Energy Plan							
Yes	226 93.8%	153 92.7%	73 96.1%	152 93.3%	74 94.9%	112 94.1%	114 93.4%
No	11 4.6%	9 5.5%	2 2.6%	7 4.3%	4 5.1%	6 5.0%	5 4.1%
Don't Know	4 1.7%	3 1.8%	1 1.3%	4 2.5%	0 0.0%	1 0.8%	3 2.5%
% Energy Savings Returned to Institution							
Mean	57.3	57.7	56.3	52.5†	64.0	61.2†	53.6
Standard Deviation	47.6	47.5	47.8	48.0	46.2	46.7	48.1
Sample Size	689	475	214	391	298	334	355
% Energy Savings Returned to Department							
Mean	13.3	14.1	11.7	13.7	12.8	14.1	12.6
Standard Deviation	31.6	32.33	29.9	31.8	31.3	32.3	30.9
Sample Size	685	474	211	386	299	330	355

*Chi-square significant at $p < .05$.

† Analysis of variance F probability significant at $p < .05$.

Table C.22: Audits

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Audit Since 1980				*	*	*	*
Yes	565 73.5%	381 72.6%	184 75.4%	338 78.6%	227 67.0%	297 82.3%	268 65.7%
No	195 25.4%	140 26.7%	5 22.5%	88 20.5%	107 31.6%	62 17.2%	133 32.6%
Don't Know	9 1.2%	4 0.8%	5 2.0%	4 0.9%	5 1.5%	2 0.6%	7 1.7%
Audit Delivery Media							
Computer Printout							
Yes	78 10.1%	56 10.6%	22 9.0%	41 9.5%	37 10.8%	35 9.7%	43 10.5%
No	682 88.2%	465 87.9%	217 88.9%	382 88.6%	300 87.7%	324 89.5%	358 87.1%
Don't Know	13 1.7%	8 1.5%	5 2.0%	8 1.9%	5 1.5%	3 0.8%	10 2.4%
Detailed Written Report				*	*	*	*
Yes	455 58.9%	312 59.0%	143 58.6%	277 64.3%	178 52.0%	257 71.0%	198 48.2%
No	305 39.5%	209 39.5%	96 39.3%	146 33.9%	159 46.5%	102 28.2%	203 49.4%
Don't Know	13 1.7%	8 1.5%	5 2.0%	8 1.9%	5 1.5%	3 0.8%	10 2.4%
Brief or Oral Report							
Yes	126 16.3%	83 15.7%	43 17.6%	65 15.1%	61 17.8%	54 14.9%	72 17.5%
No	634 82.0%	438 82.8%	196 80.3%	358 83.1%	276 80.7%	305 84.3%	329 80.0%
Don't Know	13 1.7%	8 1.5%	5 2.0%	8 1.9%	5 1.5%	3 0.8%	10 2.4%

*Chi-square significant at $p < .05$.

Table C.22 continued: Audits

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Most Recent Audit Performed by:							
Utility							
Yes	60 7.8%	37 7.0%	23 9.4%	29 6.7%	31 9.1%	19 5.2%	41 10.0%
No	711 92.0%	490 92.6%	221 90.6%	402 93.3%	309 90.4%	342 94.5%	369 89.8%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.2%
Private Contractor				*	*	*	*
Yes	409 52.9%	277 52.4%	132 54.1%	243 56.4%	166 48.5%	224 61.9%	185 45.0%
No	362 46.8%	250 47.3%	112 45.9%	188 43.6%	174 50.9%	137 37.8%	225 54.7%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.2%
College Employee							
Yes	90 11.6%	66 12.5%	24 9.8%	58 13.5%	32 9.4%	52 14.4%	38 9.2%
No	681 88.1%	461 87.1%	220 90.2%	373 86.5%	308 90.1%	309 85.4%	372 90.5%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.2%
State Personnel				*	*		
Yes	34 4.4%	19 3.6%	15 6.1%	32 7.4%	2 0.6%	13 3.6%	21 5.1%
No	737 95.3%	508 96.0%	229 93.9%	399 92.6%	338 98.8%	348 96.1%	389 94.6%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.2%
Local Gov't Personnel							
Yes	1 0.1%	0 0.0%	1 0.4%	0 0.0%	1 0.3%	0 0.0%	1 0.2%
No	770 99.6%	527 99.6%	243 99.6%	431 100.0%	339 99.1%	361 99.7%	409 99.5%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.3%

*Chi-square significant at $p < .05$.

Table C.22 continued: Audits

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Most Recent Audit Performed by:							
Others							
Yes	27 3.5%	14 2.6%	13 5.3%	19 4.4%	8 2.3%	13 3.6%	14 3.4%
No	744 96.2%	513 97.0%	231 94.7%	412 95.6%	332 97.1%	348 96.1%	396 96.4%
Don't Know	2 0.3%	2 0.4%	0 0.0%	0 0.0%	2 0.6%	1 0.3%	1 0.3%
Number of Buildings Audited							
Mean	15.00	17.60†	9.61	15.80	13.80	18.24†	11.41
Standard Deviation	18.3	20.4	1.3	19.4	16.6	14.9	20.5
Sample Size	565	381	184	338	227	297	268
Year Most Recent Audit Performed							
Mean	1984	1984	1984	1984	1984	1984	1984
Standard Deviation	2.0	2.0	2.0	2.0	1.9	2.0	1.9
Sample Size	554	372	180	331	223	292	262

†Analysis of variance F probability significant at $p < .05$.

Table C.23: Who Performs Mechanical Work

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Mechanical Work by Staff							
Yes	715 96.1%	496 97.1%	219 94.0%	403 96.9%	312 95.1%	341 97.7%	374 94.7%
No	29 3.9%	15 2.9%	14 6.0%	13 3.1%	16 4.9%	8 2.%	21 5.3%
Mechanical Work Contracted Out							
Yes	514 80.3%	360 81.1%	154 78.6%	269 78.7%	245 82.2%	252 81.3%	262 79.4%
No	126 19.7%	84 18.9%	42 21.4%	73 21.3%	53 17.8%	58 18.7%	68 20.6%

Table C.24: Occupant Problems Associated with Energy Conservation Measures: First Response

	Total	4-Year*	2-Year	Public	Private	ICP*	Non-ICP
No Response	327 42.3%	207 39.1%	120 49.2%	180 41.8%	147 43.0%	142 39.2%	185 45.0%
Comfort	200 25.9%	138 26.1%	62 25.4%	119 27.6%	81 23.7%	110 30.4%	90 21.9%
Constraints	22 2.8%	19 3.6%	3 1.2%	13 3.0%	9 2.6%	12 3.3%	10 2.4%
Occupant Behavior	188 24.3%	133 25.1%	55 22.5%	104 24.1%	84 24.6%	78 21.5%	110 26.8%
Other	36 4.7%	32 6.0%	4 1.6%	15 3.5%	21 6.1%	20 5.5%	16 3.9%

*Chi-square significant at $p < .05$.

