

## **Appendix B**

### **How the Survey Was Conducted**



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## Introduction

The Commercial Buildings Energy Consumption Survey (CBECS) is conducted by the Energy Information Administration (EIA) on a triennial basis to provide basic statistical information on energy consumption and expenditures for U.S. commercial buildings and also to provide data on energy-related characteristics of these buildings. To obtain this information, a survey is conducted based upon a sample of commercial buildings selected according to the sample design requirements described in the "Sample Design" section of this appendix. A "building" is the basic unit for the CBECS as opposed to an "establishment" because a building is the energy consuming unit.

This is the fifth in a series of surveys for the commercial sector. Previous surveys were conducted in 1979, 1983, 1986, and 1989. The first three surveys were called the Nonresidential Buildings Energy Consumption Survey (NBECS). In 1989, the survey's name was changed to Commercial Buildings Energy Consumption Survey (CBECS); however, the survey's design remained essentially the same. For consistency, all the surveys will be referred to as CBECS in this report. A special feature of the 1992 CBECS is that it was designed as a longitudinal survey to revisit the same buildings as interviewed in the 1986 CBECS.

The CBECS is conducted in two major data collection stages: a Building Characteristics Survey and an Energy Suppliers Survey. The first stage, the Building Characteristics Survey, collects information about selected commercial buildings through voluntary personal interviews with the buildings' owners, managers, or tenants. These data are collected on Forms EIA-871A, Building Questionnaire (consisting of the Building Questionnaire together with the Authorization Form) and EIA-871G, Construction Improvements and Maintenance and Repairs Supplement, for the Bureau of the Census (Census). The Census Form was incorporated as Section R of Form EIA-871A. The Authorization Form is used to secure the release of the buildings' energy consumption and expenditures records from the energy supplier. These data are collected during the Energy Suppliers Survey, which is the second stage.

The Energy Suppliers Survey obtains data concerning the building's actual consumption of energy and expenditures for energy from records maintained by energy suppliers. This information is obtained by means of a mail survey conducted under EIA's mandatory data collection authority using Forms EIA-871C through F. Additionally, the 1992 CBECS asked energy suppliers about any Demand-Side Management (DSM) programs they may have provided to the building. Under EIA's direction, a survey research firm conducted both the personal interviews for the Building Characteristics Survey and the mail survey for the Energy Suppliers Survey.

The data presented in this report are from the Building Characteristics Survey only. A companion volume to this report, to be published at a later date, will cover data on energy consumption and expenditures for these buildings.

This appendix has two main sections: Sample Design and Building Characteristics Survey. These sections focus on components of the sample and on the procedures for collecting and processing the first-stage survey data. Additional sections include Public-Use Data Preparation, Confidentiality, Longitudinal Issues, and Special Data Collection for the Census. The data collected for the Bureau of the Census are published by the Census Bureau and are not included in this report. The Building Questionnaire, the Authorization Form, and Census Supplement are shown in Appendix G.

## Target Population

The target population for the 1992 CBECS consisted of all commercial buildings in the United States larger than 1,000 square feet. Thus, to be eligible for the survey, a building had to satisfy three criteria: (1) it had to meet the survey's definition of a building, (2) it had to be used primarily for some commercial purpose, and (3) it had to measure 1,001 square feet or more. A commercial building is defined by CBECS as a structure totally enclosed by walls that extend from the foundation to the roof and is intended for human access. To be primarily used for some commercial purpose, the building must have more than 50 percent of its floorspace devoted to activities that are neither residential, industrial, nor agricultural. Further information on these criteria are provided later in the "Building Characteristics Survey" section under "Determining Building Eligibility for CBECS." The 1992 CBECS estimated that there were 4,806 thousand buildings in the target population.

## What's New in 1992 CBECS

For the 1992 CBECS, new questions were added and some of the previous questions were expanded on the Building Questionnaire. The new questions collected information on issues such as energy-related functions and DSM programs. The expanded questions collected more detailed information on issues ranging from building use to lighting. Also, wording and structural changes were incorporated into the 1992 questionnaire in order to: (1) improve data quality by ensuring comparability with the 1986 Building Questionnaire; (2) resolve ambiguities, which ultimately help the interviewers and the respondents to better understand the questions; and (3) meet the user needs which were reported in an extensive CBECS User-Needs Study conducted in 1991. (See Appendix G for the Building Questionnaire.)

### HIGHLIGHTS OF CHANGES IN THE 1992 CBECS

- Sample size increase of 400 buildings including 150 new, large office buildings
- Longitudinal revisit of 1986 CBECS provides data on the same building at two different points of time
- Expanded questions about the building to assist the interviewer in selecting the correct structure to interview
- Extensive CBECS user-needs study to maintain client-oriented survey results in extending and adding new questions to provide more detail on energy-related building characteristics:
  - Equipment - lighting, personal computers, refrigeration, hot water heating
  - Physical Characteristics - below-ground level floors, building shape, ground-level length and width of square and rectangular buildings, attachment to other structures, renovations and demolitions
  - Conservation and Energy Management - Demand-Side Management (DSM) participation, additional operating hours for equipment, responsibility for operation and maintenance of equipment, economizer cycles, special space functions
  - Energy Source and Related Information - gas transported for the account of others, photovoltaic cells (PVC's), solar thermal panels, wood, special energy technologies.

## Comparability with the 1986 Building Questionnaire

Since the 1992 CBECS was a longitudinal revisit of the same buildings as in the 1986 CBECS, revisions were made to ensure that for certain questions, the CBECS Building Questionnaire for 1992 was comparable to the one for 1986. Additionally, a section of questions was added to confirm that the interview was being conducted for the same building as defined for the 1986 CBECS interview. These questions required the interviewer to compare the statistics provided in 1986 and 1992 for square footage, number of floors, and year constructed. The respondents were required to explain any differences in the numbers. This additional information assisted the interviewer when determining if the 1992 building was the same building for which the interview was conducted in 1986.

## Resolving Ambiguities

Some questionnaire revisions were conducted to resolve ambiguities noted in the 1989 CBECS. One such ambiguity involved identifying the correct structure to interview. The resulting revision was the development of a section (interviewer observation of the building) for the interviewer to complete before the interview began. This section assisted the interviewer in selecting the correct structure and parts of the structure to interview. Other revisions that occurred to resolve ambiguities are discussed below.

## 1992 CBECS User-Needs Study

Assessment of previous CBECS data through an extensive CBECS user-needs study<sup>18</sup> conducted in 1991, resulted in a list of specific user needs and led to revisions in the 1992 CBECS Building Questionnaire content. EIA conducted this assessment in response to heightened awareness of energy-related issues sparked by the Department of Energy's development of the National Energy Strategy (NES) and the associated pending Congressional legislation (Energy Policy Act of 1992, enacted in 1993). Since CBECS is the sole nationwide data set addressing energy-related issues in commercial buildings, changes to the CBECS Building Questionnaire were essential to begin addressing questions raised by the energy legislation. Major changes to the 1992 CBECS Building Questionnaire are listed below.

### ***Equipment***

- **Lighting** - Questions related to types of lighting were expanded to distinguish among incandescent, fluorescent, compact fluorescent, HID, and other types of lighting. A 1986 question about lighting conservation features was expanded to record whether specular reflectors, daylighting controls, occupancy sensors, time clocks or timed switches, dimmer switches, or other lighting conservation equipment existed in the building.
- **Office** - 1992 was the first time CBECS requested the number of personal computers/computer terminals. Office equipment is believed to be the fastest growing segment of energy consumption in buildings. Personal computers/computer terminals are an indication of other office equipment such as facsimile machines and copying machines.

