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ENERGY CONSERVATION

Federal Home Energy Audit Program Has Not Achieved Expectations

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Comptroller General
of the United States

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To The President of the Senate and the
Speaker of the House of Representatives

This report evaluates the Residential Conservation Service program, which was established in 1978 to improve the energy efficiency of residential dwellings. The Congress, concerned about the program's limited success, enacted the Conservation Service Reform Act of 1986, which terminates the program in 1989. To assist in deciding whether the program should be continued beyond this date, the act required the Comptroller General to prepare and transmit this report to the Congress before December 31, 1986.

Copies of this report are also being sent to the Secretary of Energy.

This work was performed under the direction of James Duffus III, Associate Director. Other major contributors are listed in appendix IV.

Charles A. Bowsher

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Comptroller General
of the United States

Executive Summary

Purpose

An estimated 6 percent, or fewer, of eligible U.S. households have participated in the Residential Conservation Service (RCS) program, established in 1978 to improve the energy efficiency of the residential sector. The Congress, concerned about the program's limited success, enacted the Conservation Service Reform Act of 1986, terminating the program in 1989. To assist in deciding whether the program should be continued beyond this date, the act required the Comptroller General to examine and assess, among other things,

- the program's potential for achieving energy savings,
- program costs and benefits, including measured energy savings, and
- utilities' implementation efforts and adoption of other residential conservation programs.

Background

The National Energy Conservation Policy Act of 1978 established the RCS program. The act required (1) states to prepare and submit plans to the Department of Energy (DOE) on how they planned to implement the RCS program and (2) utilities to offer on-site home energy audits to residential customers at a maximum cost of $15. Utilities recovered their cost of operating the RCS program—$490 million through 1985—through participants' audit fees and customers' energy rates. DOE developed the RCS program regulations and spent $23 million implementing the program. States regulated utilities' program implementation and spent $7.7 million on administrative costs.

Utilities were required to send out program announcements offering an audit at least every 2 years prior to 1985 to all eligible customers. The home energy audit provides information to customers on how to reduce their household energy use, primarily by recommending energy conservation measures. Participating customers have to decide whether to purchase and install such measures. Utilities assist customers by providing information about suppliers and installers of conservation measures and offering to arrange such installation.

Results in Brief

Nationally, the RCS program has not achieved expectations in reducing residential energy consumption because the program participation rates have been lower than anticipated and the percentage of houses insulated with conservation measures has not increased significantly. On the basis of four state studies that estimated energy savings, GAO believes that savings, due to the program, for participants have been relatively

small—in the range of 0 to 4 percent of their annual energy consumption.

In response to GAO's national questionnaires, most utilities and states indicated that the program's termination would have minimal impact on utility rates and generating capacity requirements. Further, most utilities said termination of the program would not affect their conservation efforts because they have other effective residential conservation programs and many would continue to offer home energy audits. States' views varied on how terminating the RCS program could affect conservation efforts.

Principal Findings

Potential for Achieving Energy Savings

According to an Energy Information Administration report, in 1984 about 86 percent of the nation's single-family homes were less than fully insulated in that they did not have a combination of recommended attic insulation, wall insulation, and storm windows on 90 percent of their windows.

According to DOE, about 5.9 percent of all eligible customers have participated in the RCS program. This rate is lower than the 7.5- to 35-percent participation rate estimated by DOE as a 5-year goal in 1979. Further, utilities responding to GAO's national questionnaire indicated that future participation rates will probably remain low.

Program Costs and Benefits

Through 1985 DOE, states, and utilities spent about $521 million implementing the program, of which utility costs accounted for 94 percent. In 1985 utility program costs were about $112 million, which resulted in an annual increase in residential customers' utility bills ranging from 1 cent to $2.85 per customer.

RCS program participants' annual energy savings, due to the program, were between 0 to 4 percent of annual consumption in states where GAO was able to determine the savings. GAO estimated these savings for customers in California, Michigan, Minnesota, and Wisconsin on the basis of studies conducted by DOE's Oak Ridge National Laboratory, utilities, and Michigan's Department of Commerce. Benefits most frequently cited by states and utilities in response to GAO's national questionnaires were

improved utility-customer relations and increased conservation awareness by participants. Most utilities said participants received no or little benefit in terms of lower utility bills and increased resale value of their homes. Few benefits to nonparticipants and society were cited.

Utility Programs

For the RCS program, utilities have used a wide variety of implementation strategies, with notices inserted in customer bills as the most widely used method of announcing the program. Utilities with higher participation rates used more marketing strategies, charged customers less for audits, and spent more per eligible customer to implement the program than utilities with lower participation rates.

Most utilities also offered other residential conservation programs including weatherization and less comprehensive home energy audits. Of the 63 utilities that had evaluated their programs (or about 28 percent of all utilities responding to our national questionnaire), over 80 percent said their most successful residential conservation program saved more energy than the RCS program.

Matters for Congressional Consideration

Nationally, the RCS program has not achieved expectations in reducing energy consumption in the residential sector. The Congress in enacting the Conservation Service Reform Act of 1986 recognized that utilities should be given some flexibility in offering different types of residential conservation programs. Under the act utilities, in some circumstances, are permitted to implement alternative residential conservation programs instead of RCS home energy audits. It is not known, however, how many utilities will implement alternative programs or to what extent these programs will be more successful in saving energy than RCS home energy audits. Consequently, GAO is making no recommendation about whether the RCS program, as amended, should be continued beyond June 30, 1989. DOE is required by the act to provide reports to the Congress in 1987 and 1989 that will contain information on the operation of utilities' alternative residential conservation programs.

In deciding the future of the RCS program, the Congress should consider the extent to which the following have occurred:

- Energy conservation measures have been installed in residential dwellings between 1984 and 1989. The Energy Information Administration plans to update its report on the prevalence of various conservation measures in the housing stock in 1988.

- Residential energy savings have occurred under alternative programs compared with the RCS program. DOE is required to issue reports in 1987 and 1989 on alternative programs.
- Termination of the authority provided to utilities for conducting below-cost RCS audits might adversely influence energy conservation efforts in states where below-cost home energy audits are offered. This would occur because without federal statutory authority to provide such audits, utility and state programs offering below-cost audits could be challenged for violating antitrust laws.

Recommendations

As explained above, GAO is making no recommendations.

Agency Comments

DOE found the report to be a thorough and professional review of the Residential Conservation Service program and related conservation programs. DOE also recognized that the Conservation Service Reform Act of 1986 responds to the needs of states and utilities for more flexibility in designing and implementing energy conservation programs.

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Abbreviations

BPA	Bonneville Power Administration
Btu	British thermal unit
DOE	Department of Energy
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
GAO	General Accounting Office
MBtu	1 million Btu's
NECPA	National Energy Conservation Policy Act
PSC	Public Service Commission
RCED	Resources, Community, and Economic Development Division
RCS	Residential Conservation Service
RECS	Residential Energy Consumption Survey
SR/EEUD	Staff Report/Energy End Use Division
TVA	Tennessee Valley Authority
WP&L	Wisconsin Power and Light

Introduction

The Residential Conservation Service (RCS) program was established in 1978 to reduce energy consumption in residential households by informing them of the benefits of installing energy conservation measures and simplifying their search for financing and contractors to install the measures. A principal element of the program is the utilities' offering of home energy audits to their eligible customers. With residential dwellings accounting for about one fifth of the total U.S. energy consumption in 1978, the Congress considered the residential energy sector to be a substantial target for energy savings. The Department of Energy (DOE) is responsible for administering the RCS program.

In August 1986 the Congress enacted the Conservation Service Reform Act of 1986, which changed certain provisions relating to the RCS program. One of the major changes is that the act allows the states to develop and implement other energy conservation plans as alternatives to the RCS home energy audit. This change also allows utilities to develop alternative energy conservation programs. The act extends the RCS program until June 30, 1989, when it will terminate unless extended by the Congress.

The act requires the Comptroller General to prepare and transmit a report to the Congress before December 31, 1986, evaluating the RCS program. The act also requires the Secretary of Energy to conduct a survey in consultation with the Comptroller General to collect the information necessary for preparing such a report. This report represents the culmination of efforts to meet these two requirements.

Background

In the 1970's energy prices rose sharply and concern grew about the amount of imported oil the United States consumed. Because of this, the administration and the Congress took action to reduce energy consumption in the residential sector. In 1977 the President issued the National Energy Plan with a goal of reducing the nation's energy consumption and dependence on foreign oil supplies. The National Energy Plan established two national objectives related to the residential sector: (1) insulating 90 percent of existing homes and (2) increasing the use of solar energy in homes.

In 1978 the Congress established the RCS program as part of the National Energy Conservation Policy Act (NECPA) (Public Law 95-619), to aid in achieving these objectives. The Congress relied on large utilities in conjunction with states to implement the RCS program because of their experience and expertise in energy matters and their established links

with households throughout the United States. The RCS program requires large electric and natural gas utilities to offer a variety of conservation services including on-site residential energy audits to customers. In addition, utilities were required to assist customers in implementing recommended conservation measures.

Major requirements that NECPA placed on states and utilities for administering the RCS program included

- preparing plans for carrying out the RCS program;
- offering utility home energy audits to residential customers; and
- providing assistance, such as information about suppliers and installers of conservation measures, to residential customers.

NECPA required states and large nonregulated utilities (i.e., utilities whose activities are not governed by state regulatory agencies) to submit plans to DOE describing how they planned to implement the RCS program. These plans were to include all requirements placed on utilities for carrying out the RCS program and to indicate how the plan would be enforced. For example, plans were to describe how states would monitor utility activities to supply, install, and finance conservation measures and explain consumer protection, quality assurance, and/or consumer complaint procedures.

As the centerpiece of the program, each utility involved is required to offer a home energy audit to customers who live in single or certain multifamily dwellings in which energy consumption is separately metered.[1] To ensure that all eligible customers were offered a home energy audit, utilities were required, until January 1, 1985, to send out program announcements offering an audit at least every 2 years. If requested by a customer, utilities have to provide a comprehensive on-site (class A) energy audit, conducted by a qualified energy auditor at a maximum cost to the customer of $15. As of January 1, 1985, utilities were no longer required under NECPA to inform customers of the availability of audits, but had to maintain the capability to respond to customer requests for audits. However, as amended by the Conservation Service Reform Act of 1986, utilities are required to announce the program once again between August 28, 1986, and June 30, 1989, and to make offers to perform audits to new customers.

[1]NECPA was amended by the Energy Security Act of 1980 to include separately metered multifamily dwellings.

Under NECPA, utilities were to assist customers who receive RCS audits by presenting them with state-compiled lists of qualified suppliers and installers of conservation measures as well as lists of institutions that provide financing for conservation measures. Utilities are also to help customers arrange for the installation and financing of conservation measures. NECPA also directed that state plans establish procedures for resolving customers' complaints arising from RCS program activities.

DOE developed the RCS program regulations, which were made final in November 1979. In June 1980 the Congress enacted the Energy Security Act (Public Law 96-294), which amended NECPA and provided more flexibility in certain aspects of the program by, for instance, lifting the general prohibition on utility financing of conservation measures. These amendments were then formally incorporated into DOE's program regulations.

We have issued two previous reports on the RCS program: Residential Energy Conservation Outreach Activities—A New Federal Approach Needed (EMD-81-8, Feb. 11, 1981) and The Residential Conservation Service: Issues Affecting the Program's Future (EMD-82-70, Mar. 29, 1982). These reports provide information about DOE's initial implementation of the RCS program.

Objectives, Scope, and Methodology

Objectives

We began evaluating the RCS program in response to a June 20, 1985, letter from the Chairman, Senate Committee on Energy and Natural Resources, which requested that we prepare such a report, as called for in S.410, 99th Congress, 1st Sess., 103 CONG. REC. S10214 (1985). That provision of S.410 was subsequently enacted in the 1986 Reform Act.

Section 104(c) of the Conservation Service Reform Act of 1986 (Public Law 99-412) requires the Comptroller General to report to the Congress before December 31, 1986, on the following:

- the potential for achievable energy savings through the installation of residential energy conservation measures in residential dwellings in the

United States and the importance of the RCS program in achieving these savings (see ch. 2);
- the cost of the RCS program, taking into consideration the cost to the taxpayer and ratepayers of affected utilities (see ch. 3);
- the benefits of the RCS program, taking into consideration the value of energy conserved and the value of deferral of investment in new capacity to provide energy (see ch. 4);
- efforts of utilities to encourage the implementation of residential energy conservation measures by their customers and the relationship between these efforts and the RCS program (see ch. 5);
- measured energy savings achieved in residential dwellings in which residential energy conservation measures have been installed under the RCS program (see ch. 6);
- the extent to which utilities have adopted programs, voluntarily or under state law, that offer more potential for encouraging energy efficiency than the RCS program (see ch. 7);
- the extent of unfair, deceptive, or anticompetitive acts or practices affecting commerce that relate to the implementation of the RCS program and the adequacy of procedures that are in effect to prevent such unfair, deceptive, or anticompetitive acts or practices (see ch. 8);
- the extent to which modifications in the regulations implementing the RCS program could improve the cost-effectiveness of the program (see ch. 9);
- legislative changes that are necessary to improve the cost-effectiveness of the RCS program (see ch. 9); and
- such other matters as the Comptroller General considers appropriate in order to assist the Congress in deciding the future of the RCS program (see ch. 9).

Scope

Our review focused on DOE, utilities, and the 50 states involved in the nationwide implementation of the RCS program as it existed before changes enacted as part of the 1986 Reform Act. In carrying out the review, we were interested in determining how the program has worked nationally and how the program implementation has varied from region to region and state to state.

The scope of our review also covered (1) the extent to which U.S. households have installed conservation measures and the potential for households to achieve energy savings by installing such measures in the future and (2) how other residential conservation activities carried out by utilities compared to the RCS program. Under the 1986 Reform Act, utilities and states are allowed to carry out alternative conservation

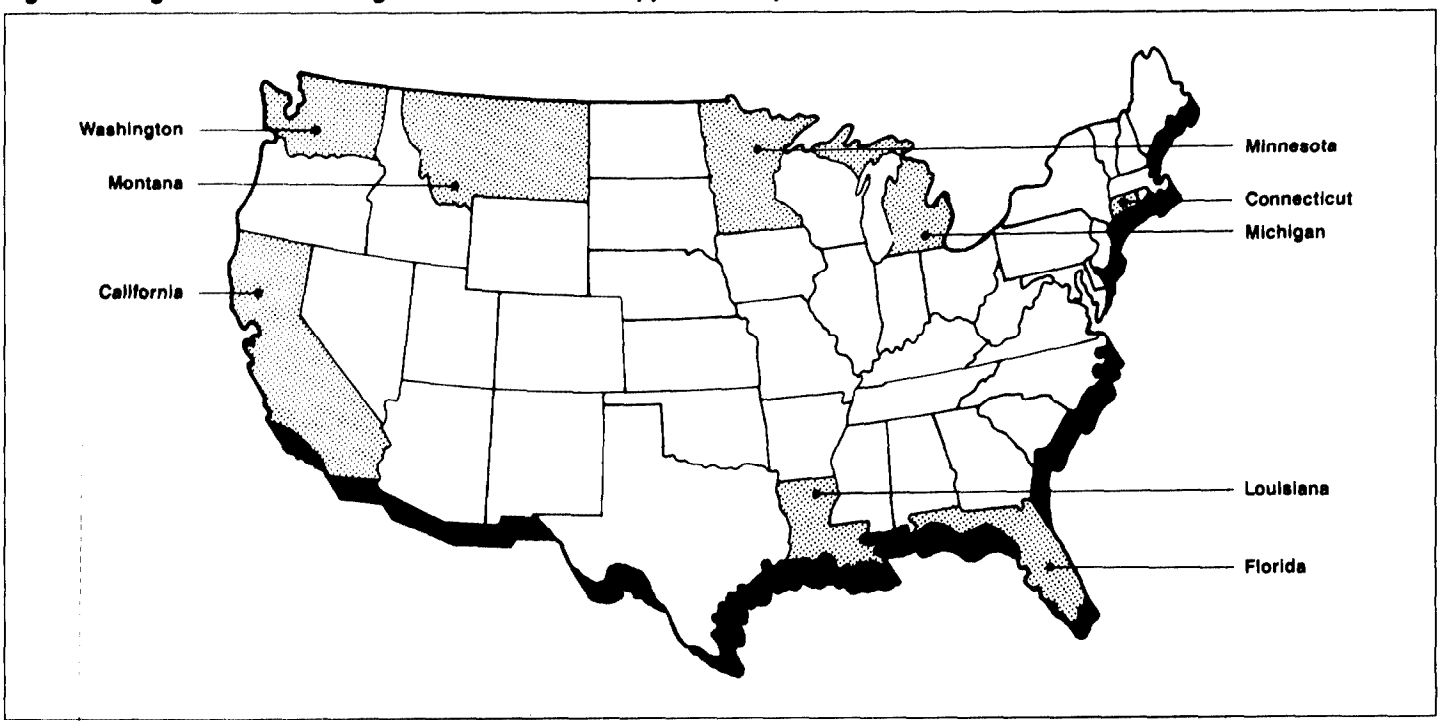
efforts in place of RCS home energy audits. These alternative efforts were outside the scope of our review. DOE is required, as part of the act, to provide reports to the Congress in 1987 and 1989 on the operation of these alternative efforts.

Methodology

For our review we carried out an extensive examination of existing studies of the RCS program and of material collected by DOE, state, and utility officials and other experts in energy conservation to obtain their views about possible methodologies. The methodology we developed consisted of four major work efforts, which are discussed more fully in appendix I:

- two questionnaires, to collect program data and views from 262 of the 298 utilities and 44 state agencies involved in the RCS program;
- in-depth audit work at 36 utilities and state agencies in eight states—California, Washington, Montana, Minnesota, Michigan, Connecticut, Florida, and Louisiana—selected to reflect the nationwide variety of RCS programs (see fig. 1.1);
- an Energy Information Administration (EIA) report, prepared at our request, that assesses the potential for residential conservation energy savings on the basis of an analysis of information the EIA collected in its Residential Energy Consumption Surveys on single-family houses; and
- critiques of studies that evaluated the extent, if any, to which customers who participated in the RCS program decreased their energy use.

Figure 1.1: Eight States Whose Agencies and Utilities Supplied In-Depth Information



As part of the first and second work efforts, we sent questionnaires to the state agency responsible for administering the RCS program in 44 states and performed detailed interviews with 8 of these states.[2] We also sent questionnaires to 262 of the 298 utilities that, according to DOE, participate in the RCS program. In addition, we carried out in-depth interviews with officials at the remaining 36 of the 298 utilities. Of the 44 state and 262 utility questionnaires we sent out, 29 state agencies and 228 utilities responded.

Because all states and utilities did not respond to our questionnaire, we could not use the information we obtained from the questionnaire to compute nationwide RCS program participation that would reflect all eligible customers or aggregate state and utility RCS program costs. However, the information we obtained does provide a perspective on the variation in RCS participation and program costs experienced by utilities. Further, although we obtained information on RCS program costs and benefits, we did not attempt to carry out a cost-benefit analysis of the

[2]We excluded six states because they did not have approved state plans and, therefore, their RCS programs were administered by DOE.

program. All of the information needed to perform an accurate cost-benefit analysis of the program was not available. In addition, because EIA's report was prepared at our request, EIA did not give the report a complete technical review and considered it to be a "service report" rather than an "official" EIA product.

In addition to these four major work efforts, we also obtained information about the extent to which unfair or anticompetitive practices in violation of NECPA may have occurred, and reviewed procedures used by states and DOE to prevent them from occurring and to provide redress to persons injured by such practices.

We carried out audit work at DOE headquarters in Washington, D.C., in 8 states, and at 36 utilities in those 8 states. We discussed all issues addressed in the review with federal, state, and utility officials as well as energy and economic experts and consumer and contractor groups. Our work was conducted from July 1985 through June 1986 and was performed in accordance with generally accepted government auditing standards.

Importance of RCS Program in Conserving Energy

The potential for installing additional energy conservation measures in the nation's residential dwellings, numbering 86.3 million in 1984, would appear to be considerable. According to a 1986 EIA estimate, these households accounted for about 15 quadrillion (quad) Btu's, [1] or 20 percent, of the total U.S. energy consumption of 74 quads in 1984. About 10 quads, or 66 percent, of the energy consumed by residential households was for heating, cooling, and hot-water energy use, which the RCS program was established to reduce. Of the 86.3 million residential dwellings in 1984, 57.6 were single-family housing units. EIA estimated that in 1984 about 86 percent of these single-family households were not fully insulated in that they did not have a combination of recommended attic insulation, wall insulation, and storm windows on at least 90 percent of their windows.

The RCS program's national participation rate has been lower than DOE's 1979 program impact analysis estimate of 7.5 to 35 percent for the ensuing 5-year period.[2] A 1986 DOE report stated that 5.9 percent of all households eligible to participate in the program have received audits as of September 1985.[3] A tabulation of responses provided by 211 utilities responding to our national questionnaire showed that during the period 1981 through 1985, their median cumulative RCS participation rate was about 2 percent of their eligible customers. A summary of utility responses showed that if the RCS program is continued, the median participation rate is expected to increase to 5 percent by 1995.

Utilities in the Northeast had a higher median customer participation rate of 8 percent. The expected increased median customer participation rate for utilities in the Northeast, if the program is continued, is 20 percent.

Since the RCS program participation rate nationwide has been low, it is unlikely that the program has substantially increased the percentage of U.S. households with conservation measures. Further, on the basis of a DOE study, participating homeowners tend to install less than half of the measures recommended as a result of the home energy audit. They also tend to have more conservation measures in place than nonaudited households.

[1] Household consumption, excluding electricity losses due to generation and transmission, is about 9 quads for 1984.

[2] By participation rate we mean the percentage of eligible customers who actually have received an RCS audit since the program began.

[3] Update of the Evaluation of the Residential Conservation Service Program, Sept. 24, 1986.

