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Multifamily Building Study Pilot: Methods, Findings, and Lessons Learned

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Executive Summary

We designed the Multifamily Building Study (MBS) pilot to assess the feasibility of collecting data on the characteristics of multiunit residential buildings, such as apartments, condominiums, and co-ops. The target population was multifamily and multifamily mixed-use buildings that were more than 50% residential by floor space or square footage and that contained five or more residential units. For each selected building, we attempted to identify and interview individuals most knowledgeable about the building's energy-related characteristics and energy use. We collected data from July to October 2021. Overall, the unweighted MBS response rate was 31.4%.

We conducted the MBS pilot in four geographical areas chosen because of their estimated high proportion of units in multifamily buildings, their inclusion of large and small cities and rural areas, and their spread across the four census regions: the state of New York; California; the Denver Metropolitan Statistical Area (MSA); and Harris County, Texas. We selected a total sample of 859 building addresses from the 2020 *Residential Energy Consumption Survey* (RECS) Household Survey sample, which is an address-based sample of housing units. The sample was stratified by the four geographic areas and building size (number of housing units).

We designed the MBS questionnaire to collect building-level characteristics related to energy consumption. The questionnaire asked about:

- Building structure
- Characteristics and uses of different spaces
- Fuels and equipment used for major end uses
- Billing and metering information

The survey took on average about 20 minutes per building to complete. We programmed the survey instrument as both a computer-assisted web interview (CAWI, or web) and computer-assisted telephone instrument (CATI, or phone). The web instrument was also mobile optimized.

The 859 selected buildings from the starting sample were assigned to a contact-tracing task. We reviewed results for each address returned from common internet search methods. These results included street views, apartment websites, rental postings, property records, and realty websites.

After we completed contact-tracing efforts, we contacted individuals in the sampled buildings using a standard contact protocol. Although CATI interviewers did not complete many CATI surveys (14 of 269 surveys), they were successful in tracking down additional contact information, particularly email addresses, when speaking with building contacts over the phone. They also gained cooperation from respondents; multiple contact attempts by the same interviewer over time built trust and rapport.

At the end of data collection, we received 269 completed questionnaires, where about 95%, or 255 interviews, were completed via web and 5%, or 14 interviews, were completed by phone. The overall unweighted response rate was 31.4%; responses varied by region and building size. The Denver MSA had the highest response rate (36.7% of buildings responded), and New York had the lowest response rate (29.2% of buildings responded). Larger buildings, with more than 140 units, were also more likely to respond (37% responded).

Introduction

We identified multifamily and mixed-use buildings as a significant gap in our building energy consumption program, which includes the *Residential Energy Consumption Survey* (RECS) and the *Commercial Buildings Energy Consumption Survey* (CBECS). The RECS sample includes individual units in multifamily buildings; it excludes common areas and amenities in multifamily buildings and commercial spaces in multifamily mixed-use buildings. The CBECS sample includes buildings with some multifamily units but only those that dedicate most of their square footage to commercial purposes.

In its 2012 report on EIA's energy consumption surveys, the Committee on National Statistics (CNSTAT) recommended we pursue a "whole building" supplement to RECS to "address the data gap related to multiunit residential buildings." Since the release of that report, stakeholders and data users have indicated that estimates of energy use at the building level for multifamily and mixed-use buildings are important for building benchmarking programs and evaluating efficiency and other energy-related policies. To begin addressing this data need, we piloted a Multifamily Building Study (MBS) in conjunction with the 2020 RECS data collection.

Pilot Objectives

We worked with both internal and external stakeholders to develop a set of pilot objectives, taking into account timing and resource constraints:

- Objective 1: Develop a defined contact protocol for the multifamily and mixed-use building population.
- Objective 2: Develop an instrument to collect characteristics data for multifamily and mixed-use buildings. The building characteristics we collect should support *future* modeling of end uses and consumption.
- Objective 3: Conduct research on how to develop a frame for the multifamily and mixed-use building population.

We designed and conducted the MBS in collaboration with IMG-Crown and RTI International, who were are also contracted by EIA to conduct the 2020 RECS Household Survey.

Frame and Sample Selection

The MBS pilot was conducted in four geographical areas that were chosen because they include a high proportion of units in multifamily buildings, they represent large and small cities and rural areas, and they represent different climate regions. The sample frame was restricted to addresses that geocode to these selected geographies. The four areas are:

- New York (state)
- California
- Denver-Aurora-Lakewood, Colorado, Metropolitan Statistical Area (Denver MSA)
- Harris County, Texas (Houston and surrounding areas)

In addition, we also considered local energy policy around benchmarking in the selection process; three of the four locations selected have laws in place for multifamily building energy benchmarking. Harris County, Texas had no local energy policies identified for multifamily building energy benchmarking at the time of the study.

We derived the MBS pilot's sample frame from individual housing unit addresses sampled in the 2020 RECS Household Survey, which included both respondents and nonrespondents, in the selected geographic areas. We selected the Household Survey sample from RTI International's Address-Based Sample (ABS) frame, which was derived from the U.S. Postal Service's Computerized Delivery Sequence (CDS) file of active mail delivery points. We identified multifamily buildings using building addresses that appeared in the ABS frame multiple times with different unit numbers. We created a count of how many distinct unit numbers were present at a single building address to create an indicator for number of units. To create the sampled building address for the MBS pilot, the unit numbers were stripped from the RECS sampled address. Drop point addresses were not included in this pilot because those addresses were not included in the 2020 RECS sample.