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<sup>18</sup> For a detailed discussion of the 1992 CBECS user-needs study, see *User-Needs Study for the 1992 Commercial Buildings Energy Consumption Survey*, DOE/EIA-0555(92)/4, Energy Information Administration (Washington, D.C: Government Printing Office, September 1992).

- Heating, Ventilation, and Cooling System (HVAC) - The equipment questions were expanded to obtain a more precise identification of the types of HVAC equipment in buildings, such as: an open-ended question about the overall system used to heat and/or cool the building; questions asking the percent of floorspace that was heated by each type of equipment and linking the distribution system to the specific heating equipment (also asking the same for cooling); and, residential-type central air conditioners were added to the types of specific equipment that may be a part of the cooling system.
- Other - Refrigeration questions were expanded to obtain more details about the types of refrigeration units. For the first time, the number of refrigeration units was also obtained. Also, this was the first time CBECS asked whether the hot water heating system was a centralized or distributed system.

### ***Building Characteristics***

- Physical Characteristics - Questions were expanded to determine: whether there were any below-ground level floors in buildings; whether the building was attached to another building; the shape of the building; and the length and width at ground level of square-and rectangular-shaped buildings. Also, the exterior wall material category "concrete panels" was renamed "pre-cast concrete panels," and "sheet metal panels" were added as a category.
- Building Activities - This was the first time CBECS separated the principal building activity category of "assembly" into "public assembly" and "religious worship." Also, for the first time CBECS asked how space was used in a building (space function) and the percent of floorspace used for each of the following energy-related space functions: commercial food preparation and serving; computer room(s) with separate air-conditioning systems; special ventilation equipment such as laboratories or clean rooms; any activity requiring large amounts of hot water, and any other function that requires large amounts of energy.
- Renovations and Demolitions - As in 1989, the 1992 CBECS Building Questionnaire asked whether the building's floorspace had increased or decreased since 1986 and, if so, by how much.

### ***Conservation Activities and Energy Management***

- DSM - This was the first time detailed questions about DSM programs were asked. These questions included whether the building's electric or natural gas utility had sponsored any DSM programs; whether the building or facility had participated in, or planned to participate in, any DSM programs sponsored in-house, by a utility, or a third-party; which specific DSM program areas the building had participated in, such as, lighting, building envelope, and HVAC systems; identification of specific program sponsors; and what type of assistance was received through the DSM program, such as, general information, incentives, or alternatives rates. During the Energy Suppliers Survey, additional data were collected on DSM participation for the specific building.
- Ownership and Occupancy Characteristics - Questions about vacant buildings were expanded to ask which months the building or part of the building was vacant and the percentage of floorspace vacant each month. The occupancy characteristic questions were changed to distinguishing the occupant by type of government agency, privately-owned utility company, church or other occupant. Questions were added about detailed daily operating schedules and the number of workers across all shifts as well as the main shift.
- Energy Management Characteristics - Energy management questions were expanded to ask whether or not there was a change in the temperature setting or a reduction in the use of the hot water heating, lighting, or other equipment when the building was not in full use. Questions were added to obtain the "shoulder hours" for the HVAC and lighting equipment. That is, the additional hours other than normal operating hours when the HVAC and/or lighting equipment was in use. If there were shoulder hours, the 1992 CBECS obtained the approximate hours per week this equipment was operating.

Also, the 1992 CBECS specifically asked about the individual responsible for the day-to-day operation and maintenance of the building's HVAC equipment; whether most windows could be opened; whether a heating and/or cooling system had variable air-volume and/or an economizer cycle; and whether there were any special energy technologies in the building.

### ***Energy Source and Related Information***

- Gas Transported for the Account of Others - Questions were included about gas transported for the account of others (often referred to as transported gas). These included whether the building purchased it, who supplied it, and what costs were involved.
- Renewable Energy Sources - Questions were asked about photovoltaic cells (PVC's) that convert sunlight directly into energy and solar thermal panels that use sunlight to heat fluids. PVC's and solar thermal panels were added as separate categories for the types of fuels or energy sources used in the building.
- Wood - Questions were asked about the number of cords burned in the building by the end of calendar year 1992, whether the wood was purchased or provided free of charge from some other source, and categorical expenditures for wood during calendar year 1992.
- Special Energy Technologies - This was the first time since the 1983 survey that a question was asked about special energy technologies that might be present in buildings. The categories asked were thermal energy storage (TES) or pump storage; passive solar features; geothermal energy; well water for cooling; waste incineration to produce energy; and wind generation.

## **Sample Design**

A consistent, comprehensive list of all buildings in the target population does not exist. Such a list for the entire Nation would be prohibitively expensive to develop and maintain. As a result, the sample design for the CBECS is not based upon sampling from a national list of commercial buildings.

The sample design for the CBECS is a multistage area probability cluster sample design supplemented by a list sample of "large" buildings, recently constructed buildings, and "special" buildings (Federal Government buildings, post offices, hospitals, nursing homes, colleges, universities, secondary schools, and elementary schools). The area sample portion of the design is a sample from the broad spectrum of commercial buildings. The supplemental list sample provides an oversample of "large" buildings and "special" buildings. Similarly, for recently constructed buildings, the area sample is used to provide a sample from the broad spectrum of new buildings and the supplemental list sample provides an oversample of "large," new buildings.

The accuracy of the estimates of the total amount of energy used in commercial buildings is increased if energy-intensive buildings are sampled at a higher rate. The sampling rate for different types of buildings varies in the area sample portion of the design, but the cost of the area sample design increases as the difference between sampling rates increases. The addition of the supplemental list sample to the sample design allows the use of very high sampling rates for the largest commercial buildings at a lower cost than expanding the scope of the area sample. Similarly, it is more cost effective to use the supplemental list sample to oversample "special" buildings and recently constructed buildings than to expand the area sample approach.

## Longitudinal Sample Design

The sample design for the 1992 CBECS was essentially the same as for earlier CBECS, particularly the 1986 CBECS. The 1992 CBECS is a longitudinal revisit of the 1986 sample and deliberately maximizes overlap with that earlier sample. The buildings selected in 1986 were re-selected in 1992 with some exceptions as described in the "Field-Listing Buildings Within Segments" section.

The primary objective of the longitudinal sample design was to observe the changes in a sample of the same commercial buildings over a 6-year period between two CBECS (1986 and 1992). Previously, a longitudinal sample design was incorporated in the 1983 CBECS using the 1979 CBECS buildings. However, data analysis revealed that 4 years were not enough time to expect a change in energy consumption and expenditures.

## Sample Design Updates

The 1986 sample was updated for the 1992 CBECS in three ways:

### Area Sample

- For the area sample, field workers visited a portion of the areas surveyed in 1986 and updated the building listings from that earlier survey. A sample of buildings was selected from the "new" (i.e., not previously listed) buildings identified during this area sample list update.

### Supplemental List Sample

- Large facilities that were sampled from the 1986 lists were recontacted in 1992 by telephone to ascertain if there were any new buildings constructed since the 1986 sample.
- An additional list sample was selected from Dodge Reports of new construction projects to ensure better representation in the sample of (1) newly constructed large buildings and (2) large (250,000 square feet or more) office buildings. This list frame identified buildings constructed between the 1986 and 1992 CBECS.<sup>19</sup> For more indepth discussion, see "Supplementary Sample from Lists of Large and Specialized Buildings" section in this appendix.