Table C.25: Occupant Problems Associated with Energy Conservation Measures: Second Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	413 92.6%	299 92.9%	114 91.9%	234 93.2%	179 91.8%	205 93.2%	208 92.0%
Comfort	4 0.9%	0 1.2%	4 0.0%	2 0.8%	2 1.0%	1 0.5%	3 1.3%
Constraints	4 0.9%	4 1.2%	0 0.0%	2 0.8%	2 1.0%	0 0.0%	4 1.8%
Occupant Behavior	22 4.9%	12 3.7%	10 8.1%	13 5.2%	9 4.6%	12 5.5%	10 4.4%
Other	3 0.7%	3 0.9%	0 0.0%	0 0.0%	3 1.5%	2 0.9%	1 0.4%

Table C.26: Types of Financing

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
General Operating and Capital Funds							
Used	628 81.2%	434 82.0%	194 79.5%	358 83.1%	270 78.9%	301 83.1%	327 79.6%
Planned	373 48.3%	267 50.5%	106 43.4%	229* 53.1%	144 42.1%	193* 53.3%	180 43.8%
Commercial Loans							
Used	34 4.4%	28 5.3%	6 2.5%	6* 1.4%	28 8.2%	11 3.0%	23 5.6%
Planned	25 3.2%	20 3.8%	5 2.0%	11 2.6%	14 4.1%	12 3.3%	13 33.2%
Lease/Lease Purchase							
Used	61 7.9%	46 8.7%	15 6.1%	26* 6.0%	35 10.2%	28 7.7%	33 8.0%
Planned	45 5.8%	29 5.5%	16 6.6%	26 6.0%	19 5.6%	20 5.5%	25 6.1%
Savings-Based							
Used	100 12.9%	74 14.0%	26 10.7%	48 11.1%	52 15.2%	53 14.6%	47 11.4%
Planned	99 12.8%	73 13.8%	26 10.7%	58 13.5%	41 12.0%	58* 16.0%	41 10.0%
Tax-Exempt Bonds							
Used	47 6.1%	40* 7.6%	7 2.9%	27 6.3%	20 5.8%	31* 8.6%	16 3.9%
Planned	46 6.0%	34 6.4%	12 4.9%	32 7.4%	14 4.1%	28 7.7%	18 4.4%
Grants							
Used	356 46.1%	250 47.3%	106 43.4%	213* 49.4%	143 41.8%	257* 71.0%	99 24.1%
Planned	247 32.0%	177 33.5%	70 28.7%	143 33.2%	104 30.4%	151* 41.7%	96 23.4%

*Chi-square significant at $p < .05$.

Table C.27: Awareness of ICP

	Total	4-Year	2-Year	Public*	Private*	ICP*	Non-ICP*
Yes	519 68.9%	362 70.2%	157 66.2%	320 76.0%	199 59.9%	297 83.9%	222 55.6%
No	220 29.2%	144 27.9%	76 32.1%	93 22.1%	127 38.3%	52 14.7%	168 42.1%
Don't Know	14 1.9%	10 1.9%	4 1.7%	8 1.9%	6 1.8%	5 1.4%	9 2.3%

*Chi-square significant at $p < .05$.

Table C.28: ICP Grant Applications

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Applied for ICP Grant						*	*
Yes	378 73.1%	272 75.3%	106 67.9%	234 73.4%	144 72.7%	271 91.9%	107 48.2%
No	120 23.2%	77 221.3%	43 27.6%	73 22.9%	47 23.7%	17 5.8%	103 46.4%
Don't Know	19 3.7%	12 3.3%	7 4.5%	12 3.8%	7 3.5%	7 2.4%	12 5.4%
Why No Application Made for ICP Grant							
Lack of Funding	13 15.9%	8 14.8%	5 17.9%	10 19.2%	3 10.0%	1 7.7%	12 17.4%
Ineligible	10 12.2%	7 13.0%	3 10.7%	5 9.6%	5 16.7%	3 13.1%	7 10.1%
No Need for ICP or Other Assistance	9 11.0%	4 7.4%	5 17.9%	8 15.4%	1 3.3%	0 0.0%	9 13.0%
Lack of Information	7 8.5%	5 9.3%	2 7.1%	3 5.8%	4 13.3%	1 7.7%	6 8.7%
Complexity of Process	18 22.0%	13 24.1%	5 17.9%	10 19.2%	8 26.7%	2 15.4%	16 23.2%
Program's Reputation	3 3.7%	1 1.9%	2 7.1%	3 5.8%	0 0.0%	1 7.7%	2 2.9%
Other	20 24.4%	14 25.9%	6 21.4%	11 21.2%	9 20.0%	3 23.1%	17 24.6%
Don't Know	2 2.4%	2 3.7%	0 0.0%	2 3.8%	0 0.0%	2 15.4%	0 0.0%
Why No Application Made for ECM Grant							
Government Rules and Regulations	19 36.5%	14 35.0%	5 41.7%	13 35.1%	6 40.0%	8 26.7%	11 50.0%
Federal Support Not Needed	3 5.8%	3 7.5%	0 0.0%	3 8.1%	0 0.0%	2 6.7%	1 4.5%
Other	29 55.8%	23 57.5%	6 50.0%	20 54.1%	9 60.0%	19 63.3%	10 45.5%
Don't Know	1 1.9%	0 0.0%	1 8.3%	1 2.7%	0 0.0%	1 3.3%	0 0.0%

*Chi-square significant at $p < .05$.

Table C.29: ICP Grants Denied/Received

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Number of TA Grants Applied For							
Mean	9.20	11.11*	4.32	7.36*	12.22	9.61	8.21
Standard Deviation	23.2	25.7	14.0	19.3	28.2	22.69	23.42
Sample Size	378	272	106	234	144	271	107
Number of TA Grants Received							
Mean	5.54	6.45	3.44	5.87	4.94	5.60	5.34
Standard Deviation	14.8	16.0	11.1	5.9	4.9	13.0	18.5
Sample Size	288	201	87	186	102	206	82
Number of ECM Grants Applied For							
Mean	9.38	10.51	6.48	8.94	10.10	9.92	8.02
Standard Deviation	22.3	23.7	17.8	21.4	23.7	22.0	23.0
Sample Size	378	272	106	234	144	271	107
Number of ECM Grants Received							
Mean	5.63	5.82	5.11	4.93	6.75	5.16	7.10
Standard Deviation	15.2	15.0	15.6	12.8	18.3	12.1	22.2
Sample Size	325	235	90	201	124	247	78
Reason for Denial of ECM Grant							
Ineligible	6 4.4%	5 5.2%	1 22.6%	3 3.6%	3 5.8%	5 4.9%	1 3.1%
Grant Ranking	106 78.5%	80 82.5%	26 68.4%	64 77.1%	42 80.8%	84 81.6%	22 68.8%
Other	19 14.1%	11 11.3%	8 21.1%	13 15.7%	5 11.5%	12 11.7%	7 21.9%
Don't Know	4 3.0%	1 1.0%	3 7.9%	3 3.6%	1 1.9%	2 1.9%	2 6.3%

*Analysis of variance F probability significant at $p < .05$.

Table C.30: Sources of Financing

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Utility Companies				*	*		
Yes	230 38.5%	155 37.6%	75 40.5%	118 36.3%	112 41.2%	100 38.6%	130 38.5%
No	333 55.8%	232 56.3%	101 54.6%	195 60.0%	138 50.7%	146 56.4%	187 55.3%
Don't Know	34 5.7%	25 6.1%	9 4.9%	12 3.7%	22 8.1%	13 5.0%	21 6.2%
Federal Agencies				*	*	*	*
Yes	257 43.7%	190 46.5%	67 37.4%	181 54.7%	76 29.6%	201 70.5%	56 18.5%
No	285 48.5%	185 45.2%	100 55.9%	136 41.1%	149 58.0%	62 21.8%	223 73.8%
Don't Know	46 7.8%	34 8.3%	12 6.7%	14 4.2%	32 12.5%	22 7.7%	24 7.9%
State Agencies				*	*	*	*
Yes	339 54.9%	232 54.5%	107 55.7%	250 68.7%	89 35.0%	216 74.0%	123 37.7%
No	241 39.0%	169 39.7%	72 37.5%	100 27.5%	141 55.5%	60 20.5%	181 55.5%
Don't Know	38 6.1%	25 5.9%	13 6.8%	14 3.8%	24 9.4%	16 5.5%	22 6.7%
Local Agencies							
Yes	20 4.3%	14 4.3%	6 4.3%	7 2.8%	13 5.9%	9 4.6%	11 4.0%
No	412 87.8%	288 87.5%	124 88.6%	229 91.6%	183 83.6%	170 87.6%	242 88.0%
Don't Know	37 7.9%	27 8.2%	10 7.1%	14 5.6%	23 10.5%	15 7.7%	22 8.0%

*Chi-square significant at $p < .05$.