The MBS pilot building address frame was limited to city-style addresses and focused on buildings with an estimated count of five or more units. The pilot focused on buildings with five or more units because of the higher likelihood that these buildings would have common areas, amenities, or commercial spaces in mixed-use buildings. We identified 2,306 RECS individual-unit addresses as the basis for deriving the building-level MBS pilot frame in the four geographic areas (Table 1).

Our target starting sample for the pilot was 750 buildings, allocated equally among the four geographies. In addition, the sample was intended to be allocated across various building-size categories (for example, 5 to 20 units, 21 to 55 units, etc.) However, because sample selection prioritized building addresses provided by RECS respondents, we did not perfectly achieve our intended allocation. The final sample selection, which included 774 building addresses, was allocated to the MBS starting sample in the following priority order:

1. RECS respondents who provided contact information for someone knowledgeable about their entire building who could answer questions about energy use in common areas
2. RECS respondents who did not provide contact information
3. RECS nonrespondents who responded to a short nonresponse follow-up (NRFU) survey
4. A simple random sample of RECS nonrespondents selected to meet the target MBS sample allocation shown in Table 1

We later added an additional 85 addresses, bringing the total starting sample to 859 cases. The additional 85 addresses were selected to increase the percentage of cases that could be fielded in computer-assisted telephone interview (CATI) data collection. Online tracing of the initial 774 addresses resulted in a higher-than-anticipated count of cases with no phone contact information. Cases with no phone contact information were fielded in a mail-only protocol, which at the time of planning, we expected to yield a lower response rate. This expectation was later confirmed in analysis of the data collection protocols.

Table 1. Multifamily Building Study (MBS) pilot sample allocation

MBS pilot location	Building size category	Total MBS frame	MBS Sample				Target MBS sample allocation	Achieved MBS sample allocation
			RECS respondents with contact information	RECS respondents without contact information	RECS NRFU respondents	RECS nonrespondents		
Overall		2,306	197	411	8	243	750	859
New York (state)	< 5 units*	11	2	9	0	0	-	11
	5–20 units	306	18	56	0	2	60	76
	21–55 units	267	23	45	0	1	60	69
	56–140 units	316	21	50	2	2	65	75
	> 140 units	228	17	43	1	6	65	67
California	< 5 units*	17	9	8	-	-	-	17
	5–20 units	304	25	50	-	-	60	75
	21–55 units	200	18	39	1	13	60	71
	56–140 units	168	17	35	1	18	65	71
	> 140 units	147	11	26	1	29	65	67
Harris County, Texas	< 5 units*	-	-	-	-	-	-	0
	5–20 units	13	-	2	-	1	-	3
	21–55 units	13	-	1	-	-	-	1
	56–140 units	40	3	2	-	32	65	37
	> 140 units	132	14	20	-	57	65	91
Denver Metropolitan Statistical Area	< 5 units*	2	-	2	-	-	-	2
	5–20 units	39	4	5	2	24	30	35
	21–55 units	33	6	4	-	22	30	32
	56–140 units	29	4	7	-	16	30	27
	> 140 units	41	5	7	-	20	30	32

Data source: U.S. Energy Information Administration, Multifamily Building Study

Notes: PO boxes were included only if the respondent provided a building address and reported that their home was within a building with five or more units (that is, TYPEHUQ = 5); cases were excluded if the secondary address information indicated the address was a pier, slip, space, lot, or trailer.

NRFU=nonresponse follow-up

RECS=*Residential Energy Consumption Survey*

* Cases included because RECS or RECS NRFU respondents indicated residing in a building with five or more units, but our frame estimates indicate the building as having fewer than five units

Questionnaire Design

We designed the MBS questionnaire to collect building-level characteristics related to energy consumption. We asked about the building structure, characteristics and use of different spaces, fuels and equipment used for major end uses, and billing and metering information, among other questions. These characteristics were identified based on the subject-matter expertise of the RECS and CBECS teams as well as stakeholder input. Where possible, the MBS questionnaire borrowed questions directly from the RECS or CBECS instrument or from other federal surveys focusing on multifamily housing. For topics where an existing question was not identified, we developed a new question.

Time and resource constraints limited extensive pretesting as an option for the MBS pilot, so we obtained feedback through two main pretesting activities—expert review of the questionnaire by survey methodologists and an expert panel review with representatives from large multifamily housing property management companies and advocacy organizations. We incorporated feedback from both of these activities into the final MBS pilot questionnaire.

