

4. Nonresponse

Nonresponse occurs in each of the three RECS surveys: Household, Rental Agent, and Supplier Surveys. *Unit nonresponse* occurs when no information at all is obtained from an assigned sample unit or when so little information is obtained that the questionnaire is classified as unusable. *Item nonresponse* occurs when a usable questionnaire is obtained but the desired information is missing for one or more items. Item nonresponse can occur because a respondent is unable or unwilling to answer a specific question, because the interviewer fails to ask it, or because a data entry clerk fails to key the response.

Both kinds of nonresponse affect the quality of the survey results. The magnitude of their effects can seldom be determined precisely. They depend in part on the efficacy of the imputation and estimation techniques that are used to try to limit the extent of bias due to nonresponse. They also depend on how large the nonresponse rates are and the degree to which the characteristics of nonrespondents differ from those of respondents.

This chapter presents information about the amount of, and trends in, nonresponse in the three component surveys, the characteristics of nonrespondents, the reasons for nonresponse, and the techniques that are used to minimize nonresponse rates. The imputation and estimation techniques used to deal with nonresponse are covered in detail in Chapters 6 and 7, respectively; however, a brief summary is given at this point. Figure 4.1 summarizes these techniques by survey component and type of nonresponse.

For the *Household Survey*, weighting adjustments are used to minimize the biases caused by unit nonresponse. For most variables based on the Household Survey questionnaire, missing values are imputed by using one of several different deterministic or probabilistic imputation techniques. For a few variables, some or all of the missing values are not imputed. Housing characteristics not fully imputed in the 1990 RECS included several variables related to conservation practices, such as thermostat settings, participation in demand-side management programs, and the use of insulation, caulking, and weatherstripping. Also not fully imputed in 1990 were missing responses to questions on the age and other characteristics of appliances and equipment and on the number of years survey respondents expected to remain in their present homes.

For households in multi-unit structures with one or more fuels included in the rent, the *Rental Agent Survey* is designed to provide the most accurate information possible about the main space heating fuel and equipment and the main fuels for water heating and air-conditioning. Information provided by rental agents is the preferred source for this kind of information--that is, it is usually considered to be more accurate than the corresponding answers obtained from household respondents. When information is not available from the Rental Agent Survey due to unit or item nonresponse, the fallback procedure is to rely on information reported in the Household Survey.

For households that pay suppliers directly for one or more delivered fuels, the *Supplier Survey* provides information from billing records about housing unit consumption and expenditures by fuel type. When no Supplier Survey information for a specific fuel is obtained for a household, the household's consumption and expenditures for that fuel are imputed on the basis of household

Figure 4.1. Treatment of Nonresponse by RECS Component

Survey Component	Type of Nonresponse	
	Unit	Item
Housing unit	Weighting adjustments	Varies by item: <ul style="list-style-type: none"> • Impute • Publish as NA
Rental agent	Use corresponding data from housing unit survey	
Supplier	Impute from housing characteristics	Varies by fuel: <ul style="list-style-type: none"> • Impute from part-year data (electricity, NG) • Impute from housing characteristics (other fuels)

Source: Energy Information Administration, *Housing Characteristics* (1993); *Consumption and Expenditures* (1993).

characteristics by using a nonlinear regression method. When partial information is obtained in the Supplier Survey, the imputation technique depends on the fuel type. For electricity and natural gas, annual consumption and expenditures are sometimes imputed on the basis of part-year data from the Supplier Survey. For other fuels, part-year data on billings are not used; consumption and expenditures are imputed in the same way as if no data had been obtained in the Supplier Survey.

The next section of this chapter covers nonresponse in the Household Survey, with subsections on unit and item nonresponse. The following two sections present comparable information for the Rental Agent and Supplier Surveys, respectively. The final section summarizes the nature and consequences of nonresponse in these three components of RECS.

Nonresponse in the Household Survey

Unit Nonresponse

The information on overall unit response rates for RECS survey years 1978 through 1993 has been summarized (Table 4.1). *All rates shown in Table 4.1 and subsequent tables in this chapter are unweighted*--that is, they are based on counts of eligible sample units and do not reflect variations in the overall selection probabilities of individual units. The implications of using unweighted rates are discussed later in this section.

Table 4.1. Household Survey Eligibility and Response Rate by Survey Year: 1978-1993

Category	Survey Year								
	1978	1979	1980	1981	1982	1984	1987	1990	1993
Number of units assigned to interviewers	4,849 ^a	4,935	7,338	7,668	5,903	7,658	8,232	6,757	9,869
Percent ineligible:									
Not housing units	NA	2.8	1.4	1.5	1.6	1.6	2.7	2.2	2.0
Vacant or seasonally vacant	7.1	7.0	8.1	9.2	9.1	10.2	10.0	10.3	9.3
Number of units eligible	4,507	4,453	6,634	6,841	5,272	6,752	7,183	5,909	8,753
Percent completed by interview	85.2	85.5	87.5	86.7	84.8	81.1	81.5	81.7	79.0
Percent not completed by interview:									
Refusal	NA	NA	8.4	8.2	11.5	14.9	14.0	12.1	15.3
No one home	NA	NA	2.2	3.2	1.9	2.5	3.1	3.8	2.7
Other	NA	NA	2.0	1.8	1.7	1.5	1.4	2.4	3.0
Percent completed by mail ^b	5.3	5.1	3.7	4.9	4.7	3.0	5.2	4.5	2.2
Percent completed by interview or mail	90.5	90.6	91.2	91.6	89.5	84.1	86.7	86.2	81.2

^aData unavailable for assigned units that were not housing units.

^bData for 1993 include households completed by mail and telephone.

NA = Not Available.

Sources: Energy Information Administration, *Housing Characteristics* (1980-1993); *Consumption and Expenditures* (1978-1979).