Table C.30 continued: Sources of Financing

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Associations							
Yes	44 9.2%	34 10.1%	10 7.0%	22 8.6%	22 10.0%	22 10.9%	22 7.9%
No	391 81.8%	270 80.6%	121 84.6%	218 84.8%	173 78.3%	161 80.1%	230 83.0%
Don't Know	43 9.0%	31 9.3%	12 8.4%	17 6.6%	26 11.8%	18 9.0%	25 9.0%
Parent Organization				*	*		
Yes	85 18.6%	59 18.9%	26 17.9%	75 29.1%	10 5.0%	39 20.9%	46 17.0%
No	339 74.2%	231 74.0%	108 74.5%	170 65.9%	169 84.9%	135 72.2%	204 75.6%
Don't Know	33 7.2%	22 7.1%	11 7.6%	13 5.0%	20 10.1%	13 7.0%	20 7.4%
Other				*	*		
Yes	14 4.9%	12 5.9%	2 2.4%	4 22.9%	10 6.8%	5 4.7%	9 5.0%
No	236 82.5%	164 80.8%	72 86.7%	122 88.4%	114 77.0%	89 84.0%	147 81.7%
Don't Know	36 12.6%	27 13.3%	9 10.8%	12 8.7%	24 16.2%	12 11.3%	24 13.3%

*Chi-square significant at $p < .05$.

Table C.31: Helpfulness of Parent Organization

	Total	4-Year*	2-Year*	Public*	Private*	ICP	Non-ICP
Helpful	161 31.6%	103 29.3%	58 36.7%	147 45.0%	14 7.7%	78 34.1%	83 29.5%
Not Helpful	302 59.2%	224 63.6%	78 49.4%	155 47.4%	147 80.3%	135 59.0%	167 59.4%
Don't Know	47 9.2%	25 7.1%	22 13.9%	25 7.6%	22 12.0%	16 7.0%	31 11.0%

*Chi-square significant at $p < .05$.

Table C.32: Financial Problems Associated with Energy Conservation Measures: First Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	260 33.6%	169 31.9%	91 37.3%	138 32.0%	122 35.7%	115 31.8%	145 35.3%
Investment Criteria	107 13.8%	79 14.9%	28 11.5%	59 13.7%	48 14.0%	49 13.5%	58 14.1%
Funding Availability	390 50.5%	269 50.9%	121 49.6%	225 52.2%	165 48.2%	190 52.5%	200 48.7%
Other	16 2.1%	12 2.3%	4 1.6%	9 2.1%	7 2.0%	8 2.2%	8 1.9%

Table C.33 Financial Problems Associated with Energy Conservation Measures: Second Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	479 93.4%	338 93.9%	141 92.2%	271 92.5%	208 94.5%	230 93.1%	249 93.6%
Investment Criteria	6 1.2%	2 0.6%	4 2.6%	5 1.7%	1 0.5%	4 1.6%	2 0.8%
Funding Availability	28 5.5%	20 5.6%	8 5.2%	17 5.8%	11 5.0%	13 5.3%	15 5.6%
Other	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%

Table C.34: Motivations in the Decisionmaking Process†

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
High Energy Costs							
Mean	1.32	1.33	1.30	1.34	1.29	1.32	1.32
Standard Deviation	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Sample Size	766	525	241	427	339	358	408
Not Applicable = 1 (0.1%)							
Rising Energy Prices							
Mean	1.71	1.72	1.70	1.73	1.69	1.68	1.74
Standard Deviation	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Sample Size	761	521	240	424	337	356	405
Not Applicable = 2 (0.3%)							
Utility Rate Structures							
Mean	1.91	1.97*	1.76	1.85	1.97	1.91	1.91
Standard Deviation	0.9	0.8	0.9	0.9	0.9	0.9	0.9
Sample Size	750	514	236	417	333	350	400
Not Applicable = 8 (1.0%)							
Cost Containment							
Mean	1.97	1.97	1.97	1.97	1.97	1.95	1.98
Standard Deviation	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Sample Size	719	491	228	408	311	341	378
Not Applicable = 30 (3.9%)							
Tax Incentives							
Mean	3.44	3.47	3.38	3.51	3.4	3.53	3.36
Standard Deviation	0.9	0.9	0.9	0.8	1.0	0.9	0.9
Sample Size	400	268	132	222	178	190	210
Not Applicable = 339 (43.9%)							
Success Elsewhere							
Mean	2.59	2.60	2.56	2.58	2.60	2.65	2.53
Standard Deviation	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Sample Size	749	517	232	417	332	352	397
Not Applicable = 14 (1.8%)							
Information on Energy Costs							
Mean	2.36	2.39	2.30	2.37	2.36	2.38	2.35
Standard Deviation	0.9	0.8	0.9	0.9	0.8	0.8	0.9
Sample Size	747	512	235	418	329	351	396
Not Applicable = 23 (3.0%)							
Outside Funds							
Mean	2.24	2.25	2.21	2.37	2.36	2.08*	2.38
Standard Deviation	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sample Size	707	485	222	389	318	345	362
Not Applicable = 47 (6.1%)							

† Motivation measured on a four-point scale: 1 = highly important, 4 = not at all important.

*Analysis of variance F probability significant at $p < .05$.

Table C.34 continued: Motivations in the Decisionmaking Process†

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Marketing Influences							
Mean	2.67	2.71	2.58	2.69	2.64	2.77*	2.58
Standard Deviation	0.8	0.8	0.8	0.8	0.9	0.8	0.8
Sample Size	736	508	228	48	328	345	391
Not Applicable = 23 (3.0%)							
Utility Company Programs							
Mean	2.77	2.87*	2.54	2.79	2.75	2.91*	2.65
Standard Deviation	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sample Size	719	496	223	399	320	341	378
Not Applicable = 38 (4.9%)							
Energy Cost Savings							
Mean	2.32	2.35	2.25	2.22*	2.43	2.32	2.31
Standard Deviation	1.1	1.1	1.2	1.1	1.0	1.1	1.1
Sample Size	671	467	204	362	309	320	351
Not Applicable = 85 (11.0%)							
Administration Support							
Mean	2.00	2.01	1.98	1.98	2.03	1.95	2.04
Standard Deviation	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Sample Size	756	519	237	420	336	354	402
Not Applicable = 7 (0.9%)							
Other							
Mean	1.81	1.74	2.00	1.88	1.74	1.83	1.80
Standard Deviation	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Sample Size	43	31	12	24	19	18	25
Not Applicable = 65 (8.4%)							

†Motivation measured on a four point scale: 1 = highly important, 4 = not at all important.

*Analysis of variance F probability significant at $p < .05$.

Table C.35: Persons Responsible for Setting General Objectives

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Governing Body	237 30.7%	153 28.9%	84 34.4%	145* 33.6%	92 26.9%	106 29.3%	131 31.9%
College/Univ. Administrator	304 39.3%	203 38.4%	101 41.4%	182 42.2%	122 35.7%	144 39.8%	160 38.9%
Other Administrator	140 18.1%	98 18.5%	42 17.2%	90* 20.9%	50 14.6%	62 17.1%	78 19.0%
Chief Financial Officer	156 20.1%	111 21.0%	45 18.4%	77 17.9%	79 23.1%	80 22.1%	76 18.5%
Director of Physical Plant	393 50.8%	279 52.7%	114 46.7%	219 50.8%	174 50.9%	183 50.6%	210 51.1%
College/Univ. Engineer	74 9.6%	63* 11.9%	11 4.5%	42 9.7%	32 9.4%	39 10.8%	35 8.5%
Energy Committee	85 11.0%	69* 13.0%	16 6.6%	59* 13.7%	26 7.6%	40 11.0%	45 10.9%
Private Consultant	51 6.6%	30 5.7%	21 8.6%	28 6.5%	23 6.7%	24 6.6%	27 6.6%
Academic Department	12 1.6%	8 1.5%	4 1.6%	6 1.4%	6 1.8%	7 1.9%	5 1.2%
Other	34 4.4%	25 4.7%	9 3.7%	18 4.2%	16 4.7%	14 3.9%	20 4.9%
No Designated Individual	9 1.2%	8 1.5%	1 0.4%	5 1.2%	4 1.2%	5 1.4%	4 1.0%

*Chi-square significant at $p < .05$.

