2025 Commercial Building Stock Assessment (CBSA) Final Report

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This 2025 CBSA Final Report was prepared for NEEA and its funders by Westat with input from Michaels Energy.

Westat thanks the CBSA Workgroup members for their support in providing expertise and guidance on making critical decisions on all aspects of the study design and analysis and reporting plans.

Executive Summary

The **2025 Commercial Building Stock Assessment (CBSA)** represents the fifth study conducted on behalf of the Northwest Energy Efficiency Alliance (NEEA) and its funders since 2003. This rigorous stock assessment collects, analyzes, and presents data on commercial and multi-family residential buildings' characteristics, installed equipment, and energy consumption across four Northwestern states: **Idaho, Montana, Oregon, and Washington**. The study provides critical data to inform regional energy savings potential, load flexibility, and forecasting.

Findings Highlights

692	66%	37%	0.42
PARTICIPATING BUILDINGS	LED FIXTURE SHARE	BUILDINGS WITH HEAT PUMPS	LPD (WATTS/SQ FT)

Methodological Advancements and Frame Precision

Moving away from methods typical of nonprobability sample designs and estimation procedures used in 2019, the 2025 CBSA instituted a rigorous **probability sample design**. Key enhancements include the following:

- **Shift to building-level sampling**: Transitioned from tax-parcel "sites" to individual "buildings" as the secondary sampling unit. This standardization of the unit for which participation was requested facilitated recruitment and data collection.
- **Enhanced frame via virtual listing**: Leveraged Westat's proprietary virtual listing tools to supplement traditional purchased data databases, adding 24 percent of the final building stock frame that was unlisted or misclassified in purchased databases (27% for small buildings).
- **Expanded scope**: Introduced new primary building activities (Multi-Family Residential, Vacant – Commercial) and building types within existing primary building activities (college/university classrooms and small nursing homes).
- **In-person recruitment focus**: Shifted from remote-first call center protocols to an in-person–first approach, significantly boosting building participation and nonresponse tracking.

Energy Use Intensity (EUI)

The 2025 CBSA paired survey findings with utility billing records (electricity data for 475 buildings; natural gas data for 277 buildings).

- **Efficiency gains:** Electricity EUIs decreased across nearly all categories since 2019, driven predominantly by substantial reductions in lighting power density.
- **Seasonal fuel dynamics:** Proportions of electricity and natural gas usage was consistent with 2019 (e.g., winter peaks for space heating), but summer gas usage fell.[1]
- **Gas intensity baselines:** Natural gas EUI averaged 24 kBTU/sq ft. Public assembly and lodging recorded the highest gas EUIs (36 and 30 kBTU/sq ft), while warehouses and offices were lowest (18 kBTU/sq ft each).

Heating and Cooling Equipment

- **Combustion de-escalation:** Fossil fuel combustion remained the most common heating approach, but its share of heating, ventilation, and air conditioning (HVAC) systems dropped significantly from 55 percent in 2019 to 46 percent in 2025.
- **Heat pump proliferation:** Heat pump adoption jumped from 18 percent to 37 percent of regional buildings. Education buildings led at 66 percent adoption, followed by Multi-Family Residential buildings (57%). Washington (42%) and Oregon (41%) led adoption over Montana (23%). At 26 percent, Idaho did not differ significantly from other states.
- **Cooling and controls:** Air-cooled direct expansion (DX-Air) systems represented 75 percent of cooling systems. Manual thermostats remained prevalent (61%) across all buildings, while complex energy management systems governed 68 percent of buildings over 200,000 sq ft.

Lighting Market Transformation

Lighting represents the clearest sign of comprehensive market transformation across the Northwest.

- **LED dominance:** LED technology claims 66 percent of all commercial fixtures (up from 37% in 2019). Use of linear fluorescent (T8) bulbs dropped 20 percentage points to 18 percent in 2025.
- **Fixture and lamp reductions:** Total fixtures decreased by 26 percent since 2019, reflecting de-lamping, fixture consolidation, and superior lumen efficacy of modern LEDs, in addition to key CBSA sample design changes.
- **Code and legislative drivers:** LED adoption varied by state policy: Washington's LED share was lowest at 61 percent (ahead of its 2029 fluorescent ban), while Idaho (78%), Montana (75%), and Oregon (71%; ban active in 2025) demonstrate higher saturation.

Emerging Energy Drivers

- **Server spaces:** Dedicated server infrastructure is maintained in 29 percent of properties, concentrated heavily within education (64%) and office (50%) environments.
- **On-site generation:** One percent of regional buildings employ solar panels, while 10 percent integrate secondary backup generation (56% fueled by diesel). Facilities between 25,000 and 50,000 sq ft had the largest share of backup generation at 70 percent.
- **Electric vehicle (EV) infrastructure:** EV charging stations are available at 5 percent of buildings overall, scaling with building size to include 51 percent of buildings over 200,000 sq ft.

[1] This decline in summer natural gas use is likely due to fewer participating food service, food sales, and hospital buildings in in 2025 vs. 2019.

A. 2025 CBSA Overview and Changes From the 2019 CBSA

1. 2025 CBSA Overview

1.1 Introduction

The 2025 Commercial Building Stock Assessment (CBSA), the fifth CBSA conducted on behalf of NEEA and its funders since 2003, collects, analyzes, and publishes data on the characteristics, installed equipment, and energy consumption of commercial and muti-family residential buildings in four states in the Northwest region of the United States: Idaho, Montana, Oregon, and Washington. Data from the study are intended to inform energy savings potential, load flexibility, load forecasting, and other regional data needs for the commercial and multi-family residential sectors.

1.2 Study Objectives

The aim of the 2025 CBSA was to produce regionally representative estimates for the Northwest region as well as estimates by state and by various building characteristics, such as building size and use (primary activity).

The study consisted of two data collection components: a building survey and collection of billing data from utility service providers. In the first component, building characteristic data were collected via online surveys and in-person site visits. In the second component, electric and natural gas consumption data were collected from associated utility service providers for participating buildings. A detailed accounting of completed web surveys and site visits is shown in Table 3 and in Section C.10.1. Billing data collection results are provided in Section C.7.6.

1.3 Report Overview

This report presents an overview of energy-related data for commercial and multi-family residential buildings and highlights key findings from the data collected, including building stock characteristics, energy use intensities, heating and cooling, water heating, and lighting.

It also provides a description of the statistical and operational methodologies used to conduct the 2025 CBSA, including sampling and weighting approaches, recruiting strategies, data collection protocols for both the building characteristic survey and the utility data collection component, and completion results including response rates.

1.4 Methodological Context and Data Interpretation

The following points are intended to assist readers of this report and 2025 CBSA data users in navigating the presentation of the study's key findings, interpreting the data, and understanding the study methodology behind the results.

- **Methodology.** Detailed documentation of the 2025 CBSA sample design and data collection methodology is provided in Section C. Throughout Sections A and B, references to report subsections with methodological details are provided for context. Readers who desire a complete understanding of the study design to assist in interpreting the study findings may wish to read Section C before reading other report content.
- **Market Description.** The 2025 CBSA is designed to describe the market as it currently stands rather than explain the implications of each trend or change in the data. Throughout the report, additional context is provided, but the commentary is not exhaustive.
- **COVID-19 Implications.** There may be differences in the commercial building landscape due to the COVID-19 pandemic that cannot be accounted for. For office buildings, real estate market research points to reductions in total floorspace, more vacant buildings, and an increase in partially occupied buildings; even in 2025, more workers worked remotely either part time or full time than in 2019. Retail floorspace saw similar shifts, alongside increases in warehouse floorspace to balance the increase in e-commerce over shopping in physical locations. Recent studies suggest that retail floorspace is rebounding, but much of the new floorspace was still under construction or not yet occupied in 2025.
- **Full and Adjusted 2025 Data.** Given the sample design changes outlined in Section A.2, this report presents data from both the full 2025 CBSA data and an adjusted version that excludes building categories not included in the 2019 CBSA. In all tables and figures, these are labeled as "2025" and "2025 Adjusted," respectively. Throughout the text, the full 2025 CBSA data are used as the reference point because they provide a more representative picture of commercial and multi-family residential buildings across the Northwest (see Section A.2 for additional detail). The analytic data files also include a

field that allows users to filter the data based on whether the building category would have been included in 2019.

- **Error Bars and Confidence Intervals.** Throughout Section B, select figures include error bars showing 90 percent confidence intervals. These bars provide a sense of how precise each estimate is, with wider bars for less precise estimates. When comparing groups, nonoverlapping 90 percent confidence intervals indicate the difference between the estimates is statistically significant at the 0.10 significance level[2]; overlapping intervals do not necessarily mean there is no difference, but they suggest the evidence is less clear. Throughout the report, we use the word significant only where there is a statistically significant difference between the comparison groups. Where error bars are not included, the appendix tables provide standard errors, which can be used to determine confidence intervals.
- **Subgroup Sample Size and Degrees of Freedom.** Analyses in Section B are focused on comparison groups with adequate sample sizes to make reliable inferences about commercial buildings in the Northwest. For example, some primary building activities did not have enough participating buildings dispersed across the Northwest to reliably represent the region. Appendix tables and the underlying data include all groups, but data users should review subgroup-level degrees of freedom for all analyses and proceed with caution if any subgroup results in fewer than 8 degrees of freedom due to small sample sizes. Small degrees of freedom generally result in a wide confidence interval and an unstable variance estimate. See the Commercial Building Stock Assessment (CBSA) 2025 User Guide for instructions on calculating the appropriate degrees of freedom for subgroup analyses.
- **2019 and 2025 Primary Building Activity Alignment.** Although there are differences in the primary building activity categories used during data collection in each year, all primary building activity categories for the 2019 CBSA used throughout Section B are aligned to 2025 primary building activity categories. This helps ensure comparability across study years despite these changes (see Section A.2.6 for details).

[2] A statistically significant difference at the 0.10 level means that if there was truly no difference in the population values between the groups, there would be less than a 10 percent chance of observing a difference this large (or larger) due to sampling variability alone.

- **Subsampled Data.** Data flagged as subsampled[3] should be interpreted with caution due to inconsistencies in the way field technicians administered the subsampling procedures. For example, in a building where less representative or fewer-than-expected rooms were subsampled, lighting fixtures may have been undercounted even after estimation to the building level was completed. Out of the 692 buildings in the 2025 CBSA sample, 22 buildings (3 percent) are flagged as subsampled; given the small number, these cases should have minimal effect on most high-level analyses and are included in all analyses in Section B.
- **Nonresponse Bias.** Although the nonresponse weighting adjustments reduced the potential for nonresponse bias, there is still some evidence of nonresponse bias for buildings in very urban and very rural areas due to low and variable response rates. See Sections 3.1–3.3 of the *2025 CBSA NRBA Report* in Appendix 8 for more information on how the nonresponse weight adjustments addressed this bias.

2. Changes From the 2019 CBSA

To improve the accuracy of the final estimates, the 2025 CBSA features several substantive methodological changes from the 2019 CBSA including the sampling frame (i.e., the list used to select buildings for participation), the methods of data collection, the weighting procedures, and the fields included in the analytic datasets. These methodological changes impact the direct comparability of the 2019 and 2025 CBSA data and are thus important for readers and data users to understand.

2.1 Improvements in the Sample Design and Estimation Procedure

Probability sample designs, where every element in the population has a known nonzero probability of being selected and estimates are computed based on those probabilities, are the hallmark of high-quality survey designs and make the results more representative and trustworthy. Lohr (2021) describes the generalizability of data from probability samples and contrasts this with data collected from nonprobability samples. When samples are chosen using nonprobability methods (as in 2019), estimates rely on assumptions about how the units were

[3] In some instances, details about all spaces of a building could not be documented during a site visit due to practical limitations such as access or if there was insufficient time to visit all floors of a building. If data were not obtained for the full building, within-site subsampling was applied to determine which spaces to document and how much of the total building they represent (see Section C.2.3.2.4). Collected data have been adjusted accordingly using the inverse of the probability of selection to account for within-site subsampling.

selected, and those assumptions can be difficult to justify or verify. As a result, estimates from nonprobability samples are subject to selection biases and margins of error may not be valid. In particular, estimated margins of error can be misleading and provide a false sense of precision.

The 2025 design was a probability sample and data from the respondents were weighted using standard survey sampling procedures such as those described by Lohr (2021). The 2019 CBSA final documentation was unclear about how units were chosen for the study and did not report response rates. The 2019 study did not use weights based on the probabilities of selection; instead, it created estimates using logistic regression to model inclusion propensities. These methods are typical of nonprobability sample designs and estimation procedures and may, as Lohr notes, rely on assumptions that are unverifiable and not generalizable to the population.

The 2025 CBSA probability sample design and weighting creation process included the following standard methods:

- Calculating probabilities of selection for each stage of selection to account for the oversampling of certain buildings
- Reporting response rates overall and by key subgroups of interest
- Creating final weights based on probability theory and the calculated probabilities of selection, and adjusting for nonresponse to produce estimates that are representative of the population sampled

2.2 Improved Distribution Across Geographic Subregions

The 2025 CBSA identified three geographic subregions as high priority analytic domains (Figure 1). These subregions are combinations of Bonneville Power Administration (BPA) administrative regions and are proxies of the three primary heating climate zones defined by the Northwest Power and Conservation Council.

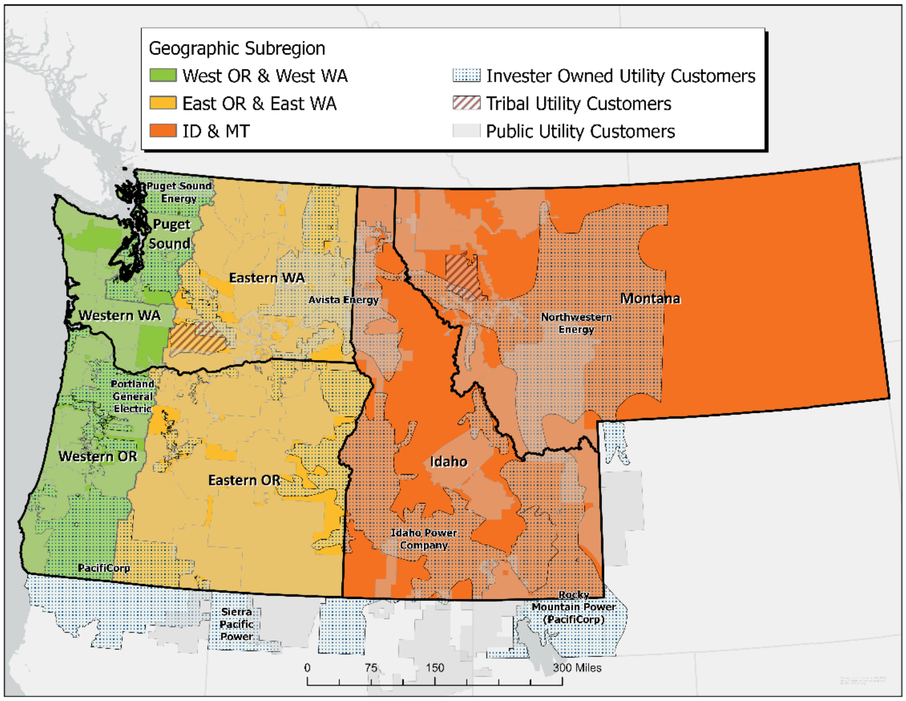
- Subregion 1: Puget Sound, Western Oregon, and Western Washington
- Subregion 2: Eastern Oregon and Eastern Washington
- Subregion 3: Idaho and Montana

To ensure adequate representation from buildings for these geographic subregions, the 2025 sample design stratified census tracts[4] by BPA administrative subregion. This is a standard approach to improve the precision of estimates in probability samples.

[4] The U.S. Census Bureau defines tracts as "small, relatively permanent statistical subdivisions of a county or statistically equivalent entity…Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people."

The 2019 sample design stratified the selection of Census blocks by state but not any geographic subregions within state and did not include any geographic identifiers (state or subregions within states) in the model for generating final weights. Because no geographic variables were included as predictor variables, the 2019 inclusion probability model may not have fully addressed the imbalance in sampling by geographic subregion, which could lead to distortions in estimates by geographic subregion.

Figure 1. Geographic subregions



Note. Image generated by Westat based on a county-level file provided by NEEA containing BPA administrative region assignments and a publicly available file of BPA utility customer service areas downloaded from htttp://data-bpagis.hub.arcgis.com.

(https://www.census.gov/programs-surveys/geography/about/glossary.html#par_textimage_13). See Figure 64 for a visual image of census tracts within a county.

2.3 *Secondary Sampling Unit Differences*

Another improvement in the 2025 design was the choice of the secondary (i.e., lowest level) sampling unit. The secondary sampling unit in 2019 was a *site*, defined as “one or more commercial buildings within a census block that are situated on one or more contiguous parcels of land that have the same property taxpayer.” Data collectors conducted site visits with all or a subsample of buildings at the selected site. The concept of a site can be difficult to comprehend and increase complexity. For example, in 2019, although buildings within sites had the same property tax owners, they may have had different buildings managers or operators. Tracking building contacts and participation within a site introduces additional complexity and opportunities for refusals.

The 2025 CBSA defined a building as a structure totally enclosed by walls extending from the foundation to the roof and intended for human access. To be eligible for the study, the total square footage within the exterior walls must have been greater than 1,000 square feet. To meet the criteria of a commercial building, more than half of the square footage must have been used for commercial purposes.

In 2025, the secondary sampling unit was the *building*, a more straightforward term for data collection purposes. This change was possible because of the use of the proprietary virtual listing tools developed by Westat.

2.4 *Improved Process for Creating an Accurate Sampling Frame of Secondary Sampling Units*

The process used in 2025 to create a comprehensive commercial building sampling frame was substantively different from the method used in 2019 to create a site sampling frame. In 2019, the site sampling frame was based on tax assessor data purchased from SMR Research and data from Google Places, which is fundamentally a points of interest (POI) database. A study of POI data quality by Yeow et al. (2021) defined POI as “places of interest frequently visited by human traffic throughout the day, including restaurants, supermarkets, transportation hubs, parks, and cafes” This definition is consistent with the primary use of Google Places as a tool that allows people to discover establishments visited by the public. As a result, lists of commercial sites or buildings that use Google Places data may underrepresent establishments that are not open to the public or that have limited public interaction, such as warehouses. Indeed, Yeow and colleagues found that POI databases “have poor completeness with errors of commission and omission.” Moreover, through Westat’s experience collecting data for multiple cycles of the Commercial Buildings Energy Consumption Survey (CBECS), conducted by the

U.S. Energy Information Administration, it is evident that tax assessor data and vendor-purchased lists of commercial buildings are incomplete. These sources regularly miss commercial buildings entirely and misclassify the size and use of many commercial buildings (Hubbard et al., 2021, Hubbard et al., 2023).

As a result, the 2025 CBSA adopted the procedures of CBECS that involve updating building data purchased from Dun & Bradstreet using in-person or virtual listing methods to improve the completeness and accuracy of the building-level sampling frame (see Section C.3). As shown in Table 1, for the 2025 CBSA, 24 percent of the commercial buildings in the frame were added from the virtual listing process (they were not on the list of commercial buildings purchased from Dun & Bradstreet). Having a more complete and accurate sampling frame is a necessary component of producing estimates that are generalizable to the population.

Table 1. Percent of commercial buildings added from the virtual listing process by building size

Building size	Buildings on commercial building frame	Percent of buildings added via virtual listing process
1,001–10,000 sq ft	8,313	27%
10,001–25,000 sq ft	2,257	22%
25,001–50,000 sq ft	928	17%
50,001–100,000 sq ft	558	13%
100,001–200,000	310	13%
200,001+ sq ft	147	18%
Total	**12,513**	**24%**

2.5 Expanded Building Use Inclusion

Beyond methodological changes to the sampling frame construction, additional types of building were included in the 2025 CBSA that were not included in the 2019 CBSA. These changes align the CBSA building categories more closely with 2018 CBECS building use categories.

- **Vacant – Commercial buildings:** The 2025 sampling frame included as a separate primary building activity category, buildings that were vacant at the time of listing but for which the most recent building use was commercial. Although these buildings generally have lower energy use, they make up an important subset of commercial buildings, particularly given the substantial changes in commercial vacancy rates over the last 5 years (Cushman & Wakefield, 2026).
- **College and university buildings:** Alongside K–12 school buildings, preschool/daycare centers, and other types of education buildings, the 2025 sampling frame added college

and university classroom buildings in the Education primary building activity category. These buildings were often large and may have had different energy use compared with K–12 and preschool buildings.

- **Small nursing home buildings:** The 2025 sampling frame included small nursing homes under 10,000 sq ft in the Nursing Home category. These small nursing homes were excluded from the 2019 sampling frame because some were considered “home-based businesses.” Given that these homes would typically be excluded from residential studies because they are used primarily for commercial purposes, they were included in the 2025 CBSA.
- **Other previously excluded building types:** Stadiums and courthouses were categorized as Public Assembly and Public Safety and Order buildings, respectively, and were included in the 2025 sampling frame. Buildings associated with ports were included in the building activity category that most closely represented the work happening in that building; most qualified as Warehouses.
- **Multi-Family Residential buildings:** The 2025 sampling frame included as a separate category, Multi-Family Residential, buildings with four or more floors used for residential purposes *and* five or more separate dwelling units. Multi-Family Residential buildings were included at NEEA’s request to help supplement information collected on multi-family residential buildings as part of the 2022 Residential Building Stock Assessment, but they were not included in any prior CBSA cycles. Henceforth in this report, the term “commercial” is used to describe both commercial and multi-family residential buildings in the context of the 2025 CBSA.

Table 2 provides descriptions and examples of all primary building activities included in the 2025 CBSA. Appendix 3 provides additional details on the building use categories.

2.6 Revised Primary Building Activities

In addition to expanding the primary building activities included in the 2025 CBSA, the definitions of some primary building activities shifted from the 2019 CBSA definitions. Examples include the following:

- In the 2025 CBSA, the Health Care category included medical and dental offices as well as other outpatient care centers that were categorized under Office in the 2019 CBSA.
- Five new primary building activities were added in 2025 to provide additional granularity: Religious Worship, Public Order and Safety, Automotive, Laundry/Dry Cleaner, and Other Service. These building categories were included in the 2019 CBSA but were not broken

out in separate categories. For example, buildings classified as Religious Worship in the 2025 CBSA were classified as Public Assembly in the 2019 CBSA. Buildings used for vehicle repair were classified as Automotive in the 2025 CBSA and Retail in the 2019 CBSA.

- The 2025 CBSA did not include a primary building activity of Mixed Commercial as did the 2019 CBSA. Buildings were classified by the category that most closely matched their purpose for the majority of the commercial space (e.g., retail, food service).

Throughout this report, primary building activities are based on the 2025 categories, including comparisons to the 2025 adjusted data and 2019 data. Using detailed building descriptions from the 2019 CBSA data, all buildings in the 2019 data were aligned to 2025 primary building activity codes to ensure comparability across study years, as detailed in Appendix 2.

Table 2. 2025 CBSA primary building activity descriptions

Primary building activity	Description	Examples
Automotive	Buildings used for sales, care, and maintenance of automotive vehicles	
Education	Buildings used for academic or technical classroom instruction	Preschool/daycare; Elementary/middle/high school; College/university classroom; Religious education classroom
Food Service	Buildings used for preparation and sale of food and beverages for consumption	Restaurant; Cafeteria; Caterer; Coffee shop; Fast food; Bar
Food Sales	Buildings used for retail or wholesale sale of food	Convenience store; Farmers' market; Grocery store; Specialty food store
Health Care	Buildings used as diagnostic and treatment facilities for inpatient or outpatient care	Inpatient facilities (hospital, rehabilitation facility); Outpatient facilities (dental or medical office, medical or urgent care clinic, mental health clinic); Veterinary facilities
Laundry/Dry Cleaner	Buildings used for laundry services	Laundromat; Dry cleaner
Lodging	Buildings used to offer multiple accommodations for short-term or long-term residents	Hotel/motel/inn; Shelter/group home; Halfway house
Multi-Family Residential	Buildings with four or more residential floors and five or more dwelling units	Apartment buildings; Condominium buildings
Nursing Home	Buildings used as facilities that offer 24-hour nursing/medical care	Skilled nursing; Assisted living
Office	Buildings used for general office space, professional offices, and administrative offices	Administration; Banking; Government; Insurance; Law; Real estate; Sales or leasing
Other Service	Buildings that offer services not included in any other category	Animal shelter; Printing center; Salon/spa; Barber shop
Public Assembly	Buildings in which people gather for social or recreational activities	Entertainment (theater, art gallery, stadium); Civic (convention center, library, meeting hall); Recreational (community center, gym, recreation center)
Public Order and Safety	Buildings used for the preservation of law and order or public safety	Courthouse/probation office; Fire/police station
Religious Worship	Buildings in which people gather for religious activities	Church; Synagogue; Temple; Mosque
Retail	Buildings used for sales and display of goods	Bookstore; Clothing store; Drugstore; Department store; Furniture/appliance store

Primary building activity	Description	Examples
Vacant – Commercial	Buildings that are currently vacant or being vacated but were previously used for or intended to be used for commercial purposes	
Warehouse	Buildings used to store goods, manufactured products, merchandise, or raw materials	Refrigerated or nonrefrigerated warehouse or storage; Self-storage; Distribution center
Other	Buildings not included in any other type	Airplane hangar; Data center

As in 2019, buildings on military bases, correctional facilities, psychiatric hospitals, and other buildings with extremely high security were considered ineligible and not included in the 2025 CBSA, at NEEA's request, due primarily to accessibility concerns.

2.7 Recruiting Methods

Recruitment for the 2025 CBSA was largely conducted in person, supported by remote efforts. This differed substantially from the methods used in the 2019 CBSA, where most buildings were recruited via a call center and hard copy mail. Recruitment for the 2025 CBSA initially attempted an all-remote approach but struggled to adequately connect with potential respondents by phone and mailed invitations. After modifying study protocols to employ in-person recruiting, the number of completed buildings increased substantially. The success of in-person visits helped to maximize response rates and reduce nonresponse bias. For additional details on the 2025 recruitment approach, see Section C.5.

2.8 Data Collection Instruments

All data were collected electronically for the 2025 CBSA, as was the case for the 2019 CBSA. However, instead of the single site visit survey tool used in 2019, the 2025 CBSA used two complementary data collection instruments: a web questionnaire (referred to as the "web survey"), which was self-administered by knowledgeable building personnel, and a site visit survey instrument (see Section C.4 for detailed descriptions of both data collection instruments). Together, these instruments gathered the desired building characteristic data. As in 2019, the site visit instrument was completed on site by a trained field technician on a cellphone or tablet. About 80 percent of building respondents who completed a web survey ultimately participated in a site visit (Table 3). Although the web survey was typically completed before the site visit, about 2 percent of participating buildings completed a site visit but did not complete a web survey. As a result of these different sample groups, the final data include separate weights for web survey and site visit data. For additional details on the 2025 data collection approach, see

Section C. For information on which weights to use by data element, see the CBSA 2025 User Guide.

Table 3. Percent of buildings that completed each data collection tool

Data collection tool	Number	Percent
Site visit only	16	2
Web survey only	124	18
Site visit and web survey	552	80
Total	**692**	**100**

2.9 Special Data Collection Procedures for Lodging, Hospital, and Nursing Home Buildings

Standard 2025 CBSA data collection protocols were modified for lodging, hospitals, and nursing home buildings. The employment of these procedures was informed by challenges surveying guest rooms in hotels and motels, patient rooms in hospitals, and resident rooms in nursing homes during the 2019 CBSA, where site contacts frequently refused to allow field technicians access to such spaces due to occupant security and privacy concerns. For these building types, field technicians collected data on central systems, common spaces, and non-repeated room space. Specific data collection activities varied by building type:

- **Lodging Buildings:** Field technicians inspected one guest room of each type within the building. Sampled hotels typically had at least two guest room types (a standard and suite style room); some had up to seven guest room types identified. Data were recorded for each unique room type and multiplied by the number of rooms of each type.
- **Hospital Buildings:** Field technicians did not inspect patient rooms, regardless of occupancy, due to concerns about patient privacy.
- **Nursing Home Buildings:** Field technicians did not inspect resident rooms, regardless of occupancy, because they were considered residential spaces, consistent with data collection protocols for Multi-Family Residential buildings.

Given these data collection differences, there may be changes in energy use for Health Care and Nursing Homes building categories between 2019 and 2025, particularly for lighting, which are explained by procedural rather than substantive changes. Based on 2019 CBSA final documentation, some buildings refused to allow inclusion of all spaces within a building, leading to data collection based on respondent choice. Although such refusals in 2019 may have resulted in less representative data, there were some buildings where participants agreed and data were collected. In 2025, guest rooms, patient rooms, and resident rooms were systematically excluded from data collection to ensure that data were collected using standard protocols across all lodging, hospital, and nursing home buildings. Beyond building-level refusals for these building types, there is not sufficient available documentation of the 2019 CBSA data collection procedures to provide direct comparisons.

2.10 Data Elements

The 2025 CBSA collected many of the same data elements as the 2019 CBSA, including electric and natural gas use; heating, ventilation, and air conditioning (HVAC) system details; and lighting and water heating frequency and type. Although many of the data elements in 2025 were comparable with 2019, some fields had different collection requirements. For example, the HVAC Systems section of the site visit was restructured in 2025 to facilitate efficient data collection. Although generally the same information was collected in both cycles, some data fields no longer had one-to-one matches between the two, and some response options differed. Also, some additional questions about pumping systems were added in 2025, and to increase data collection efficiency, some questions that had been asked for all pumps in 2019 were only asked for a targeted subset of pumps in 2025.

The 2025 CBSA also collected data related to building and window characteristics, ENERGY STAR® certification, and energy storage and microgrids.

Data collection protocols differed between 2019 and 2025 for equipment that could not be directly observed and for which the on-site respondent could not provide information. In 2019, the guidance given to field technicians was to estimate or use their best judgment to fill in gaps in data elements. In 2025, most data elements had an option for “could not assess” that was to be used in these situations. As a result of these differing protocols, the 2025 data have a higher rate of missing values than the 2019 data, but they also have a higher rate of precision and accuracy in nonmissing data fields.

B. Key Findings

This section highlights broad takeaways from the 2025 CBSA and, where possible, makes comparisons with the 2019 CBSA to highlight trends in commercial and multi-family residential building stock characteristics, energy use intensities, heating, cooling, and water heating systems, and lighting. Given the robust sampling frame, the probability sample design, rigorous recruitment protocols, and survey research best practices for creating final weights, the 2025 CBSA provides an accurate representation of the commercial building stock in the Northwest region of the United States. Throughout the report, we also include adjusted results, which provide 2025 estimates after removing building use types included in the 2025 CBSA but not in the 2019 CBSA (see Section A.2.5 for additional details). While this may not adjust for every possible difference between the 2019 and 2025 data collection efforts, it may facilitate comparisons over time. All tables and figures are weighted to make appropriate inferences about the commercial and multi-family residential building population for the given year, with the exception of the distribution of participating buildings among key variables of interest.

1. Building Stock Characteristics

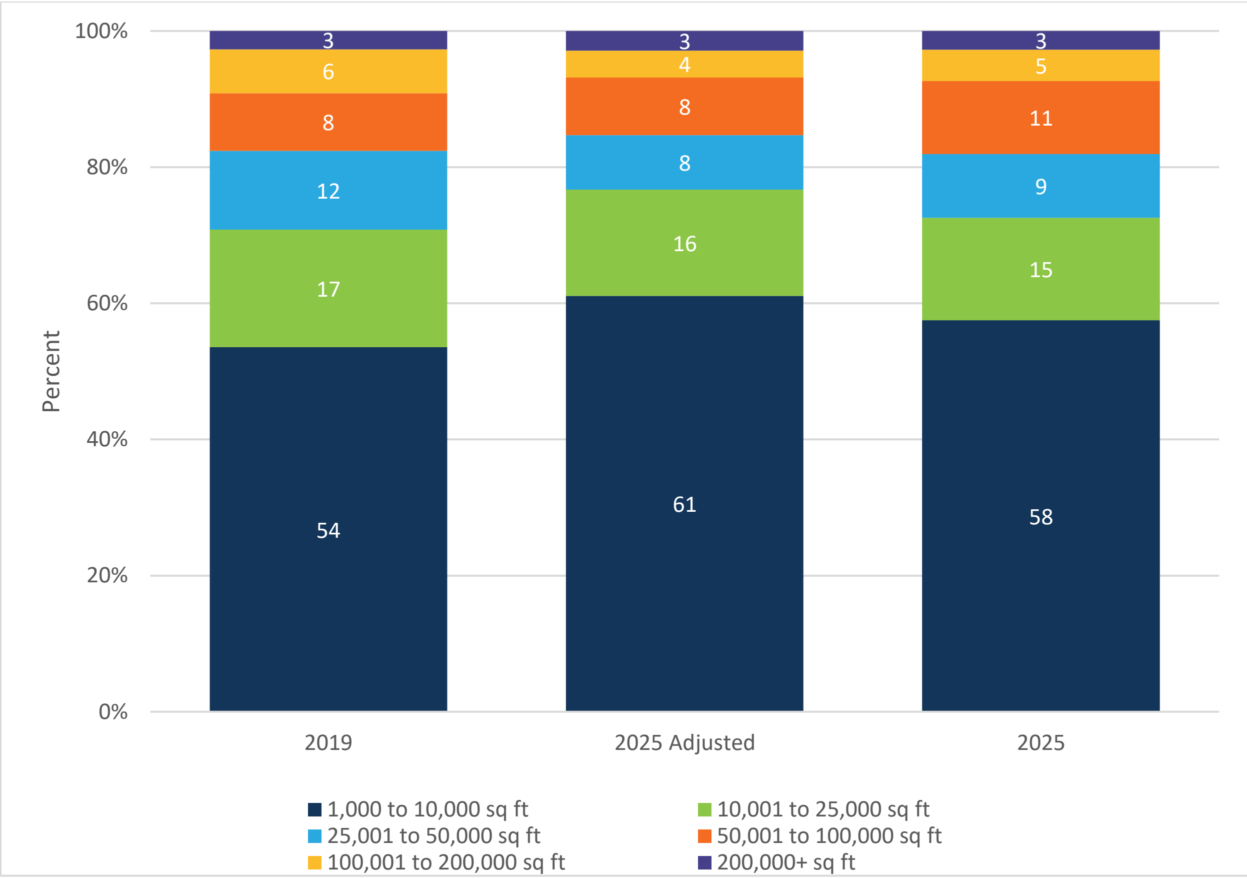
1.1 Participating Buildings

In this section, the sample of participating buildings is described using unweighted sample percentages within characteristics of interest: building size, primary building activity, state, and age of building. For each of these characteristics, figures and text demonstrate the percentage of participating buildings from the 2019, 2025 adjusted, and 2025 samples that are included in different categories.

1.1.1 Building Size

Figure 2 highlights the unweighted proportion of participating buildings by building size and shows that the 2025 sample had a relatively similar distribution of buildings within building size categories as the 2019 sample, with more than half of the buildings falling into the smallest size category (1,000 to 10,000 sq ft), and only 3 percent of participating buildings being more than 200,000 sq ft.

Figure 2. Percentage of participating buildings by size, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=627; 2025 n=692. Unweighted sample percentages.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

1.1.2 Primary Building Activity

In line with the sampling methodology described in Section C.2, participating buildings differed by their primary activity. In 2025, the Warehouse, Office, and Education buildings represented the largest proportions of participating buildings (21%, 16%, and 10%, respectively), while Other Service, Food Service, Lodging, Health Care, Food Sales, Nursing Homes, and Vacant – Commercial buildings each accounted for 4 percent or less of participating buildings, as highlighted in Table 4, which displays the most prevalent primary building activities in 2025 first. The table also shows the change in proportion of each primary activity between 2019 and 2025. Differences in sampling and eligibility criteria led to two new primary activities that were included in 2025 but not 2019: Multi-Family Residential and Vacant – Commercial buildings accounted for 6 percent and 1 percent of the 2025 sample, respectively. In addition to new primary building activities, specific eligibility criteria for some primary building activities were modified in 2025, which may impact differences between the 2025 and 2019 samples. See Section A.2 for more information on these changes.

Table 4. Percentage of participating buildings by primary activity, 2019 and 2025

Primary building activity	2019	2025 adjusted	2025	2025 to 2019 difference
Warehouse	12.8%	23.3%	21.4%	+8.6
Office	12.7%	17.5%	15.9%	+3.2
Education	7.8%	10.0%	9.8%	+2.0
Retail	11.5%	9.3%	8.5%	-3.0
Automotive	2.9%	8.5%	7.7%	+4.8
Public Assembly	6.9%	7.7%	7.2%	+0.4
Multi-Family Residential	0.0%	0.0%	6.1%	+6.1
Religious Worship	2.7%	5.9%	5.3%	+2.7
Other Service	1.8%	4.6%	4.2%	+2.4
Food Service	6.1%	4.3%	4.0%	-2.1
Lodging	9.1%	4.1%	3.8%	-5.4
Health Care	11.4%	1.8%	1.7%	-9.6
Food Sales	6.8%	1.9%	1.7%	-5.0
Nursing Home	4.8%	1.1%	1.3%	-3.5
Vacant – Commercial	0.0%	0.0%	1.3%	+1.3
Unknown	2.8%	0.0%	0.0%	-2.8

Note. 2019 n=932; 2025 Adjusted n=627; 2025 n=692. Unweighted sample percentages.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

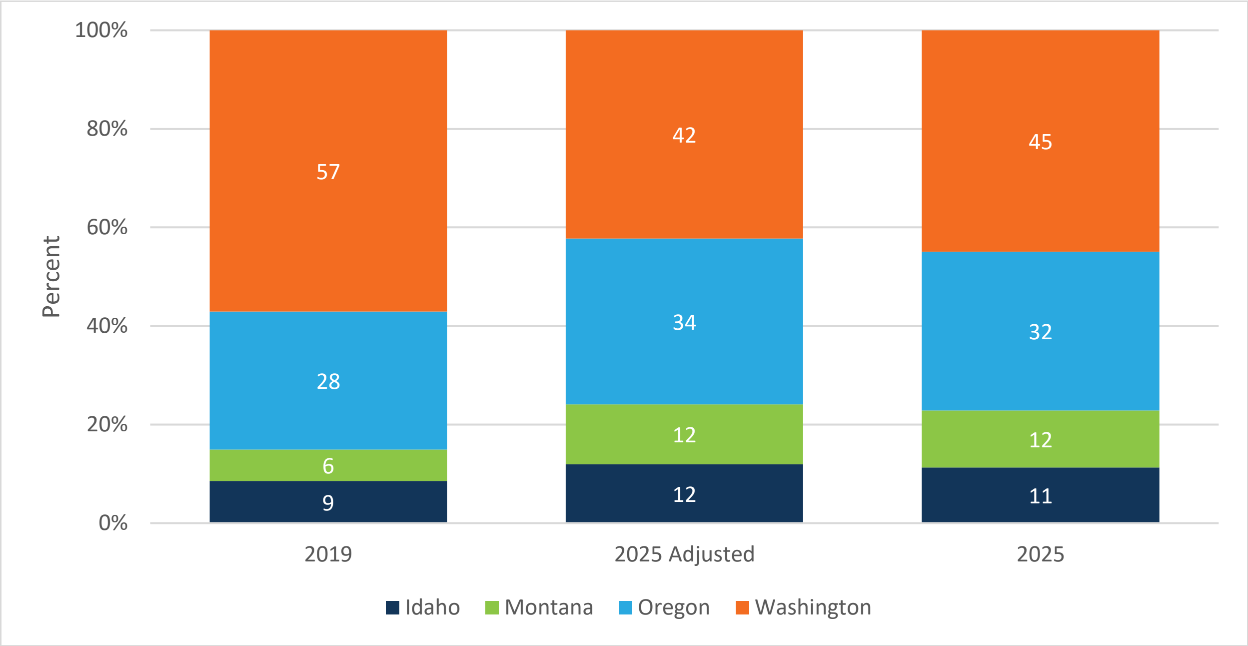
Of the primary building activities included in 2025, some do not have at least eight degrees of freedom for analysis by primary building activity.[5] Although these types are always included in totals and are included in the analyses for their other relevant characteristics (e.g., state, climate zone), they are not presented separately for analysis by primary building activity. The activities that are not presented in subsequent charts are Food Sales, Food Service, Health Care, Nursing Home, Other Service, Vacant – Commercial, and Unknown.

[5] Subgroups with fewer than eight degrees of freedom generally have insufficient sample sizes that generally result in very wide confidence intervals that make it difficult to estimate with any precision what the value in the population may be. Note that statistical software packages like R and Python compute and provide the appropriate degrees of freedom for each subgroup analysis.

1.1.3 State

The 2025 sample had a higher proportion of participating buildings from Idaho, Oregon, and Montana compared with the 2019 sample, balanced by a lower proportion of buildings located in Washington (Figure 3).

Figure 3. Percentage of participating buildings by state, 2019 and 2025



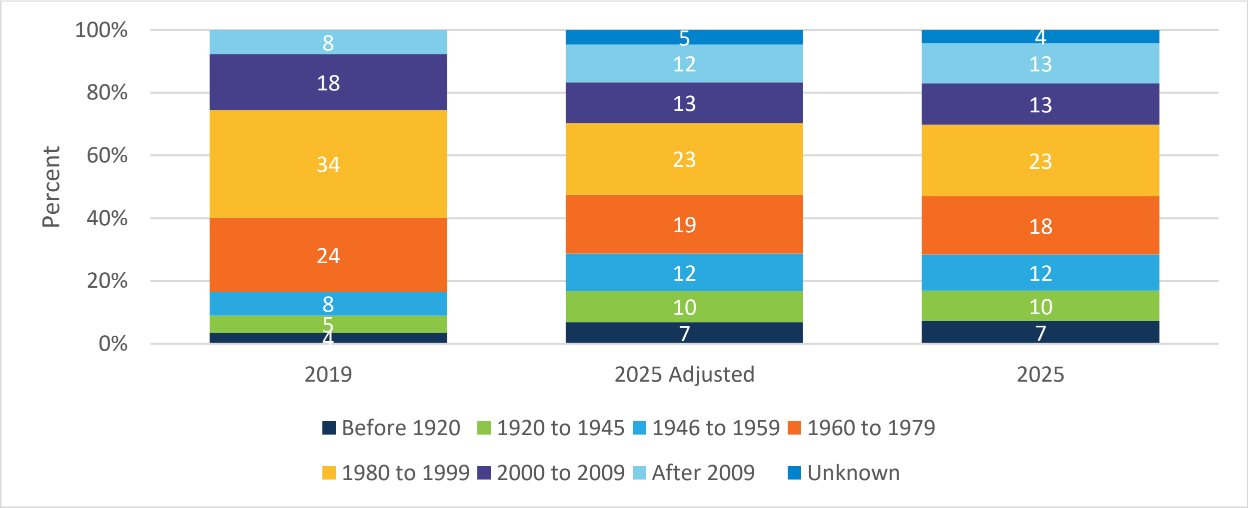
Note. 2019 n=932; 2025 Adjusted n=627; 2025 n=692. Unweighted sample percentages.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

1.1.4 Building Age

Unsurprisingly, the proportion of participating buildings that were built after 2009 (the newest buildings) was higher in 2025 (13%) than in 2019 (8%) (Figure 4). The 2025 sample also had a higher proportion of the oldest buildings (built before 1960) than the 2019 sample. The proportion of buildings built between 1960 and 2009 was smaller in 2025 than in 2019. In 2025, respondents did not provide the building age for 4 percent of participating buildings, while building age was recorded for all cases in 2019, but this is a small proportion relative to other categories.

Figure 4. Percentage of participating buildings by age of building, 2019 and 2025



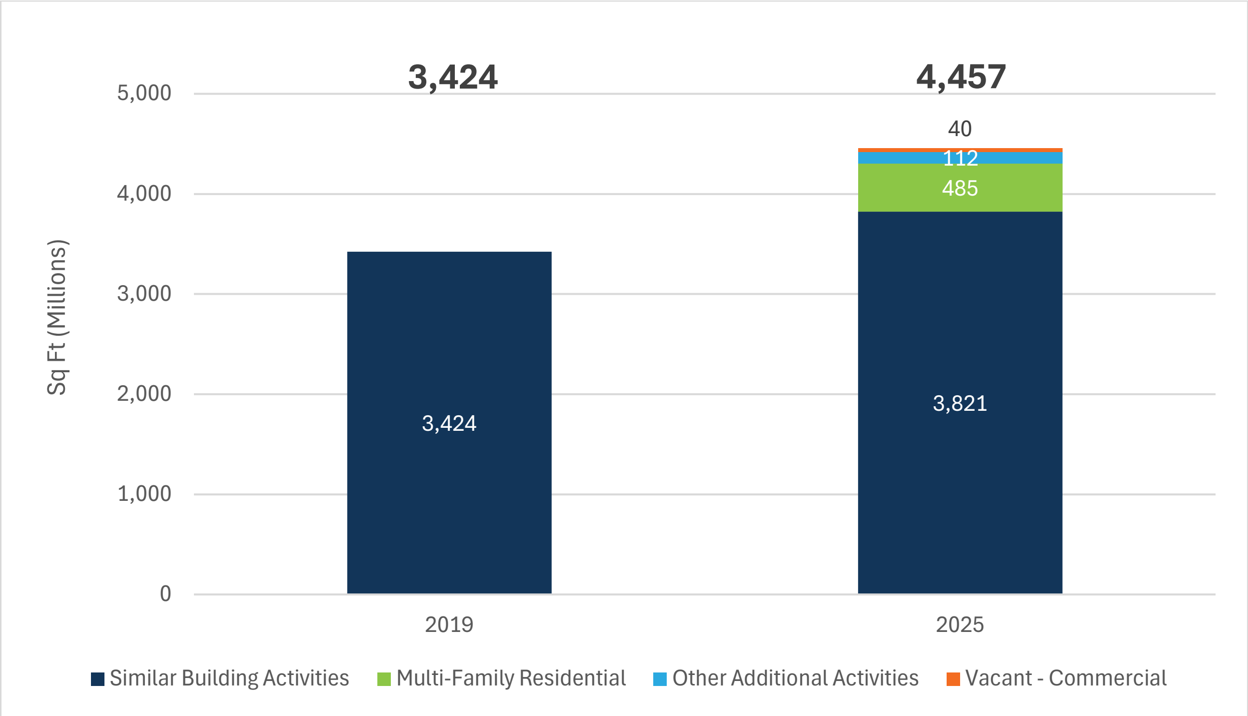
Note. 2019 n=932; 2025 Adjusted n=627; 2025 n=692. Unweighted sample percentages.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

1.2 Floor Space

This section presents weighted population estimates of building square footage by selected characteristics. The 2025 CBSA population estimate of total building square footage in the region is substantially larger than the 2019 CBSA estimate. However, the 2025 estimate is affected by the changes in eligibility requirements, with much of the increase coming from the addition of Multi-Family Residential buildings. When comparing estimates only from the 2025 buildings that would also be eligible in 2019 (i.e., the adjusted 2025 estimate), the increase in square footage from 2019 to 2025 is within the 90 percent confidence interval, suggesting these estimates may not be statistically significant in their difference (see Appendix 1 tables). Figure 5 shows the comparable buildings as the base of the estimate, with the additional categories unique to 2025 stacked above that.

Figure 5. Total commercial floor space, 2019 and 2025



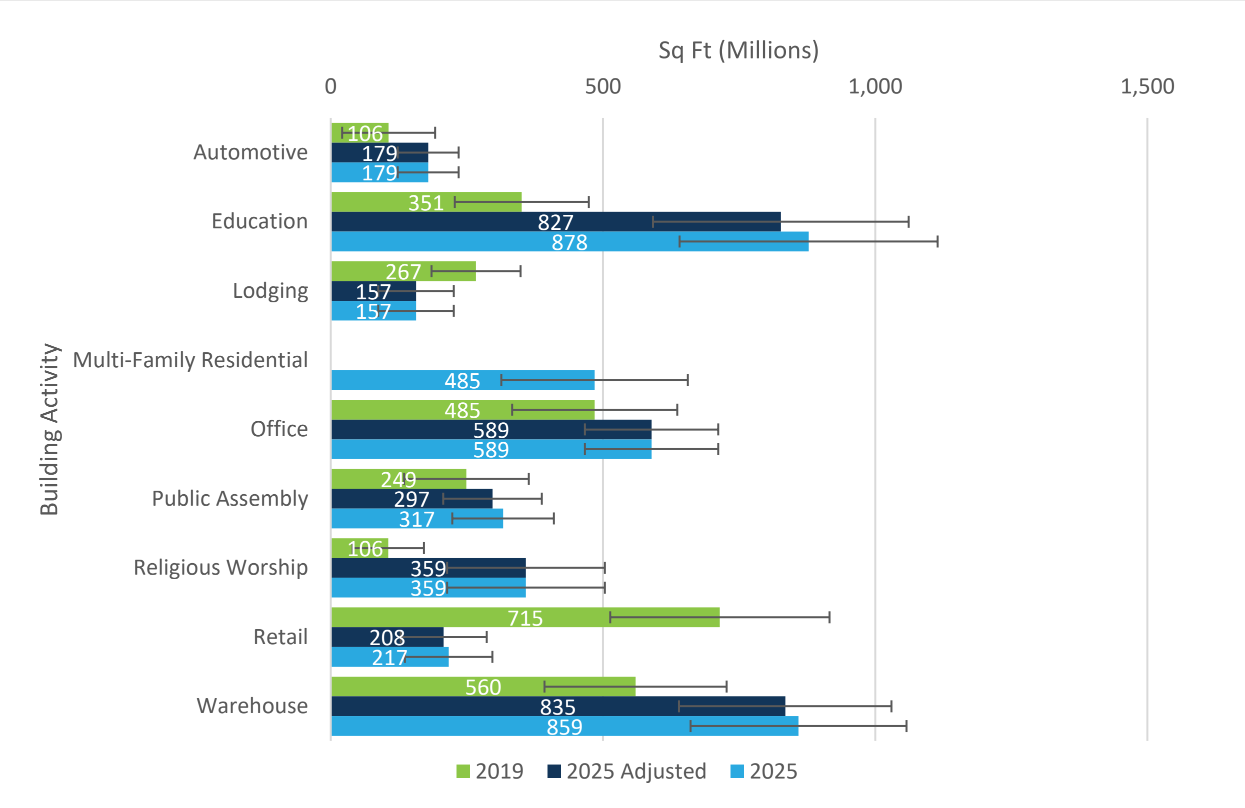
Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates. "Other Additional Activities" include universities and colleges, nursing homes under 10,000 sq ft, and public use buildings such as courthouses and stadiums.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

In 2025, buildings with primary activities of Education, Warehouse, Office, and Multi-Family Residential are the largest contributors to the estimated total floor space of the population of commercial buildings (Figure 6). Compared with 2019, the 2025 estimates reflect an increase in the estimated floor space of buildings used for Education and Religious Worship, and a decrease in the floor space of buildings used for Retail. Although the inclusion criteria for Education buildings was expanded in 2025, the adjusted 2025 estimate reflecting a closer comparison with 2019 criteria also showed an increase in the floor space used for Education, so the criteria change does not appear to be the only factor in this increase.