As explained in Chapter 2, the multi-wave, multi-mode data collection procedure used in the Household Survey is designed to maximize the level of survey response for the eligible units in the initial sample. Following multiple attempts to complete a personal interview for each unit, mail questionnaires are sent to most of the remaining addresses. In the 1993 RECS, a telephone followup was inserted between the personal interview and mail phases of data collection.

Substantially abbreviated versions of the personal interview questionnaires are used in the telephone and mail phases of data collection, their main purpose being to identify suppliers and obtain respondent waivers so that consumption and expenditure data for these units can be obtained in the Supplier Survey. The mail and telephone versions also include some of the basic items used to estimate end-use consumption for these housing units. One consequence of using abbreviated questionnaires for the mail and telephone followups is that item nonresponse is automatic for all data items not included on those questionnaires.

Personal interview and mail/telephone response rates are shown separately in Table 4.1, each being calculated as a percent of all housing units eligible for interviews. Personal interview completion rates remained fairly stable, in the neighborhood of 85 percent, from 1978 through 1982, but declined to a lower level, in the neighborhood of 80 percent, for all subsequent surveys. For most survey years, mail response rates were close to 5 percent, the exceptions being 1980, 1984, and 1993. In 1993, the proportion of all eligible units completed by mail and telephone combined was only 2.2 percent, and the overall response rate, 81.2 percent, was the lowest yet experienced in the RECS Household Survey.

Two kinds of explanations can be sought for the decline in unit response rates for RECS in the four most recent survey years. It might be argued that there has been a general decline in the willingness of persons to respond to national household surveys for which participation is voluntary. Such a trend can be countered to some extent by increased efforts to motivate response and to contact persons or households that are difficult to reach, but there are limits to what can be done to counteract outright refusals. The question of whether such a trend has actually occurred is controversial. Based on a review of eight periodic demographic surveys, a subcommittee of the Office of Management and Budget's Federal Committee on Statistical Methodology recently concluded that:

... there was little evidence of declining response rates over time ... There was some evidence that refusal rates were increasing in demographic surveys; however, the analysis revealed that there are no changes in *overall* response rates. This could be due to a greater effort in data collection. (Gonzalez, Kasprzyk, and Scheuren 1994)

Response trends in a specific survey can also be affected by changes in the survey's design and procedures. There have been several changes in Household Survey procedures that might be expected to have some impact on unit response (Figure 4.2).

Of the five design features shown in Figure 4.2, only the first two, involving the use of incentives, might be expected to *increase* unit response rates. The first RECS, in 1978, used a \$2 cash incentive that was given to each household at the time it was first contacted, plus another \$2 included with the questionnaires mailed to households for which personal interviews had not been obtained. To evaluate the effectiveness of the initial \$2 incentive, an experiment was undertaken in the 1979 RECS. Primary sampling units in large cities, where response rates are usually lower, were excluded from the experiment. In the remaining 80 primary sampling units, the incentive was used in 60 randomly selected secondary sampling units and was not used in the remaining 20. The \$2 incentive had no significant effect on unit and item nonresponse rates,

but more of the respondents who received the incentive agreed to sign waivers allowing EIA to collect data from their energy suppliers and a slightly higher proportion of them permitted interviewers to measure floor space inside the house, rather than outside (Thompson 1985b).

Figure 4.2. Design Changes That May Have Affected Unit Response Rates

Design Feature	Survey Year								
	1978	1979	1980	1981	1982	1984	1987	1990	1993
Initial incentive payment ^a	Y	Y	Y	N	N	N	N	N	N
Mail questionnaire incentive ^b	Y	Y	Y	Y	Y	N	Y	Y	Y
Longitudinal component	N	N	N	N	Y	Y	Y	Y	N
Returning households identified for interviewers ^c	---	---	---	---	N	Y	N	N	---
Low-income supplement	N	N	N	Y	N	Y	Y	N	Y

^aIn 1979, the incentive payment was provided to a subset of the sample households as part of an experiment.

^bFrom 1978 to 1982, a cash incentive was used. From 1987 on, a token gift has been used.

^cApplicable only in years with a longitudinal component.

--- = No longitudinal component.

Source: Energy Information Administration, *Housing Characteristics* (for years shown).

Nevertheless, the initial \$2 incentive was discontinued after the 1980 RECS. The \$2 incentive that accompanied the mail questionnaires was continued through 1982. In 1984, no incentive was used; in the 1987, 1990, and 1993 surveys a non-cash token gift was included with the mail questionnaires. The absence of any mail incentive, cash or non-cash, in 1984 may explain the low mail response rates observed in that year.

Among the factors that might be expected to lead to *lower* response rates was one that clearly had this effect--the introduction, starting in 1982, of a longitudinal survey design component, involving the collection of data from some households in two successive surveys. A subset of the households affected were also asked, in the interval between the two surveys, to participate in the Residential Transportation Energy Consumption Survey (RTECS). Many of the RTECS households were requested to keep track of their vehicle mileage and fuel purchases for a period of several months. Table 4.2 shows personal interview and mail response rates, separately for new households and those included in the sample previously, for the four years in which RECS included a longitudinal component. Clearly the new units had lower refusal rates and higher overall response rates, especially in 1984, 1987, and 1990.

The data do not distinguish, among households previously included in the sample, between those that participated in RTECS and those that did not (Table 4.2). A special study (Hersey and McCarthy 1986) provided such a comparison for the 1984 RECS. The sample for the 1983 RTECS included all households in the 1982 RECS that reported having driven their vehicles 12,500 miles or more and a subsample of the remaining households. Therefore, the most direct and relevant comparison is of the response rates for the RTECS participants and non-participants among the latter group, those households that reported fewer than 12,500 vehicle miles driven. In that group, the 1984 RECS participation rates were 75.4 percent for 644 households that had been included in the sample for the 1983 RTECS and 80.6 percent for 375 households that had not been selected.