## Sampling Procedures

As briefly described earlier, the 1992 CBECS sample was a multistage area probability sample supplemented by a sample from lists of "large" buildings and "special" buildings. For both the area sample and the supplemental list sample, sampling procedures began with the selection of Primary Sampling Units (PSU) the geographic areas of the country in which all subsequent sampling procedures were carried out. Sampling procedures for the area sample were as follows: ZIP Code Groups were subsampled as the Secondary Sampling Units (SSU's) within the sampled PSU's; segments were subsampled within the SSU's; lists of all nonresidential buildings were compiled for all sampled segments; and, buildings were selected from those lists. For the supplemental list sample, "large" and "special" buildings were selected directly from the lists of large and specialized buildings for each PSU. These lists covered the entire PSU's, not just the sampled ZIP Code Groups used for the area sample.

<sup>19</sup>Dodge Reports are collected, maintained, and distributed by the F.W. Dodge Division of the McGraw-Hill Information Systems Company, New York, NY.

### ***Projected Sampling Results***

The goal of the 1992 CBECS sampling procedures (both the area sample and the supplemental list sample) was to achieve completed interviews of 6,400 buildings, including an additional 150 large, new office buildings taken from the Dodge list of large (250,000 square feet or more) office buildings. This total would include 4,850 buildings from the area sample and 1,550 buildings from the supplemental list sample, which includes the "large" buildings and "special" buildings lists and lists of new construction projects since 1986.

### ***Actual Sample Selected***

In order to achieve the 1992 CBECS sampling goal, the actual sample selected included 7,699 buildings from the area sample and 2,472 buildings from the supplemental list sample.

### ***Actual Sampling Results***

These procedures resulted in 6,637 completed interviews. This total included 4,944 buildings from the area sample and 1,693 buildings from the supplemental list sample. Therefore, the 1992 CBECS sampling procedures achieved the goals for the number of completed surveys. More importantly, the 1992 CBECS adequately represents the U.S. commercial buildings population to efficiently measure commercial buildings energy consumption.

The following sections provide more details about the sample design and selection for the area sample and the supplemental list sample components.

## **Multistage Area Probability Sample**

The area component of the 1992 CBECS sample used a four-stage cluster sampling design: Selecting Primary Sampling Units, Selecting Secondary Sampling Units, Selecting Segments, and Selecting Buildings (Figure B1). The first three of these stages involved sampling progressively smaller geographic areas. For the 1992 CBECS, the PSU's, SSU's and Segments selected for the 1986 CBECS were reused, since 1992 was a revisit of the 1986 sample. For the fourth stage of sampling, selection of buildings were re-executed in 1992 using procedures to update the building lists from the 1986 CBECS to include new construction in selected segments and to maximize the overlap with the 1986 sample.

### ***Selecting Primary Sampling Units***

To prepare for the first-stage of the area sample, approximately 3,100 counties and independent cities of the United States were grouped into 1,799 PSU's. A PSU typically consists of one or more contiguous counties, such as a metropolitan statistical area (MSA) with surrounding suburban counties or a set of one or more rural counties. Essentially, for the first stage, the same PSU's were selected for the 1986, 1989, and 1992 CBECS. These CBECS all used the same PSU's that were selected for the first stage of the 1984 Residential Energy Consumption Survey (RECS).<sup>20</sup> The two survey designs diverged at the second and subsequent stages.

<sup>20</sup> Energy Information Administration. Office of Energy Markets and End Use, *1987 Residential Energy Consumption Survey Sample Design Procedures Manual* (Princeton, NJ: Response Analysis Corporation, September 1988.)

**Figure B1. Multistage Area Probability Sample Portion for the 1992 CBECS**

PSU's with similar characteristics were grouped to form 129 strata. Characteristics used to define the strata were Census division, MSA or non-MSA status, the predominant residential heating fuel in 1980, and climate zone.<sup>21</sup> Within each stratum, one PSU was selected with probability proportional to its 1980 Census population. The design of efficient area samples requires that the area segments be as nearly equal in size as possible. For CBECS, population is correlated with the survey's characteristic of interest--commercial buildings.

Probability-proportional-to-size (PPS) sampling is commonly used to take advantage of existing knowledge about the sample units to improve the reliability of survey estimates. For quantities roughly proportional to these measures of size (MOS's), estimates based on PPS sampling have lower variances than estimates based on equal-probability sampling. The 1980 population of a PSU was a useful MOS because of its relationship with commercial activity and energy consumption.

Thirty-two PSU's had populations large enough for each of these PSU's to form a stratum by itself, so that each was selected with certainty. For the noncertainty PSU's, the Keyfitz method was used to assign selection probabilities.<sup>22</sup> This method enhanced the probability of inclusion of specific PSU's that had been selected for the previous RECS, while ensuring that the current RECS selection probabilities were still proportional to 1980 population levels. Controlled selection was used to improve the geographic coverage of the sample by maximizing the number of different States represented by the sampled PSU's.<sup>23</sup>

For the 1989 CBECS and 1992 CBECS, 10 non-MSA PSU's were randomly deleted from the initial sample of PSU's to reduce survey costs. The PSU's to be dropped were selected in 1989 by subsampling PSU's from entirely non-MSA strata in each of the four Census regions. The same 10 PSU's that were dropped for the 1989 CBECS were dropped again in 1992, reducing the number of PSU's from the 129 in the 1986 CBECS to 119 in 1989 and 1992.

The reduction in the number of PSU's was accompanied by a reduction in the buildings in the sample. That is, there was no attempt to "replace," in other PSU's, the buildings that would have been selected from the deleted PSU's. An additional weighing factor was introduced in the 1989 sample design and again in the 1992 sample design to compensate for the reduced sampling rate in entirely non-MSA strata.

### **Selecting Secondary Sampling Units**

To form second-stage sampling units for CBECS, each sampled PSU was divided into areas corresponding to five-digit ZIP Codes.<sup>24</sup> ZIP Codes covering small areas or representing individual buildings or post office boxes were grouped together with larger area ZIP Codes. All second-stage sampling units are, thus, referred to as ZIP groups. A total of about 3,900 ZIP groups were formed within the sampled PSU's. Of these, 444 ZIP groups were selected, using probabilities proportional to a second-stage MOS which was the estimated number of buildings in the ZIP group. The second-stage MOS was designed to reflect the level of commercial activity and was computed for each ZIP group using employment data from the Census' 1983 County Business Patterns (CBP) reports, and employee occupancy rates in different building types obtained from the 1979 CBECS.

<sup>21</sup> 1987 Residential Energy Consumption Survey Sample Design Procedures Manual.

<sup>22</sup>M.H., Hansen, W. N. Hurwitz, and W. G. Madow, *Sample Survey Methods and Theory*, Vol. 2 (New York: John Wiley and Sons, 1953.)

<sup>23</sup>R.M. Groves, and I. Hess, "An Algorithm for Controlled Selection," *Probability Sampling of Hospitals and Patients*, 2nd ed. I. Hess, D. Riedel, and T. Fitzpatrick (Eds.) (Ann Arbor, MI, 1975.)

<sup>24</sup>Energy Information Administration, Office of Energy Markets and End Use, The 1992 *Commercial Buildings Energy Consumption Survey Sample Selection Procedures Manual* (Princeton, NJ: Response Analysis Corporation, October 1992.)

The ZIP group MOS was used to select ZIP groups into the sample, using a procedure that was closely integrated with the selection of the third-stage units. The 129 sampled PSU's were sorted into cells defined by Census region and MSA/non-MSA status. A size for each cell was defined as the sum of the PSU-weighted MOS of all ZIP groups in the PSU's of that cell. The desired number of third-stage sampling units (prior to deletion of the 10 non-MSA PSU's) were allocated to the cells, proportional to the cell sizes. The third-stage units were then suballocated to the PSU's within the cells, again using the ZIP group MOS.