Confidence intervals provide a sense of how precise each estimate is. They are represented in figures as error bars or brackets on each bar in a figure. Wider bars indicate less precise estimates, and narrower bars indicate more precise estimates. When comparing groups, nonoverlapping confidence intervals generally indicate a statistically significant difference between the estimates; overlapping intervals do not necessarily mean there is no difference, but they suggest the evidence is less clear. All confidence intervals included in this report show 90 percent confidence intervals (standard error*1.645). Where error bars are not included, the appendix tables provide standard errors, which can be used to determine confidence intervals.

Figure 6. Total commercial floor space by primary building activity, 2019 and 2025

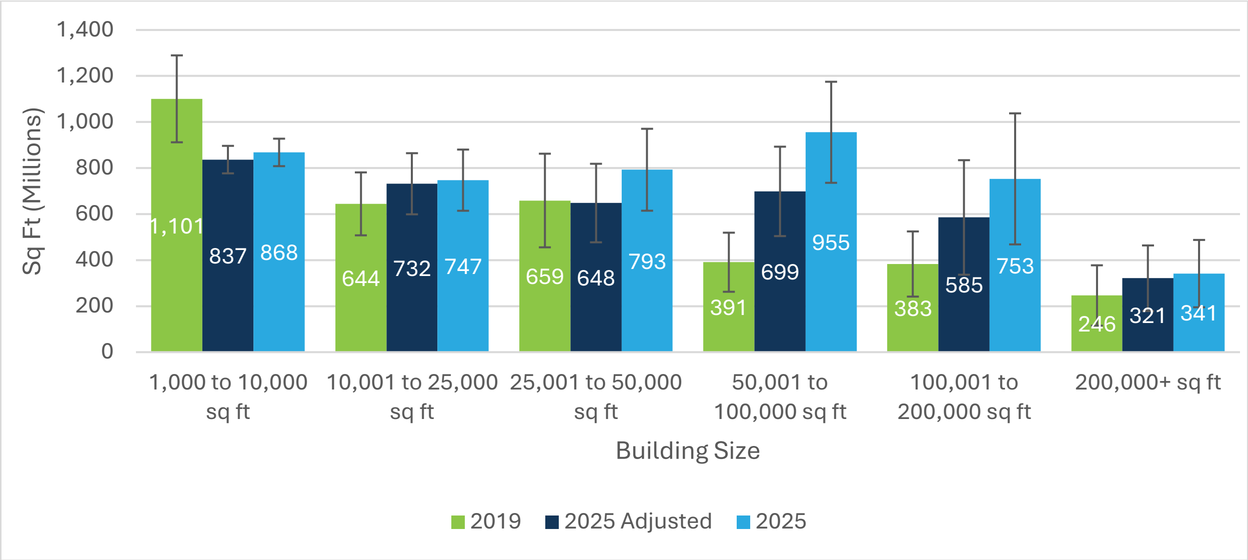


Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates.

Sources. Commercial Building Stock Assessment 4 (2019) Data Files, 2020; Commercial Building Stock Assessment 5 (2025) Data Files, 2026 (Web Survey).

The largest buildings (200,000+ sq ft) contributed less to the overall floor space in use in 2025 compared with buildings of other sizes (Figure 7) because there were fewer of the largest buildings in the commercial building stock. The other building sizes contributed relatively similarly to the overall total floor space. Compared with 2019, there was a decrease in the floor space of the smallest buildings in the 2025 adjusted sample and an increase in the floor space of buildings that were 50,001 to 100,000 sq ft in the full 2025 sample. For all other building size categories, there was no statistically significant difference between 2019 and 2025 (full or adjusted) because their error bounds overlapped.

Figure 7. Total commercial floor space by building size, 2019 and 2025

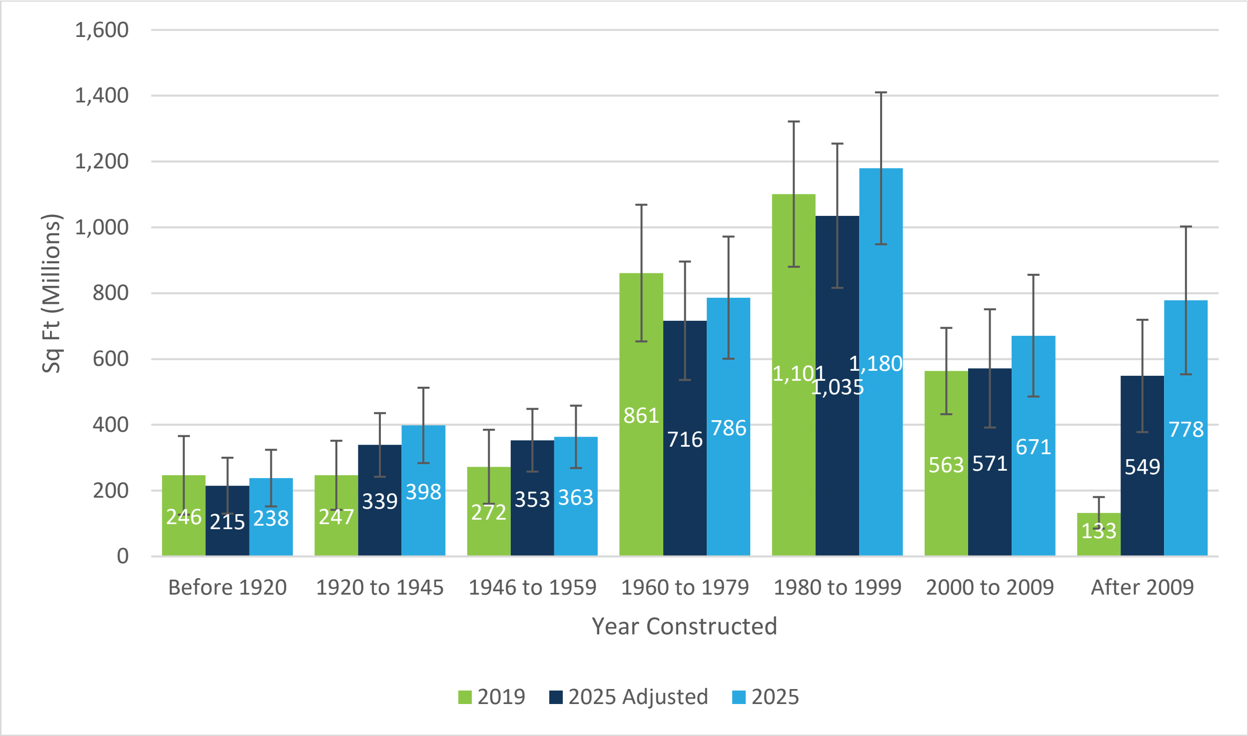


Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Buildings constructed after 1959 represent most of the square footage estimated by the 2025 CBSA (Figure 8). Compared with the 2019 sample, both the full and adjusted 2025 sample included more floor space from buildings constructed after 2009, but estimates from other vintage ranges were similar in 2019 and 2025.

Figure 8. Total commercial floor space by building vintage, 2019 and 2025

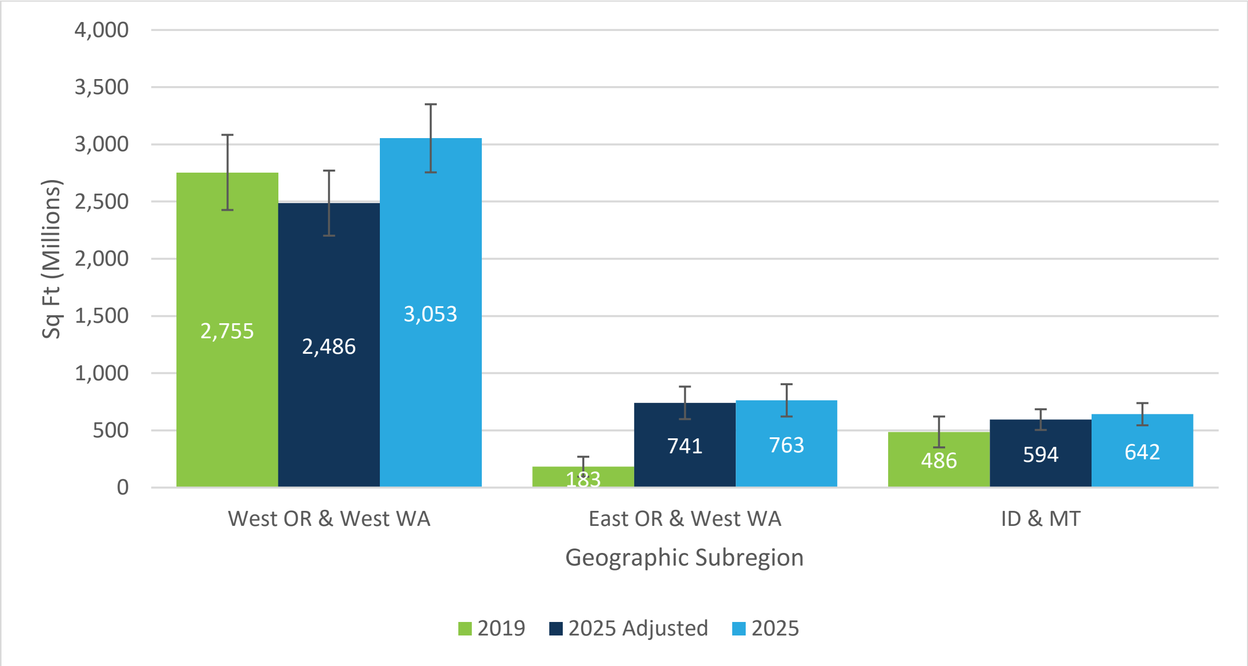


Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

The majority of building floor space was in West Oregon and West Washington, which includes Seattle and Portland (Figure 9). Idaho, Montana, East Oregon, and East Washington accounted for approximately one-third of the floor space, compared with West Oregon and West Washington which contain approximately two thirds of the floor space. There was an increase in floor space in East Oregon and East Washington between 2019 and 2025.

Figure 9. Total commercial floor space by geographic subregion, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files, (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

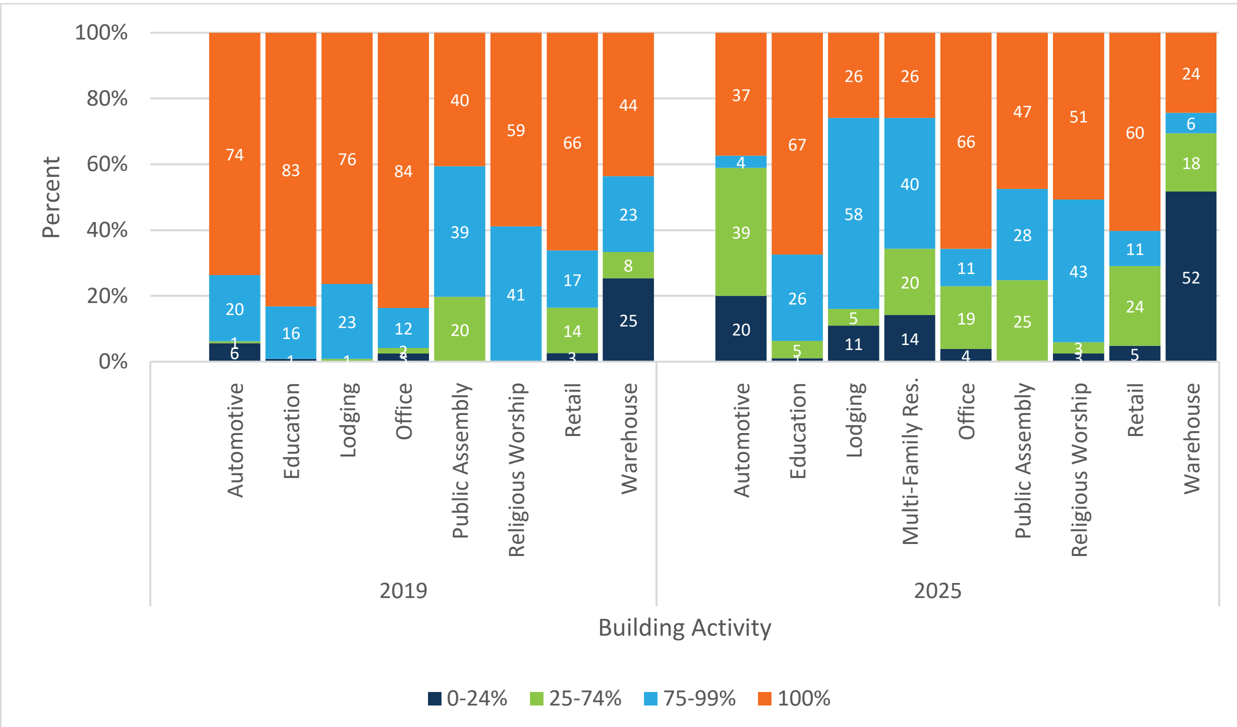
1.2.1 Conditioned (Heated or Cooled) Floor Area

In addition to the amount of overall floor space, the amount of conditioned space (either heated or cooled) affects a building's energy use. In Figure 10, each building has been categorized by how much of its space is conditioned (0–24%, 25–74%, 75–99%, or 100%). These categories reflect the response options available in the 2025 web survey, with response options 25–49 percent and 50–74 percent collapsed here for reporting. The respondent was first asked for a specific value of the square feet of conditioned floor area; if they did not answer this question, they were asked a follow-up question with the percent ranges noted above. Due to the level of missing data in the specific value, these responses were categorized and combined with the categorical responses for analysis.

Figure 10 shows the weighted percentage of buildings, by primary building activity, in each percentage of conditioning category. In 2025, Warehouses had the most buildings where only 0–24 percent of the space was conditioned (52%), while buildings used for either Education or Religious Worship were almost all at least 75 percent conditioned. Within each primary building activity displayed, the reported percentage of conditioned space was lower in 2025 than in

2019, which may in part reflect differences in how the data were collected; the conditioned space was self-reported by the web survey respondent in 2025, while in 2019 it was documented by the field technician.

Figure 10. Percentage of conditioned space by primary building activity, 2019 and 2025



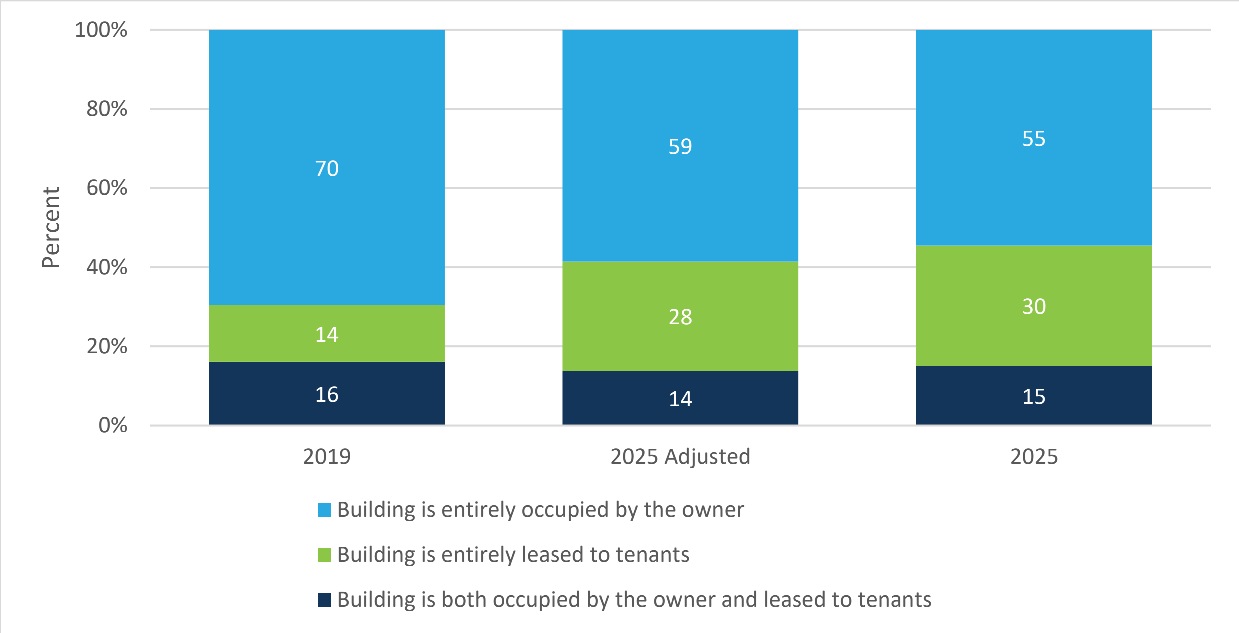
Note. 2019 n=932; 2025 n=676. Weighted population estimates. 2025 Adjusted is excluded for figure clarity but is similar to 2025.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

1.2.2 Building Ownership and Occupancy by Floor Space

Across all floor space with determined occupancy status in 2025, 55 percent was in buildings entirely occupied by the owner, 30 percent was in buildings entirely leased by tenants, and 15 percent was in buildings both occupied by the owner and leased by tenants (Figure 11). Occupancy status was collected via self-report in the web survey, and respondents for 15 percent of buildings did not provide occupancy type status and are not included in these proportions. In 2019 and 2025, the floor space in buildings that were both owner and tenant occupied was similar, whereas in 2025 there was a decrease compared with 2019 in the percentage of floor space in buildings entirely occupied by the owner (70% to 55%) and more floor space in buildings entirely leased to tenants (14% to 30%).

Figure 11. Percentage of floor space by building occupancy status, 2019 and 2025

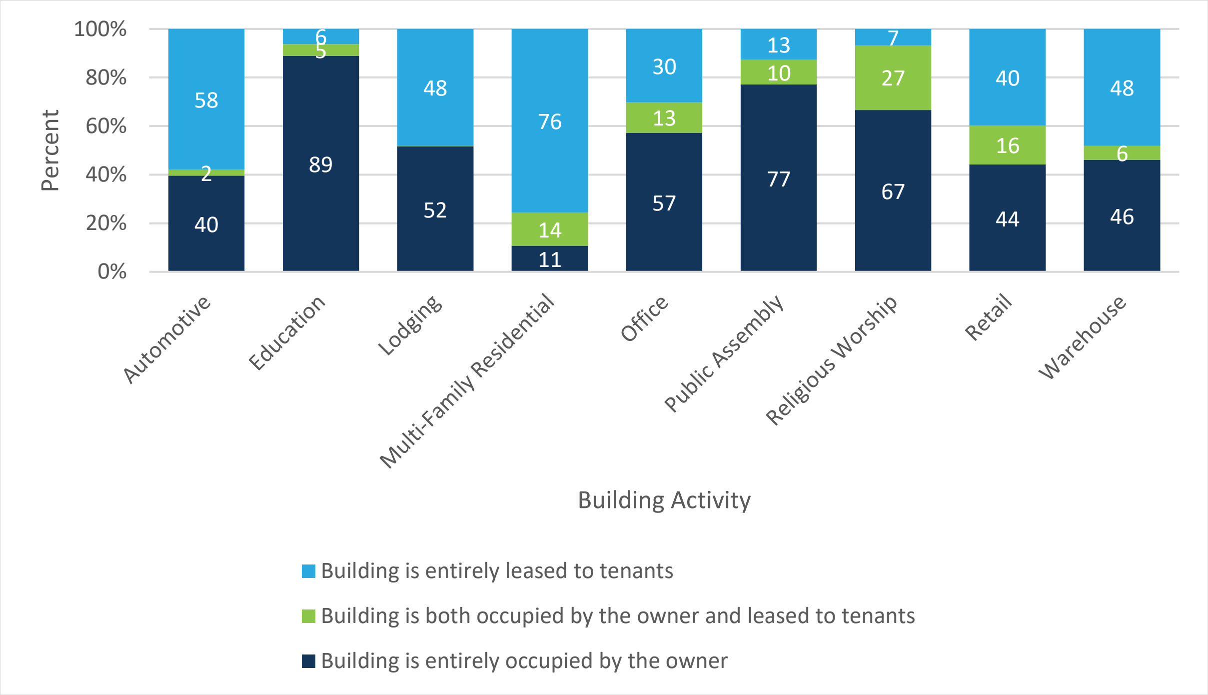


Note. 2019 n=932; 2025 Adjusted n=611; 2025 n=676. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

In 2025, the proportion of floor space entirely leased to tenants varied substantially by primary building activity (Figure 12). Although more than half of Multi-Family Residential buildings (76%) and Automotive buildings (58%) were fully occupied by tenants, buildings used for Education (6%), Religious Worship (7%), and Public Assembly (13%) had much smaller proportions of buildings leased entirely to tenants. Across all primary activities, having either no tenants or 100 percent tenants was most common, with fewer buildings reporting a mix.

Figure 12. Percentage of tenants by primary building activity, 2025



Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

1.2.3 Electric Utility Ownership by Floor Space

Electric utilities can be either publicly or privately owned. The 2025 CBSA found that public and private utilities each supplied energy to half of the total floor space of buildings, while the 2019 CBSA found that private electric utilities covered 63 percent of the total floor space of buildings and public utilities covered only 37 percent.

2. *Energy Use Intensity (EUI)*

EUI is a measure of how much energy a building uses per square foot of floor space over a given period of time (calculated by dividing the total energy usage by the total floor space of the building). By looking at EUI, the effect of the size of the building is reduced, allowing more direct comparisons between buildings based on other characteristics, such as primary building activity.

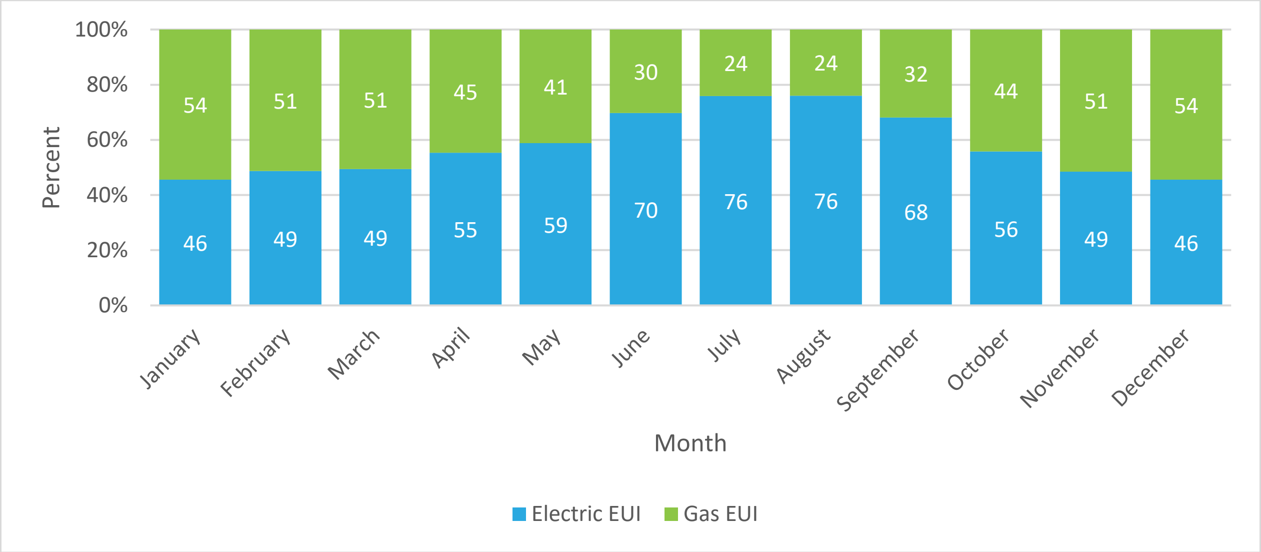
Out of the 692 total participating buildings, the 2025 CBSA collected utility data on electricity use for 475 buildings and natural gas use for 277 buildings. See Section C.7 for information on billing data collection procedures and response rates and see Section C.8.3 for details on how the data were edited and why data for some buildings could not be included in the datasets or in analysis.

2.1 Combined EUI

Many commercial buildings use a combination of electricity and natural gas. Figures 13, 14, and 15 demonstrate the expected pattern in the proportions of the total EUI for each fuel type throughout the year. The pattern is that natural gas accounted for a much larger proportion of the total EUI in the winter months than in the summer months because the primary use of natural gas in most commercial buildings is heating.

When comparing 2025 and 2019, electricity and natural gas accounted for very similar proportions of the total EUI in the winter months. There was more variation in the summer months, when natural gas generally accounted for a smaller proportion of the total EUI in 2025 compared with 2019; this may be due to proportional differences in sampled buildings by primary activity in each year. For example, in Food Service buildings, natural gas may be used extensively for kitchen equipment in addition to heating (U.S. Energy Information Administration, 2022). Food Service buildings made up a larger proportion of the sample in 2019 (6%) than in 2025 (4%).

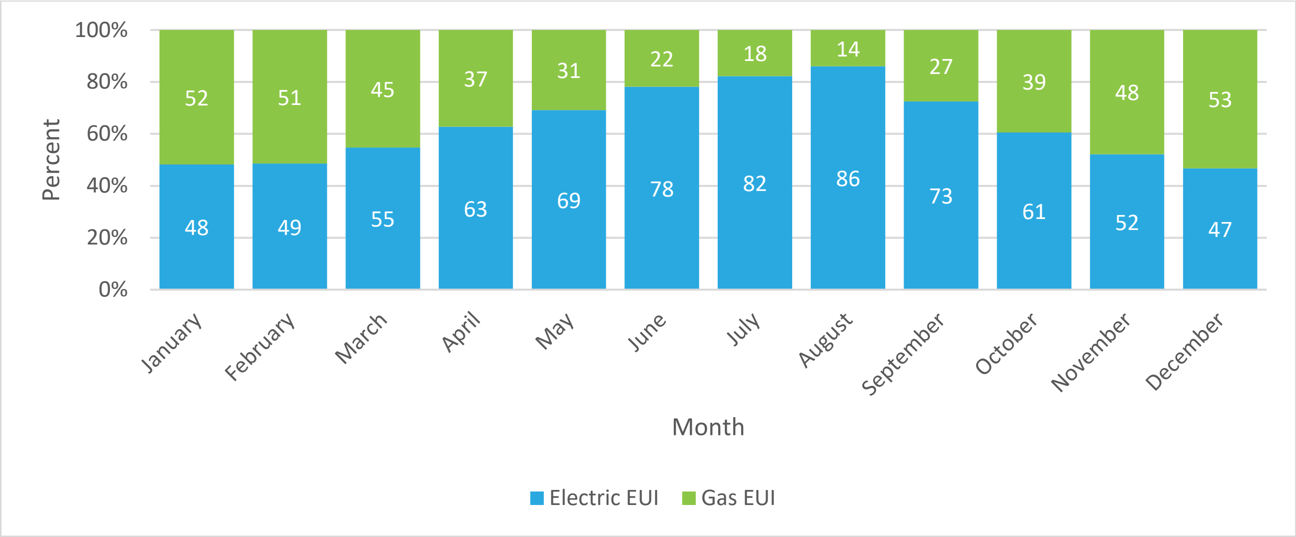
Figure 13. Percentage of total EUI by fuel type and month, 2019



Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

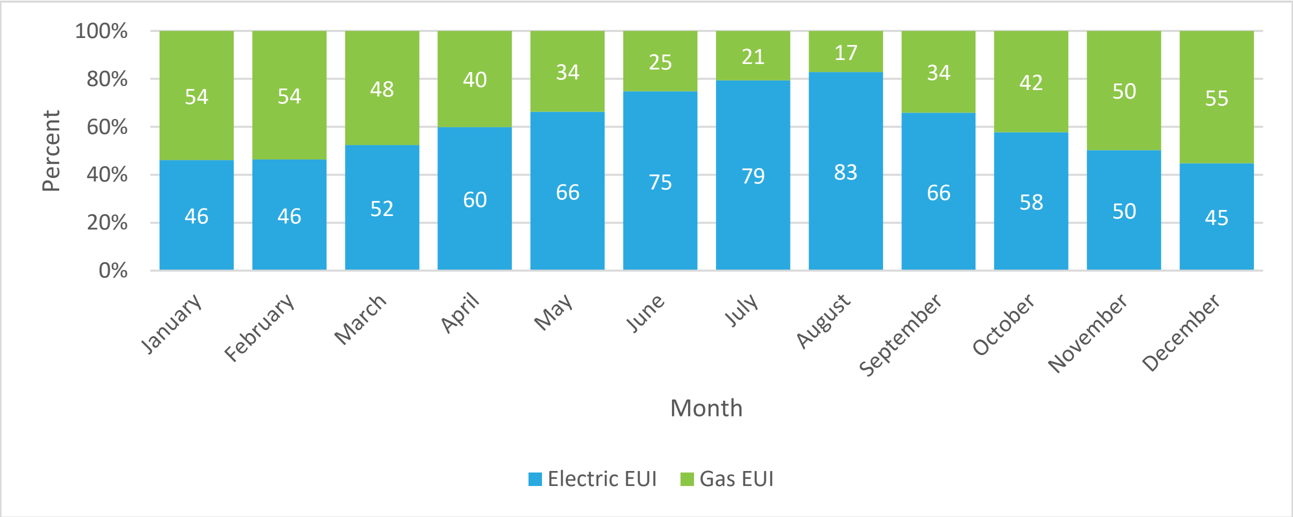
Figure 14. Percentage of total EUI by fuel type and month, 2025 adjusted



Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Figure 15. Percentage of total fuel type and month, 2025

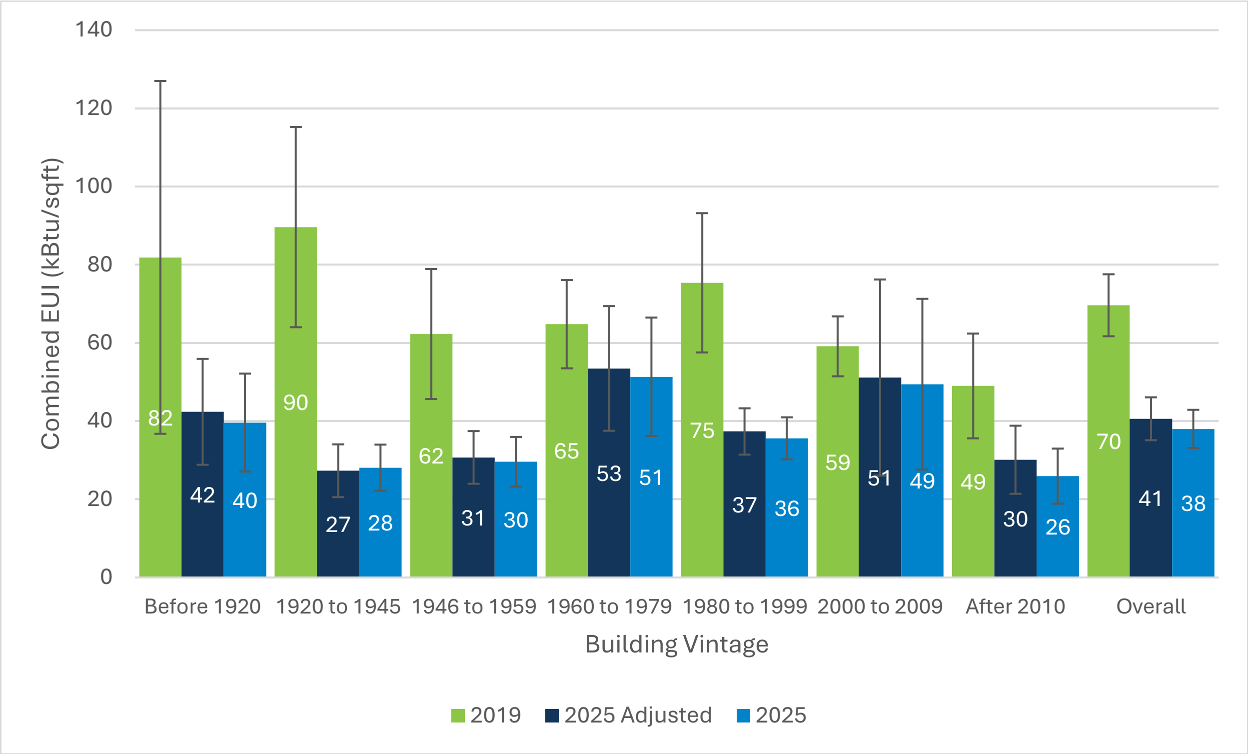


Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Looking at annual combined EUIs by building vintage, 2025 buildings that were constructed between 1920 and 1945 and between 1946 and 1959 had significantly lower average EUIs than the same vintages in 2019, as well as lower average EUIs than 2025 buildings constructed between 1960 and 1979 and between 2000 and 2009 (Figure 16).

Figure 16. Average annual combined EUI by building vintage, 2019 and 2025

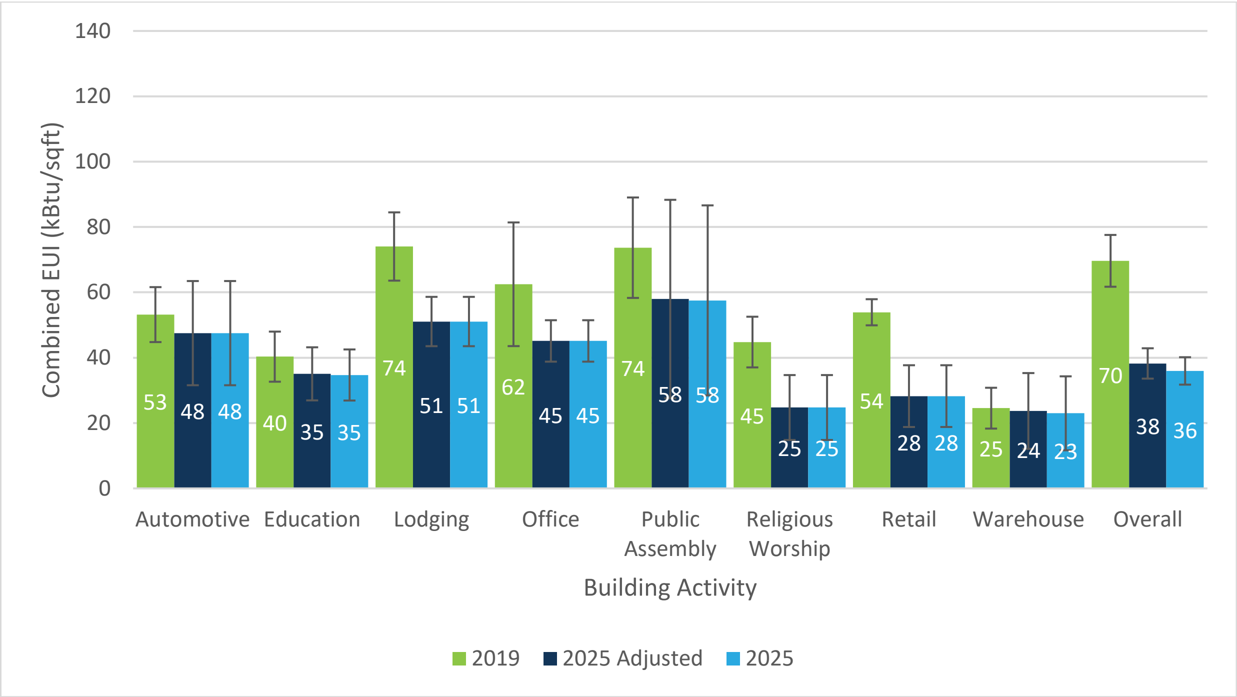


Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Among primary building activity types, buildings primarily used for Lodging, Religious Worship, and Retail show lower EUIs in 2025 than 2019 (Figure 17). Beyond this general trend, small sample sizes and variations in proportion of building activity types for both datasets complicated the reliability of any specific conclusions. These effects were magnified by the fact that billing data were not available or usable for all buildings; the resultant subset of buildings used for comparison here are therefore less representative of the region. For example, the 2025 data included billing data for 69 percent of all buildings in the study, but only 64 percent of Food Service buildings and 50 percent of Health Care buildings—two building activity types that typically have higher EUIs. In comparison, Warehouse buildings, which had the lowest EUIs in both 2019 and 2025, were underrepresented in the 2019 data, which likely resulted in a higher overall EUI for that year.

Figure 17. Average annual combined EUI by primary building activity, 2019 and 2025



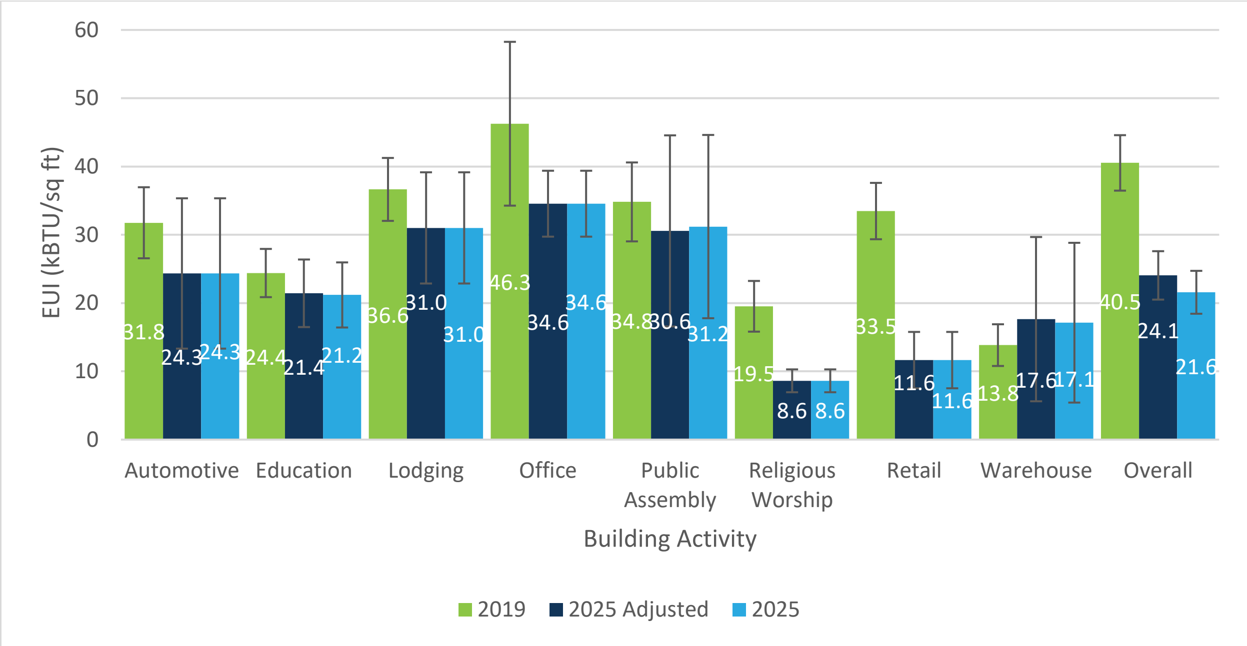
Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

2.2 Electricity EUIs

Electricity EUIs overall were 22,000 British Thermal Units per square foot (22 kBTU/sq ft) across all primary building activities, with EUIs ranging from 9 to 35 (Figure 18). Electricity EUIs for most building activity types remained relatively consistent between 2019 and 2025, but buildings in the Religious Worship and Retail categories decreased significantly from 2019 to 2025, and the overall average was also significantly lower. Again, small sample sizes and variability in the types of buildings completed in 2019 versus 2025—and for which billing data were available—make it difficult to make direct comparisons between 2025 and 2019 for specific building activity categories.

Figure 18. Average electric EUI by primary building activity, 2019 and 2025

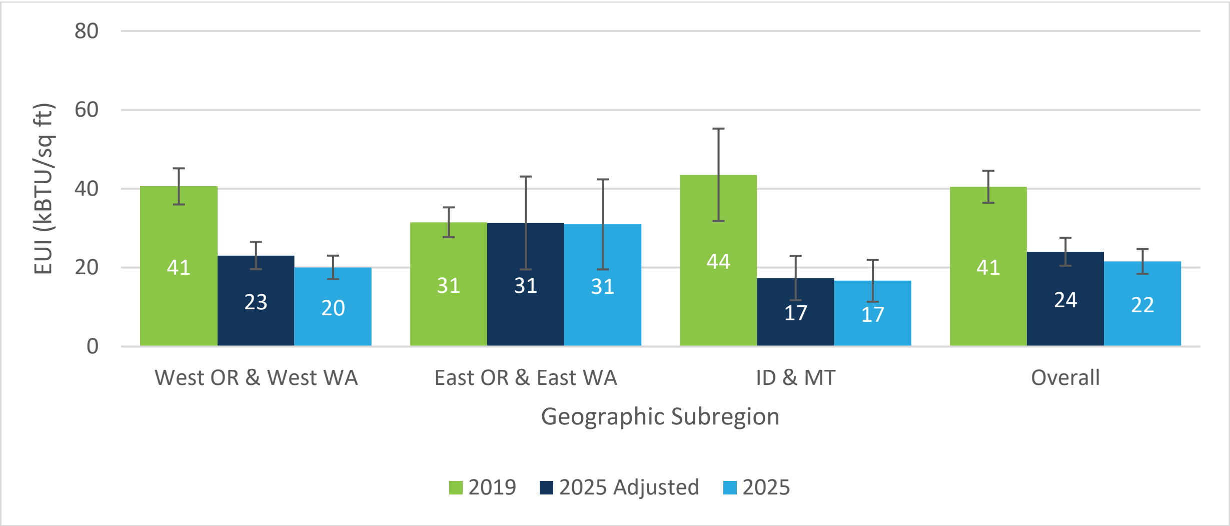


Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Although average electric EUI remained constant from 2019 to 2025 in Eastern Oregon and Eastern Washington, the electric EUI decreased in the other two geographic subregions and overall (Figure 19).

Figure 19. Average electric EUI by geographic subregion, 2019 and 2025



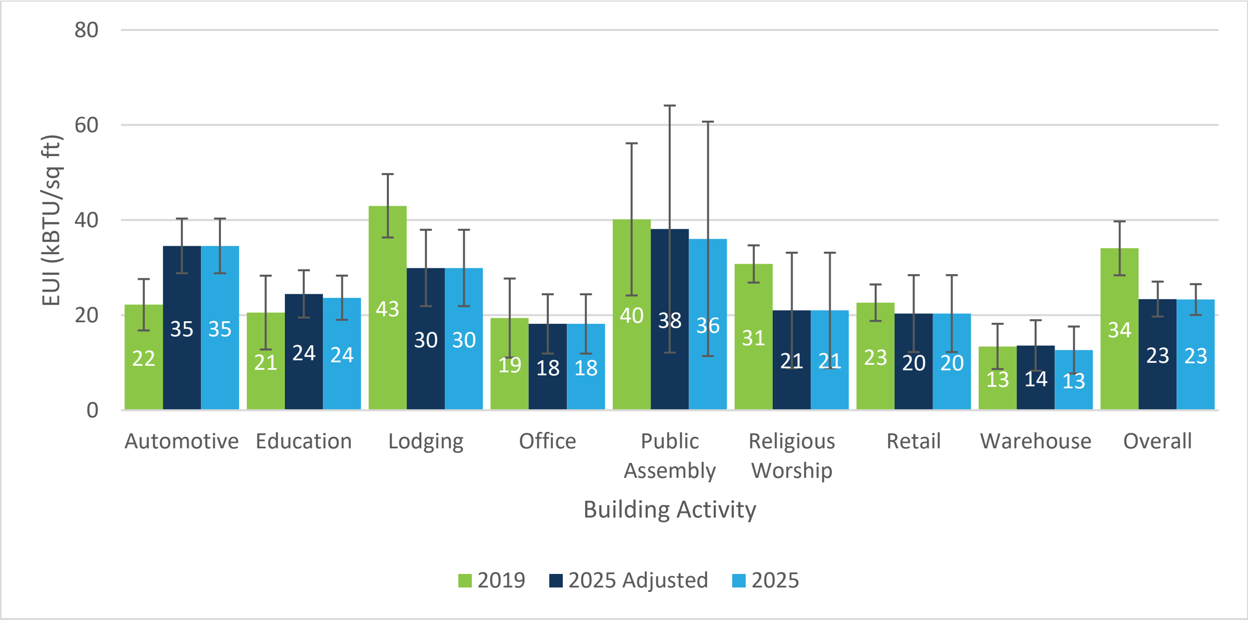
Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

2.3 Natural Gas EUI

Natural gas EUIs overall were 23 kBTU/sq ft across all primary building activities, with EUIs ranging from 13 to 36 (Figure 20). Public Assembly and Lodging buildings (36 and 30 kBTU/sq ft, respectively) had the highest natural gas EUIs of all the buildings included in the 2025 sample; Warehouse and Office buildings (13 and 18 kBTU/sq ft, respectively) had the lowest. Changes to natural gas EUIs between 2019 and 2025 were less substantial than changes to electricity EUIs.

Figure 20. Gas EUI by primary building activity, 2019 and 2025

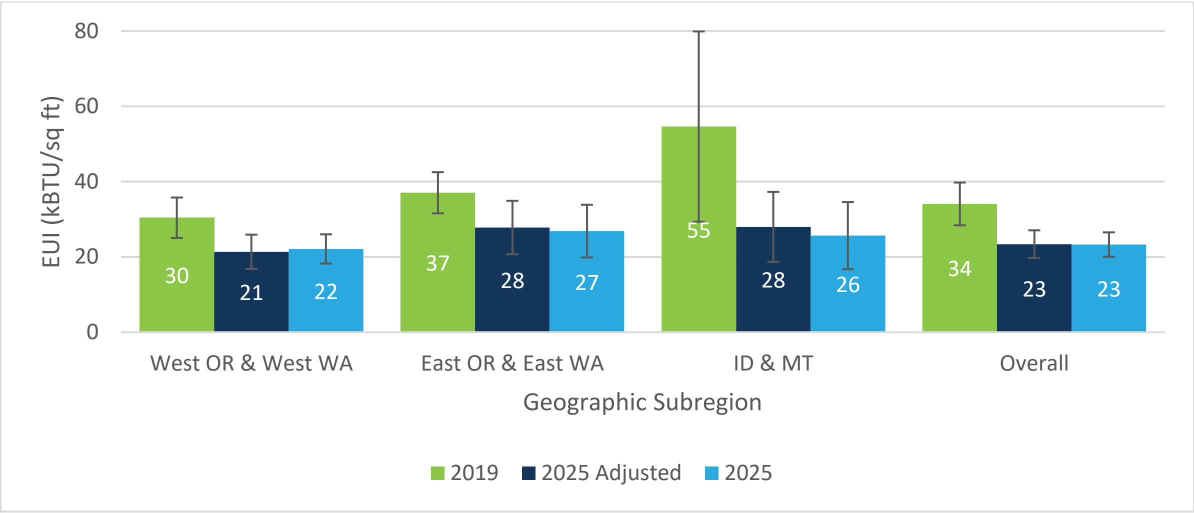


Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

The distribution of natural gas EUIs across geographic subregions (Figure 21) was more even than the distribution of electric EUIs. Heating degree days, similar to cooling degree days, measure how much space heating was needed to keep the buildings warm. In 2025, the average annual heating degree days was similar for all three geographic subregions, ranging from 22 to 27 kBTU/sq ft, corroborating the similar EUIs.

Figure 21. Average gas EUI by geographic subregion, 2019 and 2025



Note. 2019 n=749; 2025 Adjusted n=423; 2025 n=472. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

3. Heating and Cooling

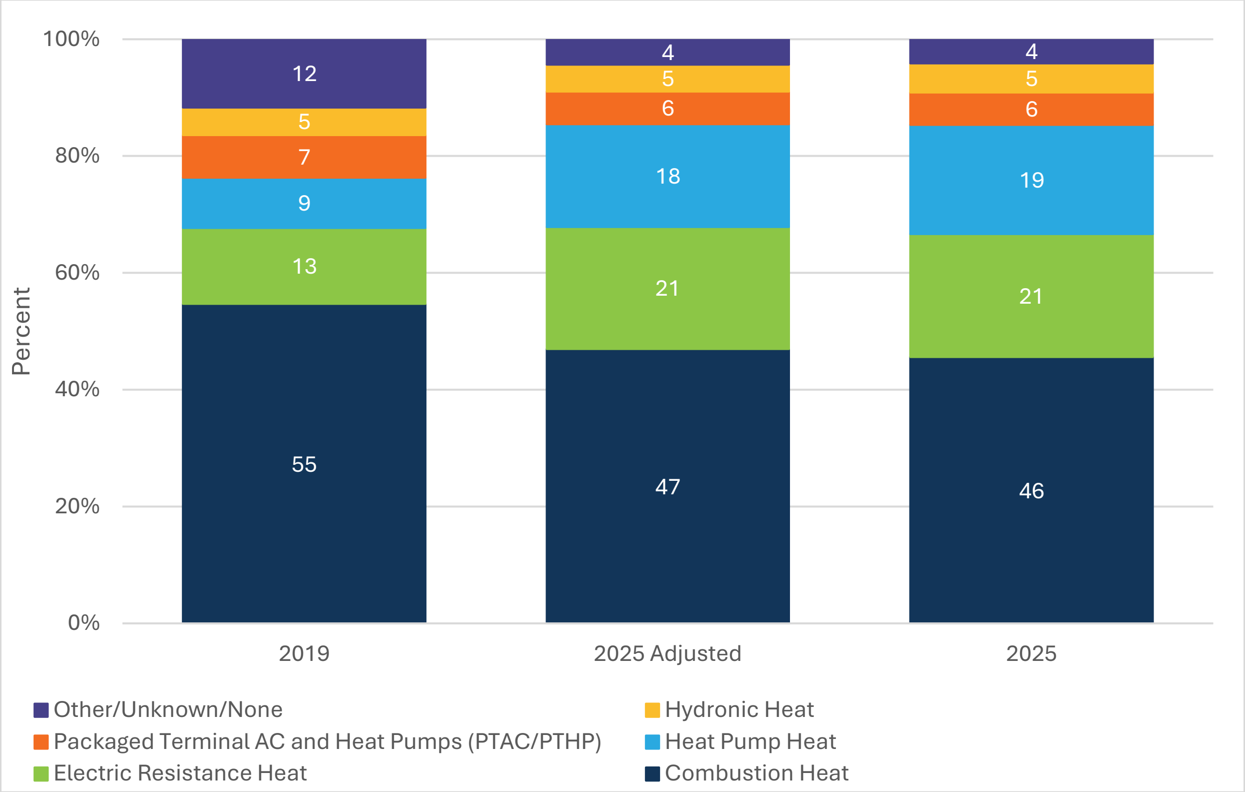
Heating and cooling systems account for a substantial portion of commercial energy use each year, but some systems use energy more efficiently than others. To understand more about the type of heating and cooling systems used in the Northwest region, the 2025 CBSA collected data on 1,968 heating and cooling systems across 565 participating buildings. Analyses of heating and cooling systems include both primary and secondary systems because some buildings may have multiple systems considered "primary." Throughout this section, we include figures illustrating both the proportion of all heating or cooling systems as well as the proportion of buildings with that type of system, indicated in both the figure note and text.