Table C.36: Persons Responsible for Selecting Specific Actions

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Governing Body	41 5.3%	22 4.2%	19 7.8%	23 5.3%	18 5.3%	18 5.0%	23 5.6%
College/Univ. Administrator	135 17.5%	71* 13.4%	64 26.2%	81 18.8%	54 15.8%	57 15.7%	78 19.0%
Other Administrator	167 21.6%	108 20.4%	59 24.2%	105* 24.4%	62 18.1%	78 21.5%	89 21.7%
Chief Financial Officer	142 18.4%	95 16.2%	47 21.1%	70 17.1%	72 19.5%	62 54.1%	80 41.8%
Director of Physical Plant	485 62.7%	341 64.5%	144 59.0%	271 62.9%	214 62.6%	236 65.2%	249 60.6%
College/Univ. Engineer	142 18.4%	123* 23.3%	19 7.8%	89 20.6%	53 15.5%	81* 22.4%	61 14.8%
Energy Committee	59 7.6%	44 8.3%	15 6.1%	45* 10.4%	14 4.1%	27 7.5%	32 7.8%
Private Consultant	151 19.5%	99 18.7%	52 21.3%	83 19.3%	68 19.9%	86* 23.8%	65 15.8%
Academic Department	4 0.5%	3 0.6%	1 0.4%	2 0.5%	2 0.6%	3 0.8%	1 0.2%
Other	43 5.6%	32 6.0%	11 4.5%	27 6.3%	16 4.7%	22 6.1%	21 5.1%
No Designated Individual	3 0.4%	3 0.6%	0 0%	1 0.2%	2 0.6%	1 0.3%	2 0.5%

*Chi-square significant at $p < .05$.

Table C.37: Persons Responsible for Financing Capital Projects

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Governing Body	335 43.3%	230 43.5%	105 43.0%	180 41.8%	155 45.3%	163 45.0%	172 41.8%
College/Univ. Administrator	171 22.1%	121 22.9%	50 20.5%	92 21.3%	79 23.1%	91 25.1%	80 19.5%
Other Administrator	140 18.1%	87 16.4%	53 21.7%	90* 20.9%	50 14.6%	66 17.1%	74 19.2%
Chief Financial Officer	388 50.2%	286* 54.1%	102 41.8%	199* 46.2%	189 55.3%	199* 54.1%	192 46.7%
Director of Physical Plant	120 15.5%	91 17.2%	29 11.9%	79 18.3%	41 12.0%	61 16.9%	59 14.4%
College/Univ. Engineer	19 2.5%	16 3.0%	3 1.2%	14 3.2%	5 1.5%	12 3.3%	7 1.7%
Energy Committee	8 1.0%	6 1.1%	2 0.8%	5 1.2%	3 0.9%	3 0.8%	5 1.2%
Private Consultant	12 1.6%	7 1.3%	5 2.0%	8 1.9%	4 1.2%	7 1.9%	5 1.2%
Academic Department	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Other	27 3.5%	19 3.6%	8 3.3%	20 4.6%	7 2.0%	18 5.0%	9 2.2%
No Designated Individual	3 0.4%	2 0.4%	1 0.4%	2 0.5%	1 0.3%	1 0.3%	2 0.5%

*Chi-square significant at $p < .05$.

Table C.38: Persons Responsible for Daily Management

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Governing Body	7 0.9%	6 1.1%	1 0.4%	1 0.2%	6 1.8%	2 0.6%	5 1.2%
College/Univ. Administrator	27 3.5%	12* 2.3%	15 6.1%	11 2.6%	16 4.7%	5* 1.4%	22 5.4%
Other Administrator	72 9.3%	43 8.1%	29 11.9%	38 8.8%	34 9.9%	23* 6.4%	49 11.9%
Chief Financial Officer	53 6.9%	33 6.2%	20 8.2%	26 6.0%	27 7.9%	20 5.5%	33 8.0%
Director of Physical Plant	524 67.8%	334* 63.1%	190 77.9%	293 68.0%	231 67.5%	242 66.9%	282 68.6%
College/Univ. Engineer	187 24.2%	160* 30.2%	27 11.1%	107 24.8%	80 23.4%	96 26.5%	91 22.1%
Energy Committee	13 1.7%	10 1.9%	3 1.2%	10 2.3%	3 0.9%	5 1.4%	8 1.9%
Private Consultant	5 0.6%	4 0.8%	1 0.4%	1 0.2%	4 1.2%	4 1.1%	1 0.2%
Academic Department	13 1.7%	6 1.1%	7 2.9%	10 2.3%	3 0.9%	6 1.7%	7 1.7%
Other	59 7.6%	44 8.3%	15 6.1%	36 8.4%	23 6.7%	35 9.7%	24 5.8%
No Designated Individual	9 1.2%	6 1.1%	3 1.2%	5 1.2%	4 1.2%	4 1.1%	5 1.2%

*Chi-square significant at $p < .05$.

Table C.39: Information Sources for Setting General Objectives

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Others' Experience	370 47.9%	246 46.5%	124 50.8%	220 51.0%	150 43.9%	175 48.3%	195 47.4%
Financial Status	222 28.7%	155 29.3%	67 27.5%	120 27.8%	102 29.8%	114 31.5%	108 26.3%
Manufacturers	120 15.5%	77 14.6%	43 17.6%	69 16.0%	51 14.9%	55 15.2%	65 15.8%
Energy Service Companies	85 11.0%	54 10.2%	31 12.7%	38* 8.8%	47 13.7%	38 10.5%	47 11.4%
Attending Conferences	324 41.9%	214 40.5%	110 45.1%	211* 49.0%	113 33.0%	166* 45.9%	158 38.4%
Publications	288 37.3%	205 38.8%	83 34.0%	153 35.5%	135 39.5%	138 38.1%	150 36.5%
Professional Societies	333 43.1%	237 44.8%	96 39.3%	183 42.5	150 43.9%	163 45.0%	170 41.4%
Other Professionals	276 35.7%	187 35.3%	89 36.5%	160 37.1%	116 33.9%	134 37.0%	142 34.5%
State/Federal Personnel	187 24.2%	122 23.1%	65 26.6%	135* 31.3%	52 15.2%	94 26.0%	93 22.6%
Utilities	207 26.8%	142 26.8%	65 26.6%	113 26.2%	94 27.5%	87 24.0%	120 29.2%
Consultants/Auditors	178 23.0%	114 21.6%	64 26.2%	108 25.1%	70 20.5%	90 24.9%	88 21.4%
Other	26 3.4%	21 4.0%	5 2.0%	14 3.2%	12 3.5%	11 3.0%	15 3.6%

*Chi-square significant at $p < .05$.