Within each PSU, a controlled selection procedure was used to allocate third-stage units to the ZIP groups within that PSU, such that ZIP groups of various MOS were represented in the sample. A ZIP group was considered to be selected into the sample if one or more third-stage units were allocated to it. Of the ZIP groups sampled, most were selected once. However, some ZIP groups with a large MOS were selected two or more times. A total of 509 selections occurred within the original sample of 129 PSU's, representing 444 unique ZIP groups. The number of times that a ZIP group was selected corresponded to the number of third-stage sampling units to be drawn into the sample from that ZIP group.

### ***Selecting Segments***

The third-stage sampling unit was the segment, which was a geographically compact area containing roughly 100 nonresidential buildings. Sampled ZIP groups were divided into segments based on field maps and rough counts of the number of nonresidential buildings on each block face. Within the original sample of 129 PSU's, a total of 509 segments were selected from within sampled ZIP groups using equal probability sampling. If the field mapping and counting procedures were performed in all PSU's and ZIP groups nationwide, approximately 43,260 potential segments would result. Thus, the 509 segments actually selected represented a sampling rate of roughly 1 in 85 segments nationwide. Within PSU's and ZIP groups, the segments were selected such that 509 of the 43,260 potential segments nationwide were sampled with equal overall probabilities. However, due to the subsampling of PSU's mentioned earlier, segments in the non-MSA PSU's in the 119 PSU's designated for the 1992 CBECS had overall probabilities of selection equal to approximately three-fourths of the probabilities of selection of segments in the MSA PSU's. After deleting the 10 subsampled PSU's (and the 23 segments located in them), a total of 486 segments remained for the area sample for the 1992 CBECS.

### ***Field-Listing Buildings Within Segments***

Once segments were selected, preparations were made for the fourth stage of sampling, selecting commercial buildings from within segments. With a few exceptions, a building, for purposes of CBECS, is defined as a structure totally enclosed by walls extending from the foundation to the roof; Commercial buildings house some type of commercial activity.

Since the 1992 CBECS is a longitudinal revisit of the 1986 sample, the 1992 sample deliberately maximized overlap with that earlier sample. That is, the buildings selected in 1986 were re-selected in 1992, with the exception of the 1986 buildings that were in the 10 PSU's that were dropped from the 1989 and 1992 surveys. These 1986 buildings in the dropped PSU's were excluded from the 1992 building selection.

In 1986, field workers canvassed on foot each sampled segment, identifying and listing the addresses of all commercial buildings. Field workers also estimated the square footage and apparent principal usage of listed buildings. This information was subsequently used to assign buildings to strata for sampling.

**Updating the Area Sample for New Construction.** A complete relisting (updating) of 191 of the originally sampled 509 segments was conducted for the 1992 CBECS to account for any buildings newly constructed or converted to commercial use after the earlier survey as well as those demolished or converted *from* commercial use. The selection in 1989 of the 191 update segments was made randomly within strata defined on the basis of advance estimates of the number of newly constructed buildings in the segment. Since the update segments represented a stratified subsample of the original sample of segments, new buildings in these segments could be appropriately weighted to provide national estimates of newly constructed buildings. The remaining segments were not updated, and thus were weighted to reflect only those buildings in existence at the time of the 1986 CBECS.

To avoid double counting, buildings in nonupdate segments that were constructed after the 1986 listings were not eligible for the sample, since such new construction was already represented by the weighted update sample. For this reason, if a sampled building in a nonupdate segment was found during the interview to have a construction year later than 1986, the building was deleted on the assumption that it was a new building on the site of an old listing. Nonupdate segment buildings reported as constructed in 1987 were retained if they otherwise matched the 1986 listing description.

**Selecting Buildings.** Buildings were sampled within size/usage strata with equal probability. However, sampling fractions varied between strata so that strata containing large buildings were sampled more intensively than strata containing small buildings. For example, while the stratum of office buildings under 10,000 square feet was sampled at an overall rate of only 1 in 1,400 (.000714), the stratum of office buildings with 50,000 or more square feet was sampled at a rate of 1 in 204 (.004902). This stratified sampling is similar to PPS sampling in that each uses MOS (but in a different way) to increase the reliability of estimates of square footage and energy consumption. The desired overall sampling rates used for selection of the area sample for the 1992 CBECS are provided in Table B1.

**Table B1. Area Sampling Rates by Size and Use Class**

Use Class	Size (Square Feet)			
	Under 10,000	10,000 - 24,000	25,000 - 49,999	50,000 or more
Retail . . . . .	.000595	.002101	.003677	.004902
Office . . . . .	.000714	.002451	.003677	.004902
Open Space . . . . .	.000714	.002451	.004902	.007354
Other . . . . .	.000794	.002451	.003677	.003677

Source: Energy Information Administration, Office of Energy Markets and End Use, 1992 Commercial Buildings Energy Consumption Survey.

Approximately 16 buildings were sampled from each of the 486 segments. The number of buildings included in the CBECS varied from the number sampled, depending on what the interviewer actually found at the building site. If during the interview a sample selection turned out to be a facility (for example, a campus or complex) of two or three buildings rather than a single building, all buildings in the facility were taken into the sample. Buildings at facilities of four or more buildings were subsampled. A final total of 7,699 buildings was selected into the multistage area probability sample.

### Supplementary List Sample from Lists of Large and Specialized Buildings

As mentioned previously, a supplemental list sample was used to correct the under-representation of some commercial buildings in the 1992 CBECS sample. To ensure adequate coverage of buildings that were significant energy users, the multistage area probability sample was supplemented within each selected PSU by a sample from a list of "large" buildings or facilities. In addition, to improve the precision of energy consumption estimates for certain types of buildings, a supplementary sample was drawn from seven lists of special buildings (Figure B2).

**Figure B2. 1992 CBECS Sample Design**

### **Compiling the Large Building and Special Building Lists**

In PSU's that were MSA's, the list of large buildings contained buildings with 250,000 or more square feet of enclosed floorspace. In the non-MSA PSU's, this list included buildings of 100,000 or more square feet. The list was compiled through inquiries with Chambers of Commerce, other local sources, and special directories. The seven lists of specialized buildings were limited to certain types of buildings or facilities with 50,000 or more square feet. These lists included (1) hospitals, (2) colleges and universities, (3) elementary and secondary schools, (4) post offices, (5) Federal Government buildings, (6) Dodge reports for "small" new construction projects (50,000 to 250,000 square feet) and (7) Dodge reports for "large" new construction projects (over 250,000 square feet).

These lists of specialized buildings were used for three reasons. First, they contained many large buildings and, thus, helped ensure accurate coverage of significant energy users. (The Dodge reports ensured better representation in the sample of newly constructed large buildings.) Second, the special lists ensured good coverage for certain building types that are distinguished separately in CBECS reports, such as health care and education. Third, the lists compensated for inadequacies in the MOS's developed for ZIP groups using the CBP reports. The CBP reports do not cover employees exempt from the Social Security System, such as a portion of the Federal workforce.

The weighing procedure used for the final sample does not require that the supplemental lists be comprehensive to produce unbiased estimates. However, the more complete these lists are, the more efficient the sample design.

**Updating the Supplemental List Sample.** The compiled supplemental lists included both individual buildings and facilities (complexes of buildings). Facilities from the supplemental list sample were updated centrally by telephone prior to field work to determine how many buildings were in the facility. If there were four or more buildings, all buildings were listed (by phone if possible) and the listings were subsampled. If there were three or fewer buildings, all the buildings were included. All facilities that could not be updated centrally were updated during the field period.