To better evaluate changes across the wide variety of heating systems in commercial buildings, we use constructed analytic HVAC system categories throughout this section. These broad system types are characterized primarily by their heating attributes, including the heat source and use of electric resistance heating, and the system design, e.g., ducted, ductless. For example, any system listed by a field technician as a furnace, dedicated outdoor air system, makeup air unit, air handling unit, or packaged rooftop unit that used some type of fossil fuel-based combustion, e.g., natural gas, propane, was categorized as "Ducted HVAC: Combustion Heat." Radiant overhead or unit heaters with similar combustion-based heat sources were categorized as “Zonal: Combustion Heat.” Appendix 2 provides more detail about how each HVAC system was categorized.

3.1 Heating Systems

Across all heating systems observed in the 2025 CBSA, combustion heating was the most common.[6] Estimates from the 2025 CBSA indicate that 46 percent of all heating systems used fossil fuel–based combustion (Figure 22). The second most common type of heating system was electric resistance heat (21%), followed by heat pump heat (19%), packaged terminal AC and heat pumps (PTAC/PTHP) (6%), and hydronic heat (5%). Four percent of all heating systems used some other type of heating.

Figure 22. Percentage of heating systems by heating system type, 2019 and 2025



Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

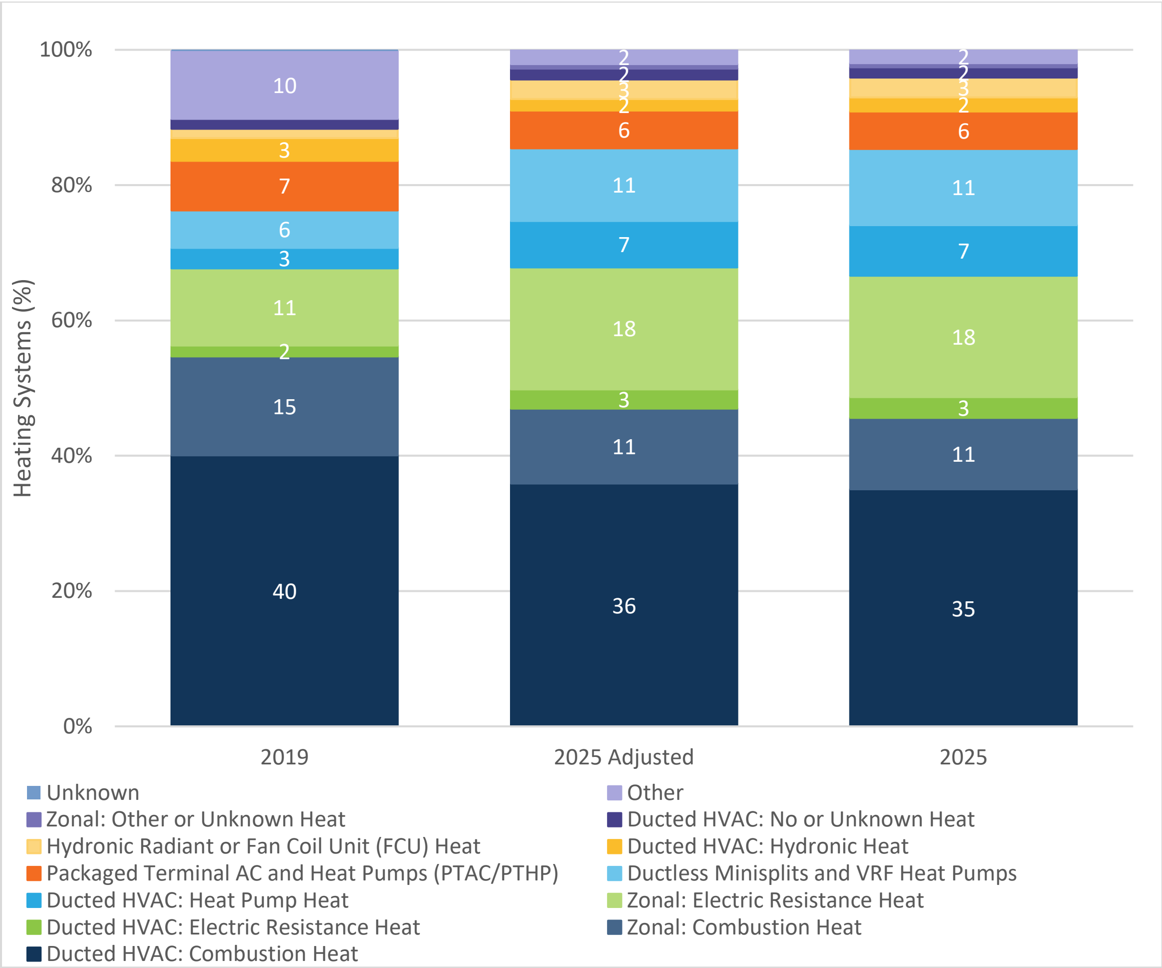
[6] Combustion heating systems included those that leverage natural gas, propane, oil, and wood.

The 2025 heating estimates were relatively comparable with the 2019 CBSA, with combustion-based systems making up the largest proportion of any heating system type. However, significantly fewer heating systems relied on combustion heating in 2025 than in 2019 (46% vs. 55%), with a larger proportion of commercial heating systems using electric resistance and heat pump heat (Figure 23). A smaller proportion of heating systems used other or unknown types of heating systems in 2025 when compared with 2019.

Within heating system types, there was some variation in the proportion of ducted, zonal, and other types of systems—35 percent of all heating systems use ducted combustion heat, while 11 percent use zonal combustion heat (Figure 23). Zonal electric resistance heating was the second most common type of commercial building heating system (18%). Just 3 percent used ducted electric resistance. Heat pump heat was split between ductless minisplits and variable refrigerant flow (VRF) heat pumps (11%) and ducted heat pumps (7%). Six percent of heating systems used packaged terminal AC/heat pumps (PTAC/PTHP), and 5 percent used hydronic heat, split between radiant or fan coil unit heat (3%) and ducted hydronic heat (2%). Four percent of all heating systems used some other type of ducted or zonal heating.

Estimates from the 2025 CBSA were relatively comparable to the 2019 CBSA, with ducted combustion heating systems making up the largest portion of any heating system type. However, fewer heating systems relied on ducted combustion heating in 2025 than in 2019 (40% vs. 35%), and larger proportions of commercial heating systems used zonal electric resistance, ductless minisplits and VRF heat pumps, and ducted heat pump heat in 2025 than in 2019 (Figure 23). The increase in zonal electric resistance may be related to the increase in Warehouse buildings in the sample, highlighted in Section A.2. Warehouses tend to use unit heaters for large open storage areas and loading zones. A smaller proportion of heating systems used zonal combustion heat and other types of heating systems in 2025 than in 2019.

Figure 23. Percentage of heating systems by detailed heating system type, 2019 and 2025



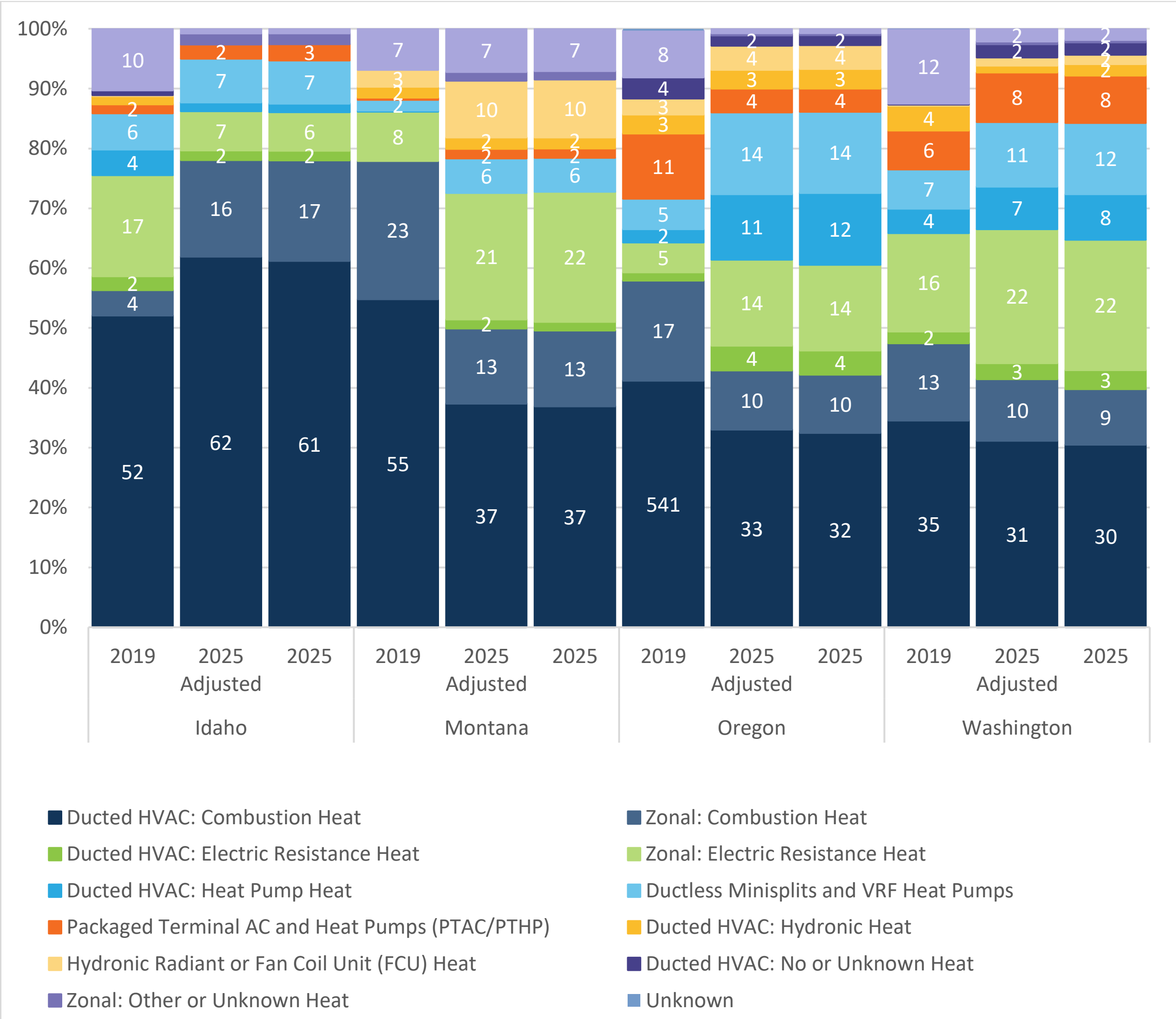
Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems. Labels not shown for values less than 2 percent.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Heating system prevalence differed significantly by state (Figure 24). In the 2025 CBSA, buildings in Idaho had roughly twice as many ducted combustion heating systems than those in Washington (61% vs. 30%). Estimates indicate that the proportion of commercial heating systems in Idaho using ducted combustion heating systems increased from 52 percent in 2019 to 61 percent in 2025, while all other states in the 2025 CBSA saw a decrease in the use of ducted combustion heating. Although buildings in Montana (37%) had a slightly higher proportion of ducted combustion heating systems when compared with Washington (30%) and Oregon (32%), Idaho topped all states by at least 24 percentage points.

Less reliance on ducted combustion heating systems in these three states made way for broader use of other heating systems (Figure 24). Buildings in Montana (22%), Washington (22%), and Oregon (14%) had a larger proportion of zonal electric resistance heating than buildings in Idaho, an increase from 2019 for all three states. Similarly, buildings in Washington and Oregon both had higher proportions of ductless minisplits and VRF heat pumps and ducted heat pump heat than buildings in Idaho and Montana. See Section B.3.1.1 for more on the use of heat pumps.

Figure 24. Percentage of heating systems by detailed heating system type and state, 2019 and 2025

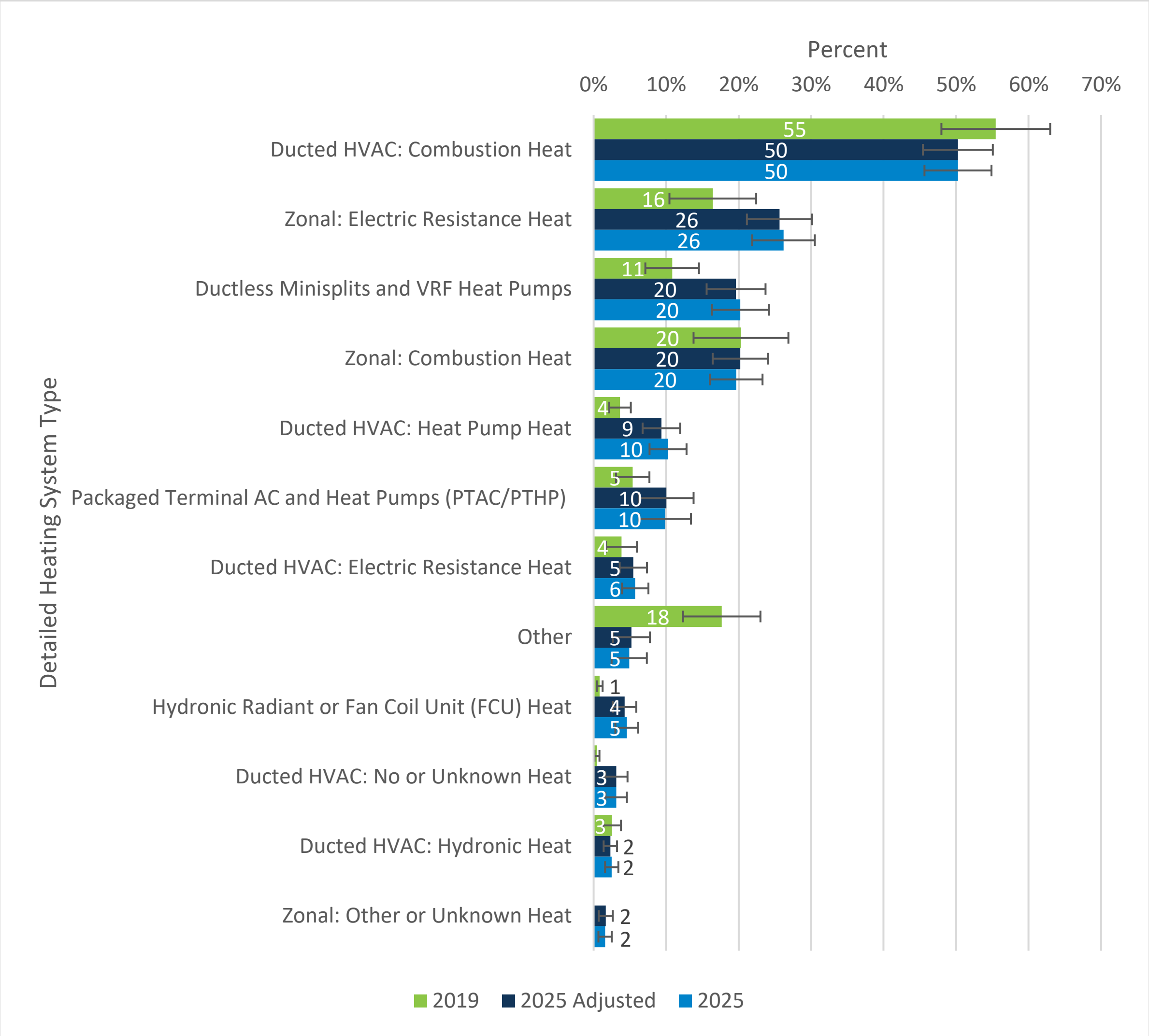


Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems. Labels not shown for values less than 2 percent.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Considering heating system use at the building level can provide context for the types of systems used while addressing potential overemphasis on individual buildings that have many heating systems. In the 2025 CBSA, half of all buildings used ducted combustion heat (Figure 25). Another quarter (26%) used zonal electric resistance heat, and 20 percent each used ductless minisplits and VRF heat pumps and zonal combustion heat. Ducted hydronic heating systems were among the least common, with just 2 percent of buildings using these systems. Estimates from the 2025 CBSA are largely consistent with estimates from the 2019 CBSA—ducted combustion heating was the most commonly used heating system across all buildings. However, much like use at the heating system level, more buildings in 2025 than in 2019 used ductless minisplits and VRF heat pumps (an increase of 9 percentage points) and ducted heat pump heat (an increase of 6 percentage points). Hydronic radiant heat also saw a small but significant increase from 1 to 4 percent of buildings.

Figure 25. Percentage of buildings by detailed heating system type, 2019 and 2025



Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

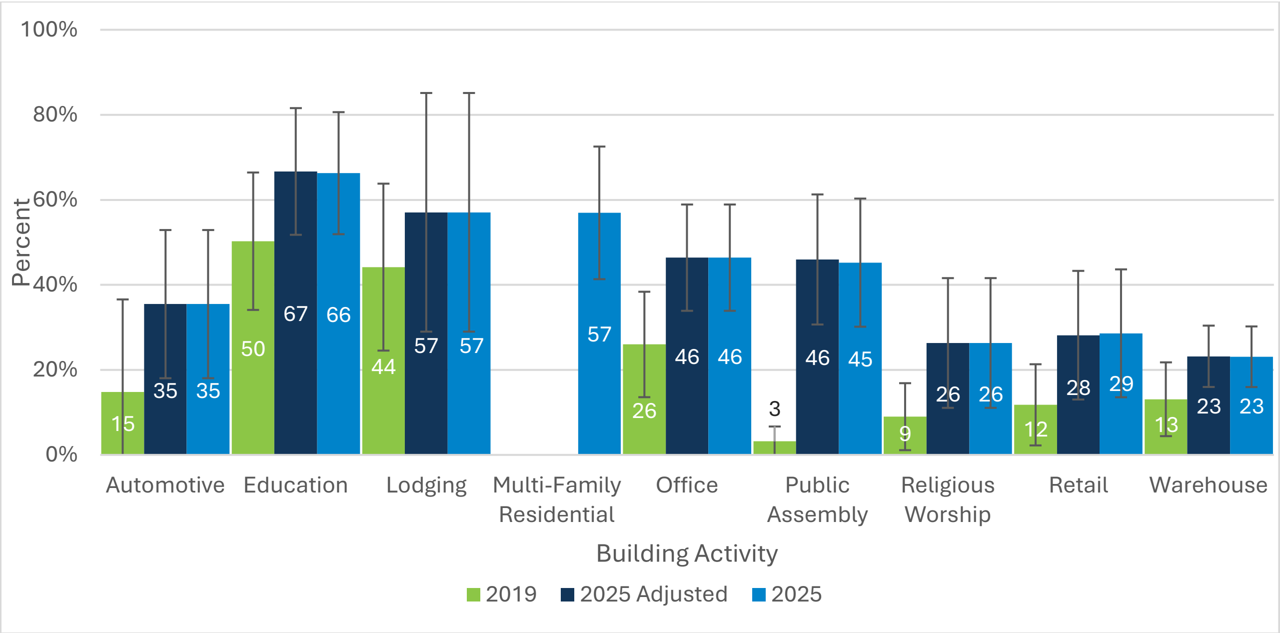
Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

3.1.1 Heat Pump Heating Use

Heat pumps offer the opportunity for significant electricity savings in the Northwest. The 2025 CBSA estimated that about 37 percent of buildings used some type of heat pump. As customers and contractors have become more comfortable with the technology, heat pump use has increased significantly, jumping 19 percentage points since 2019, when 18 percent of buildings had heating pumps.

Heat pump use varied by primary building activity (Figure 26). In 2025, Education buildings used heat pumps most frequently (66%), followed by Multi-Family Residential (57%), Lodging (57%), Retail (29%), Religious Worship (26%), and Warehouse (23%) buildings. Although many building categories used a greater proportion of all heat pumps when compared with 2019, only Public Assembly buildings had a significant change from 2019, increasing from 3 percent in 2019 to 46 percent in 2025. Although there were differences in the type of Public Assembly buildings included in 2025 (see Section A.2.5), these buildings are excluded from the 2025 adjusted data, which also show a significant difference from the 2019 CBSA.

Figure 26. Percentage of buildings that used heat pump heating by primary building activity, 2019 and 2025

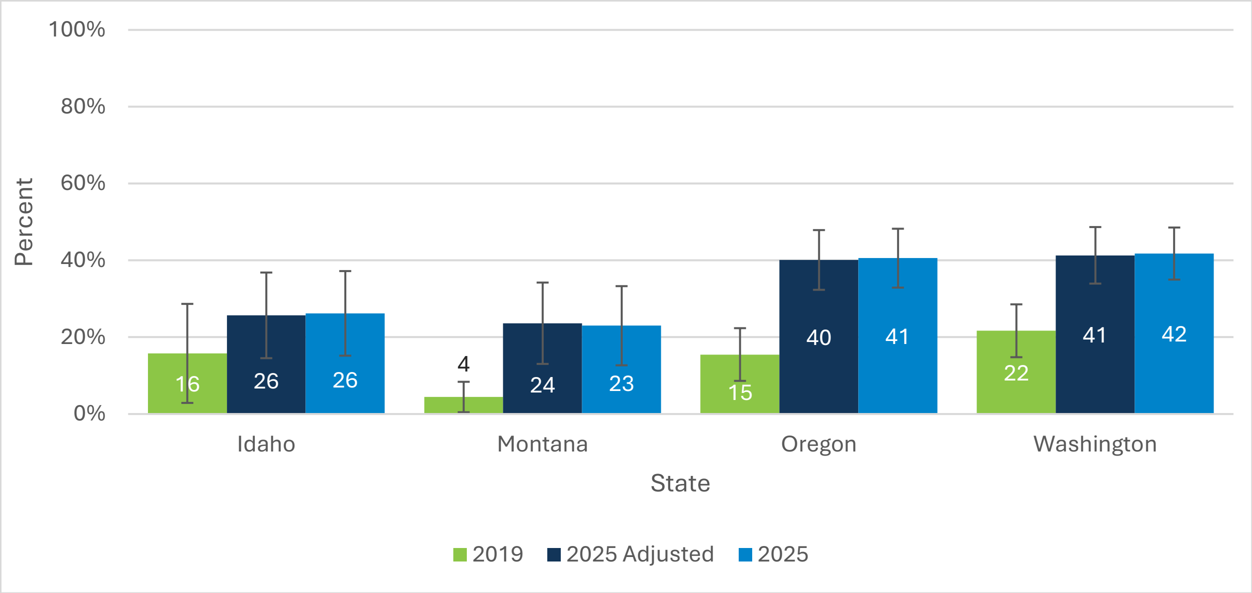


Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Heat pump use varied by state (Figure 27). More than one-third of buildings in Washington (42%) and Oregon (41%) used heat pumps for some amount of heating, significantly more than the proportion of buildings in Montana that did so (23%). Although heat pump use was lower in Idaho (26%) than Washington and Oregon, the difference was not statistically significant. More temperate climates and relatively mild winters in Washington and Oregon likely contributed to this difference in heat pump use. Additionally, since 2019, the percentage of buildings using heat pumps increased significantly in Washington, Oregon, and Montana.

Figure 27. Percentage of buildings that used heat pump heating by state, 2019 and 2025

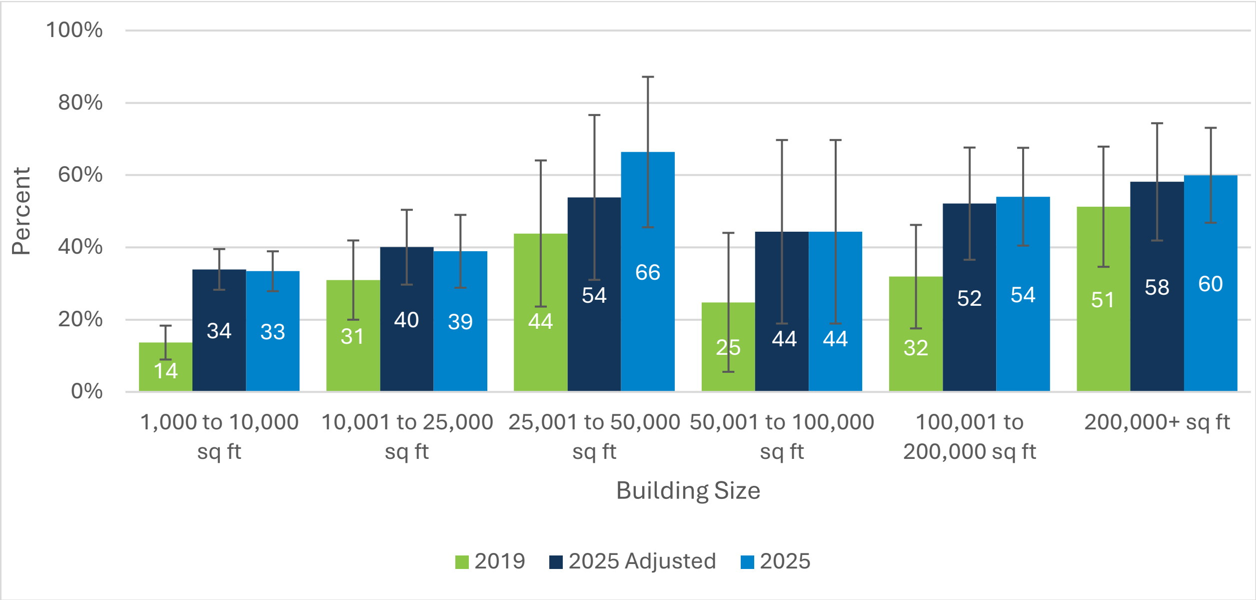


Note. 2019 n=882; 2025 Adjusted; n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Heat pump use varied by building size—buildings between 50,001 and 200,000 sq ft generally used heat pumps for heating at a higher rate than did the smallest buildings (Figure 28). Nearly two-thirds (66%) of buildings between 25,000 and 50,000 sq ft had a heat pump, compared with 39 percent for buildings between 10,001 and 25,000 sq ft and 33 percent for buildings between 1,000 and 10,000 sq ft. Although the smallest buildings had the lowest rate of heat pump use, this is the only building size category in which heat pump use increased significantly since 2019.

Figure 28. Percentage of buildings that used heat pump heating by building size, 2019 and 2025



Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

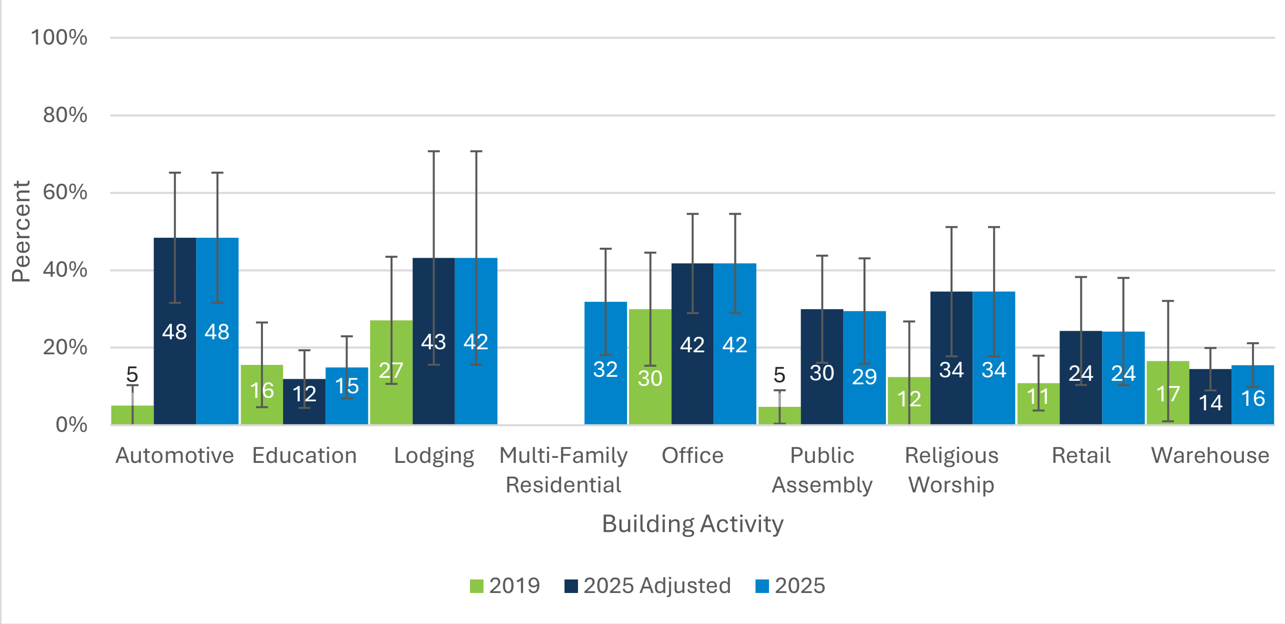
Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

3.1.2 Electric Resistance Heating Use

Use of electric resistance for any kind of commercial building heating also varied by primary building activity and state (Figure 29). Overall, estimates from the 2025 CBSA indicate that 26 percent of buildings used electric resistance for some type of heating, compared with 18 percent in 2019. However, buildings used primarily for Automotive, Lodging, and Office purposes used electric resistance heating most frequently (48%, 43%, and 42%, respectively). In Lodging buildings, these electric resistance units were typically PTAC units in guest rooms. In Office buildings, electric resistance heating units were not typically the primary heating system but rather were secondary heating systems in the form of space heaters for individual offices or cubicles. Although 2025 CBSA estimates indicate that about 32 percent of Multi-Family Residential buildings used electric resistance heating in some capacity, this was only for heating systems included in the 2025 CBSA site visit, such as common areas, offices, and storerooms. Including living spaces within these buildings would likely increase the proportion of Multi-Family Residential buildings with some type of electric resistance heating. Education and Warehouse buildings used electric resistance heating at lower rates (15% and 16%, respectively).

Automotive and Public Assembly buildings increased their use of electric resistance heating compared with 2019 (by 43 percentage points and 24 percentage points, respectively). Although there were changes to the definition of Public Assembly buildings in the 2025 CBSA (see Section A.2.5), the differences existed in both the adjusted 2025 and full 2025 estimates, suggesting that the difference in Public Assembly buildings was not a result of these administrative differences. However, it is possible that the differences were a result of a different sample of buildings being included in these primary building activities in each year.

Figure 29. Percentage of buildings that used electric resistance heating by primary building activity, 2019 and 2025

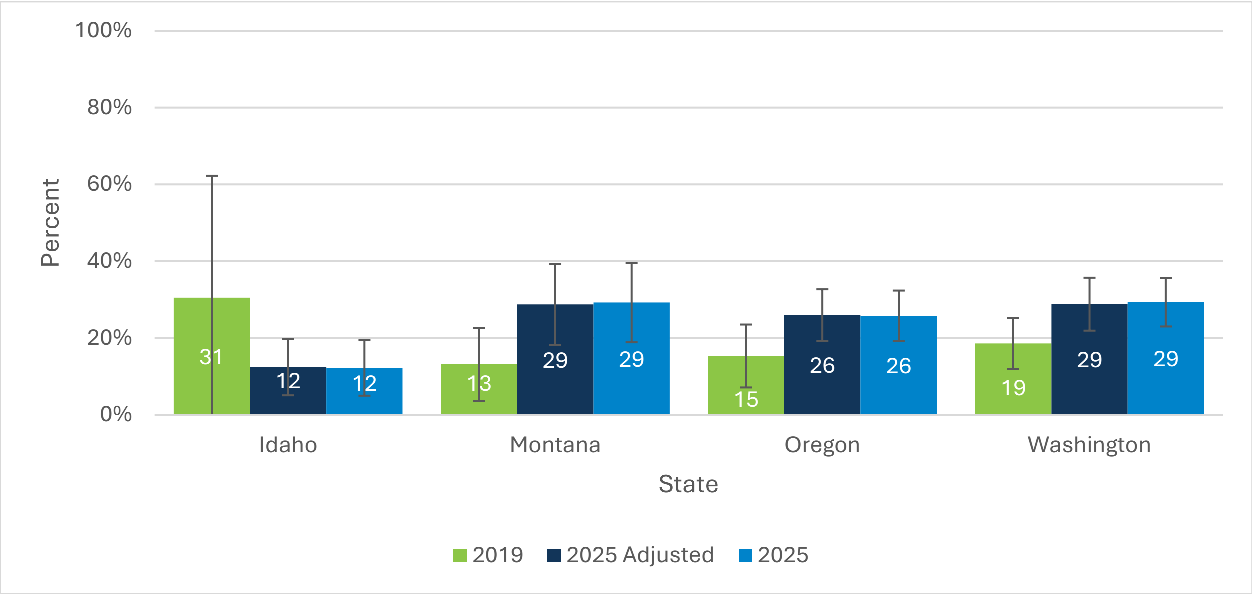


Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

While more than one-quarter of commercial buildings in Montana, Washington, and Oregon used electric resistance heating (29%, 29%, and 26%, respectively), a significantly smaller proportion of buildings in Idaho did so (12%). Electric resistance heating use increased from 2019 to 2025 in Montana, Oregon, and Washington, but the differences were not significant (Figure 30).

Figure 30. Percentage of buildings that used electric resistance heating by state, 2019 and 2025



Note. 2019 n=882; 2025 Adjusted n=440; 2025 n=485. Weighted population estimates of all heating systems as a proportion of all buildings with at least one heating system.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

3.2 Cooling Systems

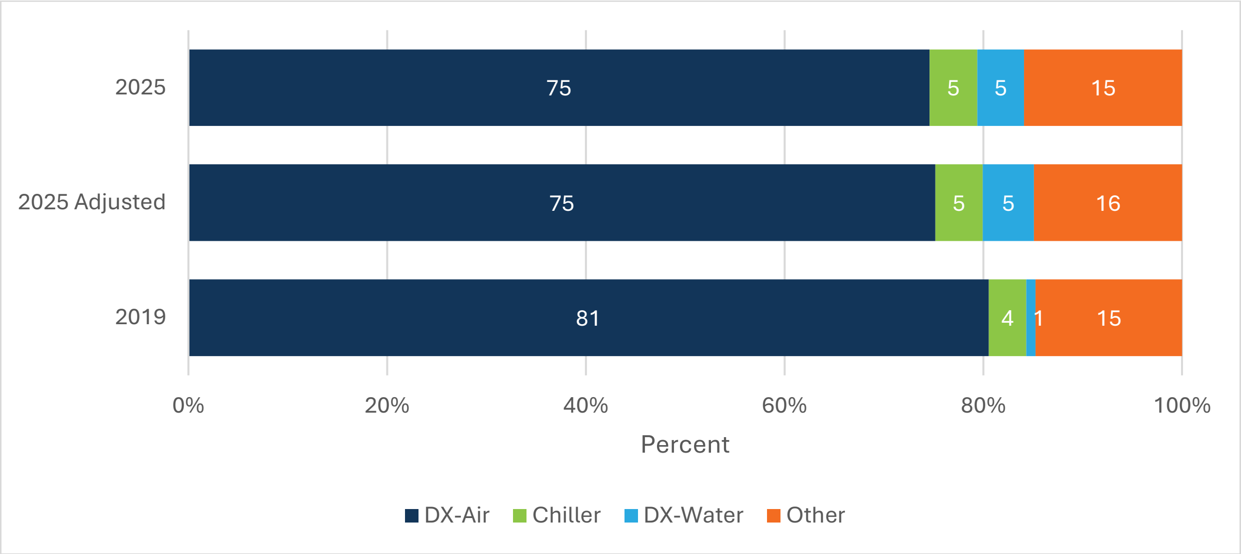
Across all cooling systems in the 2025 CBSA, air-cooled direct expansion (DX-Air) systems[7] were by far the most common type of system (Figure 31). Estimates from both the 2025 CBSA and the 2019 CBSA indicate that most cooling systems used DX-Air for cooling, although the proportion in 2025 (75%) reflects a significant decrease from the proportion in 2019 (81%). In 2025, 5 percent of cooling systems used chillers,[8] 5 percent used water-cooled direct expansion

[7] DX-Air systems use refrigerant-based heat transfer and an outdoor air-cooled unit to provide cooling without a central water loop. Typically, if a cooling system did not have a chiller (water- or air-cooled) and did not use any hydronic loops or condenser water loops, it was considered a DX-Air system.

[8] A chiller is a central refrigeration system that removes heat from water and circulates the chilled water to air-handling equipment for building cooling. Typically, if a cooling system had some type of chiller (water- or air-cooled) it was considered a chiller.

(DX-Water) systems,[9] and about 15 percent used some other type of cooling system.[10] The proportion of cooling systems that used DX-Water increased significantly from 2019 to 2025.

Figure 31. Percentage of cooling systems by cooling system type, 2019 and 2025



Note. 2019 n=757; 2025 Adjusted n=338; 2025 n=383. Weighted population estimates of all cooling systems.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Although most cooling systems used DX-Air, there was variation across states (Figure 32). From 2019 to 2025, the percentage of buildings that uses DX-Air remained consistent in Washington but decreased significantly in Oregon, from 79 percent to 67 percent of buildings.

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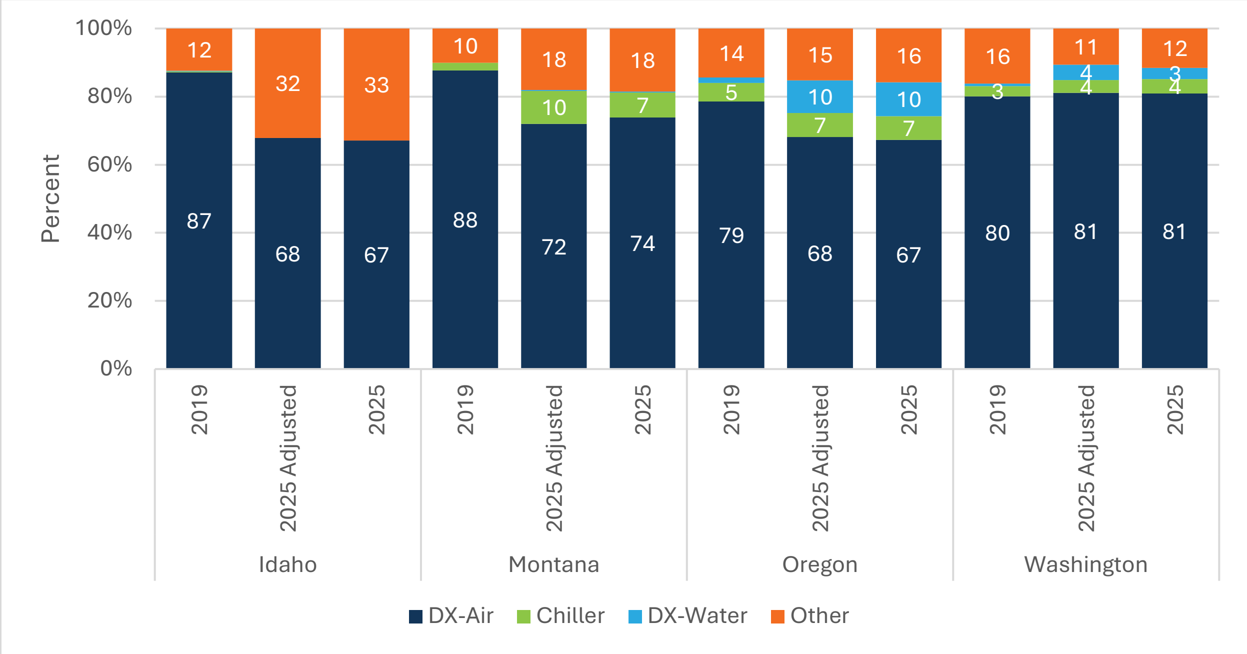
[9] DX-Water systems condition indoor air through direct refrigerant evaporation and condensation, with heat exchanged to or from a condenser water loop instead of directly with outdoor air. Typically, if a cooling system did not have a chiller (water- or air-cooled) but used hydronic loops or condenser water loops, it was considered a DX-Water system.

[10] Other types of cooling systems include cabinet-style fan coil units without hydronic cooling, DOAS without a chiller or hydronic or condenser loops, and systems listed as "Other" types.

Figure 32. Percentage of cooling systems by cooling system type and state, 2019 and 2025

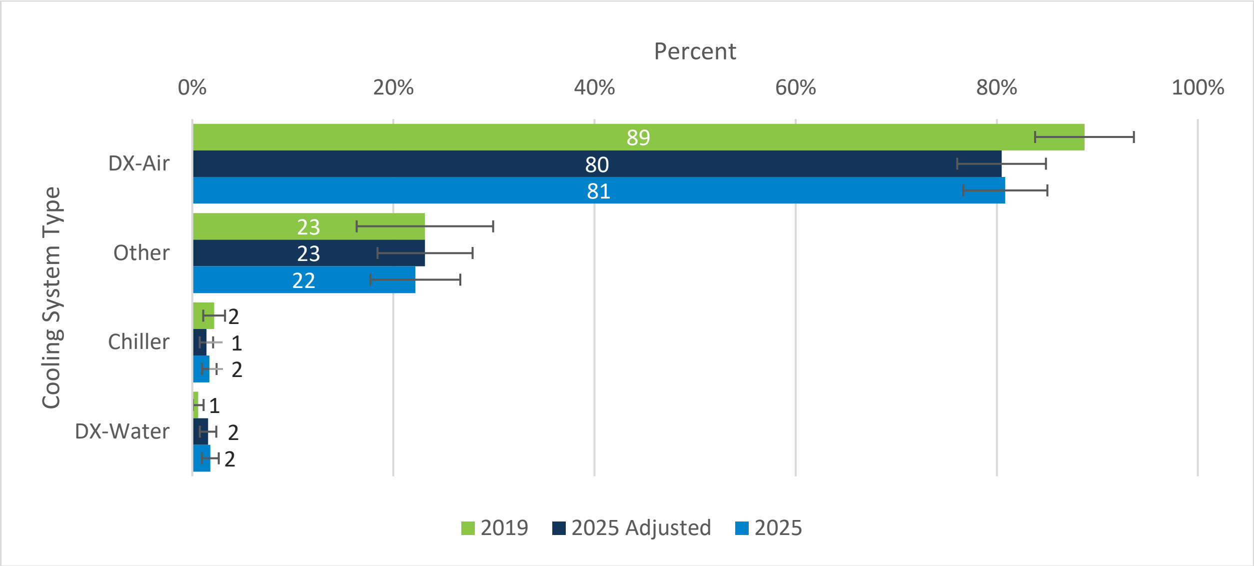


Note. 2019 n=757; 2025 adjusted n=338; 2025 n=383. Weighted population estimates of all cooling systems.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

As with heating systems, considering cooling systems at the building level can provide context for the types of cooling systems used while also addressing potential overemphasis on individual buildings that have multiple systems. More than three-quarters (81%) of all buildings used some type of DX-Air cooling (Figure 33) in 2025, while 2 percent each used chillers and DX-Water, and 22 percent used other types of cooling systems. The use of cooling systems at the building level in 2025 showed no significant changes from 2019.

Figure 33. Percentage of buildings by cooling system type, 2019 and 2025



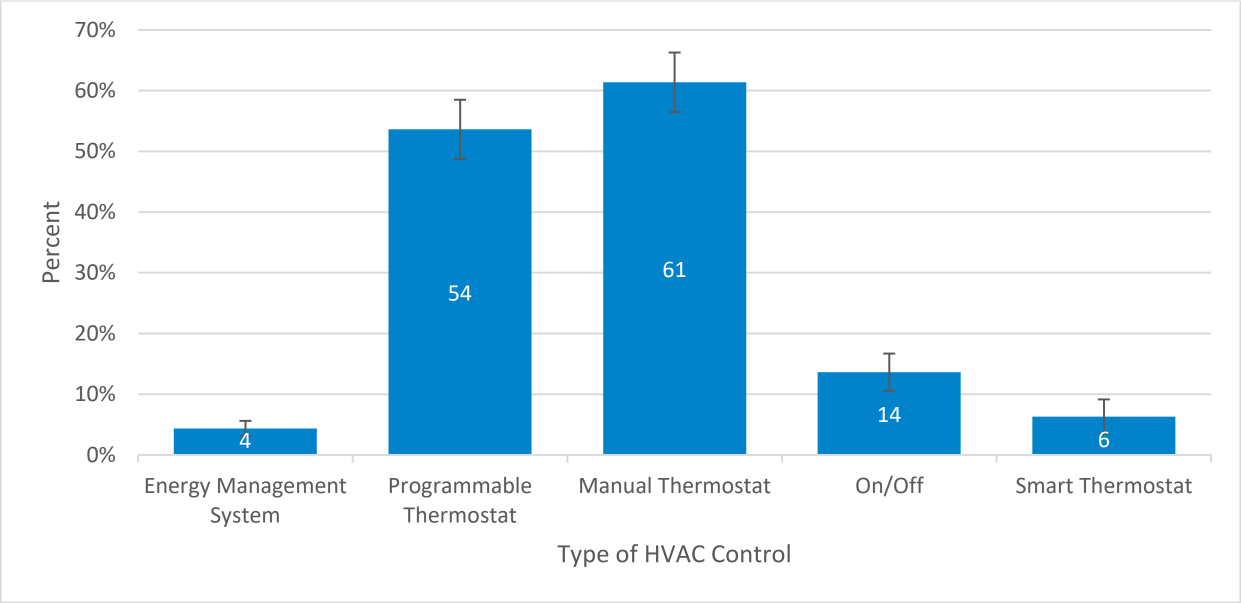
Note. 2019 n=757; 2025 Adjusted n=338; 2025 n=383. Weighted population estimates of all cooling systems as a proportion of all buildings with cooling systems.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

3.3 HVAC System Controls

Across HVAC system types, buildings have varied mechanisms for system control. Among all commercial buildings, 61 percent used manual thermostats to control their HVAC systems, and 54 percent used programmable thermostats that set the temperature for different schedules throughout the day and week (Figure 34). Fourteen percent of buildings used on/off switches for their HVAC systems, while 6 percent used smart thermostats, and 4 percent used an energy management system.

Figure 34. Percentage of buildings by HVAC system control type, 2025

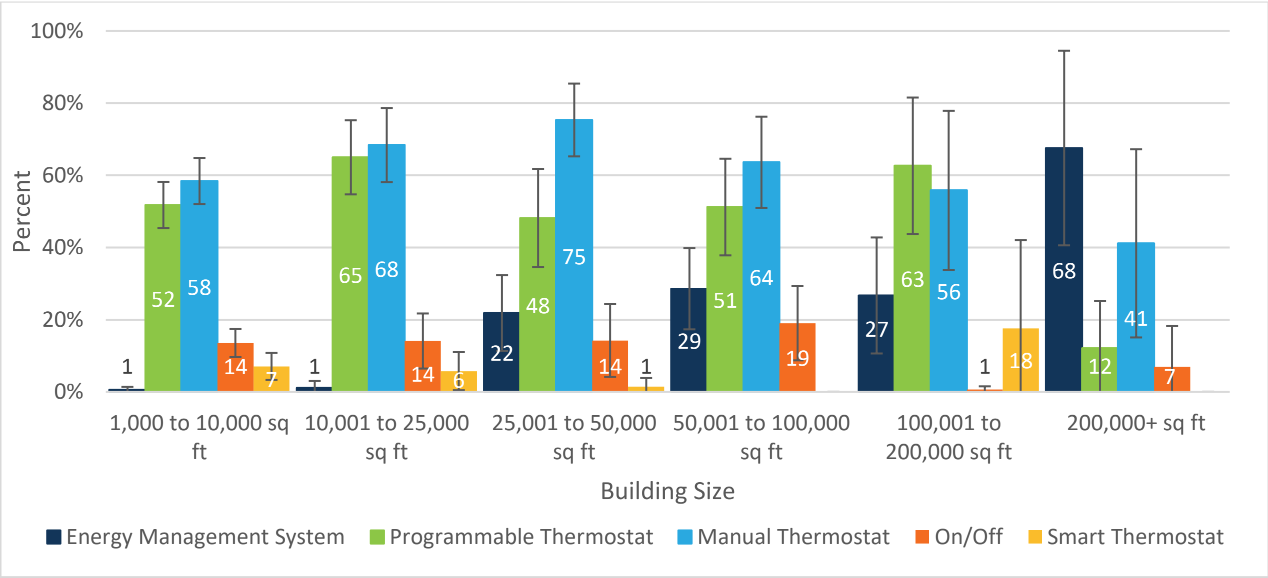


Note. 2025 n=480. Weighted population estimates of all HVAC controls.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Although the bulk of buildings used manual or programmable thermostats for HVAC system control, some types of HVAC controls varied by building size (Figure 35). For example, 4 percent of all buildings used energy management systems, and 68 percent of buildings over 200,000 sq ft used energy management systems, likely to assist with more complex system designs and flows. Just 1 percent of commercial buildings under 10,000 sq ft used energy management systems, whereas 58 percent used manual thermostats and 52 percent used programmable thermostats. Buildings over 200,000 sq ft were significantly less likely to use programmable thermostats (just 12% used this type of HVAC control) than buildings in every other size category.

Figure 35. Percentage of buildings by HVAC system control type and building size, 2025



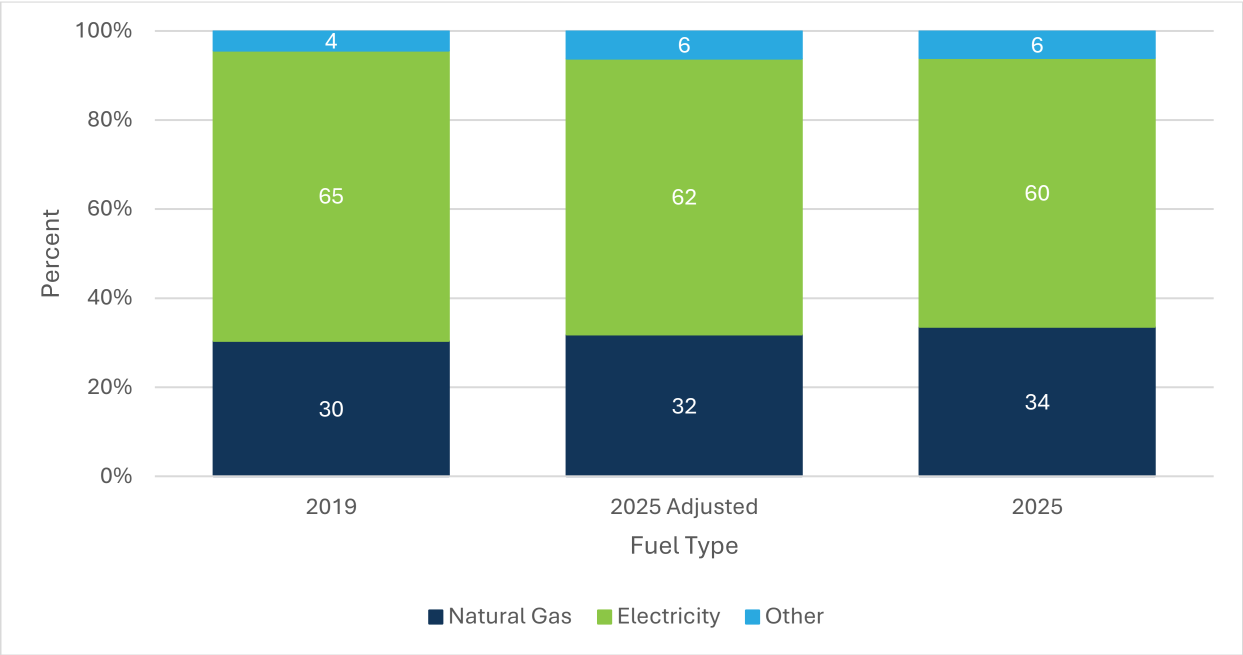
Note. 2025 n=480. Weighted population estimates of all HVAC controls.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

4. *Service Water Heating*

The 2025 CBSA collected data on 569 water heating systems across 424 participating buildings. Electricity was the most commonly used fuel type for water heaters, accounting for 60 percent of water heaters (Figure 36). Natural gas fueled another 34 percent, with the remaining 6 percent comprising other fuel types like propane and solar thermal. However, natural gas represented 70 percent of the total input capacity, compared with 22 percent for electricity (Figure 37). Input capacity is the amount of energy the system is designed to consume in one hour.