Existing Residential Energy Conservation Measures

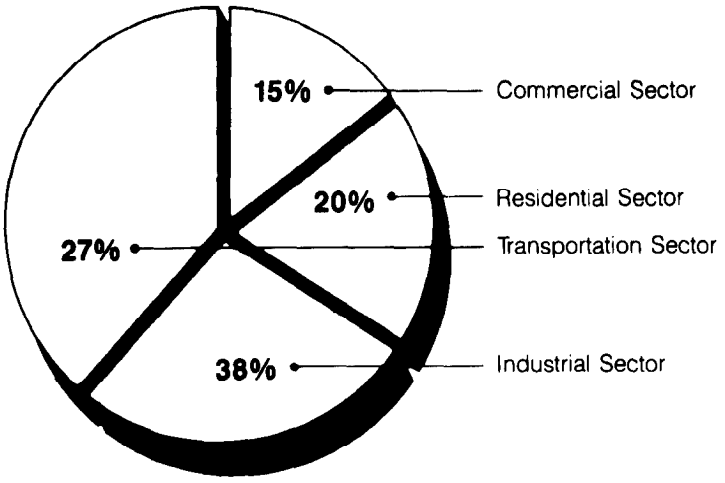
As shown in figure 2.1, the 86.3 million residential households in 1984 accounted for about 20 percent of the total U.S. energy use. EIA's July 9, 1986, report, Residential Conservation Measures (SR/EEUD/86/01), primarily evaluated the prevalence of various conservation measures in existing single-family housing units in 1984, numbering about 57.6 million, or about 67 percent of all housing units. EIA's report included information primarily on single-family dwellings because the data it collects about residential dwellings do not include information about conservation measures for other houses in the RCS program (i.e., 2- to 4-unit dwellings and multifamily units that are separately metered). Mobile units, which are also eligible under the program and which EIA included in its report, are not included in this chapter because they constitute only about 6 percent of all residential households.

EIA reported that many of the 57.6 million single-family houses had conservation measures such as attic, wall, and floor insulation; weather stripping and caulking; and storm windows or doors.[4] However, 86 percent of single-family homes could be considered less than fully insulated in that they did not have a combination of recommended attic insulation, wall insulation, and storm windows on at least 90 percent of their windows. In general, houses in the colder Northeast and North Central regions tended to have more conservation measures in place than those in the West and South. Although EIA's report also showed a nominal increase in the percentage of housing units that had a particular conservation item, none of the increases between 1978 and 1984 were statistically significant at the 95-percent confidence level.[5]

[4]Sampling errors at the 95-percent level of confidence for EIA data presented in the text are presented in appendix II.

[5]EIA collected data on the prevalence of conservation measures in the residential housing stock between 1978 and 1984. Changes to the housing stock that took place in 1985 and 1986 are not reflected in EIA's analysis.

Figure 2.1: 1984 U.S. Energy Use by Sector



Source: DOE/EIA

As shown in table 2.1, EIA's study reported that between 53 and 78 percent of the 57.6 million single-family households in the United States had various energy conservation measures in place in 1984. The most common individual conservation measure, in approximately 78 percent of the housing units nationwide, was attic insulation. The next most common conservation measures were storm doors and storm windows, with about 70 and 66 percent, respectively, of the households reporting their presence. Among the least common conservation measures was wall insulation, with about 53 percent of households reporting its presence. While a high percentage of housing units have various conservation measures, fewer have complete levels of these measures. For example, although about 78 percent of housing units nationwide had attic insulation, about 63 percent had attic insulation covering the entire attic area. Similarly, while 66 percent of housing units nationwide reported the presence of some storm windows, about 55 percent had storm windows on more than three fourths of their windows.

Table 2.1: Conservation Measures in Single-Family Units in 1984

Figures in percent

Conservation measure	Total U.S.	Region			
		Northeast	North Central	South	West
Attic insulation	78	77	85	75	78
Storm doors	70	93	91	63	31
Storm windows	66	94	94	49	30
Caulking	59	66	66	54	50
Floor insulation	58	64	64	54	52
Weather stripping	57	63	60	50	59
Wall insulation	53	59	64	49	42

Source: EIA, Residential Conservation Measures, 1986.

Table 2.1 also shows regional estimates of the percentage of housing units with various conservation measures. For most items the regional differences found were between the colder Northeast and North Central regions and the South and West regions. For example, the presence of storm windows in these colder regions is estimated to be about 90 percent higher than the level in the South and about three times that of housing units in the West. Likewise, regional differences can also be seen for other conservation measures. The Northeast and North Central regions have similar profiles in terms of the percentages of housing units with various conservation measures, although a greater proportion of homes in the North Central region have attic insulation.

Each of EIA's Residential Energy Consumption Surveys (RECS) has shown that some households (although frequently a relatively small number) have added certain conservation items to their homes.[6] However, even though the RECS data show an increase from 1978 to 1984 in the percentages of houses with some individual conservation measures, the increase has been too small to be measured with any statistical confidence.

EIA noted two possible reasons why the RECS data did not indicate statistically significant changes in the percentage of housing units with conservation measures. First, the RECS sample sizes were not large enough to detect small changes in percentages. For example, the percentage of single-family houses with attic insulation observed in the RECS data would have had to increase more than 5 percent between 1978 and 1984 for the increase to have been considered statistically significant at the

[6]RECS is a survey of households, carried out nationwide by EIA annually from 1978 through 1982 and in 1984, to collect information on residential energy use, conservation measures in place in existing homes, and conservation behavior.

95-percent level of confidence (i.e., for percentages reported in different RECS surveys to represent a real difference in the housing stock at the 95-percent level of confidence, not just a random difference caused by sampling). Second, the housing stock is of sufficient size that it could take many years for new building practices to substantially increase conservation measures in the nation's entire housing stock.

About One Third of U.S. Houses Considered Largely Uninsulated

In its 1986 report, EIA provided information about the existence of various combinations of conservation measures in single-family residential dwellings both nationwide and by region. This information provides a perspective on the number of housing units most likely to benefit from installing measures such as attic or wall insulation or storm windows.[7] However, EIA's RECS data sample was not large enough for it to accurately reflect all possible combinations of attic, wall, or floor insulation; storm windows or doors; and caulking and weather stripping that are present in housing units in each geographical region or weather zone. Therefore, EIA evaluated the extent to which housing units are likely to have conservation measures in place (ranging from houses filled fully with measures to ones with essentially no measures) on the basis of the presence of three conservation measures—attic insulation (with the recommended number of inches and 96 percent of the area covered), wall insulation, and storm windows (on at least 90 percent of all windows).[8] We considered houses that had each of these three measures, in the specified amount, to be fully insulated. On the other hand, we considered houses with few of these measures, particularly in colder climates, to be largely uninsulated. (See app.I.) Approximately one third of single-family U.S. housing units fell into the largely uninsulated category.

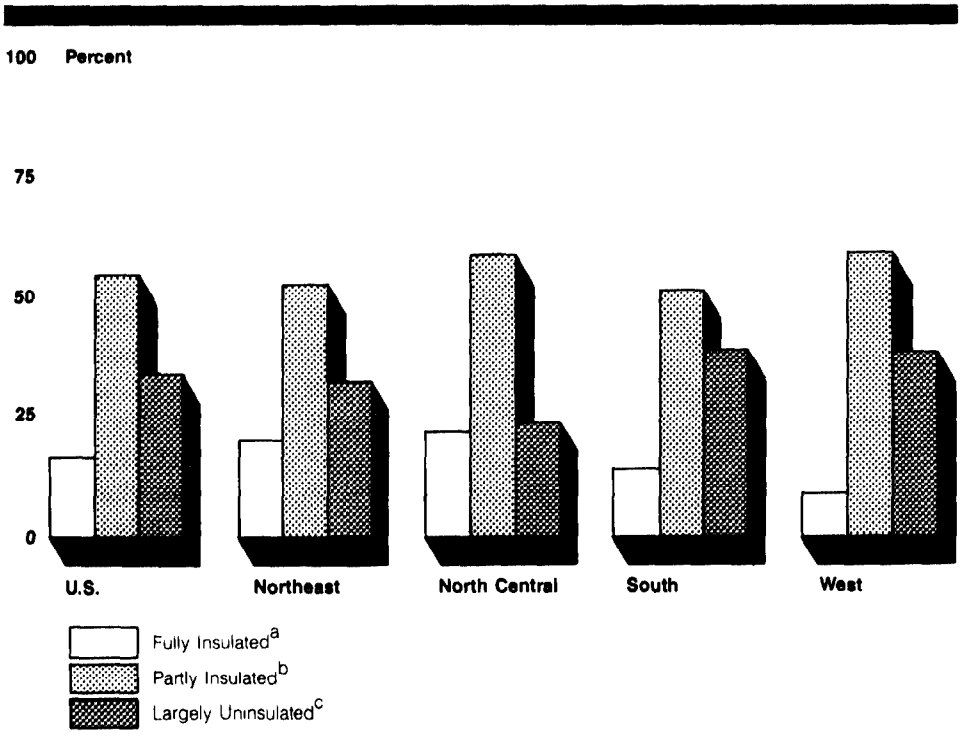
Figure 2.2 shows that for the nation about 14 percent of single-family housing units in 1984 were fully insulated, on the basis of these criteria. Another 13 percent of housing units, which are included in the partly insulated category, had full attic area coverage, but less than the recommended number of inches of attic insulation, and had both storm windows on 90 percent of their windows and wall insulation. By contrast,

[7]The cost-effectiveness of installing additional conservation measures in residential households and the energy savings associated with installing them is uncertain.

[8]The measures not included in the EIA analysis were storm doors, caulking, weather stripping, and floor insulation. EIA offered the following reasons for excluding these measures. Storm doors were not included because they were relatively expensive and there is less evidence they provide effective protection than other items. Caulking and weather stripping are important, but they were usually present in houses that had attic and wall insulation and storm windows. Basement insulation was excluded because a minority of homes, which are difficult to determine, benefit from it.

according to data in EIA's report, about 31 percent of the nation's single-family housing units are largely uninsulated. That is, they have partial or no attic insulation and are either missing wall insulation, storm windows, or both. In this uninsulated group, about 9 percent of the nation's single-family housing units had less than full attic insulation, no wall insulation, and no storm windows.

Figure 2.2: Combination of Insulation and Air Infiltration Protection by Region



Note: Sampling errors for the data presented in this figure can be found in appendix II.

Source: Based on EIA, Residential Conservation Measures, 1986.

a Housing units with at least 96 percent of ceiling area covered and at least the minimum recommended number of inches of insulation, some or total wall insulation, and storm windows on at least 90 percent of the windows.

b Housing units with a range of conservation measures from full attic insulation with the recommended number of inches and some combination of wall insulation and storm windows to those with partial or no attic insulation and some combination of wall insulation and storm windows. Combinations of wall insulation and storm windows include housing units with no wall insulation and 90-percent storm windows as well as those with no storm windows and full wall insulation.

c Housing units that are substantially or completely lacking in at least two of the three conservation measures.

According to EIA, distinct regional variations occurred in the percentages of housing units that were fully insulated. In general, higher percentages of housing units in the colder Northeast and North Central regions were fully insulated compared to units in the South and West. In the Northeast and North Central regions, 17 and 20 percent, respectively, of the households were estimated to be fully insulated. By way of comparison, in the South and West regions about 13 and 6 percent of the housing units, respectively, were estimated to be fully insulated. Further, most single-family homes in the Northeast and North Central regions have some storm windows and wall insulation. Generally, higher percentages of single-family housing units in colder areas were fully insulated than were those in warmer climates.

RCS Program Potential

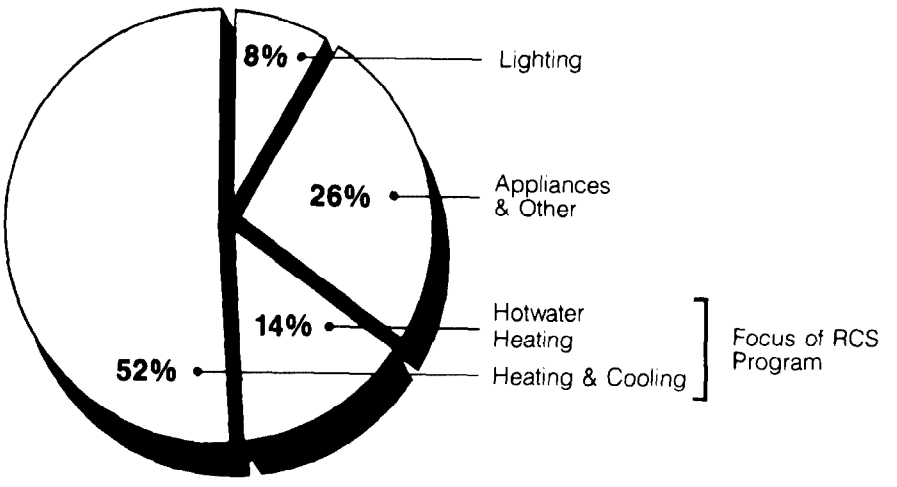
The RCS program was established to help reduce energy use by residential households, in part by providing them with home energy audits in which cost-effective conservation measures would be recommended. In 1984 total U.S. energy consumption for all sectors of the economy was about 74 quadrillion Btu's, about 15 quadrillion of which was consumed in the residential sector. According to EIA's Energy Conservation Indicators 1984 Annual Report, the proportion of U.S. energy consumed in the residential sector has not changed substantially since the RCS program was initiated in 1978. While the number of households increased during this period, the average amount of energy consumed per household has declined.

A variety of explanations exist for why per-household energy consumption has declined, including the installation of energy conservation measures, household behavioral changes (e.g., reductions in thermostat settings in the winter), improved thermal performance of new homes, or improved appliance efficiency. All these factors have, in some way, affected household energy consumption trends.

Another factor that may explain energy consumption trends during this period is the change in energy prices paid by residential users. Between 1978 and 1984 the prices of natural gas and fuel oil increased 152 percent and 122 percent (in nominal terms), respectively, while electricity prices increased 77 percent. In contrast, between 1984 and 1986 natural gas, fuel oil, and electricity prices all decreased (by 32 percent, 43 percent, and 9 percent, respectively). According to Data Resources, Inc., gas prices are expected to remain relatively constant through 1990 while electricity and oil prices are expected to increase somewhat.

About 85 percent of residential households in the United States are eligible to participate in the RCS program.[9] As shown in figure 2.3, approximately 52 percent of energy used in the residential sector, on average, was for heating and cooling. Another 14 percent was consumed for hotwater needs. Therefore, about 66 percent of the energy used in the residential sector was considered a potential RCS target for increased energy efficiency or reduced energy consumption. The remaining energy used by residential households for lights, appliances, or other needs was not a potential target for RCS.

Figure 2.3: Residential Energy Use by Function in 1984



Source: DOE/EIA

Participation Rates Lower Than Expected

In 1977 the President proposed to the Congress a National Energy Plan with a goal of reducing the nation's dependence on foreign oil supplies. To this end the plan established two national objectives: (1) insulating 90 percent of existing houses by 1985 and (2) increasing the use of solar energy in homes. The RCS program was intended to aid in achieving these goals. DOE indicated in its report Residential Conservation Service Program Regulatory Analysis (Oct. 1979) that to meet this 90-percent goal, the RCS program would have to achieve an annual response rate of 18 percent for 5 years. However, on the basis of DOE's analysis of other

[9]NECPA allowed single, mobile, and 2- to 4-unit multifamily dwellings to participate in RCS. These households constitute about 85 percent of all residential households. Most of these households are covered by large electric and gas utilities in the program. In addition, the Energy Security Act also allowed multifamily dwellings larger than 4 units, with separately metered heating and/or cooling systems, to participate. However, data were not available to determine what percentage of these dwellings is separately metered.

programs similar to RCS, the maximum response rate DOE expected for a program with a free home energy audit was about 7 percent per year or 35 percent for the 5-year period. DOE's analysis noted further that with a home energy audit cost of "less than $15," a 1.5 percent per year response rate was expected, or 7.5 percent for 5 years.

Nationwide Utilities

On the basis of information we obtained from DOE and our own analysis of 228 utility responses to our national questionnaire, RCS program participation rates have lagged behind expected rates. According to a 1986 report prepared for DOE by Centaur Associates, Inc., and DHR, Inc., Update of the Evaluation of the Residential Conservation Service Program (Sept. 24, 1986), approximately 5.9 percent of all eligible customers had received RCS audits as of September 1985. To verify this cumulative program participation rate, we sent a national questionnaire to 262 utilities involved in the program and collected similar information from the remaining 36 utilities. Because not all the utilities responded to our national questionnaire (228 responded), we were unable to calculate a nationwide cumulative participation rate that included all eligible utility customers. Nonetheless, 211 of the 228 utilities responding to our questionnaires, or 70 percent of all utilities in the program, did provide their cumulative participation rates in the RCS program. The median cumulative participation rate of the 211 utilities from 1981 through 1985 was about 2 percent. A more detailed examination of this participation rate indicates that about two thirds of the utilities had participation rates of 5 percent or less. (See fig. 2.4.) Although the median participation rate from the 211 responding utilities cannot be directly compared to DOE's estimate,[10] the results show that from either perspective, cumulative program participation has been lower than anticipated. Nonetheless, some utilities did have higher participation rates. For example, 11 responding utilities reported participation rates above 25 percent.

Participation rates reported by some utilities may, however, be somewhat overstated. In some instances, utilities may have included other

[10]The DOE participation rate was calculated by dividing the cumulative RCS audits given nationwide by the total eligible customers. Our median participation rate reflects the middle estimate by the 211 responding utilities of their cumulative RCS participation from 1981 through 1985 (i.e., there was an equal number of utilities with estimated rates above and below the 2-percent figure). Using two DOE contractor reports on the RCS program, 1983 RCS Evaluation Highlights: Cost-Benefit Evaluation of the Residential Conservation Service Program (Dec. 1983) and Update of the Evaluation of the Residential Conservation Service Program, Vol. I: Report (Sept. 1986), the median participation rate in the program as reported by states was 1.8 percent and 2.1 percent, respectively.

EIA Report on Conservation Potential

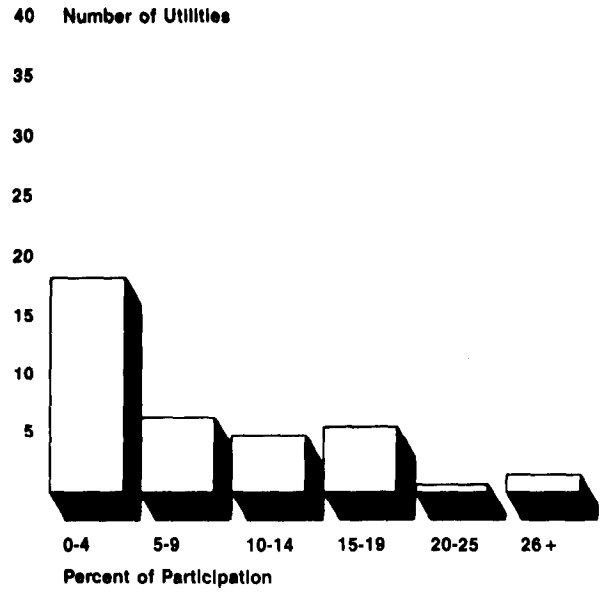
We requested that EIA prepare a report assessing the potential for residential conservation energy savings largely on the basis of an analysis of information collected in its Residential Energy Consumption Survey (RECS).[1] RECS is a survey of households with a sample size varying between 4,000 and 6,000 households, carried out nationwide by EIA annually from 1978 through 1982 and in 1984. The survey collected information on residential energy use (e.g., energy used for space heating and cooling), conservation measures in place in existing homes, and conservation behavior.

Since the RECS data did not show a statistically significant change at the 95-percent level of confidence in the prevalence of residential conservation measures between 1978 and 1984, the data presented in this report, unless otherwise specified, are for 1984. Not finding a statistically significant change in the RECS data does not rule out the possibility that a change occurred. If the amount of change was relatively small, the RECS sample size may not have been large enough to detect it. For example, the percentage of single-family homes with attic insulation observed in the RECS data would have had to increase by more than 5 percent between 1978 through 1984 in order for it to be considered statistically significant at the 95-percent level of confidence. Nonetheless, RECS data represent the most up-to-date, detailed national information available on conservation measures and practices in existing homes. EIA had not previously analyzed this information from the perspective of residential conservation potential.

Because the 1984 RECS data were preliminary when EIA conducted its analysis, the associated standard errors were estimated using an equation derived from 1982 RECS data. Since the 1982 and 1984 sample sizes were similar, EIA believed that no large difference would exist between these preliminary standard errors and final standard errors. All figures in EIA's report are accompanied by their associated sampling errors at the 95-percent level of confidence (1.96 x preliminary standard error). We subsequently developed three tables by collapsing certain data categories from EIA's report. EIA then calculated the associated sampling errors for these three tables. Because these calculations occurred after the 1984 RECS data were finalized, these sampling errors are based on the actual 1984 equation rather than the earlier estimated one. Sampling errors for EIA data cited in this report are shown in appendix II.

[1]EIA's report, Residential Conservation Measures (SR/EEUD/86/01) was published July 9, 1986.

Figure 2.5: Participation in Eight States



Note: Percent of participation rounded down to the integer (e.g., 9.8 becomes 9).

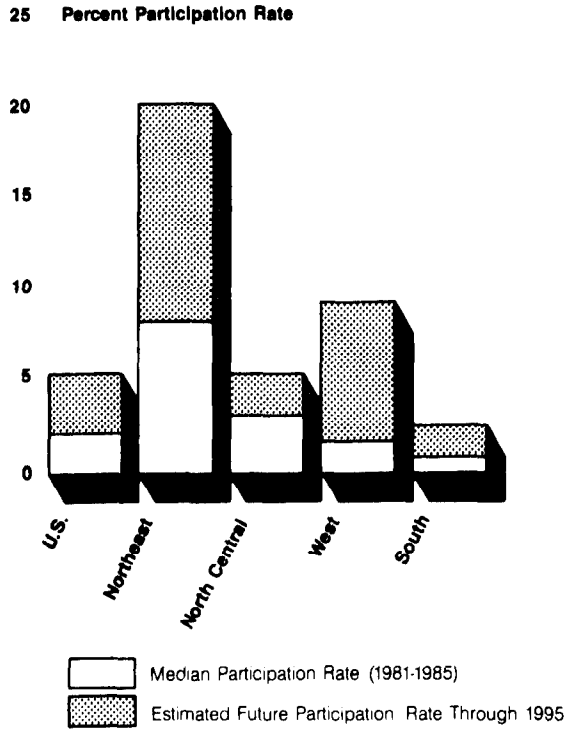
Source: 8 case-study state survey. 36 utilities responded to the question.

Projected Participation

While program participation rates have been low nationwide, utility and state agency officials projected that cumulative participation rates in the future will be somewhat higher than the current median participation rate of about 2 percent. We surveyed utility and state agencies in our eight case-study states and nationwide to obtain their estimates of the percentage of their eligible households that would receive an RCS home energy audit by December 31, 1995, with and without the continuation of program announcements.

Figure 2.6 summarizes and compares nationwide and regional RCS participation rates from 1981 through 1985 and utilities' estimates of the percentages of households that are likely to participate in the program through 1995 if program announcements are continued. Responding utilities' median estimates of the increase in RCS participation range from about 2 percent (the current median) to about 5 percent if program announcements are continued and to about 4 percent if they are not. This is as compared to the median state agency estimate of about 8.5 percent if program announcements are continued and 7.2 percent if they are not.