Table C.40: Information Sources for Selecting Specific Actions

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Others' Experience	322 41.7%	230 43.5%	92 37.7%	198* 45.9%	124 36.3%	157 43.4%	165 40.1%
Financial Status	259 33.5%	190* 35.9%	69 28.3%	133 30.9%	126 36.8%	118 32.6%	141 34.3%
Manufacturers	369 47.7%	261 49.3%	108 44.3%	217 50.3%	152 44.4%	183 50.6%	186 45.3%
Energy Service Companies	113 14.6%	75 14.2%	38 15.6%	62 14.4%	51 14.9%	55 15.2%	58 14.1%
Attending Conferences	307 39.7%	215 40.6%	92 37.7%	200* 46.4%	107 31.3%	151 41.7%	156 38.0%
Publications	343 44.4%	237 44.8%	106 43.4%	207* 48.0%	136 39.8%	159 43.9%	184 44.8%
Professional Societies	298 38.6%	215 40.6%	83 34.0%	173 40.1%	125 36.5%	163* 45.0%	135 32.8%
Other Professionals	392 50.7%	283* 53.5%	109 44.7%	226 52.4%	166 48.5%	190 52.5%	202 49.1%
State/Federal Personnel	150 19.4%	100 18.9%	50 20.5%	110* 25.5%	40 11.7%	79 21.8%	71 17.3%
Utilities	233 30.1%	155 29.3%	78 32.0%	139 32.3%	94 27.5%	107 29.6%	126 30.7%
Consultants/Auditors	299 38.7%	204 38.6%	95 38.9%	181* 42.0%	118 34.5%	170* 47.0%	129 31.4%
Other	28 3.6%	19 3.6%	9 3.7%	15 3.5%	13 3.8%	12 3.3%	16 3.9%

*Chi-square significant at $p < .05$.

Table C.41: Information Sources for Financing Capital Projects

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Others' Experience	85 11.0%	62 11.7%	23 9.4%	45 10.4%	40 11.7%	47 13.0%	38 9.2%
Financial Status	451 58.3%	324* 61.2%	127 52.0%	250 58.0%	201 58.8%	230* 63.5%	221 53.8%
Manufacturers	38 4.9%	22 4.2%	16 6.6%	23 5.3%	15 4.4%	19 5.2%	19 4.6%
Energy Service Companies	27 3.5%	20 3.8%	7 2.9%	13 3.0%	14 4.1%	12 3.3%	15 3.6%
Attending Conferences	68 8.8%	43 8.1%	25 10.2%	42 9.7%	26 7.6%	36 9.9%	32 7.8%
Publications	45 5.8%	32 6.0%	13 5.3%	21 4.9%	24 7.0%	23 6.4%	22 5.4%
Professional Societies	72 9.3%	44 8.3%	28 11.5%	48 11.1%	24 7.0%	40 11.0%	32 7.8%
Other Professionals	62 8.0%	36 6.8%	26 10.7%	39 9.0%	23 6.7%	26 7.2%	36 8.8%
State/Federal Personnel	221 28.6%	152 28.7%	69 28.3%	158* 36.7%	63 18.4%	139* 38.4%	82 20.0%
Utilities	71 9.2%	38* 7.2%	33 13.5%	50* 11.6%	21 6.1%	32 8.8%	39 9.5%
Consultants/Auditors	82 10.6%	52 9.8%	30 12.3%	49 11.4%	33 9.6%	45 12.4%	37 9.0%
Other	15 1.9%	11 2.1%	4 1.6%	10 2.3%	5 1.5%	5 1.4%	10 2.4%

*Chi-square significant at $p < .05$.

Table C.42: Information Sources for Daily Management

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Others' Experience	176 22.8%	129 24.4%	47 19.3%	100 23.2%	76 22.2%	94 26.0%	82 20.0%
Financial Status	103 13.3%	73 13.8%	30 12.3%	55 12.8%	48 14.0%	43 11.9%	60 14.6%
Manufacturers	130 16.8%	94 17.8%	36 14.8%	69 16.0%	61 17.8%	62 17.1%	68 16.5%
Energy Service Companies	55 7.1%	38 7.2%	17 7.0%	25 5.8%	30 8.8%	25 6.9%	30 7.3%
Attending Conferences	225 29.1%	158 29.9%	67 27.5%	135 31.3%	90 26.3%	108 29.8%	117 28.5%
Publications	231 29.9%	167 31.6%	64 26.2%	129 29.9%	102 29.8%	106 29.3%	125 30.4%
Professional Societies	208 26.9%	158* 29.9%	50 20.5%	117 27.1%	91 26.6%	110* 30.4%	98 23.8%
Other Professionals	208 26.9%	145 27.4%	63 25.8%	118 27.4%	90 26.3%	101 27.9%	107 26.0%
State/Federal Personnel	52 6.7%	31 5.9%	21 8.6%	36 8.4%	16 4.7%	20 5.5%	32 7.8%
Utilities	129 16.7%	86 16.3%	43 17.6%	71 16.5%	58 17.0%	57 15.7%	72 17.5%
Consultants/Auditors	104 13.5%	75 14.2%	29 11.9%	60 13.9%	44 12.9%	54 14.9%	50 12.2%
Other	33 4.3%	24 4.5%	9 3.7%	18 4.2%	15 4.4%	18 5.0%	15 3.6%

*Chi-square significant at $p < .05$.

Table C.43: Number of Colleges and Universities Mentioned as Models

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	507 65.6%	337 63.7%	170 69.7%	270 62.6%	237 69.3%	239 66.0%	268 65.2%
One Institution	118 15.3%	83 15.7%	35 14.3%	70 16.2%	48 14.0%	55 15.2%	63 15.3%
Two Institutions	67 8.7%	49 9.3%	18 7.4%	38 8.8%	29 8.5%	30 8.3%	37 9.0%
Three or More Institutions	59 7.6%	46 8.7%	13 5.3%	37 8.6%	22 6.4%	28 7.7%	31 7.5%
Many	11 1.4%	8 1.5%	3 1.2%	8 1.9%	3 0.9%	5 1.4%	6 1.5%
Other	11 1.4%	6 1.1%	5 2.0%	8 1.9%	3 0.9%	5 1.4%	6 1.5%

Table C.44: Energy Use Reporting/Feedback

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Energy Report Prepared				*	*	*	*
Yes	562 73.1%	395 75.1%	167 68.7%	332 77.2%	230 67.8%	281 78.3%	281 68.5%
No	201 26.1%	128 24.3%	73 30.0%	96 22.3%	105 31.0%	76 21.2%	125 30.5%
Don't Know	6 0.8%	3 0.6%	3 1.2%	2 0.5%	4 1.2%	2 0.6%	4 1.0%
To Whom Energy Report Presented†							
Energy Committee	65 4.5%	50 4.8%	15 3.6%	49 5.7%	16 2.7%	36 4.8%	29 4.2%
Director of Physical Plant	429 29.6%	309 29.8%	120 29.2%	251 29.2%	178 29.2%	223 30.3%	206 29.7%
College/University Engineer	111 7.7%	101 9.7%	10 2.4%	66 7.7%	45 7.7%	64 8.5%	47 6.7%
Governing Body	101 7.0%	62 6.0%	39 9.5%	70 8.1%	31 5.3%	56 7.5%	45 6.5%
Chief Financial Officer	289 20.0%	204 19.7%	85 20.7%	155 18.0%	134 22.8%	155 20.7%	134 19.2%
College/University Administrator	145 10.0%	97 9.4%	48 11.7%	79 9.2%	66 11.2%	72 9.6%	73 10.5%
Other Administrator	124 8.6%	90 8.7%	34 8.3%	79 9.2%	45 7.7%	63 8.4%	61 8.8%
Maintenance/Custodial Staff	117 8.1%	75 7.2%	42 10.2%	65 7.6%	52 8.8%	51 6.8%	66 9.5%
Other	66 4.6%	48 4.6%	18 4.4%	45 5.2%	21 3.6%	30 4.0%	36 5.2%

*Chi-square significant at $p < .05$.

† Multiple responses possible; percentages and totals based on responses, not cases.