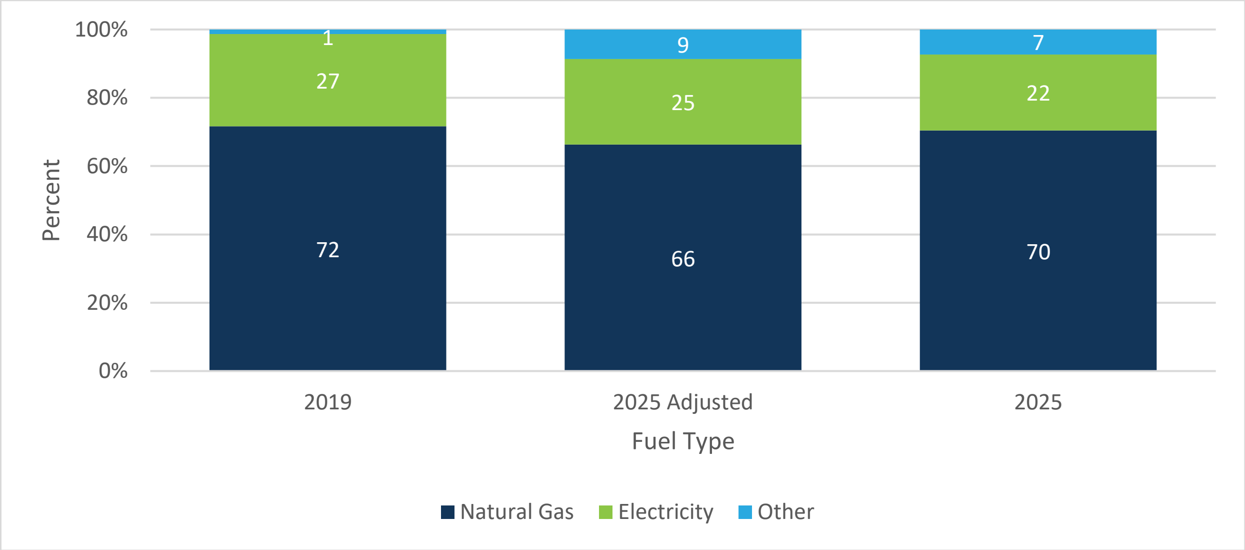
Figure 36. Percentage of water heater units by fuel type, 2019 and 2025



Note. 2019 n=812; 2025 Adjusted n=377; 2025 n=424. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Figure 37. Percentage of water heater input capacity by fuel type, 2019 and 2025

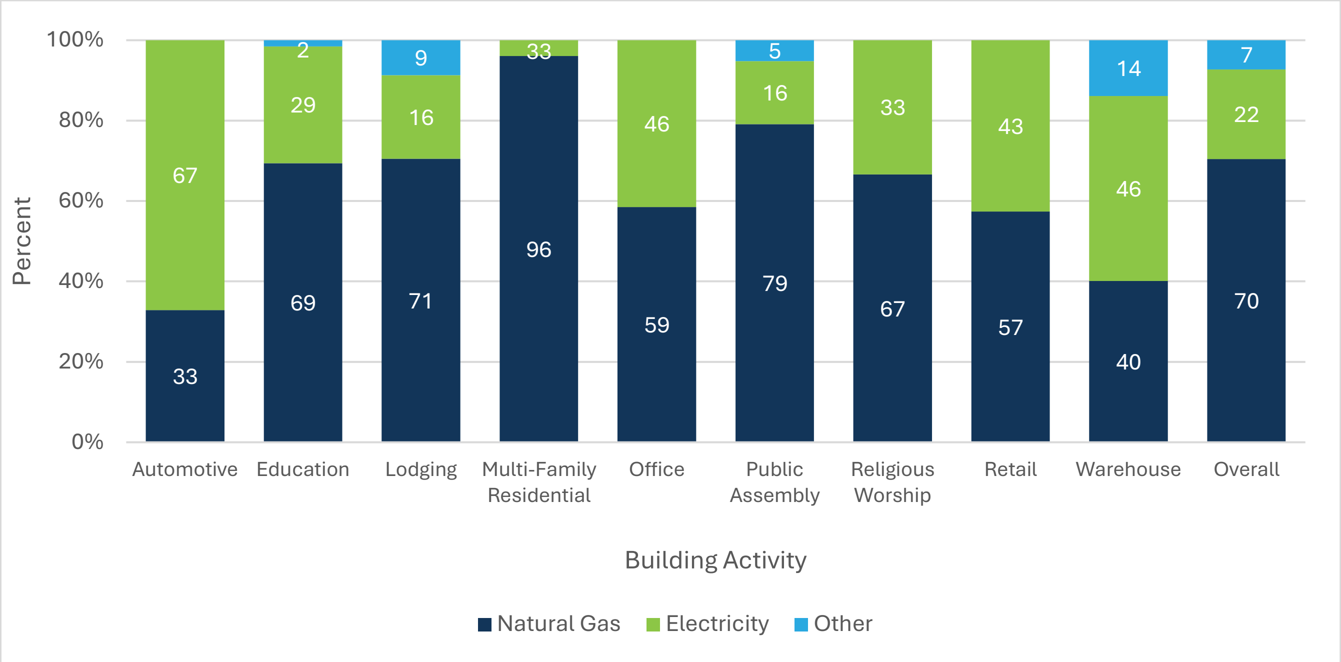


Note. 2019 n=812; 2025 Adjusted n=377; 2025 n=424. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

When looking at water heater fuel types in 2025 by primary building activity, electricity was the most commonly used fuel type in Automotive buildings (67%) and Warehouse buildings (46%), while natural gas was the most commonly used fuel type for all other building categories (Figure 38).

Figure 38. Percentage of water heaters by fuel type and primary building activity, 2019 and 2025

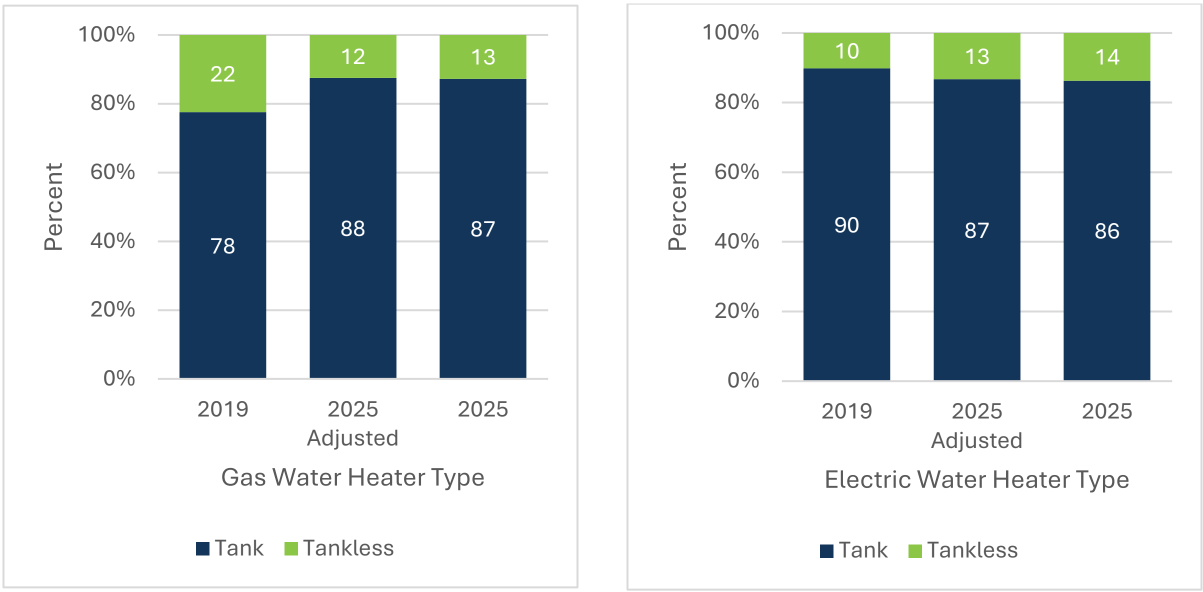


Note. 2019 n=812; 2025 Adjusted n=377; 2025 n=424. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

In 2025, the majority of water heaters had tanks—that is, 87 percent of gas water heaters and 86 percent of electric water heaters had tanks (Figure 39). This distribution of tank versus tankless is similar to that in 2019.

Figure 39. Percentage of gas and electric water heaters by type, 2019 and 2025



Note. 2019 n=812; 2025 Adjusted n=377; 2025 n=424. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

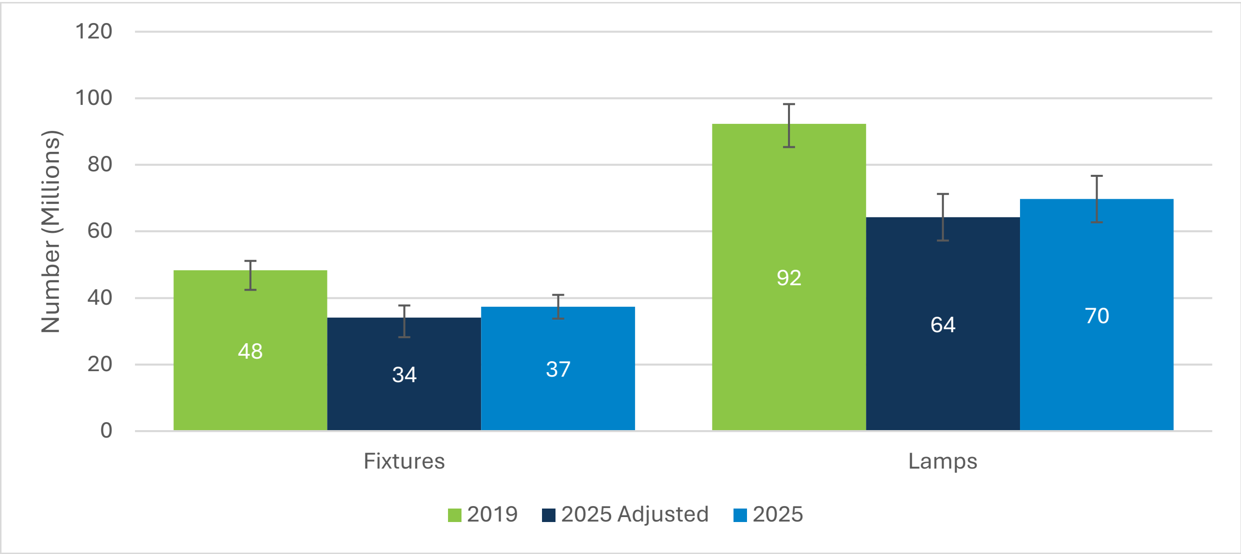
5. Lighting

5.1 Total Lighting

Alongside heating and cooling, lighting accounts for a significant portion of energy use in commercial buildings. Estimates from the 2025 CBSA suggest that buildings had more than 37 million fixtures and 70 million individual lamps (Figure 40). This decline in fixtures reflects a decrease of 26 percent (11 million fixtures) from the 2019 CBSA estimates.

There are likely several contributing factors to the large decrease in both lighting fixtures and lamps between 2019 and 2025. First, the transition to LED lighting in buildings is often accompanied by redesigned lighting layouts, including de-lamping and fixture consolidation strategies due to the improved efficacy and optical control of LEDs (Lee et al., 2024). Second, there were substantial changes in the 2025 sample compared with the 2019 sample (see Section A.2). For example, the greater proportion of Warehouse buildings in the 2025 sample may have further reduced the total numbers of fixtures and lamps. Finally, the data collection differences between 2019 and 2025 may have led to the documentation of fewer fixtures and lamps in certain building categories, including Health Care and Nursing Home buildings, where patient/resident rooms were excluded in 2025.[11] Additionally, although both fixtures and lamps provide useful information about lighting loads, fixtures are highlighted throughout the rest of this section to better align with shifts in LED technology, which may use fewer watts and lamps.

Figure 40. Total number of lighting fixtures and lamps, 2019 and 2025



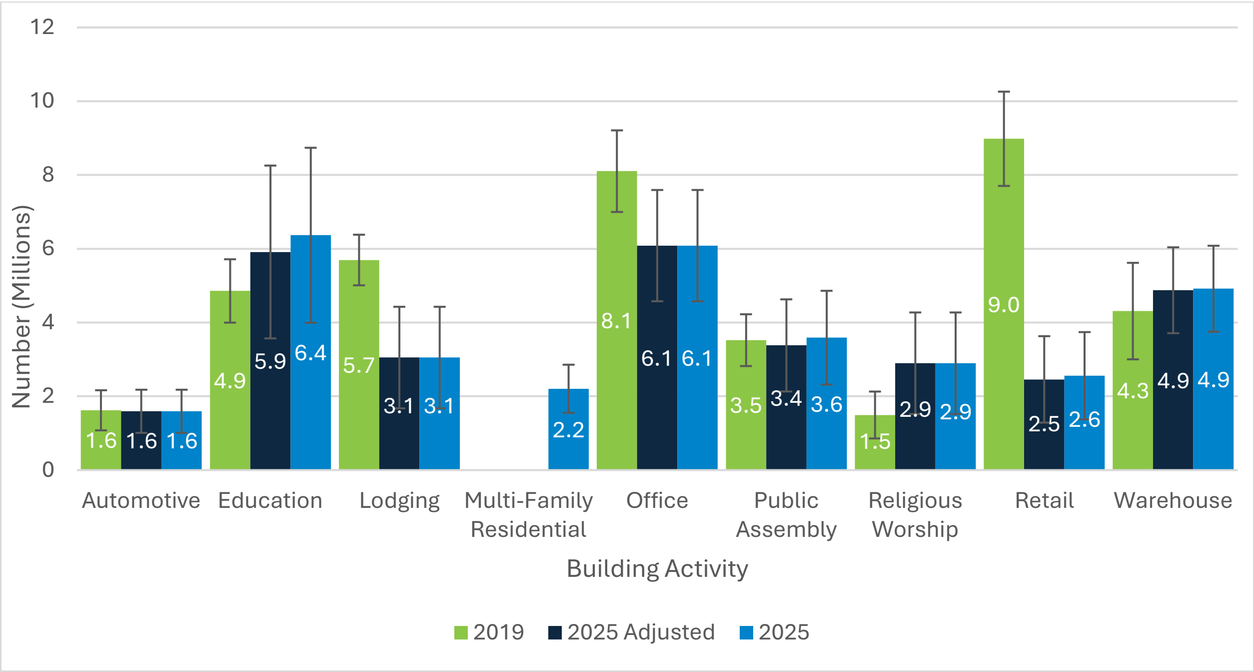
Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Estimates from the 2025 CBSA suggest that Education and Office buildings had the most lighting fixtures (6.4 million and 6.1 million, respectively), followed by Warehouse (4.9 million), Public Assembly (3.6 million), and Lodging (3.1 million) buildings (Figure 41). Automotive buildings had the fewest fixtures (1.6 million). Retail and Lodging buildings had significantly fewer fixtures in 2025 than in 2019.

[11] Hospitals and nursing homes are not broken out separately due to having too few participating buildings in each category to make reliable inferences for the region.

Figure 41. Total number of lighting fixtures by primary building activity, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

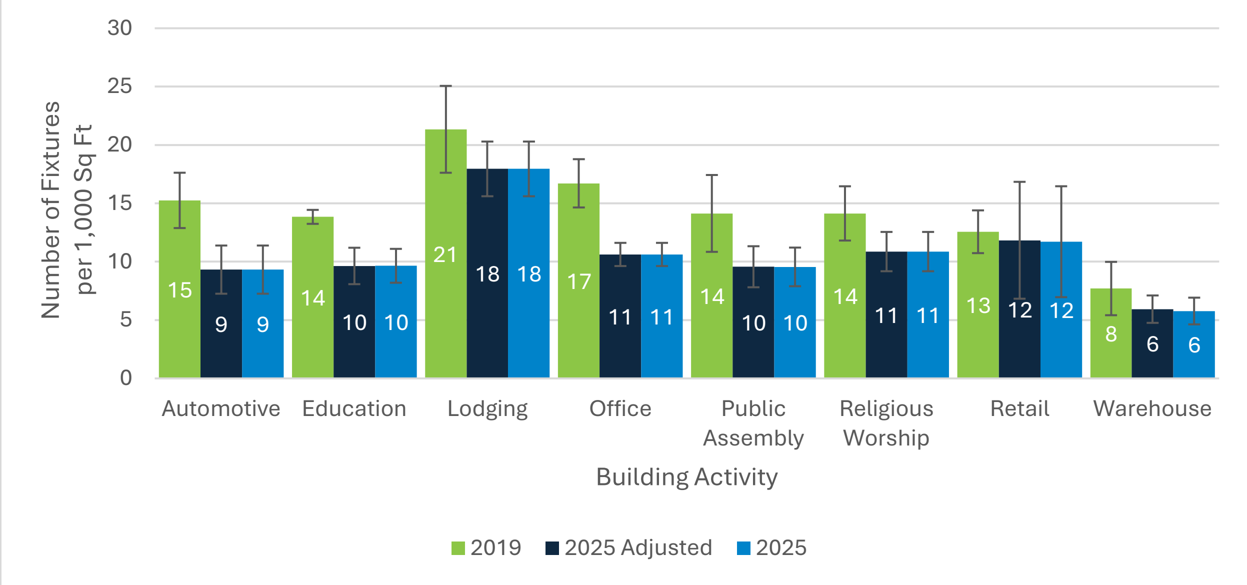
Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Although the total fixture estimate for Retail buildings in 2025 differed significantly from the estimate in 2019, the estimate for total lighting fixture density did not, suggesting that the difference in total Retail fixtures is driven primarily by the difference in retail building size between the two study years, rather than by substantive lighting changes (Figure 42). Indeed, the average size of a participating Retail building in 2025 was 11,560 sq ft, compared with 33,404 sq ft in 2019. Total fixture estimates remained comparable for all other building categories.

Although the total number of lighting fixtures provides a measure of lighting magnitude across the region, lighting fixture density accounts for differences in the amount of space for each building type, which can account for differences in building size. Using the total number of fixtures per 1,000 sq ft, the 2025 estimates suggest an overall fixture density of 9.5 fixtures per 1,000 sq ft across all building types, compared with 14.1 fixtures per 1,000 sq ft in 2019 (Figure 42). Across building categories, lighting fixture density in 2025 was relatively consistent—most categories had between 6 and 12 fixtures per 1,000 sq ft. The fixture density was significantly higher for Lodging buildings (17.9 per 1,000 sq ft), which may be a function of many small fixtures within individual hotel rooms. Warehouses had the lowest fixture density (5.8 fixtures per 1,000 sq ft).

Office, Automotive, and Education buildings had significantly lower lighting fixture densities per 1,000 sq ft when compared with 2019 (Figure 42). In 2025, Office buildings had 10.6 fixtures per 1,000 sq ft, compared with 16.7 fixtures per 1,000 sq ft in 2019. Similarly, Education buildings in 2025 had 9.6 fixtures per 1,000 sq ft, compared with 14.4 fixtures per 1,000 sq ft in 2019. Although colleges and universities were added to the Education category in the 2025 sample, this did not appear to have a significant impact on fixture density—the 2025 adjusted estimates for fixture density were similar to the 2025 full estimates. In addition, the slightly lower fixture density among Warehouse buildings, along with the larger proportion of these buildings in the final sample, is likely a contributing factor in the decrease in total fixture counts between 2025 and 2019 (by 2.0 fixtures per 1,000 sq ft).

Figure 42. Total lighting fixture density by primary building activity, 2019 and 2025

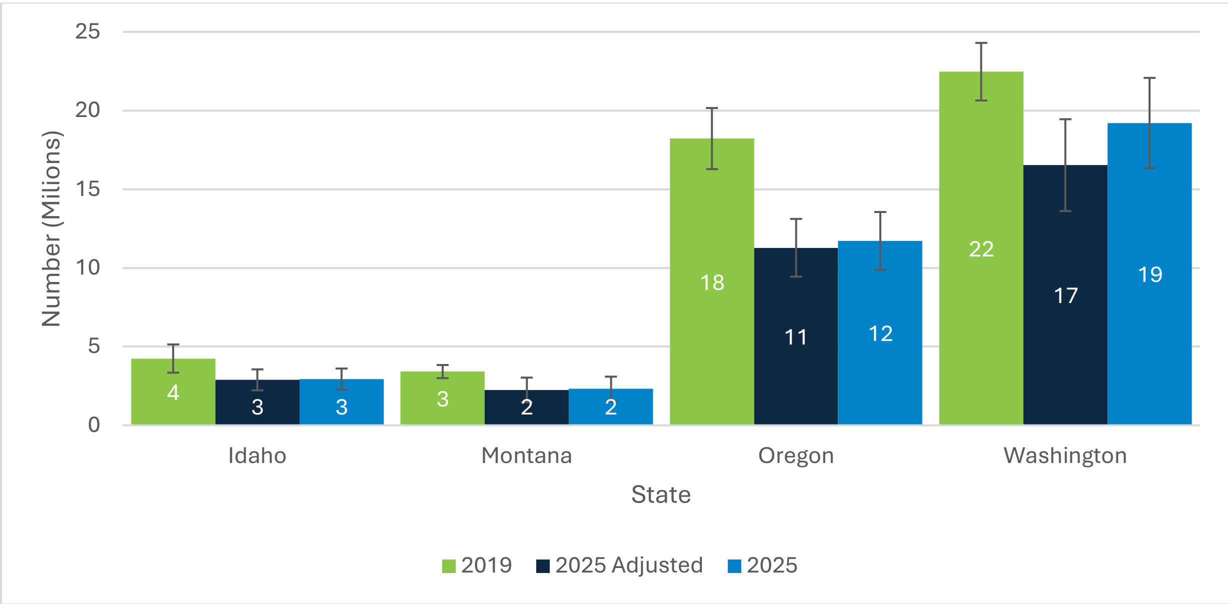


Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates. Multi-Family Residential buildings are excluded from fixture density calculations for 2025 because only nonresidential space was surveyed during the site visit and there are no accurate estimates for square footage of common spaces.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

As with primary building activity, the estimated number of lighting fixtures varied by state (Figure 43). Washington had the largest number of fixtures (19.2 million) in 2025. This was significantly higher than the 11.7 million fixtures in Oregon, 2.9 million fixtures in Idaho, and 2.3 million fixtures in Montana. Although 2019 estimates showed a similar trend (i.e., the largest proportion of fixtures being in Washington, followed by Oregon), the magnitude was quite different. In 2019, there were an estimated 18 million fixtures in Oregon, compared with 12 million fixtures in 2025, a decrease of 36 percent. This difference is, in part, driven by sampling frame and sampling changes that allowed for better distribution of sampled buildings across states (see Section A.2). Although 2025 estimates indicate far fewer fixtures in Oregon, there was no significant change in total fixtures in Washington, Idaho, or Montana.

Figure 43. Total number of lighting fixtures by state, 2019 and 2025

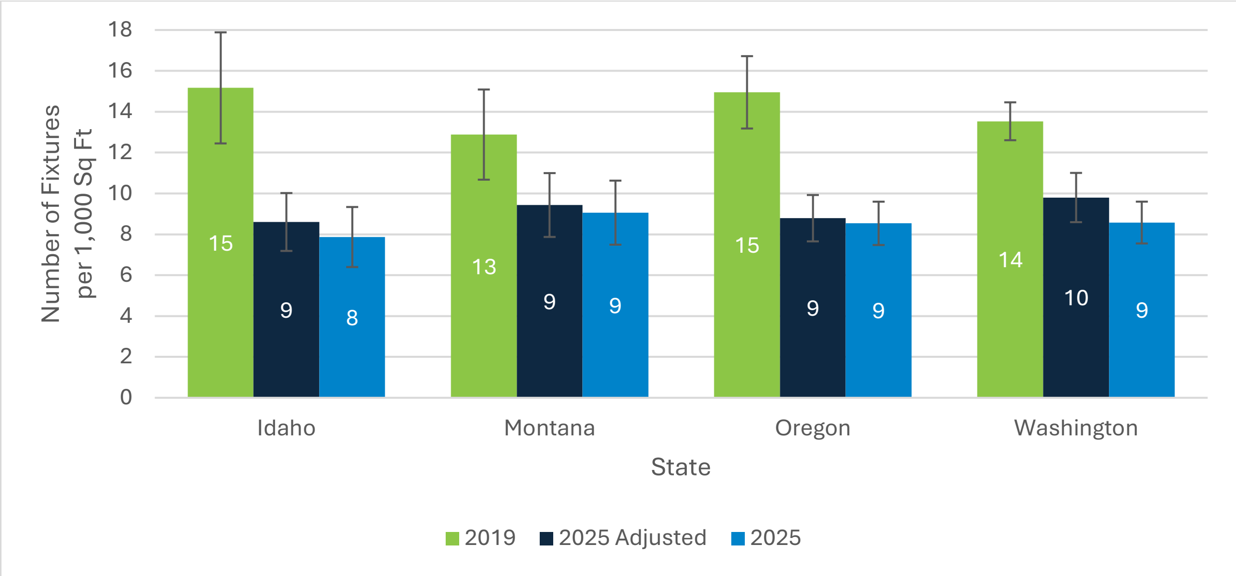


Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

The 2025 CBSA estimates 9.6 fixtures per 1,000 sq ft across buildings in all states, with relative consistency between states (Figure 44). Much like the differences seen by primary building activity, across all states there were between 8 and 9 fixtures per 1,000 sq ft. Montana had a slightly higher lighting density (9.1 fixtures per 1,000 sq ft) than Washington and Oregon (8.6 and 8.5 fixtures per 1,000 sq ft). Lighting density estimates were lowest in Idaho (7.6 fixtures per 1,000 sq ft). In the adjusted 2025 sample, lighting density estimates were slightly higher than the full sample because of the low lighting density buildings (Vacant – Commercial and Multi-Family Residential) that were excluded from the adjusted 2025 sample.

Figure 44. Total lighting fixture density by state, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates. Multi-Family Residential buildings are excluded from fixture density calculations for 2025 because only nonresidential space was surveyed during the site visit and there are no accurate estimates for square footage of common spaces.

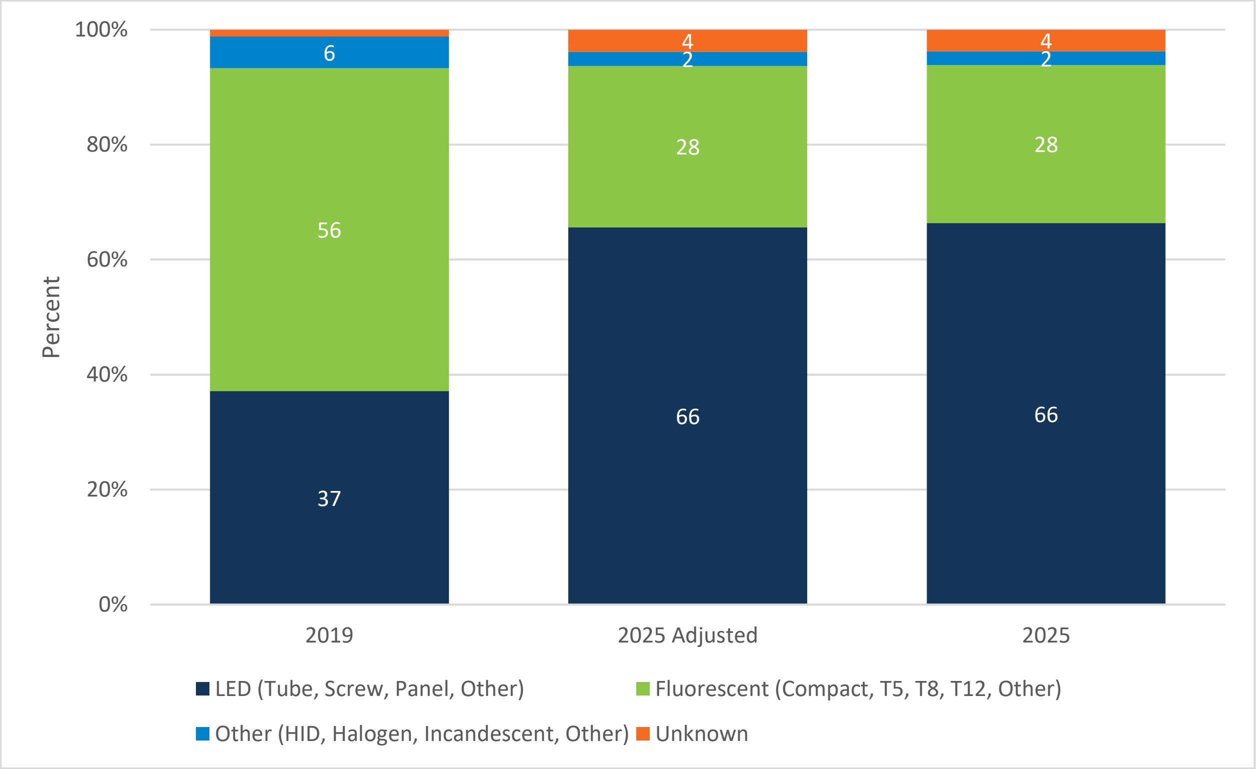
Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Lighting fixture density estimates in 2025 differed significantly from the lighting density estimates from the 2019 CBSA, which estimated 14.1 fixtures per 1,000 sq ft. Both the Idaho and Montana subregion and the Western Oregon and Western Washington subregion saw significant decreases in lighting fixture density, decreasing by 4 fixtures per 1,000 sq ft. Lighting fixture density in the Eastern Oregon and Eastern Washington subregion was similar in 2019 and 2025.

5.2 Lighting Fixture Types

Lighting fixtures differed significantly over time in terms of lamp technology (Figure 45). In the 2025 CBSA, 66 percent of lighting fixtures used LEDs, a nearly 30 percentage point increase in LED lighting fixtures compared with the 2019 CBSA. As LED use has continued to grow over the last decade and the lighting market has transformed significantly, fluorescent use has declined.[12] In 2025, an estimated 28 percent of lighting fixtures were fluorescent, compared with 56 percent in 2019. Less common lighting fixture types in both years included high-intensity discharge (HID), halogen, and incandescent lights.

Figure 45. Percentage of lighting fixtures by lamp technology, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Considering 2025 estimates specifically, 61 percent of lighting fixtures in commercial buildings in Washington used LED technology, lower than any other state in the 2025 CBSA (Figure 46). More than three-quarters of fixtures in commercial buildings in Idaho (78%) and Montana (75%) used LED technology, followed by 71 percent in Oregon. Greater use of fluorescent lighting in Washington (33% of lighting fixtures) is consistent with differing implementation dates for state commercial fluorescent lighting bans. Idaho and Montana do not have statewide legislation

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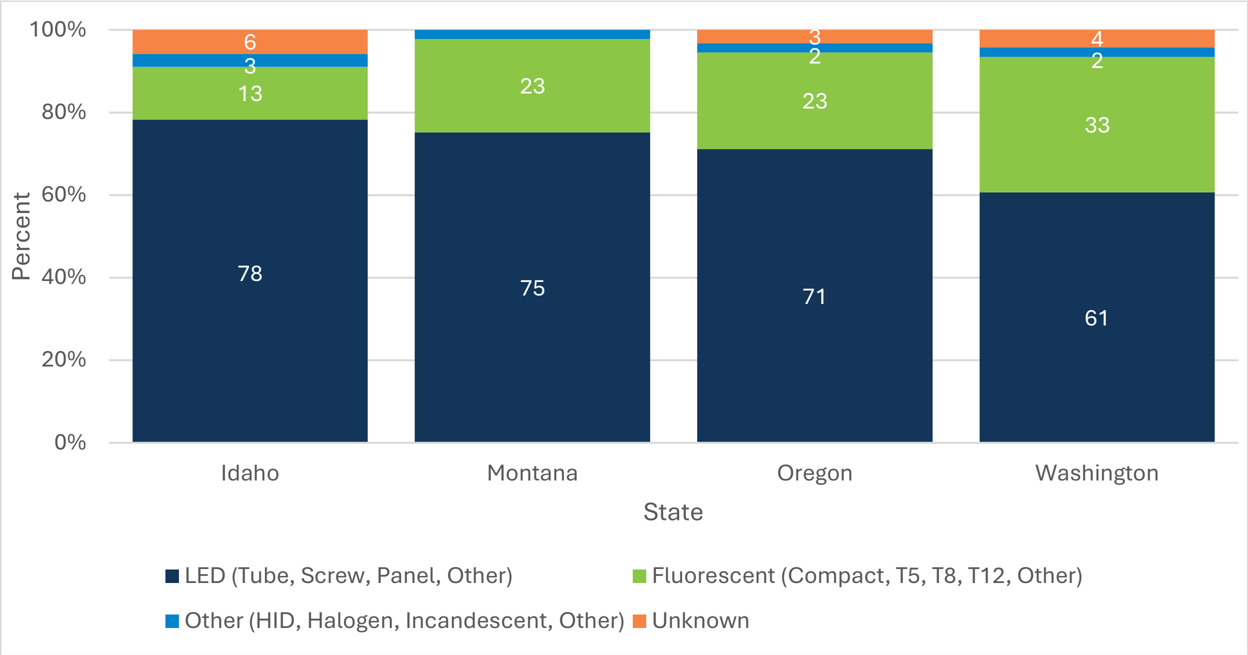
[12] Oregon's House Bill 2531 enacted a complete ban on the sale and distribution of all general-purpose fluorescent tubes and compact fluorescent lamps (CFLs) as of January 1, 2025. This forces a rapid, comprehensive transition to energy-efficient LED technology across all commercial facilities in the state. While Washington has passed similar wide-reaching legislation, its full ban on these common commercial bulbs will not take effect until January 1, 2029.

related to commercial building lighting, but higher LED use in these states may indicate the effectiveness of current energy codes and utility incentives.

Figure 46. Percentage of lighting fixtures by lamp technology and state, 2025

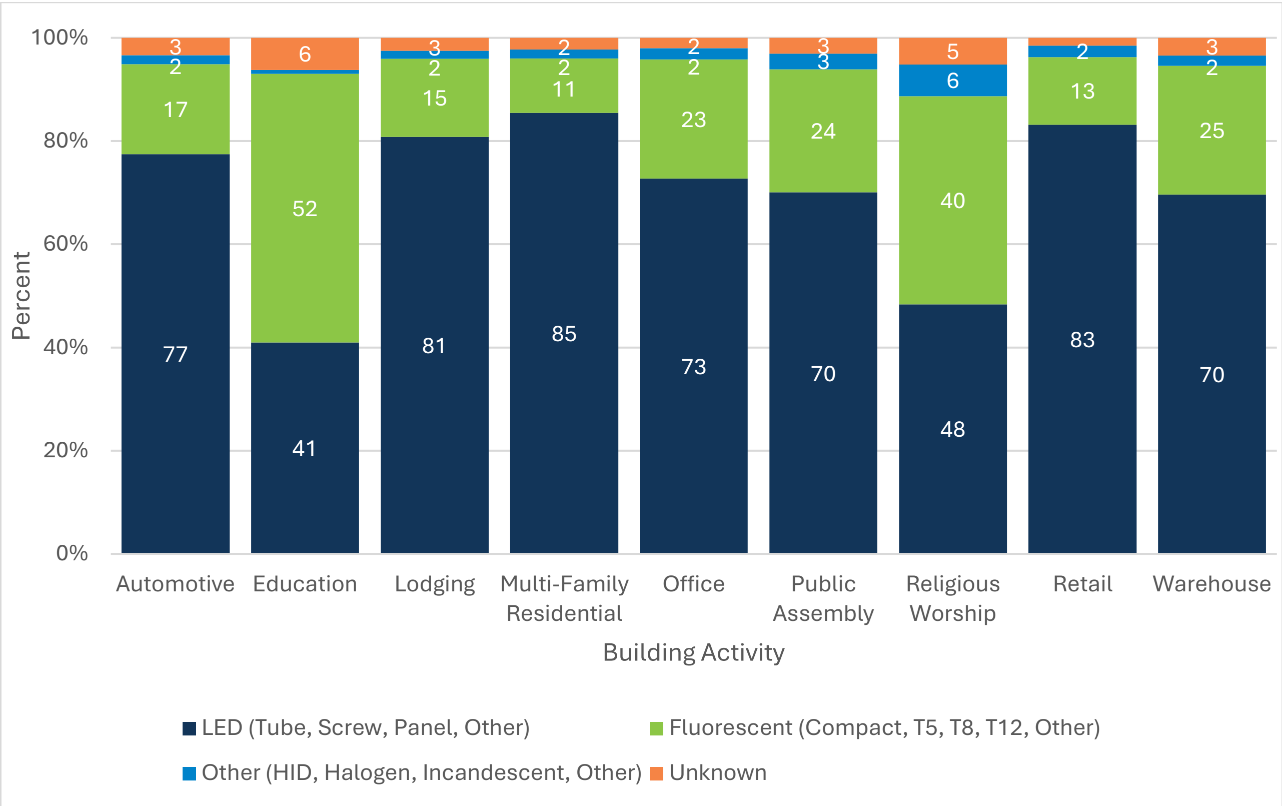


Note. 2025 n=552. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

In addition to state-level differences, lamp technologies differed by primary building activity. Multi-Family Residential, Retail, and Lodging buildings had the highest proportions of lighting fixtures leveraging LED technology (85%, 83%, and 81%, respectively) (Figure 47). Education and Religious Worship buildings had the lowest proportion of lighting fixtures using LEDs (41% and 48%, respectively). Commercial buildings that had a lower proportion of LED fixtures used a higher proportion of fluorescent lighting. For example, among Education buildings, 52 percent of lighting fixtures used fluorescent lighting, with just 6 percent of unknown fixtures and one percent of fixtures that used other types of lamp technology, such as HID, halogen, or incandescent bulbs.

Figure 47. Percentage of lighting fixtures by lamp technology and primary building activity, 2025

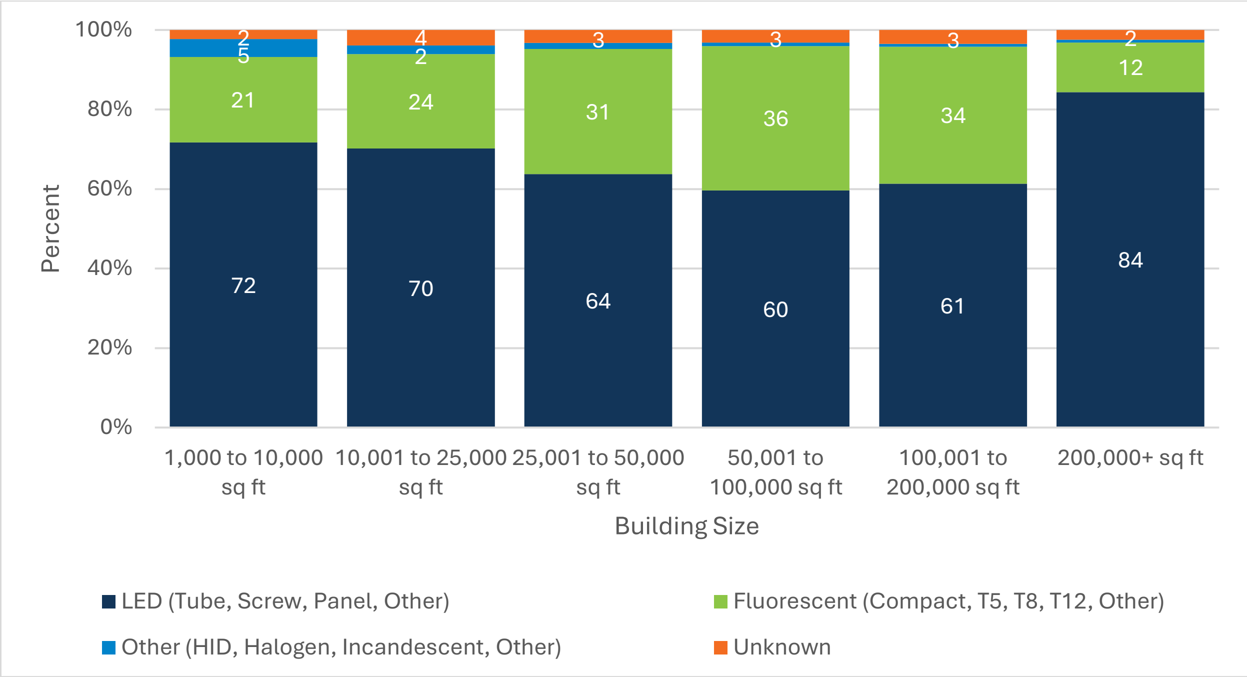


Note. 2025 n=552. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Buildings over 200,000 sq ft had the highest proportion of LED lighting—84 percent of lighting fixtures were LED and 12 percent were fluorescent lighting (Figure 48). Just 2 percent of lighting fixtures in these buildings came from other or unknown types of fixtures. Estimates for smaller buildings indicate that about 72 percent of fixtures in buildings between 1,000 and 10,000 sq ft and 70 percent of fixtures in buildings between 10,001 and 25,000 sq ft used LED technology, while less than one-quarter of fixtures in both size ranges used fluorescent lighting. In medium-sized buildings, 60 to 64 percent of lighting fixtures used LED technology. There may be a variety of factors that contributed to the lower use of LED fixtures in medium-sized buildings, including a common middle market gap in adoption of energy innovation due to less investment and greater complexity in ownership and tenancy arrangements (Hart, 2026).

Figure 48. Percentage of lighting fixtures by lamp technology and building size, 2025



Note. 2025 n=552. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Looking more closely at different types of lamp technology, LED tube lighting was the most commonly used in 2025, representing about one-quarter (26%) of lighting fixtures (Table 5). Linear fluorescent (T8) bulbs were used in 18 percent of lighting fixtures, followed closely by LED screw bulbs (17%). Compared with the 2019 CBSA, other LED fixtures saw a notable increase, jumping by 10 percentage points from 2019 to 2025 (5% in 2019 vs. 15% in 2025). Other LED fixtures include decorative or specialty LED fixtures that may have been specifically designed to fit a space. The proportion of lighting fixtures using linear fluorescent (T8) bulbs declined significantly, by about 20 percentage points between 2019 and 2025. Compact fluorescent lighting fixture use also decreased significantly from 2019 to 2025, dropping from 11 percent in 2019 to 4 percent in 2025. Linear fluorescent (T5) fixtures were the only fluorescent lighting fixture type to increase in use, from 2 percent of fixtures in 2019 to 4 percent of fixtures in 2025. Among the lesser used bulbs, incandescent bulbs saw the biggest decrease, from 3 percent of fixtures in 2019 to 2 percent of fixtures in 2025.

Table 5. Percentage of lighting fixtures by lamp technology with lamp detail, 2019 and 2025

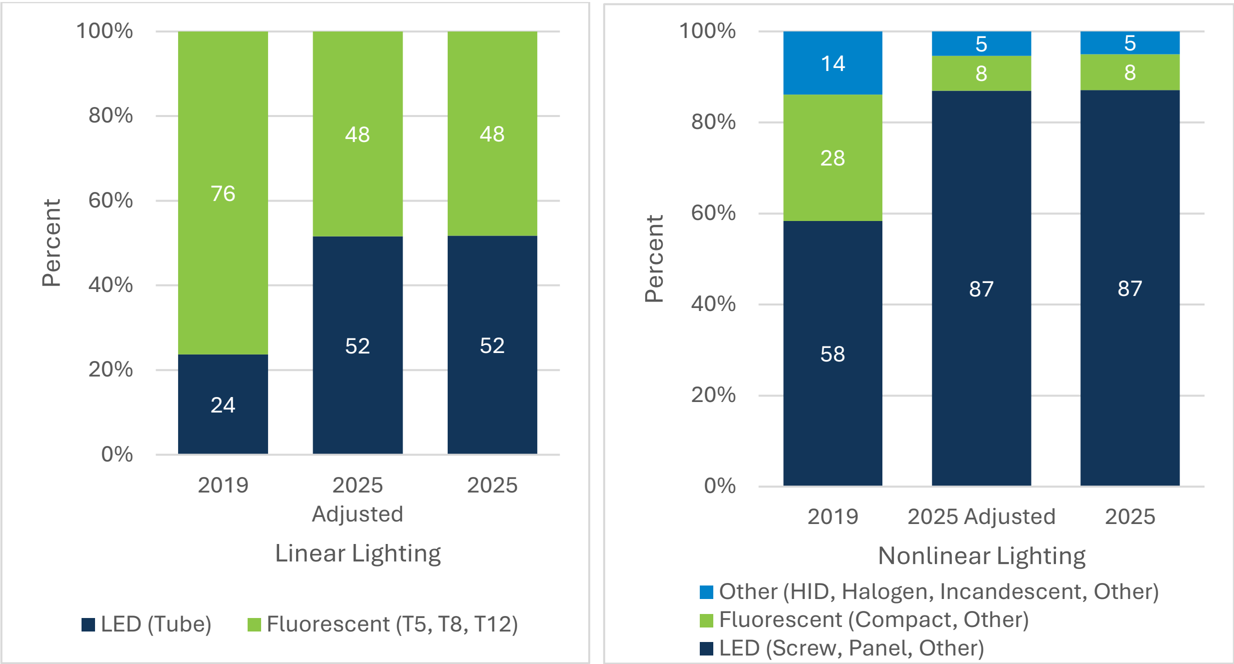
Lamp Technology	2019	2025 Adjusted	2025
LED Total	**37.2%**	**65.7%**	**66.5%**
LED Tube	14.0%	26.2%	25.6%
LED Screw	17.0%	17.1%	16.9%
LED Panel	1.5%	8.4%	9.1%
LED Other	4.7%	14.0%	14.9%
Fluorescent Total	**56.2%**	**28.1%**	**27.6%**
Compact Fluorescent	11.0%	3.5%	3.7%
Linear Fluorescent (T12)	4.9%	1.5%	1.7%
Linear Fluorescent (T5)	1.9%	4.5%	4.3%
Linear Fluorescent (T8)	38.2%	18.4%	17.7%
Linear Fluorescent Other	0.2%	0.1%	0.1%
Linear Fluorescent Unknown	0.0%	0.1%	0.1%
Other Total	**5.5%**	**2.5%**	**2.3%**
HID	0.4%	0.1%	0.1%
Halogen	1.7%	0.4%	0.4%
Incandescent	3.3%	1.6%	1.5%
Other	0.1%	0.4%	0.3%
Unknown	1.2%	3.8%	3.8%
Overall Total	**44,582,489**	**31,572,123**	**34,479,151**

Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

The increase in LED technology is similar across linear and nonlinear fixture types; however, LEDs made up a much larger proportion of nonlinear lighting fixtures (Figure 49). Estimates from the 2025 CBSA suggest that 87 percent of nonlinear fixtures were LED, compared with 58 percent in 2019. Among linear fixtures, roughly half (52%) were LED fixtures, more than twice the proportion in 2019 (24%). Although LED lighting increased significantly since 2019, there is still considerable room for growth in continuing to shift to linear LEDs.

Figure 49. Percentage of linear and nonlinear lighting fixtures by lamp technology, 2019 and 2025

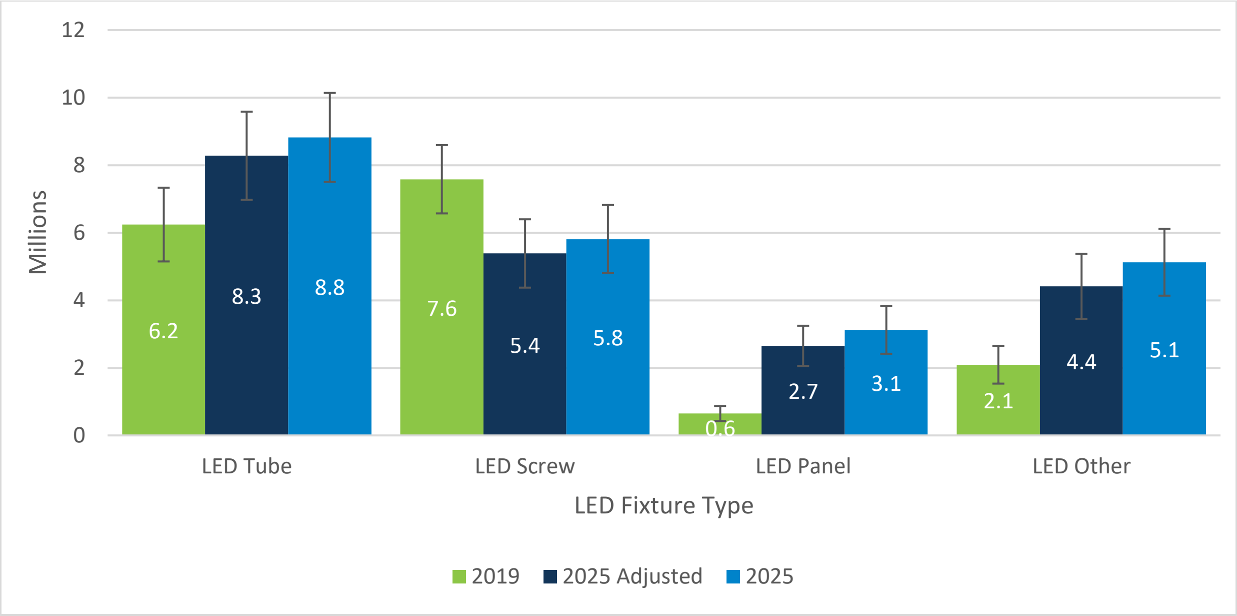


Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

The 2025 CBSA estimates that significantly more lighting fixtures used LED tube, LED panel, and other types of LED lighting than in 2019, despite a decrease in the total number of fixtures when compared with 2019 (Figure 50). Fixtures that used LED screw bulbs were the only type of LED lighting that did not significantly change from 2019, which aligns with recent U.S. Department of Energy forecasts that integrated LED luminaires have become the dominant form of new lighting installations in many sectors (Yamada et al., 2019).