Table 4.2. Household Survey Response Rates by Survey Year and Prior Sample Status: 1982-1990

Survey Year and Prior Status ^a	Response Rates (percent of eligible units)			Personal Interview Nonresponse Rates (percent of eligible units)	
	Personal Interview	Mail	Total	Refusals	Other
1982					
Previously in sample	83.9	4.8	88.7	12.7	3.4
New units	85.9	4.6	90.5	10.3	3.9
1984					
Previously in sample	78.2	2.8	81.0	17.6	4.2
New units	84.1	3.2	87.3	12.2	3.7
1987					
Previously in sample	79.5	5.2	84.7	16.3	4.2
New units	83.5	5.1	88.6	11.7	4.8
1990					
Previously in sample	79.4	4.5	83.9	13.9	6.7
New units	84.0	4.5	88.5	10.4	5.6

^aThe category "Previously in Sample" includes a few units missed in the previous survey or constructed subsequently.
Source: Energy Information Administration, *Housing Characteristics* (for years shown).

Another factor, which was operative only in the 1984 RECS, was a sample assignment procedure which made it possible for the survey interviewers to know which of the units assigned to them had already been included in the 1982 RECS. There is no direct evidence about how this knowledge may have affected interviewers' efforts, but it has been suggested that interviewers might not have tried as hard to obtain interviews for these "recycled" housing units as they did for new ones (Response Analysis Corporation 1987).

A change in the relative sample selection probabilities for different subsets of the RECS target population can affect *unweighted* unit response rates. An example of this is provided by the low-income supplements that were included in RECS in survey years 1981, 1984, 1987, and 1993. In these years, housing units in secondary sampling units that were classified by interviewers as low-income areas were oversampled, with the result that a larger proportion of the total sample was located in such areas. Data for the 1987 RECS (Slider 1995) show that response rates were somewhat higher in the areas that were oversampled, so that the overall unweighted response rates were higher in 1987 than they would have been if there had been no low-income supplements in these years. *Weighted* response rates, of course, would not be affected by differences in sampling rates for different segments of the population.

There is some evidence that personal interview response rates may be higher for interviewers who have had experience in prior RECS survey years. A special tabulation for the first round of interviewing in the 1990 RECS showed that interviews were completed for 73.7 percent of the sample households assigned to interviewers who had also worked in the 1987 RECS, as compared with only 64.7 percent for interviewers who had not worked in 1987 (Response Analysis Corporation 1991, Table 11). However, these findings could also be explained by higher turnover rates in areas where respondents tend to be less cooperative.

The proportion of experienced interviewers (those who had worked on earlier RECS surveys) was in the neighborhood of 60 percent for survey years 1981, 1982, and 1984. It declined to about 45 percent in 1987 and to about 35 percent in 1990 and 1993. To some extent, this trend tracks the decline in personal interview response rates in the most recent survey years, but 1984, with a high proportion of experienced interviewers and a low response rate, is an exception.

The 5 percent drop in response rates between 1990 and 1993 resulted primarily from a conscious decision to reduce the target response rate for RECS from 85 to 80 percent. In order to maintain the desired sample size, the level of followup effort for households not completed in the initial wave of interviewing was reduced in comparison with prior survey years. Another factor that *may* have influenced response rates for the 1993 RECS was the substantial increase in the length of the Household Survey questionnaire compared with preceding surveys. The basic household questionnaire contained 117 pages in 1993, compared to 63 in 1990 and 50 in 1987. Potential respondents might not have had a very clear idea, when approached to participate in the survey, of the length of the questionnaire or the time it might take to complete it. However, some of the experienced interviewers, knowing of the increased length of the 1993 questionnaire, might not have tried quite as hard to enlist the cooperation of initially reluctant respondents, knowing that there was an increased risk of their breaking off the interview prior to its completion.

In summary, the drop of 5.4 percentage points in overall response rates between the 1982 and 1984 survey appears to have resulted from the confluence of several factors: the elimination of incentives, cash or noncash, for mail questionnaires; the inclusion of a longitudinal component and a low income supplement; and the use of a procedure which allowed interviewers to identify housing units previously interviewed. Several steps were taken to try to increase response rates in the 1987 RECS. These measures appear to have had some success in 1987 and 1990, but did not bring the rates back to the levels achieved prior to 1984. In the 1993 RECS, the absence of a longitudinal component was not accompanied by the reduction in refusal rates that might have

been expected; on the contrary, the proportion of eligible housing units refusing personal interviews increased to its highest level. The increased length of the 1993 Household Survey questionnaire may have played a role. This increase, in combination with a substantial decline in the success of mail and telephone followups, led to the lowest overall completion rate so far experienced in the RECS Household Survey.

The effects of nonresponse on the quality of survey estimates depend not only on the overall level of nonresponse but also on its distribution among subgroups of the RECS target population. Trends in overall response rates (personal interview, plus mail/telephone) for selected housing unit characteristics--Census region, urban-rural location, and type of structure--for survey years 1979 through 1993 are important (Table 4.3).

Even with the declining trend in overall response rates, some fairly consistent patterns in relative rates are evident. The Northeast Region has consistently had the lowest overall response rates. The South has consistently had the highest response rates for personal interviews but has had the lowest mail response rates in nearly all survey years. Households located in urban areas (the central cities of metropolitan statistical areas) have consistently had the lowest overall response rates and those in rural areas have had the highest rates. Except for 1993, households in structures with five or more housing units have had the lowest personal interview response rates. Households in single-family structures (including mobile homes) have had the highest overall response rates except in 1990, when the rates for units in structures with two to four housing units were the same as those for units in single family structures. As explained further in Chapter 7, the weighting procedures used to produce RECS estimates include weighting factors that are specifically designed to minimize the effects of nonresponse bias arising from differential response rates by Census region and urban/rural status.