Table C.45: Management Problems Associated with Energy Conservation Measures: First Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	465 60.2%	306 57.8%	159 65.2%	249 57.8%	216 63.2%	203 56.1%	262 63.7%
Approval Process	59 7.6%	49 9.3%	10 4.1%	27 6.3%	32 9.4%	26 7.2%	33 8.0%
Inadequate Staff	159 20.6%	112 21.2%	47 19.3%	99 23.0%	60 17.5%	88 24.3%	71 17.3%
Unreceptive Management	60 7.8%	40 7.6%	20 8.2%	36 8.4%	24 7.0%	29 8.0%	31 7.5%
Other	30 3.9%	22 4.2%	8 3.3%	20 4.6%	10 2.9%	16 4.4%	14 3.4%

Table C.46: Management Problems Associated with Energy Conservation Measures: Second Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	290 94.2%	208 93.3%	82 96.5%	169 92.9%	121 96.0%	146 91.8%	144 96.6%
Approval Process	2 0.6%	1 0.4%	1 1.2%	2 1.1%	0 0.0%	2 1.3%	0 0.0%
Inadequate Staff	4 1.3%	4 1.8%	0 0.0%	2 1.1%	2 1.6%	3 1.9%	1 0.7%
Unreceptive Management	11 3.6%	10 4.5%	1 1.2%	8 4.4%	3 2.4%	7 4.4%	4 2.7%
Other	1 0.3%	0 0.0%	1 1.2%	1 0.5%	0 0.0%	1 0.6%	0 0.0%