Figure 2.6: Utility Estimates of Past and Future Participation Rates, Nationwide and Regional



Source: GAO National Survey.

Substantial regional differences arose in RCS participation rates to date and utility estimates of future participation rates. For example, figure 2.6 shows that the 8-percent median participation rate reported by utilities in the Northeast was substantially above that of other regions. Further, the 20-percent median participation rate estimated by utilities in the Northeast through 1995, a 12-percentage-point increase, is well above those of the other regions.

Installation of Recommended Conservation Measures

Participation in the RCS program means that a utility customer requests an audit but does not imply that the customer will install additional conservation measures or adopt behavioral changes in order to conserve energy after the audit. The most recent RCS program evaluation report prepared for DOE, Update of the Evaluation of the Residential Conservation Service Program (Sept. 24, 1986), pointed out, however, that most program participants carried out at least one of the recommended

actions suggested by the auditor during an RCS home energy audit. Further, the report noted that low-cost items, such as weather stripping, caulking, and water heater insulation were the most frequently adopted measures.

DOE's report stated that low-cost measures were installed 30 to 50 percent of the time they were recommended to participating households. Among the higher-cost measures, thermal integrity improvements such as insulation and storm windows, were typically installed 20 to 40 percent of the time they were suggested.[11] Therefore, according to DOE's report, less than half of the recommended conservation measures were installed by participating households.

Both the participation rate and the adoption of conservation measures are influenced by a household's perception of the cost-effectiveness of conservation activities. For example, more activity would be expected where the climate requires more heating energy consumption or during periods of high energy prices. In general, participation rates and the adoption of conservation measures are not expected to approach 100 percent because some households will judge these activities not to be cost-effective.

Likely Participants May Have More Measures in Place

Although most residential households are eligible to participate in the RCS program, some households are more likely to participate than others. According to the 1986 DOE report cited above, participants in the RCS program tend to have

- higher household incomes;
- larger, owner-occupied homes;
- higher levels of education (usually college);
- higher energy bills;
- greater levels of past conservation actions; and
- younger heads of household.

[11] In both instances, where either low- or high-cost conservation measures were installed, nonparticipants also installed conservation measures. However, data on the frequency with which conservation measures were installed in participants' houses, compared to nonparticipants' homes were too limited to be useful.

Using EIA's data we analyzed the extent to which relationships exist between the presence of energy conservation measures and (1) household income and (2) household ownership.[12] EIA's study reported that higher income families and homeowners were more likely to have installed certain combinations of conservation measures in their homes than were lower income families and renters. These relationships generally existed both nationally and in the four geographical regions.

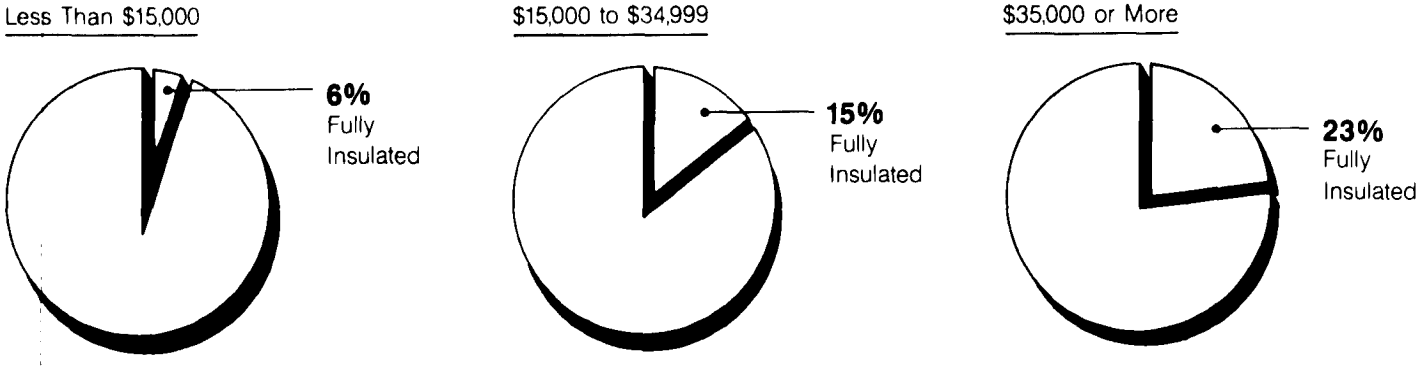
EIA's study showed a strong association between household income and the presence of combinations of conservation measures. As shown in figure 2.7, EIA estimates that for the nation, 6 percent of households with incomes less than $15,000 could be considered fully insulated, while 23 percent of households with incomes of $35,000 or more were fully insulated. Similarly, 46 percent of single-family households with incomes less than $15,000 could be considered largely uninsulated. This is more than twice as large a percentage compared to those with incomes of $35,000 or more.

[12]We did not analyze how other socioeconomic characteristics associated with RCS participants relate to the likelihood of their having conservation measures in place.

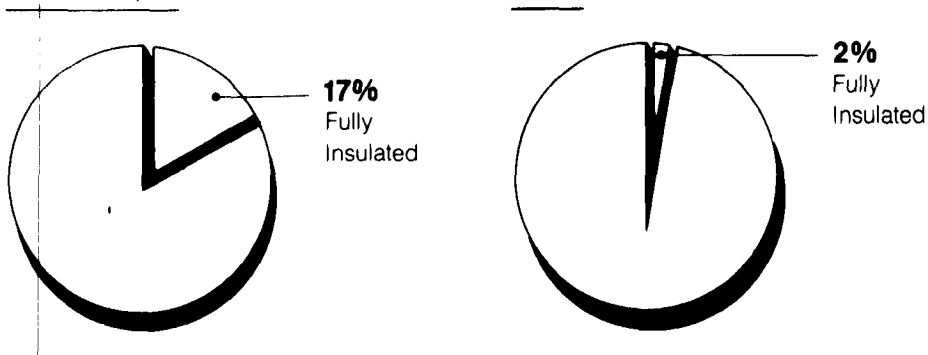
Figure 2.7: Percent of Single-Family Homes That Are Fully Insulated, by Income and Ownership in 1984

RCS participants tend to have high incomes. Single-family households with higher incomes are more likely to be fully insulated than those with lower incomes.

All U.S. single-family households earning . . .



RCS participants tend to own their homes. U.S. owner-occupied, single-family homes are more likely to be fully insulated than those that are rented.



Source: Based on EIA, Residential Conservation Measures, 1986.

In addition to family income, homeowners, as also shown in figure 2.7, were much more likely to have conservation measures than were renters.[13] Nationwide, about 83 percent of single-family housing units were occupied by their owners. About 17 percent of these owner-occupied homes could be considered fully insulated, compared to 14 percent

[13]Renters include only those paying rent.

for all single-family households. However, only 2 percent of homes rented by households could be considered fully insulated. Perhaps even more importantly, 65 percent of rented homes could be considered largely uninsulated, compared to 25 percent of owner-occupied homes that were largely uninsulated.

Summary

In principle, the RCS program has the potential to reduce energy consumption by residential households by encouraging them to install conservation measures. Installing these measures could reduce space heating, cooling, and hot-water heating energy use, which in 1984 accounted for about two thirds of all energy used in the residential sector. For example, while a large percentage of single-family residential housing units have at least some individual conservation measures, only about 14 percent of these units nationwide were fully insulated. In addition, about 31 percent of single-family households nationwide were largely uninsulated. Therefore, the potential for installing additional energy conservation measures in single-family houses would appear to be considerable.

Nationwide the RCS program's participation rate has been lower than expected. Although some increases are anticipated by states and utilities, cumulative participation nationally will probably remain relatively low. On the other hand, the Northeast appears to have experienced the highest regional participation rate in the country. Further, the greatest future participation in the program, according to responding states and utilities, is also expected to occur in this region. Nonetheless, participating households generally install less than one half of the recommended conservation measures. It appears, therefore, that the RCS program has contributed little, thus far, to increasing the installation of conservation measures nationwide in the residential sector. EIA's 1986 study lends support for this conclusion, since it shows that while the percentage of households with some individual conservation measures may have increased between 1978 and 1984, the increase was too small to be measured with any statistical confidence.

Program Costs

DOE reported that a total of about $520.5 million was spent on implementing the RCS program through 1985. Utilities spent $489.8 million, or 94.1 percent of this total; DOE spent $23 million, or 4.4 percent of the total; and states spent $7.7 million, or 1.5 percent of the total.[1]

Utility costs for the RCS program may be influenced by several factors, including the number of eligible customers and utility aggressiveness in promoting the home energy audit. However, variations in the accounting methods used by utilities make exact comparison of their program expenditures difficult. In 1984 the median utility cost per RCS audit reported by utilities responding to our nationwide questionnaire was $113. Utilities charged $15 or less to persons receiving the audits. The remaining costs were recovered through energy rates charged to utility customers. The median annual cost to residential customers in 1985 reported by the 129 utilities responding to this question was about 45 cents.

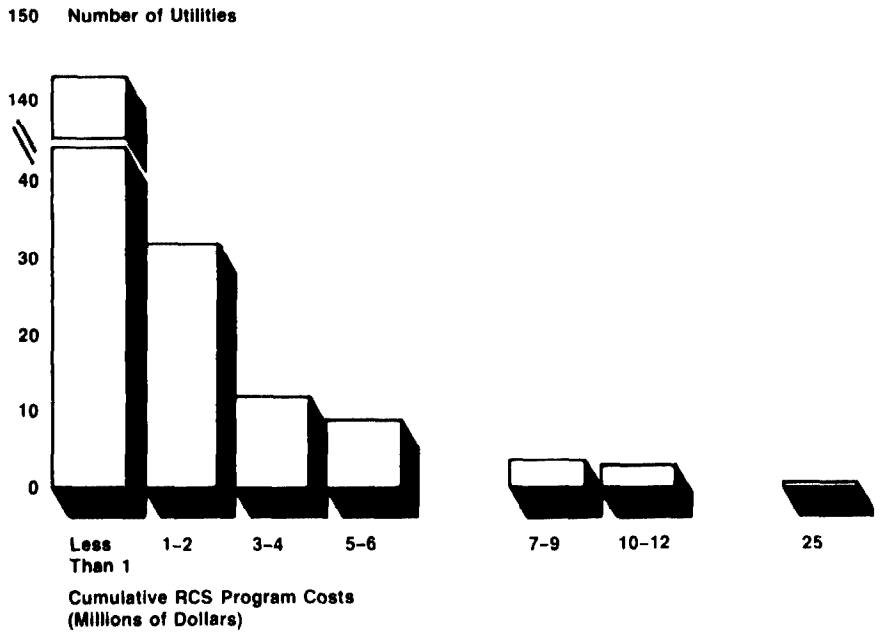
Utility Costs

In our nationwide questionnaire, we asked utilities to provide information on what their costs were to operate the program between 1981 and 1985. As shown in figure 3.1, the range of cumulative program costs reported by the 204 responding utilities were from $100 to over $25 million, with a median cost about of $405,000.[2] About 60 of the utilities incurred program costs of $1 million or more. Because DOE did not approve all state plans during the first year of the program, not all utilities were operating the RCS program continuously between 1981 and 1985. Therefore, the median cost was probably lower than it would have been if all utilities had been operating the program for 5 years.

[1]Costs as reported by DOE in 1984 dollars.

[2]Gas utilities in Connecticut did not report program costs. In Connecticut the RCS program is implemented by ConnSave, a consortium of electric and gas utilities. ConnSave had total program costs of $21.9 million during the program years 1981 through 1985.

Figure 3.1: Cumulative Program Costs for 204 Responding Utilities



Note: All values less than $1 million were placed in the "less than one" category. The remainder of the data (all values of $1 million or more) were rounded down to the whole million (e.g., $1.7 million became $1 million).

Source: GAO National Survey. 204 utilities responded to this question.

RCS program costs may vary for a variety of reasons in addition to the number of years utilities operated the program. The number of customers a utility served, ranging from several thousand or less to several million, could have an impact on a utility's total cost to carry out the program. How much a utility spent to advertise or market the program also affected total program costs (see ch. 5).

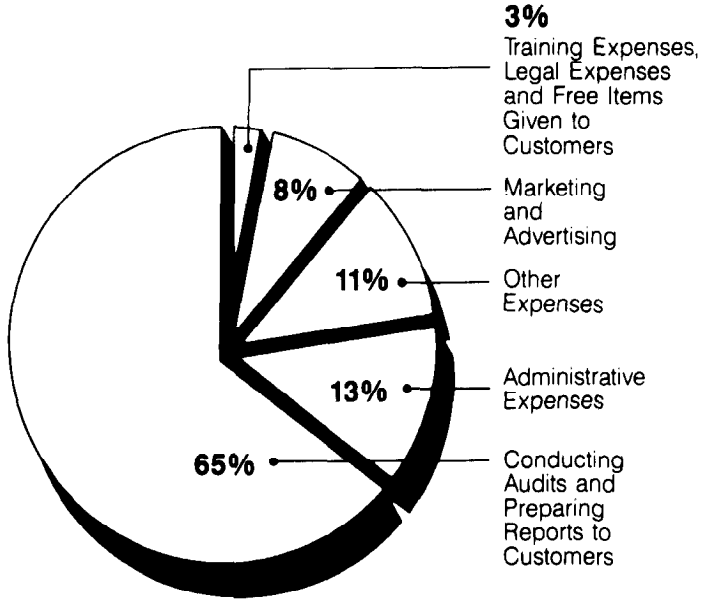
In the eight states we visited, the costs that utilities incurred to implement the RCS program between 1981 and 1985 ranged from a high of almost $51 million to a low of zero with a median cost of $552,900. One reason the median program costs for utilities in our eight states was above the median for utilities responding nationally may be that many of the utilities in the visited states tended to market and promote the home energy audit program more aggressively, as indicated by their use of multiple marketing strategies, rebates, and low-interest loan programs.

Utility Expense Categorization

DOE does not require utilities to maintain accounting records that categorize RCS program expenses according to the type of expense involved in implementing the program. In our eight case-study states, utilities used different accounting methods to document administrative and other program expenses. Further, even within states there appears to be considerable flexibility in terms of categorizing program costs. For example, in Florida one utility separated its program costs into payroll and benefits, materials and supplies, outside services, advertising, vehicles, revenue, and other. Another utility separated its costs into labor, materials, and data processing. Therefore, comparison of the expenses that utilities incurred to implement the RCS program was difficult.

To obtain information on the types of expenses that utilities incurred to implement the RCS program, we asked utilities in our eight case-study states to break down their RCS program expenses into certain categories. As shown in figure 3.2, a tabulation of utility responses showed that the largest percentage of program expenses involved conducting audits and preparing reports for customers.

Figure 3.2: Utility Program Expenses



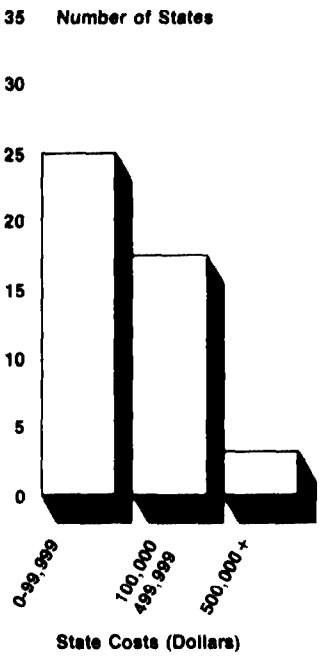
Source: Utilities in the eight case-study states.

DOE and State Costs

Through 1985 DOE spent $23 million to implement the RCS program and the states spent $7.7 million, comprising about 4 percent and 2 percent, respectively, of the program's total cost. The majority of DOE costs, or about $17 million, was spent to administer the RCS program during the first 4 years of the program's operation.

State costs to oversee the RCS program have been the smallest portion of total costs. State RCS-related costs have varied from zero in some states to over $1 million in Vermont. In at least two states—Indiana and Michigan—utilities paid for most or all of the implementation costs of the states' lead agency. Because no tax dollars were used, these states reported no expenses. The median total cumulative cost for states to implement the RCS program was about $72,505. Figure 3.3 shows the distribution of state costs as they have been reported to DOE by state agencies administering the program.

Figure 3.3: State Agency RCS Costs

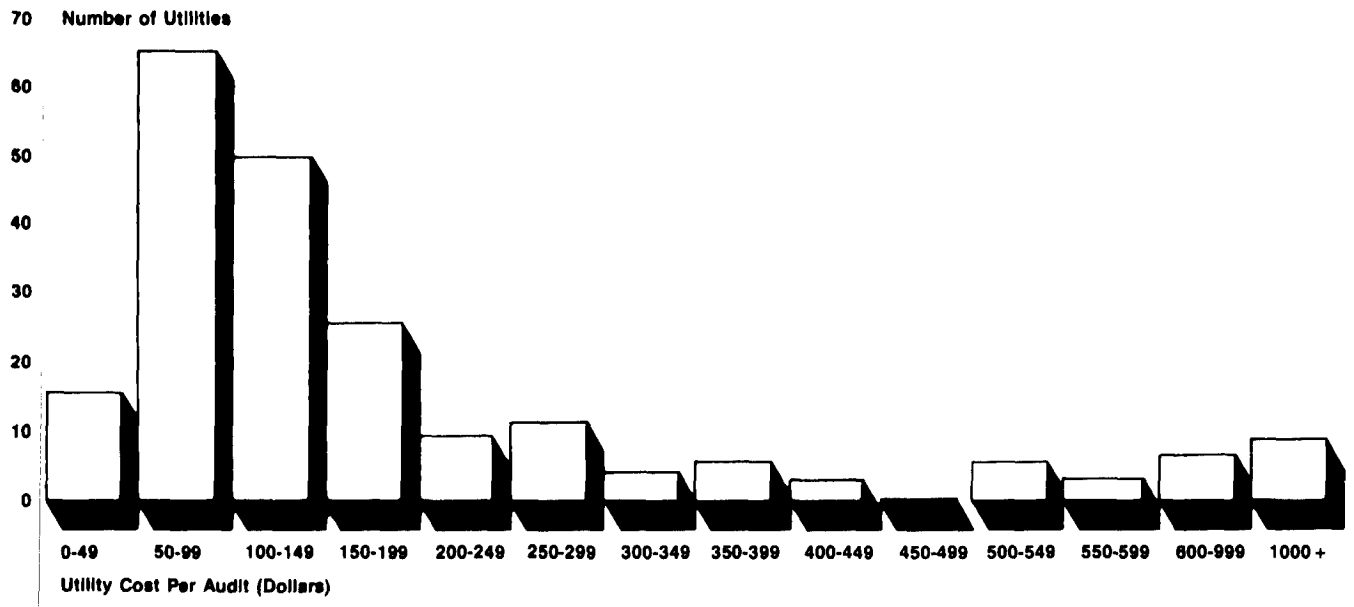


Source: State cost as reported to DOE.

Cost of Home Energy Audit

In our nationwide questionnaire, we asked utilities to provide us information on how much it cost them to conduct a home energy audit. In 1984, a year during which most utilities were operating the program, the median reported cost per audit was $113. As shown in figure 3.4, about 70 percent of the 199 utilities responding reported energy audit costs of between $50 and $200 each. Seven utilities reported audit costs of over $1,000 each, while 14 utilities reported audit costs of less than $50. Utilities reporting very high audit costs generally conducted only a small number of audits. For example, 5 of the 7 utilities with audit costs over $1,000 in 1984 carried out fewer than 50 audits in that year.

Figure 3.4: Average Cost Per RCS Audit in 1984



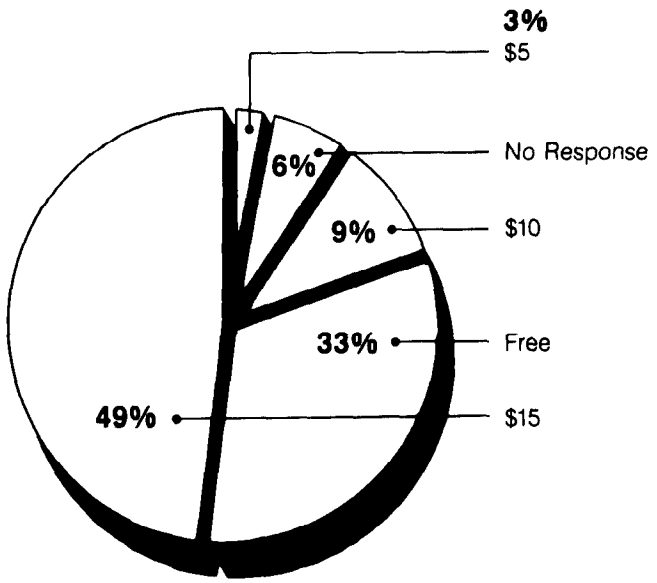
Source: GAO National Survey

Most Costs Passed on to Ratepayers

Utilities recovered their costs of operating the RCS program, including the cost to perform audits, through the audit fee they charged customers who received audits and through rates they charged customers. By law, utilities cannot charge their customers more than $15 for an RCS audit. As shown in figure 3.5, a little under half the 228 utilities responding to our nationwide questionnaire charged their customers the full $15 for

an audit. The remaining utilities charged $10 or $5 or provided the audit at no cost.

Figure 3.5: Customers' Cost of RCS Audits



Source: GAO National Survey.

To determine the effect of the RCS program on utility rates, we asked utilities in our nationwide questionnaire how much of the average annual bill received by a residential customer was attributed to the RCS program. Ninety-three percent of the responding utilities indicated that in 1985, between 1 cent and $2.85 of customers' annual bills could be attributed to the RCS program. The median utility response was about 45 cents. EIA's latest data, Consumption and Expenditures, April 1984 through March 1985, gave the preliminary estimate of the average annual fuel expenditure in 1984 for a residential household at about $1,123.[3] These figures suggest that, overall, RCS program costs were a small share of a residential customer's energy bill.

Summary

Cumulative program costs, which constituted about 94 percent of the RCS program cost, varied substantially among utilities. They ranged from $100 to over $25 million. Nationwide the median total cost to operate RCS programs between 1981 and 1985 was slightly over $400,000.

[3]This EIA report is expected to be published in early 1987. Therefore, this number is preliminary. In 1982, the average annual fuel expenditure for a residential household was $1,048.

Utility costs to perform home energy audits also varied, but about 70 percent of responding utilities reported costs between $50 and $200 per audit. A few utilities reported per-audit costs of over $1,000, although they generally performed few audits. Utilities can recover a maximum of only $15 directly from customers. The remaining utility costs are recovered through rates charged to customers. Utility officials estimated that the effect of the RCS program on customers' utility bills would be very small. For example, in 1985, when utilities spent about $112 million on RCS, they ranged from 1 cent to $2.85 for 93 percent of the responding utilities as compared to customers' average annual fuel expenditures of over $1,000.