Item Nonresponse

Responses to individual items on a completed questionnaire can be assigned to one of the following categories:

1. No entry required for item (skip based on prior item)
2. Entry required for item
 - a. Item left blank
 - b. Allowable nonresponse
 - (1) Don't know or not sure
 - (2) Refused
 - c. Non-standard response
 - d. Standard response

Table 4.3a. Household Survey Response Rates by Region, Urban Status, and Structure Type: 1979-1993

Census Region and Survey Year	Response Rates (percent of eligible units)			Personal Interview Nonresponse Rates (percent of eligible units)	
	Personal Interview	Mail Questionnaire ^a	Total Response	Refusals	Other
Northeast					
1979	82.0	6.0	88.0	NA	NA
1980	83.8	4.9	88.7	10.5	5.7
1981	83.2	6.3	89.5	10.5	6.3
1982	81.7	5.2	86.9	13.1	5.2
1984	81.2	2.0	83.2	15.1	3.7
1987	79.0	5.7	84.7	16.3	4.7
1990	77.5	5.9	83.4	13.8	8.7
1993	75.8	2.6	78.3	16.6	7.7
Midwest					
1979	86.7	4.4	91.1	NA	NA
1980	87.4	3.7	91.1	9.0	3.6
1981	86.7	5.2	91.9	8.8	4.4
1982	84.4	5.4	89.9	12.5	3.0
1984	79.7	4.1	83.8	16.5	3.8
1987	80.7	5.9	86.6	15.1	4.2
1990	83.1	4.3	87.4	11.8	5.1
1993	80.4	2.9	83.3	15.5	4.1
South					
1979	87.6	3.8	91.4	NA	NA
1980	89.8	3.1	92.9	6.8	3.4
1981	88.9	3.4	92.3	6.2	4.9
1982	86.5	3.2	89.7	9.7	3.8
1984	83.5	2.1	85.6	12.8	3.7
1987	84.0	4.2	88.2	11.7	4.3
1990	84.9	3.1	88.0	10.3	4.8
1993	81.0	1.8	82.8	13.8	5.2
West					
1979	84.2	7.5	91.7	NA	NA
1980	87.9	3.5	91.4	8.8	3.3
1981	86.9	5.3	92.2	8.4	4.7
1982	85.9	5.4	91.3	11.2	2.9
1984	79.4	4.0	83.4	15.7	4.8
1987	81.8	5.1	86.9	13.3	4.9
1990	80.4	5.1	85.6	13.0	6.6
1993	77.9	1.9	79.8	16.0	6.1

^aData for 1993 include mail and telephone questionnaires.

NA = Not Available.

Source: Energy Information Administration, *Housing Characteristics* (1979-1993).

Table 4.3b. Household Survey Response Rates by Region, Urban Status, and Structure Type: 1981-1993

Location Type and Survey Year ^a	Response Rates (percent of eligible units)			Personal Interview Nonresponse Rates (percent of eligible units)	
	Personal Interview	Mail Questionnaire ^b	Total Response	Refusals	Other
Urban					
1981	82.4	6.5	88.9	10.0	7.6
1982	80.8	6.1	86.8	13.6	5.6
1984	79.4	3.5	82.9	15.8	4.8
1987	79.8	5.2	85.0	14.4	5.8
1990	79.0	4.9	83.8	12.3	8.7
1993	77.6	1.7	79.4	15.5	6.8
Suburban					
1981	85.8	5.9	91.7	9.7	4.6
1982	85.0	4.6	89.6	12.5	2.5
1984	79.3	3.7	83.0	16.7	4.0
1987	80.4	6.0	86.4	15.6	4.0
1990	80.6	5.2	85.9	13.7	5.7
1993	77.6	2.9	80.5	17.1	5.4
Rural					
1981	91.1	2.6	93.7	5.4	3.5
1982	89.7	3.2	93.0	7.5	2.8
1984	86.2	1.4	87.6	10.9	2.9
1987	85.6	4.1	89.7	10.9	3.5
1990	87.2	2.8	89.9	9.3	3.5
1993	84.2	1.5	85.7	11.1	4.7

^aData available for 1979 and 1980 are based on a different location type classification.

^bData for 1993 include mail and telephone questionnaires.

Source: Energy Information Administration, *Housing Characteristics* (1981-1993).

Table 4.3c. Household Survey Response Rates by Region, Urban Status, and Structure Type: 1979-1993

Structure Type and Survey Year	Response Rates (percent of eligible units)			Personal Interview Nonresponse Rates (percent of eligible units)	
	Personal Interview	Mail Questionnaire ^a	Total Response	Refusals	Other
Single Family					
1979	87.6	4.3	91.9	9.7	2.6
1980	88.9	3.3	92.2	6.4	2.7
1981	88.3	4.1	92.4	8.1	3.6
1982	86.2	4.4	90.6	11.6	2.3
Mobile Home					
1979	88.1	2.8	90.9	7.5	4.4
1980	90.0	2.1	93.0	8.4	2.7
1981	89.2	2.6	91.8	6.1	4.7
1982	87.4	2.0	89.5	8.9	3.6
Single-Family/Mobile Home					
1984	83.8	1.2	85.0	12.2	4.0
1987	82.3	5.4	87.7	14.5	3.2
1990	82.3	4.4	86.7	12.8	4.9
1993	79.6	2.3	81.9	15.8	4.6
Buildings with 2-4 units					
1980	80.1	7.1	87.2	NA	NA
1981	86.4	4.8	91.2	7.2	6.4
1982	85.0	4.2	89.2	10.2	4.8
1984	81.4	2.9	84.3	12.7	5.9
1987	80.1	3.9	84.0	12.4	7.5
1990	83.2	3.5	86.7	8.0	8.8
1993	74.7	2.5	77.1	17.0	8.4
Buildings with 5 or more units					
1980	76.3	9.5	85.8	NA	NA
1981	78.6	9.9	88.5	10.5	10.9
1982	76.7	7.9	84.5	13.0	10.3
1984	79.4	3.8	83.2	14.4	6.2
1987	79.4	5.4	84.8	13.0	7.6
1990	77.4	6.0	83.4	11.7	10.9
1993	78.6	1.7	80.2	12.0	9.4

^aData for 1993 include mail and telephone questionnaires.