Figure 50. LED fixtures by lamp type, 2019 and 2025

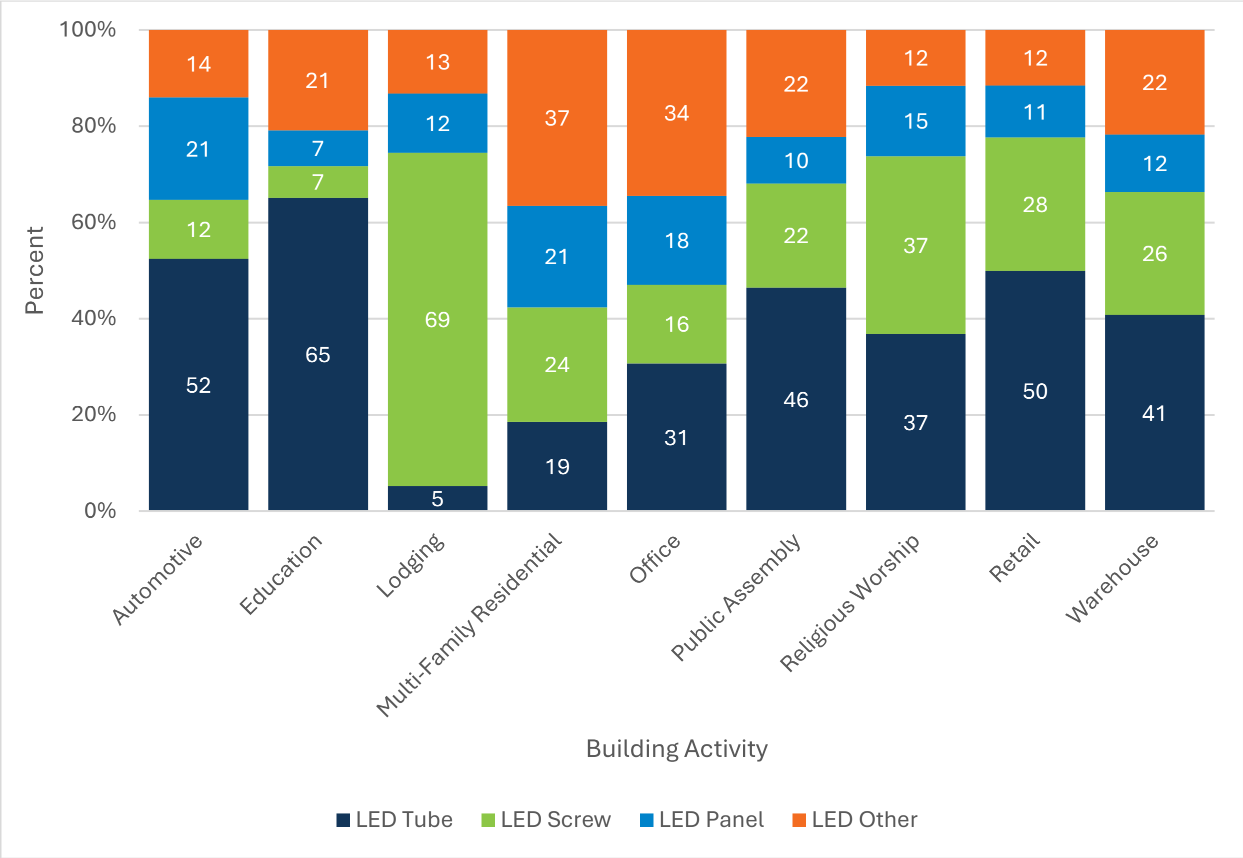


Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

In 2025, there were differences in the type of LED technology used for lighting fixtures across primary building activities. LED tube lighting fixtures were most common in Education (65%), Automotive (52%), and Retail (50%) buildings (Figure 51). Although LED tube lighting was the most common type across all lighting fixtures in 2025, it was much less common in Lodging buildings, where only 5 percent of fixtures used LED tubes. Sixty-nine percent of all LED fixtures in Lodging buildings used LED screw bulbs, likely a result of hotel rooms having multiple small fixtures. Multi-Family Residential buildings (19%) also used fewer LED tube lighting fixtures compared with other primary building activities.

Figure 51. Percentage of LED fixtures by lamp type and primary building activity, 2025

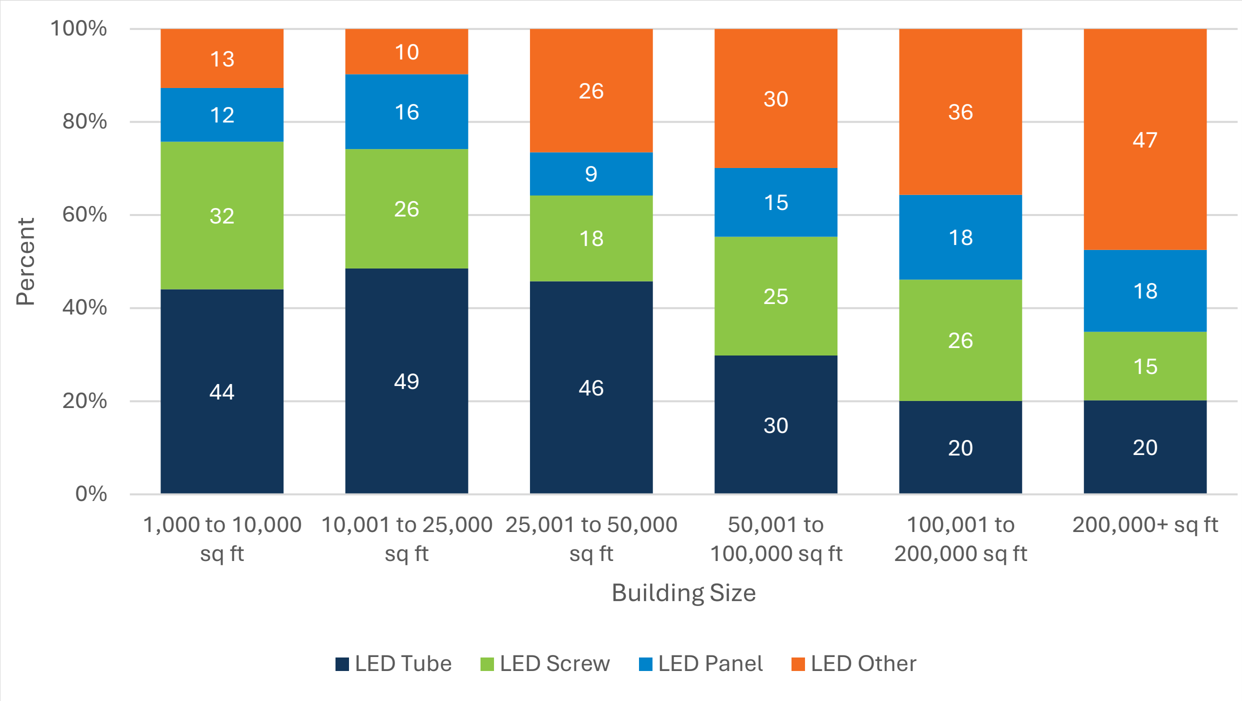


Note. 2025 n=552. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

The 2025 CBSA estimates show that LED fixture use differed by building size (Figure 52). Buildings 50,000 sq ft or smaller used a larger proportion of LED tube fixtures compared with buildings larger than 50,000 sq ft. Estimates indicate that these smaller building sizes used LED tube lighting for more than 40 percent of their lighting fixtures, compared with 30 percent or less for buildings over 50,000 sq ft. In place of LED tube lighting, larger buildings tended to use a larger proportion of lighting fixtures with other types of LED technology. For example, among buildings that were larger than 200,000 sq ft, 40 percent of commercial lighting fixtures used some other type of LED technology. Other LED fixtures may have specialty functions that were more common in larger buildings than smaller buildings.

Figure 52. Percentage of LED fixtures by lamp type and building size, 2025

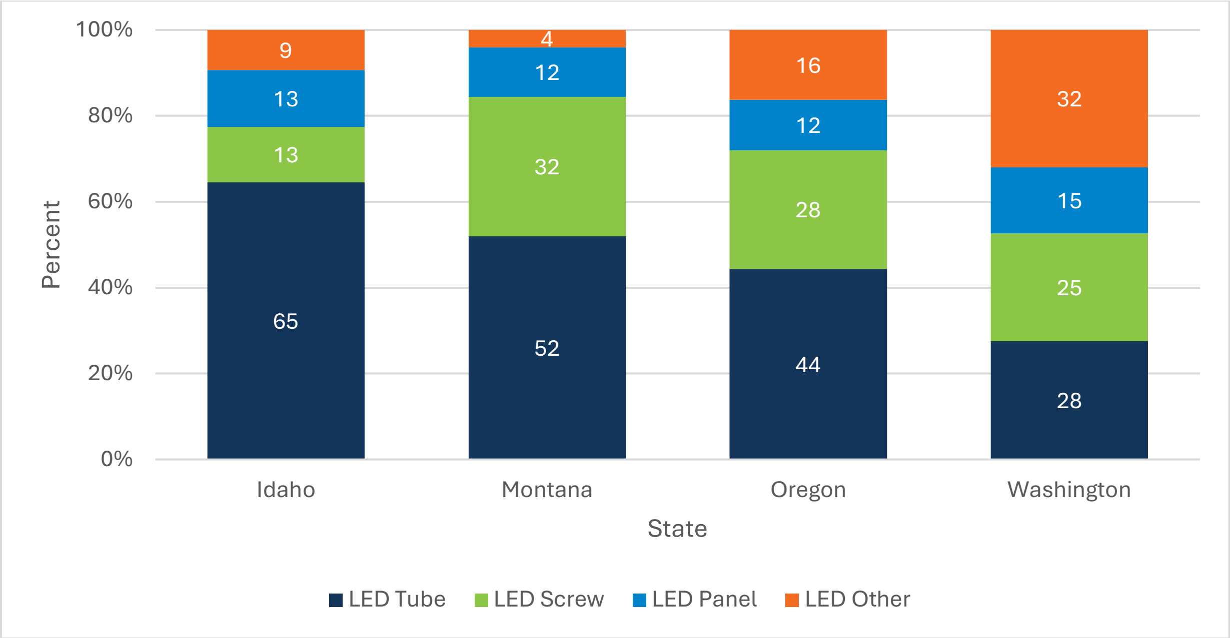


Note. 2025 n=552. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

LED fixture technology varied by state (Figure 53). Estimates from the 2025 CBSA indicate that the majority of LED lighting fixtures in Idaho and Montana used LED tube lighting (65% and 53%, respectively). In Montana and Oregon, lighting fixtures that used LED screw bulbs were quite common, accounting for 32 percent and 28 percent of LED lighting fixtures, respectively. LED fixtures in Washington tended to be more evenly distributed across the different types of LED technology compared with the other states, with about one-quarter of all LED fixtures using LED tube (28%) and LED screw (25%) lighting. A significantly larger proportion of LED lighting fixtures in Washington used other types of LED technology (32%) compared with the other states.

Figure 53. Percentage of LED fixtures by lamp type and state, 2025



Note. 2025 n=552. Weighted population estimates.

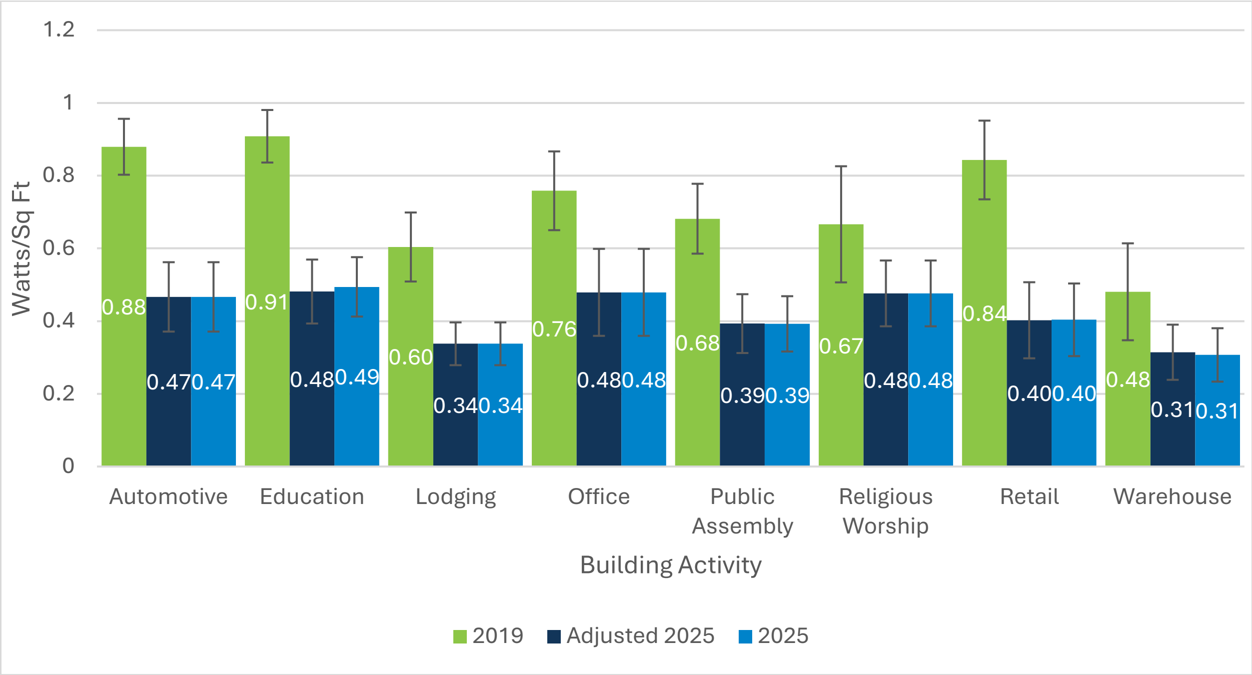
Source. 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

5.3 Indoor Lighting Power Density

Indoor lighting power density (LPD) facilitates understanding of lighting use and compliance with state energy code requirements. Overall indoor LPD, calculated as the ratio of total wattage to total floor space (watts/sq ft) within a category, was 0.42 watts/sq ft in 2025. Although LPD varied by primary building activity, all buildings had an indoor LPD between 0.3 and 0.5 watts/sq ft (Figure 54). Education, Office, Religious Worship, and Automotive buildings each had an indoor LPD of 0.47 or higher watts/sq ft. Similar to total fixture density, Warehouse buildings had the lowest indoor LPD of all the primary building activities (0.31 watts/sq ft). Lodging buildings also had a lower indoor LPD (0.34 watts/sq ft) compared with other primary building activities, likely a result of many fixtures with low wattage bulbs.

The 2025 CBSA estimated significantly lower indoor LPD compared with the 2019 CBSA, dropping 0.3 watts/sq ft (from 0.74 in 2019 to 0.42 in 2025). This difference may, in part, be explained by continued proliferation of more energy efficient LED lighting, highlighted earlier in Figure 45. The different sample design and frame creation processes in 2025 (see Section A.2) may also contribute to this difference. Despite differences in magnitude between 2019 and 2025, the trends by primary building activity are relatively similar—Education and Automotive buildings had among the highest indoor LPD (in addition to Office and Religious Worship buildings), and Warehouse and Lodging buildings had the lowest.

Figure 54. Indoor LPD by primary building activity, 2019 and 2025

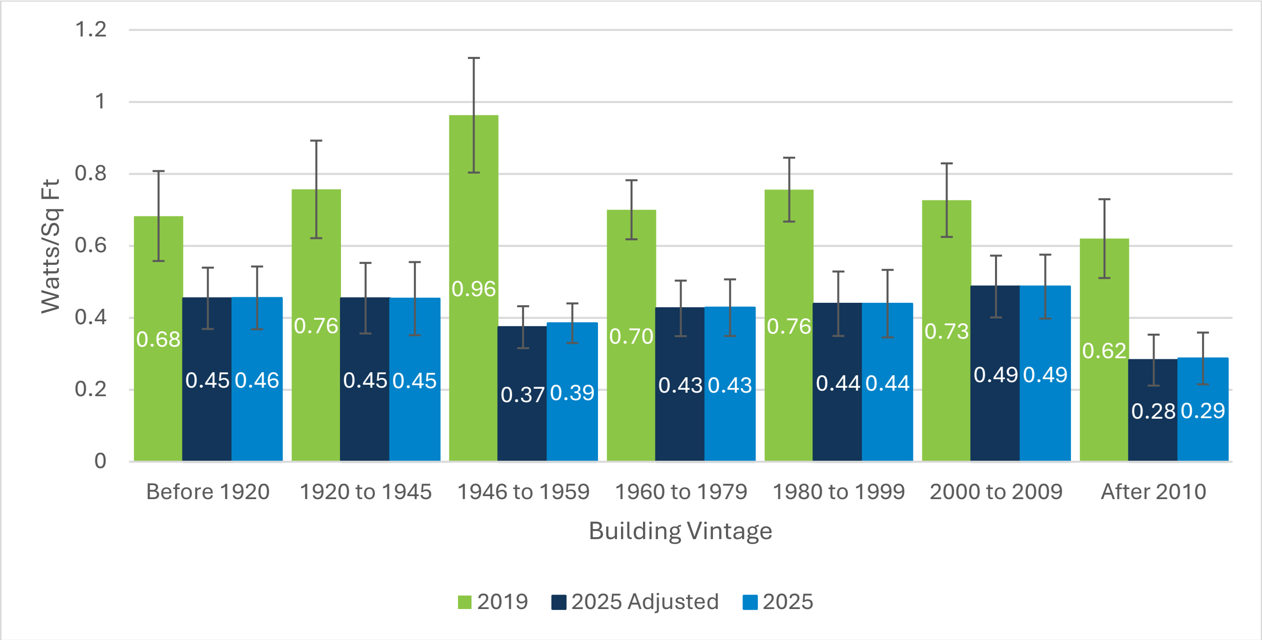


Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates. Multi-Family Residential buildings are excluded from fixture density calculations because only nonresidential space was surveyed during the site visit.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

Indoor LPD also varied by building vintage (Figure 55). In 2025, newer buildings (i.e., those constructed after 2010) had a significantly lower indoor LPD (0.29 watts/sq ft) than did slightly older buildings, which ranged from 0.39 to 0.49 watts/sq ft. In 2019, indoor LPD varied more by building age, ranging from 0.62 watts/sq ft among the newest buildings to 0.96 watts/sq ft for buildings constructed between 1946 and 1959. In 2019, indoor LPD was highest for buildings constructed between 1946 and 1959, while indoor LPD estimates in 2025 were relatively steady across building vintages. The lack of consistency across years suggests that the specific buildings in the 2019 sample may have driven the finding, rather than a broader change in indoor LPD for buildings constructed between 1946 and 1959.

Figure 55. Indoor lighting power density by building vintage, 2019 and 2025



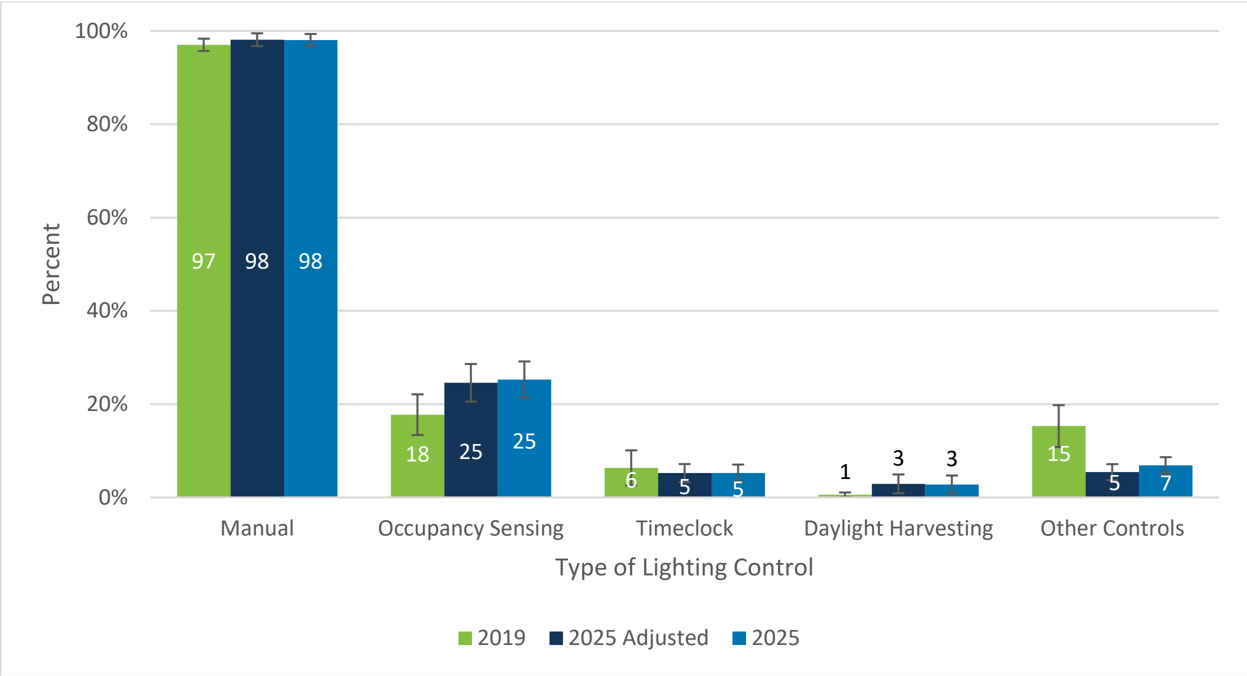
Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates. Multi-Family Residential buildings are excluded from fixture density calculations because only nonresidential space was surveyed during the site visit.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

5.4 Lighting Controls

Across all buildings in the 2025 CBSA, manual lighting controls were the most common lighting control type (Figure 56). Ninety-eight percent of buildings used manual lighting controls. In addition to manual lighting controls, 25 percent of buildings used some type of occupancy sensing to control lighting. A much smaller proportion of buildings used some other type of lighting control (7%), timeclocks (5%), and daylight harvesting (3%). In 2025, “no controls” was a selectable response option, and 37 percent of buildings reported indoor lighting fixtures with no lighting controls. More than half of the lighting fixtures with no controls were lighted signs, likely associated with emergency lighting designed to run regardless of power outages (e.g., exit signs). However, there were no directly comparable data collected in 2019, so potential change for this category is unknown.

Figure 56. Percentage of buildings with each lighting control type, 2019 and 2025



Note. 2019 n=932; 2025 Adjusted n=492; 2025 n=552. Weighted population estimates.

Sources. 2019 Commercial Building Stock Assessment Data Files (2020); 2025 Commercial Building Stock Assessment Data Files (2026), Site Visit.

6. Miscellaneous Uses and Characteristics

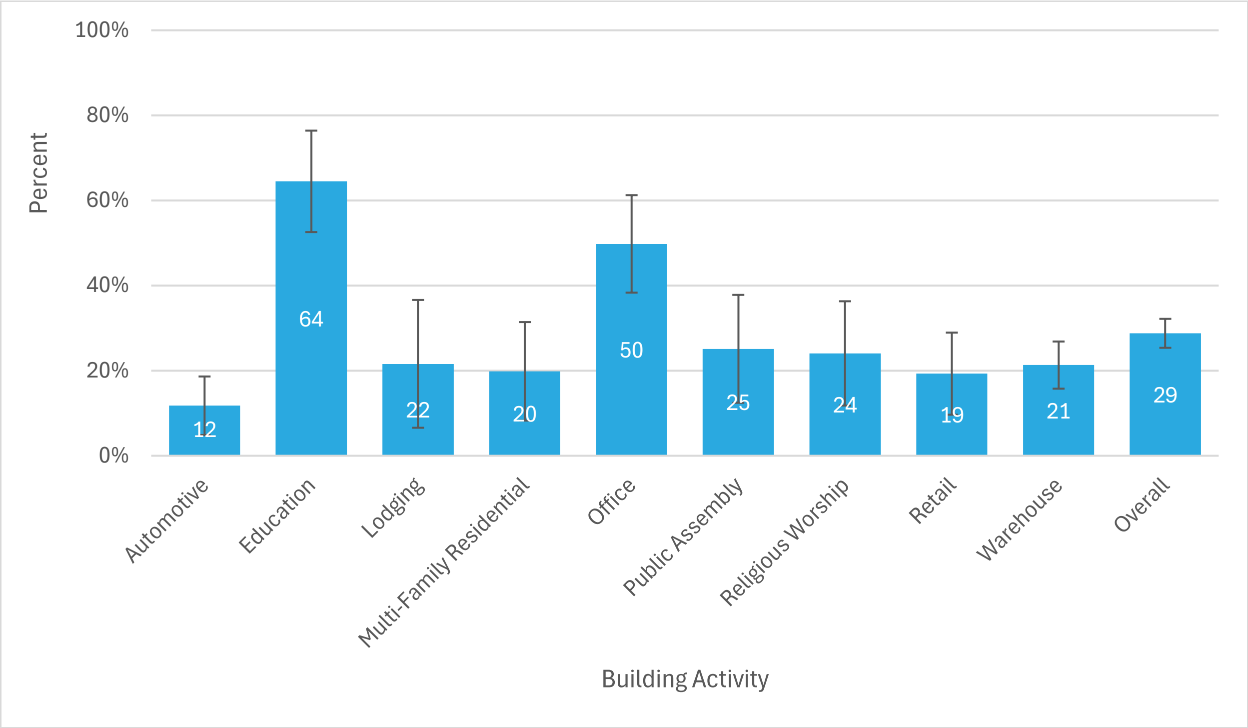
The 2025 CBSA included some new items related to emerging energy use drivers, including dedicated server space, on-site energy generation, and the availability of charging for electric vehicles (EVs).

6.1 Servers

Data centers are an emerging interest, with implications for energy use, but there are not currently many buildings in the Northwest region that are dedicated fully to this purpose. No buildings that primarily served as a dedicated data center were part of the 2025 sample; however, there were some building categories that contained server space to support the work of employees. Dedicated server space in a building can indicate greater, more continuous energy use in a limited amount of space. Overall, the estimated total floor area of all server space was just over 6 million sq ft, out of the estimated 4.5 billion sq ft of all commercial floor space (0.01%). Twenty-nine percent of buildings had a dedicated server space of any size

(Figure 57). Compared with other building categories, more Education and Office buildings had dedicated server space (64% and 50% of these buildings, respectively, had such space), while fewer Automotive buildings did (12%).

Figure 57. Percentage of buildings with any server space by primary building activity, 2025



Note. 2025 n=676. Weighted population estimates.

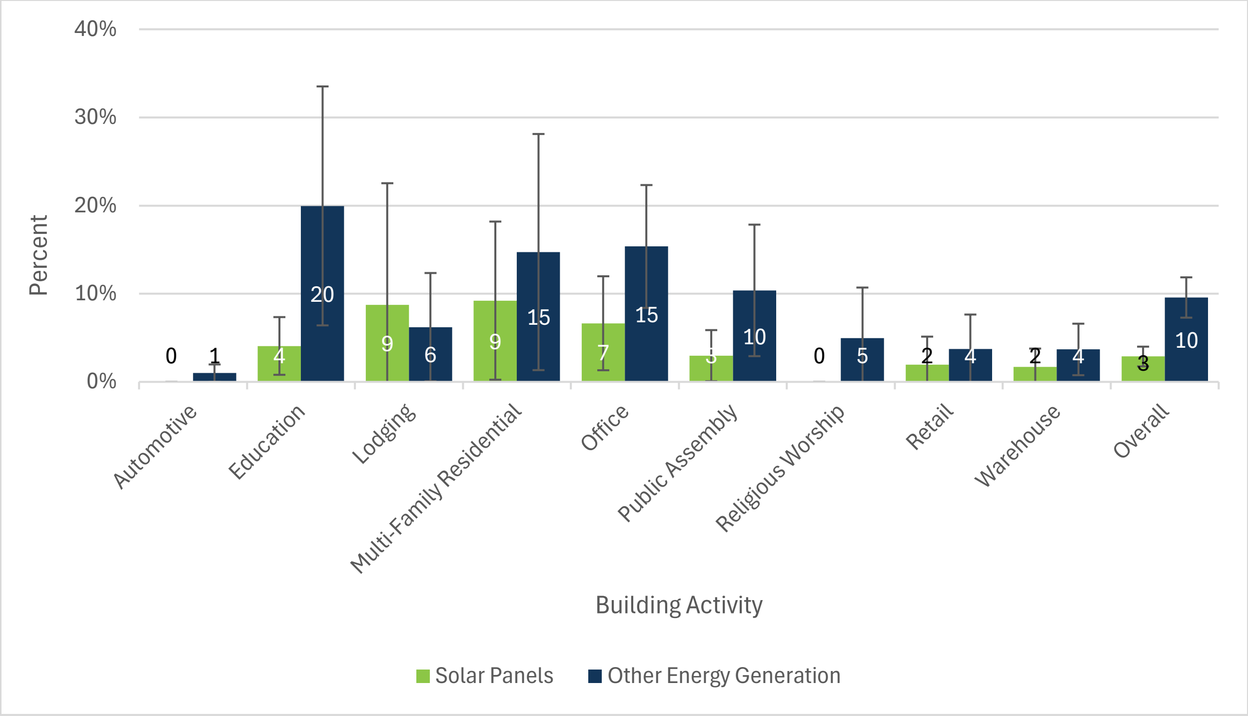
Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

Use of larger server spaces, such as a server room or a data center, was more limited. Only 5 percent of all buildings contained these types of server spaces in 2025, and there was much more variance by primary building activity. Additionally, 5 percent of buildings had dedicated cooling for a server space, which was more common in buildings larger than 25,000 sq ft than in buildings 25,000 sq ft and smaller.

6.2 On-Site Energy Generation

On-site energy generation can include options for ongoing energy generation as well as backup generators. Overall in 2025, 3 percent of buildings used solar panels, and 10 percent used other energy generation, which most respondents indicated was backup generators (Figure 58). Other energy generation was reported more frequently than were solar panels across all primary building activities, with more Education, Multi-Family Residential, and Office buildings reporting other energy generation than other building categories, although there was high variability in these estimates as demonstrated by the wide confidence intervals.

Figure 58. Percentage of on-site energy generation by primary building activity, 2025

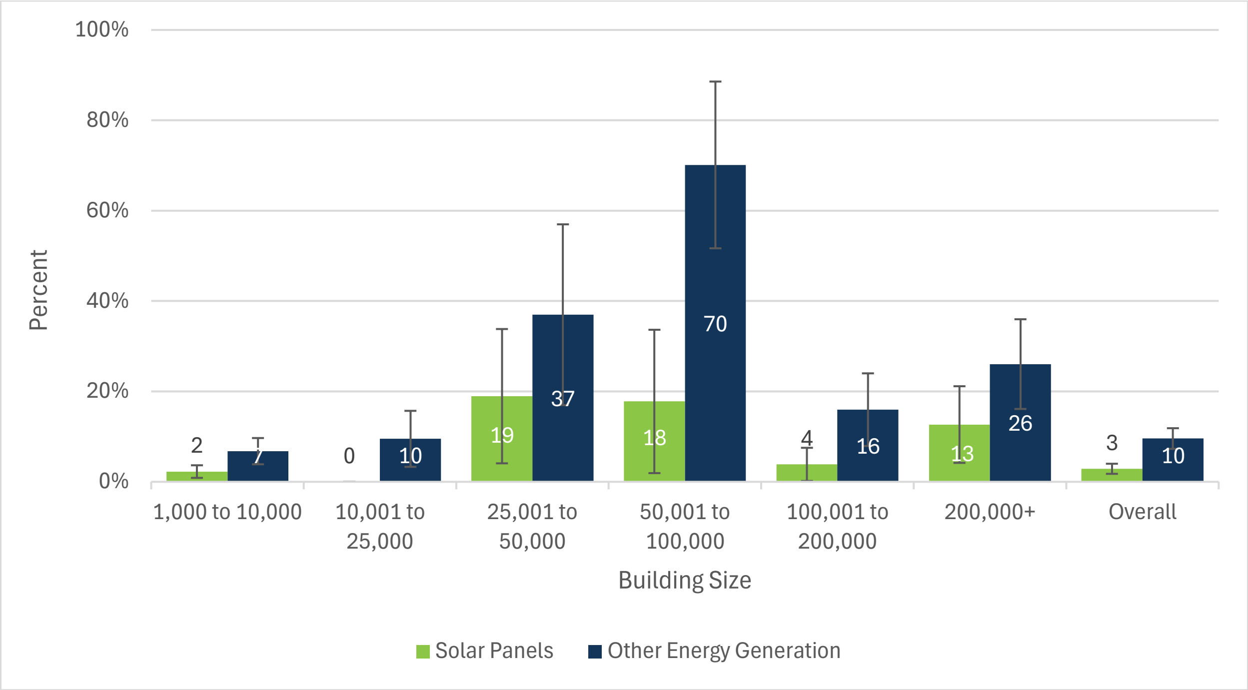


Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

When looking at on-site energy generation by building size in 2025, buildings ranging between 25,001 and 50,000 sq ft had the highest estimated on-site energy generation (70% of these buildings generated energy on-site). In general, buildings that were 25,001 sq ft or larger more commonly used both solar panels and other energy generation than did buildings that were 25,000 sq ft or smaller (Figure 59). These findings align with prior research indicating that commercial energy generation adoption is concentrated in medium- and large-scale commercial facilities where reliability requirements and load economics support investment in on-site energy generation (LaCommare et al., 2006).

Figure 59. Percentage of on-site energy generation by building size, 2025

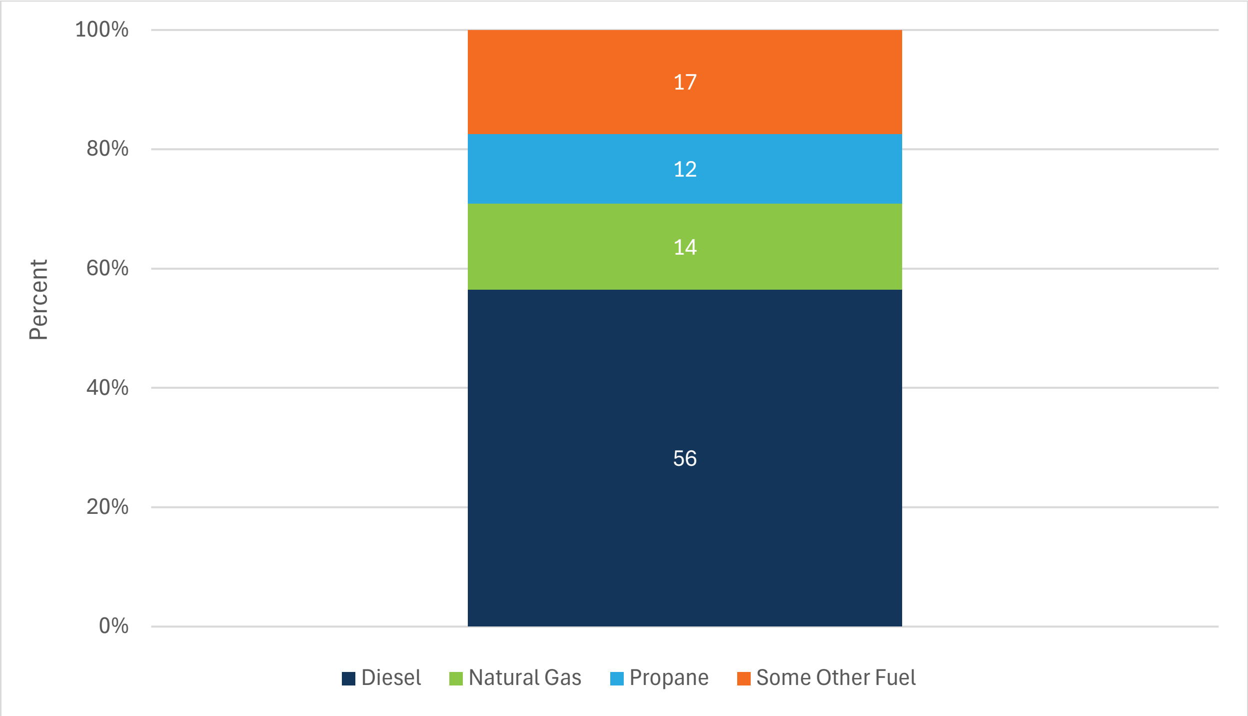


Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

In 2025, for buildings that used a generator for on-site energy generation, 56 percent of the generators were fueled by diesel, with the remainder split relatively evenly between natural gas, propane, and some other type of fuel (Figure 60).

Figure 60. Percentage of generator fuel type of on-site energy generation, 2025



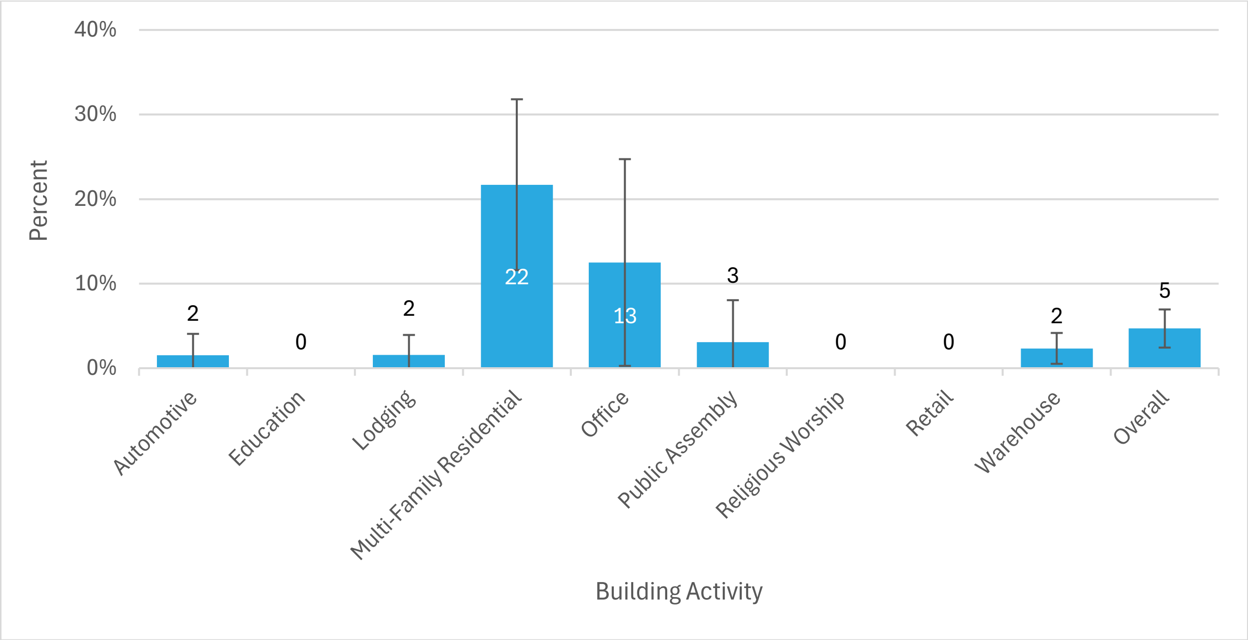
Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

6.3 EV Charging

The 2025 CBSA also collected data related to EV charging for the first time. Five percent of buildings overall had charging for EVs available (Figure 61). Of the participating buildings with EV charging, nearly all (88%) offered Level 2 chargers, while the charging type could not be determined for the remaining 12 percent. Twenty-two percent of Multi-Family Residential buildings offered EV chargers, as did 13 percent of Office buildings, although with a higher variance of the estimate. Three percent or less of buildings with other primary activities offered EV charging.

Figure 61. Percentage of EV charging availability by primary building activity, 2025

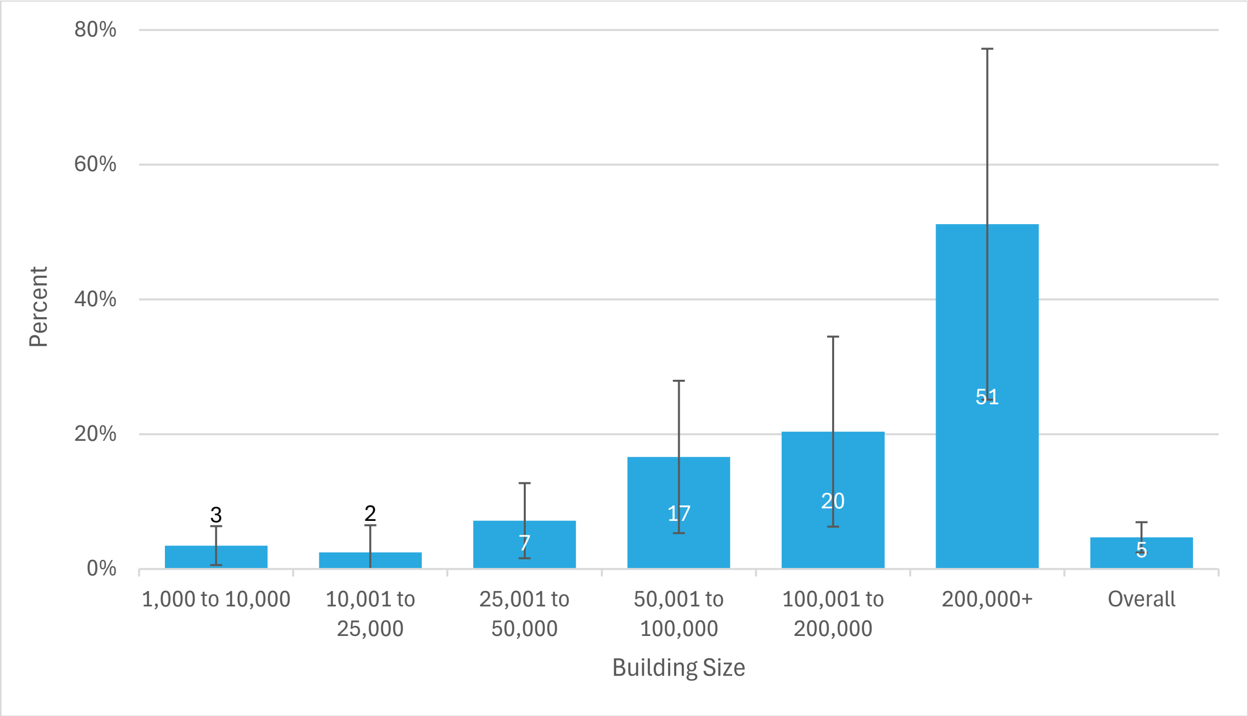


Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

With respect to building size, larger buildings more frequently had EV chargers when compared with smaller buildings in 2025; 51 percent of the largest buildings (those larger than 200,000 sq ft) had EV chargers (Figure 62), while only 2 to 3 percent of buildings smaller than 25,001 sq ft did.

Figure 62. EV charging availability by building size, 2025



Note. 2025 n=676. Weighted population estimates.

Source. 2025 Commercial Building Stock Assessment Data Files (2026), Web Survey.

C. Methods and Data Collection Protocols

1. Overview

This section of the report documents the study methodology for both data collection components of the 2025 CBSA: the building survey and the utility billing data. Descriptions are provided for the sample design and frame development, recruitment methodology, data collection protocols, data processing and quality control procedures, weighting and variance estimation, and other important operational details.

2. Sample Design

2.1 Overview

The 2025 CBSA sample design aimed to achieve 950 completed building interviews, with a design that would produce margins of sampling error of no more than 10 percent with 90 percent confidence for both estimates of total natural gas and electricity use, and for estimates of proportions of buildings with various characteristics. To achieve these precision goals while controlling data collection costs, the 2025 CBSA sample design used a stratified, two-phase probability sample. The two phases of selection were as follows:

- **Phase 1 – Selection of tracts.** Ninety census tracts were selected within Idaho, Montana, Oregon, and Washington. Fifteen census tracts were selected from the "Small" tract stratum, which contained tracts with 6 to 30 commercial buildings and 75 census tracts were selected from the "Large" tract stratum, which contained tracts with 31 or more commercial buildings. Within both the Small and Large tract strata, the tracts were further stratified by Bonneville Power Administration (BPA) administrative subregion (see Figure 1 in Section A.2.2), to help ensure the selected tracts were proportionately allocated by these geographic areas and eliminated samples that were poorly distributed. As illustrated in Table 6, the 2025 CBSA tract sampling frame (i.e., the list of tracts from which to select a sample) and the CBSA tract sample contained very similar proportions of tracts by stratum and BPA administrative subregion, indicating the tract sample was well balanced geographically across the Northwest region.

Table 6.	2025 CBSA tract-level frame and sample counts of tracts by tract-level stratum and BPA administrative subregion				
Tract-level stratum	**BPA administrative subregion**	**Frame**	**Percentage of frame in stratum**	**Sample**	**Percentage of sample in stratum**
Large (31+ buildings in tract)	Eastern Oregon	137	5%	3	4%
	Eastern Washington	322	12%	8	11%
	Idaho	363	14%	10	13%
	Montana	251	10%	7	9%
	Puget Sound	718	27%	24	32%
	Western Oregon	663	25%	18	24%
	Western Washington	190	7%	5	7%
Large stratum total		2,644	100%	75	100%
Small (6–30 buildings in tract)	Eastern Oregon	14	2%	0	0%
	Eastern Washington	80	10%	2	13%
	Idaho	83	11%	1	7%
	Montana	26	3%	1	7%
	Puget Sound	353	45%	7	47%
	Western Oregon	167	21%	3	20%
	Western Washington	62	8%	1	7%
Small stratum total		785	100%	15	100%
Overall total		**3,429**		**90**	

The tract-level sample design included two specific measures to limit the number of tracts selected with fewer than 30 eligible buildings. These measures helped control costs by increasing the efficiency of data collection trips. First, all tracts with fewer than 6 eligible buildings were ineligible for selection.[13] Second, the remaining tracts were split into two strata: tracts with 6–30 eligible buildings and tracts with more than 30 eligible buildings. Tracts in the more than 30 eligible buildings stratum were selected at higher rates than those in the 6–30 eligible buildings stratum.

Different selection methods were also used in the two strata. In the stratum with tracts containing more than 30 eligible buildings, the tracts were randomly sampled proportional to size, with the size being the estimated commercial building square footage in tract to the two-thirds power. As explained further in Sections C.2.2.3.2 and C.2.3.2.1, estimated

[13] In the 2025 CBSA Geographic region, only two percent of all tracts had fewer than six eligible buildings.

commercial building square footage to the two-thirds power, rather than just estimated commercial building square footage, was used as the size variable to balance the desire for reasonable levels of precision for energy consumption totals and proportions. In the stratum with tracts with 30 or fewer buildings, the tracts were randomly sampled with equal probability (i.e., each tract had the same probability of selection).

- **Phase 2 – Selection of buildings.** Using a projected 84 percent eligibility rate and a 20 percent response rate, 5,654 commercial and multi-family residential buildings were selected from the sampling frame produced via virtual listing in the 90 sampled tracts (see Section C.3).

  In the 90 selected tracts, all multi-family residential buildings, buildings greater than 50,000 sq ft, and buildings in tracts with 20 or fewer buildings were selected with certainty (i.e., all buildings were selected) to achieve the desired level of precision overall for totals and proportions and achieve as precise an estimate as possible for multi-family residential buildings. Buildings in selected tracts with 21–30 buildings were randomly selected with equal probability. The remaining buildings were explicitly stratified by size, implicitly stratified by building use category, and sampled using an optimal allocation with probability proportional to size (PPS). Section C.2.3 provides details on the building within tract sample design.

2.2 Phase 1 – Selection of Tracts

2.2.1 Dun & Bradstreet's Enhanced Business File Processing

The Enhanced Business File (EBF) is a building-level file of commercial and residential buildings in the United States compiled by Dun & Bradstreet (D&B). Each EBF record includes the building address, geographical data (e.g., Federal Information Processing System (FIPS) state and county code, census tract and block codes, longitude and latitude coordinates), and characteristics related to the building size, such as square footage, building footprint square footage, number of stories, and number of deliverable mailing units within the building. The EBF also provides information on the primary and secondary use of the building (e.g., agricultural, commercial, industrial, residential single-family home, residential multi-dwelling unit).

To create a frame of eligible buildings and tracts for sampling purposes, Westat conducted the following EBF file processing steps.

Step 1: Exclude buildings based on primary building use and building location. The primary building use variable was used to exclude buildings whose primary use was agricultural, industrial, residential single-family housing, military, parking (garage or lot), correctional facility, or psychiatric hospital. We excluded buildings with a primary use of military, correctional facility, and psychiatric hospital due to security concerns and access issues. We also excluded the 39 tracts in eastern Montana whose residents receive their electricity or natural gas from a utility company other than NorthWestern Energy.

Step 2: Impute the number of building stories and calculate an estimated building square footage. Building square footage was estimated as the product of the EBF building footprint square footage and the number of stories, capped at 1 million sq ft. Buildings with missing values for the number of stories had a value imputed. A distribution for imputation was set using the number of units in the building.

Step 3: Exclude multi-family residential buildings with fewer than four stories or fewer than five units and buildings less than 1,001 sq ft. The remaining EBF buildings were filtered by excluding any residential multi-family buildings with less than four stories (using the imputed value) or less than five mailing units, as well as all buildings less than 1,001 sq ft. After these exclusions, the frame for tract selection contained 300,624 eligible buildings.

2.2.2 Tract Frame Creation, Stratification, and Allocation

In the process of generating a tract-level sampling frame, we aggregated the 300,624 EBF records and their estimated square footage to the tract level. There was a sizable proportion of tracts with relatively few buildings; nearly 25 percent of the eligible tracts had fewer than 31 eligible buildings. Selecting tracts that contained very few buildings would increase the number of tracts that needed to be selected to achieve the desired number of completed cases. To help control data collection costs, we first excluded all 230 buildings in the 73 tracts with fewer than 6 eligible buildings. In the remaining tracts with 6 or more eligible buildings, we created two tract-level strata:

- Small stratum: tracts with 6–30 eligible buildings
- Large stratum: tracts with 31 or more eligible buildings

2.2.3 Tract Selection Procedures by Stratum

There is a tension that must be balanced in this sample design at both the tract and building level in supporting estimates for totals and proportions. Sampling tracts based on the total square footage of buildings in the tract are efficient for variables that tend to scale with square footage, such as total natural gas and electricity consumption, because these quantities have greater absolute variability in larger buildings (Green et al., 2019). However, a proportional allocation where tracts are assigned an equal chance of being sampled is more efficient. Proportional allocation would generate a sample with more tracts with smaller total square footage than sampling proportional to a square-foot-size scheme. To achieve a compromise that balances both, we implemented different sampling procedures for the two strata.

2.2.3.1 Small Stratum

In the Small stratum, we selected an implicitly stratified, systematic, equal probability sample of 15 tracts. Implicitly stratifying the tracts by two key geographic variables—state and BPA administrative subregion—and using a systematic selection procedure helped ensure that the 15 selected tracts were proportionately allocated and eliminated samples that were poorly distributed.

Within the Small stratum, the probability of selection was a constant for all tracts in the stratum, calculated as follows:

$$\pi_{1i} = \frac{n_{1i}}{N_{1i}} = \frac{15}{785} = \sim 0.019$$

where

π_{1i}	=	the probability of selection of tract *i* in the Small tract stratum
n_{1i}	=	the number of tracts selected in the Small tract stratum
N_{1i}	=	the number of tracts in the Small tract stratum

2.2.3.2 Large Stratum

In the Large stratum, an implicitly stratified PPS sample of 75 tracts was selected. Like the Small tract stratum, we implicitly stratified the tracts in the Large tract stratum by state and BPA administrative subregion to prevent samples poorly distributed on these two characteristics. The goal in using the PPS sampling method was to oversample tracts based on total building square footage, while being judicious with the oversampling rate to strike a reasonable balance between the precision for energy consumption totals and proportions. To help maintain this balance, the measure of size (MOS) was the total building square footage within the stratum raised to the two-thirds power.