Program Benefits

The RCS program could provide a wide range of benefits to participants, nonparticipants, utilities, and society as a whole; however, these program benefits are difficult to measure.[1] Therefore, we solicited views about such benefits from utilities and state agencies in our questionnaires and during our in-depth review in eight states. Further, chapter 6 provides an in-depth discussion of measured energy savings resulting from the program to participating utility customers.

States and utilities most frequently cited increased conservation awareness for participating customers and improved utility-customer relations as major benefits. Utilities and states responding to our questionnaires cited few benefits to society resulting from the RCS program. Few utilities and states indicated that energy savings resulting from the RCS program would be large enough to influence utility rates or defer the building of new power plants.

Potential Program Benefits

Benefits to those participating in the RCS program could include energy savings resulting from the implementation of the conservation measures recommended in an RCS audit, additional comfort from adjusted thermostat settings, lower utility bills, increased resale value of their homes if conservation measures were added, and increased conservation awareness.

Other utility customers not participating in the RCS program could benefit from lower utility rates if energy savings resulting from the program were large enough to reduce or eliminate the need for new and more costly generating plants. Nonparticipants in the program could also benefit from the RCS program in terms of increased energy conservation awareness.

Utilities could benefit from the RCS program if energy savings were large. Large energy savings could reduce the demand for energy, postpone the need to raise capital to construct new power plants, and result in lower costs to supply energy. Utilities could benefit from improved customer relations or relations with regulatory authorities or state agencies as a result of their RCS-related activities.

[1] We did not attempt to analyze the cost-effectiveness of the RCS program because of the lack of reliable data needed to carry out such an analysis. Primary areas of uncertainty are future energy savings, future energy prices, and participating households' expenditures on conservation measures.

Indirect benefits to society could accrue as a result of the program. Purchases of conservation measures, such as attic insulation and storm windows, by program participants could create employment for workers to produce or install these measures. If energy savings were substantial as a result of the RCS program, environmental benefits could occur, such as the deferral or elimination of environmental problems associated with constructing new power plants.

Utility and State Views on Benefits

In our questionnaires, we asked utilities and state agencies to provide their views on benefits that participants, nonparticipants, utilities, and society have received from the RCS program. Utilities and state agencies most often cited increased conservation awareness and comfort as being of great benefit to program participants. Nonparticipants, according to both, received few, if any, benefits. The most often cited benefit to utilities was improved customer relations. Most utilities cited little or no benefit to society in general.

Benefits to Participants

Responding utilities most frequently cited increased conservation awareness as a benefit to customers participating in the RCS program. Seventy-two percent of the 203 utilities responding to the question said that the RCS program had resulted in some or great benefits to participating customers in terms of increased conservation awareness. Twenty-three percent rated the benefit as great. Other benefits to participants were rated as great by 7 percent or less of responding utilities. Forty-five percent of the responding utilities indicated that energy savings were of some or great benefit to participants. (Measured energy savings benefits resulting from the installation of various conservation measures under RCS are discussed in detail in ch. 6.) Increased comfort was cited by 43 percent of the utilities as of some benefit. Sixty-six percent of the utilities said participants received no or little benefit in terms or lower utility bills, and 71 percent said the same about the resale value of participants' homes.

The 36 responding states had views similar to the utilities' about the benefits that program participants received. However, 60 percent of the responding states said that energy savings were of some benefit, and 16 percent said that they were of great benefit. Table 4.1 summarizes utility and state views on the types of benefits program participants received.

Table 4.1: Benefits to Participants

Amount of benefit figures in percent[a]

	Utility views					State views				
	Number answering question	Amount of benefit				Number answering question	Amount of benefit			
		None	Little	Some	Great		None	Little	Some	Great
Energy savings	197	8	47	40	5	25	8	16	60	16
Comfort	194	13	37	43	7	34	6	26	50	18
Lower utility bills	194	15	51	32	3	34	15	26	50	9
Resale value of home	189	37	34	26	2	33	21	39	27	12
Increased conservation awareness	203	6	23	49	23	34	0	15	38	47

[a]Totals may not equal 100 percent because of rounding.

Source: GAO national surveys to utilities and states.

Benefits to Nonparticipants

As shown in table 4.2, 94 percent of the responding utilities and 86 percent of the responding state agencies said that nonparticipants received few or no RCS benefits in the form of lower utility bills. However, 24 percent of responding utilities and about one third of the responding state agencies said that nonparticipants benefited some from increased conservation awareness.

Table 4.2: Benefits to Nonparticipants

Amount of benefit figures in percent[a]

	Utility views					State views				
	Number answering question	Amount of benefit				Number answering question	Amount of benefit			
		None	Little	Some	Great		None	Little	Some	Great
Lower utility rates	185	84	10	4	1	34	68	18	12	0
Increased conservation awareness	195	27	45	24	4	34	26	38	35	0

[a]Totals may not equal 100 percent because of rounding.

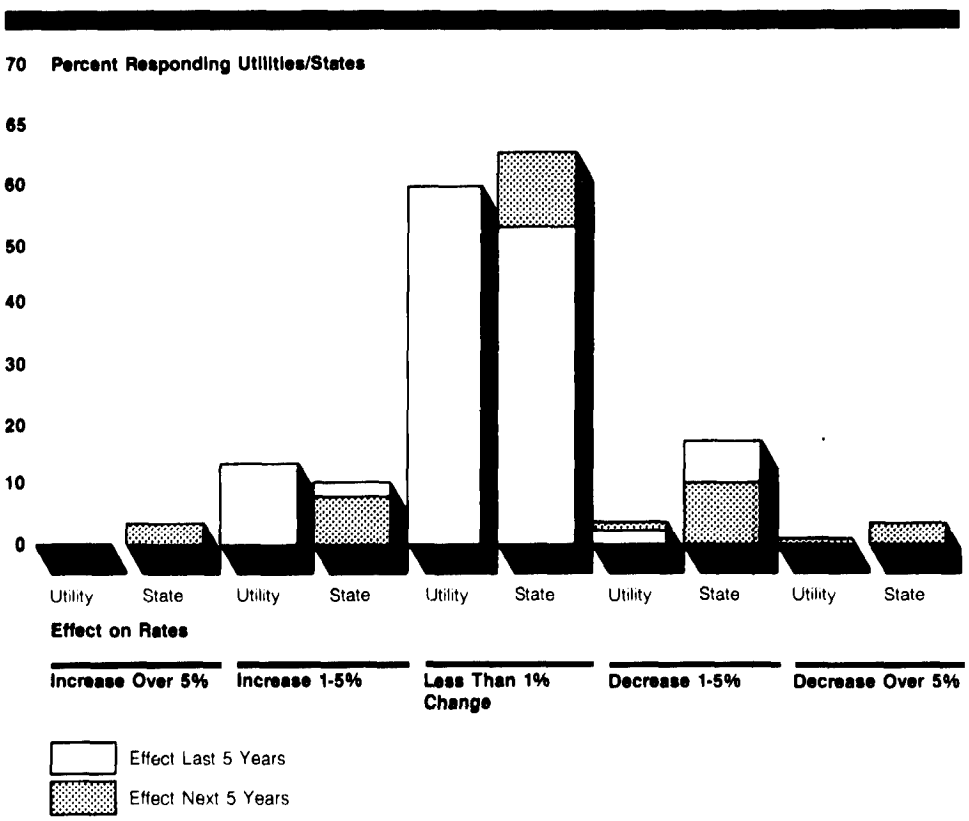
Source: GAO national surveys to utilities and states.

Program benefits to nonparticipating households could be realized through lower customer utility rates. In our questionnaires, we asked utilities and states their views on how the RCS program had influenced, and might influence, residential customer rates during the previous and upcoming 5-year periods.

As shown in figure 4.1, about 58 percent of the utilities and 52 percent of the states stated that the RCS program had influenced residential customer rates less than 1 percent. Fifty-eight percent of utility officials

and 62 percent of state officials believed the influence of RCS on rates would remain less than 1 percent in the next 5 years. About 2 percent of responding utilities said that the RCS program decreased residential customer rates more than 1 percent, while 13 percent said it increased rates between 1 and 5 percent. In contrast, a greater percentage of state agencies said that the RCS program decreased rates by more than 1 percent than said it increased them by that amount.

Figure 4.1: Utility and State Views on the Program's Effect on Rates



Source: GAO National Surveys to Utilities and States.

Benefits to Utilities

Table 4.3 shows the utilities' and states' responses regarding RCS program benefits to utilities. The utilities and states responding most often cited improved customer relations as the major program benefit. Nineteen percent of the utilities and 40 percent of the states said improved utilities' customer relations was of great benefit. Improved relations with regulatory authorities or state energy offices was the

next most cited benefit to utilities. Demand management, reduced generating capacity needs, and lower costs to supply energy were most often rated by states and utilities as of little or no benefit.

Table 4.3: Benefits to Utilities

Amount of benefit figures in percent[a]

	Utility views					State views				
	Number answering question	Amount of benefit				Number answering question	Amount of benefit			
		None	Little	Some	Great		None	Little	Some	Great
Demand-side management	192	60	31	9	1	34	47	29	15	9
Reduced future generating capacity	189	71	20	8	1	35	49	37	6	9
Lower cost to supply energy	195	75	20	5	0	35	51	34	11	3
Improved customer relations	206	12	25	44	19	35	6	23	31	40
Improved relations with regulatory authority or state energy office	200	23	27	39	12	34	15	35	32	18

[a]Totals may not equal 100 percent because of rounding.

Source: GAO national surveys to utilities and states.

If energy savings resulting from the RCS program were sufficiently large, utilities might be able to reduce or eliminate the need to build new power plants. To address this issue, we asked gas and electric utilities in our nationwide questionnaire if they believed that the RCS program had helped them defer the construction of additional generating capacity. Eighty-five percent of the 228 utilities said the RCS program had not allowed them to defer such construction, while 7 percent said that it had. The other 8 percent did not respond to the question.[2]

In the eight states we visited, five electric utilities said they had received some benefits in the form of reduced future generating capacity needs. Another 15 electric utilities, however, reported little or no benefit in this regard. One reason only five utilities reported capacity deferral benefits due to the RCS program may be the difficulty of estimating the energy savings associated with the program, as discussed in chapter 6.

[2]Only one utility provided an estimate of this deferred investment--$1,963,350. However, the estimate was based on engineering estimates of the total energy savings associated with RCS audits that the utility had performed. Engineering estimates tend to overestimate energy savings because not all conservation measures are installed correctly. In addition, these estimates do not take into account the effects of installing various measures together or the effects of changes in household behavior, such as adjustments in thermostat settings.

Benefits to Society

Most of the utilities responding said that society had benefited little or not at all from RCS, as shown in table 4.4. Eighty-two percent of the utilities rated the effects on local employment from RCS as being of little or no benefit.

Table 4.4: Benefits From RCS for Society/State

Amount of benefit figures in percent[a]

	Utility views					State views				
	Number answering question	Amount of benefit				Number answering question	Amount of benefit			
		None	Little	Some	Great		None	Little	Some	Great
Increased local employment (e.g. installers, contractors)	203	46	36	14	4	34	26	41	29	3
Minimize environmental impact of utilities	197	75	18	7	1	34	62	21	12	6
Minimize the amount of money going out of state	NA	NA	NA	NA	NA	33	42	27	27	3

[a]Totals may not equal 100 percent because of rounding.

Source: GAO national surveys to utilities and states.

In our questionnaire, we asked states for their views on benefits to society in terms of their individual states. As shown in table 4.4, the benefits most often cited were increased local employment and minimizing the amount of money leaving the state. About 30 percent of the responding state agencies said the program was of some benefit in terms of increased local employment, such as for installers and contractors, and 3 percent said it was of great benefit. For example, state officials in Michigan (in our eight-state, in-depth review) estimated that at least 500 jobs statewide had been created because of the RCS program.

Summary

Because many RCS program benefits are difficult to measure, we obtained utilities' and states' views on the extent to which the program has produced benefits to program participants, nonparticipants, utilities, and society. Both utilities and states gave the highest ratings to increased conservation awareness for participating customers and improved utility-customer relations. They generally believed there were few or no benefits to nonparticipants and society from the RCS program.

Utilities' and states' views varied on the extent to which the RCS program had produced energy savings; producing such savings is a major objective of the program. Sixteen percent of responding states and 5 percent of utilities rated RCS energy savings as being of great benefit, while

60 percent of the states and 40 percent of utilities reported some benefit. The remaining 24 percent of the states and 55 percent of the utilities saw little or no benefit from RCS in terms of energy savings.[3] If total energy savings are sufficiently large, utilities may charge their customers less for residential power (because they can defer expensive new power plants) and thereby reduce customers' utility bills below what they would have been if no energy savings had occurred. However, 94 percent of the utilities and 86 percent of the state agencies saw little or no benefit from the program to nonparticipating customers in terms of lower utility bills.

[3]In chapter 6 we analyzed the results of studies which attempted to quantify energy savings realized by RCS program participants.

Utilities' Program Implementation

To implement the RCS program, utilities used a variety of marketing and promotional strategies including direct mail, television and newspaper advertisements, free audits, and low-interest loans. In some states, RCS program implementation has been consolidated under a single organization, such as ConnSave,[1] to achieve greater program participation.

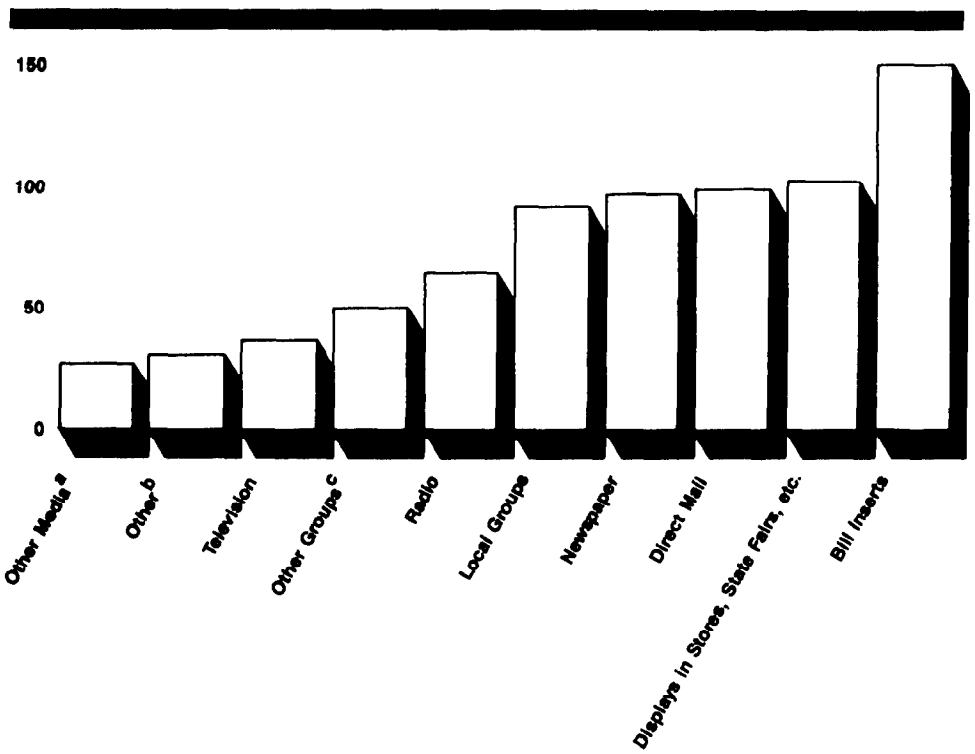
Marketing and promotional strategies used by utilities have affected program participation. Those utilities that used a variety of marketing and promotional strategies, charged less for a home energy audit, and spent more per eligible customer to implement the program had higher participation rates than other utilities. Utilities offering other programs or services in conjunction with an RCS audit, such as low-interest loans to customers installing conservation measures, said they had higher program participation rates as a result.

Implementation Strategies

The 228 utilities responding to our questionnaire reported that they used a number of strategies to market and promote the RCS program. As shown in figure 5.1, these strategies included inserts in customer bills; direct mailings; television, radio, and newspaper advertisements; and promotional displays at shopping centers, stores, and state fairs. Some utilities also used local neighborhood groups, professional organizations, and community action agencies to help promote the program. The most popular advertising strategy among the responding utilities was inserts in customer bills. About 150 utilities, or about 66 percent of those responding, reported using this strategy. Displays in such places as shopping centers and stores were the second most-used advertising strategy with 99 utilities, or 43 percent of respondents, reporting their use.

[1]ConnSave is a nonprofit consortium of utilities in Connecticut that was established to administer the RCS program in that state.

Figure 5.1: Marketing and Promotional Strategies



[a]Includes speakers, bureaus and information centers

[b]Includes newsletters and magazines

[c]Includes service clubs and professional organizations

Source: GAO National Survey.

A number of utilities used innovative methods to advertise the RCS program. For example, utilities in Michigan employed a telemarketing campaign, contacting households directly by telephone. The utilities reported that between 20 and 25 percent of those customers contacted by telemarketing requested an RCS audit. Additionally, the utilities said telemarketing gave them a more consistent participation rate from year to year and better control over the geographic location of their home energy audit workload.

Implementation Methods Other Than Advertising

In addition to advertising, some utilities also charged less than $15 or offered free home energy audits to encourage program participation. Of the total 228 responding utilities nationwide and the 36 utilities in our 8 case-study states, 89, or 34 percent, offered free energy audits in 1984. About 48 percent of the 264 utilities said they charged less than $15 for

the RCS audit. Further, some of these utilities, such as those in ConnSave's program, offered a "sale," discounting the normal $10 price of the audit.

Some utilities combined the RCS program with other conservation programs and services. Nationwide, about 28 percent of the 204 utilities responding to our question offered interest-free or low-interest loans so that households that received an RCS audit could purchase and install energy-efficient measures. For example, in Montana, utilities offered up to $2,000 loans interest-free to RCS home energy audit participants. Depending upon the utility, customers were provided 48 to 60 months to repay the loans. In addition, about 15 percent of the responding utilities nationwide offered free energy kits to customers during the audit. One utility in California, for example, included a hot-water-heater blanket and a low-flow showerhead in its free energy kit whenever an RCS audit was performed. Other utilities said they offered other types of program services and rebates to customers but to a lesser extent.

Utilities have also formed nonprofit organizations to provide RCS home energy audits to eligible customers. For example, utilities in Connecticut established a nonprofit organization— ConnSave—to administer their RCS program. The member utilities, which fund and supervise ConnSave, included municipal and investor-owned gas and electric companies. ConnSave, which is regulated by the state, has been responsible for completing RCS-related tasks that the utilities usually perform, such as marketing the program, arranging and performing audits, and completing necessary administrative tasks. Since 1980 ConnSave has completed 149,435 audits for 5 utilities servicing 95 percent of the state's households. Similar organizations have been formed in other states, such as Rhode Island and Massachusetts.

Strategies' Effect on Participation Rates

Table 5.1 summarizes the promotional strategies used by 228 responding utilities and the utilities' views on their effectiveness in increasing RCS program participation.

Table 5.1: Promotional Strategies by Utilities and Effectiveness in Increasing Participation

Effective figures in percent[a]

Strategy	Utilities using strategy	Not at all effective	Somewhat effective	Very effective
Inserts in or on customer bills	150	21	63	15
Direct mailings	96	23	53	24
Television	33	15	82	1
Radio	67	27	72	1
Newspaper	94	28	70	2
Other media	25	12	76	12
Displays in shopping centers, stores, states fairs, etc.	99	34	62	4
Local neighborhood groups	91	23	56	21
Other groups	49	12	51	37

[a]Totals may not equal 100 percent because of rounding.

Source: GAO national survey.

The most-used strategy, inserts in customer bills, was rated as being somewhat or very effective at increasing participation by almost 78 percent of responding utilities that used this strategy. Although displays in shopping centers were the next most-used advertising strategy, 66 percent of utilities rated it as being somewhat or very effective and 34 percent rated such displays as not at all effective at increasing participation. Direct mailings to customers by utilities were rated by almost 77 percent of utilities as being somewhat or very effective.

Factors Affecting Participation Rates

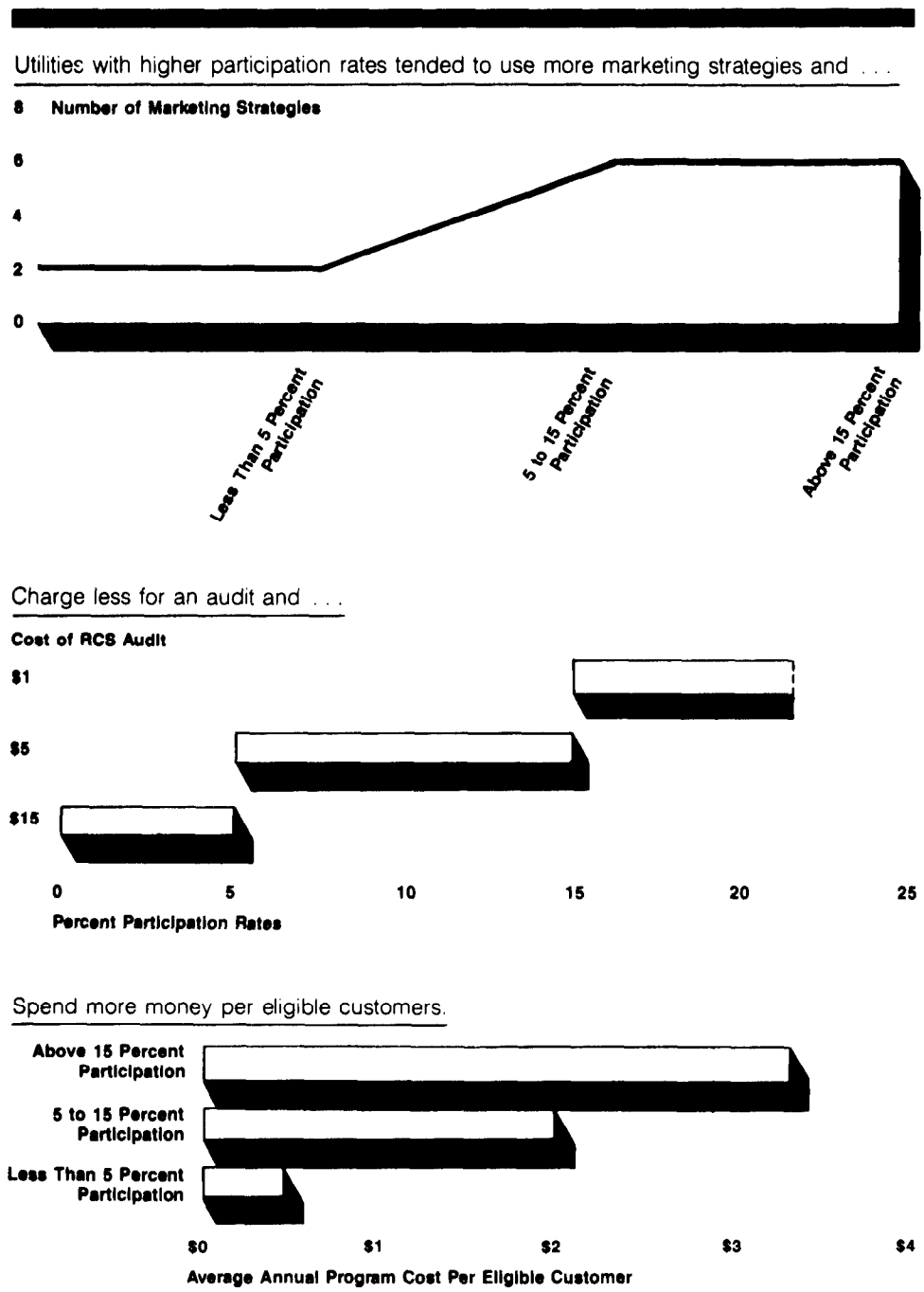
To help determine whether utilities' marketing and promotional strategies affected RCS participation rates, we examined three factors: (1) the number of marketing strategies used by utilities, (2) the amount charged to residential customers receiving audits, and (3) how much money the utilities spent per eligible customer to implement the RCS program. We then separated the utilities into three groups on the basis of their cumulative RCS participation rates: low, with participation rates of less than 5 percent; middle, with participation rates of between 5 and 15 percent; and high, with participation rates above 15 percent. We examined whether statistically significant relationships existed among these groups for the three factors above.