NA = Not Available.

Sources: Energy Information Administration, *Housing Characteristics* (1980-1993); *Consumption and Expenditures* (1979).

Some of these categories can be illustrated by the 1990 RECS item on age of water heating equipment (Item C-5). The item was skipped (Category 1) if the preceding question "Does the main equipment for heating water for your home also heat water for other buildings or housing units?" was answered "Yes" or "Don't know." If item C-5 was asked, acceptable entries included "Don't know" (Category 2b(1)) and "As old as the house/original equipment" (Category 2c). Standard responses (Category d) were ranges for number of years. For this item, blanks and "Don't know" responses would be counted as item nonresponse.

A few items specifically permit the interviewer to check "Refused"; on the 1990 questionnaire these were the items on family income, account numbers of fuel suppliers, and relationship to respondent of person to whom fuel bills are addressed. Except for family income, refusals to these items had no direct effect on the survey estimates.

For the purpose of this chapter, item nonresponse will consist of categories 2a and 2b, blanks, and allowable nonresponse. Nonstandard responses generally provide some kind of usable information. In the example given above, if the response to the item on age of water heating equipment were "As old as the house/original equipment," the response to the item on age of house or building would be used to assign an age range to the water heating equipment. Nonresponse rates are calculated by dividing the number of households with nonresponse (2a plus 2b) by the number of households for which a response was required (total number of questionnaires minus those in category 1).

Item nonresponse in the Household Survey has been relatively low for most items on questionnaires completed by personal interview. As noted above, many questions are not included on the mail and telephone questionnaires. To the extent that these excluded items apply to all housing units, the additional item nonresponse from this source has varied from 2.7 to 5.9 percent--mail response as a percent of total response--depending on the survey year (see Table 4.1).

A tabulation of the 1990 RECS Household Survey personal interview data file prior to computer edits shows that, of 416 survey variables based on questionnaire entries, 51 (12 percent) had item nonresponse rates of 5.0 percent or more. Variables related to household measurements were excluded from this count; nonresponse for this topic is discussed separately below.

Table 4.4 lists the 10 questionnaire items with the highest nonresponse rates in the 1990 RECS. Of the 10 items listed, only 3--age of water heater and two items related to household income--required entries on more than 10 percent of the questionnaires. The basic household income item, which asked each sample household to report its total income in one of 25 class intervals, had a nonresponse rate of 14.4 percent, with half of the nonresponse being accounted for by refusals. Nonrespondents to the basic item were asked whether their income was above or below \$35,000, the cutoff used for deciding whether to ask about participation in income-tested government assistance programs. Nonresponse to this question was 21.4 percent, so there was no income information of any kind available for 3.1 percent of the sample households.

Table 4.4. Ten Variables with Highest Item Nonresponse Rates: 1990 RECS

Question No.	Description	Number of Housing Units			Nonresponse Rate
		Entry Required for Item	Type of Response		
			Don't Know	No Entry	
L-5	Amount received from government for home heating costs	255	72 ^a	10	32.2
H-18	Amount per gallon paid for kerosene	209	51	10	29.2
B-5	Month of change in main heating fuel	137	--	38	27.7
I-8	Proportion of kerosene bill for nonhousehold uses	4	--	1	25.0
K-10	Household income over or under \$35,000	695	38	111 ^b	21.4
P-7	Sales of agricultural products	100	15	4	19.0
K-10	Household income	4,840	250	445 ^c	14.4
L-4e	Other form of government payment for home heating costs	239	1	33	14.2
C-5	Age of water heater	4,089	400	171	14.0
B-5	Year of change in main heating fuel	137	7	12	13.9

^aResponse category "Not sure."

^bIncludes 100 refusals.

^cIncludes 347 refusals.

Source: Preliminary tabulation of 1990 RECS data prior to edit changes.

Items on age of equipment had relatively high nonresponse rates, as follows:

Water heater (shown in Table 4.4)	14.0
Main heating equipment	12.9
Central air-conditioning equipment	12.9
Most used window or wall unit	9.3
Most used refrigerator	6.5
Second most used refrigerator	5.1

The higher nonresponse rates in this group were for the ages of equipment that was less readily accessible at the time of the interview. Perhaps for the same reason, water heater capacity had a nonresponse rate of 10.1 percent. Although no items on insulation were among the 10 with the highest nonresponse rates, 7 of 18 items relating to presence and extent of insulation had nonresponse rates in the range of 5 to 11 percent.

Households living in rental units in multiunit buildings are more likely to be unable to respond to questions on age and other characteristics of equipment. In the 1990 RECS more than half (57 percent) of the "don't know" responses to the item on age of main heating equipment came from such households. Recent occupancy of the housing unit is another factor associated with some types of nonresponse. The 1990 data show that 91 percent of the "don't know" responses to the question on main heating fuel used at the time of the 1987 RECS were given by members of households that had moved into their current residences subsequent to 1987.

The highest item nonresponse rate, 32.2 percent, was recorded for a question on the total dollar amount received from the government for assistance with home heating costs. Other dollar amount items with high nonresponse rates were amount per gallon paid for kerosene, 29.2 percent, and sales of agricultural products, 19.0 percent.

The extent of missing information on household size merits special attention. RECS interviewers were instructed to measure the dimensions of all "area enclosed from the weather," using a retractable 50-foot metal tape measure. Outside measurements were preferred, but interviewers were allowed to measure from the inside when necessary. They were instructed to record which of these options was employed for each housing unit. They were asked to prepare a rough diagram of the floor plan, indicating which areas were heated, which were unheated, and the dimensions of each.