The questionnaire collected building information from respondents on the following topics:

Structural characteristics

- Information on the campus (if applicable)
- Square footage
- Percentage of residential space
- Year of construction
- Number of floors and elevators
- Conditioned spaces
- Roof construction
- Wall construction
- Percentage of building covered in glass and windows
- If the building had undergone renovations, and if so, what types of renovations
- If the building has a green certification

Residential space

- Number of units and types (by number of bedrooms)
- Whether the building consists of apartments or condos
- Ownership structure
- Percentage occupied

Commercial spaces

- Percentage of commercial floorspace
- Commercial activities (if applicable)

Common areas

- Types of common areas
- Percentage of common area floorspace
- Presence of common area kitchen
- Characteristics of indoor parking areas
- Presence of electric vehicle chargers
- Presence of pool and pool characteristics
- Common area or in-unit laundry
- Common area lighting

Heating

- Central or individual units
- Central heating equipment and fuels
- Equipment and fuels used for heating in units
- Commercial spaces and common areas
- Heating control

Air-conditioning

- Central or individual units
- Central air-conditioning equipment and fuels
- Equipment and fuels used for air-conditioning in units
- Commercial spaces and common areas
- Air-conditioning control

Water heating

- Central or individual units
- Central water heating fuels
- Fuels used for water heating in units
- Commercial spaces and common areas

Cooking

- Fuels used for cooking in units
- Commercial spaces and common areas

Generation

- Presence of solar panels and backup generation equipment

Metering and billing

- Building master metering
- Individual metering for electricity and natural gas
- Payment responsibility for electricity or natural gas

We designed the MBS questionnaire to take an average of about 20 minutes per building. We programmed the survey instrument as both a computer-assisted web interview (CAWI, or web) and a computer-assisted telephone instrument (CATI, or phone). The web instrument was also mobile optimized.

We made changes to the survey instrument based on mode of administration, mainly to accommodate the differences between a self-administered (web) versus an interviewer-administered (phone) survey. For example, although only select questions in the web instrument displayed a *Don't Know* option, every question in the phone instrument needed to include a *Don't Know* or *Refused* option for the interviewer to be able to move on to the next question. We also slightly changed wording to accommodate the difference between a person reading the question to themselves and seeing the possible answer categories in the web instrument versus having the question and answer categories read to the respondent in the phone instrument. We've included an example question with mode differences in Figure 1. The web mode text is in the top row, and the phone text is in the bottom row. For the phone instrument, capitalized text indicated information for the phone interviewer, but it was not read to the respondent.

Figure 1. Example of survey question with adaptations for web and phone administration

RENV, RENV_NADKREF	
ASK	All respondents

Excluding original construction, in what year was the last major renovation to the building (valued at $10,000 per unit or more) completed?

_____

{ALLOW RANGE 1700 – 2021}

-3 Not applicable – Building has not had major renovations
-4 Don't know

Excluding original construction, do you know in what year the last major renovation to the building, valued at $10,000 per unit or more, was completed? If there have been no major renovations or you do not know the year of the last major renovation, please let me know.

IF NECESSARY: AND, IN WHAT YEAR WAS THAT RENOVATION COMPLETED?

_____

{ALLOW RANGE 1700 – 2021}

-3 NOT APPLICABLE – BUILDING HAS NOT HAD MAJOR RENOVATIONS
-4 DON'T KNOW
-5 REFUSED

Contact-Tracing and Data Collection Protocols

We assigned the 859 selected buildings from the starting sample to a contact-tracing task. We reviewed results for each address that were returned from common internet search methods. These results included street views, apartment websites, rental postings, property records, and realty websites. From these sources, we collected the following information:

- **Complex** name, phone, email, and mailing address (if different than building address)
- **Contact person** name, phone, and email
- **Management company** name, phone, email, and mailing address

Of the starting sample, 87% of buildings had a phone number, which was the preferred method of making contact with the building respondent, and 13% (112 buildings) did not have a phone number and were assigned a mail-only protocol. Only 3 of 112 mail-only cases had an email address, and one of those was found to be ineligible (a single-family detached home), so an email-only protocol was not pursued. During data collection, 24 of the 112 cases were flagged for in-person field tracing. An in-person field tracer visited the address to obtain contact information for the building, but the field tracer

did not conduct the survey. If the field tracer ended up speaking directly to the best point of contact, they mentioned that a survey request would be forthcoming.

In addition, we found an email address for 30% of buildings through online tracing. Unlike phone numbers obtained through tracing efforts, where the probability of finding a phone number increased as building size increased, the likelihood of finding an email address for a building was not related to building size.

After contact-tracing efforts were complete, we made contact with sampled buildings using a standard contact protocol. The protocol included a pre-notice postcard for buildings with phone information, who would be contacted by a phone interviewer. A mailed survey invitation, which included web login information, was sent to cases with no phone contact information available. If the phone interviewer was able to get a valid email address, a series of emails, including login and password information and reminder follow-ups were sent. At predetermined dates during data collection, buildings who had not yet completed the survey were sent reminders via USPS, UPS, and FedEx. Additional email and letter follow-up proved important for a productive MBS data collection.

Although CATI interviewers did not complete many CATI surveys (14 of 269 completed surveys were CATI mode), they successfully collected additional contact information, particularly email addresses, when speaking with building contacts over the phone. Interviewers also gained the cooperation of respondents; multiple contact attempts by the same interviewer over time built trust and relationships.

Several buildings shared common property management companies. After online tracing, we identified 17% (148 buildings) of the sample to have shared management among 53 property management companies. Respondents commonly noted that they needed permission from corporate to participate in the survey; however, when we reached out to corporate contacts, they would often tell us to contact the buildings directly for the kind of information the survey requested. Custom corporate outreach that did not rely on the set CATI script or invitation email language was useful for larger companies in our sample; however, we did not see much utility in custom outreach for the smaller companies. It was more efficient to work cases without tailoring the protocol based on a commonly shared corporate contact. Of the companies with a corporate contact, 24% of companies completed surveys for each of their buildings selected, 37% completed surveys for only some of the buildings selected, and 39% did not complete surveys for any of their buildings.