The probability of selection of tract *i* within the Large tract stratum depended on the MOS (M_{2i}) and the desired number of tracts selected (i.e., 75), as follows:

$$\pi_{2i} = 75 \frac{M_{2i}}{\sum M_{2i}}$$

where

π_{2i}	=	the probability of selection of tract *i* in the Large tract stratum
M_{2i}	=	the MOS for tract *i* (i.e., two-thirds power of the sum of the square footage of all eligible buildings in the tract) in the Large tract stratum

2.3 Phase 2 – Selection of Buildings

The building-level sample design involved creating a building sampling frame, assigning the buildings to 2025 CBSA size and use categories, determining the allocation and building sampling rates to meet the 2025 CBSA precision targets, specifying the sampling procedures, and monitoring the eligibility and response rates during data collection. Sections C.2.3.1 and C.2.3.2 describe each of these steps in detail.

2.3.1 Building Frame Creation

2.3.1.1 Virtual Listing Methodology

Westat's Virtual Listing System (VLS) was used to create a building frame for each of the sampled tracts. Because listing was used to create the frame, the sampling unit is a commercial or multi-family residential building rather than a street address; in other words, each record on the frame represents a physical building structure (i.e., a building footprint). See Section C.3 for details about the VLS.

2.3.1.2 Using Substitution When a Tract Could Not Be Virtually Listed

We reviewed the 90 selected tracts and identified 9 tracts that needed to be replaced because satellite imagery was not available. For each of these 9 tracts, we identified a substitute tract by sorting the frame of tracts in the stratum to which the tract belonged by geographic subregion, state, and total square footage of the tract. We then reviewed the tracts just above and below the originally selected tract in the sorted tract order and chose as the substitute the tract that was closest in total building square footage to the original tract.

2.3.1.3 Definition of Eligible Buildings

The target population for the 2025 CBSA is commercial and residential multi-family buildings larger than 1,000 sq ft in eligible tracts in Idaho, Montana, Oregon, and Washington. To be considered a building for the 2025 CBSA, a structure must have been totally enclosed by walls extending from the foundation to the roof and intended for human access. Structures with no totally enclosed space and enclosed structures where people cannot usually enter, such as cooling towers of a nuclear power plant or pumping stations, were excluded. The total square footage within the exterior walls must have been greater than 1,000 sq ft.

To meet the criteria of a commercial building, more than half of the square footage must have been used for commercial purposes or have been a residential multi-family building with at least four stories and at least five mail delivery units. Buildings that were predominantly used for industrial, agricultural, or military purposes; buildings where access was restricted for national security purposes, single-family residences, parking garages, mobile offices that were not placed on a permanent foundation; and any building not ready for occupancy during 2025 were not eligible.

2.3.2 Building Stratification, Allocation, and Selection

2.3.2.1 Building Stratification and Allocation

The sample design objective for the 2025 CBSA was to yield approximately 950 completed site visits (including approximately 900 from buildings in the Large tract stratum) and achieve margins of error of no greater than 10 percent for both totals and proportions. Based on the results from virtual listing, we created six building-level strata to achieve this objective:

Stratum 1: Small tract buildings that were (a) greater than 50,000 sq ft, (b) a multi-family building, or (c) in a tract with less than 20 buildings. The buildings in this stratum were selected with certainty (i.e., all buildings were selected).

Stratum 2: Small tract buildings that were not in Stratum 1.

Stratum 3: Large tract buildings that were (a) greater than 50,000 sq ft or (b) multi-family buildings. Like Stratum 1, the buildings in this stratum were selected with certainty.

Stratum 4: Large tract, non–multi-family buildings that were between 1,001 and 10,000 sq ft.

Stratum 5: Large tract, non–multi-family buildings that were between 10,001 and 25,000 sq ft.

Stratum 6: Large tract, non–multi-family buildings that were between 25,001 and 50,000 sq ft.

Table 7 provides the counts and percentages of buildings on the building-level frame and in the building sample by stratum.

Table 7. 2025 CBSA building-level frame, sample, and projected site visit counts					
Building-level stratum	**Frame**	**Percentage of frame**	**Sample**	**Percentage of sample**	**Projected site visits**
Stratum 1	89	1%	89	2%	15
Stratum 2	308	2%	221	4%	36
Stratum 3	1,212	10%	1,212	21%	204
Stratum 4	7,992	64%	2,916	52%	490
Stratum 5	2,113	17%	825	15%	139
Stratum 6	799	6%	391	7%	66
Total	**12,513**	**100%**	**5,654**	**100%**	**950**

We allocated projected completed site visits to the six strata in three steps. First, as seen in Table 7, we selected the buildings in Strata 1 and 3 with certainty (i.e., we selected all buildings). Next, we allocated enough completed site visits in Stratum 2 to achieve the goal of 50 completed site visits among buildings in Small tracts. Finally, among the remaining 695 desired site visits after the allocations to Strata 1 through 3, we employed a variation of a full Neyman allocation in Strata 4 through 6. A Neyman allocation oversamples the strata that have more variation in the key statistic of interest for the sample design, which for the 2025 CBSA was total building square footage. The purpose of the oversampling is to reduce the margin of error (i.e., increase the precision) of this total at the overall level, as well as other statistics of totals highly correlated with this one statistic, compared to selecting a sample in Strata 4 through 6 using a proportionate allocation (i.e., no oversampling). As explained in further detail later in this section, the variation of the Neyman allocation we used oversampled buildings in Stratum 6, which reduced the margin of error for total square footage without much increase in the margins of error for proportions.[14]

Strata 1 and 3 were created to select three types of buildings with certainty: buildings greater than 50,000 sq ft, multi-family residential buildings, and buildings in Small tracts with fewer than 20 buildings. The reasons for selecting these buildings with certainty were as follows:

- Based on the weighted estimated building square footage from the virtual listings, there was significantly more variation in total building square footage among buildings greater than 50,000 sq ft compared with those between 1,001 and 10,000 sq ft.[15] Compared with

[14] Although buildings in Strata 1, 3, 4, and 6 were oversampled, as is explained in more detail in Section C.10.2 we used the inverse of the probability selection of each building to account for this oversampling in the final weight generation process and produce weighted estimates of the full population that are unbiased (i.e., on average they equal the population value).

[15] Buildings between 1,001 and 10,000 sq ft had a smaller standard deviation for total building square footage (S_h) than the other building size groups, and thus, its S_h was used to create ratios to compare the amount of variation

buildings between 1,001 and 10,000 sq ft, the variation in total building square footage was 5.4 times larger for buildings between 50,001 and 100,000 sq ft, 10 times larger for buildings between 100,001 and 200,000 sq ft, and 55 times larger for buildings greater than 200,000 sq ft. Selecting the buildings greater than 50,000 sq ft with certainty helps reduce the margin of error for totals.[16]

- Only 68 multi-family residential buildings were identified via virtual listing; due to their high analytic interest, they were all selected.
- All Small tract buildings in tracts with fewer than 20 buildings were selected with certainty to increase the efficiency of data collection trips to the smallest of the Small tracts.

As shown in the projected site visits column of Table 7, after selecting all 89 buildings in Stratum 1 and accounting for the projected 84 percent eligibility rate and 20 percent response rate, we projected completing 15 site visits in this stratum. To complete approximately 50 site visits in buildings from Small tracts, we allocated 36 completed site visits to Stratum 2. Accounting for the projected eligibility and response rates, we needed to select 221 of 308 buildings in Stratum 2.

In Stratum 3, after selecting all 1,212 buildings with certainty, we projected completing 204 site visits. Thus, across the first three strata, we projected 255 completed site visits. This left 695 projected complete site visits to allocate across Strata 4 through 6. In these remaining three strata, we employed a variation of Neyman allocation to achieve a balance between precision for totals and proportions. The general formula for Neyman allocation is as follows:

$$n_h = n \frac{N_h S_h}{\sum_{h=1}^{H} N_h S_h}$$

where

n_h	=	the sample size allocated within-building size stratum *h*
n	=	the overall sample size to be allocated
N_h	=	the population size of buildings in building size stratum *h*
S_h	=	the population standard deviation of total building square footage in stratum *h*
h	=	Stratum 4, 5, or 6

[16] The virtual listing team found 1,015 buildings greater than 50,000 sq ft in the 90 selected tracts. Even after selecting all and accounting for the projected 84 percent eligibility rate and 20 percent response rate, we anticipated completing only 170 site visits in these largest buildings.

Neyman allocation for a commercial building study that focuses on total energy consumption and/or total square footage (which is highly correlated with total energy consumption) would heavily oversample buildings in Stratum 6, because there is greater variation in these totals in the larger buildings than in the smaller buildings. On the other hand, a proportional allocation, which would have allocated nearly 75 percent of the remaining 695 site visits to Stratum 4, minimizes the variance of proportions. The compromise allocation was a two-thirds power Neyman allocation, which uses ${S_h}^{2/3}$ instead of S_h in the Neyman allocation formula. This allocation provides results between the full Neyman and proportional allocation; it will give estimates for totals that are not substantially less precise than the full Neyman allocation but will also provide precise estimates for proportions.

Within the four strata that were not selected with certainty (i.e., Strata 2, 4, 5, and 6), the buildings were implicitly stratified by BPA subregion, tract, building use category, zip code, and building square footage. Implicit stratification within explicit strata occurs when the sampling units inside each stratum are ordered according to an additional variable (or variables) related to key outcomes such as the ones mentioned in the previous sentence. Even though the sample is drawn without formally defining new strata, this ordering, combined with systematic random sampling, spreads the chosen units more evenly across the range of that ordering variable. As a result, implicit stratification can improve representativeness and precision of the sample without increasing the design complexity of creating more explicit strata.

The building use category variable that was one of the implicit stratification variables consisted of five broad categories. Table 8 shows how the 18 detailed building use categories were combined to create these five broad categories and shows that due to the implicit stratification, the distribution of commercial buildings in each broad building use category in the frame and the sample are remarkably similar. The one exception is the Multi-Family Residential building use category, where we selected all 409 multi-family buildings within the 90 selected tracts in order to achieve as precise estimates for multi-family buildings as possible.

Table 8. 2025 CBSA building-level frame and sample counts by broad building use category

Broad building use category	Detailed building use categories within broad category	Frame	Percentage of frame	Sample	Percentage of sample
1	Multi-Family Residential	409	3%	409	7%
2	Office, Public Assembly, Religious Worship, Food Sales, Retail, Automotive, Gas Station, Post Office/Mailing Center, and Other Service	6,365	51%	2,750	49%

Broad building use category	Detailed building use categories within broad category	Frame	Percentage of frame	Sample	Percentage of sample
3	Education, Lodging, Nursing Home, and Public Order and Safety	1,113	9%	602	11%
4	Health Care, Food Service, Laundry/Dry Cleaner, Laboratory, and Other	1,284	10%	493	9%
5	Warehouse and Vacant	3,322	27%	1,400	25%
Total		**12,513**	**100%**	**5,654**	**100%**

2.3.2.2 Actual Sample Sizes and Building Sampling Rates

The sample size needed to achieve the target number of completed site visits within strata was calculated by using the projected eligibility and response rates. This sample size ($n_{h,actual}$) per building stratum *h* was calculated as follows:

$$n_{h,actual} = \frac{n_{h,responding}}{(r_{h,eligibility})(r_{h,response})} = \frac{n_{h,responding}}{(0.84)(0.20)}$$

Strata 1 and 3 building sampling rates

The sampling procedures and calculations for building *k* in building stratum *h* and tract *i* ($\pi_{k|h,i}$) differed by building stratum. Buildings in Strata 1 and 3 were sampled with certainty ($\pi_{k|1,i} = 1;\ \pi_{k|3,i} = 1$).

Stratum 2 building sampling rates

Within Stratum 2 and tract *i*, the probability of selection $\pi_{k|2,i}$ was a constant for all 308 buildings in the stratum, calculated as follows:

$$\pi_{k|2,i} = \frac{n_{2,actual}}{N_2} = \frac{221}{308} = \sim 0.718$$

The tracts in building Stratum 2 were implicitly stratified by BPA subregion, tract, building size category, building use category, zip code, and building square footage.

Strata 4 through 6 building sampling rates

Buildings in Strata 4 through 6 were sampled using a stratified, systematic PPS selection procedure. Within each stratum, the buildings were implicitly stratified by BPA subregion, tract, building use category, zip code, and the building MOS (the building square footage to the two-thirds power). The buildings were then selected using the building MOS as the size measure in the PPS selection procedure.

The building sampling rates for each of Strata 4 through 6 were calculated as the ratio of the actual sample sizes ($n_{h,actual}$) to the estimated population measures of size computed from the virtual listing (Z_h):

$$\pi_h = \frac{n_{h,actual}}{Z_h}$$

The sampling rate for building k in building stratum h in tract i was calculated as follows:

$$\pi_{k|h,i} = min\{1, M_k \pi_h \}$$

where

$\pi_{k\|h,i}$	=	the conditional probability of selection of building *k* in stratum *h* and tract *i*
M_k	=	the MOS of building *k* (i.e., the building square footage to the two-thirds power)

2.3.2.3 Multi-Building Structure Subsampling

During data collection, there were a small number of instances where Westat's recruiting specialists discovered that the selected structure believed to be a single building on the sampling frame was actually two or more buildings sharing a wall. We use the term multi-building structure (MBS) for this type of situation. Completing more than two site visits at a single structure can be time consuming and increase costs, so the number of site visits at an MBS was reduced through selecting a simple random sample of two buildings within the structure. The formula for the conditional (i.e., within-structure) probability of selection, p_k, for each MBS is as follows:

$$p_k = \frac{2}{N_k}$$

where N_k is the number of buildings within the originally selected structure *k*. (Note: Because no MBS contained more than five buildings, the smallest value for p_k was 0.4, which limited the variation in the building weights due to MBS subsampling.)

2.3.2.4 Within-Building Subsampling

Despite the coverage offered by and the detailed information available in the building-level sampling frame that was created through the VLS, some adjustments to the sample were necessary when there were more units (e.g., businesses, rooms, lighting, and heating, ventilation, and air conditioning [HVAC] systems[17]) in the building than were feasible to measure during the building visit. For example, one building may contain multiple businesses (e.g., a dry cleaner, a barbershop, and a laundromat) occupying multiple storefronts. In these situations, the field technician listed the units representing the originally selected building and used a systematic selection procedure to randomly select a set of units with a constant sampling rate. To limit variation within building weights, the constant sampling rates for businesses within buildings, rooms within buildings, and rooms within businesses were no lower than 0.2.

3. Sampling Frame Development

3.1 Virtual Listing Overview

To sample buildings for participation in 2025 CBSA, a building list or frame was required that included the universe of commercial buildings and eligible multi-unit residential buildings within sampled census tracts (see Section C.2.2). Because there is no existing commercial building list with sufficient accuracy to support CBSA sampling, Westat created the CBSA sampling frame through a process called “listing.” Historically, listing to create sampling frames has been conducted in person by field listers canvassing selected geographic areas on the ground, listing the addresses and other key characteristics of all eligible sample units (e.g., commercial buildings). This in-person listing practice is time consuming and costly. Recent advances in internet mapping systems and supplementary data sources have made it possible to conduct listing “virtually” with a degree of accuracy equivalent to or better than in-person listing. Virtual listing uses geographic information system (GIS) data and tools available in an office setting, which makes it possible for listing to occur remotely on a workstation, without sending listers to the field.

Westat’s VLS was initially developed in support of the 2018 CBECS. Westat developed an updated version of the VLS for use on the 2025 CBSA, tailored to the CBSA project requirements.

[17] There was no within-room subsampling. When there were more lights and/or HVAC systems than feasible to measure during the building visit, the field technician subsampled rooms within the building (or business) and then attempted to collect data on all lights and/or HVAC systems in the subsampled rooms.

3.2 System Development

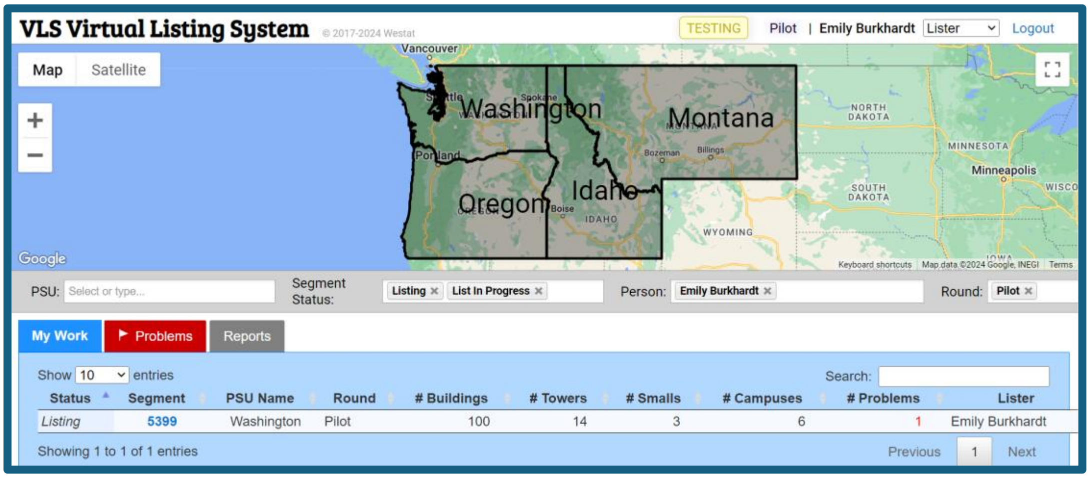
The VLS is a fully integrated, custom web-based system for observing, cataloging, and documenting eligible commercial buildings. The VLS virtually transports the lister to their assigned geographic area and enables them to canvass it remotely, using Google's 2D and 3D aerial satellite views and panoramic street images from Google Street View. The system includes custom geographic layers that are used as a reference for identifying buildings. Once a building is identified as eligible for the study, the lister lists the building by tracing the outline of the building's roof. The building's outline, or "footprint," is captured in the VLS, which automatically calculates and stores the building's square footage once the number of floors is entered. Other primary and secondary building characteristics are also entered and stored.

Primary characteristics for each building in the CBSA frame included building use classification and building size (i.e., square footage). Secondary building attributes that assisted in field data collection/site visits included building name, address, coordinates/location, and whether the building was freestanding or attached to another structure.

The VLS was designed around using known area boundaries to organize and monitor data collection. For CBSA, three geographic levels—states, census tracts, and census blocks—provided a convenient framework for assigning, capturing, and reviewing listing progress and monitoring the overall project work. This nested framework enabled spatial organization and integration with Google Maps.

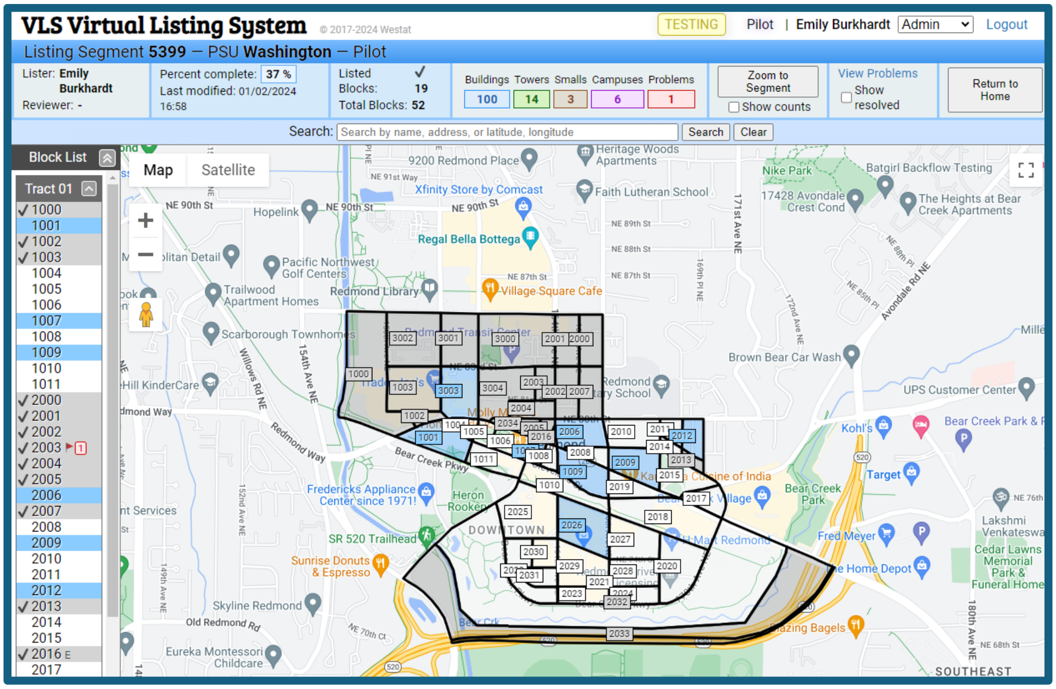
When logging in to the CBSA VLS, the user was taken to the VLS home page (Figure 63). The map frame was set to the extent of the four states in the 2025 CBSA.

Figure 63. Screenshot of VLS home page (testing version)



Virtual listing work was organized by block, enabling a tract to be broken down into many small sections for work organization and tracking. Figure 64 shows the listing tract or segment page.

Figure 64. The VLS listing segment page



VLS features updated for the 2025 CBSA version include improving search capabilities, converting the application to an externally facing one accessible to NEEA staff, and enhancing the footprint-drawing methodology to enable more accurate square-footage estimates for buildings with nonuniform floor counts throughout their footprint.

3.3 Training

Twelve Westat staff members, many of whom had prior virtual listing experience, were trained as CBSA virtual listers. The team of trainers included Westat GIS staff, CBSA project staff, and VLS developers.

Training was conducted in person at Westat over 2 days. Time was split between teaching listing concepts through a series of presentations in a classroom setting and hands-on practice for trainees at dedicated VLS workstations. The classroom content included general CBSA background information as well as the following topics:

- What Is a Building?
- VLS Overview

- Reviewing Key Concepts
- Entering Problems and Viewing Status Reports

In addition to the training, a Virtual Listing Manual was developed that provided virtual listers with a complete resource for project background, identifying eligible buildings, using the VLS, documenting problems within the VLS, and using VLS reports. Chapter 2 of the manual, which details building eligibility requirements, is included as Appendix 3.

3.4 Operations

Virtual listers who were located on Westat's campus performed listing in a dedicated lab with multiple VLS workstations; other listers performed listing remotely. Westat training staff were available both in person and virtually to answer listers' questions in real time. Weekly production was monitored to evaluate lister performance, provide supplemental training to listers as needed, and monitor improvement.

3.5 Quality Assurance (QA)/Quality Control (QC) and Editing of Listings

QA/QC processes are an integral component of the VLS. Reviewers followed a series of checks (automated and manual) for each completed tract. The first part of the QC process involved resolving all problems reported for a given assignment. Issues could be resolved directly by the reviewer or sent back to the lister with details for resolution. Once all problems were resolved, 10 percent of the census blocks in the assignment were marked for review. Each review block was examined by the reviewer, looking for completeness and accuracy at both the block and building levels.

Table 9 shows the listing results by state. A total of 12,513 buildings were listed, with an average of 139 listings per tract.

Table 9. Total numbers and tract averages of listings by state

State	Number of tracts	Number of listings	Average listings per tract
Idaho	11	1,728	157
Montana	8	1,488	186
Oregon	24	3,239	135
Washington	47	6,058	129
Total	**90**	**12,513**	**139**

4. Data Collection Instruments

4.1 Overview

The 2025 CBSA used two complementary data collection instruments: an online questionnaire (referred to as the "web survey") and a site visit instrument, which together collected the necessary building characteristic data. Study participants were recruited for both efforts, but not all participated in both (see Section A, Table 3). After a respondent at the sampled building was successfully recruited to participate in the study, they were sent a link to access the web survey. The web survey was designed to be a self-administered questionnaire with an expected completion time of about 30 minutes. Recruiters were also able to administer the questionnaire to the respondent in person or by phone, at the respondent's request. After a building's web survey was completed, the in-person site visit was conducted. During the site visit, a trained field technician collected information using the site visit instrument installed on their tablet or smartphone. Select data elements from the web survey were preloaded into the site visit instrument for the field technician to review or confirm.

The following sections describe the instrument design process and give more details about the web survey and the site visit instrument. Instrument development activities generally occurred between October 2023 and July 2024, in preparation for data collection beginning in August. As described in Section C.4.4.4, a small number of instrument revisions were made during the data collection period.

4.2 Instrument Design

4.2.1 Determination of Priorities

NEEA, the CBSA Workgroup, Westat, and Michaels Energy (hereinafter, Michaels) collaborated to develop the 2025 CBSA data collection instruments. A key priority for the instrument design process was to simplify the site visit instrument to reduce the burden and cost associated with in-person data collection without compromising data value or quality.

The instrument design process began with workgroup members reviewing and prioritizing prior CBSA data elements. Workgroup members also suggested new content to include for the current cycle data collection. After this review, an initial determination was made of the desired instrument content and the best collection mode (web survey or site visit) for each topic. We then moved to develop the survey specifications, as described in the next section.

Across multiple rounds of review, the web survey and site visit instruments were further refined to ensure data were collected via the appropriate mode and with the appropriate level of detail to meet analytic needs, while eliminating low-priority, low-quality, or highly burdensome items. Data elements that were ultimately dropped for the 2025 study included the following:

- Items that were very rarely collected in the 2019 study, identified by a review of frequencies in the data files (e.g., skylight *u*-value, lighting ballast factor, water heater preheat).
- Items that were determined to be not easily observable or required a disproportionate amount of time or burden to access (e.g., wall insulation material, wall insulation *r*-value, roof insulation thickness).
- Items that collected open-ended responses when "other" was the response option selected, such as for floor type, roof type, and window frame type. NEEA provided general guidance to drop such open-ended responses to reduce burden.
- The entire Pool and Hot Tub section, which was determined to be a low priority for NEEA.

4.2.2 Development of Survey Specifications

After initial content decisions were made, specifications for each instrument were developed. These specifications detailed global design requirements such as layout, headers, and footers, as well as item-level aspects, including variable name, question text, response options, item type, routing, and any validation checks. For items that were intended to be functionally the same as in prior CBSA cycles, variable names and item types were retained to the extent possible.

Specifications were updated frequently throughout the instrument design process and used by project staff, programmers, and testers to ensure the instruments functioned as intended. Final specifications for each instrument were delivered to NEEA.

4.3 Web Survey

4.3.1 Item Summary

It was anticipated that web survey respondents would be someone knowledgeable about the sampled building, such as a building manager, property manager, or operations staff member. The web survey included items about building or business characteristics likely to be known by most survey respondents, items that may not be easily observable during a site visit, and background information that would be useful to prepare for the site visit. Additionally, the web survey collected respondents' consent to participate in the study and contact information to facilitate the site visit and utility data collections. After the web survey was completed, Westat emailed the respondent a data-sharing agreement form via Docusign.

The web survey included the following content sections:

- **Building information.** Building characteristics such as building name, square footage, year of construction, number of floors, and features such as escalators and elevators.
- **Building activity.** Building uses and key energy-related drivers (e.g., for schools, the number of classrooms and students were collected).
- **Ownership, occupancy, and hours.** Building ownership status, any tenants, and hours the building is open to employees and the public.
- **Energy sources and uses.** Main source(s) of energy used and basic details about heating and cooling.
- **On-site generation and storage.** Whether and how any electricity is generated or stored on site.
- **Computers and data centers.** Information about computers and servers, including any server room or data center spaces.
- **Food service.** Food preparation or serving areas and the number of meals served daily, if applicable.
- **Other energy uses.** Miscellaneous energy uses such as refrigeration equipment, laundry equipment, laboratory and medical equipment, air compressors, and parking areas associated with the building.

4.3.2 Software

The web survey was developed using Blaise 5, a multi-mode survey software created by Statistics Netherlands and widely used for large, complex data collections. Blaise 5 entries are saved and submitted in real time, offering flexibility in switching users and devices and allowing for breakoffs and restarts without data loss. A consistent layout was used across the web survey, with typically one question presented per screen. There were a few exceptions where two or more related questions were asked on the same screen (e.g., the number of floors above and below ground level).

Westat worked with NEEA to design and host a CBSA website that was linked from the main CBSA study participant landing page at neea.org. The website URL, https://neea.org/CBSA2025, was provided in the study recruitment materials (see Appendix 5).

Building respondents used this website to learn more about the study and to access the web survey.

4.3.3 Development and Testing

Web survey development occurred between January and July 2024, with Westat staff leading the instrument specification, programming, and testing activities. During the development period, NEEA, CBSA Workgroup members, and Michaels had multiple opportunities to review and provide feedback on the web survey. This feedback helped to refine the web survey content and ensure it met analytic needs.

4.4 Site Visit Instrument

4.4.1 Item Summary

The site visit instrument was used by trained field staff from Michaels to conduct data collection at sampled sites. The instrument included items designed to collect technical information about building systems or equipment, items that were straightforward to observe and collect consistently, information needed for the HVAC model-matching task (see Section C.8.2.4), and photos of key equipment or features.

The site visit instrument included the following content sections:

- **General building information.** Reviewed and confirmed key information from the web survey
- **Lodging rooms (only for lodging).** Types of rooms in the building, to facilitate inspection of a sample of them
- **Building envelope.** Floor, roof, walls, and windows
- **HVAC.** Equipment used for heating, air conditioning, and ventilation, including fans
- **Boilers.** Boilers and their usage
- **Chillers.** Chillers and their usage
- **Heat rejection.** Heat-rejection equipment associated with HVAC systems
- **Energy management system.** Energy management systems and building controls, including capabilities and communications
- **Water heaters.** Water heaters and their usage
- **Pumping systems.** Pumping systems, their usage, and controls
- **Food service equipment.** Food service equipment and fuels

- **Refrigeration.** Refrigeration equipment, including reach-ins, display cases, walk-ins, and storage boxes, and associated compressors and condensers
- **Lighting.** Indoor and outdoor lighting fixtures, types, and control strategies
- **Miscellaneous.** Building ENERGY STAR® certification, laundry equipment, battery storage, electric vehicle charging stations, and irrigation systems

Appendix 6 includes screenshots from the data collection tool of items in each section.

4.4.2 Software

The site visit instrument was developed using ArcGIS Survey123 software. ArcGIS Survey123 is created by Esri and allows for form-based data collection via an app. Michaels Energy's field technicians accessed Survey123 using mobile phones or tablets (Apple or Android). Notable Survey123 capabilities included collecting a variety of data element types (e.g., numeric, drop down, checkbox, text fields) to accurately assess energy-related equipment and characteristics; complex instrument design features, including skip logic, repeats, calculations, constraints, and integration of preloaded or previously collected data; and the ability to take photos, for example of building features, equipment nameplates, and appliances or lighting fixtures. The site visit instrument was designed to prompt for any photos at the end of each topical section, such as Roofs, Chillers, or Indoor and Outdoor Lighting.

Given the unpredictable nature of site visits at various types of buildings, it was advantageous that the Survey123 app supported offline data collection. After recording all necessary data elements and photos while on site, field technicians could securely upload the data when internet access was available, such as later that evening or the following day.

4.4.3 Development and Testing

Site visit instrument development occurred between March and July 2024, with Westat staff leading all instrument specification, programming, and testing activities. The site visit instrument was optimized for the Surface Pro and iPhone and tested using multiple devices. During the development period, NEEA, CBSA Workgroup members, and Michaels had multiple opportunities to review and provide feedback on the site visit instrument. This feedback helped to refine the site visit instrument content and ensure it met field technician and analytic needs.

4.4.4 Instrument Revisions

After data collection began, a few instrument revisions were made to improve or streamline the collection process. These included a revision to collect names for up to 10 unique HVAC systems (instead of the original 5) for linking with other reported equipment; revising the skip logic for a small number of HVAC items; and later in the field period, eliminating many of the heating and cooling questions from the web survey to reduce respondent burden, since these items were redundant with those collected during the site visit. All revisions were thoroughly tested, and the timing of updates was coordinated with Michaels to ensure data collection was not impacted and that field technicians always had the latest version of the site visit instrument.

5. Building Recruitment

5.1 Overview

CBSA building recruitment started in July 2024, a month before data collection began, and continued through April 2025, several weeks before data collection ended in May 2025. Westat employed both remote and in-person recruiting specialists, referred to hereafter as "recruiters." Remote recruiters worked solely by phone and email. In-person recruiters worked in the field, contacting sampled buildings primarily in person, although they also conducted some phone and email recruitment communication with buildings as needed.

Recruitment was typically an iterative process that involved making initial contact with building personnel, determining building eligibility, identifying an appropriate respondent for each eligible building, and then gaining the cooperation of a respondent to participate in the three study components: the web survey, the utility data-sharing agreement, and the site visit.

Several shifts in recruitment approaches were made throughout the field period to focus on strategies that proved more effective for achieving the CBSA targeted response rates and number of completed cases. Perhaps the most impactful change was a gradual shift away from remote recruitment to more in-person recruitment to address unexpected challenges in securing building participation by phone and email. This section describes the 2025 CBSA recruiting approaches, procedures, and materials, and the shifts in recruiting strategies made throughout the field period.

Westat structured building recruitment in two stages:

1. **Fieldwork preparation,** which involved a systematic review of the full sample and "tracing" to identify potential respondent leads and contact information for each building

2. **Rolling building recruitment,** during which sampled buildings were released for recruiting in four unequal waves based on geography

5.2 Fieldwork Preparation

The fieldwork preparation steps taken before the recruitment period laid the groundwork for successful recruitment. During the sample review, affiliated buildings were identified and linked in Westat's case management system to facilitate the pursuit of a common respondent. Extensive tracing was then conducted to gather initial contact information and leads at the sampled buildings to assist the recruiters as they began their contact attempts.

5.2.1 Sample Review

The sample review was a critical step that grouped buildings together, where applicable, in efficient ways to streamline the recruitment and data collection process. Buildings were found to be affiliated in various ways, such as ownership, management, or corporate identity. Potential affiliations were identified by matching sampled buildings with information from D&B and several other databases and using natural language processing techniques. Westat staff then manually reviewed the matches to confirm or reject the affiliation.

Identifying these commonalities before fieldwork began improved recruitment and data collection efficiency, reduced respondent burden, and increased response rates. For example, several public-school systems had multiple buildings sampled across the district. All buildings belonging to a school district were identified during the sample review and then assigned to the same recruiter. The recruiter was able to start with a much more effective recruiting approach by first contacting the district office rather than individual schools. The recruiter was to funnel requests for all sampled schools to the appropriate district staff member, who would then help coordinate outreach for those schools and encourage their participation in the study.

5.2.2 Tracing

Identifying a suitable point of contact for each building was a central challenge in the recruitment process. Before recruitment began, initial building contact information was obtained through the following sources and methods:

D&B. Westat worked with D&B to obtain business-level contact data. D&B matched the sampled building addresses to their business data, sending back a matched file with a contact name, title, phone number, and email address. Westat received 1,028 contacts for 148 sampled buildings (2.6%), but recruiters found that many were outdated.

Web scraping. Web scraping processes yielded initial contact information for about 73 percent of sampled cases across all waves; however, for many cases, this was simply any phone number associated with the sampled building. Because this contact information was rarely associated with a building manager or owner, using it required significant effort and follow-up to find a potential respondent. For example, the phone number provided for a large regional medical center was the general hospital line, linked to an extensive phone tree with no options to reach hospital administration or facilities.

Online tracing. Westat conducted extensive online tracing to identify potential respondents and associated contact information. A team of experienced Westat tracing specialists used multiple sources—including paid subscription services, a host of public websites that provided property and tax records, corporate websites, and commercial real estate sites—to find and vet initial contact information. Tracers searched for current names and titles, phone numbers, and email addresses of building personnel who might be knowledgeable to serve as respondents or refer the recruiter to potential respondents, such as building or company managers, owners, administrative assistants, property managers, facilities managers, engineers, and sustainability directors. When personnel names could not be found, tracers searched for general building phone numbers and email addresses. Tracers were successful in finding some contact information for 92 percent of Wave 1 buildings.

Online tracing by the tracing team was initially designed to be conducted on a rolling basis immediately before each recruitment wave. Tracing for Wave 1 was conducted in June and July 2024 for the wave released in August. This extensive advance tracing effort was resource intensive and yielded results that were often not useful. Therefore, advance tracing was not conducted for future waves. Instead, tracing was incorporated into the recruiters' responsibilities.

Recruiter tracing. For Waves 2–4 recruiters were trained to research each of their assigned buildings to obtain names and contact information for building personnel to facilitate their initial outreach. Many buildings required iterative tracing efforts while working a case, including in-person building visits, to find additional names, phone numbers, and email addresses to successfully make building contact. In-person tracing involved asking neighbors, postal workers, building staff, and on-site security officers for building information. Tracing conducted by recruiters proved reliable and efficient because recruiters could follow up on leads quickly, had project and building context, and were highly motivated to find an appropriate building respondent.

5.3 Recruitment Waves

Westat recruited buildings using a rolling approach, releasing cases in four unequal waves grouped by sampled building geography, as shown in Table 10. This approach enabled a focused effort on a more clustered, smaller group of buildings at a time for efficient recruitment and site visit scheduling. Additionally, staggering the release of sampled buildings in waves made it possible to test outreach materials and procedures with a smaller group of buildings and make improvements for upcoming waves. This approach proved useful given early recruitment challenges (see Section C.5.4), allowing time to evaluate, retool, and train additional staff to recruit a broader group of cases in subsequent waves.

Table 10. Recruitment wave mailing and start dates

Wave	Geography	Mailed invitation letter	Started working	Cases
1	Seattle, Washington, and Portland, Oregon	7/17/2024	7/23/2024	1,312
2	Remaining Washington and Oregon areas	11/12/2024	11/19/2024	3,049
3	Idaho	12/6/2024	2/22/2025	704
4	Montana	12/6/2024	2/24/2025	609
Total				**5,674**

Wave 1 consisted of cases in Seattle and Portland, which included approximately one-quarter of the total sampled buildings. These urban centers were selected at NEEA's request to provide an opportunity to test study recruitment procedures and messaging across a variety of building types, essentially using Wave 1 as an integrated pretest. Additionally, Seattle and Portland contained large numbers of buildings anticipated to take longer than average to recruit (e.g., larger buildings and those belonging to large corporations), so it was important to release the majority of these buildings at the beginning of the field period.

Recruitment for Waves 1 and 2 was slow, for a variety of reasons discussed in the following sections. Therefore, based on experiences and lessons learned during the first few months of recruitment, Westat revised several respondent outreach materials and protocols before releasing Waves 3 and 4. Revised procedures and materials focused more heavily on recruitment for the site visit rather than completion of the web survey as a prerequisite to scheduling the site visit. In addition, several new materials were developed to help gain and maintain respondent cooperation, including a web survey summary and a next steps card for recruiters to leave with respondents (see Section C.5.6).

5.4 Recruitment Modes

Successful CBSA recruitment required a multi-mode approach that integrated both remote and in-person efforts. Recruitment began using a team of trained remote recruiters, with a plan to add a very limited number of in-person recruiters later in the field period to target certain hard-to-reach buildings. Several months into Wave 1 and throughout the remainder of the recruitment period, a gradual shift away from remote recruitment to mostly in-person recruitment was made to address unanticipated challenges with securing building participation by phone and email that slowed recruitment.

5.4.1 Remote Recruitment

Remote recruitment involved contacting building personnel by telephone and email, using contact information collected during tracing. This included speaking with gatekeepers, navigating phone trees to reach a knowledgeable person, and sending a myriad of emails.

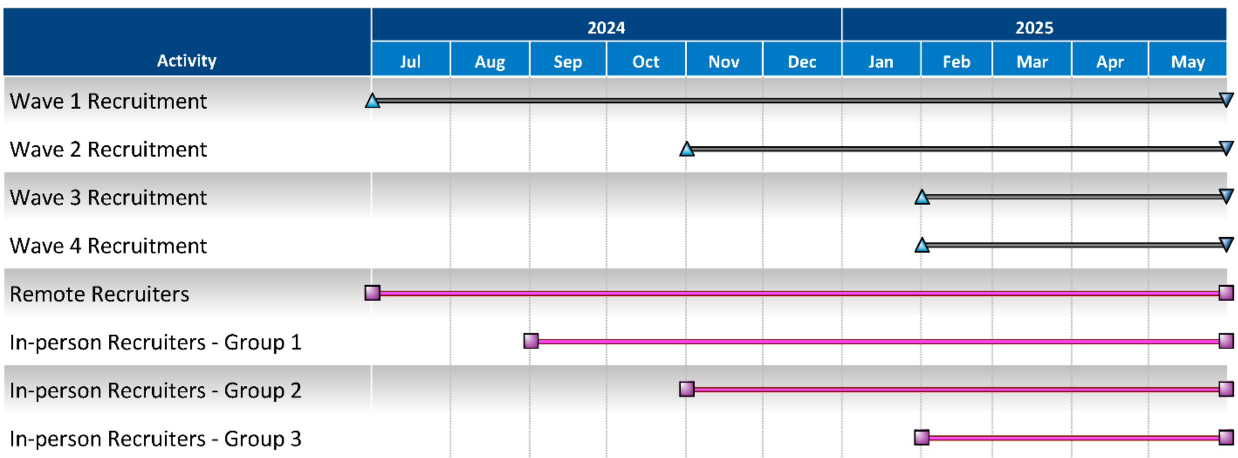
For Wave 1 cases, Westat developed procedures and materials around a remote recruitment model to be used due to its perceived cost effectiveness. However, this "remote first" approach proved challenging, particularly for identifying an appropriate respondent, eliciting potential respondent attention, and addressing concerns about legitimacy.

- **Identifying an appropriate respondent.** In most cases, remote recruiters started with contact information gathered from online research and other tracing efforts for at least one person associated with each sampled building. However, as described in Section C.5.2, contacts obtained via tracing were often not viable building respondents or were names no longer associated with the building. Furthermore, the person who answered the phone was usually a gatekeeper (e.g., receptionist, office clerk) who could not make decisions about participation or who limited access to decision-makers, particularly at large buildings.
- **Eliciting respondent attention.** Building contacts were often dismissive of "cold" phone calls and emails soliciting their study participation. It was easier for recipients to ignore phone and email outreach compared with in-person building visits. In cases where the building contacts were receptive to the remote recruiter's attempts to contact them, recruiters often encountered refusals that were difficult to convert by phone or email.
- **Concerns about legitimacy.** Due to the prevalence of phone and email phishing and scams, building contacts were often reluctant to provide contact information for potential decision-makers.

5.4.2 In-Person Recruitment

The shift to in-person recruitment was rolled out incrementally, as shown in Figure 65. Two months into Wave 1 recruitment, Westat trained and deployed a small group of field recruiters to make in-person contact with sampled buildings that had not been responsive to phone and email contact attempts. In-person recruiting included identifying and recruiting respondents through visits to sampled buildings and the surrounding neighborhood. In-person recruiters made initial assessments about building eligibility, obtained contact information from building personnel, and spoke with neighboring buildings to obtain information about sampled buildings that were vacant, closed, or inaccessible.

Figure 65. Recruitment timeline



Initially in-person recruitment was intended to be a supplement to remote recruitment for a small percentage of buildings, typically those with no available contact information or where there were eligibility concerns. When in-person recruiters began work in the field, it was quickly evident that in-person work positively facilitated gaining cooperation. It was easier to reach building personnel in person, and once a recruiter identified a potential respondent, their physical presence made it more difficult for the respondent to ignore the request or refuse participation.

Due to the success of the in-person recruitment conducted in Wave 1 and the continuing challenges faced by remote recruiters, Westat trained an additional small group of in-person recruiters who were deployed for Wave 2. The success of the now larger team of in-person recruiters was seen almost immediately and consistently throughout Wave 2. Therefore, additional in-person recruiters were hired, trained and deployed to start working around the time that Waves 3 and 4 were released.[18] Although the basic in-person recruiting tasks were similar to those required during remote recruitment, the shift to an in-person–first approach provided more opportunities to tailor recruitment approaches, meet respondents where they were, and add geographic efficiencies to the work.

Certain types of cases, however, such as large Office buildings and medium-sized Multi-Family Residential buildings managed by an off-site property manager, still benefited from a remote approach. In many of these cases an off-site manager completed the web survey and signed the billing release but coordinated with a local maintenance worker for the site visit. Therefore, a small team of remote recruiters, along with a much larger group of in-person recruiters, worked through the end of the recruitment period in May 2025.

5.5 Utility Outreach Materials

Engagement with regional utilities was critical to the success of the 2025 CBSA. As a precursor to building recruitment, Westat and NEEA developed a formal plan for communicating with utilities about the CBSA. This plan included an email notification to inform utilities about the upcoming CBSA data collection activities and recruitment schedule for customers in their territory (see Appendix 4). The email, sent by NEEA, invited utilities to support the study and provided resources needed to give customer support for their selected study participants. Attached to the email were a set of FAQ and the study brochure (see Appendix 5) provided talking points to address commonly asked questions about the study that customers might direct to the utility.

NEEA sent the notification email to regional utilities with sampled customers approximately 1 month before the start of recruitment for each wave. Utilities were sent the email prior to the wave containing sampled buildings in their jurisdiction.

5.6 Building Outreach Materials and Support

Respondent outreach materials and support formed the core of CBSA recruitment by confirming the study's legitimacy, providing information to overcome common barriers to participation, and motivating potential respondents.

[18] Wave 3 (Idaho) and Wave 4 (Montana) were released together due to the additional number of in-person recruiters available and the waning data collection period.

5.6.1 Respondent Materials

In coordination with NEEA, Westat developed a set of 2025 CBSA outreach materials that were provided to respondents and other personnel associated with the building. Recruiters used the materials (shown in Appendix 5) for contacting, identifying, and gaining cooperation from respondents.[19]

- **Advance letter.** The advance letter was the first communication with sampled buildings about the CBSA 2025. It was addressed to the building owner or manager, alerting them to their building's inclusion in the study. The letters were written in coordination with key state stakeholders to lend legitimacy to the study and printed on letterhead that varied by state.[20] Sampled buildings were mailed one of three versions of the state letter depending on the building's incentive amount (see Section C.5.7).
- **Invitation letter.** The invitation letter was mailed from NEEA to each sampled building and was addressed to the building owner or manager. The letter invited the building to participate in the CBSA 2025 and outlined the next steps. Buildings received one of three versions of the letter depending on the building's incentive amount.
- **Study brochure.** The brochure provided a broad overview of the study, addressed frequently asked questions, and included instructions for participation. All sampled buildings received a study brochure with the invitation letter. The brochure was also shared electronically with respondents via email and on the respondent website (see Section C.5.6.2) and in hard copy during in-person recruiting visits.
- **FAQ.** The study FAQ provided answers to common questions for building personnel and respondents. Key items from the FAQ were also printed in the study brochure. The full FAQ document was available on the respondent website and as a job aid for recruiters.
- **Sorry I missed you (SIMY) card.** The SIMY card provided a brief overview of the 2025 CBSA for in-person recruiters to leave at a building if a potential respondent was not available. The card provided NEEA and Westat contact information and a space for the recruiter to write their name and the date.
- **Web survey summary.** This document was developed during the field period in response to repeated questions from respondents about detailed survey content. It was

[19] Materials shown in Appendix 5 are the most recent version, reflecting any updates made during the recruitment period.

[20] Buildings received letters on letterhead from the following agencies/organizations: Idaho: Avista Utilities, Bonneville Power Administration, Idaho Power, and NEEA; Montana: Bonneville Power Administration, NorthWestern Energy, and NEEA; Oregon: Oregon Department of Energy; Washington: Washington State Department of Commerce.

designed to help respondents gather information needed to complete the survey before starting the questionnaire.

- **Site visit infographic.** These hard copy and electronic information sheets provided additional context for the site visit. There were three versions of the infographic, tailored to building size (square footage), that covered what to expect during the site visit, the estimated site visit length, and study contact information.
- **Next steps card.** In-person recruiters used this card to provide respondents with information about what to do and expect after they agreed to participate. The card included space for the recruiter to write the respondent's web survey personal identification number (PIN), site visit date, and incentive amount, and it listed follow-up emails to expect.
- **Authorization letter.** This letter, signed by NEEA, was designed for recruiters to present in person in case of questions about recruitment efforts from building personnel or community members (e.g., security guard, postal worker).
- **Email templates.** Recruiters were provided with several email templates for contacting and gaining cooperation from sampled buildings.
- **Nonresponse letters.** These letters were sent as needed to sampled buildings when (1) a recruiter had identified a potential respondent but had not been able to reach them by phone and email or (2) a respondent had agreed to participate but had not completed their web survey after several email and phone prompts. Nonresponse letters were sent via FedEx to convey additional importance.

5.6.2 CBSA Web Page

To support data collection, NEEA launched a 2025 CBSA web page within its general website. The page served as a recruitment tool throughout the field period and was referenced with the URL in respondent recruitment materials.

The CBSA web page provided general study information, including:

- A description of the study's three data collection components: web survey, utility data-sharing agreement, and site visit
- Respondent incentive
- How the data would be used
- FAQ about the study
- Study contact information
- A web survey link for participating respondents

The web page also provided information about the firms conducting the 2025 CBSA, Westat and Michaels Energy, and a list of utilities endorsing the study.

At the end of the data collection period (June 2025), the web page was updated to notify respondents that data collection for the study was complete.

5.6.3 Telephone Call Guides

Westat developed call guides to assist recruiters when making phone contact with sampled buildings and respondents. Call guides were available for initial calls, web survey reminder calls, and calls to schedule site visits with Michaels.

- The **initial call guide** walked the recruiter through the key points to cover during building outreach, including asking to speak with a person knowledgeable about the building's energy use and equipment, a brief description of the CBSA, and confirming building eligibility. If the building was eligible, the guide provided language for the recruiter to briefly introduce the web survey, site visit, and incentive and guidance on identifying an appropriate study respondent, collecting the respondent's name and contact information, and explaining the next steps for participation.
- The **prompt call guide** provided recruiters language to use when calling a respondent to remind them to complete the web survey. It guided the recruiter through asking if the respondent received the email with the web survey URL and log-on PIN and, if not, confirming their contact information, and answering questions the respondent may have had about the study.
- When a case was ready to transition to Michaels for site visit scheduling, recruiters used the **handoff call guide** to give the respondent more details about the site visit, ask for any special security requirements needed to access the building, and explain that Michaels would contact them soon to schedule the site visit.

Call guides were revised several times between waves to be more user friendly for recruiters, to reflect changes in recruiting procedures, and to be more versatile for both phone and in-person recruiting situations.

5.6.4 Respondent Support Desk

To address the questions and concerns of utilities and respondents, Westat provided email and telephone support. Email and voicemail were monitored by Westat staff from 9 a.m. to 5 p.m. Eastern Time. Inquiries received after office hours were addressed on the following business day. Typical building correspondence with the support desk was related to study participation: agreeing or declining to participate, questions about the study, technical support with launching or completing the web survey, site visit scheduling, and the use of incentive debit cards.