Figure 5.2 shows that utilities with high participation rates consistently used more marketing and promotional strategies, charged less for an RCS audit, and spent more on implementing the program than utilities with low participation rates. These differences were statistically significant,

as were differences between utilities with middle and low participation rates. However, we found no statistically significant differences between utilities with middle and high participation rates.[2]

[2]In addition to these three variables, we also evaluated the relationship between participation and average total program cost per eligible customer. Average total costs are not shown in fig. 5.2 because they do not take into account the number of years a utility had been operating the program. The relationship between total costs and participation was similar to that between average annual cost and participation.

Figure 5.2: Effect of Program Implementation on Participation Rates



Source: GAO National Survey.

On the basis of this analysis, utilities with higher participation rates may have promoted the program more aggressively by using a broader range of marketing strategies, such as mail, television, radio, and other advertising methods. More extensive use of such strategies could be a reason why these utilities spent more per eligible customer than utilities with lower participation rates. Further, the cost of an RCS audit to the customer appears to have influenced participation rates. As the cost of the audit decreased, participation rates increased.

In our questionnaire we asked utilities if they offered other programs or services to RCS participants, such as low-interest loans to assist customers in installing recommended measures, rebates to customers who received audits and installed measures, free energy kits, or other services. Utilities were also asked how these programs or services affected participation rates. Table 5.2 summarizes the responses of the utilities who answered this question.

Table 5.2: Effect of Services or Other Programs on Participation

Increase figures in percent[a]					
Program or service	**Utilities responding**	**No increase**	**Some increase**	**Great increase**	**Don't know**
Low- or no-interest loans	55	22	45	27	5
Rebates	15	33	40	27	0
Free energy kits	32	47	31	16	6
Other[b]	25	16	52	24	8

[a]Total may not equal 100 percent because of rounding.

[b]This included linking the RCS program to state energy conservation grants, the low-income weatherization program, and the state solar bank.

Source: GAO national survey.

Summary

Utilities used a variety of promotional and marketing strategies to implement the RCS program. Some of the strategies they used affected participation rates. For example, utilities that had cumulative RCS program participation rates above 15 percent generally used more marketing and promotional strategies, charged their customers less for an audit, and spent more per eligible customer to promote the program than did utilities with participation rates below 5 percent. In addition, some utilities said other energy conservation programs or services that they offered in conjunction with an RCS audit, such as low-interest loans to customers installing recommended conservation measures, increased program participation rates.

Measured Energy Savings

Energy savings resulting from the implementation of conservation measures recommended in an RCS audit is the most direct benefit to utility customers who participated in the RCS program. To determine the extent to which participants in the RCS program realized measured energy savings, we analyzed five studies conducted in the states of California, Connecticut, Michigan, Minnesota, and Wisconsin.

The studies evaluated the energy savings achieved in households that had participated in the RCS program.[1] However, methodological weaknesses in the studies affected their results. After considering these weaknesses, we believe measured annual energy savings due to RCS are probably in the range from 0 to 4 percent of participants' annual energy consumption. Further, the RCS program's contribution to reducing total residential energy consumption is much smaller since not all customers are eligible to participate in RCS and generally few eligible customers have participated.

Results of Studies

To try to determine whether measured energy savings were realized by RCS participants, we analyzed studies—conducted by DOE's Oak Ridge National Laboratory, a state agency, and a utility—of RCS energy savings in five states. These studies of the RCS program used household-specific data from fuel bill records and regression analysis[2] of these data to control for the influence of factors, other than the program, that affect energy consumption. The following summarizes each study we reviewed, including its estimation of energy savings for program participants.

California Study

The Pacific Gas and Electric Company sponsored an evaluation of the RCS audits conducted for its gas and electric customers in the fall of 1981.[3] The study combined 1 year each of pre- and post-audit fuel records with survey data for samples of about 5,500 participating customers and for about 4,900 nonparticipating customers. The total

[1]RCS participants who add conservation measures can improve the energy efficiency of their homes. Part of the savings that could occur to a household installing them (if thermostat temperatures remain the same) could be taken in the form of increased comfort by setting their thermostat higher in the winter and lower in the summer. Because few data are available about these behavioral changes, they are not included in our analyses.

[2]In statistics, regression analysis determines the extent to which one measure varies predictably in relationship to another.

[3]Pacific Gas and Electric Company, Residential Conservation Services, Audit Program Evaluation Energy Savings Analysis, July 1983.

number of audits performed during the period of the study was not reported. The study used regression analysis to evaluate savings in specific end-use categories and those associated with specific conservation measures. The study reported annual energy savings for participants, due to the program, of 2.4 percent of preprogram consumption for electric heat customers and 3.9 percent for gas heat customers as compared with nonparticipants.

Connecticut Study

This 1983 report, performed by DOE's Oak Ridge National Laboratory in conjunction with Northeast Utilities and ConnSave, studied audits conducted by ConnSave during the spring of 1981.[4] About 8,000 audits were performed during this period. Researchers collected usable fuel consumption and survey data for about 250 participant and 570 nonparticipant households. A neighborhood matching scheme was used to develop the sample of nonparticipants. Despite similarities between the two groups, several differences remained that were statistically significant for some important household characteristics. For example, the sample of participants had more education and higher incomes. Data for one heating season each before and after the audit were collected for electric, gas, and oil heat customers.

The study reported that participating households had greater potential for energy savings prior to the program and had installed more conservation measures after receiving audits than nonparticipants did during the same period.

On the basis of engineering estimates of annual savings that could be achieved with measures installed as a result of an RCS audit, the study estimated that participants cut their annual energy consumption by 10 percent more than did nonparticipants. However, regression analysis of fuel bill records showed no significant difference in energy savings between participants and nonparticipants. The authors noted that the engineering estimates were likely to have overstated energy savings and,[5] therefore, concluded that actual savings due to the program were probably between the regression estimates of no savings and the engineering estimate of 10 percent savings.

[4]Oak Ridge National Laboratory, The Residential Conservation Service in Connecticut; Evaluation of the CONN SAVE Program, Sept. 1983.

[5]Engineering estimates tend to overstate energy savings, as discussed later in this chapter.

Michigan Study

The Energy Administration, Michigan Department of Commerce, conducted a study in 1984 using 2 years of post-audit fuel bill data for natural gas customers of several Michigan utilities.[6] The sample included 493 households that had had audits in 1981 or 1982 and 252 nonparticipating households. Altogether about 176,000 audits were performed in Michigan during this time period, about 5.3 percent of the eligible households in the state. On the basis of a comparison of average consumption levels before and after the audits, the study concluded that households receiving audits reduced annual energy consumption by about 4 percent compared with nonparticipants. This estimate was not based on regression analysis, although some regression results were presented in an appendix. Since the regression analysis was discussed little in the text, we could not evaluate the validity of these results.

Minnesota Studies

Oak Ridge National Laboratory carried out two studies of the RCS program experience of Northern States Power, the largest utility in Minnesota. Both studies focused on the effects of gas customer audits conducted between April 1981 and mid-1982. A total of about 12,000 households received RCS audits between April 1981 and December 1982. The first study (December 1983) analyzed first-year savings due to the RCS program in 344 audited and 151 nonaudited households.[7] The second, which included data on 245 audited and 107 nonaudited households for 2 years after the audits, was completed in January 1985.[8] In addition to examining fuel records, Oak Ridge collected survey data concerning household characteristics that could influence energy consumption, including conservation actions taken before or after the audit period.

The 1983 study concluded that annual energy savings due to the program for participants were about 3 percent of preprogram use. Similarly, the 1985 study found that participants' annual energy savings 1 and 2 years after participation in the program ranged from 2 to 3 percent of their preprogram natural gas consumption use. The study also reported that total natural gas savings, when RCS and other factors such

[6]M. Kushler and P. Witte, Longer Term Fuel Savings Impacts of RCS Home Energy Audits in Michigan: A Two-Year Post-Audit Analysis, Energy Administration, Michigan Department of Commerce, 1984.

[7]Oak Ridge National Laboratory, Evaluation of Home Energy Audit and Retrofit Loan Programs in Minnesota: The Northern States Power Experience, 1983.

[8]Oak Ridge National Laboratory, Energy Savings One and Two Years After Participation in Minnesota Home Energy Audit and Retrofit Loan Programs, 1985.

as increases in energy prices were considered, were 7.4 percent for the first year of the audit and 10.5 percent for the second year. Net savings were larger for audit recipients who also participated in the utility's loan program (14 percent).[9] Participants were more likely to install conservation measures, such as insulation, than nonparticipants, but the adoption of conservation practices, such as reducing thermostat settings, was about the same across the two groups.

Wisconsin Study

A 1982 study by Oak Ridge focused on the heating energy savings of 466 Wisconsin Power and Light (WP&L) gas customers who received audits during 1978.[10] The total number of households receiving audits during the time period covered by the study was not reported although the study noted that by June 1980, about 19,000 audits had been delivered, about 25 percent of WP&L's customers. Fuel bill data for 3 years were collected for households that had received audits and 384 that had not. The study evaluated natural gas savings by customers both 1 and 2 years after they had received an RCS home energy audit. The customers of WP&L differed from those of the other studies in that they were from small cities or towns.

On the basis of regression analysis, the study concluded that annual energy savings due to an RCS home energy audit were about 1 to 2 percent of participants' preprogram consumption as compared with that of nonparticipants. The study reported that participants adopted more conservation measures, but the use of conservation practices appeared about the same for both RCS program participants and nonparticipants.

Methodological Problems With Savings Estimates

The five studies we analyzed reported annual energy savings ranging from 1 to 4 percent for participants compared with that of nonparticipants. Because of methodological weaknesses in each of the studies, however, the estimated savings are uncertain. Weaknesses included self-selection bias (i.e., customers chose whether to participate in the program), data limitations such as samples that may not represent the population in the area, and violations of statistical standards such as multicollinearity (i.e., variables that are so closely related it is difficult to determine which is influencing savings).

[9]The loan program involved primarily urban customers while the RCS program involved suburban customers. This difference could affect the energy savings to each group.

[10]Oak Ridge National Laboratory, Evaluation of Utility Home Energy Audit Programs: A Wisconsin Example, 1982.

Self-Selection Bias

Self-selection bias may arise because utility customers chose whether or not to participate in the RCS program. That some customers chose to participate may show that they are more conservation-conscious. That possible factor must be taken into account when computing energy savings resulting from the program. For instance, some participants may have decided to install energy conservation measures even if they had not participated in the RCS program. This seems likely because the sample of participants in these studies differed from nonparticipants in ways that were likely to affect their energy consumption and conservation behavior. For example, most of the studies showed that participants had higher average incomes than did nonparticipants. EIA's study discussed in chapter 2 shows that income is likely to be associated with more conservation activity.

Among the studies we reviewed, the Minnesota study reported that many households installed conservation measures before receiving their energy audits, suggesting that the audit was not the only influence on the decision to install measures. Little is known about the magnitude of the self-selection bias. The 1983 Minnesota study reported in an appendix that a test for self-selection bias showed that it had an insignificant effect on the energy savings estimates. That result may be unreliable, however, because few high energy-using households were among the sample of nonparticipants relative to the sample of participants. A study for the Electric Power Research Institute (EPRI) using a more sophisticated regression methodology found that correcting for self-selection bias could reduce energy savings estimates for some conservation programs by more than 50 percent.[11]

Data Limitations

We identified several limitations in the data used by these studies to estimate energy savings. For example, an important concern in analyzing such studies is whether the samples drawn for the study are representative of the population from which they are drawn. Some of the studies used samples that were small relative to the total population of utility customers, which raises concerns that the results may not accurately represent the underlying population. The problem was compounded in some studies because incomplete or missing data on some

[11]EPRI, Measuring the Impact of Residential Conservation, Vol. 2, An Econometric Analysis of Portland General Electric Company Data, (1984) pp. 4-18.

households reduced the samples.[12] A related problem in the studies was the high rate of nonresponses on some of the survey questions used to collect data. As the Wisconsin study acknowledged, this problem complicates the interpretation of the regression results. None of the studies use robust regression techniques[13] that produce estimates that are less sensitive to the presence of such problems in the data.

Violations of Statistical Standards

Several important statistical criteria associated with the use of regression analysis may have been violated in the studies. If these standards are not met, or if we cannot judge from the studies whether they are met, the single-value estimates from the regression analysis may not be reliable.

An important potential problem in the analyses for each of the studies we reviewed is the potential for multicollinearity, or near dependence between the variables expected to influence energy consumption. Multicollinearity makes it difficult to estimate the effects of any two variables that are related. Thus, some of the effect due to one of the variables may be erroneously attributed to the other. Since the authors do not report the results of tests for this problem, its impact is unknown. However, the large number of variables in some of the studies means that multicollinearity is likely.

Another problem in some of the studies is the inappropriate treatment of data values that are much larger or smaller than average. In the 1983 and 1985 Minnesota studies, for example, some households were dropped from the analysis because their estimated energy consumption was considered abnormal. Subjective criteria were used for determining abnormality of observations instead of consistent statistical criteria. Since data that were substantially different than average can have very diverse effects on regression estimates, one preferable method might have been to include these observations by using robust regression techniques.

[12]In the 1985 Minnesota study, for example, Oak Ridge excluded a large number of households from the final sample because they viewed them as unrepresentative or because data were missing on some of their characteristics. Similar reservations about small, possibly unrepresentative samples affect the Michigan and Connecticut studies' results.

[13]These are statistical techniques that are insensitive to minor deviations from statistical assumptions.

Another statistical problem was the omission of key variables. In the Wisconsin, Michigan, and California studies, some key variables were excluded from the regression analyses because of incomplete data or insufficient variation across households. For example, none of those studies included the price of energy in their regression models of energy consumption. In the California study, the price of energy rose 20 percent during the timeframes in the analysis. Since RCS households consumed more energy than nonaudited households, they may have been affected differently by this price increase. The omission of key variables causes concern because these variables might affect the relationship between other variables, including the role of RCS program participation, and energy consumption.

Other Problems

In the Connecticut study, as we noted above, the savings estimates due to RCS are based partly on engineering estimates of savings that might be expected when certain conservation measures are installed. These estimates may overstate actual savings because they assume no errors are made in the installation of the measures and because they do not take into account the interactions between measures when more than one are installed. These estimates also assume that no change is made in household behavior toward energy conservation (e.g., changing thermostat settings). Since the analysis of fuel bill records in the Connecticut study found no statistically significant evidence of savings due to the RCS program, we do not believe the study provides reliable evidence of any energy savings. According to the authors of that study, however, possible data quality problems in their fuel record data may have affected their results.

Estimated Energy Savings

Although statistical weaknesses exist in the studies, four of the five studies provided evidence of energy savings as a result of the RCS program. Because of the statistical weaknesses in the studies, the actual value of those savings are uncertain. Given the uncertainty, we believe the studies' results should be presented as confidence intervals, which reflect a range of likely values of energy savings. The confidence intervals we calculated are shown in table 6.1. The Connecticut study did not have adequate evidence to support an estimate of energy savings.

Table 6.1: Participants' Likely Range of Annual Household Energy Savings Due to RCS

State	Savings (percentage of consumption)
Minnesota	From 1 to 4 for gas heat
Wisconsin	From 0 to 2 for gas heat
Michigan	From 0 to 4 for gas heat
California	From 0 to 4 (0 to 2 percent for electric and 0 to 4 percent for gas)

Source: GAO analysis of 4 studies.

One way to put this range of measured energy savings attributable to households' participation in the RCS program into perspective is to compare them with these households' total energy consumption during the same period. For example, in the Minnesota study, RCS program participants reduced energy consumption as a result of factors other than the audit, such as increases in energy prices.[14] Participants reduced their total consumption, compared with their preprogram level, by 7.4 percent the first year after the audit. The reduction in total consumption due to RCS ranged from 1 to 4 percent. Therefore, about 14 to 54 percent of the total reduction in energy consumption of 7.4 percent for participants during this period could be attributable to the RCS program.[15]

Although RCS may have contributed to some extent to the overall reduction in an individual participant's energy consumption, its contribution to a utility's overall energy needs appeared to be very small. To obtain perspective on the effect of RCS program savings on a utility's overall energy needs, we used the participants' estimated savings from the Minnesota study to calculate the approximate reduction in the utility's (Northern States Power) gas sales to residential customers. Each participant in the program in the years 1981 and 1982 probably saved between 1 and 7 million Btu's (MBtu) per year. Since 12,000 audits were performed during this 1-year period, this translates into total annual energy savings of 12,000 to 84,000 MBtu's. On the basis of average energy consumption values reported in the study, the total consumption by all eligible households during this period was about 81,984,000 MBtu's. Therefore, the savings due to RCS in 1981-1982 represented about 0.01 to 0.1 percent of annual energy consumption by eligible households.

According to our nationwide survey, Northern States Power performed 39,945 RCS audits between 1981 and 1985. If each of these households

[14]In Minnesota the price of natural gas increased about 38 percent in real terms between the heating season prior to the audits and the second heating season after the audits.

[15]As participants continued to reduce total energy consumption in the second year after the audit, RCS' share decreased as a proportion of the total.

reduced their annual energy consumption by 1 to 7 MBtu's, the total reduction in annual energy consumption by RCS participants would be between 39,945 and 279,615 MBtu's. This represents between 0.05 and 0.3 percent of total annual energy consumption by eligible customers in 1981-1982 (81,894,000 MBtu's). This estimate may, however, over- or understate RCS' impact on total energy consumption because, in some instances, both total energy consumption and energy savings to participants may not have remained constant between 1981 and 1985.

It should also be noted that RCS energy savings contribute even less toward reducing energy consumption by all the utility's customers. First, eligible households represent about 75 percent of all residential households in the utility's customer base. Second, residential customers represent only a portion of the utility's total customer base. On a statewide basis, residential customers consumed about 41 percent of all gas used in Minnesota in 1983.

Summary

Measured energy savings is the most direct benefit to utility customers who participate in the RCS program. The five studies we analyzed, which evaluated energy savings in houses that received an RCS home energy audit in five states, had methodological weaknesses that affected their results. Taking into consideration the studies' statistical weaknesses, we considered a likely range of measured annual energy savings for RCS program participants to be from 0 to 4 percent.

RCS may have contributed somewhat to reducing an individual participant's total energy consumption. For example, in the Minnesota study, RCS program participants reduced energy consumption compared with their preprogram level by 7.4 percent during the first year of the audit. The reduction in total consumption due to RCS was about 14 to 54 percent of the total reduction. However, RCS' contribution in terms of reducing a utility's total energy needs was probably very small. The Minnesota study appears to indicate that savings due to RCS in 1981-1982 represent only about 0.01 to 0.1 percent of annual energy consumption by all eligible households.

Other Residential Conservation Programs

Eighty-two percent of the 228 utilities responding to our national questionnaire said they had adopted residential energy conservation programs in addition to the RCS program. Half of these utilities said that their other programs were as important or more important than the RCS program. Eighty-four percent of the utilities that had carried out a written evaluation of their most successful programs also reported that the program they evaluated was more successful than the RCS program in achieving energy savings.

The Conservation Service Reform Act of 1986 allows states to develop and implement alternative residential conservation plans in lieu of RCS. It also allows utilities to obtain waivers from requirements in state plans in order to develop alternative energy conservation programs that are designed to save as much or more energy than the RCS program. Because the act was passed after our audit work was completed, it was not possible to determine how many utilities and states will implement such alternative residential energy conservation plans and programs and the extent to which they will result in greater energy savings than the existing RCS program. However, the act requires DOE to prepare reports in 1987 and 1989 summarizing reports it receives from states on the implementation and results of the alternative conservation efforts.

Reasons for Other Residential Conservation Programs

Many utilities offer other residential conservation programs in addition to the RCS program. Utilities offer some of these programs voluntarily, while others are required by the state in which the utility operates. The type and number of programs utilities offer may depend on both utilities' and states' attitudes toward energy conservation. A utility's attitude toward energy conservation may relate to such factors as the type of energy it supplies, gas or electricity; its costs of generating or purchasing additional energy compared to the cost of achieving energy savings through conservation; and the extent to which conservation activities may achieve other utility objectives, such as improving customer relations and meeting environmental requirements. States' attitudes toward conservation and actions to conserve energy depend on such factors as whether the state produces a large portion of its own energy or must obtain energy from other states and the extent to which population growth in the state or other factors are increasing energy demand.

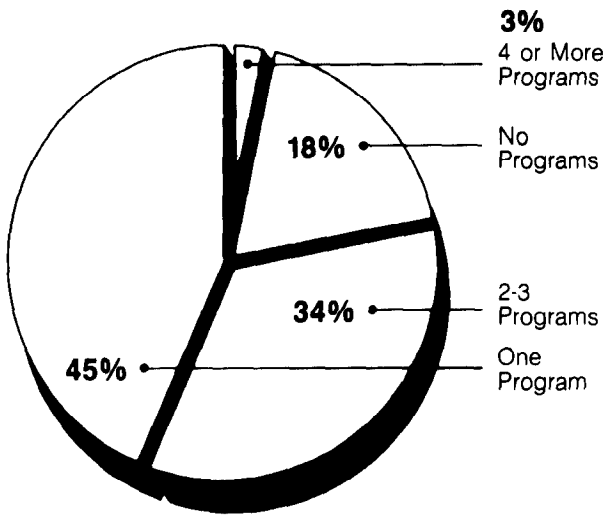
States can influence utility conservation activities in various ways. For example, states, such as Connecticut and Florida, have enacted legislation similar to the residential conservation provisions of NECPA requiring

utilities to adopt residential conservation programs independent of the RCS program. Montana has established incentives for utilities to undertake conservation activities. In Montana, utilities are allowed state tax credits in certain instances when they make low-interest loans to customers who install residential energy conservation measures.