**Selecting Buildings.** The lists within each sampled PSU were stratified by building size and general usage, and buildings were sampled with equal probability within strata. (For some buildings, building size in square feet was estimated from available data such as the number of beds for hospitals, or the number of students for education buildings.) As in the area sample, strata containing large buildings were sampled more intensively than strata of small buildings. Also, as with the area sample, if a selected unit turned out to be a facility with three or fewer buildings, all were taken into the sample. Otherwise, the facility was subsampled.

The eight lists (that is, the large buildings list and seven specialized building lists) were sampled independently. The problem of overlap was handled by unduplicating the large buildings list to the extent possible, and by using a "priorities" approach, whereby, a building present on a lower priority list was disregarded if it was selected from a higher priority list. The priorities of the lists, in descending order, were as follows: (1) hospitals, (2) colleges and universities, (3) elementary and secondary schools, (4) post offices, (5) large buildings lists, and (6) Federal Government buildings, (7) Dodge reports over 250,000 square feet and (8) Dodge reports 50,000 to 250,000 square feet. For example, if a given building was present on the hospitals list, its selection from a lower priority list was disregarded.<sup>25</sup>

<sup>25</sup>Energy Information Administration, Office of Energy Markets and End Use, The 1992 *Commercial Buildings Energy Consumption Survey Sample Selection Procedures Manual* (Princeton, NJ: Response Analysis Corporation, October 1989.)

The desired overall sampling rates used for selection of the large buildings and special buildings list for the 1992 CBECS were the same as the area sample, supplemented by rates for larger size classes. The supplemental list sampling rates by size class are as follows: 100,000 to 249,999 square feet, .013889; 250,000 to 399,999 square feet, .05; 400,000 to 999,999 square feet, .10; 1,000,000 to 4,999,999 square feet, .10; 5,000,000 square feet or more, 1.00.

### ***Dodge Lists of New Construction***

For the Dodge reports on large projects (over 250,000 feet), a complete list of projects in each sampled PSU was obtained, and a sample was drawn from that list. Thus, it was possible to determine if a building sampled from some other source was also included in this Dodge list. For small Dodge projects (between 50,000 and 250,000 square feet), only a sample was obtained. Therefore, there was no way to verify whether a building that by definition should have been covered by this list was in fact included in the list from which that sample was drawn. For this reason, this "conceptual list" was given lowest priority.

There was also a problem of overlap between the supplemental list sample and the multistage area probability sample. Computation of joint probabilities of selection would be somewhat intractable in the complex design. Instead, a less efficient, but unbiased, procedure was adopted where buildings were made self-representing if they were sampled from an area segment and also appeared on one of the list frames.<sup>26</sup> A new building sampled from an update segment of the area sample and between 50,000 and 250,000 square feet in size was assumed to appear on the (unverifiable) Dodge list for that size range. Smaller new buildings were assumed not to appear on Dodge lists, and larger ones were checked against the complete lists that were obtained for that size range.

### ***Sample of Large, New Office Buildings***

In the 1992 CBECS, in addition to the regular supplemental list sample of Dodge reports of New Construction, another sample of approximately 150 buildings was selected from the Dodge list of large (250,000 or more square feet) office buildings. This sample was limited to buildings with a construction start date after February 1, 1989, and was included to permit special study of energy conservation issues in office buildings. The final weights for the sample were adjusted to compensate for this oversampling.

The overall sampling rates for the Dodge lists were the same as for other list samples except for the newer large office buildings. The sampling rates by size class for the newer large office buildings were as follows: 100,000 to 249,999 square feet, .208333; 250,000 to 399,999 square feet, .75; 400,000 to 999,999 square feet, 1.0; 1,000,000 to 4,999,999, 1.0; 5,000,000 square feet or more, 1.0. These rates achieved the desired supplemental list sample of newer large office buildings.

### ***Total List Sample***

A total of 1,871 list entries were sampled. Because some entries were multibuilding facilities, the final list sample comprised 2,472 individual buildings.

<sup>26</sup>A. Chu "Proof that the Assignment of Conditional Weights Will Produce Unbiased Estimates," in Weighing Procedures for CBECS III, Technical Memorandum (Rockville, MD: Westat., 1987).

# Building Characteristics Survey

## Determining Building Eligibility

To be eligible for the survey, a building had to satisfy three criteria: (1) it had to meet the survey's definition of a building, (2) it had to be used primarily for some commercial purpose, and (3) it had to measure 1,001 square feet or more. The eligibility of a building for inclusion in this survey was evaluated at three different times: during the development of the area and supplemental sample listings, at the time the interviewer observed the building, and during the interview of the building owner or manager. To prevent inaccurate exclusion of eligible buildings based on lister or interviewer judgment, somewhat looser criteria were applied at the stages of listing and interviewer observation to allow a knowledgeable respondent to ultimately screen eligible buildings during the interview.

The first eligibility criterion, building definition, has been used consistently in all the CBECS. The second criterion, commercial activity, has been more strictly interpreted in the successive surveys, to concentrate on a well-defined population that does not overlap with a group covered by other EIA surveys. The third criterion, size, was added in the 1986 CBECS to eliminate the very small buildings, which form a large, inherently ill-defined, group of marginal structures. These buildings contribute minimally to total commercial floorspace and energy consumption of the overall sample; yet, different, reasonable decisions on how to identify these buildings could lead to substantial variations in building counts.

### ***Criterion 1: Building Definition***

The definition of a building was the same one used in previous CBECS: a structure totally enclosed by walls that extend from the foundation to the roof and intended for human access. Thus, structures such as water, radio and television towers were excluded from the survey. Also excluded were (1) partially open structures, such as lumber yards; (2) enclosed structures that people usually do not enter, such as pumping stations and cooling towers at electric power plants; (3) enclosed structures that are not buildings, such as oil tanks, statues, and monuments; and (4) dilapidated or incomplete buildings missing a roof or a wall. There are two exceptions to the building definition criterion: a structure built on pillars so that the first fully enclosed level is elevated; and parking garages since they can have energy-using equipment such as HVAC and lighting equipment.

### ***Criterion 2: Building Use***

The second criterion was that a building had to be primarily used for some commercial purpose; that is, more than 50 percent of the building's floorspace must have been devoted to activities that were neither residential, industrial, nor agricultural. The primary use of the sampled building governed whether the building was included in the CBECS. That is, if an administrative office building within an industrial complex was the sampled building, it was considered in scope because its principal building activity was commercial. However, if the sampled building was an industrial processing plant within the same complex, it would have been out of scope because its principal building activity was industrial. Examples of nonresidential buildings that were not included in the CBECS samples are:

- Farm Buildings, such as barns, unless space is used for retail sales to the general public
- Industrial or Manufacturing Buildings that involve the processing or procurement of goods, merchandize, or food
- Buildings on most military bases

- Buildings where access is restricted for national security reasons
- Single-family detached dwellings that are primarily residential, even if the occupants use part of the dwelling for business purposes
- Mobile homes that are not placed on a permanent foundation (even if the mobile home is used for nonresidential purposes)

Buildings used for industrial purposes and for processing of agricultural products were included in the listing stage. However, during the interviewing stage, interviewers were instructed not to begin interviews at buildings where they observed 75 percent or more of the floorspace used for residential, industrial, or agricultural purposes. Once the interview began, initial screening questions instructed the interviewer to terminate the interview if the respondent indicated that 50 percent or more of the square footage was used for residential, industrial, or agricultural purposes. In the 1979 and 1983 CBECS, buildings used primarily for residential purposes, but having any commercial activity, were included in the survey and report tables. Beginning with the 1986 CBECS, if more than 50 percent of the floorspace of these buildings was used for residential purposes they were excluded from CBECS. In 1992, interviewers retired 463 buildings prior to beginning the interview and terminated 948 interviews because the building's use was not predominantly commercial.