Table C.47: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Insulation							
1973–1979	205 26.5%	167* 31.6%	38 15.6%	124 28.8%	81 23.7%	112* 30.9%	93 22.6%
1980–1986	442 57.2%	323* 61.1%	119 48.8%	234 54.3%	208 60.8%	217 59.9%	225 54.7%
1987–1990	229 29.6%	173* 32.7%	56 23.0%	142* 32.9%	87 25.4%	114 31.5%	115 28.0%
Caulking/ Weatherstripping							
1973–1979	237 30.7%	184* 34.8%	53 21.7%	141 32.7%	96 28.1%	121 33.4%	116 28.2%
1980–1986	457 59.1%	333* 62.9%	124 50.8%	244 56.6%	213 62.3%	224 61.9%	233 56.7%
1987–1990	227 29.4%	179* 33.8%	48 19.7%	126 29.2%	101 29.5%	114 31.5%	113 27.5%
Windows— Reflective Film							
1973–1979	93 12.0%	74* 14.0%	19 7.8%	64* 14.8%	29 8.5%	55* 15.2%	38 9.2%
1980–1986	209 27.0%	151 28.5%	58 23.8%	120 27.8%	89 26.0%	110 30.4%	99 24.1%
1987–1990	83 10.7%	66* 12.5%	17 7.0%	50 11.6%	33 9.6%	39 10.8%	44 10.7%
Window Replacement							
1973–1979	102 13.2%	82* 15.9%	18 7.4%	58 13.5%	44 12.9%	49 13.5%	53 12.9%
1980–1986	302 39.1%	25* 47.3%	52 21.3%	14* 33.9%	156 45.6%	154 42.5%	148 36.0%
1987–1990	233 30.1%	189* 35.7%	44 18.0%	119 27.6%	114 33.3%	115 31.8%	118 28.7%
Windows— Other ECMs							
1973–1979	62 8.0%	57* 10.8%	5 2.0%	34 7.9%	28 8.2%	31 8.6%	31 7.5%
1980–1986	145 18.8%	11* 21.9%	29 11.9%	75 17.4%	70 20.5%	82* 22.7%	63 15.3%
1987–1990	98 12.7%	80* 15.1%	18 7.4%	57 13.2%	41 12.0%	43 11.9%	55 13.4%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Other Openings							
1973-76	87 11.3%	73* 13.8%	14 5.7%	51 11.8%	36 10.5%	45 12.4%	42 10.2%
1980–1986	185 23.9%	139* 26.3%	46 18.9%	91* 21.1%	94 27.5%	103* 28.5%	82 20.0%
1987–1990	122 15.8%	93 17.6%	29 11.9%	69 16.0%	53 15.5%	62 17.1%	60 14.6%
Building Envelope— Manual Adjustments							
1973–1979	149 19.3%	120* 22.7%	29 11.9%	85 19.7%	64 18.7%	75 20.7%	74 18.0%
1980–1986	263 34.0%	178 33.6%	85 34.8%	145 33.6%	118 34.5%	125 34.5%	138 33.6%
1987–1990	127 16.4%	100 18.9%	27 11.1%	69 16.0%	58 17.0%	60 16.6%	67 16.3%
HVAC Time Clocks							
1973–1979	299 38.7%	219* 41.4%	80 32.8%	186* 43.2%	113 33.0%	158* 43.6%	141 34.3%
1980–1986	352 45.5%	248 46.9%	104 42.6%	172* 39.9%	180 52.6%	163 45.0%	189 46.0%
1987–1990	118 15.3%	90 17.0%	28 11.5%	63 14.6%	55 16.1%	50 13.8%	68 16.5%
HVAC EMS							
1973–1979	146 18.9%	117* 22.1%	29 11.9%	103* 23.9%	43 12.6%	84* 23.2%	62 15.1%
1980–1986	429 55.5%	310* 58.6%	119 48.8%	260* 60.3%	169 49.4%	240* 66.3%	189 46.0%
1987–1990	290 37.5%	227* 42.9%	63 25.8%	167* 38.7	123 36.0%	162* 44.8%	128 31.1%
Other HVAC Controls							
1973–1979	28 3.6%	22 4.2%	6 2.5%	16 3.7%	12 3.5%	14 3.9%	14 3.4%
1980–1986	75 9.7%	55 10.4%	20 8.2%	42 9.7%	33 9.6%	37 10.2%	38 9.2%
1987–1990	53 6.9%	37 7.0%	16 6.6%	33 7.7%	20 5.8%	27 7.5%	26 6.3%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Electrical/Lighting Time Clocks							
1973–1979	254 32.9%	183 34.6%	71 29.1%	147 34.1%	107 31.3%	127 35.1%	127 30.9%
1980-1986	306 39.6%	210 39.7%	96 39.3%	163 37.8%	143 41.8%	148 40.9%	158 38.4%
1987–1990	118 15.3%	91* 17.2%	27 11.1%	62 14.4%	56 16.4%	55 1.2%	63 15.3%
Electrical/ Lighting EMS							
1973–1979	71 9.2%	55 10.4%	16 6.6%	48* 11.1%	23 6.7%	40 11.0%	31 7.5%
1980–1986	232 30.0%	165 31.2%	67 27.5%	147* 34.1%	85 24.9%	133* 36.7%	99 24.1%
1987–1990	224 29.0%	175* 33.1%	49 20.1%	135 31.3%	89 26.0%	124* 34.3%	100 24.3%
Electrical/Lighting— Other							
1973–1979	31 4.0%	22 4.2%	9 3.7%	20 4.6%	11 3.2%	13 3.6%	18 4.4%
1980–1986	107 13.8%	79 14.9%	28 11.5%	65 15.1%	42 12.3%	49 13.5%	58 14.1%
1987–1990	93 12.0%	73* 13.8%	20 8.2%	51 11.8%	42 12.3%	42 11.6%	51 12.4%
Fuel Conversion							
1973–1979	78 10.1%	59 11.2%	19 7.8%	46 10.7%	32 9.4%	41 1.3%	37 9.0%
1980–1986	187 24.2%	152* 28.7%	35 14.3%	87* 20.2%	100 29.2%	107* 29.6%	80 19.5%
1987–1990	99 12.8%	77* 14.6%	22 9.0%	60 13.9%	39 11.4%	59* 16.3%	40 9.7%
Air Conditioning							
1973–1979	105 13.6%	80 15.1%	25 10.2%	70* 16.2%	35 10.2%	52 14.4%	53 12.9%
1980–1986	321 41.5%	238* 45.0%	83 34.0%	183 42.5%	138 40.4%	174* 48.1%	147 35.8%
1987–1990	189 24.5%	151* 28.5%	38 15.6%	115 26.7%	74 21.6%	100 27.6%	89 21.7%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Replace Burner							
1973–1979	87 11.3%	73* 13.8%	14 5.7%	37* 8.6%	50 14.5%	47 13.0%	40 9.7%
1980–1986	231 29.9%	186* 35.2%	45 18.4%	107* 24.8%	124 36.3%	118 32.6%	113 27.5%
1987–1990	119 15.4%	96* 18.1%	23 9.4%	62 14.4%	57 16.7%	64 17.7%	55 13.4%
Replace Boiler							
1973–1979	79 10.2%	63* 11.9%	16 6.6%	41 9.5%	38 11.1%	49* 13.5%	30 7.3%
1980–1986	244 31.6%	195* 36.9%	49 20.1%	130 30.2%	114 33.3%	121 33.4%	123 29.9%
1987–1990	172 22.3%	136* 25.7%	36 14.8%	96 22.3%	76 22.2%	82 22.7%	90 21.9%
Insulate Boiler							
1973–1979	52 6.7%	42 7.9%	10 4.1%	31 7.2%	21 6.1%	28 7.7%	24 5.8%
1980–1986	131 16.9%	109* 20.6%	22 9.0%	64 14.8%	67 19.6%	73* 20.2%	58 14.1%
1987–1990	67 8.7%	55* 10.4%	12 4.9%	39 9.0%	28 8.2%	36 9.9%	31 7.5%
Steam Traps/Valves							
1973–1979	131 16.9%	118* 22.3%	13 5.3%	71 16.5%	60 17.5%	79* 21.8%	52 12.7%
1980–1986	343 44.4%	291* 55.0%	52 21.3%	164* 38.1%	179 52.3%	192* 53.0%	151 36.7%
1987–1990	212 27.4%	189* 35.7%	23 9.4%	107 24.8%	105 30.7%	116* 32.0%	96 23.4%
Heating— All Other ECMs							
1973–1979	92 11.9%	80* 15.1%	12 4.9%	58 1.5%	34 9.9%	52 14.4%	40 9.7%
1980–1986	271 35.1%	205* 38.8%	66 27.0%	152 35.3%	119 34.8%	159* 43.9%	112 27.3%
1987–1990	187 24.2%	146* 27.6%	41 16.8%	109 25.3%	78 22.8%	109* 30.1%	78 19.0%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Insulate Pipes/Ducts							
1973–1979	154 19.9%	121* 22.9%	33 13.5%	96 22.3%	58 17.0%	77 21.3%	77 18.7%
1980–1986	341 44.1%	267* 50.5%	74 30.3%	177 41.1%	164 48.0%	180* 49.7%	161 39.2%
1987–1990	216 27.9%	184* 34.8%	32 13.1%	117 27.1%	99 28.9%	107 29.6%	109 26.5%
Distribution System— Other ECMs							
1973–1979	69 8.9%	60* 11.3%	9 3.7%	47* 10.9%	22 6.4%	37 10.2%	32 7.8%
1980–1986	254 32.9%	186 35.2%	68 27.9%	159* 36.9%	95 27.8%	141* 39.0%	113 27.5%
1987–1990	169 21.9%	137* 25.9%	32 13.1%	110* 25.5%	59 17.3%	98* 27.1%	71 17.3%
Hot Water							
1973–1979	145 18.8%	115* 21.7%	30 12.3%	90 20.9%	55 16.1%	73 20.2%	72 17.5%
1980–1986	344 44.5%	249* 47.1%	95 38.9%	190 44.1%	154 45.0%	171 47.2%	173 42.1%
1987–1990	157 20.3%	128* 24.2%	29 11.9%	85 19.7%	72 21.1%	88* 24.3%	69 16.8%
Cogeneration							
1973–1979	19 2.5%	17 3.2%	2 0.8%	16* 3.7%	3 0.9%	12 3.3%	7 1.7%
1980–1986	45 5.8%	36 6.8%	9 3.7%	25 5.8%	20 5.8%	27 7.5%	18 4.4%
1987–1990	135 17.5%	113* 21.4%	22 9.0%	81 18.8%	54 15.8%	85* 23.5%	50 12.2%
HVAC— Manual Adjustments							
1973–1979	210 27.2%	159* 30.1%	51 20.9%	132* 30.6%	78 22.8%	106 29.3%	104 225.3%
1980–1986	372 48.1%	261 49.3%	111 45.5%	210 48.7%	162 47.4%	180 49.7%	192 46.7%
1987–1990	188 24.3%	149* 28.2%	39 16.0%	106 24.6%	82 24.0%	95 26.2%	93 22.6%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
HVAC—Energy Recovery Devices							
1973–1979	56 7.2%	47* 8.9%	9 3.7%	42* 9.7%	14 4.1%	30 8.3%	26 6.3%
1980–1986	200 25.9%	163* 30.8%	37 15.2%	122 28.3%	78 22.8%	115* 31.8%	85 20.7%
1987–1990	154 19.9%	119* 22.5%	35 14.3%	97 22.5%	57 16.7%	82 22.7%	72 17.5%
HVAC—Other							
1973–1979	16 2.1%	13 2.1%	3 1.2%	11 2.6%	5 1.5%	8 2.2%	8 1.9%
1980–1986	47 6.1%	36 6.8%	11 4.5%	33 7.7%	14 4.1%	27 7.5%	20 4.9%
1987–1990	35 4.5%	29 5.5%	6 2.5%	17 3.9%	18 5.3%	16 4.4%	19 4.6%
Lighting Conversion							
1973–1979	214 27.7%	170* 32.1%	44 18.0%	136* 31.6%	78 22.8%	123* 34.0%	91 22.1%
1980–1986	504 65.2%	359* 67.9%	145 59.4%	279 64.7%	225 65.8%	255* 70.4%	249 60.6%
1987–1990	304 39.3%	232* 43.9%	72 29.5%	176 40.8%	128 37.4%	163* 45.0%	141 34.3%
Lighting Modifications							
1973–1979	186 24.1%	149* 28.2%	37 15.2%	121* 28.1%	65 19.0%	101* 27.9%	85 20.7%
1980–1986	486 62.9%	339 64.1%	147 60.2%	281 65.2%	205 59.9%	240 66.3%	246 59.9%
1987–1990	298 38.6%	235* 44.4%	63 25.8%	166 38.5%	132 38.6%	156* 43.1%	142 34.5%
Electrical/Lighting—Manual Adjustments							
1973–1979	149 19.3%	122* 23.1%	27 11.1%	94 221.8%	55 16.1%	74 20.4%	75 18.2%
1980–1986	260 33.6%	173 32.7%	87 35.7%	151 35.0%	109 31.9%	115 31.8%	145 35.3%
1987–1990	135 17.5%	105* 19.8%	30 12.3%	77 17.9%	58 17.0%	62 17.1%	73 17.8%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Other Electrical Applications							
1973–1979	32 4.1%	22 4.2%	10 4.1%	20 4.6%	12 3.5%	19 5.2%	13 3.2%
1980–1986	103 13.3%	75 14.2%	28 11.5%	52 12.1%	51 14.9%	53 14.6%	50 12.2%
1987–1990	87 11.3%	64 12.1%	23 9.4%	42 9.7%	45 13.2%	47 13.0%	40 9.7%
Passive Solar							
1973–1979	8 1.0%	8 1.5%	0 0.0%	4 0.9%	4 1.2%	4 1.1%	4 1.0%
1980–1986	38 4.9%	29 5.5%	9 3.7%	24 5.6%	14 4.1%	14 3.9%	24 5.8%
1987–1990	24 3.1%	18 3.4%	6 2.5%	18 4.2%	6 1.8%	10 2.8%	14 3.4%
Active Solar							
1973–1979	16 2.1%	10 1.9%	6 2.5%	11 2.6%	5 1.5%	9 2.5%	7 1.7%
1980–1986	51 6.6%	38 7.2%	13 5.3%	31 7.2%	20 5.8%	25 6.9%	26 6.3%
1987–1990	14 1.8%	10 1.9%	4 1.6%	8 1.9%	6 1.8%	4 1.1%	10 2.4%
Other Solar							
1973–1979	1 0.1%	1 0.2%	0 0.0%	1 0.2%	0 0.0%	1 0.3%	0 0.0%
1980–1986	6 0.8%	4 0.8%	2 0.8%	3 0.7%	3 0.9%	3 0.8%	3 0.7%
1987–1990	8 1.0%	4 0.8%	4 1.6%	5 1.2%	3 0.9%	2 0.6%	6 1.5%
Conversion to Renewables							
1973–1979	3 0.4%	1 0.2%	2 0.8%	3 0.7%	0 0.0%	2 0.6%	1 0.2%
1980–1986	15 1.9%	12 2.3%	3 1.2%	10 2.3%	5 1.5%	8 2.2%	7 1.7%
1987–1990	15 1.9%	10 1.9%	5 2.0%	8 1.9%	7 2.0%	9 2.5%	6 1.5%