Other Residential Conservation Programs

Of the 228 utilities responding to our national questionnaire, 187, or 82 percent, said they offered at least 1 other residential energy conservation program. Figure 7.1 provides a breakdown of the number of other residential conservation programs offered by the 228 utilities.

Figure 7.1: Alternative Programs Offered



Source: GAO National Survey.

Thirty-three of the 36 utilities we contacted in our 8 case-study states also offered at least 1 other residential conservation program that did not require an RCS home energy audit. Seven utilities offered 1 other program, 14 offered 2 or 3 programs, and 12 offered 4 or more programs. Three offered no programs. The types of programs offered by these utilities included other home energy audits, weatherization services, low-interest loans, and conservation during peak demand periods (load management).

In addition, utilities that purchased power from the Bonneville Power Administration (BPA) and the Tennessee Valley Authority (TVA) also participated in non-RCS programs these two agencies offered.

Other Home Energy Audits

Seventy-four responding utilities said they offered another home energy audit in addition to the RCS audit. For example, several utilities in Florida offered "walk-through" audits in addition to RCS audits. The walk-through audit is similar to the RCS audit in that it requires an on-site survey by an energy auditor. However, the walk-through audit does not use a computer to analyze the results of the survey and generally takes less time to complete than the RCS audit.

Twenty utilities responding to our questionnaire also used mail-in audits. Mail-in audits generally involve homeowners, as opposed to utility representatives, surveying a residence to determine whether conservation measures are present. The results of the survey are then mailed to a utility that analyzes them to determine if additional conservation measures are needed. In addition to these types of audit programs, 13 respondents to our questionnaire offered audits in which community groups were involved in providing audit services.

Weatherization Services

Eighty-six utilities responding to our national questionnaire offered some type of weatherization service. Such services included ones in which conservation materials, such as weather stripping and insulation, were provided to customers and installed in their residences. For example, some utilities in Connecticut offered services through which conservation measures were installed in homes of low-income or disadvantaged persons. These programs were frequently carried out in coordination with various state or community agencies and frequently provided technical advice on conservation measures. The utilities also promoted weatherization services to install low-/no-cost conservation measures for the general population. This was intended to provide a service not readily available from the private sector.

Low-Interest Loans

Some utilities offered programs in which customers were given loans at below-market interest rates to finance the installation of conservation measures in their homes. In some cases utilities linked home energy audit and low-interest loan programs so that customers were able to obtain loans to finance conservation measures that had been recommended in the audit.

Load Management

Utilities were conserving energy during peak demand periods by controlling energy use in residential customers' homes. For example, some Florida utilities visited customers' residences and installed devices on

large electrical appliances (such as hot-water heaters, pool pumps, and electric furnaces) that interrupt the power supply (i.e., turn off the appliance) for 15 minutes during peak demand hours. In return, the customers received a rebate, or credit, on their bills from the utility. Other utilities in our eight case-study states offered rebates to customers who purchased energy-efficient appliances or installed conservation measures and held energy workshops at which they disseminated information on conservation and presented installation demonstrations.

TVA and BPA Programs

Both BPA and TVA have developed an array of residential energy conservation programs independent of the RCS program. BPA is a federal agency that provides electricity to most public utilities in the Pacific Northwest, including Idaho, Oregon, Washington, and western Montana. TVA provides electricity to public utilities in Tennessee, Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia. Utilities purchasing power from BPA or TVA were involved in the two agencies' residential conservation programs.

BPA Programs

BPA administered various energy conservation activities through its participating utilities, some of which are described briefly below.

- The Residential Weatherization Buy Back Program. BPA provides no-, low-, or market-rate interest loans and rebates to finance the installation of conservation measures.
- Model Conservation Standards. BPA's Early Adoptor Program assists municipal utilities in the adoption of model conservation standards (set by the Northwest Power Planning Council)[1] for new construction. Under this program, BPA provides (1) technical assistance, (2) financial assistance to conduct enforcement activities, and (3) some reimbursement to builders who incur additional costs because of these standards.

TVA Programs

TVA has designed conservation and load management programs aimed at reducing energy waste and high-cost peak demand. Utilities obtaining power from TVA offered customers residential conservation services that are part of TVA's "Energy Package," as well as other TVA residential programs.

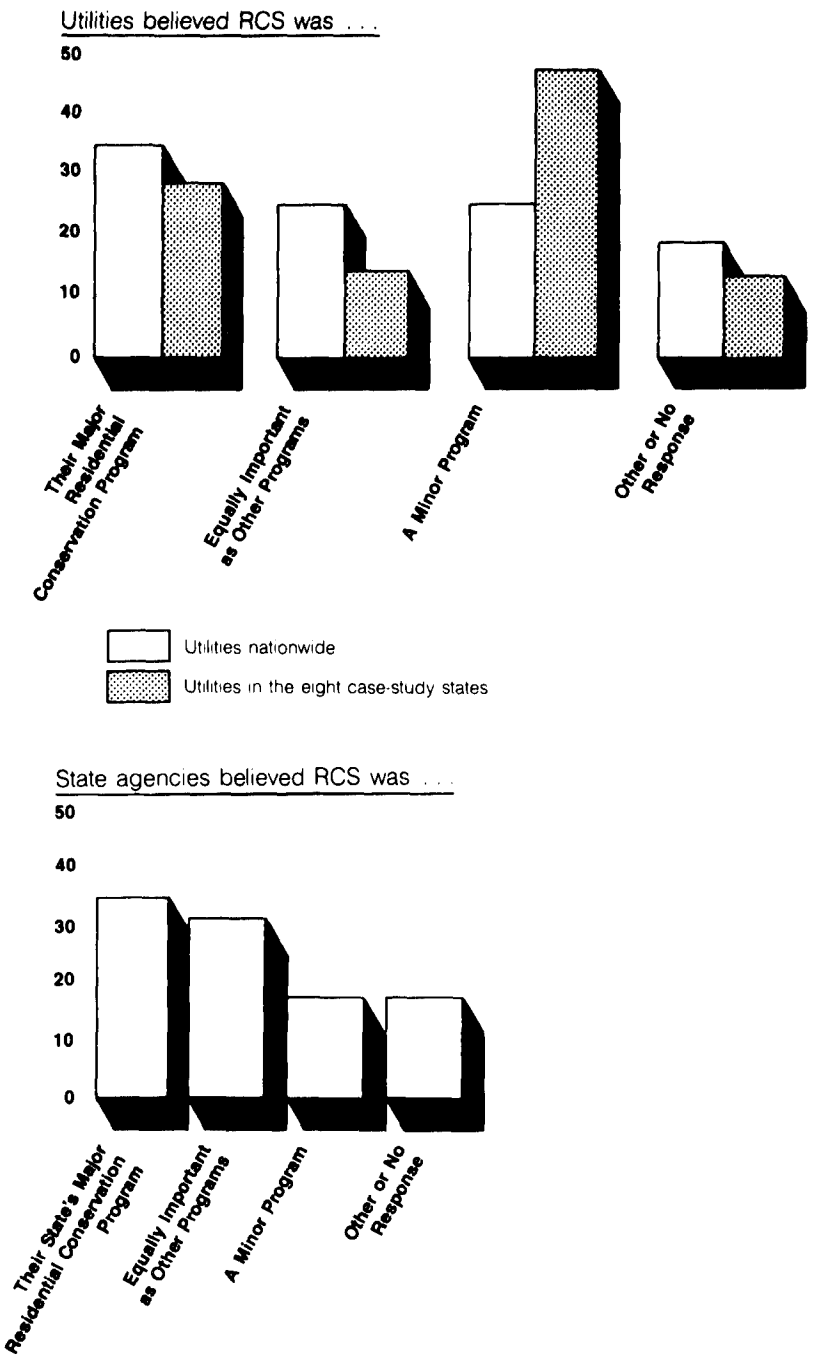
[1]The Northwest Power Planning Council, created in 1981, is required, among other things, to develop and monitor a Northwest regional power plan.

- Weatherization Program. This Energy Package program offers free home weatherization surveys along with no- or low- interest loans. More than one third of all TVA customers have had a free survey since the program began in 1977.
- Cycle and Save. This is a voluntary Energy Package load management program designed to reduce power demand during peak usage periods. Cycling switches are installed on major appliances. In return participating customers receive credit against their electric bills.
- Solar Collection Program. The program helps customers evaluate their own homes to determine the potential for passive solar energy.

Utility and State Views on Importance of RCS Compared With Other Conservation Programs

Utility and state views of the importance of RCS and other conservation programs varied. As shown in figure 7.2, 34 percent of the utilities responding to our nationwide questionnaire and 10 of the 36 utilities in our 8 case-study states (or 28 percent) said that RCS was their major residential conservation program. On the other hand, 25 percent of utilities responding nationwide and 17 of the 36 utilities in our 8 case-study states (or 47 percent) said RCS was a minor program. Of the 29 states responding to our questionnaire, including our 8 case-study states, 34 percent believed RCS was their major residential conservation program while 17 percent believed it was a minor program.

Figure 7.2: Importance of the Program



Source: GAO National Surveys to utilities and states and utilities in eight case-study states

Utility Views on Success of Other Conservation Programs

Utilities frequently viewed their other residential conservation programs as being more successful than the RCS program. Utilities responding to our nationwide questionnaire were asked to identify the most successful residential energy conservation program for which they had performed a written evaluation and to compare it to the RCS program.[2] Sixty-three utilities identified programs they had evaluated, and of these, 26 said their most successful program was a weatherization program, 23 said it was another type of program, and 14 said it was a home energy audit program other than RCS. As shown in table 7.1, 81 percent of the 63 programs identified were viewed as being more successful than RCS in terms of achieving energy savings, and 83 percent were considered more cost-effective to utility customers.

Table 7.1: Comparison of Utilities' Most Successful Non-RCS Program With RCS

Successfulness figures in percent[a]

Criterion	Number responding	Utilities responding viewed non-RCS programs as... More successful	Equally successful	Less successful
Achieving energy savings	63	81	14	5
Cost-effectiveness to utility[b]	60	88	12	0
Cost-effectiveness to all customers[b]	60	83	12	5
Cost-effectiveness to participating customers	63	94	5	2
Increased awareness, by participating customers, of energy conservation	63	68	30	2
Increased awareness, by nonparticipating customers, of energy conservation	55	55	29	16
Making it easier for customers to implement energy conservation measures[b]	57	93	5	2
Making it easier for customers to arrange financing[b]	31	90	6	3
Making it easier for customers to find and hire contractors	39	79	15	5

[a]Totals may not equal 100 percent because of rounding.

[b]Excludes nonapplicable responses.

Source: GAO national survey.

The following are examples of specific programs that utilities cited as being (1) more successful than RCS in achieving energy savings and (2)

[2]We did not assess their evaluations of these programs.

more cost-effective to the utility and to all customers whether or not they participated in the program:

- Weatherization programs cited by utilities included programs in which (1) families with annual incomes of $16,000 or less had conservation measures, such as ceiling insulation, heat pumps, door and window weather stripping, and caulking, installed, (2) low-income families in electrically heated homes were provided audits, weatherization, and consumer education using matching funding from weatherization agencies, and (3) a home weatherization program for senior citizens was administered by senior citizens.
- Other programs included (1) a rebate program in which cash rebates were given for installing high efficiency furnaces and water heaters, (2) a water heater wrap program in which customers were given various conservation measures, and (3) a program in which the utility provided guidance and advice to residential builders and customers on the importance of adequate insulation when installing electric heating.
- Other home energy audits included programs in which (1) all electricity use in the residence was addressed (for example, customers were informed about how use of appliances may affect their bills) and no-cost and low-cost conservation measures were suggested and (2) a free home energy checkup was combined with financing for a high efficiency air conditioning system and attic insulation. A cash bonus was also given for installing a high efficiency air conditioning system.

Reasons Cited for Success of Other Conservation Programs

Utilities in our eight case-study states cited various reasons why other programs were more effective than the RCS program. Some utilities stated that (1) the RCS program was a generic program that did not meet the needs of all utilities, (2) programs developed by the utilities are more flexible and better adapted to their customers' needs, and (3) RCS audit results were not easily understood by customers. In addition, some utilities stated that the RCS audit was requested most often by customers who were least in need of assistance and would benefit the least from it. According to the utilities, such customers were typically better educated and had higher incomes than those not requesting an RCS audit and had already installed conservation measures prior to the audit. Still other utilities stated that the RCS audit, in and of itself, does not provide enough incentives. They believed other programs, such as zero-interest loans, rebates on utility bills, and free conservation supplies, provided customers better incentives for conserving energy.

Several utilities in the eight states we visited had carried out evaluations of other programs. Two of these evaluations compared the success of these programs with that of the RCS program. A major Connecticut utility evaluated its overall energy conservation program and found that several programs, including a weatherization program and an energy-efficient new construction program, were more cost-effective than the RCS home energy audit program it offered. However, the study reported that the RCS program saved more energy over the life of the installed conservation investments than other programs the utility offered in 1985. A California utility conducted a study of the energy savings potential for RCS and other residential conservation programs. The study reported that the potential for energy savings was greater for the RCS program than for most of its other residential conservation programs, including weatherization, energy information, and conservation metering programs.[3]

New Legislation Allows Use of Alternative Programs

The Conservation Service Reform Act of 1986, which modified legislative requirements of the RCS program, allows utilities to offer residential conservation programs in lieu of RCS home energy audits in certain instances. Under the act a utility may obtain a waiver from RCS legislative requirements or from requirements in state RCS plans if the utility can show that as much or more residential energy savings would result from energy conservation programs that would be implemented if the waiver were granted. Further, the act allows states to formulate and implement an alternative state energy conservation plan, keyed to the state's particular energy needs and conservation potential. The state plan must, among other things, be designed to result in annual residential energy conservation savings of 2 percent or more. The state may also establish incentives for utilities to meet the goals contained in the alternative plan.

Since the act was passed after our audit work had been completed, it was not possible to determine how many utilities will offer alternative programs in lieu of RCS home energy audits or how effective they might be when compared with RCS audits. However, the act requires DOE to prepare reports in 1987 and 1989 summarizing reports it receives from states on the implementation and results of alternative conservation efforts.

[3]We did not attempt to evaluate the methodologies used in either study, nor did we examine studies of non-RCS programs carried out by utilities.

Summary

Eighty-two percent of the utilities responding to our nationwide questionnaire offered at least one other conservation program. These programs included other home energy audit, weatherization, load management, and low-interest loan programs. Sixty-three utilities responding to our national questionnaire said they had carried out written evaluations of other residential conservation programs. About 80 percent of these utilities believed that their other programs evaluated as most successful were more successful in achieving energy savings than was the RCS program.

The Conservation Service Reform Act allows states and utilities under certain circumstances to develop and implement alternative residential conservation efforts in lieu of the RCS program. Because the act was passed after our audit work had been completed, we are not in a position to say how many states or utilities will develop or implement alternative conservation efforts. Further, it is not possible to say how successful they will be compared with RCS home energy audits.

Supplying and Installing Conservation Measures

Utilities play an important role under NECPA in encouraging the adoption of residential energy conservation measures. Prior to 1986, the act required utilities to distribute to customers the names of financial institutions, suppliers, and contractors available to assist in homeowner acquisition and installation of conservation measures. The act currently permits utilities, in certain instances, to finance, install, and supply residential conservation measures.

At the same time, NECPA guards against unfair, discriminatory, and anticompetitive behavior on the part of utilities. To prevent utilities from unfairly competing with, or discriminating among, other providers of conservation measures, NECPA requires utilities to obtain exemptions or waivers from DOE before selling or installing residential energy conservation measures.

Of the 298 utilities participating in the RCS program, 69 obtained exemptions and 13 received waivers from DOE. Of the 228 utilities responding to our national questionnaire, 17 said they had received complaints of anticompetitive behavior in 1984 or 1985. NECPA provides state-level redress procedures for persons— including conservation measure sellers and installers—alleging injury due to utility company violations of the state plan. However, according to the responding utilities, no forum for redress has ruled that utility actions have adversely affected competition.

Representatives of several national contractor groups believed that procedures developed by DOE and states under NECPA to provide redress to parties injured under RCS did not provide effective means for resolving their concerns about unfair utility competition and discrimination. Our review indicates that 17 state plans noted that redress was available solely through the courts. Other plans designated state administrative redress procedures or both judicial and administrative procedures. In response to concerns expressed about redress procedures available under state plans, the Conservation Service Reform Act of 1986 modified these procedures. Persons alleging injury as a result of utility activities that may be unfair or anticompetitive are now entitled to either state administrative redress forums or consideration by the Federal Trade Commission.

Legislative and Program Provisions

In establishing the RCS program, the Congress recognized that utilities have potential for encouraging energy conservation improvements by their customers. However, it was also concerned that anticompetitive

effects could result if—in addition to offering home energy audits and establishing lists of suppliers, installers, and financiers of energy conservation measures— utilities were also allowed to sell and install residential energy conservation measures.

Because of these concerns, the Congress, in NECPA, permitted utilities to sell and install such measures under only two circumstances.[1] First, NECPA allows utilities that were already supplying or installing conservation measures when NECPA was enacted to continue to do so through exemptions.[2] Second, it allowed the Secretary of Energy to waive the prohibition against sales and installation of conservation measures if, upon petition from the utility and after consulting with the Federal Trade Commission, the Secretary found that the proposed utility activities would not result in unfair methods of competition or unfair or deceptive acts.

NECPA also requires the Secretary of Energy to monitor utility supply and installation activities and to report annually to the Congress on them. DOE is authorized, after consulting with the Federal Trade Commission, to terminate utility activities that have an adverse effect on competition; that involve the use of unfair, deceptive, or anticompetitive acts or practices; or that involve unreasonable rates, terms, or conditions.

In addition to the above requirements, which directly relate to utility sales and installation of conservation measures, the Congress sought to ensure that utilities do not discriminate against or among suppliers, contractors, or financial institutions when establishing master lists or helping customers arrange for installation. Under NECPA utilities had been required to provide customers with a master list of financial institutions, suppliers, and contractors that sell, finance, or install conservation measures. To ensure that master lists were compiled in a way that did not unfairly discriminate among or against financial institutions, suppliers, or contractors, states had to include, in their RCS implementation plans, procedures that specified how and under what circumstances these business concerns would be included or removed from these master lists. Furthermore, under NECPA and DOE regulations, state plans

[1]NECPA also originally prohibited utilities from financing conservation measures; however, this prohibition was repealed by the Energy Security Act of 1980.

[2]This exemption also covers supply or installation activities that at the time of NECPA's enactment were broadly advertised or for which preparations were substantially completed, as well as activities that were then required or permitted by law or regulation.

were required to extend their redress procedures to persons claiming they have been improperly excluded from such lists.

Utility Sales and Installation of Energy Conservation Measures

According to DOE records, of the 298 utilities participating in the RCS program, 69 have received exemptions to sell and install residential conservation measures and 13 have received DOE-approved waivers to provide such measures. These exemptions and waivers cover sales and installation of measures ranging from various types of insulation to solar devices and furnace modifications. However, DOE data on utilities' actual RCS sales and installation activities are incomplete. The 36 utilities in our 8 case-study states provided some additional insight. Seven had received exemptions or waivers. Three of the seven reported supply and installation activities in 1985.

Although DOE regulations require states and nonregulated utilities to submit reports to DOE on utility supply and installation activities, the reports received by DOE are incomplete. For example, DOE's fourth annual report to the Congress on such activities indicated that 17 states had not filed their 1984 annual reports to DOE. Further, the report noted that 28 percent of reporting states and utilities provided no data on lending, supply, and installation activities undertaken during the reporting period. Thus, these data from DOE's report to the Congress do not provide a complete perspective on the extent of supply and installation activities under the RCS program.

In our 8 case-study states, 4 of 36 utilities had received exemptions, and 3 had received waivers to sell or install conservation measures. Three utilities reported carrying out supply or installation activities in 1985. Of these utilities only one sold and installed major conservation measures, such as ceiling and wall insulation and storm windows. This utility, which had provided similar measures to its customers prior to the RCS program, also sold and installed solar systems. Of the two remaining utilities, one installed conservation measures, such as insulation or weather stripping, but did not sell them. The third utility sold and installed low-cost measures, such as caulking and weather stripping, as part of a "Home Energy Fix-up" program.

Anticompetitive Complaints

Utilities and state agencies responding to our national questionnaire received few complaints about anticompetitive sales, installation, or financing of conservation measures in 1984 and 1985. No responding utilities or state agencies received a finding or found that utilities' RCS

activities had had adverse impacts on competition. Federal agency officials we spoke with believed that no major competitive problems had occurred. However, representatives of national groups representing contractors involved in sales and installation of conservation measures expressed a greater concern about competitive effects.

Utilities and States

The 228 utilities responding to our national questionnaire reported receiving 17 complaints in 1984 or 1985. The 29 responding states reported having received 14 complaints. Table 8.1 summarizes information they provided on the nature of the complaints received. In some cases complaints received covered more than one issue.

Table 8.1: Nature of Complaints Received by Utilities and State Agencies Relating to Competitive Problems

	Number of times an issue was cited in complaints during 1984 and 1985	
Issue cited in complaints	State	Utility
Utility charges below-market prices	3	3
Exclusion of contractors from the master list	3	2
Competition from utility against private audit companies[a]	1	7
Exemptions or waivers that provide an unfair advantage to utilities in selling or installing conservation measures	2	5
Utility charged below-market rates for financing conservation measures	0	2
Other	1	4

[a]*Utilities' being allowed under RCS to offer below-cost audits is regarded by some as anticompetitive.*

Source: GAO national survey to utilities and states.

No utility responding to our national questionnaire stated that a court or state agency had found its activities under the RCS program to have adversely affected competition. Similarly, no responding state agency said it had found that utility activities under the RCS program had adversely affected competition.

The 36 utilities in our 8 case-study states reported having received a total of 5 complaints in program years 1984 and 1985. These complaints involved two utilities. Four complaints received by one utility dealt with excluding contractors from master lists prepared by the state. The other utility's complaint dealt with poor installation of conservation measures by a contractor.