Future MBS data collections should continue to test possible corporate engagement strategies. Direct outreach from EIA staff or from a government (".gov") email address could add legitimacy, for example. Although contacting corporate first in the case of smaller companies did not yield higher response rates, it is likely still important to manage possible linkages across the sample. For example, several interviewers contacting a single company about multiple addresses on different phone calls could increase confusion and refusals. Interviewers need to be aware of possible linkages so they can capitalize on them if a common reporter is willing to report for multiple addresses.

Results and Analysis - Data Collection

At the end of data collection, we received 269 completed questionnaires. The majority of those interviews (95%, or 255 interviews) were completed via web, and 5% (14 interviews) were completed by phone. The following sections will highlight some key analysis on both the data collection process and building characteristics.

Note, these results are unweighted and not representative of the multifamily building population nationally or in the selected geographic areas.

The overall unweighted response rate was 31.4%, and responses varied by geography and building size (Tables 2 & 3). The Denver MSA had the highest response rate (36.7% of buildings responded), and New York had the lowest (29.2%). Larger buildings with more than 140 units were also more likely to respond, at 37%. We selected Harris County, Texas, specifically for its lack of building benchmarking targets for multifamily buildings to see if this affected response rates. However, the response rate in Harris County was very similar to response rates in both New York and California.

Table 2. Response rates overall and by geography

Geography	Sample size[1]	Number of MBS respondents	Response rate
Combined	858	269	31.4%
New York (state)	298	87	29.2%
California	301	93	30.9%
Harris County, Texas	131	42	32.1%
Denver Metropolitan Statistical Area	128	47	36.7%

Data source: U.S. Energy Information Administration, Multifamily Building Study

[1] Excludes cases with a final disposition status of ineligible.

MBS=Multifamily Building Study

Table 3. Response rates by building size and geography

Building size: frame	Geography														
	Combined			New York			California			Harris County, Texas			Denver Metropolitan Statistical Area		
	SS[1]	#R	RR	SS[1]	#R	RR	SS[1]	#R	RR	SS[1]	#R	RR	SS[1]	#R	RR
< 5 units[2]	30	8	26.7%	11	1	9.1%	17	7	41.2%	0	0	0.0%	2	0	0.0%
5–20 units	189	48	25.4%	76	24	31.6%	75	19	25.3%	3	0	0.0%	35	5	14.3%
21–55 units	173	43	24.9%	69	17	24.6%	71	15	21.1%	1	0	0.0%	32	11	34.4%
56–140 units	209	75	35.9%	75	21	28.0%	71	25	35.2%	36	15	41.7%	27	14	51.9%
≥ 141 units	257	95	37.0%	67	24	35.8%	67	27	40.3%	91	27	29.7%	32	17	53.1%

Data source: U.S. Energy Information Administration, Multifamily Building Study

SS = sample size; #R = number of Multifamily Building Study respondents; RR = response rate

[1] Excludes cases with a final disposition status of ineligible.

[2] Includes RECS respondents who indicate residing in a building with five or more units, contradicting frame estimates that a building has fewer than five units.

CATI contact attempts ranged from 0 to a maximum of 26. Buildings with 1 to 10 CATI contact attempts produced more respondents than nonrespondents. However, as the number of contact attempts needed for a building increased beyond 10, the conversion rate declined to less than 4% for buildings with 16 or more CATI contact attempts. Among the 92 buildings where no CATI contact attempts were made, 8.7% resulted in a completed interview. The average number of CATI contact attempts per building was 10.2 with little variation by geography (Table 4). On average, larger buildings had a greater number of contact attempts than smaller buildings (Table 5), which is likely related to the quality and amount of phone contact information available. Larger buildings may also require more attempts to identify and contact a knowledgeable respondent due to more organizational layers in larger buildings.

Table 4. Distribution of number of computer-assisted telephone instrument (CATI) contact attempts by geography

Geography	N	CATI contact attempts				
		Total	Mean	Median	Minimum	Maximum
Combined	859	8,774	10.2	11	0	26
New York	298	3,082	10.3	12	0	26
California	301	2,828	9.4	11	0	26
Harris County, Texas	132	1,574	11.9	12	0	21
Denver Metropolitan Statistical Area	128	1,290	10.1	11	0	21

Data source: U.S. Energy Information Administration, Multifamily Building Study

Table 5. Distribution of number of computer-assisted telephone instrument (CATI) contact attempts by building size

Building size: frame	N	CATI contact attempts				
		Total	Mean	Median	Minimum	Maximum
< 5 units[1]	30	307	10.2	11.5	0	26
5–20 units	189	1,516	8.0	8	0	24
21–55 units	173	1,766	10.2	11	0	23
56–140 units	210	2,123	10.1	12	0	22
≥ 141 units	257	3,062	11.9	12	0	26

Data source: U.S. Energy Information Administration, Multifamily Building Study

[1] Includes RECS respondents who indicate residing in a building with five or more units, contradicting frame estimates that a building has fewer than five units.