Table 4.5 shows, for survey years 1980 through 1993, the extent to which the interviewers succeeded in providing some or all of the household size information. (Comparable data on total and heated floor space were not obtained in the 1978 and 1979 surveys.) The data in Table 4.5 cover only housing units for which personal interviews were conducted. The data for survey years 1982 and 1984, the first two years in which RECS included a longitudinal component, exclude a substantial number of units for which the measurements were taken from the data file for the previous survey.

Table 4.5. Housing Unit Survey, Completeness of Household Size Information: 1980-1993

Category	Survey Year						
	1980	1981	1982	1984	1987	1990	1993
Number of personal interviews completed ^a	5,804	5,937	3,648 ^b	4,895 ^c	5,856	4,828	6,918
Percent with:							
Complete measurement information	81.5	82.2	62.4	56.0	73.0	75.4	66.4
Partial Information:	15.4	15.4	32.3	37.5	25.8	21.4	28.4
Unknown if inside or outside otherwise complete	(9.9)	(9.2)	(27.3)	(31.7)	(20.7)	(15.9)	(22.8)
Some measurements missing	(5.5)	(6.2)	(5.0)	(5.9)	(5.1)	(5.5)	(5.7)
No usable information	3.2	2.4	5.3	6.4	1.2	3.2	5.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

^aExcludes housing units for which mail or telephone questionnaires were completed.

^bExcludes 827 units for which measurements from 1981 survey were used.

^cExcludes 584 units for which measurements from 1982 survey were used.

Source: Energy Information Administration, *Housing Characteristics* (1980-1993).

The substantial year-to-year variation in the proportion of cases for which full information was obtained has resulted primarily from wide variations in the proportion of cases for which all required measurements were obtained, but interviewers did not specify whether they were inside or outside measurements. That proportion peaked in the 1982 and 1984 surveys, at 27.3 and 31.7 percent, respectively. In those same years, the proportions of cases with no usable information, 5.3 and 6.4 percent, were also higher than in other years, although 1993 was not far behind, with 5.1 percent in this category. The proportion of cases with some measurements missing (some of which may also have failed to distinguish heated and unheated areas) has been remarkably stable, in the vicinity of 5 or 6 percent.

These variations in the proportion of cases for which the method of measurement was not clearly specified may have resulted in part from changes in how interviewers were asked to record this information. Variations used from 1980 through 1993 have been as follows:

<u>Survey Year</u>	<u>Location of Question on Measurement Procedure</u>	<u>Response Categories</u>
1980	Start of measurements module	Inside, outside
1981	Same as 1980	Inside, outside, other
1982	End of measurements module	Inside, outside, and 4 other options
1984	Same as 1982	Same as 1982
1987	After <i>each</i> floor, attic and basement	Inside, outside, other
1990, 1993	Same as 1987	Same as 1987

The information on where the measurements were made is needed in order to standardize area measurements for all housing units to outside dimensions. For housing units known to have been measured on the inside, scale factors are used to convert their values to outside dimensions. For this purpose, all housing units for which the measurement method was not specified were assumed to have been measured on the outside, this being the much more commonly used method, at least for single-unit structures.

Nonresponse in the Rental Agent Survey

As explained in the introduction to this chapter, the Rental Agent Survey covers households in multiunit structures that have one or more fuels included in their rent. Its main purpose is to improve the quality of information about types of fuels used for space heating, water heating, and air-conditioning and the main type of heating equipment used. In 2 survey years, 1980 and 1984, permission was also requested from some of the rental agents to collect consumption and expenditure data for buildings from their fuel suppliers. In those two years, both personal and telephone interviews were conducted; in other years, the rental agents have been contacted entirely by telephone. Each rental agent is requested to provide information for all of the sample housing units for which the agent is responsible, whether the units are located in a single building or in more than one building.

Table 4.6 shows response rate information for the Rental Agent Survey for survey years 1981 through 1993 and partial information for 1979 and 1980. The proportion of interviewed households eligible for the Rental Agent Survey has varied from 10.7 to 15.4 percent. The higher eligibility rates in 1984 and 1987 were probably associated with the inclusion of low-income supplements in those years. The average numbers of housing units per rental agent interviewed were also higher in those years, as well as in 1981 and 1993, when there were also low-income supplements.

Table 4.6. Rental Agent Survey Eligibility and Response Rates by Survey Year: 1979-1993

Category	Year ^a							
	1979	1980	1981	1982	1984	1987	1990	1993
No. of household interviews completed			6,269	4,724	5,682	6,229	5,095	7,111
Eligible for rental agent survey								
Number	NA	NA	746	540	826	961	646	764
Percent			11.9	11.4	14.5	15.4	12.7	10.7
Rental agent survey completed								
Number	NA	551	466	308	549	856	550	625
Percent of eligible	NA	NA	62.5	57.0	66.5	89.1	85.1	81.8
No. of rental agents interviewed	109 ^b	283	203	168	210	303	281	285
Mean no. of housing units per rental agent	NA	1.95	2.30	1.75	2.61	2.83	1.96	2.19

^aRental Agent Survey was conducted in 1978, but no data on response are available.

^bOf 141 identified.

NA = Not Available.

Sources: Energy Information Administration, *Housing Characteristics* (1980-1993); *Consumption and Expenditures* (1979).

The response rates in Table 4.6 represent the proportion of eligible housing units for which Rental Agent Survey information was obtained. Because of more focussed and systematic efforts to contact rental agents, beginning with the 1987 survey, the response rates achieved for 1987, 1990, and 1993--all in the 80 to 90 percent range--were substantially higher than those that had been achieved in the three prior survey years.

The probable consequence of nonresponse in the Rental Agent Survey is that the information for the items covered in that survey will be less accurate for the housing units for which interviews were not completed. Data from the Rental Agent Survey are compared with corresponding data from the Household Survey, and the former source is generally considered more accurate with respect to main fuels used and main heating equipment. Data for survey years 1981 through 1987 show that one or more changes were made on the basis of this comparison for 30 percent of the housing units in 1981, 26 percent in 1982, 32 percent in 1984, and 42 percent in 1987. Most of the changes were for main heating fuel and equipment and main water-heating fuel.