Of the state agencies in the eight case-study states, only Florida reported having received complaints relating to utilities' selling or

installing energy conservation measures. For program years 1984 and 1985, Florida reported receiving fewer than 10 complaints. These complaints related to waivers or exemptions granted to utilities that small businesses believed provided unfair advantages to the utilities. However, none of the states in our eight case-study states told us that they had issued decisions against utilities, in the last 5 years, for carrying out RCS activities that adversely affected competition.[3]

Concerns of Federal Officials and National Contracting Groups Differ

DOE officials responsible for administering the RCS program and Federal Trade Commission officials involved in reviewing utility activities under NECPA told us that they recognized the potential for the sales and installation of conservation measures by utilities to create competitive problems. They also believed no major problems had occurred. However, DOE's RCS program manager told us that his office relies on state agency reports to DOE to identify problems relating to competition.

On the other hand, representatives of the Small Business Administration's Office of Advocacy and representatives of the Air Conditioning Contractors of America; the Plumbing, Heating and Cooling Contractors; and the American Supply Association expressed concern about the competitive effects of utility supply and installation activities. These officials also cited several cases alleging anticompetitive practices relating to utility sales and installation of conservation measures that had been brought before courts or state agencies. These cases are also discussed in a June 10, 1986, report, Utility Competition with Small Business, by Stronberg and D'Addario, DHR Incorporated, prepared for the Office of Advocacy, Small Business Administration. We are aware of no state agency or court decisions finding that utility activities violated anticompetitive provisions contained in NECPA, and DOE has not revoked any utility waivers or exemptions as a result of such actions.

State Procedures to Address Competitive Concerns

Under NECPA state plans are required to contain provisions to ensure the redress of injuries that result from violations of their RCS plans. Redress procedures provided in state plans may include judicial or administrative actions or a combination of the two. The representatives of several national contractor groups stated to us that pursuing redress through judicial procedures may be too expensive and time-consuming for many small businesses. Recently, however, the Congress enacted legislation to supplement the redress procedures.

[3]The California state agency administering the RCS program did not respond to our questionnaire.

Current State Plans

Section 213(c) of NECPA states that

"No residential energy conservation plan submitted for regulated utilities shall be approved by the Secretary unless such plan contains provisions to assure that any person who alleges any injury resulting from a violation of any plan provision shall be entitled to redress under such procedures as may be established by the Governor or State agency."

The type of redress procedures required by NECPA is not specified in the act itself or in its legislative history. While section 213(c) may be read as requiring that states establish administrative redress procedures, it is also reasonable to interpret the section as requiring only that the state plan mention the adjudicative forum available to private parties alleging injury under the plan. DOE has interpreted section 213(c) as requiring state plans only to mention available forums, and accordingly, DOE regulations do not compel states to include specifically created administrative redress procedures in their state plans. Mention of available judicial forums in state plans satisfies DOE regulations and section 213(c) in this regard.

Of the 45 state residential conservation plans that have been approved by DOE as of January 1, 1986, 17 provided that the court system be used as a forum for redress. In 11 other plans the state established only an administrative redress procedure, such as adjudicatory proceedings by the state public utility commission. The remaining 17 state plans included both administrative and judicial redress procedures. Judicial forums for relief would be available to persons alleging injury resulting from violation of the plan, even if not noted in the plan.

Representatives of several national contractor groups believed that procedures contained in state plans did not provide effective means for resolving redress problems. For example, they stated that in states whose plans provide only judicial forums for relief, small businesses that supply and install conservation measures may not have sufficient resources to pursue redress against utilities.

While references in state plans to the availability of redress through state courts do not appear to expand the remedies available to persons under the RCS program, such references comply with redress requirements under NECPA.

New Legislation for Redress Procedures

Because of concerns expressed about the adequacy of redress procedures contained in NECPA, the Congress modified these redress procedures in the Conservation Service Reform Act of 1986. The legislation provides that persons alleging injury from unfair public utility activities can request a state regulatory authority or, under certain circumstances, the Federal Trade Commission to review these activities.

In instances where the state regulatory authority cannot or will not review the complaint, the Federal Trade Commission is to review the allegations of unfair competition. Congressional Conferees indicated in the report accompanying Senate bill S.410 that the Commission's review of these complaints should no longer be subject to a "public interest" test currently required for the review of certain antitrust violations. Rather, the report suggests that the Commission determine if it has "reasons to believe," on the basis of the information provided, that a utility is carrying out the activities that are unfair. Therefore, the new legislation provides individuals, having documented complaints about utility practices, with an opportunity to have their cases reviewed by a state regulatory authority or the Federal Trade Commission.

Summary

Utilities, state agencies, and DOE reported few complaints of discriminatory or anticompetitive behavior on the part of the utilities arising from the RCS program in the 1984 and 1985 program years. Further, no utility or state agency indicated that any court ruling or state agency decision had found a utility's RCS activities to be adversely affecting competition.

Representatives of several national contractor groups believed that state-established procedures providing redress to parties injured under RCS were not effective. Our review found that 17 out of 50 state plans provided redress procedures consisting of only the court system. Other plans provided for state-established administrative redress procedures or a combination of both administrative and judicial procedures. The Conservation Service Reform Act of 1986 supplemented these procedures. Persons alleging injury as a result of RCS can now request a state regulatory authority or the Federal Trade Commission to review utility activities that may be unfair, deceptive, or anticompetitive in nature.

Deciding the Future of the RCS Program

This chapter briefly highlights the key results and conclusions in this report. In addition to this report overview, the chapter also addresses

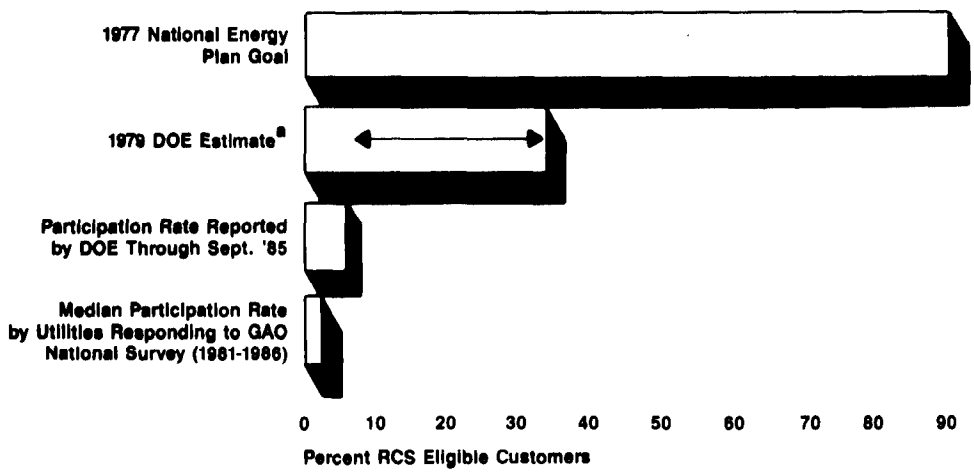
- utility and state views about possible changes to improve the RCS program,
- utility and state views on the effects of terminating the RCS program, and
- observations for the Congress to consider in determining the future of the RCS program.

Program Results

Through 1985 about $521 million was spent on implementing the RCS program. Nationally, however, the program has not worked well because participation in the program has been low. RCS has also not substantially increased the percentage of U.S. homes that have installed various conservation measures. In addition, on the basis of our analysis of four studies that estimated RCS energy savings, energy savings resulting from the program appears to have been approximately 4 percent or less for participating households. In view of the limited program success as shown in figure 9.1, the RCS program does not appear to have significantly reduced energy consumption in the residential sector.

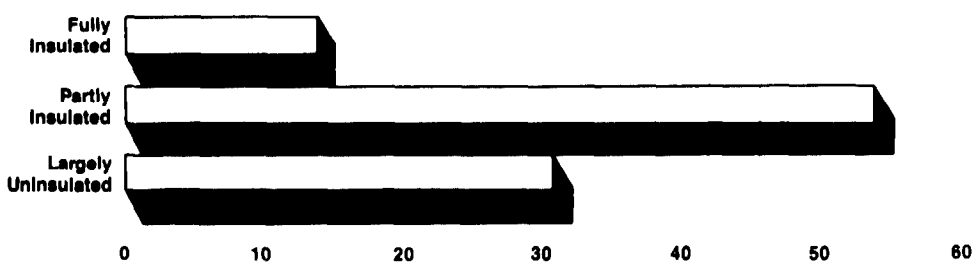
Figure 9.1: RCS Participation, Fully Insulated Single-Family Homes, and Apparent Energy Savings

RCS program participation was lower than anticipated, . . .

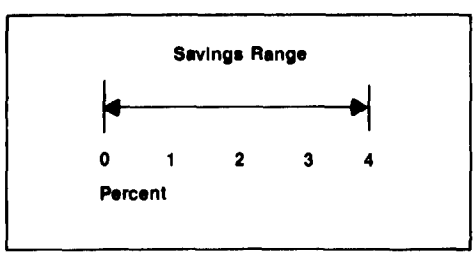


[a]DOE estimate of participation ranged from 7.5 percent to 35 percent.

The percentage of fully insulated, single-family homes nationwide in 1984 was relatively low, and . . .



The energy savings of RCS participants in 4 states where GAO could determine the savings were small.



Source: GAO Analysis of Studies.

Program Participation

According to DOE about 5.9 percent of all households eligible to participate in the program have received RCS home energy audits as of September 1985. Looking at program participation from another perspective, the median participation rate reported by utilities responding to our national questionnaire (77 percent of all utilities in the program) from 1981 to 1985 was about 2 percent. These rates were below the 7.5- to 35-percent participation rate estimated in DOE's regulatory impact analysis. Utilities expected the median program participation rate to be 5 percent or less through 1995, if the program were continued with periodic announcements offering a home energy audit.

Some utilities reported participation rates substantially higher than the national average. Those with participation rates above 15 percent tended to charge less for an RCS audit, use more marketing and promotional strategies, and spend more on implementing the program than utilities with participation rates below 5 percent.

Installed Conservation Measures

The RCS program has not substantially increased the percentage of U.S. homes with conservation measures as anticipated in the 1977 National Energy Plan. The plan set a goal of insulating 90 percent of existing houses by 1985. However, using EIA data, it appears that the prevalence of various conservation measures in the existing housing stock did not change substantially between 1978 and 1984. In addition, according to a DOE study, households that participated in the RCS program installed less than half of the measures recommended as a result of the audit. Low- or no-cost conservation measures were most frequently installed.

Energy Savings and Other Benefits

The RCS program has resulted in relatively small energy savings, the most direct benefit to customers participating in the program. However, savings are difficult to measure and few quantifiable estimates exist. On the basis of our review of RCS studies that measure actual household energy use, participants' measured energy savings ranged from 0 to 4 percent. Given the small energy savings to participating households and low program participation nationally, it is unlikely that RCS has contributed substantially to reducing residential energy consumption.

While the RCS program may have resulted in other benefits, which are inherently less quantifiable than energy savings, few responding utilities or states identified substantial program benefits other than improved customer relations to utilities or increased conservation awareness and comfort to participating customers.

Suggested RCS Program Changes

Utilities and states responding to our questionnaires suggested specific changes to improve the RCS program. About 46 percent, or 104, of the 228 responding utilities suggested that they no longer be required to provide lists of available financiers or contractors. Some utilities in our eight case-study states also suggested eliminating this provision because it would reduce program delivery costs. Responding state agencies most often suggested allowing utilities greater flexibility in the content of RCS program announcements,[1] followed by eliminating financing or contractor list information. About 50 percent and 47 percent of responding states suggested these changes, respectively. The Conservation Service Reform Act eliminates financing and contractor list requirements and requires utility program announcements only once between 1986 and the program's termination in 1989.

Utility and State Views on Program Termination

Terminating the RCS program, according to utilities responding to our questionnaire, is likely to have little or no impact on other utility conservation programs, rates charged to customers, or utility generating requirements. However, state views about terminating the program varied.

Effect on Conservation Efforts

In total about 93 percent of the 228 responding utilities said that the elimination of the federally mandated RCS program would have either a positive effect (about 23 percent) or no effect (about 70 percent) on their other residential conservation efforts. The remaining 7 percent of the utilities either saw a negative effect or did not provide a response. By way of comparison, about half the state agencies (18 of 35) said that the elimination of RCS' federal mandate would have no effect on conservation efforts in their states. However, about 43 percent of responding state agencies (15 of 35) believed that terminating the federal mandate would have a negative effect and two state agencies said it would have a positive effect.

Many utilities stated that if RCS were terminated, they would continue to offer other residential conservation programs because they believed these programs were more cost-effective or saved more energy than RCS. The type, number, and importance of these other programs varied from

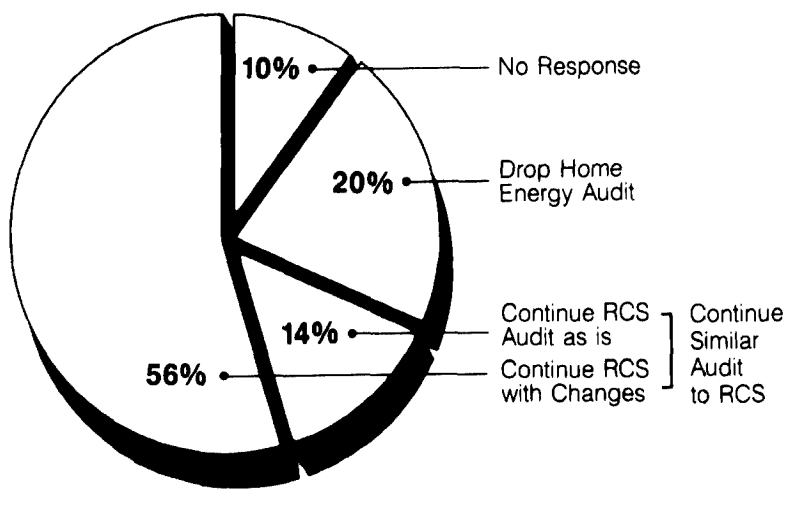
[1]NECPA required utilities to announce the program to their customers at least every 2 years. Although this provision terminated January 1, 1985, the Conservation Service Reform Act of 1986 requires utilities to announce the program once more before June 30, 1989. The content of program announcements includes such items as possible conservation measures for residential buildings and estimates of typical savings in energy costs resulting from such measures.

state to state and utility to utility. Of the 228 responding utilities, 103 said they offered 1 other program, and 6 offered 4 or more programs. About one third of the utilities and state agencies considered RCS to be their major conservation program.

Continuation of Home Energy Audits

We asked utilities nationwide and in our eight case-study states if they would continue to offer a home energy audit with no federal mandate. As shown in figure 9.2, 70 percent of the 228 responding utilities said they would continue to offer a home energy audit program similar to RCS. More than one half (56 percent) of the utilities, however, said the program would be changed to allow greater flexibility in making home energy audit offers, reduce contractor and financial institution cost information, or provide audits more tailored to customers' needs. About 91 percent of the 34 utilities (or 31 utilities) in our eight review states said they would continue to offer a home energy audit if RCS were terminated.

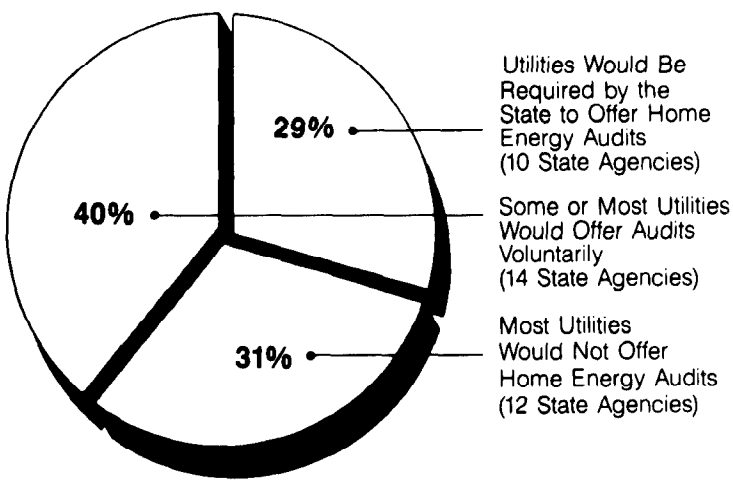
Figure 9.2: Continuation of Home Energy Audits



Source: GAO National Survey.

As shown in figure 9.3, 24 of the 35 states responding said that either they would require utilities to offer home energy audits similar to RCS or most of the utilities in their states would continue to offer audits voluntarily. The remaining states said that they believed most or all utilities in their states would no longer offer audits similar to RCS.

Figure 9.3: Views on Continuing Home Energy Audits



Source: GAO National Survey to States.

Fee Charged for Audit

Another aspect of terminating the RCS program that may affect participation rates for future residential conservation programs is whether utilities continuing to offer home energy audits could offer below-market prices. As required under NECPA, utilities can not charge more than $15 per household for an RCS home energy audit even though the audit generally costs utilities about $113 to perform. It appears that if no federal mandate for the program existed, utilities offering below-cost audits could be challenged, in some instances, for violating antitrust laws. It is unclear whether states would be prohibited under federal antitrust laws from allowing utilities to offer below-cost residential conservation services, such as audits.

Whether a particular state action, such as allowing utilities to provide low-cost home energy audits, is immune from antitrust laws depends upon the degree to which the state actively supervises and clearly articulates the policy. Provisions in state laws specifically allowing below-cost conservation services would more likely be immune from antitrust laws than provisions for such services approved by public utility commissions.

Effects on Rates and Utility Generation Capacity Requirements

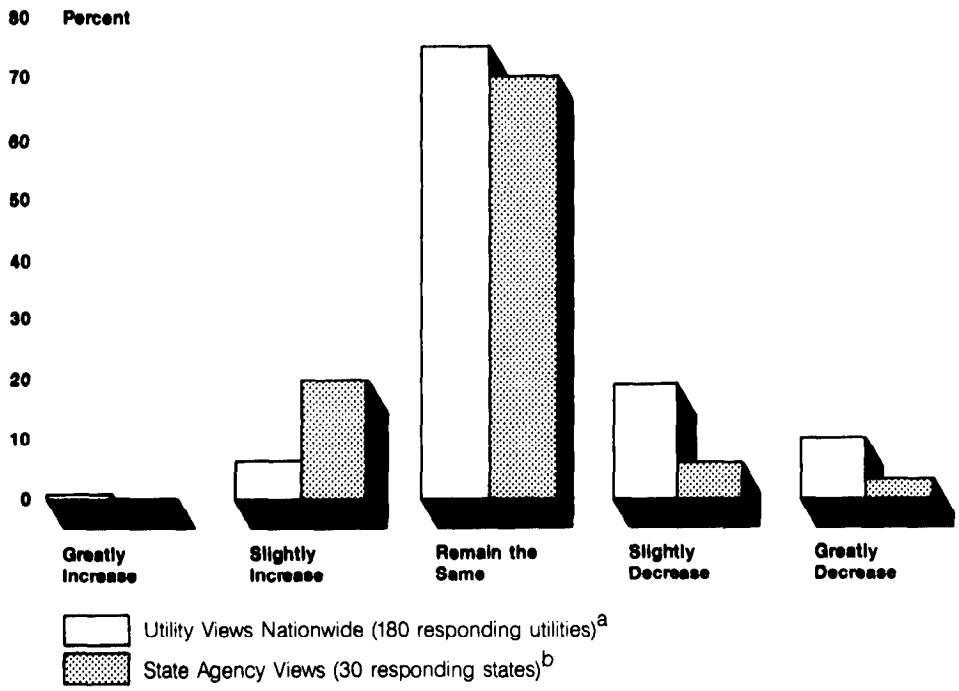
The majority of responding utilities and state agencies believed that RCS termination on January 1, 1988,[2] would have little or no effect on utility rates and utility capacity requirements or fuel needs.[3]

As figure 9.4 shows, about 94 percent of the 180 utilities nationwide that provided a definite response to the question indicated that utility rates would remain the same or decrease if the program were terminated. The utilities in our eight case-study states held views on rates that were consistent with those of the utilities responding nationwide. About 70 percent of the 30 states that provided a definite response to this question in our questionnaire believed that terminating RCS would not affect residential customer rates adversely.

[2]We used January 1, 1988, in our questionnaire because it was the RCS termination date called for in Senate bill S.410, which called for us to prepare this report.

[3]Utilities were asked about effects on their rates and capacity requirements while state agencies were asked about effects on utilities in their states.

Figure 9.4: Effect on Utility Rates If RCS Were Terminated



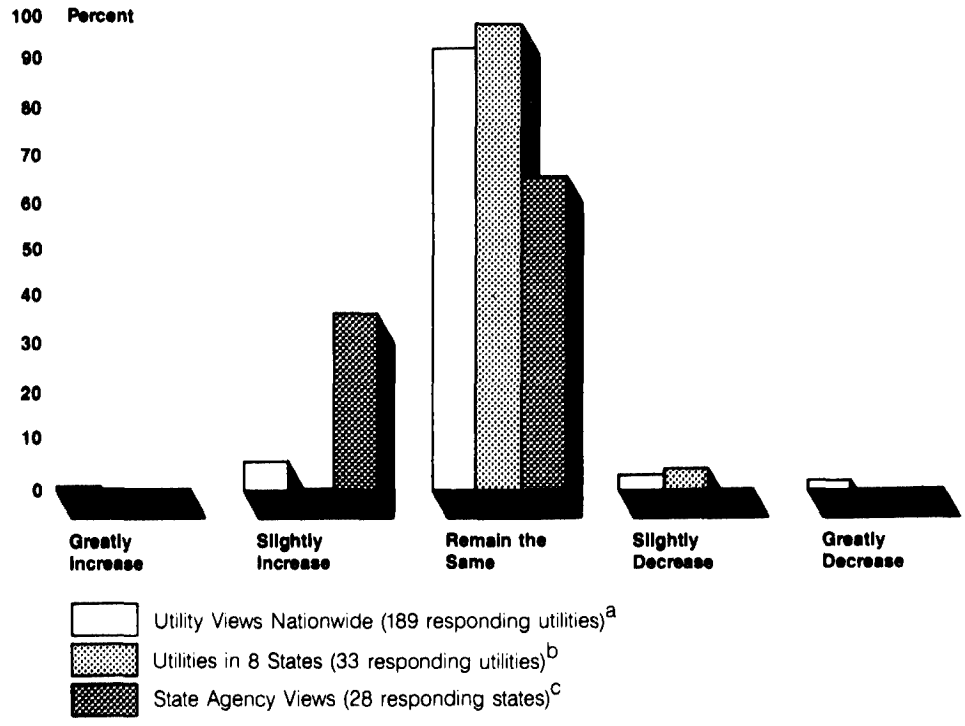
[a] 36 utilities did not know
12 utilities did not answer

[b] 5 states did not know
1 state did not answer

Source: GAO National Surveys to Utilities and States.