Results and Analysis–Select Building Characteristics

Approximately 82% of all buildings responding to the MBS were run exclusively as apartment rentals, an additional 10% of the buildings were condominiums, and 8% were owned as a cooperative (Table 6). This distribution varied by geography. In New York, only 69% of responding buildings were apartment rentals, and nearly 25% were cooperatives. Conversely, more than 95% of the buildings in Harris County, Texas, were apartment rentals, and none of the buildings that responded to the MBS were cooperatives.

The distribution of respondents by building size, as measured by both number of units and square footage, is fairly evenly distributed across categories. Although RECS respondents or the frame calculation indicated that some buildings had 5 or more units in the building, there were still 5 buildings with fewer than 5 units that responded to the survey (Table 6).

Table 6. Multifamily Building Study (MBS) respondent distribution of building characteristics by geography

	Geography									
	Combined		New York		California		Harris County, Texas		Denver Metropolitan Statistical Area	
Characteristic	N	%	N	%	N	%	N	%	N	%
Residential type										
Apartment rentals	219	81.7%	60	69.0%	81	87.1%	40	95.2%	38	82.6%
Condominiums	27	10.1%	6	6.9%	11	11.8%	2	4.8%	8	17.4%
Cooperatives	22	8.2%	21	24.1%	1	1.1%	0	0.0%	0	0.0%
Residential units[1]										
< 5 units	5	1.9%	2	2.4%	2	2.2%	0	0.0%	1	2.2%
5–20 units	68	26.0%	21	24.7%	35	37.6%	6	15.8%	6	13.0%
21–55 units	38	14.5%	11	12.9%	12	12.9%	3	7.9%	12	26.1%
56–140 units	68	26.0%	29	34.1%	21	22.6%	8	21.1%	10	21.7%
≥ 141 units	83	31.7%	22	25.9%	23	24.7%	21	55.3%	17	37.0%
Square footage										
≤ 5,000	15	6.0%	4	5.2%	7	8.0%	3	7.5%	1	2.3%
5,001–10,000	30	12.0%	10	13.0%	17	19.3%	2	5.0%	1	2.3%
10,001–25,000	39	15.7%	9	11.7%	19	21.6%	5	12.5%	6	13.6%
25,001–50,000	36	14.5%	10	13.0%	8	9.1%	3	7.5%	15	34.1%
50,001–100,000	33	13.3%	13	16.9%	10	11.4%	3	7.5%	7	15.9%
100,001–200,000	33	13.3%	16	20.8%	11	12.5%	5	12.5%	1	2.3%
200,001–500,000	39	15.7%	6	7.8%	8	9.1%	16	40.0%	9	20.5%
> 500,000	24	9.6%	9	11.7%	8	9.1%	3	7.5%	4	9.1%

Data source: U.S. Energy Information Administration, Multifamily Building Study (MBS)

Note: Distribution is based on nonmissing values for each characteristic.

[1] Number of residential units is based on MBS responses to number of apartment units (NUMAPTS), which may differ from the building size on the frame or reported by the RECS respondent.

The most prevalent types of common areas reported by respondents included a laundry room (61.4%), leasing or management office (59.6%), lobby (59.2%), conference or party room (40.3%), pool or hot tub (38.8%), and gym or fitness center (37.7%). Laundry rooms were found in at least 50.0% of buildings regardless of size (Table 7).

Table 7. Prevalence of common areas by number of residential units

	Combined		Number of residential units: MBS									
			< 5 units		5–20 units		21–55 units		56–140 units		≥ 141 units	
Common area	N	%	N	%	N	%	N	%	N	%	N	%
Gym or fitness center	98	37.7%	1	20.0%	12	18.2%	4	10.8%	20	31.7%	61	73.5%
Indoor sports area	7	2.8%	0	0.0%	1	1.5%	0	0.0%	1	1.7%	5	6.4%
Conference room or party room	106	40.3%	0	0.0%	13	19.4%	9	24.3%	27	41.5%	57	68.7%
Lobby	155	59.2%	1	20.0%	12	18.2%	22	57.9%	51	78.5%	67	81.7%
Leasing or management office	155	59.6%	1	20.0%	24	35.8%	13	35.1%	45	69.2%	72	88.9%
Indoor parking	61	23.9%	1	20.0%	8	12.1%	4	10.5%	16	26.2%	32	40.5%
Pool or hot tub	100	38.8%	2	40.0%	20	29.9%	5	13.5%	18	29.0%	55	67.9%
Sauna or steam room	16	6.3%	0	0.0%	3	4.5%	0	0.0%	3	4.8%	10	12.7%
Laundry room	159	61.4%	3	60.0%	34	51.5%	24	64.9%	51	81.0%	47	57.3%
Community fireplace or fire pit	41	15.9%	0	0.0%	3	4.5%	2	5.4%	6	9.7%	30	36.6%
Other	34	20.0%	1	33.3%	5	11.6%	3	11.5%	9	20.5%	16	31.4%

Data source: U.S. Energy Information Administration, Multifamily Building Study (MBS)
Note: Prevalence estimates exclude respondents with missing values.

Among all MBS respondents, about 12.7% reported commercial space in the building, and the rate was much higher in New York (25.3%) than the other three areas (Table 8).