Nonresponse in the Supplier Survey

The Supplier Survey covers households that pay the supplier directly for one or more of five fuels: electricity, natural gas, fuel oil, kerosene, and LPG. It does not cover fuels included in the payment of rent. Fuels purchased on a cash and carry basis, primarily kerosene, are also excluded. For each fuel, eligible housing units are asked to sign waiver forms allowing their suppliers to provide billing information to the survey contractor.

Table 4.7 shows eligibility and response rates for the Supplier Survey for survey years 1980 through 1993. For survey years 1980, 1981, and 1982, a single Supplier Survey form was used for fuel oil and kerosene; hence the data for fuel oil and kerosene are combined for these survey years. From 1984 on, the two fuels are shown separately. Except for kerosene, most of the households not eligible for the Supplier Survey occupied rental units in buildings with two or more units. A large proportion of the households that used kerosene were ineligible for the supplier survey because they purchased it on a cash and carry basis. Respondents for these households were asked to estimate the amount of kerosene used or purchased during the past 12 months. For the 1982 survey year, following a substantial increase in the proportion of households using kerosene as a supplemental heating fuel, followup telephone calls were made to such households to request estimates of the amounts used during the 1982-1983 heating season. Estimates were obtained from 65 of 96 eligible households (EIA 1984b, p.101).

Table 4.8 shows, for the 1980 to 1984 survey years, eligibility rates for the Supplier Survey for electricity and natural gas by type of structure. For housing units in single-family structures, eligibility rates were high for both fuels. They were lower for housing units in structures with 2 to 4 units and lowest in structures with 5 or more units. The corresponding data for fuel oil for 1984 (the only year for which separate data were available for fuel oil and kerosene) show an even more pronounced pattern. The housing-unit eligibility rates were 98.0 percent for single-family structures, 37.6 percent for structures with 2 to 4 units, and only 2.2 percent for structures with 5 or more units. Most large apartment buildings that use fuel oil for heating have central systems, with no metering of consumption by individual units.

The primary measure of completeness of response for the Supplier Survey is the proportion of eligible housing units for which usable records were obtained. As shown in Table 4.7, these rates have been consistently high, in the neighborhood of 90 percent, for electricity and natural gas. They have been somewhat lower for fuel oil and LPG and very low for kerosene. Except for natural gas, the lowest rates for all fuels occurred in the 1984 survey.

The primary reason for nonresponse in the Supplier Survey for electricity, natural gas, and LPG has been failure to obtain permission from respondents to contact their suppliers. For these fuels, the proportion of eligible respondents not providing waivers has consistently been between 5 and 10 percent. Other reasons for failure to obtain usable records include: supplier unknown or not contacted; supplier refused to participate (a very small proportion for all fuels); supplier could not find household in records; and supplier did not provide records covering a sufficient part of the desired reference period. Records for electricity and natural gas were considered unusable if they covered less than 5 months and included seasonal use (heating or cooling) or covered less than 2 months. Records for fuel oil, kerosene, and LPG were considered unusable if they

Table 4.7. Supplier Survey Eligibility and Response Rates by Fuel and Survey Year: 1980-1993

Fuel Type and Survey Year	Number of Households Using Fuel ^a	Percent of Total Households		Percent of Eligible Households for which:			
		Eligible for Supplier Survey ^b	Eligible and Usable Records Obtained	Usable Records Obtained	Unusable Records		
					No Waiver Obtained	Other Reasons	
Electricity							
1980	6,048	93.0	82.5	88.7	6.9	4.4	
1981	6,263	92.2	80.8	87.6	8.9	3.5	
1982	4,721	92.4	83.4	90.3	7.0	2.7	
1984	5,677	91.0	79.5	87.4	8.1	4.5	
1987	6,228	92.5	83.0	89.7	7.2	3.1	
1990	5,094	94.0	85.1	90.5	5.7	3.8	
1993	7,108	95.1	85.6	90.0	5.6	4.4	
Natural gas							
1980	3,725	83.9	75.2	89.6	6.8	3.6	
1981	3,850	81.7	71.7	87.8	9.2	3.0	
1982	2,951	82.3	74.3	90.3	6.8	2.9	
1984	3,599	79.0	70.0	88.6	8.1	3.3	
1987	3,990	83.3	74.0	88.8	7.6	3.6	
1990	3,255	85.8	76.6	89.3	5.7	5.0	
1993	4,069	86.2	77.0	89.4	6.2	4.4	
Fuel oil/kerosene							
1980	1,132	91.7	54.6	59.5	7.9	32.6	
1981	1,122	93.2	46.7	50.1	7.3	42.6	
1982	863	94.7	48.3	51.0	5.6	43.4	
Fuel oil							
1984	918	68.1	43.2	63.4	12.2	24.4	
1987	951	75.3	55.6	73.8	8.4	17.8	
1990	700	80.9	58.1	71.8	7.5	20.7	
1993	865	82.1	60.5	73.8	5.7	20.5	
Kerosene							
1984	421	50.5	9.7	19.2	8.5	72.3	
1987	414	36.5	11.6	31.8	1.4	66.8	
1990	278	37.4	10.1	27.0	2.9	70.1	
1993	272	45.2	12.9	28.4	5.8	65.8	
LPG							
1980	574	95.7	65.5	68.4	8.0	23.6	
1981	627	97.3	61.3	63.0	8.2	28.8	
1982	413	94.0	67.3	71.6	6.9	21.5	
1984	525	93.7	58.5	62.4	7.9	29.7	
1987	543	94.5	64.5	68.3	9.3	22.4	
1990	461	95.2	65.3	68.6	6.4	25.0	
1993	684	97.1	71.6	73.8	5.2	21.0	

^aIncludes households for which mail questionnaires were obtained.