### ***Criterion 3: Building Size***

The third criterion was that a commercial building had to measure more than 1,000 square feet (about twice the size of a two-car garage) to be considered in scope for the 1992 CBECS. This building size criteria was met in two successive size cutoffs, which were evaluated during the listing and interviewing stages. During the listing stage, a building had to measure 500 square feet to be included in the segment listing. Interviewers did not begin interviews when they observed a building to be 500 square feet or less. During the interviewing stage, a building had to measure more than 1,000 square feet for continuance of the interview. Interviewers asked screening questions designed to terminate the interview when the square footage was 1,000 square feet or less. In 1992, 154 buildings were retired during the listing stage and interviewers terminated 521 interviews because the building's size was less than 1,000 square feet.

## **Data Collection**

Data Collection for the 1992 CBECS involved many phases and began with the questionnaire design. After the questionnaire design, the data collection phases continued with supervisor and interviewer training, data processing, and concluded with minimizing nonresponse to ensure output of quality data. A survey contractor performed the data collection under the direction of EIA.

### ***Building Questionnaire Design***

Questionnaire design work for the 1992 CBECS was conducted by EIA. Although a set of core questions remained the same as those used in previous surveys, the 1992 Building Questionnaire was redesigned to improve data quality. The redesign of the 1992 Building Questionnaire included new questions, expanded questions, and incorporated some structural and wording changes to questions. A more detailed discussion of revisions to the 1992 CBECS Building Questionnaire is provided in "What's New in 1992 CBECS" section of this appendix.

As in 1989, the 1992 CBECS Building Questionnaire also asked if the sampled building was part of a multibuilding facility and whether the multibuilding facility had a central physical plant that produced district heating, district cooling, or electricity. In 1992, the CBECS asked for the primary function of multibuilding facilities or complexes to help provide a standard building classification scheme for these commercial buildings.

In the 1992 CBECS, questions were added at the request, and with the financial support of the Department of Energy's Office of Energy Efficiency and Renewable Energy. These questions obtained information about special ways space was used in the building, special energy technologies, water heating equipment, the energy source distribution system, building shape, and how energy was managed in the building.

Also, as in 1986 and 1989, the 1992 CBECS Building Questionnaire contained questions added at the request, and with the financial support, of the Census (Section R, Form EIA-871G, Construction Improvements and Maintenance and Repairs Supplement). The content of Section R, collected by EIA as an agent for the Census, was essentially unchanged from 1989. For more details on the Census-funded questions, see "Special Data Collection for the Bureau of the Census" later in this appendix.

### ***Supervisor and Interviewer Training***

The CBECS Building Questionnaire is a complex instrument designed to be collected in a personal interview at the building site. Well-trained interviewers are imperative to collecting the technical information. Training for the 1992 CBECS included three in-person training sessions: one for supervisors and two for interviewers. At all sessions, mixed media techniques were used including lectures, slide presentations, small group sessions to practice interviewing and administering the questionnaire, and a tour of the HVAC system at the hotel where the training was conducted. EIA and the Census personnel observed the interviewer training sessions and were available as resource persons. EIA personnel also participated in all training sessions providing an overview of the CBECS and a presentation on the key 1992 CBECS energy concepts.

In July 1992, six regional supervisors and their assistants were trained at a four-day supervisor training session in Washington, DC. They were trained in CBECS data collection, field office procedures, and quality control. The supervisors were also trained to serve as small-group leaders at the subsequent interviewer training sessions.

Prior to interviewer training, all interviewer trainees received the CBECS Interviewers' Manual, the survey questionnaire, a home study exercise to be completed prior to training, and a training agenda. The CBECS Interviewer's Manual included step-by-step instructions for planning, conducting, and recording interviews. Interviewer trainees who had not previously worked as CBECS interviewers received *CBECS: General Interviewing Techniques Manual* and *Home Study Guide* with exercises to be completed and reviewed by the supervisor prior to training.

In August 1992, 162 interviewer trainees attended one of two, three-and-a-half-day interviewer training sessions in either the Washington, DC area or Denver, Colorado. All interviewers working on CBECS were trained at one of these sessions. Forty-six of the interviewing staff had worked on the 1989 CBECS. Of the 162 interviewers, 114 had some prior interviewing experience, and 48 had no prior interviewing experience.

For the first time, the 1992 CBECS interviewing training sessions included a formalized evaluation process. Based on the results of a key concepts quiz/test and an evaluation by supervisors, the interviewers were considered to have successfully completed training, or were placed on probation, or were released from the study. At the end of the interviewer training sessions, 13 interviewers were placed on probation and one trainee was released. The remaining interviewers successfully completed training and were certified to conduct CBECS interviews.

Each interviewer training session was conducted by the survey contractor's central office staff with the assistance of the regional supervisors. The sessions covered the background of the CBECS, the definition of a building, finding the sampled building, determining a building's activity, a review of the most important or different questions in the questionnaire, and administrative information. New interviewers were trained in an additional session on general interviewing techniques, which included a video tape on basic interviewing techniques. All interviewers received the question-by-question specifications describing the intent of each question, definitions of terms used in the survey, and how to ask each question. These materials completed the CBECS Interviewers Manual that the interviewers received prior to attending the interviewer training sessions. All interviewers had completed four scripted-practice interviews by the conclusion of the training session. Each trainee's performance was monitored and evaluated by the regional supervisors, and only those judged qualified were given field assignments.

### ***Interviewer Supervision***

Several steps were taken to ensure that the interviews were conducted as intended. Questionnaires were field-edited twice; once by the interviewer and once by the supervisor before being mailed to the central office for data processing. For more information about how the data were edited, see "Data Editing" later in this appendix.

In addition, the regional supervisor conducted a validation of a random sample of 10 percent of each interviewer's work. Interviewers were informed that a sample of their work would be validated, but they were not informed which completed interviews would be checked. The regional supervisors telephoned the respondents identified on the questionnaire to confirm that the interview had been conducted and to verify several key data items. Overall, 17.9 percent of completed interviews were validated.

Corrective actions were taken when problems with an interviewer's performance were identified. These actions included monitoring the interviewer's work more closely, retraining the interviewer on the sections of the questionnaire causing the interviewer problems and, as a last resort, dismissing the interviewer.

### ***The Interview***

Each interview began with a series of screening questions designed to verify the building's address, location within the segment boundaries, and eligibility for the survey. Respondents were asked about the building as a whole rather than individual establishments located within the building.

The completed building interview lasted an average of 49 minutes. This included the time for the interviewer to ascertain and record if the listing was correct, to ask all questions on the Building Characteristics Questionnaire, and to obtain a signed authorization form from the respondent. The Census section added six minutes to the interview.

The average time for each completed interview (including interviewer preparation, travel, callbacks, interviewing, and editing time) was 6 hours and 14 minutes. Each interviewer conducted an average of 46 interviews: 9 interviewers each completed 10 or fewer interviews, while 5 interviewers each completed more than 90.

### ***Data Collection Procedures***

Initial contacts with the building representatives were made through an introductory letter mailed to them at each building in the survey sample. The letter, signed by the Director of the Office of Energy Markets and End Use of the EIA, was addressed to the building owner or manager. The letter explained that the building had been selected for the survey, introduced the survey contractor, assured the building manager that the data would remain confidential, and discussed the uses and needs for the CBECS data in setting national energy policies. To protect confidentiality, the letter was addressed by the survey contractor after it was signed at EIA.

Data collection began the week of August 28, 1992, and ended December 4, 1992. The data were collected by the contractor's field staff consisting of 162 interviewers under the supervision of six regional supervisors and their assistants and a central office staff consisting of a project manager, a field director, and a subsampling assistant.