Table 8. Prevalence of commercial space by geography

	Geography									
	Combined		New York		California		Harris County, Texas		Denver Metropolitan Statistical Area	
Characteristic	N	%	N	%	N	%	N	%	N	%
Commercial space										
Yes	34	12.7%	22	25.3%	6	6.5%	2	4.8%	4	8.7%
No	234	87.3%	65	74.7%	87	93.5%	40	95.2%	42	91.3%
Percentage commercial										
≤ 5%	11	36.7%	10	52.6%	1	20.0%	0	0.0%	0	0.0%
6%–10%	7	23.3%	2	10.5%	3	60.0%	1	50.0%	1	25.0%
> 10%	12	40.0%	7	36.8%	1	20.0%	1	50.0%	3	75.0%

Data source: U.S. Energy Information Administration, Multifamily Building Study

Residential units were individually metered for electricity in more than 90.0% of buildings in California; Harris County, Texas; and the Denver MSA. In New York, only 74.7% of buildings had individual metering (Table 9). Across all geographies, residents were directly responsible for paying for the electricity used in residential units in 86.6% of buildings. Less than half of buildings that used natural gas as an energy source had individual metering for residential units (42.7%), although individual metering for natural gas was more common in California and the Denver MSA (Table 9). In 43.3% of buildings, residents were directly responsible for the natural gas used in residential units, and in 37.8% of buildings, it was included in the rent, a condo fee, or utility fee.

Table 9. Respondent distribution of metering and billing characteristics by geography

Metering or billing characteristic	Geography									
	Combined		New York		California		Harris County, Texas		Denver Metropolitan Statistical Area	
	N	%	N	%	N	%	N	%	N	%
Units individually metered for electricity										
Yes	233	86.6%	65	74.7%	85	91.4%	40	95.2%	43	91.5%
No	36	13.4%	22	25.3%	8	8.6%	2	4.8%	4	8.5%
Units individually metered for natural gas										
Yes	93	42.7%	27	35.1%	42	52.5%	3	13.6%	21	53.8%
No	125	57.3%	50	64.9%	38	47.5%	19	86.4%	18	46.2%
Pay for electricity in residential units										
Residents	221	82.5%	61	70.1%	83	90.2%	39	92.9%	38	80.9%
Included in rent, condo fee, or utility fee	24	9.0%	13	14.9%	5	5.4%	1	2.4%	5	10.6%
Split between residents and rent or fees	7	2.6%	1	1.1%	2	2.2%	1	2.4%	3	6.4%
Some other arrangement	16	6.0%	12	13.8%	2	2.2%	1	2.4%	1	2.1%
Pay for natural gas in residential units										
Residents	94	43.3%	22	28.6%	47	58.8%	4	19.0%	21	53.8%
Included in rent, condo fee, or utility fee	82	37.8%	38	49.4%	23	28.8%	12	57.1%	9	23.1%
Split between residents and rent or fees	10	4.6%	3	3.9%	2	2.5%	1	4.8%	4	10.3%
Some other arrangement	31	14.3%	14	18.2%	8	10.0%	4	19.0%	5	12.8%

Data source: U.S. Energy Information Administration, Multifamily Building Study
Note: Distribution is based on nonmissing values for each characteristic.

Among building ownership types (Table 10), residential units in condominiums (100.0%) were more likely to be individually metered for electricity than apartment rentals (86.3%) or buildings that were owned as cooperatives (72.7%). With apartment rentals and condominiums, more than 80.0% of respondents reported that residents were directly responsible for the electricity used in residential units. In buildings that were owned as cooperatives, residents were typically responsible for electricity use in residential units (63.6%), but including the cost in the rent, a condo fee, or utility fee was also common (36.4%). Individual metering for natural gas in residential units was less common than individual metering for electricity across all building types (Table 4.15). Natural gas used in residential units was also more likely to be included in the rent, a condo fee, or utility fee compared with electricity used.

Table 10. Respondent distribution of metering and billing characteristics by building type

Metering or billing characteristic	Building type							
	Combined[1]		Apartment rentals		Condominiums		Cooperatives	
	N	%	N	%	N	%	N	%
Units individually metered for electricity								
Yes	233	86.6%	189	86.3%	27	100%	16	72.7%
No	36	13.4%	30	13.7%	0	0.0%	6	27.3%
Units individually metered for natural gas								
Yes	93	42.7%	75	42.1%	7	38.9%	11	50.0%
No	125	57.3%	103	57.9%	11	61.1%	11	50.0%
Pay for electricity in residential units								
Residents	221	82.5%	184	84.4%	22	81.5%	14	63.6%
Included in rent, condo fee, or utility fee	24	9.0%	14	6.4%	2	7.4%	8	36.4%
Split between residents and rent or fees	7	2.6%	4	1.8%	3	11.1%	0	0.0%
Some other arrangement	16	6.0%	16	7.3%	0	0.0%	0	0.0%
Pay for natural gas in residential units								
Residents	94	43.3%	78	44.1%	8	44.4%	8	36.4%
Included in rent, condo fee, or utility fee	82	37.8%	61	34.5%	8	44.4%	13	59.1%
Split between residents and rent or fees	10	4.6%	9	5.1%	0	0.0%	1	4.5%
Some other arrangement	31	14.3%	29	16.4%	2	11.1%	0	0.0%

Data source: U.S. Energy Information Administration, Multifamily Building Study
Note: Distribution is based on nonmissing values for each characteristic
[1] The *Combined* column includes respondents with a missing value for number of residential units.