^bFor kerosene, excludes households for which estimated purchases were reported in the Household Survey.

Source: Energy Information Administration, *Consumption and Expenditures* (1980-1993).

Table 4.8. Supplier Survey Eligibility Rates for Electricity and Natural Gas by Structure Type: 1980-1984

Fuel Type and Year	Type of Structure			
	Single Family	2-4 Units	>5 Units	Mobile Home
Electricity				
1980	98.6	85.2	68.4	99.5
1981	98.8	82.7	65.7	93.1
1982	98.4	80.1	69.5	92.8
1984	98.2	81.9	68.5	89.2
Natural Gas				
1980	98.3	66.4	25.6	78.4
1981	98.4	73.2	17.7	83.2
1982	98.3	55.5	27.5	85.1
1984	98.1	61.2	21.9	88.2

Source: Energy Information Administration, *Consumption and Expenditures* (1980-1984).

did not cover a full year. The tighter requirement for the latter three fuels has led to somewhat higher rejection rates for records submitted by their suppliers. For kerosene and LPG, a significant part of the nonresponse has occurred because companies were unknown or were not contacted for other reasons.

For each fuel, the proportion of eligible households for which consumption was imputed or estimated was lowest in the 1993 RECS. The high estimation/imputation rates for kerosene occur partly because only one-half to one-third of the households using kerosene were eligible for the Supplier Survey and partly because Supplier Survey data were successfully obtained for fewer than one-third of the eligible households each year.

When supplier survey information is not obtained for an eligible sample household, the consumption of the affected fuel for that household is estimated or imputed by a nonlinear regression model that makes use of reported data for relevant characteristics of the housing unit. The same methods are used to estimate or impute consumption for households not eligible for the supplier survey. Consumption and cost information derived from billing records is not necessarily 100 percent accurate for every housing unit (see further discussion in Chapter 6); nevertheless, the precision and reliability of such information is likely to be substantially greater than that of values imputed for housing units that were not eligible for the Supplier Survey or for which the supplier did not respond. Based on the data shown in Table 4.7, ranges of the proportion of user households for which consumption and cost have been imputed (or, for kerosene, based largely on user estimates) are:

<u>Fuel Type</u>	<u>Years</u>	<u>Proportion Imputed</u>
Electricity	1980-1993	14.4 to 20.5 percent
Natural Gas	1980-1993	23.0 to 30.0 percent
Fuel Oil	1984-1993	39.5 to 56.8 percent
Kerosene	1984-1993	87.1 to 90.3 percent ^a
LPG	1980-1993	28.4 to 41.5 percent

^aIncludes units for which consumption was estimated by the household respondent.

Summary

This chapter has presented information about unit and item nonresponse in the three data collection components of RECS: the Household Survey, the Rental Agent Survey, and the Supplier Survey. A summary of the highlights follows.

Household Survey

- Overall (personal interview, plus mail and telephone) unit response rates have varied from a high of 91.6 percent in the 1981 RECS to a low of 81.2 percent in 1993 (Table 4.1).
- Between the 1978 and 1990 survey years, the percentage of eligible housing units for which mail questionnaires were completed varied between a high of 5.3 percent in 1978 and a low of 3.0 percent in 1984. In the 1993 RECS, mail or telephone questionnaires were completed for only 2.2 percent of the eligible units (Table 4.1). The mail and telephone questionnaires are abbreviated versions of the personal interview questionnaires; hence item nonresponse is automatic for all items not included on these questionnaires.
- The inclusion of a longitudinal component to RECS in survey years 1982 to 1990 led to a increase in unit nonresponse each year for households that had been included in the prior survey (Table 4.2). The increase was greatest for households that participated in the Residential Transportation Energy Consumption Survey in the interval between the RECS survey years.
- The highest unit nonresponse rates have consistently occurred in the Northeast Region, in central cities, and in buildings containing more than one housing unit (Table 4.3).
- Item nonresponse rates for questionnaires completed by personal interview have been relatively low, with only 12 percent of the items having nonresponse rates of 5.0 percent or more in 1990. The highest nonresponse rate for an item required of all sample households was 14.4 percent for family income (Table 4.4).

- The proportion of interviewed housing units with complete information on size measurements has varied from a high of 82.2 percent in 1981 to a low of 56.0 percent in 1984. The most common omission has been failure of the interviewer to indicate whether measurements were made inside or outside the housing unit (Table 4.5).

Rental Agent Survey

- The proportion of households eligible for the Rental Agent Survey has varied from 10.7 to 15.4 percent of all households for which questionnaires were obtained by interview or mail. Response rates for eligible households have ranged from a low of 57.0 percent in 1982 to a high of 89.1 percent in 1987 and have exceeded 80 percent in each of the last three survey years (Table 4.6).

Supplier Survey

- The proportion of households eligible for the Supplier Survey varies by fuel and type of structure. Eligibility rates have consistently been over 90 percent for electricity and LPG, and close to or above 80 percent for natural gas. Rates for fuel oil have been somewhat lower. Most of the households not eligible for the Supplier Survey for these fuels are living in rental units located in buildings with two or more units (Table 4.8).
- Low eligibility rates for the Supplier Survey for kerosene occur largely because many of the households using that fuel purchase it only on a cash and carry basis.
- Among households eligible for the Supplier Survey, generally between 5 and 10 percent have been unwilling to sign a waiver to allow the survey contractor to contact their suppliers (Table 4.7).
- Taking into account the joint effects of eligibility and the extent of success in obtaining usable records for eligible households, supplier data have been obtained consistently for close to or better than 80 percent of all electricity users, over 70 percent of natural gas users, and close to or better than 60 percent of LPG users. For fuel oil, the corresponding rates have varied from 43 percent in 1984 to 60 percent in 1993, and for kerosene they have been in the vicinity of 10 percent (Table 4.7). By this measure, the best results for each of the 5 major fuels was obtained in the 1993 Supplier Survey.