**Natural Disaster Areas**

Several natural disasters occurred in areas that affected the 1992 CBECS. In these areas, all data collection procedures were stopped after the disaster. To allow EIA to evaluate the effect of these disasters on the CBECS sample, procedures were developed to obtain the following information about the sampled buildings: (1) condition of the building and surrounding buildings; (2) current principal building activity; (3) approximate size; and (4) approximate age. Extra efforts were undertaken to make up for the loss of these buildings by assuring that the response rate for the nonaffected buildings would remain high. (See Appendix C, "Nonsampling and Sampling Errors" for a discussion on imputations for these buildings.)

**Interviewers**

Prior to the interview, the interviewer observed the outside of the building to assess the approximate size and the principal building activity. Interviewers visited all sampled buildings in person to ascertain if the structure met the eligibility requirements of the survey. Failure to meet any one of several criteria resulted in the building's ineligibility for interviewing. These criteria were explained in the "Determining Building Eligibility" section; however, several other circumstances may have resulted in ineligible buildings. These circumstances included duplication of buildings, demolished buildings, and buildings for which construction was not completed. When these circumstances occurred, buildings were assigned an "ineligible for contact" disposition code. For certain demolished buildings, interviewers obtained information on the condition of the building, the current principal building activity, the approximate size, and the estimated age of the building.

During the initial visit to the sampled buildings, the interviewers also identified and attempted to schedule an interview with an individual associated with the building who met the survey criteria for a building representative and who could serve as that building's respondent. The respondent could be the owner of the building, a tenant, a hired building manager or engineer, or a spokesperson for a management company. Table B2 shows the number of in-person contacts required to obtain a completed 1992 CBECS Building Questionnaire.

**Table B2. Number of In-Person Contacts to Obtain a Completed Building Questionnaire**

Number of In-Person Contacts	Completed Interviews	Percent
1 .....	1,775	26.7
2 .....	2,443	36.8
3 .....	1,313	19.8
4 .....	589	8.9
5+ .....	517	7.8
Total .....	6,637	100.0

Source: Energy Information Administration, Office of Energy Markets and End Use, 1992 Commercial Buildings Energy Consumption Survey.

## Minimizing Nonresponse

Several approaches were employed in the effort to minimize nonresponse, including: advance mailings to building owners or managers; in-person visits and telephone callbacks; establishment of an 800 "hot line" number to address respondents' concerns or questions; personalized letters to documented refusals; and providing additional field staff in several MSA's to help those who still had problem cases. These approaches dealt with the three categories of nonresponse for CBECS: refusals, cases where the knowledgeable respondent was located outside of the sample PSU's, and cases where the respondent was unavailable during the field data collection period. Although a telephone version of the 1992 CBECS Building Questionnaire was produced and ready for use, the 1992 CBECS response rates were sufficiently high that telephone nonresponse conversion was not warranted.

An additional type of nonresponse conversion dealt with respondents who declined to sign the authorization forms that would allow their energy suppliers to release the building's energy consumption records and information on DSM program participation. Personalized written requests for signed authorization forms were mailed for all buildings for which energy usage had been reported and a signed form had not been obtained by an interviewer. Such requests were mailed to 305 buildings interviewed by field staff. A total of 83 signed authorization forms were received by mail.

As previously noted, before the initial contact with the building was made, a letter, along with a brochure showing the 1989 CBECS data, was sent from the Director of the Office of Energy Markets and End Use to each building owner or manager. Then, during the field period, the interviewer assigned to the building was authorized to make up to four in-person visits at different times of the day throughout the week to minimize the number of building representatives not contacted. After two failed in-person visits, the interviewer and supervisor discussed the case to determine if subsequent in-person visits should be authorized. After the fourth in-person visit, three additional in-person visits could be authorized only to obtain signed authorization forms. Field supervisors also notified the central office of potential refusals and the field director sent personalized letters addressing individual concerns and urging participation. Approximately 330 such letters were mailed to 363 buildings (or facilities); completed interviews were obtained for 102 of these buildings.

## Response Rates

As mentioned in the "Sample Design" section, the total 1992 CBECS sample consisted of 10,171 buildings; 7,699 from the area sample and 2,472 from the supplemental list sample (Figure B2). Of these, 7,282 buildings were eligible for interviewing, 5,464 from the area sample and 1,818 from the supplemental list sample. Of the total number of buildings eligible, interviews were completed at 91.1 percent, or 6,637 buildings. Authorization forms were obtained for 88.5 percent of interviews completed (5,719 of 6,463 buildings) where energy was used in the buildings. Eligibility was not determined for an additional 146 buildings located in areas devastated by natural disasters. Of these, 133 were from the area sample and 13 from the supplemental list sample. (See Appendix C, "Nonsampling and Sampling Errors," for a discussion of imputation procedures used for these buildings.) Table B3 provides the detailed information on the building disposition for the total sample, the area sample, and the supplemental list sample.

## Data Editing

Data editing for the 1992 CBECS Building Characteristics Survey occurred at several points during data collection and processing. During data collection, questionnaires were edited by the interviewers and the supervisors. Upon receipt of the questionnaire for data processing and during data entry, questionnaires were manually edited. Once data entry was complete, questionnaires were machine edited. The final data editing occurred during review of data frequencies and crosstabulations.

**Table B3. Number and Distribution of 1992 CBECS Sample Buildings by Building Disposition**

Building Disposition	Number of Buildings	Percent of All Buildings	Percent of Eligible Buildings	Percent of Eligible & Disaster Area Buildings
<b>Combined Sample</b>				
Total .....	10,171	100.0		
Eligible for Interview .....	7,282	71.6	100.0	
Interviewed .....	6,637	65.2	91.1	89.4
Not Interviewed .....	645	6.3	8.9	
Not Eligible for Interview .....	2,743	27.0		
Natural Disaster Areas .....	146	1.4		
<b>Area Sample</b>				
Total .....	7,699	100.0		
Eligible for Interview .....	5,464	71.0	100.0	
Interviewed .....	4,944	64.2	90.5	88.3
Not Interviewed .....	520	6.8	9.5	
Not Eligible for Interview .....	2,102	27.3		
Natural Disaster Areas .....	133	1.7		
<b>List Sample</b>				
Total .....	2,472	100.00		
Eligible for Interview .....	1,818	73.5	100.0	
Interviewed .....	1,693	68.5	93.1	92.5
Not Interviewed .....	125	5.0	6.9	
Not Eligible for Interview .....	641	26.0		
Natural Disaster Areas .....	13	0.5		

Source: Energy Information Administration, Office of Energy Markets and End Use, 1992 Commercial Buildings Energy Consumption Survey.

As mentioned in the previous section, questionnaires were edited twice in the field before being sent to the central office. The first field edit was performed by the interviewer after completing the interview and before submitting it to the field supervisor. During this edit, the interviewer checked the form for legibility and completeness. Once received by the field supervisor, the form underwent a second field edit using the "Field Edit Form" to check a set of 17 specified data items. The purpose of this field edit was to provide the supervisor, the survey contractor, and the interviewer with continuous feedback on the quality of the data being collected. The supervisor mailed a copy of the form to the interviewer, discussed the results of these edits in weekly telephone conferences with each interviewer, and mailed a copy of the field edit form with each questionnaire to the survey contractor's central office.

After the central office received the questionnaires, they manually edited and coded the questionnaires in preparation for data entry. The manual scan edit checked for completeness and logical consistency and identified cases with missing data. The coding process assigned the "Other Specify" questionnaire responses to either previously created codes or newly created codes. Preparation for data entry involved checking the accuracy of the questionnaire skip patterns and checking that only allowable values or codes were entered. All data entry was performed with 100 percent verification of all keystrokes. Throughout the editing and coding process, inconsistencies or ambiguities in the data occurred that needed correcting before data entry or machine edit.