5.7 Respondent Incentives

To maximize recruitment success, Westat offered monetary incentives to motivate study participation. Incentives increased with building size to acknowledge the increased effort required by respondents of larger buildings and to improve responsiveness among large buildings (Table 11). Large buildings were especially important to adequately represent in the CBSA because they are limited in number and account for a substantial proportion of the region's energy use. In response to recruitment challenges, incentive amounts for the two smaller building sizes increased by $50 each in November 2024 at the outset of Wave 2 recruitment. This increase proved effective in improving response rates for small and medium-sized buildings.

Table 11. Incentive rates by building size

Site size (estimated from VLS)	Starting incentive (July 2024–October 2024)	Revised incentive (November 2024–June 2025)
1,000 to 9,999 sq ft	$100	$150
10,000 to 99,999 sq ft	$150	$200
100,000+ sq ft	$300	$300

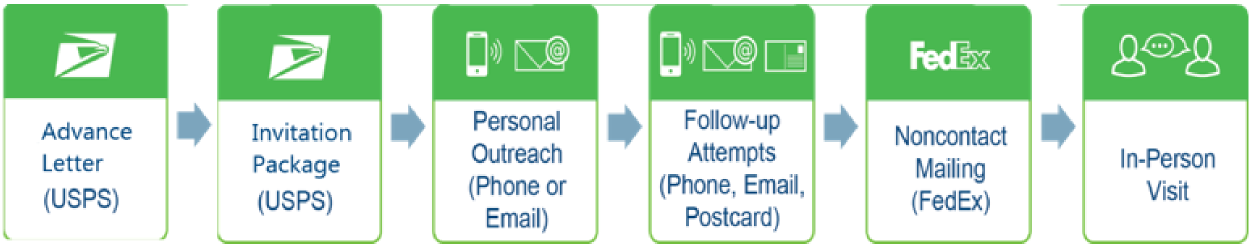
To incentivize completion of all study activities, payments were provided only on completion of all three activities—the web survey, the utility data-sharing agreement, and the site visit. Incentives were provided via a prepaid debit card, typically at the time of the site visit. Occasionally, debit cards were mailed to respondents after the site visit was completed.

Recruitment materials were tailored to highlight the incentive amount based on the building's estimated size, calculated during virtual listing (see Section C.3.2). In addition to the monetary incentives, all respondents who completed at least one of the study components and had an email address on file received an email at the end of the data collection period thanking them for their participation in the study, along with a list of tips and resources for making buildings more energy efficient.

5.8 Building Contact

Buildings were recruited using a multi-step contact protocol, shown in Figure 66.

Figure 66. Recruitment contact protocol



5.8.1 Initial Mailings

Before active recruitment began in each wave, Westat sent two initial mailings to sampled buildings about 10 days apart: the advance letter from key state stakeholders and the invitation package from NEEA. Mailings were typically sent 1–2 weeks before recruiters began conducting outreach to sampled buildings.

5.8.2 Recruiter Outreach and Follow-Up

Soon after invitation letters were sent, recruiters began tailored outreach by phone and email to sampled buildings. This outreach consisted of four main tasks: confirming the correct sampled building, identifying one or more appropriate building respondents, determining building eligibility, and gaining cooperation. Recruiters had the flexibility to follow up with buildings in a way that aligned with building circumstances, such as available contact information, gatekeeper encounters, and initial refusals.

5.8.2.1 Confirming the Sampled Building

Before the first communication with a sampled building, recruiters reviewed the building's data in the case management system, including contact information available from initial tracing efforts. During the initial contact with building personnel, the recruiter's first task was to verify the building address to confirm they had contacted the correct building. Because the physical building structure (i.e., the building footprint created during listing, not the street address) was the sampling unit (see Section C.2.3.1.1), this confirmation process was not always straightforward. Some sampled buildings used multiple addresses; for other buildings, addresses gathered during listing were occasionally incorrect or incomplete. Such address issues created the potential for recruiters to inadvertently recruit a building that was not part of the sample; therefore, confirming that the correct building was reached was critical to maintain the integrity of the sample.

To facilitate locating the correct building, recruiters used a custom interactive map of buildings that displayed the footprints of all buildings listed from a bird's-eye view, highlighting the sampled buildings. By hovering over a sampled building on the map, the recruiter could see information recorded during listing, including the building or business name, address, and square footage estimate. This tool helped recruiters mitigate incorrect identification of sampled buildings due to address inconsistencies.

5.8.2.2 Identifying a Building Respondent

After locating the correct sampled building, recruiters conducted outreach and additional tracing iteratively as needed until they found a potential respondent who could answer questions about the sampled building's energy use in the web survey and facilitate an in-person site visit to the building. Most sampled buildings had multiple gatekeepers and potential respondents. Knowing how to ask gatekeepers for an appropriate person affiliated with the building was crucial to positive recruiting outcomes. Recruiters were trained to ask for staff with titles such as building manager, facilities manager, energy efficiency coordinator, and so forth, who could make an informed decision about participating in the study.

5.8.2.3 Determining Building Eligibility

After making contact with a knowledgeable building respondent, the recruiter administered a brief screener to confirm building eligibility. Specifically, recruiters confirmed that the building fulfilled the size, use, and building status criteria:

- Over 1,000 sq ft
- Used for commercial/multi-family residential purposes
- Not under construction, condemned, or demolished

In some cases, recruiters were able to determine eligibility through observation, either remotely or in person. In-person visits often offered the advantage of making eligibility determinations without contacting the building and were more effective and efficient for confirming building demolition. If, after observing a building and/or speaking with a knowledgeable building contact, a recruiter was unable to confirm eligibility, Westat sampling specialists reviewed case details to make a final determination.

5.8.2.4 Gaining Cooperation

Gaining the cooperation of sampled buildings began with the first recruitment contact. Recruiters were trained to cultivate rapport with each person they encountered, whether a receptionist, a security guard, an executive assistant, or a building owner. They tailored their approach to each situation, emphasizing key reasons for participation, such as the incentive, the civic value in participating, or the importance of the data being collected.

The monetary incentive was a significant motivator for respondent participation, particularly with small buildings (less than 10,000 sq ft). Respondents from small buildings were generally eager to participate and to receive the incentive, particularly after the increase from $100 to $150 (see Section C.5.7). For larger buildings, the incentive was not as effective. These respondents were sometimes more successfully swayed by other benefits of study participation, such as contributing to a better understanding of energy usage among commercial buildings in the Northwest region, which could in turn inform future policies to make energy use more affordable and efficient.

Although Westat developed a standard list of FAQ and answers available on NEEA's CBSA website, many recruiters compiled their own list of frequently asked questions they encountered throughout the recruitment period. Compiling a list of answers to questions they received most often prepared recruiters to respond in their own words more confidently and effectively, which helped to secure building participation.

5.8.3 Special Efforts

Westat tailored special outreach approaches and materials to encourage various types of buildings to participate, including the following:

- **Minimizing nonresponse.** When the recruiter received a first refusal, the case was put on hold for a few weeks before determining the next best course of action. If the initial refusal resulted from a phone or email recruitment attempt, the case was often reassigned to a field recruiter for an in-person visit. If in-person recruitment was not possible or already attempted, additional tracing was conducted on the business to find another potential contact.
- **Campuses and other affiliated buildings.** In advance of the recruitment period, Westat conducted research and planning to coordinate recruitment for businesses and organizations with multiple sampled buildings. These included buildings that were geographically clustered, such as a college or airport campus, and those that were more dispersed, such as buildings belonging to a public school district or a local government.

Buildings identified as affiliated with other sampled buildings received special invitation letters and nonresponse letters highlighting the number of sampled buildings and the total incentive amount for all buildings. To improve operational efficiency and to minimize respondent burden, each set of affiliated cases was assigned to the same recruiter.

- **Incomplete web surveys.** Once recruited, respondents received an email with log-in credentials to complete the web survey. Those who did not complete the survey within 7 days received up to three weekly automated reminder emails until the survey was completed. In addition to automated reminders, recruiters prompted respondents in person or by phone to complete the survey, often offering to help them do so. For cases where recruiters could not make phone or email contact with the respondent after they agreed to participate, Westat sent a letter with their survey credentials via FedEx to request that they complete the web survey.

5.9 Staffing and Production Management

5.9.1 Staffing and Training

Experienced recruiters were crucial to meeting recruiting goals. An initial group of nine remote recruiters with telephone recruiting experience was hired and trained in July 2024. Thirty-two in-person recruiters, all with significant field recruiting experience, were hired and trained at three points during the field period. Along with the last group of in-person recruiters trained, five additional experienced remote recruiters were trained because most of the original remote recruiters were no longer available for project work. Table 12 presents the numbers and types of recruiters trained by date.

Table 12. Trainings by date and recruiter type

Training	Remote	In person	Total
July 2024	9	—	9
September 2024	—	4	4
November 2024	—	5	5
February 2025	5	23	28
Total	**14**	**32**	**46**

All trainings were conducted over several days, either in person or via Teams. Training content included study goals, building eligibility criteria, recruitment procedures, common respondent questions and concerns, and refusal conversion techniques. In addition to formal training sessions, project staff provided additional training as needed to ensure effective recruitment throughout the field period.

Field supervisors managed recruiters; one supervisor managed the in-person recruiters trained in the fall of 2024. Two additional supervisors were brought on when the large group of recruiters was trained in February; at that time, in-person and remote recruiters were split into three supervisory regions, largely based on geography: (1) Washington, (2) Oregon, and (3) Montana and Idaho.[21]

5.9.2 Recruiter Assignments and Travel

In-person recruiters were hired either as local recruiters or travelers. Local recruiters lived in or near one or more of the sampled census tracts. Travelers typically did not live in the Northwest region and traveled to areas with less local coverage, flying in for 1- to 2-week trips where they worked many cases in a concentrated period.

In-person and most remote recruiters were typically assigned cases in batches, usually one or several tracts near each other, depending on the number of sampled buildings in the tract. A few remote recruiters specialized in certain types of cases, such as those with multiple affiliated buildings or very large buildings where in-person contacts were typically not productive. Traveling recruiters generally received larger assignments and were expected to work the equivalent of full time or overtime while on a trip. For example, assignments of up to 200 cases required trips of 2 weeks or more.

5.9.3 Production Monitoring and Case Management

Within each wave, Westat project staff worked closely with NEEA and Westat statisticians to identify priority cases for recruitment. Priority cases—types of buildings needed to reach production and statistical goals—included buildings in certain size categories, specific building use types (primary building activity), and geographic locations.

Using an overall target number of recruited buildings, prioritization was designed to achieve similar proportions of recruited buildings by key subgroups (building size, building use, urbanicity) by state as sampled buildings by the same subgroups by state. For example, in Washington, two percent of the 5,654 sampled buildings were greater than 200,000 sq ft. Likewise, two percent of our recruited buildings in Washington were greater than 200,000 sq ft.

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[21] Although Waves 3 (Idaho) and 4 (Montana) were released in February when the new recruiters were trained, there was still a considerable amount of work remaining in Waves 1 and 2 (Washington and Oregon) at that time.

The purpose of this effort was to reduce potential nonresponse bias by reducing differential nonresponse across subgroup categories. Section C.2.3.2.1 describes the role that stratification played in identifying priority cases for recruitment.

Supervisors worked with recruiters to implement recruitment strategies tailored toward achieving the priority case recruitment goals.

To ensure consistent work across cases, Westat staff conducted regular case reviews. Case reviews helped identify buildings that needed additional prioritization by a recruiter or escalation to a supervisor due to challenging circumstances. Examples of priorities for case review included those with

- Incomplete web surveys 3 weeks or more after recruitment
- Incomplete contact information after recruitment
- Temporary refusals
- Affiliated buildings with differing contact information or building progress status

This ongoing review helped ensure that cases received consistent attention and provided the opportunity to prioritize cases with specific traits to align with recruitment targets.

5.10 Site Visit Scheduling

5.10.1 Handoff to Michaels Energy

After a respondent agreed to participate, Westat transitioned the case to Michaels for site visit scheduling. For most of the recruitment period, cases were scheduled only after the web survey was completed. This was done so that Westat staff could confirm building eligibility by reviewing survey data, and to use some survey data to populate the site visit instrument to facilitate visit planning and execution.

During the last several months of data collection, this rule was modified to allow in-person recruiters to help respondents schedule appointments immediately after agreeing to participate. Scheduling site visits before web survey completion gave Michaels more lead time to plan efficient travel for field technicians while helping solidify respondents' commitment, potentially reducing survey site visit nonresponse.

The handoff for scheduling was handled differently depending on the recruitment mode. When a remote recruiter secured building participation, they told the respondent that a Michaels scheduler would follow up soon and provided contact information for Michaels if the respondent preferred to proactively schedule their site visit. When an in-person recruiter secured participation, the recruiter attempted to schedule a site visit on the spot with the respondent by calling Michaels. This method had intermittent success, with a variety of dynamics affecting outcomes.

When a case was ready for site visit scheduling (or had been scheduled during an in-person visit), Westat sent the respondent a site visit handoff email outlining the next steps for study participation (see Appendix 5).

Westat informed Michaels of cases ready for site visit scheduling through a shared report, updated weekly. Michaels regularly returned the report to Westat, indicating the cases scheduled, the date and time of the site visit, cases with a completed site visit, and cases they were transitioning back to Westat for nonresponse conversion.

5.10.2 Scheduling Procedures

Michaels scheduled all site visits with respondents through their customer service department. The effort was managed and carried out by two customer service specialists who served as site visit schedulers. Michaels established and used a dedicated CBSA phone number and email address for communicating with respondents.

Michaels attempted to reach each respondent at least three times by phone and/or email to schedule the building's site visit. The schedulers consulted with Westat project staff and recruiters for guidance on buildings that were difficult to reach and then often made additional attempts to these respondents. When respondents could not be reached after multiple attempts or refused participation, Michaels returned the case to Westat for nonresponse conversion (see Section C.5.10.3).

Once a site visit was scheduled for a building, the scheduler sent the respondent an Outlook calendar invitation with the date and time of the visit, and the name and contact information of the field technician assigned to conduct it.

Specific geographic areas were typically targeted for site visits for 1- or 2-week periods, which enabled Michaels to schedule the most efficient travel and fieldwork for the field technicians.

5.10.3 Nonresponse Conversion

When Michaels encountered difficulties scheduling a site visit due to refusal or nonresponse, they sent the case back to Westat for additional recruitment efforts. Throughout the data collection period, Michaels returned 105 such cases (65 nonresponse; 40 refusal).

Nonresponse cases were those in which Michaels attempted to reach three times without contact. As Michaels returned these cases, they were assigned to a recruiter to recontact the respondent. For the majority of these cases, Westat was able to reach the respondent and obtain better contact times and/or methods for Michaels to attempt scheduling.

Refusals were cases in which a respondent informed Michaels that they were no longer interested in completing a site visit. Depending on the strength of the refusal and prior refusal history, Westat decided whether to attempt to convert the refusal. As many site visit refusals were strong, refusal conversion was often not attempted or was not successful. For cases where recruiters were able to convince the respondent to complete the site visit, Westat notified Michaels to reattempt site visit scheduling and provided new contact information as needed.

6. Data Collection – Building Survey

This section provides an overview of the three data collection components that comprised the 2025 CBSA building survey:

1. The web survey
2. The utility data-sharing agreement
3. The site visit

Data collection for the building survey was conducted over a 9-month period, beginning in August 2024. Energy-related building characteristics and equipment data were collected from sampled buildings via a self-administered web survey and an in-person site visit conducted by field technicians. A third data collection element involved obtaining a signed utility data-sharing agreement from a building representative authorizing their utility to provide energy use data for their building to Westat for the billing data collection component of the CBSA (see Section C.7).

6.1 Web Survey

6.1.1 Overview

The web survey was designed to serve three main functions:

1. Determine and confirm building eligibility to ensure that only eligible buildings participate in the study.
2. Simplify the site visit instrument, thereby reducing the burden and cost associated with in-person data collection, by including data elements in the web survey that could easily be collected in advance of the visit.

3. Obtain answers to key data elements that were preloaded into the site visit instrument to help field technicians plan an efficient visit.

Items included in the web survey are described in Section C.4.3.

The survey was designed to be the first of the three building data collection components after a respondent was recruited for study participation. Once recruited, Westat emailed the respondent instructions for completing the survey, including a URL link and a unique PIN to access the survey for their building. To help respondents correctly identify the sampled building and confirm its eligibility for the survey, each survey was prepopulated with the building's street address, building name (if recorded during listing), and an image of the building footprint created during listing.

6.1.2 Interview Modes

As described in Section C.4.1, the web survey was designed to be a self-administered questionnaire with an expected completion time of about 30 minutes. The web survey was shortened to approximately 20 minutes several months into data collection in an effort to reduce respondent burden and increase response rates (see Section C.4.4.4). During the latter part of the field period, recruiters were trained in web survey administration and were encouraged to interview respondents in person or by phone at a respondent's request or to facilitate study participation. The vast majority of web surveys were self-administered by the building respondent. A complete web survey was generally required before the site visit could take place. However, to expedite site visit scheduling toward the end of the data collection period, Michaels was permitted to schedule site visits for recruited buildings before Westat received a completed web survey. For a small number of scheduled buildings, site visits were conducted before the web survey was submitted due to timing issues. Although Westat recruiters followed up with these building respondents, securing a completed web survey after the site visit before the end of data collection proved impossible.

6.2 Utility Data-Sharing Agreement

6.2.1 Development

After agreeing to participate in the study, respondents were asked to sign an agreement allowing their utility to release energy use information about their building to Westat. Using a standard agreement form (Figure 67), respondents were asked to provide the name(s) of their electric and, if applicable, natural gas, utilities, and associated account number(s). One supplier requested a tailored data-sharing agreement, which was accommodated.

Figure 67. Utility data-sharing agreement

Utility Data Sharing Release

2025 Commercial Building Stock Assessment

The Northwest Energy Efficiency Alliance, Inc.'s (NEEA) 2025 Commercial Building Stock Assessment (2025 CBSA) is a critical resource for the Northwest that is relied upon for a wide array of uses including energy planning forecasts, codes and standards advocacy, energy efficiency program planning, and program evaluation. The main objective of the 2025 CBSA is to develop a current, robust, and representative characterization of the existing commercial and multi-family building stock in the Northwest. NEEA is working with Westat, Inc. (Westat) as its contractor to help facilitate the 2025 CBSA. By participating in the 2025 CSBA, participants are helping to achieve these goals.

By signing below, I (Participant) hereby represent and affirm that I have the authority and authorization to consent to the disclosure of the Premises' electric and/or natural gas utility accounts and related energy-use data and information. I further consent, give permission, and authorize the following servicing electric and/or natural gas utility/utilities, and their agents, to provide Westat with energy-use data and information related to the Premises, including but not limited to monthly usage histories and interval meter data, where available, for the period of July 2023 through June 2025. Sharing energy-use utility data and information is very important to the 2025 CBSA study, and I (Participant) understand that release of this energy-use utility data and information is required to participate in the study. I (Participant) further understand that this energy-use utility data and information will only be used for the 2025 CBSA, and any output of the 2025 CBSA including but not limited to any public reports will not contain any personally identifiable Participant information.

Please respond and provide the applicable information below.

Name of Participant   Phone number   Building ID *(Internal Use)*

Address of property to be surveyed (the "Premises")   Unit #   City   State   ZIP

There is electric service at the Premises: Yes [ ] No [ ]

Electric Service Provider Name   Account Number(s)

There is natural gas service at the Premises: Yes [ ] No [ ]

Natural Gas Service Provider Name   Account Number(s)

Signature of Participant   Date

NEEA Contract #52533   April 2024

6.2.2 Collection

Most data-sharing agreements were collected via electronic signature using Docusign. The agreement form was emailed via Docusign to the respondent or a person identified by the respondent as authorized to grant the release of the building's billing data to Westat. If the respondent did not sign the agreement in Docusign within 1 week, Westat sent a reminder email. As needed, Westat conducted additional follow-up by phone or email or in person to prompt the respondent to complete the data-sharing agreement before the site visit.

Although most respondents signed the agreement via Docusign, approximately one-quarter opted to complete a hard copy version (Table 13). The field technician collected signed hardcopy agreements at the time of the site visit before providing the debit card incentive. A small number of respondents submitted an electronic version of the signed form via email.

Table 13. Data-sharing agreements by receipt method

Receipt method	Number	Percentage
Docusign	428	71.7%
Hard Copy	154	25.8%
Email	15	2.5%
Total	**597**	**100%**

As data collection progressed, Westat adjusted a few requirements for completing the data-sharing agreement, including the timing and collection mode. Initially, completed agreement forms were required before Westat transferred the case to Michaels for site visit scheduling. To improve the flow of cases to Michaels for scheduling during the last months of the field period, Westat sent cases to Michaels without a signed form while continuing to prompt respondents to complete the form before the site visit. If the agreement was not obtained by the site visit date, the field technician collected a hard copy agreement on site.

6.3 Site Visits

6.3.1 Overview

As the data collection contractor, Michaels was responsible for all aspects of site visit operations. Michaels trained approximately 20 field technicians and engineers from Michaels and Driftless Energy throughout the data collection period. Most field technicians lived outside the Northwest region, so site visits were scheduled and assigned to field technicians in geographic clusters for efficient long-distance travel. Trips typically ranged from 1 to 2 weeks with 4 to 12 site visits per trip. Site visits were scheduled as half-day or full-day visits. Two half-day visits were often scheduled in 1 day, with a maximum of 60 minutes travel time between the two sites. Approximate completion time for site visits at small buildings was 1.25 to 3.5 hours, medium-sized buildings 3.5 to 5.5 hours, and large buildings 5.5 to 8 hours.

6.3.2 Site Visit Preparation

Before visiting each building for the site visit, field technicians reviewed information from several sources to ensure they were clear on the intended building and were prepared for the visit:

- Online information showing the building address and boundaries, including Google Maps, parcel maps, and campus layouts
- Westat's interactive map of sampled building footprints (see Section C.5.8.2.1)
- The building's website (if available) to assess the building's approximate size, number of floors, shape, and exterior wall perimeter, as well as the presence of common spaces, multiple business types, and roof/outdoor equipment
- Information about the building's size and use, and completion status of the web survey and billing release agreement
- Information from respondents about building access, including instructions for parking, building entrance, and security procedures
- The site visit data collection instrument for general building data prepopulated from the web survey (see Section C.4.4.1)

Field technicians were instructed to call the building respondent the day before the scheduled visit to confirm their arrival time and other logistical details. During this call, field technicians also asked if building blueprints or design specification documents could be made available during the visit to help identify the location of equipment.

6.3.3 Field Technician Tools and Supplies

Field technicians were prepared with all necessary tools and supplies for each site visit, depending on their assessment of the type of site, including:

- ID badge
- Fully charged tablet or phone with the Survey123 app and integrated camera to take photographs
- Several incentive debit cards
- Insulated multi-bit screwdriver set
- Flashlight or headlamp
- Working gloves
- Measuring tape or laser measuring tape
- Safety glasses
- Pen light

- Stepstool and/or collapsible ladder
- Notepad/paper and pen or pencil for notes
- Any additional personal protective equipment as specified by the building respondent

6.3.4 Data Collection Instrument

Field technicians accessed the site visit data collection instrument via the Survey123 app on mobile phones or tablets (see Section C.4.4). By entering the sampled building's unique case ID, the app loaded a customized instrument for the building, populated with the building address and other key information transferred from the web survey. The Survey123 app could collect and save data on- or offline, making it a well-suited tool for on-site data collection. If data were collected offline, field technicians could securely upload data to Westat's server when internet access was available.

6.3.5 Site Visit Protocols

The site visit was divided into three components:

- **Introductions.** Field technicians requested 5 to 30 minutes, depending on building size, to meet with the staff who would guide them around the building to explain site visit goals and answer questions.
- **Data collection.** Field technicians used the Survey123 instrument on a mobile device to gather data on building systems, primarily heating, cooling, water heating, lighting, and refrigeration equipment, as applicable. The full data collection protocol, including instructions for recording data in the site visit instrument, is provided in Appendix 6.[22]
- **Wrap-up meeting.** Field technicians met with the building respondent and other building staff, as applicable, to review the data collected and clarify any issues or discrepancies. Field technicians also provided the respondent with the participation incentive (see Section C.6.3.7) and collected the signed utility data-sharing agreement, if not previously submitted to Westat.

6.3.6 Within-Building Subsampling

Occasionally, a participating building was too large or too complex for the field technician to complete data collection activities in all building spaces within the maximum time allowed for a

[22] This document is a reprint of the protocols developed at the outset of data collection; minor changes made during the field period, such as instrument updates described in Section C.4.4.4, are not reflected.

site visit, 8 hours. This typically occurred when there were more businesses, floors, or rooms in the building than could be adequately assessed during the visit.

For these situations, Westat created instructions and a spreadsheet template for field technicians to execute a set of standard subsampling procedures across all buildings, where required. Using these tools, the field technician listed all units in the building of the type most appropriate for the situation—businesses, floors, or rooms—and used a systematic procedure with a constant sampling rate to randomly select a set of units for inclusion in the visit. Field technicians documented the selected units on the spreadsheet and submitted the completed file to Michaels for inclusion in the site visit QC process. Michaels then forwarded the subsampling spreadsheets to Westat for statistical review and weighting.

Field technicians conducted subsampling at 19 buildings, 4 in which businesses were sampled, and 15 in which floors or rooms were sampled. See Section C.2.3.2.4 for sampling rates and Section C.10.2.5 for weighting procedures.

6.3.7 Paying Incentives

Paying respondent incentives was a joint effort between Westat and Michaels. Westat administered the incentive debit card program and provided debit cards to Michaels for distribution to field technicians. At the conclusion of the site visit, the field technician gave the site respondent an incentive debit card along with the card shown in Figure 68 in the event the respondent had questions about their incentive or needed assistance using their debit card. After receiving confirmation from Michaels that a site visit had been completed, Westat activated the debit card given to the respondent and loaded it with the appropriate amount of money based on the building's size.

Figure 68. Incentive support card

6.3.8 Site Visit Time and Building Staff

Field technicians completed several questions at the end of the site visit instrument designed to capture summary information about the visit. These included the total time spent on site at the building, and the number of building staff directly involved in the site visit. The average number of hours field technicians spent on site was 2.84, and the average number of building staff members who participated in site visits was 1.44. Additional results of these questions are reported in Tables 14 and 15.

Table 14. Mean hours on site by building size

Size category	Mean hours
1,000 to 10,000 sq ft	2.12
10,001 to 25,000 sq ft	2.36
25,001 to 50,000 sq ft	3.90
50,001 to 100,000 sq ft	4.75
100,001 to 200,000 sq ft	5.18
200,000+ sq ft	6.17

Table 15. Counts of building staff involved in site visit

Number of staff	Count
1	348
2	158
3	27
4	5
5+	2

7. Data Collection – Utility Billing Data

7.1 Overview

Energy Use Intensity (EUI) is an important metric in assessing energy efficiency in buildings and in forecasting and other planning initiatives. The most efficient and accurate way to gather the data needed to calculate EUI—energy used per square foot—is generally to collect energy consumption data for each building from the electric and natural gas utilities that serve them. After all building data collection was completed, Westat undertook a separate data collection effort to obtain participating buildings' energy usage data from their utility companies. Utility billing data collection was conducted from July through September 2025, with data review and retrieval continuing for several additional weeks.

7.2 Eligibility

7.2.1 Utilities

Utilities were eligible to participate in the billing data collection if they provided electricity and/or natural gas to at least one eligible building (see Section C.7.2.2). Thirty-three utilities were identified at the start of data collection; of those, 29 utilities submitted data for at least one case. The remaining four were determined to be ineligible; these utilities were misidentified by building respondents, and the buildings initially assigned to them were relinked to the utilities that actually served those customers.

An eligible utility could provide electricity, natural gas, or both to its customers. Twenty-two utilities had electricity customers only, four had natural gas customers only, and three provided both electricity and natural gas.

7.2.2 Buildings

Sampled CBSA buildings were eligible for the billing data collection if:

1. A utility data-sharing agreement was completed and signed
2. A web survey and/or site visit was completed

A total of 580 buildings met the inclusion criteria for billing data collection (Table 16). There were 11 additional buildings with a completed web survey and/or site visit but without a signed utility data-sharing agreement; these buildings were excluded from billing data collection.

Table 16. Buildings eligible for billing data collection by completed survey component(s)

Completed survey component(s)	Buildings
Web survey and site visit	539
Web survey only	33
Site visit only	8
Total eligible buildings	**580**

Electricity and natural gas data were collected separately from utilities for each building. All buildings were assumed to have electricity accounts. Identification of buildings with natural gas accounts was sometimes inconsistent across the three components of the building data collection: data-sharing agreement, web survey, and site visit. To capture as much natural gas data as possible, a building was classified as having a natural gas account if it was identified as using natural gas in any of these three ways:

- The respondent identified a natural gas utility in the data-sharing agreement
- The respondent identified natural gas as an energy source in the web survey
- The site visit technician identified a natural gas meter for the building

Table 17 presents the number of buildings by fuel type.

Table 17. Number of buildings eligible for billing data collection by fuel type

Fuel type	Buildings
Buildings with electricity accounts	580
Buildings with natural gas accounts	408
Total eligible buildings	**580**

Each building was linked to an electric utility and, if applicable, to a gas utility. Linkage was primarily based on information the respondent provided in the data-sharing agreement, supplemented with data from other sources (e.g., the building's web survey, service territory maps) as needed.

7.3 Staffing and Training

Three Westat staff members were trained to collect CBSA billing data through a 1-day in-person training session held in mid-July 2025. All three data collectors, referred to as *specialists*, also served as CBSA building recruiters and had previous experience conducting similar utility billing data collection. Training topics included methods for contacting and gaining cooperation from utilities using study materials, functionality of the data collection website (see Section C.7.5), providing utility support by answering questions and giving technical assistance for submitting data, setting utility due dates for data submission, and ensuring utilities completed all study activities on time. Data collection commenced the day after training, with Westat project staff providing close monitoring and supervision.

Several weeks into the data collection period, the specialists were also trained to conduct quality control checks on submitted data and to recontact utilities to retrieve missing data (see Section C.8.3.1).

7.4 Contact Materials and Procedures

7.4.1 Data Collection Materials

Materials developed to facilitate the utility billing data collection fell into two categories: materials used by the specialists and materials sent to utilities. The first category included call guides, which were scripts designed to assist specialists when calling utilities. There were three call guides, used at different points in the contact protocol: the initial call, the confirmation call, and the prompt call.

Materials sent to utilities included the following:

- Advance email
- Introductory email
- Password email
- Check-in email
- Reminder email

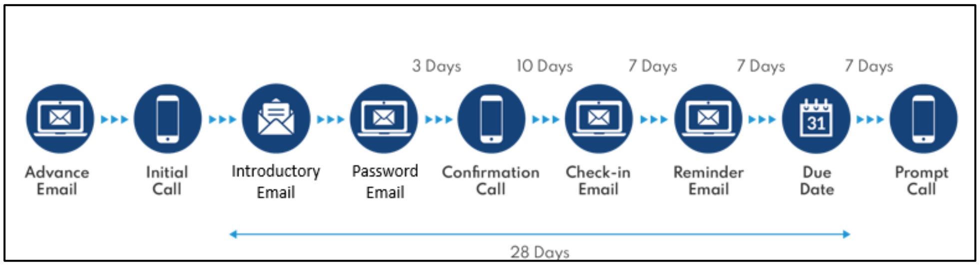
These items (described in the next section and shown in Appendix 7) were used as part of the utility contact protocol. Materials in alternate modes were also prepared to meet respondent needs; for example, although the confirmation call was designed as a telephone script, an email was also developed to send to respondents who could not be reached after multiple telephone attempts.

7.4.2 Contact Protocol

Each utility was assigned to a dedicated specialist. Westat also operated help desk resources: a project-specific email box and a toll-free telephone line to handle general incoming contacts from utilities.

A standardized multimode contact protocol of mailings, telephone calls, and emails was used for most data collection procedures (Figure 69).

Figure 69. Sequence of billing data collection contacts



- **Advance email.** The advance email introduced the CBSA billing data collection and the tasks required of the utility. It also asked the recipient to confirm whether they were the appropriate contact for the study. If so, they were asked to respond to the email to verify their contact information; if not, they were asked to provide the name and contact details of the correct person. Four versions of the advance email were used, targeted to the utility type or relationship with NEEA: CBSA Work Group Member, NEEA Funder, BPA, and Other (this version is shown in Appendix 7).
- **Initial call.** Specialists made an initial call to locate the contact person, introduce the study, and verify the utility name and contact information. Once the correct contact person was located, the specialist reviewed the study details and informed the respondent that the forthcoming introductory and password emails would contain log-in information for the data collection website.
- **Introductory and password emails.** After the initial call, respondents were sent an introductory email providing more information about the study, the due date for data submission, the data collection website URL, and the utility's website username. For security reasons, a separate password email was sent at the same time.
- **Confirmation call.** If a respondent had not begun submitting data within 3 days of receiving their introductory and password emails, the specialist attempted a confirmation call to establish whether the introductory materials were received, answer questions, and if needed, identify a new respondent. If the specialist was unable to reach the respondent by phone after several attempts, they sent a follow-up email.
- **Check-in email.** If the respondent had not submitted data within 14 days after the initial contact, the specialist sent the check-in email as another reminder to complete data submission.
- **Reminder email.** This email was sent 7 days before the due date if the utility had still not submitted any data.

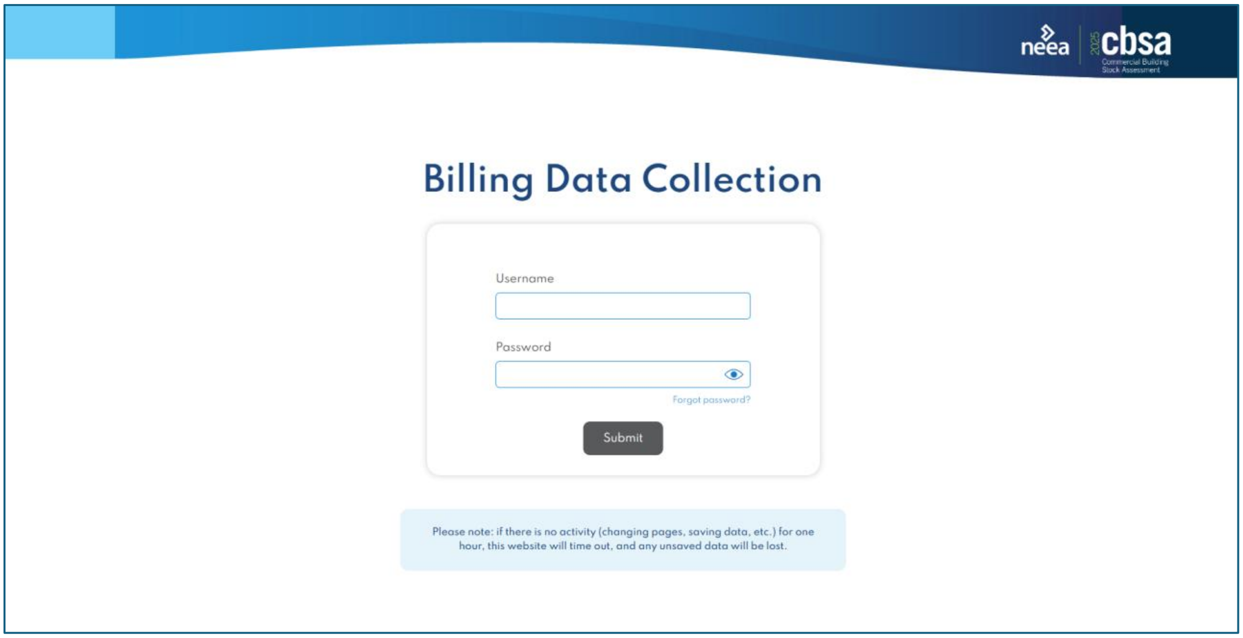
- **Prompt call.** The specialist made one or more prompt calls to the respondent if data were not received within 7 days after the due date to ask whether they needed assistance completing the data submission and offer a due date extension.

Utilities that did not provide the requested data toward the end of the data collection period were escalated to NEEA's stakeholder relations team for assistance. In the few cases where this was needed, NEEA's team was instrumental in facilitating the utility's submission of some or all of the requested data to Westat.

7.5 Data Collection Website

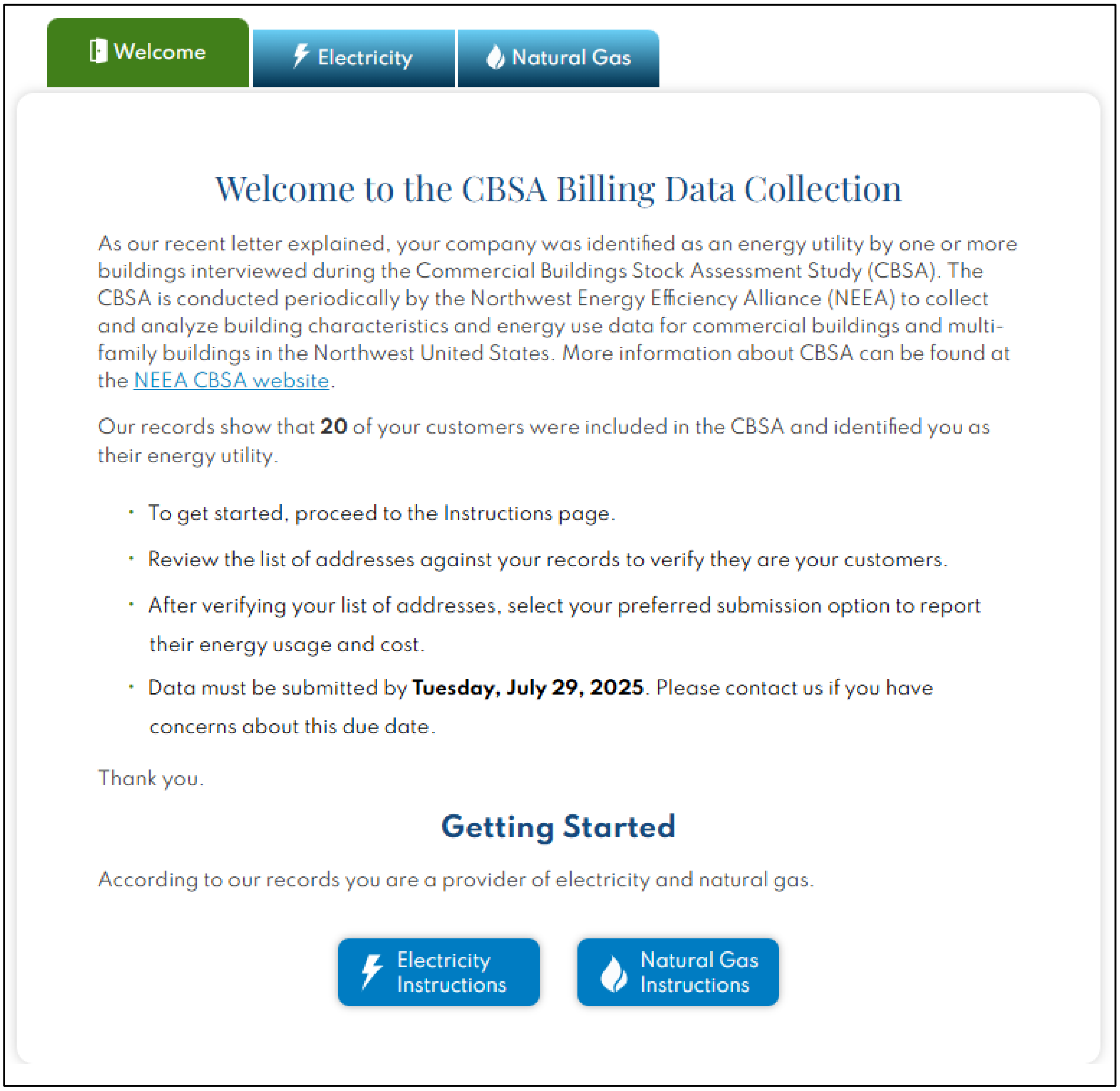
Utilities used the CBSA Billing Data Collection website to submit their customers' energy consumption data. The website described the background, purpose, and content of the survey; answered FAQ; provided website navigation instructions; outlined data elements to report; offered multiple modes for data submission (e.g., entering data online or uploading an Excel file); and provided contact information for Westat and NEEA. To enter the website, users input their username and password on the log-in page, as shown in Figure 70.

Figure 70. CBSA billing data collection log-in page



Once logged in, the respondent was taken to the Welcome page (Figure 71), which presented the total number of customers for whom the utility would report and provided a due date by which all reporting should be complete.

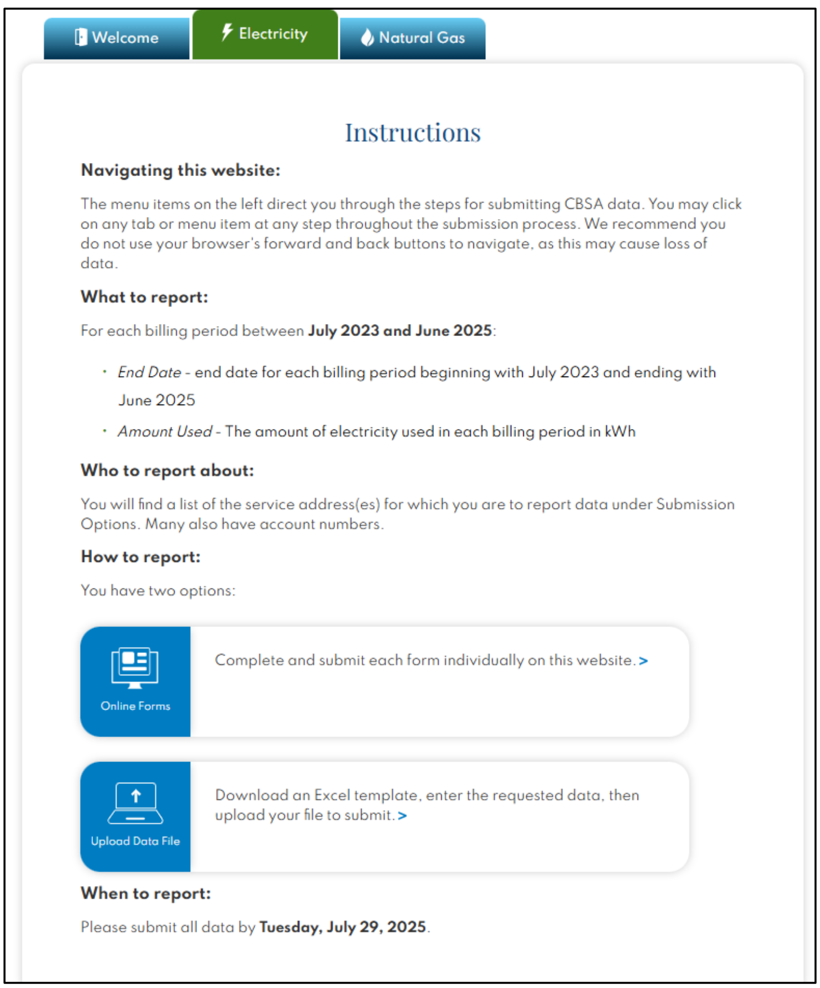
Figure 71. Welcome page



The Instructions page (Figure 72) provided an overview of how to use the website to submit data, including the following.

- **What to report:**
  - 24 months (July 2023–June 2025) of periodic data
  - End billing dates
  - Unit of measure (for natural gas utilities)
  - Amount used
- **Who to report about:** How to find the specific service address(es) for which they were reporting data
- **How to report:**
  - Complete online forms
  - Upload an Excel file

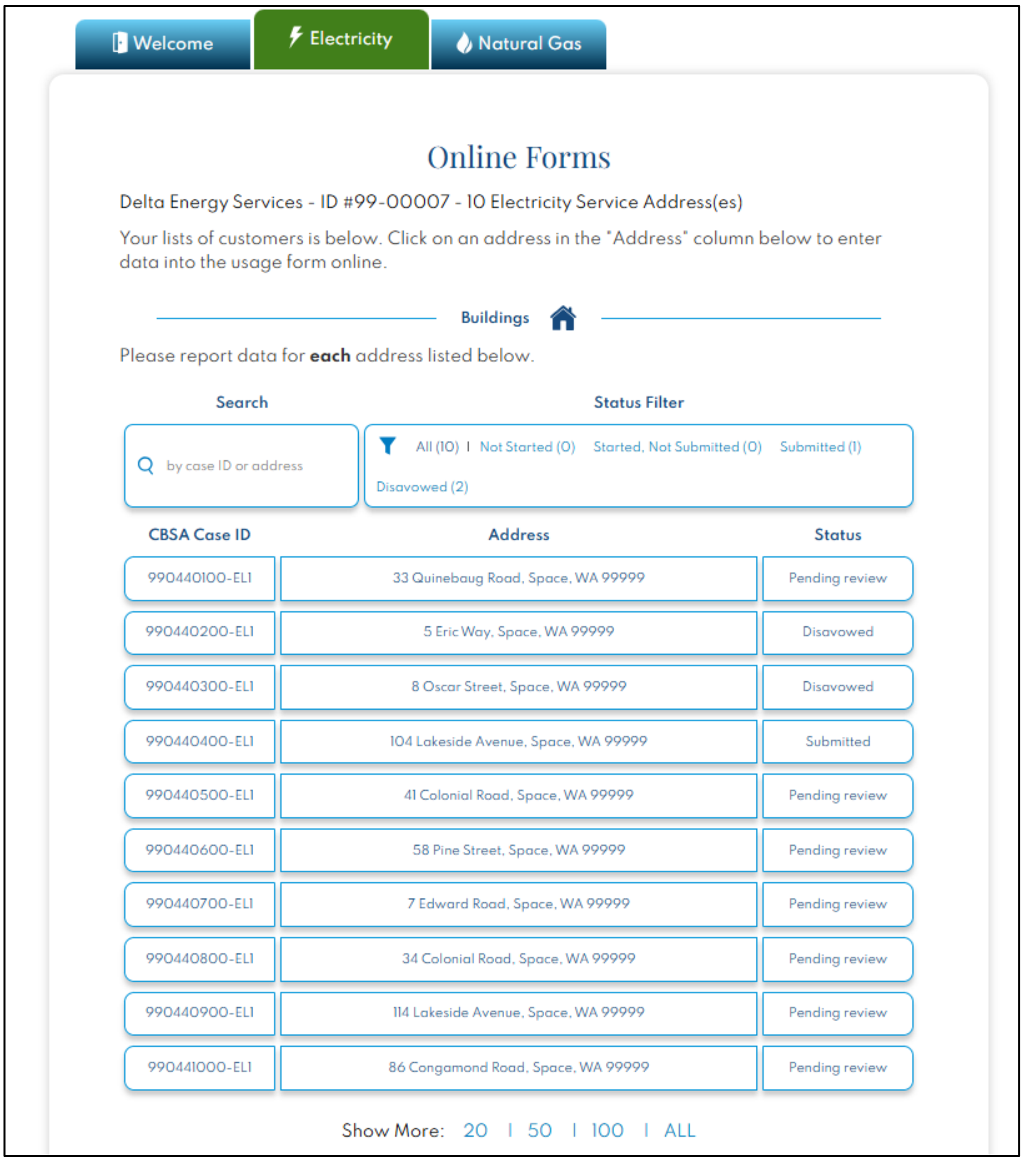
Figure 72. Instructions page



7.5.1 Online Forms

All data submitted via the online forms (Figure 73) was automatically received and loaded into the database. For each online form submitted by the utility, the associated case's data collection status on this page changed from "Not started" or "In progress" to "Submitted." When a form was saved or submitted, data entered into the form were immediately added to the secure central database accessible by Westat staff. Of the 29 utilities that submitted data, 6 (21%) predominantly used the online forms.

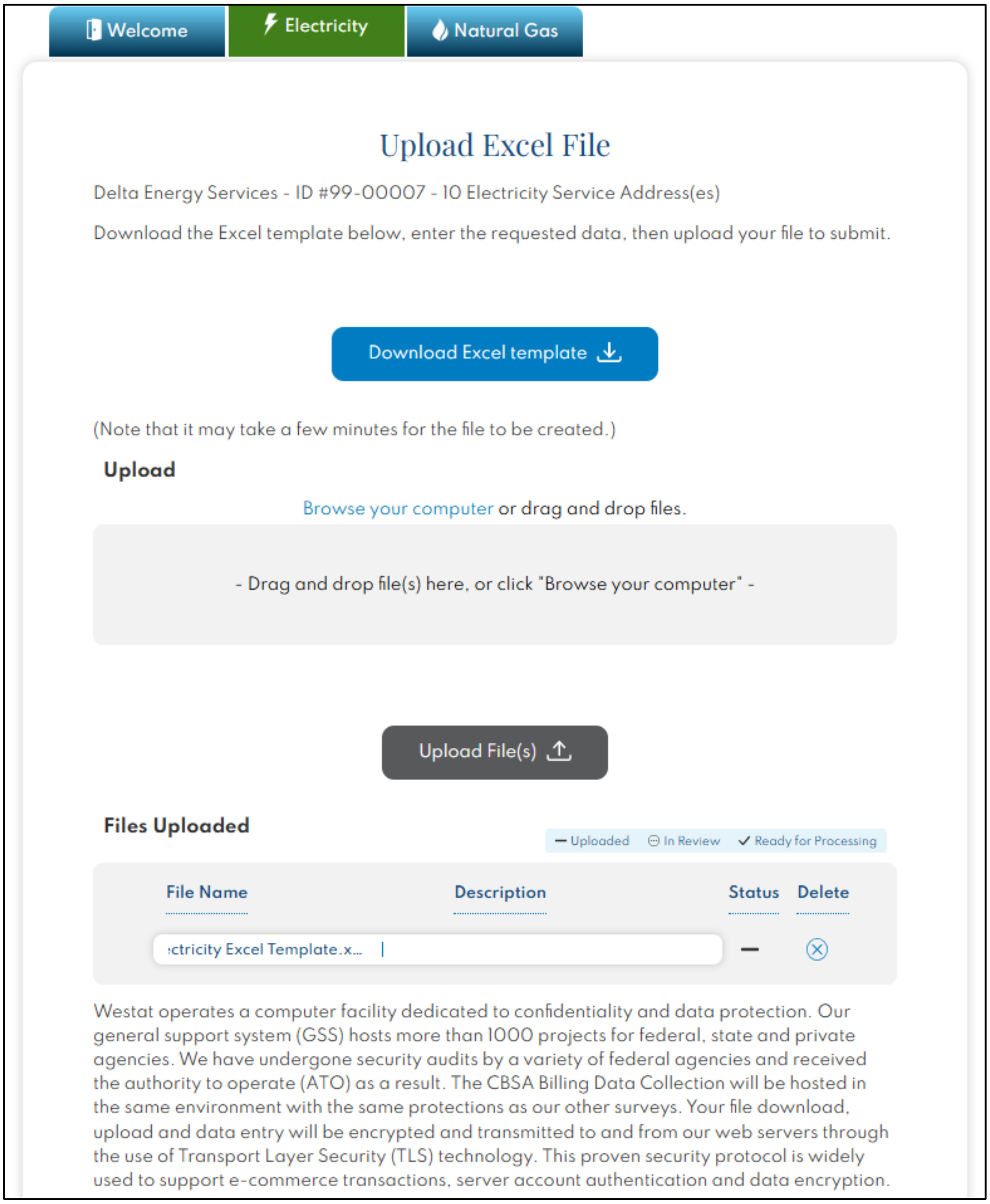
Figure 73. Online Forms page



7.5.2 Spreadsheets and Other Data File Formats

When a respondent uploaded a file via the website (Figure 74), they received an automated email confirming receipt. Incoming files were downloaded, reviewed, and processed by the specialists. Twenty-three of the 29 utilities (79%) predominantly submitted data using spreadsheets.