Figure 9.5 shows that about 91 percent of the 198 responding utilities nationwide and 97 percent of the 33 responding utilities in our 8 case-study states stated that their capacity requirements would remain the same if the federal mandate were terminated in January 1988. Approximately 64 percent of the 30 states responding to the question said that utilities' capacity requirements would remain the same if the program were terminated in January 1988.

Figure 9.5: Effect on Utility Capacity Requirements If RCS Were Terminated



[a] 28 utilities did not know
11 utilities did not answer

[b] 3 utilities did not know

[c] 6 states did not know
2 states did not answer

Source: GAO National Survey and eight case-study states.

Other Residential Conservation Programs

A majority of utilities responding to our national questionnaire said that they currently offer other residential conservation programs in addition to RCS. A majority of those who have conducted written evaluations of the effectiveness of their most successful programs believed they were more cost-effective and saved more energy than the RCS program. A few states and utilities responding to our national questionnaire suggested that they should be allowed to offer their own, more effectively targeted, residential conservation programs in lieu of RCS audits.

The Congress, in enacting the Conservation Service Reform Act of 1986, recognized that states and utilities should be given some flexibility in offering different types of residential conservation programs. Under the

act, states and utilities can offer alternative energy conservation plans and programs instead of RCS home energy audits. Through alternative plans and programs, states and utilities that want to change are allowed the flexibility to improve their efforts under RCS, while states that prefer the original RCS program can continue under it. Alternative state plans must be designed to result in annual residential energy savings of 2 percent or more. Utilities can also obtain permission from their state, through a waiver, to depart from certain provisions of the state plan so long as their programs result in savings in energy consumed equal to or greater than the savings that would have occurred under a properly implemented state RCS plan.

Matters for Consideration by the Congress

The intended purpose of the RCS program, mandated by the National Energy Conservation Policy Act of 1978, was to improve the energy efficiency of the residential sector, which annually consumes about 20 percent of the nation's energy. An on-site home energy audit, the program's main feature, provided information to households on how they could reduce energy use, primarily by installing conservation measures.

The expectation was that a substantial amount of energy could be saved and the demand for imported oil reduced if a large number of households requested an RCS audit and installed recommended conservation measures. Nationally, however, the RCS program does not appear to have substantially reduced energy consumption. Our national questionnaire and in-depth state reviews showed that participation in the program, installation of energy conservation measures, and measured energy savings to participants have been low. Further, although the RCS program may have resulted in other benefits, the most frequently cited benefits by utilities and states were improved utility-customer relations and increased conservation awareness by participants.

Most states and utilities responding to our questionnaires said termination of the RCS program would have little or no effect on residential utility rates or utility generating capacity requirements. Further, most utilities also believed that terminating the program would have little or no effect on their overall residential conservation efforts. However, state agency views varied about the effects of termination on residential conservation efforts in their states. Many utilities responding to our national questionnaire have other residential conservation programs in addition to RCS, as permitted under NECPA in 1978. Most of the 63 utilities who had evaluated their other programs believed their most successful

residential conservation program was more successful than the RCS program. In addition, the Conservation Service Reform Act of 1986, under certain circumstances, allows states and utilities to adopt alternative residential conservation efforts in lieu of the RCS program.

In enacting the Conservation Service Reform Act of 1986, the Congress recognized the need for states and utilities to be given additional flexibility in developing and carrying out residential conservation programs. At this time, it is not possible for us to reach a conclusion about how much the changes made by the act will improve the success of the RCS program. Consequently, we are not making a recommendation about whether the RCS program, as amended, should be continued beyond June 30, 1989. Terminating the program, however, could prevent utilities from providing below-cost home energy audits (i.e., for $15 or less instead of for over $100) if the utilities were found to violate antitrust laws. Further, uncertainty exists about the extent to which utilities and states will decide to implement alternative residential energy conservation programs in place of the home energy audits and how successful these programs will be in saving energy. DOE is required by the act to report to the Congress on the operation of alternative plans in 1987 and 1989. The act also terminates the program on June 30, 1989.

In deciding the future of the RCS program, the Congress should consider the extent to which the following have occurred:

- Energy conservation measures have been installed in residential dwellings in the United States between 1984 and 1989. EIA's report shows that as of December 1984, many houses are still lacking conservation measures and that any increase, between 1978 and 1984, in the percentage of single-family dwellings with specific conservation measures was too small to be measured with any statistical confidence. In determining whether to extend the program, the Congress should consider the extent to which households have installed conservation measures since 1985 compared with trends prior to this period. EIA is expected to update its data on the prevalence of conservation measures in the housing stock by mid-1988, and DOE's 1987 and 1989 reports will include an analysis of the energy-saving potential from the installation of additional residential conservation measures.
- Residential energy savings have occurred under alternative programs compared with the RCS program. RCS appears to have resulted in relatively small energy savings. However, the new act provides an opportunity to improve the success of the RCS program. Information about these

alternative programs will be available when DOE issues its reports in 1987 and 1989.

- Termination of the program might adversely influence energy conservation efforts of states operating residential conservation programs that provide below-cost home energy audits. This could occur because without federal statutory authority for utilities to offer below-cost energy audits, utilities could be challenged for violating antitrust laws. The Congress could ensure the viability of below-cost state programs by specifically providing antitrust law immunity to utilities operating under such programs if it decides to terminate the program.

Agency Comments

DOE in commenting on a draft of this report stated that, on the whole, the report was a thorough and professional review of the RCS program and related programs. The Department also supported the Conservation Service Reform Act's flexibility to allow states and utilities to design and implement energy conservation programs tailored to their individual needs. The Department pointed out that its role under the new legislation will become less prescriptive and more concerned with technology transfer, such as pilot projects and demonstrations.

Methodology

We carried out an extensive examination of existing studies of the RCS program and of material collected by DOE, state, and utility officials and other experts in energy conservation to obtain their views about possible methodologies for our review. The methodology we developed consisted of four major work efforts.

Questionnaires to States and Utilities

We developed two questionnaires to collect program data and views from utilities and state agencies involved with RCS. As originally requested by the Chairman, Senate Committee on Energy and Natural Resources, and as required by the Conservation Service Reform Act, DOE assisted us in developing the questionnaires and in sending them to state agencies and utilities. We sent questionnaires to the state agency responsible for administering the RCS program in 44 states and performed detailed interviews with 8 of these states. Six states were excluded because they did not have approved state plans, and therefore, their RCS programs were administered by DOE. We also sent questionnaires to 262 of the 298 utilities that, according to DOE, participate in the RCS program. As discussed in the next section, we carried out in-depth interviews with officials at the remaining 36 of the 298 utilities. Of the 44 state and 262 utility questionnaires sent out, 29 state agencies and 228 utilities responded.

DOE also reviewed the final questionnaires and prepared a report to us in June 1986 summarizing their results. We used this report and our own analyses of the information from the questionnaires to address each of the issues in the request. Information was collected from state agencies and utilities between January 1, 1986, and June 1, 1986.

Some utility answers to our questions on RCS participation rates were inconsistent with their answers to other questions in the questionnaire. To resolve these inconsistencies we calculated yearly participation rates for each utility using information they provided on audits performed and total eligible customers. We compared the resulting participation rates with those reported by the utilities. In the majority of cases, the two values matched closely, and we used the participation rates reported by utilities. However, in 14 cases the participation rates reported by the utilities appeared to vary widely from their responses to other questions. In some cases, for example, this occurred because they had included non-RCS audits in calculating participation rates. In 12 of these cases, we substituted our calculation of participation rates for the one reported by the utility because we believed ours was more accurate.

Two utility observations were deleted because the data provided by the utilities were not adequate to determine an accurate participation rate.

We were not able to assess the full costs and benefits of the program because of uncertainty about several important factors, such as individual utility costs and the value of energy savings and other benefits to participants, utilities, and society.

In-Depth Review in Eight States

We conducted in-depth audit work in eight states: California, Washington, Montana, Minnesota, Michigan, Connecticut, Florida, and Louisiana. On the basis of our review, these states provided a substantial amount of variation in terms of factors that may influence the outcome of RCS program activities in the United States as a whole (i.e., regional climatic conditions, fuel uses, customer participation rates, etc.). Further, in determining which states to select, we considered information contained in Selection of States for Evaluation of the Residential Conservation Service, prepared in November 1983 by Oak Ridge National Laboratory for DOE. This report discussed methodologies for selecting a cross section of states whose RCS programs could be analyzed to provide a perspective on how the RCS program was working nationwide. The states we selected are compatible with the report's results.

Our work in these states, which included in-depth discussions with 36 utilities, was used to supplement information obtained in the national questionnaire by providing more detailed information about RCS and how other residential conservation programs were working. The in-depth work was also used to evaluate the variation in the program's success from state to state and utility to utility and the reasons for this variation. We used a structured interview instrument to collect information in the eight states to ensure that the information we collected would be compatible with that obtained in the national questionnaire. For the 36 utilities in the 8 review states, we used the utilities' estimates of RCS participation rates except when they included other than RCS audits in the total. For these cases we recalculated the utilities' participation rates using additional data we had obtained from the utilities. We also interviewed state agency officials responsible for administering the RCS program in each state, as well as officials from a variety of organizations involved in conservation efforts in the state.

EIA Report on Conservation Potential

We requested that EIA prepare a report assessing the potential for residential conservation energy savings largely on the basis of an analysis of information collected in its Residential Energy Consumption Survey (RECS).[1] RECS is a survey of households with a sample size varying between 4,000 and 6,000 households, carried out nationwide by EIA annually from 1978 through 1982 and in 1984. The survey collected information on residential energy use (e.g., energy used for space heating and cooling), conservation measures in place in existing homes, and conservation behavior.

Since the RECS data did not show a statistically significant change at the 95-percent level of confidence in the prevalence of residential conservation measures between 1978 and 1984, the data presented in this report, unless otherwise specified, are for 1984. Not finding a statistically significant change in the RECS data does not rule out the possibility that a change occurred. If the amount of change was relatively small, the RECS sample size may not have been large enough to detect it. For example, the percentage of single-family homes with attic insulation observed in the RECS data would have had to increase by more than 5 percent between 1978 through 1984 in order for it to be considered statistically significant at the 95-percent level of confidence. Nonetheless, RECS data represent the most up-to-date, detailed national information available on conservation measures and practices in existing homes. EIA had not previously analyzed this information from the perspective of residential conservation potential.

Because the 1984 RECS data were preliminary when EIA conducted its analysis, the associated standard errors were estimated using an equation derived from 1982 RECS data. Since the 1982 and 1984 sample sizes were similar, EIA believed that no large difference would exist between these preliminary standard errors and final standard errors. All figures in EIA's report are accompanied by their associated sampling errors at the 95-percent level of confidence (1.96 x preliminary standard error). We subsequently developed three tables by collapsing certain data categories from EIA's report. EIA then calculated the associated sampling errors for these three tables. Because these calculations occurred after the 1984 RECS data were finalized, these sampling errors are based on the actual 1984 equation rather than the earlier estimated one. Sampling errors for EIA data cited in this report are shown in appendix II.

[1] EIA's report, Residential Conservation Measures (SR/EEUD/86/01) was published July 9, 1986.

EIA's report examined the potential for upgrading conservation measures in single-family households by examining the extent to which various combinations of three conservation measures were present or absent—attic insulation, wall insulation, and storm windows. EIA's report assigned houses to one of nine categories ranging from houses with specified levels of all three measures to houses with essentially none of the measures. For ease of presentation, in chapter two, we assigned households to one of three categories—fully insulated, partly insulated, or largely uninsulated—rather than the nine categories used by EIA. Table I.1 compares the categories we used with those in EIA's report.

Table I.1: Comparison of Groups Used by GAO and EIA

GAO categories	EIA categories
Insulation:	
Attic—full[a]	
Wall and storm windows[b]	Fully insulated
Wall and/or some storm windows[c]	Partly insulated
None in wall, no storm windows[d]	Partly insulated
Attic—full area, fewer inches[e]	
Wall and storm windows[b]	Partly insulated
Wall and/or some storm windows[c]	Partly insulated
None in wall, no storm windows[d]	Partly insulated
Attic—partial or none[f]	
Wall and storm windows[b]	Partly insulated
Wall and/or some storm windows[c]	Largely uninsulated
None in wall, no storm windows[d]	Largely uninsulated

[a]Households with at least 96 percent of the ceiling area covered and at least the minimum recommended inches of insulation.

[b]Households with some or total wall insulation and storm windows on at least 90 percent of the windows.

[c]Households with some wall insulation and/or storm windows but lacking wall insulation and storm windows on at least 90 percent of the windows.

[d]Households with no wall insulation or storm windows.

[e]Households with at least 96 percent of the ceiling area covered but with fewer than the minimum recommended number of inches.

[f]Households with less than 96 percent of the ceiling area covered, lacking attic insulation, or not knowing how much ceiling area was covered.

Included in the households described in footnote f in table I.1 are households that (1) did not know whether they had attic insulation or (2) if attic insulation was present, did not know how much ceiling area was

covered. EIA's report did not provide information on how many households with partial or no attic insulation fell into these categories. However, an EIA statistician informed us that of the 21.1 million households that EIA estimated to have partial or no attic insulation, 4.1 million did not know (or report) whether they had attic insulation and 3.1 million knew they had attic insulation but did not know (or report) the amount of insulation they had.

EIA did not estimate the potential energy savings that could result from upgrading conservation measures in single-family households. EIA's literature review concluded that findings from studies on energy savings resulting from the addition of various conservation measures were so varied that they could not provide a sufficiently reliable source for estimating potential energy savings. In addition, EIA's attempt to estimate the energy savings using multiple regression techniques did not produce results reliable enough for it to use. Because EIA could not estimate the energy savings associated with adding conservation measures, it was also unable to assess their cost-effectiveness.

Critiques of Studies on Energy Savings

To determine the extent to which the RCS program produced energy savings, we critiqued studies that evaluated whether and to what extent customers who participated in the RCS program decreased their energy use.[2] We determined a likely range of energy savings to program participants using information contained in the studies. In constructing this range of savings, we took into account the economic and statistical assumptions used in each study to determine how any existing problems were likely to affect the studies' results. The studies we used have been cited by DOE and energy conservation experts as the best RCS evaluations to date. All of the studies evaluated the results of audits conducted between 1978 and 1982 and compared actual energy use of households that had received RCS audits with households that had not. Regression analysis was used in the studies to control for the influence of factors, other than the households' participation in the RCS program, that could affect energy use. A statistical expert, from outside GAO, assisted us in conducting these evaluations.

[2]A total of five studies were evaluated assessing the RCS program in California, Connecticut, Michigan, Minnesota, and Wisconsin. We also reviewed a 1985 follow-up to the 1983 Minnesota study.

Sampling Errors for EIA Data Provided in Chapter 2

This appendix presents the EIA data shown in chapter 2 along with the sampling errors associated with that data. The sampling error at the 95-percent level of confidence is found in parentheses following its associated statistic. For example, 14(1.6) percent means that at the 95-percent level of confidence, the true result is 14 ± 1.6 percent—or between 12.4 and 15.6 percent.

Table II.1 corresponds to table 2.1 in chapter 2. Although the table in chapter 2 (2.1) gives data in percentages of single-family units in 1984, table II.1 below gives data in millions of single-family units, which can be used to calculate the percentages in table 2.1. The sampling errors for table II.1 are from EIA's 1986 report and, therefore, are preliminary. (See app. I for a more complete explanation.)

Table II.1: Conservation Measures in Single-Family Units in 1984

Figures in millions of units

		Region			
	United States	Northeast	North Central	South	West
Total units	**57.6(1.8)**	**10.9(1.1)**	**14.6(1.3)**	**21.8(1.6)**	**10.4(1.1)**
Presence of conservation measures					
Attic or roof insulation	45.2(2.2)[a]	8.4(1.0)	12.4(1.2)	16.4(1.4)	8.1(1.0)
Storm doors	40.2(2.1)	10.1(1.1)	13.3(1.2)	13.7(1.3)	3.2(0.6)
Storm windows	37.9(2.1)[b]	10.2(1.0)	13.7(1.3)	10.7(1.1)	3.1(0.6)
Caulking	33.8(1.9)	7.2(0.9)	9.6(1.1)	11.7(1.2)	5.2(0.8)
Floor insulation— has or does not need it	33.5(1.9)	7.0(0.9)	9.3(1.0)	11.8(1.2)	5.4(0.8)
Weather stripping	32.6(1.9)	6.9(0.9)	8.7(1.0)	10.9(1.1)	6.1(0.8)
Wall insulation	30.8(1.9)	6.4(0.9)	9.4(1.1)	10.6(1.1)	4.4(0.7)

Note:The value in parentheses following each statistic represents the sampling error, at the 95-percent level of confidence, of the statistic.

[a]Included in the 45.2 million single-family units with attic or roof insulation are 36.5(2.0) million with insulation covering all of the attic or roof area.

[b]Included in the 37.9 million single-family units with storm windows are 26.0(1.7) million with 100 percent of their windows covered and 5.5(0.8) million with 76 to 99 percent of their windows covered.

Table II.2 corresponds to figure 2.2 in chapter 2. Tables II.3 and II.4 correspond to the top and bottom, respectively, of figure 2.7 in chapter 2. We prepared tables II.2 through II.4 after EIA's report had been issued by collapsing data from EIA's report into three categories. EIA then calculated the associated sampling errors at the 95-percent level of confidence on the basis of final 1984 RECS data. For this reason, the sampling errors for these three tables may differ slightly from those shown in

EIA's 1986 report. For example, in EIA's report, the sampling error for the percentage of single-family homes that are fully insulated is 14(1.7) percent, whereas the final 1984 RECS data produced a sampling error of 14(1.6) percent.

Table II.2: Insulation and Air Infiltration Protection in Single-Family Units by Region in 1984

Figures in percent[a]

Extent insulated	United States	Region			
		Northeast	North Central	South	West
Fully insulated[b]	14(1.6)	17(3.6)	20(3.5)	13(2.4)	6(2.1)
Partly insulated[c]	54(2.7)[d]	53(5.1)	58(4.5)	51(3.6)	57(5.1)
Largely uninsulated[e]	31(2.2)[f]	30(4.6)	22(3.6)	37(3.5)	36(5.0)

Note:The value in parentheses following each statistic represents the sampling error, at the 95-percent level of confidence, of the statistic.

[a]Totals may not equal 100 percent because of rounding.

[b]Housing units with full attic area covered (i.e., at least 96 percent of ceiling area covered), at least the minimum recommended number of inches of insulation, some or total wall insulation, and storm windows on at least 90 percent of the windows.

[c]Housing units with a range of conservation measures from full attic insulation with the recommended number of inches and some combination of wall insulation and storm windows to those with partial or no attic insulation and some combination of wall insulation and storm windows. Combinations of wall insulation and storm windows include housing units with no wall insulation and 90 percent storm windows as well as those with no storm windows and full wall insulation.

[d]Included in the partly insulated category are 13(1.6) percent with full area coverage of the attic, but less than the recommended number of inches of attic insulation, and with both storm windows on at least 90 percent of their windows and wall insulation.

[e]Housing units that are substantially or completely lacking in at least two of the three conservation measures.

[f]Included in the largely uninsulated category are 9(1.3) percent that have little or no attic insulation, no wall insulation, and no storm windows.

Table II.3: Insulation and Air Infiltration Protection in Single-Family Units by Family Income in 1984

Figures in percent[a]

Extent insulated	All households	Family income: Income below $15,000	Family income: Income $15,000-$34,999	Family income: Income $35,000 or more
Fully insulated[b]	14(1.6)	6(1.5)	15(2.3)	23(3.1)
Partly insulated[c]	54(2.7)	48(3.5)	58(3.3)	57(3.8)
Largely uninsulated[d]	31(2.2)	46(3.5)	26(2.8)	20(3.0)

Note: The value in parentheses following each statistic represents the sampling error, at the 95-percent level of confidence, of the statistic.

[a]Totals may not equal 100 percent because of rounding.

[b]See note[b] on table II.2.

[c]See note[c] on table II.2.

[d]See note[e] on table II.2.

Table II.4: Insulation and Air Infiltration Protection in Single-Family Units by Home Ownership in 1984

Figures in percent[a]

Extent insulated	All households	Home ownership: Owned	Home ownership: Rented
Fully insulated[b]	14(1.6)	17(1.8)	2(1.2)
Partly insulated[c]	54(2.7)	59(2.3)	33(5.1)
Largely uninsulated[d]	31(2.2)	25(1.1)	65(5.4)

Note: The value in parentheses following each statistic represents the sampling error, at the 95-percent level of confidence, of the statistic.

[a]Totals may not equal 100 percent because of rounding.

[b]See note[b] on table II.2.

[c]See note[c] on table II.2.

[d]See note[e] on table II.2.

Comments From the Department of Energy

Department of Energy
Washington, DC 20585

DEC 0 1 1988

Mr. J. Dexter Peach
Assistant Comptroller General for
Resources, Community, and
Economic Development Division Programs
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Peach:

The Department of Energy appreciates the opportunity to review and comment on the General Accounting Office report entitled, "Energy Conservation: Federal Home Energy Audit Program Has Not Achieved Expectations."

On the whole, we find the report to be a thorough and professional review of the Residential Conservation Service (RCS) Program and related conservation programs. While the report contains no recommendations, three principal findings are offered: (1) that actual participation was lower than had been projected at the program's outset and utilities responding to the survey indicated that future participation rates will probably remain low; (2) that the benefits most often cited were improved utility-customer relations and increased conservation awareness and not lower utility bills or increased resale value of homes; and (3) that most utilities that had evaluated their programs concluded that their most successful (non-RCS) residential conservation program saved more energy and was more cost-effective than their RCS program. It followed from these findings that many utilities planned to continue to offer those programs believed to save more energy and to be more cost effective than RCS and that some suggested they be allowed to offer these programs in lieu of RCS.

The Conservation Service Reform Act of 1986 responds to the need of states and utilities for more flexibility in designing and implementing energy conservation programs tailored to their own individual needs and opportunities as they define them. The Department of Energy supports this approach. We feel that states and utilities are much closer than we to the residential (and commercial) energy users and are, therefore, much better able to assess what is needed--and what works best--in their jurisdictions and service areas. The Department's role, under the new legislation, will become less prescriptive and more concerned with technology transfer (i.e., needs assessment, evaluation, case studies, pilot projects and demonstrations, and networking the results of the above and of successful state or utility programs). We feel that this new approach offers a better opportunity for overcoming the deficiencies noted in the report's findings.

Again, we appreciate the opportunity to review this report and hope these comments will be helpful to GAO in its preparation of the final report. We also appreciate the courtesy shown by the GAO staff and officials during the course of this study. Technical and editorial comments are being provided to Mr. Roy J. Kirk under separate cover.

Sincerely,

Harry L. Peebles
Acting Assistant Secretary for
Management and Administration

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