The survey contractor took several steps to resolve inconsistencies or ambiguities in the data. First, the contractor reviewed other parts of the questionnaire for explanations that might help solve the problem. Several open-ended questions were included in the questionnaire, which allowed the respondent to either describe or include additional information about a particular item. Also, the interviewers had been asked to write comments or to explain any special cases in the margin of the questionnaire during and after the interview. These open-ended questions and notes were relied upon extensively in the resolution process and were very helpful in explaining some of the inconsistencies. Second, in some hard-to-resolve cases, EIA personnel provided technical guidance on how to reconcile some questionnaire responses. Finally, when these efforts failed to resolve a problem, especially when the energy sources or heating and cooling equipment were concerned, the survey contractor contacted the respondent by telephone for clarification. Telephone data retrieval only occurred before machine edit, if selected key data items were missing from the questionnaire.

After manual editing, coding and telephone data retrieval for selected missing key data items were complete, the data were machine edited to ensure further completeness and logical consistency and to verify that the values fell within allowable codes or within acceptable ranges. Items failing these edits were reviewed by trained editors to assess the nature of the problem and to determine how to correct the problem. These edit failures were most often due to problems in coding or data entry. Items failing edits that could not be resolved were referred to the contractors' supervisory-level personnel for review and resolution. EIA personnel also provided technical guidance for the error-resolution process. Telephone data retrieval was conducted for the remaining edit failures.

Overall, telephone contacts to clarify both questionable or missing information were made to the respondents for 1,558 buildings, 23 percent of all completed cases. All changes made to any questionnaire response as a result of these reviews were carefully documented and explained on an error resolution sheet attached to the questionnaire.

As the last step, prior to the delivery of the data tape to the EIA, the contractor produced data frequencies and crosstabulations. These were reviewed to search for outlying values and inconsistencies that the edits may not have identified. After having inconsistencies corrected by the contractor, the EIA began the data preparation for the report.

## **Data Preparation for the Report**

Draft data tapes from the Building Characteristics Survey portion of the 1992 CBECS were received in May and June 1993. EIA data analysts reviewed and processed the data to prepare them for the final data tape. Crosstabulations were run to check for internal consistency of the data and 1992 CBECS data were compared with data from previous CBECS. Questions concerning data accuracy or values were referred to the survey contractor for verification. Respondents were recontacted to verify responses when possible. EIA staff judgment was the final authority on some of the data items.

If retrieval of missing data for one or more items failed, or if retrieval was not performed because the item was not a key data item, data values were supplied by imputation. For a description of the imputation process, see Appendix C, "Nonsampling and Sampling Errors."

## Public-Use Data Preparation

Following the publication of the 1986 and 1989 CBECS statistical reports for both the Building Characteristics Survey and the Energy Suppliers Survey, further work was performed on the basic survey data at the microlevel to prepare the final data tape for release to the public. As in 1986 and 1989, measures for the 1992 CBECS data such as the stripping of all geographic identifiers, except Census region and Census division, were taken to mask the data to ensure that the identity of individual respondents was kept confidential. In 1986 and 1989, all of these procedures culminated in the release of a final data file containing data from both the Building Characteristics Survey and the Energy Suppliers Survey to the public through the National Technical Information Service (NTIS) and the U.S. Government Printing Office (GPO).

For the 1992 CBECS, public-use data diskettes are available in conjunction with each part of the survey. Diskettes containing only the building characteristics data will be made available upon publication of this report. The public-use data file containing data from both the Energy Supplier Survey and the Building Characteristics Survey will be made available when the *Commercial Buildings Energy Consumption and Expenditures 1992* report is published. The public-use data file issued with the reports will be on floppy diskettes to use with personal computers. (See Appendix I for information about ordering the public-use data diskettes.)

## Confidentiality of Information

The EIA does not receive or take possession of the names or addresses of individual respondents or any other individually identifiable energy data that could be specifically linked with a building respondent. All names and addresses are maintained by the survey contractor for survey verification purposes only. In addition, geographic identifiers and National Oceanic and Atmospheric Administration (NOAA) Weather Division identifiers are not included on any data files delivered to EIA. Geographic location information is provided to EIA at the Census division level. (See Appendix F for map.) Building characteristics, which could uniquely identify a particular responding building, such as number of floors, building square footage, and number of workers in the building, are masked on any data provided to the EIA. All building-level records that are placed on public-use data files are masked for further confidentiality protection.

## Special Data Collection for the Bureau of Census

For the 1986, 1989 and 1992 CBECS, the Census-funded the data collection on expenditures for construction improvements and for maintenance and repairs. EIA collected this supplemental information in the 1992 CBECS Building Questionnaire and in a subsequent Census Followup study. The Census section of the Building Questionnaire was submitted separately for clearance and approval to the U.S. Office of Management and Budget.

In the 1992 CBECS Building Questionnaire, the Census-funded questions were in Section R (Census Supplement) and all respondents were asked these questions. Any respondent who did not have access to the construction improvements was asked the name, address, and telephone number of the person who would have it. These individuals were later contacted if the building was selected for the subsequent Census Followup. Before the Census Followup was conducted, item response on the key item concerning construction improvements was 93.8 percent, or 6,155 of the 6,561 buildings had completed data for this item.

A subsequent three-phase Census Followup study was conducted to reduce both total and partial nonresponse to the Census Supplement, as well as to verify independently the data that were obtained during the original interview. Buildings owned by private utility companies were not eligible for the Census Followup. In the spring of 1993, a letter explaining the purpose of the followup study, along with worksheets and definitions, was sent to 337 building owners and tenant representatives. The respondents were told to use the worksheets to calculate and record the amount of expenditures and to retain the worksheets pending a telephone call from the data collection contractor. Several weeks later, specially trained telephone interviewers called to obtain the data. Five cases met the inclusion criteria for more than one phase of the Census Followup. The overall response rate for the Census Followup was 79.2 percent.

In the first phase of the Census Followup, "Nonresponse Conversion" buildings were selected. These were buildings that failed to answer one or both questions in the Census Supplement during the building characteristics interview. There were 104 "Nonresponse Conversion" buildings. A total of 75 responses was obtained from the first-phase followup effort.

In the second phase of the Census Followup, cases were selected for item nonresponse of "don't know" to the Census-sponsored construction improvements question. Cases were included if the respondent provided the name, address, and telephone number of the person or persons who would have the information. These referrals were often to management companies not located in the same city as the sampled buildings. There were a total of 146 item nonresponse buildings; and 120 or 82.2 percent provided additional information.

In the third and final phase of the Census Followup, cases were selected to verify independently the data obtained in the original interview when the reported expenditures for one or both questions were \$5 million or more. Packages of materials explaining the verification study and requesting the respondent to provide data on the two types of expenditures were mailed to the original respondents to the Census-sponsored questions. The respondents were then telephoned to obtain the data. Of the original interviews, a sample of 92 buildings was selected and 76, or 82.6 percent, resubmitted the data.

The results of the Census Followup study are being evaluated by the Census and will be used in the design of future surveys. The data from the construction improvements and maintenance and repairs questions will be published by the Census in a supplement to the *Current Construction Reports, C-30 Series, Value of New Construction Put in Place*.<sup>27</sup>

<sup>27</sup>1989 results were published in Expenditures for Nonresidential Improvements and Repairs:1989, *Current Construction Reports Special Studies*, Bureau of the Census, December 1991.