*Chi-square significant at $p < .05$.

Table C.47 continued: Energy Conservation Measures Over Time

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Other Renewables							
1973–1979	3 0.4%	3 0.6%	0 0.0%	3 0.7%	0 0.0%	2 0.6%	1 0.2%
1980–1986	9 1.2%	7 1.3%	2 0.8%	6 1.4%	3 0.9%	3 0.8%	6 1.5%
1987–1990	12 1.6%	9 1.7%	3 1.2%	10 2.3%	2 0.6%	5 1.4%	7 1.7%

*Chi-square significant at $p < .05$.

Table C.48: Successful Measures

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Judged Most Effective				*	*		
Envelope Measures	108 14.6%	75 14.6%	33 14.5%	51 12.4%	57 17.3%	38 10.9%	70 17.9%
Control Measures	355 48.0%	251 48.9%	104 45.8%	210 51.2%	145 43.9%	176 50.3%	179 45.9%
Cogeneration	11 1.5%	9 1.8%	2 0.9%	6 1.5%	5 1.5%	7 2.0%	4 1.0%
Heat Pumps	2 0.3%	2 0.4%	0 0.0%	1 0.2%	1 0.3%	0 0.0%	2 0.5%
Heat Recovery	3 0.4%	3 0.6%	0 0.0%	1 0.2%	2 0.6%	2 0.6%	1 0.3%
Fuel Conversion	20 2.7%	14 2.7%	6 2.6%	9 2.2%	11 3.3%	9 2.6%	11 2.8%
Lighting Measures	64 8.6%	38 7.4%	26 11.5%	43 10.5%	21 6.4%	29 8.3%	35 9.0%
Cooling Measures	27 3.6%	20 3.9%	7 3.1%	14 3.4%	13 3.9%	15 4.3%	12 3.1%
Heating Measures	86 11.6%	61 11.9%	25 11.0%	36 8.8%	50 15.2%	41 11.7%	45 11.5%
Ventilation System Measures	11 1.5%	6 1.2%	5 2.2%	10 2.4%	1 0.3%	4 1.1%	7 1.8%
HVAC System Modifications	28 3.8%	19 3.7%	9 4.0%	14 3.4%	14 4.2%	18 5.1%	10 2.6%
Domestic Hot Water Measures	2 0.3%	1 0.2%	1 0.4%	1 0.2%	1 0.3%	0 0.0%	2 0.5%
Other	23 3.1%	14 2.7%	9 4.0%	14 3.4%	9 2.7%	11 3.1%	12 3.1%
Judged Second Most Effective				†	†		
Envelope Measures	136 19.5%	102 21.1%	34 15.9%	55 14.2%	81 26.1%	61 18.4%	75 20.5%
Control Measures	134 19.2%	90 18.6%	44 20.6%	82 21.2%	52 16.8%	60 18.1%	74 20.2%
Cogeneration	6 0.9%	5 1.0%	1 0.5%	4 1.0%	2 0.6%	3 0.9%	3 0.8%
Heat Pumps	2 0.3%	1 0.2%	1 0.5%	1 0.3%	1 0.3%	2 0.6%	0 0.0%
Heat Recovery	12 2.2%	9 2.1%	3 2.3%	8 1.6%	4 2.9%	7 2.1%	5 2.2%
Fuel Conversion	15 2.2%	10 2.1%	5 2.3%	6 1.6%	9 2.9%	7 2.1%	8 2.2%
Lighting Measures	156 22.4%	96 19.9%	60 28.0%	98 25.3%	58 18.7%	72 21.8%	84 23.0%

*Chi-square significant at $p < .05$; sample size = 740.

†Chi-square significant at $p < .05$; sample size = 697.

Table C.48 continued: Successful Measures

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
Judged Second Most Effective (cont'd)							
Cooling Measures	28 4.0%	18 3.7%	10 4.7%	17 4.4%	11 3.5%	18 5.4%	10 2.7%
Heating Measures	86 12.3%	71 14.7%	15 7.0%	36 9.3%	50 1.1%	42 12.7%	44 12.0%
Ventilation System Measures	20 2.9%	16 3.3%	4 1.9%	1 3.1%	8 2.6%	12 3.6%	8 2.2%
HVAC System Modification	38 5.5%	23 4.8%	15 7.0%	32 8.3%	6 1.9%	21 6.3%	17 4.6%
Domestic Hot Water	15 2.2%	9 1.9%	6 2.8%	8 2.1%	7 2.3%	5 1.5%	10 2.7%
Other	49 7.0%	33 6.8%	16 7.5%	28 7.2%	21 6.8%	21 6.3%	28 7.7%

Table C.49: Technical Problems Associated with Energy Conservation Measures: First Response

	Total	4-Year*	2-Year	Public	Private	ICP*	Non-ICP
No Response	370 47.9%	249 47.1%	121 49.6%	197 45.7%	173 50.6%	155 42.8%	215 52.3%
Staff Training	71 9.2%	49 9.3%	22 9.0%	45 10.4%	26 7.6%	38 10.5%	33 8.0%
Staff Availability	21 2.7%	19 3.6%	2 0.8%	13 3.0%	8 2.3%	8 2.2%	13 3.2%
Consultant Capabilities	74 9.6%	56 10.6%	18 7.4%	41 9.5%	33 9.6%	34 9.4%	40 9.7%
Energy-conserving Measures	185 23.9%	115 21.7%	70 28.7%	108 25.1%	77 22.5%	94 26.0%	91 22.1%
Other	52 6.7%	41 7.8%	11 4.5%	27 6.3%	25 7.3%	33 9.1%	19 4.6%

*Chi-square significant at $p < .05$.

Table C.50: Technical Problems Associated with Energy Conservation Measures: Second Response

	Total	4-Year	2-Year	Public	Private	ICP	Non-ICP
No Response	392 97.3%	272 97.1%	120 97.6%	228 97.4%	164 97.0%	200 96.6%	192 98.0%
Staff Training	2 0.5%	2 0.7%	0 0%	0 0%	2 1.2%	1 0.5%	1 0.5%
Staff Availability	5 1.2%	3 1.1%	2 1.6%	3 1.3%	2 1.2%	2 1.0%	3 1.5%
Consultant Capabilities	1 0.2%	0 0%	1 0.8%	1 0.4%	0 0%	1 0.5%	0 0%
Energy-conserving Measures	3 0.7%	3 1.1%	0 0%	2 0.9%	1 0.6%	1 0.5%	0 0%
Other	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%

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