Across building sizes (Table 11), individual metering of residential units for electricity ranged from 73.5% in buildings with 56 to 140 units to greater than 97.0% in buildings with fewer than 20 units. In buildings with 56 or more units, it was more common for electricity costs to be included in the rent, a condo fee, or utility fee or through some other arrangement. However, the predominant method of payment was for residents to be directly responsible for electricity used in residential units across all building sizes. Individual metering for natural gas tended to be more common in smaller buildings (that is, 55 or fewer units) than larger buildings. For these smaller buildings, more than 50.0% of respondents reported that

residents were directly responsible for natural gas used in residential units, but in buildings with 56 or more units, it was more common for other payment arrangements to be made.

Table 11. Respondent distribution of metering and billing characteristics by building size

Metering or billing characteristic	Combined[2]		Number of residential units[1]									
			< 5 units		5–20 units		21–55 units		56–140 units		≥ 141 units	
	N	%	N	%	N	%	N	%	N	%	N	%
Units individually metered for electricity												
Yes	233	86.6%	5	100.0%	66	97.1%	33	86.8%	50	73.5%	72	86.7%
No	36	13.4%	0	0.0%	2	2.9%	5	13.2%	18	26.5%	11	13.3%
Units individually metered for natural gas												
Yes	93	42.7%	3	60.0%	33	58.9%	16	51.6%	19	31.7%	22	34.9%
No	125	57.3%	2	40.0%	23	41.1%	15	48.4%	41	68.3%	41	65.1%
Pay for electricity in residential units												
Residents	221	82.5%	5	100.0%	64	94.1%	31	81.6%	46	68.7%	68	81.9%
Included in rent, condo fee, or utility fee	24	9.0%	0	0.0%	2	2.9%	1	2.6%	9	13.4%	12	14.5%
Split between residents and rent or fees	7	2.6%	0	0.0%	2	2.9%	3	7.9%	1	1.5%	1	1.2%
Some other arrangement	16	6.0%	0	0.0%	0	0.0%	3	7.9%	11	16.4%	2	2.4%
Pay for natural gas in residential units												
Residents	94	43.3%	3	60.0%	35	60.3%	16	51.6%	16	27.1%	24	38.7%
Included in rent, condo fee, or utility fee	82	37.8%	1	20.0%	17	29.3%	10	32.3%	24	40.7%	29	46.8%
Split between residents and rent or fees	10	4.6%	0	0.0%	3	5.2%	1	3.2%	3	5.1%	2	3.2%
Some other arrangement	31	14.3%	1	20.0%	3	5.2%	4	12.9%	16	27.1%	7	11.3%

Data source: U.S. Energy Information Administration, Multifamily Building Study

Note: Distribution is based on nonmissing values for each characteristic.

[1] *Number of residential units* is based on MBS responses to NUMAPTS, which may differ from the building size on the frame or reported by the RECS respondent.

[2] The C*ombined* column includes respondents with a missing value for number of residential units.

Lessons Learned

The MBS pilot achieved all three pilot objectives. We produced research about the frame design, developed a contact protocol, and developed a questionnaire that collected information to enable us to develop multifamily building-level end-use models to produce estimates in future data collections. The following items are lessons learned and could be tested or built on for any future MBS studies.

Frame and sampling

We derived the sample frame for the MBS pilot from the 2020 RECS Household Survey sample. The MBS sample was stratified by building size, which was derived using the address fields on the U.S. Postal Service's Computerized Delivery Sequence to estimate how many addresses were from the same building. This derived estimate for building size matched information provided by MBS respondents approximately 70% of the time but did result in some stratum misclassification and could be a source of bias in estimates in a national MBS.

We excluded drop points from the MBS pilot because they were deliberately not fielded in the 2020 RECS Household Survey. Given the higher proportion of drop points in certain geographic areas, we should do more research on how to incorporate these buildings into future data collections to reduce bias.

At this time, many potential data sources could be useful in constructing a frame for a future MBS. However, the accessibility and content of many of these sources will likely change over time, and we can't adequately determine the relative value of a potential source based solely on publicly available information. We should also consider combinations of data sources to fill in area coverage gaps or to provide additional information.

Contact information

When selecting the sample for the MBS, we gave priority to RECS respondents who provided contact information for someone who could answer questions about energy use for the building. Buildings associated with RECS respondents who provided contact information had higher response rates than other buildings.

We should consider the availability and quality of contact information for buildings when evaluating data sources for frame construction.

MBS questionnaire

The MBS survey performed well: 44% of items had 0% missingness, and another 28% had missingness rates of less than 5%. One item of concern with high missingness was SQFT (square footage of building); however, the missing rate was greatly reduced by the addition of SQFTC, a follow-up question that asked the respondent to select the most likely option among several square footage ranges.

For the MBS pilot, we minimized survey mode differences, to the extent possible. Both CATI and web instruments were programmed in the same survey software package with minor differences in versions. Fewer differences will streamline both programming and testing and reduce the likelihood of errors.

The MBS questionnaire had an estimated burden of 20 minutes to complete. We found that web respondents on average completed the survey in 17–18 minutes, and CATI respondents in 28–29 minutes. Sample members often said they did "not have time" when they declined to take the survey, so we should lower the web timeframe estimate to less than 20 minutes to better represent the response burden. We should then include a note that interviews may take more time if completed over the phone. Any survey items found not to be useful from the pilot should be removed from future questionnaire versions to reduce the timing estimate further.

Of the 78 respondents who started the survey but did not finish it, 24 respondents (31%) broke off after consenting but before answering the first question.

Contact tracing

We needed to search online to identify phone numbers for most locations, and we needed to use those phone numbers to obtain email addresses for points of contact. Nearly 64% of phone numbers were recorded during online tracing, which raised the proportion of the sample with at least one phone number from 23% to 87%. Later, we obtained email address for nearly 71% of the sample during data collection.

A small portion of cases (24 of 112) where we could not find phone or email information after online tracing were sent to field tracing, where in-person representatives attempted to obtain contact information. We obtained information for about 75% of these buildings, but the end response rate for this small group of locations was just 13%, only a few points higher than the 8.4% for other cases that did not have a phone number or email address on file.

For future MBS pilots, we should continue online tracing for all cases. This method was quick (8.5 minutes per search) and effective in the pilot. Future larger-scale efforts should take steps to further standardize a system for tracers to add their inputs, including recording additional information such as visible commercial space, size of building, single or multiple buildings at location, renters or owners, and if the building address is actually for a townhome community (for possible exclusion). Comparing this additional information to sample performance may identify useful trends for data collection.

We should reserve field tracing for high-priority cases given the expensive cost and lower gains. We should define high-priority cases based on the goals of future MBS collections; some examples might include buildings with higher base weights, buildings in certain geographic areas, or buildings with certain characteristics of interest. To improve gains, we should provide the tracer with a packet to leave onsite that includes survey materials. Tracers should also verify contact information in the field prior to reporting back to the program office.

We will continue to evaluate other possible contact information sources. The expert panel suggested partnering with housing organizations to match to their contact lists; however, we would have to think through possible Confidential Information Protection and Statistical Efficiency Act (CIPSEA) concerns.

Contact protocols and response rates

After online tracing, 13% of the sample had a mailing address but no phone number or email address. These cases were assigned to a mail-only contact protocol. This mail-only contact protocol yielded an 8.4% response rate.

The other 87% of the sample had at least one contact number. Cases with a phone number were assigned to a mixed-mode contact protocol, which used mail, phone, and email (when an email address was available). Each email or mail blast led to a substantial increase in responses. We achieved a response rate of 35.6% for cases in the mixed-mode contact protocol. For cases where an email was available, the response rate was 39%.

In the MBS pilot, the sample size was not sufficient to include experiments on the contact protocol. It is clear that email and mail follow-up to all pending cases led to an increase in response rates. However, we still have more to learn about the optimal number and sequence of contacts. A phased approach to data collection with experiments in the first phase would be useful in identifying an optimal contact protocol to use with the majority of the sample.

The unweighted MBS response rate ranged, by area, from 29.2% in New York to 36.7% in the Denver MSA. Across all geographies combined, larger buildings (that is, buildings with 56 or more units) also tended to have higher response rates than smaller buildings (that is, those with 55 or fewer units), which is likely related to the availability and quality of contact information.

Survey mode

Phone contacts were essential for establishing a point of contact for the building. Buildings with 1 to 10 CATI contact attempts produced more respondents than nonrespondents. However, despite a considerable level of effort for phone contacts, most participants opted to complete the survey via web.

Although 65% of surveys were completed by a single individual, many respondents indicated that more than one person was needed to compile the information for the survey. Almost half of web respondents also needed more than one session to complete the survey.

Collectively, these findings, along with longer interview times among CATI respondents, suggest that web, or even paper, modes may be preferable to telephone interviews for many buildings. Investing resources in a paper survey may be more useful for response rates than continued investment in offering the CATI survey.

Regardless of survey mode offered, phone contacting is essential to the success of the MBS for both establishing and confirming a willing and knowledgeable point of contact and for nonresponse prompting.

Multi-building responders

Of the buildings selected, 17% were found to share a property management company with one or more other buildings in the sample, including 53 separate property management companies with an average of 2.8 and median of 2 buildings per company. Near the end of data collection, after multiple email blasts and mailings, MBS data collection managers established contact with leadership at two of the

largest companies in the MBS sample and attempted to negotiate participation. As a result of these negotiations, one of the representatives agreed to encourage their individual building managers to participate, and the other representative agreed to provide data on all the selected buildings and requested a customized Excel template to use in providing these responses.

For companies that have only a few buildings in the sample, contacting corporate offices proved less efficient. For smaller companies, it may be more productive to contact the buildings directly and then approach the corporate entity only on request rather than as a starting point. Although contacting corporate first in the case of smaller companies did not yield higher response rates, it is likely still important to manage possible linkages across the sample. For example, several interviewers contacting a single company about multiple addresses on different phone calls could increase confusion and refusals. Interviewers need to be aware of possible linkages so they can capitalize on them should a common reporter be willing to report for multiple addresses.

Future MBS data collections should continue to test possible corporate engagement strategies, particularly for companies associated with the largest number of buildings. Direct outreach from EIA staff or a government (".gov") email address could add legitimacy, for example.

Custom corporate outreach that did not rely on the set CATI script or invitation email language was useful for the larger corporations. These contacts are best made by interviewers with advanced training and skills or by managers.