Figure 74. Excel Spreadsheet Instructions



7.6 Billing Data Collection Response Rates

All utilities contacted for billing data collection responded to Westat's request (Table 18). Each eligible utility (i.e., those that had been correctly identified by at least one building respondent) submitted data for some or all of their assigned cases (Table 19). Some cases were not completed during data collection, for one of the following four reasons:

1. The customer was not in the utility's service territory, and the case was not reassigned to the correct utility during the data collection period
2. The customer did not use any energy during the requested time
3. The customer did not use this energy type (e.g., the requested data were for natural gas, but the customer used electricity only)
4. The utility could not locate the customer in their records, or for other reasons, was unable to provide the data during the data collection period

Unsubmitted cases with one of the first three reasons were considered ineligible (i.e., they counted against the total completion rate but not the total response rate), whereas cases with the fourth reason were considered nonresponse and counted against both the total completion rate and the total response rate.

Table 18. Billing data collection production statistics

Utility	Responded to data request	Submitted data	Completion rate	Response rate
Utilities with eligible cases	29	29	100%	100%
Utilities with no eligible cases	4	0	0%	_ --
Total utilities	**33**	**29**	**88%**	**100%**

Table 19. Production rates by energy type

Energy type	Total	Submitted	Ineligible	Nonresponse	Completion rate	Response rate
Electricity	580	496	19	65	86%	88%
Natural gas	408	318	11	79	78%	80%
Total buildings	**988**	**814**	**30**	**144**	**82%**	**85%**

Note. If a building uses both electricity and natural gas, it is counted twice: once in each row. Completion rate = Submitted / Total. Response rate = Submitted / (Total – Ineligible).

Of the 496 buildings for which electricity data were submitted, data for 475 of them were included in the final datasets. Of the 318 buildings with natural gas data submitted, data for 277 of them were included in the final datasets. That includes 10 buildings that were dropped from the overall dataset because they did not meet final eligibility requirements. The remaining exclusions were due to lack of sufficient data for analysis (i.e., less than one year of billing data submitted) or data inconsistencies that could not be resolved (e.g., buildings with very high EUIs that could not be accurately disaggregated).

8. Data Processing and QC

This chapter describes the data processing that Westat and Michaels performed during and following data collection. Also discussed are the measures taken to ensure data collection quality at every step of the process.

8.1 Web Survey Data

The web survey data were saved in real time to a secure web-based server. Management data were regularly transmitted to the case management system, and survey data were regularly extracted from the web server for review. All data eventually resided in their final state at Westat.

As each web survey was completed, key data points were reviewed to

- Confirm eligibility
- Compare size and building activity against information from listing and from the case management system to identify potential issues
- Review comments for information that might affect the site visit

8.2 Site Visit Data

8.2.1 Data Transmission

Site visit data for each building was stored locally on the field technician’s device until the technician had finished collecting and reviewing the data, at which point they transmitted them to a secure web-based server. Survey data and related photos taken by field technicians were regularly extracted from the web server for review. All data eventually resided in their final state at Westat.

8.2.2 Michaels Energy QA/QC and Delivery to Westat

To provide Michaels Energy access to the site visit data and photos for conducting QA/QC work, Westat downloaded the data from the web server, checked for major issues, sorted photos into folders by case ID, and uploaded data (in spreadsheet form) and photos to NEEA's secure SharePoint site.

Michaels conducted a series of automated QA/QC checks on the data for each site visit case. These checks identified and flagged outliers, conflicting entries, and missing data, which were then reviewed and resolved by Michaels' engineers. Photos taken during the site visit and submitted with the survey entries were used to confirm and/or clarify the data. Where updates were needed, Michaels recorded updated values that Westat applied to the data for delivery.

Michaels developed a spreadsheet-based tool to compile the data from each site visit for automated checks:

1. Data from all surveys were uploaded in batches and compiled cumulatively in a worksheet on NEEA's SharePoint, referred to as the Master Survey Sheet.
2. Survey data were decoded from coded numbers/labels/variables into human-readable text, using Excel formulas and lookups, to make the meaning of the entries clear.
3. The decoded data were then copied and pasted (values only) into a separate workbook for performing QA/QC checks.
4. A separate Excel file was created for each site, which contained multiple sheets if multiple surveys were completed at a site (for buildings with subsampling).
5. Once the data for a site visit were compiled, automated checks were completed to identify and flag outliers, conflicting survey entries, or when key data were missing. QA/QC engineers reviewed the results of the automated checks and worked with field technicians to resolve errors and fill in missing data.

Manual QA/QC checks were also employed at several stages during data collection. Early in the data collection period, Michales engineers performed manual checks on a small number of surveys to ensure the automated checks were working as expected. The automated checks were updated as needed as a result of the manual checks. Manual QA/QC checks (such as comparing photos of equipment with data entries) were performed for at least the first three sites completed by each field technician, to identify additional opportunities for more automated checks and continued field technician training. Manual review also served as "gut checks" on data that relied heavily on engineering experience and were unique to each survey. Manual QA/QC checks were those that were too difficult to reasonably program into automated checks, such as reviewing photos to ensure model numbers, manufacturers, efficiencies, etc. were entered correctly.

The compiled survey data and all the generated flags were made available to the field technicians via Microsoft Teams to facilitate collaboration with the QA/QC reviewer to address any issues with the survey data. A tracking spreadsheet was created with a list of each completed survey and its current status such as reviewed, needs revision, and revised. Field technicians were expected to address any issues with their survey data within 1 week of review and were responsible for updating the case status once all flags and comments on the survey were addressed.

All updated survey data were stored in individual files created for each site during the QA/QC process. These files were delivered to Westat. To safeguard data integrity, Westat maintained copies of the "raw" data and a changelog of all QC-related updates.

8.2.3 Variable Frequency Drive (VFD) Imputation

In cases where field technicians could not assess the presence of a VFD on site, Michaels attempted to classify pumps and fans by reviewing other equipment information and pictures taken during the site visit. For each record, Michaels assigned one of the following values:

- Confirmed VFD
- Likely VFD
- Likely no VFD
- Confirmed no VFD

Table 20 describes the logic Michaels used to classify the different types of motors collected in the site visit instrument.

Table 20. VFD classification methodology

Type	Classification	Criteria
Pumps (general)	Confirmed VFD	VFD fields are populated OR VFD verified via site visit photo
	Likely VFD	motor power ≥ 3 HP AND (reset = yes OR pump control basis includes pressure or temperature OR smart pump = yes)
	Likely no VFD	motor power < 3 HP AND (reset / smart / VFD fields do not support VFD OR control = constant / on-off)
	Confirmed no VFD	control = constant AND no VFD fields are populated

Type	Classification	Criteria
Pumps (water heaters)	Likely VFD	recirculation pump is present AND (controls are listed as variable speed OR motor power ≥ 3 HP)
	Likely no VFD	recirculation pump is not present OR motor power < 3 HP
	Confirmed no VFD	control = constant AND no VFD field populated
Fans (HVAC systems)	Confirmed VFD	control = variable speed OR VFD verified via site visit photo
	Likely VFD	motor power ≥ 3 HP OR drive = belt + multi-speed control
	Likely no VFD	motor power < 3 HP OR control = continuous full-speed operation
	Confirmed no VFD	control = on-off
Fans (ventilation)	Confirmed VFD	control = variable speed / VFD
	Likely VFD	motor power ≥ 3 HP OR control = variable airflow system OR drive = belt + modulating control
	Likely no VFD	exhaust fans OR volume supply = constant OR motor power < 3 HP OR control info is unavailable
Fans (heat rejection)	Likely VFD	EMS controls present OR fan control indicates staging / modulation OR motor power ≥ 3 HP
	Likely no VFD	motor power < 3 HP OR control info is unavailable
Fans (refrigeration condensers)	Confirmed VFD	control = variable speed
	Likely VFD	control = Q-Sync / staged / unknown AND (EMS controls are present OR condenser floating = yes)
	Likely No VFD	motor power < 3 HP

Consolidated data for all fans and pumps, along with the results of the VFD reclassification, were provided in the analytic data tables “A_Summary_Fans” and “A_Summary_Pumps.” Table 21 summarizes the VFD reclassifications.

Table 21. VFD classification results

Classification	Fans (count)	Fans (percent)	Pumps (count)	Pumps (percent)
Confirmed VFD	272	8%	60	19%
Likely VFD	134	4%	82	26%
Likely no VFD	2,011	61%	174	55%
Confirmed no VFD	887	27%	0	0%
Total records	**3,304**	**100%**	**316**	**100%**

8.2.4 Model Matching

Michaels also conducted model matching for chillers, boilers, heat-rejection systems, HVAC systems, and water heaters to verify data entered during the site visit and to fill in missing data. As with the QC updates, Michaels delivered the model-matching updates to Westat by uploading spreadsheets to the SharePoint site, and Westat applied the changes to the data as needed.

This section outlines the process used to conduct model matching including data sources used, how data gaps and errors were identified and corrected, and the site visit instrument fields subject to model matching review.

Step 1: Database development. Michaels compiled data from past baseline or market characterization studies they had performed.[23] The data compiled consisted of HVAC equipment, heat rejection equipment, boilers, chillers, and water heaters.

Step 2: Automated batch review. Data from completed site visits were combined into a single spreadsheet using a Python script. The spreadsheet formatting allowed Michaels' engineers to review data from the same related fields from multiple surveys at once. Automated scripts were then run on the data to identify entries with high levels of similarity in model numbers and identical manufacturers. This script then compared the equipment types or classifications, capacities or sizes, and efficiencies to each other and flagged entries with differing values, including data entry gaps.

Step 3: Manual batch review. The formatting created in the previous step allowed Michaels to easily perform a manual scan of the data to identify gaps and possible errors that needed to be corrected that the script did not identify. Sorting data by equipment make, model number, etc., made it possible to quickly compare similar entries, making identifying anomalies in the data easier.

Step 4: Engineer review. Engineers reviewed all manual and script-flagged entries and determined if/what adjustments were necessary. Sources for correct information included site photos, manufacturer specification sheets, model number nomenclature, or vetted online equipment databases such as AHRI, ENERGY STAR®, or the U.S. Department of Energy's Compliance Certification Database.

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[23] These data came from the 2019–2020 Consumers Energy Commercial Baseline and Market Characterization Study, the 2019–2022 Pacific Gas & Electric (PG&E) Multifamily Energy Use Study, the 2016–2017 Iowa Potential Study for the Iowa Utilities Board, and the 2023–2024 Illinois Utilities Statewide Baseline and Potential Study.

Step 5: Final review. Engineers sorted the equipment entries by make and model number and identified entries for which information was still missing (after previous steps had been completed) and had a reasonable chance of being available from online resources or the database of past studies. Efforts were prioritized based on the number of entries for a particular make/model. Tracking down missing data that could be used to fill out many entries was given priority over units of which only one or two were observed in the field. Data were readily available online for a high percentage of recently manufactured equipment, whereas relevant data were harder to find for much older equipment. A limitation of this effort was correcting or filling in data for equipment with model numbers that could not be identified during the site visit.

In the HVAC equipment data set, the parameters that were affected the most were supply fan control method, motor type, motor drive type, and equipment capacity. For heat rejection equipment, the parameters that were most often changed were capacity, motor type, and motor control method. The changes to the boiler and chiller systems data sets were almost exclusively input and output capacities. The most common changes made to the water heaters dataset were equipment capacity and type.

8.3 Utility Billing Data

8.3.1 Data File Review

The majority of utilities submitted billing data by uploading one or more data files through the secure website. The specialists individually reviewed each data file, checking for issues and reformatting to match the template provided to the utilities.

The files were processed using a series of SAS programs that collected usage data from the spreadsheets, added it to the production database tables, and then calculated and applied status changes at the building and supplier level.

8.3.2 Data Editing and Review

All cases, whether submitted online or through a data file, were run through a SAS program that contained a series of edit checks. The edits were designed to identify potential issues in the data, including the following:

- Missing or invalid dates
- Missing units of measure (for natural gas cases)
- Usage amounts less than zero

- Fewer than 12 months of data in 2024
- Duplicate data between two cases for the same utility

Westat staff reviewed the edit output to determine which of the following courses of action was appropriate for each edit failure:

1. Update data to correct keying or file processing errors and discernible typos
2. Contact the utility to verify or obtain modified data
3. Override the edit failure if no other action was needed

Most edit failures fell into category 3, overrides; that is, after reviewing the data, the failure was determined not to be an issue. The next most common outcome was category 1, where updates could be made using information already available. Category 2, following up with the utility, was a rare outcome.

8.3.3 Allocation of Energy Use for Buildings Sharing a Meter

For the 2019 CBSA, in cases where it was determined that multiple buildings shared one meter, the billing data for all buildings connected to the meter was included for analysis. Because the total square footage therefore differed from the square footage reported elsewhere in the data, a separate weight was developed to account for these cases. Although this is a valid solution to this scenario, it introduces further complications in analyzing energy use in combination with other metrics. Westat opted to take a different approach by reallocating the total energy use reported for such buildings to derive amounts appropriate for the sampled building alone. This process is also known as disaggregation.

Approximately one hundred cases were identified for further review, either during utility billing data editing or during later QC of the delivery datasets, to determine if the reported billing data represented more than just the sampled building—that is, the sampled building shared a meter with another building or buildings on the same campus. The flagged cases included those with billing data that too closely matched another building in the sample and those with EUIs outside of the expected range for their building activity.

The flagged cases were individually assessed by reviewing several sources of information, including the following:

- The original billing data and any accompanying comments submitted by the utility
- Any comments available from the field technician regarding meters or energy use
- The frame file of all listed buildings, to identify any other buildings on a given campus that could be involved, regardless of whether they were sampled or completed

For those cases identified as sharing a meter, the next step was to clarify the scope of the shared meter. In some cases, only two buildings appeared to share a single meter; in others—particularly with self-storage units—there were multiple buildings that appeared to all be connected. Some cases involved buildings only within those sampled, whereas others involved additional buildings that were listed but not sampled.

The energy use for each case was reallocated by applying a factor to the original billing data for that case. The primary determinant for the size of the factor was square footage—that is, the percentage of floorspace that the sampled building occupies in relation to the total floorspace of all buildings on the meter. In rare circumstances where additional clarifying information was available (e.g., that certain storage units were conditioned vs. unconditioned) a further prorated factor was calculated by removing the unconditioned space from the total square footage.

For example, consider a campus with three buildings. Building A and Building B were included in the 2025 CBSA sample; Building C was not. All three buildings share a single meter. In this scenario, the factors for Buildings A and B are represented by the following formulas:

$$F_a = S_a / (S_a + S_b + S_c)$$

$$F_b = S_b / (S_a + S_b + S_c)$$

where

F_a	=	factor applied to Building A
F_b	=	factor applied to Building B
S_a	=	size of Building A in sq ft
S_b	=	size of Building B in sq ft
S_c	=	size of Building C in sq ft

If it was further determined that Building C was not wired for electricity, the calculations were modified to the following:

$$F_a = S_a / (S_a + S_b)$$

$$F_b = S_b / (S_a + S_b)$$

After the factor was applied, the data for each case was processed through all subsequent calculations to generate new estimated values for all relevant fields on the delivery datasets, such as monthly and annual EUIs, both “raw” and weather normalized. The affected cases are identified in the datasets with a flag of “Estimated (Disaggregated),” while those that did not require disaggregation are identified with a flag of “Actual” (Table 22).

For six cases, the scope of buildings sharing a meter could not be determined; for these buildings, the energy use data were removed from the delivery datasets and relevant fields were updated to "-9. Not Ascertained."

Table 22. Summary of buildings with actual vs. estimated energy use

Status	Electric data	Natural gas data
Actual	385	259
Estimated (disaggregated)	90	19
Not ascertained*	217	414
Total	**692**	**692**

* In addition to the buildings that could not be disaggregated, there are multiple other reasons a building could have an energy use status of "Not Ascertained." See Section C.7.6 for further details.

8.3.4 Weather Normalization

Weather normalization is a process that adjusts actual energy usage to reflect what the energy usage would have been under "normal" weather conditions.

The prior cycle of the CBSA utilized the Typical Meteorological Year, version 3 (TMY3) datasets to produce weather normalized EUIs. However, many data users have since moved to using the TMYx datasets. TMY3 and TMYx use the same format and similar methodology. Although utilizing TMY3 data allows for more direct comparison with data from prior studies and the datasets are a stable, trusted product, the TMYx data has several other advantages:

- TMYx data are more current; although TMY3 data end in the year 2005, TMYx data cover years as recent as 2023.
- TMYx continues to be updated (with updates planned for every 2–3 years), including adding new weather station locations.
- TMYx incorporates solar radiation data from the ERA5 reanalysis data set (ERA5 | ECMWF 4) based on satellite data.

For greatest flexibility in analysis, normalized EUIs based on both TMY3 and TMYx data are provided for the 2025 CBSA, in addition to the "raw" EUIs.

The first step in calculating both raw and weather normalized EUIs was to calendarize the billing data. Data submitted by the energy utilities were by billing period, with each billing period typically covering about 30 days, but with start and end dates that did not align with calendar months. The amount for each billing period was divided by the number of days in the period to calculate approximate daily usage for each day in the calendar year of 2024, and from there, monthly and annual total energy use amounts were calculated.

Annual raw electric and gas EUIs were calculated by dividing the total usage amounts by the building's square footage. Annual raw combined EUIs were calculated by

- Converting total electric usage from kilowatt-hours (kWh) to (thousand) British thermal units (kBTU) and converting total gas usage from Therms to kBTUs,
- Adding the two converted totals together to get the annual raw combined total, and
- Dividing the combined total by the building's square footage.

In conjunction with this process, we prepared the weather data with the following three steps:

1. Identify the closest National Oceanic and Atmospheric Administration weather station for each building, based on the latitude and longitude of each service address.
2. Extract TMY3 and TMYx data—primarily, hourly temperatures—for selected weather stations from climate.onebuilding.org. Calculate TMY daily mean temperatures ($T_{mean} = (T_{max} + T_{min})/2$), separately for each weather station, for both TMY3 and TMYx datasets.
3. Extract PRISM daily mean temperatures from prism.oregonstate.edu for the year 2024, for locations corresponding to each building.

The weather normalization process used a variable-base degree day (VBDD) modeling approach pioneered by Fels (1986). Let τ_t denote the outdoor air temperature during the time interval t, H and C denote the baseline temperature for heating and cooling, respectively, HDD and CDD denote the heating degree-days and cooling degree-days, respectively. Using the PRISM temperature data, separately for gas and electricity, conduct the analysis using the following steps:

1. Separately for cooling and heating, regress the daily raw energy usage on daily degree days evaluated at a series of baseline temperatures to see which yields the best model fit; heating balance temperature **H** from 40 to 70, and cooling temperature **C** from 60 to 90.

$$Usage_t = \alpha + \beta_C(\tau_t - C)_+ + \varepsilon_t = \alpha + \beta_C CDD(C)_t + \varepsilon_t$$

$$Usage_t = \alpha + \beta_H(H - \tau_t)_+ + \varepsilon_t = \alpha + \beta_H HDD(H)_t + \varepsilon_t$$

   a. The subscript $+$ indicates 0 if the term is negative, α and β are unknown regression coefficients, and ε is the random error assumed to be normally distributed.
   b. As needed, apply independent variables from the following pool: type of HVAC equipment, primary building activity, percentage of building sq ft that is conditioned, heating/cooling setpoint, building occupancy schedule information, and other data from the web survey and site visit, to find best fit model.

c. In addition to main effects, polynomial effects and interaction effects might also be considered for the independent variables.

d. Model fit for each building and model fit for groups of similar buildings would be investigated, with to-be-determined similarity measures for the buildings (e.g., using the independent variables mentioned in item b).

e. Model goodness of fit measures include coefficient of determination (R-squared), Mallow's Cp criterion, comparison between observed and expected values.

f. Model internal validation includes evaluation of patterns in scatter plots and residual plots.

g. Model external validation is conducted by comparing the optimal baseline temperatures against likely values observed in the empirical distribution of the data, suggested values in published guidelines such as Appendix G in ASHRAE Standard 90.1 (Goel et al., 2024).

2. Separately for cooling, heating, and cooling and heating combined, regress the daily raw energy usage on daily degree days evaluated at optimal baseline temperatures.

$$Usage_t = \alpha + \beta_C CDD(\hat{C})_t + \varepsilon_t$$

$$Usage_t = \alpha + \beta_H HDD(\widehat{H})_t + \varepsilon_t$$

$$Usage_t = \alpha + \beta_C CDD(\hat{C})_t + \beta_H HDD(\widehat{H})_t + \varepsilon_t$$

a. The subscript $+$ indicates 0 if the term is negative, α and β are unknown regression coefficients, and ε is the random error assumed to be normally distributed.

b. For combined cooling and heating regressions, limit to cases where the CDD base is greater than or equal to the HDD base.

c. As needed, apply independent variables from the following pool: type of HVAC equipment, primary building activity, percentage of building sq ft that is conditioned, heating/cooling setpoint, building occupancy schedule information, and other data from the web survey and site visit, to find best fit model.

d. In addition to main effects, polynomial effects and interaction effects might also be considered for the independent variables.

e. Model fit for each building and model fit for groups of similar buildings would be investigated, with to-be-determined similarity measures for the buildings (e.g., using the independent variables mentioned in item b).

f. Model goodness of fit measures include coefficient of determination (R-squared), Mallow's Cp criterion, comparison between observed and expected values.

g. Model internal validation includes evaluation of patterns in scatter plots and residual plots.

h. Model external validation is conducted by comparing the optimal baseline temperatures against likely values observed in the empirical distribution of the data, suggested values in published guidelines such as Appendix G in ASHRAE Standard 90.1 (Goel et al., 2024).

3. Combine daily HDDs evaluated at the optimal baseline temperatures into **annual HDD** and daily CDDs into **annual CDD**, denoted $\sum HDD(\hat{H})$ and $\sum CDD(\hat{C})$, respectively.
4. Estimate **weather-normalized annual energy usage** by combining the estimated regression coefficients from the model in Step 2 with weather conditions from a normalized year.

$$Normalized\ annual\ usage_{cooling\ and\ heating\ combined} = \hat{\alpha} * 365 + \hat{\beta}_C \sum CDD(\hat{C}) + \hat{\beta}_H \sum HDD(\hat{H})$$

$$Normalized\ annual\ usage_{Heating} = \hat{\beta}_H \sum HDD(\hat{H})$$

$$Normalized\ annual\ usage_{Cooling} = \hat{\beta}_C \sum CDD(\hat{C})$$

5. Convert weather-normalized annual gas energy usage and weather-normalized annual electric energy usage to kBTU and combine to calculate weather-normalized annual combined energy usage (in kBTU).
6. Divide the weather-normalized annual energy usage by the total square-footage of the building to calculate weather-normalized annual electric EUI (kWh/ft^2), weather-normalized annual gas EUI (Therms/ft^2), and weather-normalized annual combined EUI (kBTU/ft^2).

9. Data Delivery

Westat delivered the consolidated data for both building and billing data collections to NEEA via NEEA's secure SharePoint site in iterative drafts starting in October 2025. Each delivery consisted of two types of datasets, as defined in the following:

- The **base tables dataset** is a set of flat files with comma-separated values (CSV). Each CSV file corresponds to a single table, where columns contain data for attributes of a particular object (e.g., water heaters, lighting fixtures). The tables together form a relational database suitable for data users who are comfortable using software such as R and Python to join and transform data prior to analysis.

- The **summary files dataset** consists of five summary files that collect and summarize commonly used fields from among all fields in the base tables. The five files focus on buildings, HVAC, lighting, pumps, and fans and are provided in both CSV and Excel formats. For these tables, the work of joining and transforming the data for analysis has already been completed for fields identified as critical or important to the average data user, making them accessible to a wider audience of users.

Though the summary files were delivered separately and are intended for a different audience, the record IDs for primary and foreign keys are the same as those used in the base tables dataset. Therefore, a data user is free to incorporate the summary files into their relational database for greater flexibility of data use.

Accompanying the data files were two supporting documents:

- A **data dictionary** that enumerates and defines all fields in both datasets and identifies the table where each field can be found
- A **user guide** that provides details on understanding and using the datasets, including instructions for actions such as joining tables and applying weights

10. Response Rates, Weighting, and Variance Estimation

This section outlines the data collection response categories for each sampled building, along with final response rates across key building and geographic characteristics. Additionally, this section explains the data weighting process and procedures to support estimation and variance estimation. The tables are designed to aid understanding of response patterns across various types of respondents, not to present analytic findings or attribute definitive causes to variations in responses among subgroups. For a full analysis of nonresponse effects for site visit data, see Appendix 8.

10.1 Final Sample and Response Rate Distribution

To complete the core data collection activities, recruiters obtained information about the building through observation and background research to determine whether it was obviously ineligible (e.g., residential, used for 100% agricultural or manufacturing purposes, demolished). If the building was not obviously ineligible, the recruiter proceeded with the required study tasks.

Based on the results of the data collection process and the subsampling of buildings within an MBS, the following five major response categories were defined:

Respondent. This category represents the buildings that completed a site visit or survey.

Eligible nonrespondent. This category consists of buildings determined to be eligible during the recruitment process, but a site visit was never conducted.

Ineligible. Information gathered during the recruitment process, the web survey, or the site visit helped to determine building ineligibility (see Section C.2.3.1.3).

Out of scope. Buildings classified as out of scope fall into one of the following groups:

- Selected buildings determined to be a frame duplicate or listed in error during the data collection process
- All originally selected "parent" cases of multi-structure buildings

Unknown eligibility. Any building that did not align with one of the four response rate categories listed previously was considered to be of unknown eligibility. The causes of unknown eligibility include language barriers, interviews conducted with the wrong building, final refusals, the identified respondent being unavailable to complete the web survey, inability to identify the person most knowledgeable about the building's energy usage, and inability to contact the person identified as the most knowledgeable.

Table 23 shows the distribution of sampled buildings by major response categories for site visit and web survey tasks. In addition to the major response categories used throughout weighting and variance estimation (see Section C.10.2), This table includes subcategories that provide further context in each response category. The Respondent and Eligible Nonrespondent categories differed between the site visit and survey tasks because some buildings ultimately chose not to complete all study tasks. Buildings with partially completed data are included as eligible nonrespondents under "Partial Complete."

Table 23. Number of sampled buildings by major response categories

Response categories	Site visits		Surveys	
	Number	Percent	Number	Percent
Respondent	568	10.0%	676	11.9%
Eligible nonrespondent	3,078	54.2%	2,970	52.3%
Max calls	1,978	34.8%	1,978	34.8%
Refusal	887	15.6%	887	15.6%
Partial complete	203	3.6%	95	1.7%

Response categories	Site visits		Surveys	
	Number	Percent	Number	Percent
Language barrier	7	0.1%	7	0.1%
“Subsampled” out	3	0.1%	3	0.1%
Ineligible	317	5.6%	317	5.6%
Industrial/manufacturing/agriculture	117	2.1%	117	2.1%
Residential (not multi-unit residential)	84	1.5%	84	1.5%
Under construction/demolished/ condemned	73	1.3%	73	1.3%
Other ineligible*	25	0.4%	25	0.4%
Square footage under 1,000	18	0.3%	18	0.3%
Out of scope	47	0.8%	47	0.8%
Frame duplicate	29	0.5%	29	0.5%
Not a building	15	0.3%	15	0.3%
Does not exist	3	0.1%	3	0.1%
Unknown eligibility	1,672	29.4%	1,672	29.4%
Max calls	1,031	18.1%	1,031	18.1%
Refusal	530	9.3%	530	9.3%
“Subsampled” out	110	1.9%	110	1.9%
Language barrier	1	0.0%	1	0.0%
Total	**5,682**		**5,682**	

* Includes parking garages, vacant buildings previously used for agricultural purposes, high-security buildings, and other ineligible situations.

10.1.1 Response Rate Computation

Survey response rates are commonly calculated for both the unweighted and weighted samples. For the 2025 CBSA, the unweighted response rates at the building level were computed as follows:

$$\text{Unweighted response rate} = 100 * \frac{C}{C + NR + e * UNK}$$

where

C = number of completed site visits

NR = number of eligible nonresponding buildings

UNK = number of buildings of unknown eligibility

e = interview eligibility rate among buildings of known eligibility status, estimated as $\frac{C + NR}{C + NR + I}$, and

I = number of buildings identified as ineligible but not out of scope

Note that we used the eligibility rate among in-scope buildings of known eligibility (i.e., respondents, eligible nonrespondents, and ineligibles) to estimate the number of eligible buildings among those of unknown eligibility. The weighted response rates were calculated in the same way as the unweighted rates, except that each sampled building was weighted by the inverse of the overall probability of selection (i.e., the "base weights").

The overall unweighted response rate was

RR = 11.0%

The overall base weighted response rate was

RRw = 12.7%

For unweighted and weighted response rates by key subgroups, see the *2025 CBSA NRBA Report* (Section C.2.3) in Appendix 8.

10.1.2 Response Rate Distribution

Through recruitment and data collection efforts, respondents completed 568 site visits and 676 web surveys. Table 24 shows unweighted response rates by key building characteristics. Recruitment and data collection efforts were most successful for buildings designated as "Education, Lodging, Public Order, and Safety" (15.2%), buildings in rural areas (14.1%), and buildings in Oregon (13.3%) and Montana (12.1%). Buildings with lower response rates include those in buildings designated as "Health Care, Food Service, and Labs" (7.4%), in buildings over 200,000 sq ft (8.7%) and between 10,001 and 25,000 sq ft (9.4%), in cities (9.6%), and in Idaho (9.6%) and Washington (9.9%).

Table 24. Response rates by key building characteristics

Characteristics	Site visits		Surveys	
	Number of respondents	Response rate	Number of respondents	Response rate
State				
Idaho	64	9.6%	77	11.6%
Montana	69	12.1%	78	13.6%
Oregon	179	13.3%	217	16.1%
Washington	256	9.9%	304	11.7%
Geographic subregion				
Eastern Oregon and Eastern Washington	106	13.2%	135	16.8%

Characteristics	Site visits		Surveys	
	Number of respondents	Response rate	Number of respondents	Response rate
Idaho and Montana	133	10.7%	155	12.5%
Western Oregon and Western Washington	329	10.5%	386	12.3%
Urbanicity				
City	287	9.6%	322	10.8%
Suburb	102	12.3%	130	15.7%
Town	94	12.1%	119	15.3%
Rural	85	14.1%	105	17.4%
Building size				
1,001–10,000 sq ft	327	11.4%	394	13.8%
10,001–25,000 sq ft	84	9.4%	100	11.2%
25,001–50,000 sq ft	57	12.0%	67	14.1%
50,001–100,000 sq ft	56	10.7%	66	12.6%
100,001–200,000 sq ft	32	10.9%	34	11.6%
200,000+ sq ft	12	8.7%	15	10.9%
Building use				
Office, Assembly, Sales	278	10.9%	336	13.2%
Education, Lodging, Public Order, Safety	85	15.2%	106	18.9%
Health Care, Food Service, Labs	35	7.4%	43	9.1%
Warehouse, Vacant	127	10.4%	147	12.0%
Multi-Family Residential	43	11.4%	44	11.7%

Note. Response rates are unweighted. Excludes all out-of-scope cases. Building size and building use categories are those assigned by the virtual listing team.

10.2 Weighting and Variance Estimation

The 2025 CBSA used probability sampling to select commercial buildings so that it would be possible to make valid estimates for the full population of buildings from a relatively small sample and be able to produce estimates of their reliability (confidence intervals) using the theory of probability (see Deming, 1950, p. 2). Weighting is the process of implementing the theory in practice to produce estimates that are representative of the population sampled.

This section describes the details of generating the final, building-level weights, but there are only two essential processes.

1. Base weights are created by taking the inverse of the probability of selection for the unit. When responses from the sampled units are “weighted” by the base weight it produces

an estimate of the full population that is unbiased (i.e., on average it equals the population value).

2. Nonresponse adjusted weights account for the fact that all sampled buildings do not respond so weighting the responding buildings by the base weights would not produce unbiased estimates. Nonresponse adjustments are basically the ratio of the sampled buildings to responding buildings within specified categories (e.g., building size category, building use category, state, geographic subregion). The nonresponse adjustments allow the weights to produce estimates that come back to the population total.

The specifics described in the following list are more complicated because the sampling and nonresponse are intricate. For example, sampling occurs at multiple points in the process, and the base weighting must match the sampling process. Similarly, nonresponse occurs at multiple points, and appropriate models are needed to account for the likely causes of nonresponse at each of these points to produce the most reliable population level estimates.

The details in this section that describe the data weighting process and procedures to support estimation and variance estimation include the following:

- Development of a base weight reflecting the various stages of sampling and duplication of listings within the building-level sampling frame
- Adjustment of the base weights for in-the-field subsampling of multi-building structures
- Adjustments for nonresponse
- Trimming of extreme weights (these final adjusted weights were used to produce estimates from the completed buildings)
- Within-building weight adjustments to account for subsampling
- Taylor series linearization approach for variance estimation
- Margins of error for two estimates: one total and one proportion

10.2.1 Base Weights

Every building selected for the 2025 CBSA building sample was assigned a base weight for estimation purposes. Base weights, which are the inverse of the probability of selection of each sampled building, account for the fact that some buildings had higher chances of selection than others. We calculated this base weight differently depending on whether the sampled building was determined to be a duplicate of one or more other building listings on the building frame. For the 18 sampled buildings determined to be a duplicate, we needed to revise the selection probabilities to reflect the multiple chances of selection (see Section C.10.2.1.1).

For the sampled buildings that were not determined to be a duplicate, the base weight was the reciprocal of the probability of selection and depended on the tract and the size category and residential multi-family indicator, which the building was assigned in the second phase of sampling.

The overall probability of selecting building *k* in size stratum *h* in tract *i*, π_{ihk}, is as follows:

$$\pi_{ihk} = \pi_i \pi_{k|h,i}$$

where

π_i	=	the probability of selection of tract *i* and
$\pi_{k|h,i}$	=	the conditional probability of selection of building *k* in building stratum *h* in tract *i*.

Therefore, the base weight for sampled building *k*[24] is as follows:

$$w_{BW,k} = \frac{1}{\pi_{ihk}}$$

10.2.1.1 Accounting for Duplicated Listings Within the Sampling Frame

If a sampled building was determined to be a duplicate of one or more other building listings on the building frame, the selection probabilities were revised to reflect the multiple chances of selection. Specifically, the building with the square footage on the sampling frame from the listing that was closest to what the interviewer believed to be the actual square footage was kept, and the other duplicate building (or buildings) was assigned an out-of-scope disposition code and a base weight of zero.

To generate the base weight of the building that was kept when there were duplicate buildings within the same frame, a multiplicity adjustment was made. This is unbiased yet simpler than calculating the true probability of selection for the building.[25] If a sample building was associated with more than one sampled or nonsampled building on the sampling frame, the base weight for the building that was kept was calculated as the inverse of the mean of the probabilities of selection of all constituent parts (sampled or nonsampled). Thus, the base weight for building *k* that was kept, $w_{BW,k}$, is as follows:

---

[24] We have dropped the subscripts *i* and *j* from the remaining weighting variables in the section for simplicity and ease.

[25] Calculation of the true probability of selection would require computing the joint probability of selection of all listings associated with the building.

$$\pi_{ihk}{}' = \frac{\sum_1^n \pi_{i,j}}{n_{Dup\_Listing}}$$

$$w_{BW,k} = \frac{1}{\pi_{ihk}{}'}$$

where

$n_{Dup\_Listing}$ = the total number of buildings on the frame (sampled and nonsampled) associated with building *i*

$\pi_{i,j}$ = the probability of selection of frame building *j* associated with kept building *i*

$\pi_{ihk}{}'$ = the adjusted overall probability of selecting building *k* in size stratum *h* in tract *i*, after accounting for the multiple chances of selection of building *k*

10.2.2 Adjustments of the Base Weights

The base weights described in Section C.10.2.1 were adjusted for MBS subsampling. MBS subsampling was the in-the-field subsampling of structures representing two or more buildings.

10.2.2.1 Base Weight Adjustment for an MBS

As mentioned in Section C.2.3.2.3, an MBS is a selected structure that the virtual listing team believed was a single building, but recruiters identified as representing two or more buildings. An MBS was handled in a specific manner with implications for defining survey response categories, base-weight adjustments, and nonresponse adjustments. The recruiter created a list of eligible buildings that represented the originally selected structure, and two buildings were selected. To recognize the association between the originally selected structure and the newly selected units, the originally selected structure was called the "parent" case, and the newly selected units were called "children."

The base weight of the MBS parent structure was assigned to its selected children. The originally sampled parent case of the MBS was considered out of scope and had its base weight set to zero. Then the base weights for the MBS children were further adjusted by the inverse of the MBS probability of selection.

The formula for the adjusted base weight for an MBS, $w_{BW,k}{}'$ is as follows:

$$w_{BW,k}{}' = w_{BW,k} \frac{1}{p_k}$$

where

$w_{BW,k}$	=	the base weight prior to adjustment
p_k	=	the MBS probability of selection (Note: If a selected building was not an MBS, then p_k= 1.)

10.2.3 Nonresponse Adjustments

There were two types of CBSA nonrespondents: those with unknown eligibility and those with known eligibility. This section presents these nonresponse adjustments in the order of implementation: adjustments for nonrespondents of unknown eligibility, followed by adjustments for nonrespondents of known eligibility. If nonresponse is independent of substantive variables (e.g., building characteristics of interest, energy consumption and expenditures) within nonresponse adjustment cells, then nonresponse-adjusted weights yield unbiased estimates.

We formed the cells to minimize variation in the response propensity within the cells. We used classification tree models to guide cell formation. Classification tree models partition data into homogenous subsets with respect to the selected target variable (that is, response propensity). The procedure is stepwise and creates a hierarchical tree-like structure. It selects the single predictor with the largest variation in response rates across its levels and uses it to form the first branch in a decision tree. It continues applying the same process within the subgroups (nodes) defined by the “best” predictor chosen in the preceding step. This process continues until either no significant predictor is found, or a specified minimum node size is reached.

Although nonresponse adjustment should reduce bias, it can also increase the variance of estimates. Small adjustment classes and/or low response rates (or large nonresponse adjustment factors) may substantially increase variance and lead to unstable estimates by increasing weight variability. To prevent an excessive increase in variance and thereby an adverse effect on the mean square error of the estimates, the smallest possible size class was set to 30 respondents.

The inverse of the response rate in the cells is the nonresponse weight adjustment for both the unknown-eligibility and known-eligibility steps. Variables used to form nonresponse adjustment classes must be known for both respondents and nonrespondents. Potential predictors of response propensity included in the model were building size and use categories, tract size, BPA subregion, National Center for Education Statistics (NCES) locale (i.e., a measure of urbanicity),[26] and the number of floors.

10.2.3.1 Adjustments for Nonrespondents of Unknown Eligibility

Each sampled building was assigned a weighting status code (Table 25) to adjust for nonresponse.

Table 25. Weighting status codes for nonresponse adjustment

Status	Description
1	Eligible respondent
2	Eligible nonrespondent
3	Ineligible
4	Nonrespondents of unknown eligibility

For the unknown eligibility adjustment tree, at each split, the classification tree algorithm looked to generate the largest difference in known eligibility propensity (i.e., the likelihood of an in-scope building being a respondent, eligible nonrespondent, or ineligible). For a visualization and full description of the known eligibility propensity classification tree, see the *2025 CBSA NRBA Report* (Section C.3.2) in Appendix 8. The final known eligibility propensity classification tree contained 20 unknown eligibility adjustment cells. Within each known eligibility adjustment cell, the unknown eligibility factor was computed as the ratio of the sum of the base-weighted number of buildings with known eligibility and unknown eligibility to the sum of the base-weighted number of buildings with known eligibility. The unknown eligibility adjustment factors within those cells ranged from 1.06 to 2.49.

The unknown eligibility-adjusted weight ($w_{UNK,k}$) is calculated as follows, redistributing the base weights of the unknown eligibility cases across the buildings that completed site visits, the nonresponding buildings, and the ineligible buildings:

$$w_{UNK,k} = w_{BW,k}{}' * \delta_{UNK_j}$$

where

$w_{BW,k}{}'$ = the adjusted base weight

δ_{UNK_j} = the unknown eligibility adjustment factor for status *j*

[26] See Geverdt (2015) for a description of the creation of the NCES locale variable.

10.2.3.2 Adjustments for Nonrespondents of Known Eligibility

For the weight adjustments for nonrespondents of known eligibility, we modeled response propensity via the same conditional inference tree algorithm described in the previous section and used the resulting cells as nonresponse adjustment classes. The variables used to form nonresponse adjustment classes were the same as those used for the unknown eligibility adjustment model. The classification tree was based on the propensity of known eligibles to respond to the site visit. The five nonresponse adjustment cells developed from this tree were used to create both site visit nonresponse adjustment factors and web survey nonresponse adjustment factors. The unknown eligibility adjustment factors within those cells ranged from 1.06 to 2.49.

Within each nonresponse adjustment cell, the nonresponse adjustment factor was computed as the ratio of the sum of the unknown eligibility adjusted weighted number of eligible buildings (i.e., respondents and eligible nonrespondents) to the sum of the unknown eligibility adjusted weighted number of respondents. The nonresponse adjustment factors within those cells ranged from 2.28 to 7.41. The nonresponse adjustment factors within those cells ranged from 1.06 to 2.49.

The nonresponse-adjusted site visit weight, w_{NR_SV}, is calculated as follows:

$$w_{NR\_SV} = w_{UNK,k} * \delta_{NR_{j\_SV}}$$

where

$w_{UNK,k}$	=	unknown eligibility adjusted weight
$\delta_{NR_{j\_SV}}$	=	the site visit nonresponse adjustment factor

Similarly, the nonresponse-adjusted web survey weight, w_{NR_WS}, is calculated as follows:

$$w_{NR\_WS} = w_{UNK,k} * \delta_{NR_{j\_WS}}$$

where

$w_{UNK,k}$	=	unknown eligibility adjusted weight
$\delta_{NR_{j\_SV}}$	=	the web survey nonresponse adjustment factor

10.2.4 Trimming Extreme Weights

Extremely large weights can increase variance estimates substantially. Trimming the extreme weights of these buildings can mitigate this issue. However, at the same time, trimming may introduce bias into the estimates to the extent that trimmed cases differ from the untrimmed cases for the characteristics of interest. The goal of trimming is to balance any increase in bias with a reduction in standard error, thereby minimizing mean squared error.

The following weight trimming approach was implemented for the 2025 CBSA. We used the six building-level sampling strata as cells for all trimming steps. The steps were as follows:

1. Examining separately the nonresponse adjusted weights for site visits and those for web surveys by the six building size sampling strata to identify candidates for weight trimming.
2. Trimming five nonresponse-adjusted weights according to identified thresholds.
3. Redistributing the sum of the trimmed weights to all other cases within the stratum. The weights after the redistribution are the final weights, for both the site visits (w_{Final_SV}) and the web surveys (w_{Final_WS}).

10.2.5 Within-Building Weights for Site Visits

Subsampling within buildings occurred when the number of units (e.g., businesses, rooms, lighting, HVAC equipment) was large, and it was not feasible to measure all of them during the site visit. This subsampling had implications for estimating business, room, lighting, and HVAC metrics.

For buildings where subsampling occurred during the site visit, rather than having an additional set of weights or factors for these few items, we instead used the following procedure:

1. Applied the inverse of the constant subsampling rate described in Section C.2.3.2.4 ($\frac{1}{c_{k,b}}$) to the values reported for each unit (e.g., floor, room, business) within the building
2. For each item, summed the weighted values reported across all subsampled units to estimate a building-level value
3. Provided the estimated building-level value on the public-use file, along with a variable indicating that this value was estimated based on within-building sampling

10.2.6 Variance Estimation

To obtain estimates of variability, such as the standard error of estimates or the corresponding confidence interval, analysts need to account for the complex sample design of the 2025 CBSA. The 2025 CBSA uses the Taylor series method to estimate variance, which provides unbiased estimates of variance in most multistage cluster sample designs for linear statistics, such as total natural gas and energy consumption, and consistent estimates for smooth nonlinear statistics, such as mean natural gas and electricity consumption per square foot.

10.2.6.1 Taylor Series Linearization Method

The CBSA final file includes variables for obtaining weighted estimates and for implementing a Taylor series approach to estimate standard errors for weighted survey estimates. A variety of software packages, including R and Python, can apply the Taylor series linearization method. The variables that jointly reflect the CBSA survey design include the final, nonresponse-adjusted site visit and web survey weights ($w_{Final\_SV}, w_{Final\_WS}$), the variance estimation stratum code (VARSTRAT), and the variance estimation cluster code (VARPSU) required by the variance estimation programs. See the Applying Weights and Estimating Variance section of the 2025 CBSA User Guide for sample R and Python code that appropriately accounts for the complex survey design when generating popular statistics and standard errors, as well as constructing confidence intervals.

10.2.6.2 Creating Variance Estimation Stratum and Cluster Codes

To allow analysts to account for the complex sample design when estimating variance, we provide variance strata and variance unit codes on the data files along with the weights. The first step in assigning a variance stratum value to each individual tract was to sort the list of 90 tracts by tract stratum (Small [6–30 buildings] or Large [31+ buildings]) and then by the sort order used to select tracts within each stratum. Prior to sample selection, the tracts within the Large tract stratum were sorted sequentially by state, BPA subregion, and estimated building square footage. Similarly, prior to tract sample selection, tracts within the Small tract stratum were sorted sequentially by state and BPA subregion.

Once the list of 90 tracts was sorted in this manner, we assigned a variance stratum to each of the 90 selected tracts by starting with the first tract on the sorted list and linking it to the next tract until the set of linked tracts had at least four completed site visits. Ensuring that each variance stratum has at least four completed site visits allows for stable variance estimates and accounts for many domain analyses of interest.

Based on this assignment process, we generated 52 variance strata. Within each variance stratum, we assigned each selected building a variance unit value ranging from 1 to the number of selected buildings in that stratum. For example, if the variance stratum had 15 selected buildings, the variance units would range from 1 to 15.

10.2.7 Margin of Error of the Estimates

After generating the final sampling weights, weighted estimates and their margins of error (MOEs) were computed for the total building square footage overall and by state, as well as for the proportion of buildings by state. As shown in Tables 26 and 27, the overall MOEs with

90 percent confidence for estimates compare favorably with the design requirement of an overall MOE of less than 10 percent.

Table 26. MOEs for the estimated total square footage per state (using site visit data)

State	Weighted total	Standard error of weighted total	MOE of weighted total
Idaho	377,520,679	54,607,817	24.2%
Montana	258,290,161	34,149,565	22.1%
Oregon	1,451,538,097	122,125,483	13.9%
Washington	2,291,833,585	167,269,697	12.1%
Total	**4,379,182,522**	**215,798,595**	**8.1%**

Table 27. MOEs for the percentage of commercial and multi-family residential buildings per state (using site visit data)

State	Number of buildings	Weighted count	Weighted percentage	MOE for weighted percentage
Idaho	64	33,805	11.2%	1.5%
Montana	69	35,232	11.7%	1.5%
Oregon	179	91,793	30.5%	2.0%
Washington	256	140,371	46.6%	2.1%
Total	**568**	**301,201**	**100%**	—

11. Recommendations and Lessons Learned

This section presents recommendations for the next CBSA cycle based on Westat's experience conducting the 2025 CBSA. Many of the ideas presented here were discussed in debriefing meetings with Westat project and field recruiting staff after building data collection was complete. Other recommendations emerged throughout both the building and billing data collections.

11.1 Frame Development/Virtual Listing

Building names: Building names assigned by the listers were sometimes a source of confusion for recruiters and building respondents. These building names were included in the web survey along with the building address to help respondents identify the building. However, the building name entered during listing was often a descriptive name the respondent did not recognize. Solutions include training listers to not assign a name for buildings with no obvious name, to use

Google Street View more than Google Places to find a building name, and to not include the building name in the web survey instrument.

11.2 Sample Design

Multiple buildings selected within same company: The selection of multiple buildings owned by the same company decreased participation. Even among initially cooperative respondents were less likely to complete all components of the building data collection for all their sampled buildings due to the high time commitment required. When multiple buildings have been selected within the same company, consider subsampling buildings to mitigate respondent burden.

Clarifying within building subsampling procedures: Westat recommends having field technician supervisors and statisticians meet early in the sample design process to work together to develop clear, straightforward within-building subsampling procedures for field technicians to understand and implement. The combination of complex subsampling instructions and the infrequent need for subsampling led field technicians to often misunderstand or forget how to conduct the subsampling steps. A more streamlined process would mitigate these issues.

11.3 Sample Preparation

Tracing: Using a specially trained team of CBSA project staff to perform tracing may yield higher quality building contact information than tracing with generic online tools in advance of the recruitment period. Contact data obtained from the Wave 1 advance tracing effort was often general contact information for the building rather than for specific building personnel and, often, was not current. Recruiter tracing proved much more effective. However, relying on recruiters to conduct tracing is an additional burden and takes time away from actual recruitment activities.

11.4 Instruments

Web survey: Westat does not recommend collecting data via a web survey for the next CBSA. First, the web survey was at times a barrier to respondent participation because we could not move forward with a site visit until we received the web survey data. In such cases respondents willing to participate in the study neglected to complete a web survey because they forgot or did not know some of the answers. In other cases, respondents misunderstood the participation requirements and thought completing the web survey fulfilled their participation commitment. These respondents required prompting to schedule and complete the site visit, which was sometimes met with a refusal to continue with the final step of data collection. Second, data not reported (survey items left blank) by web survey respondents proved difficult, if not impossible, to ultimately collect, because it required recontacting respondents. Although missing data were not a significant problem, there were some data elements more often missing than others, for example the total area of conditioned space in the building.

11.5 Recruitment

Wave 1: Tackling the two largest cities in the region as the first recruitment wave proved challenging operationally. Compared with other urban or suburban areas in the sample, recruiters reported that respondents in Seattle and Portland expressed greater concerns about the study burden, citing the adverse impact of local and state energy auditing and benchmarking requirements on willingness to participate. Additionally, these two cities had a much larger proportion of sampled buildings over 100,000 sq ft, which were more difficult to recruit than smaller buildings. Starting recruitment in less urban areas could offer several benefits, including allowing newly trained recruiters to begin work in areas with easier-to-recruit buildings, sending an earlier steadier stream of buildings to field technicians for efficient site visit scheduling, and maintaining high morale and productivity among the recruitment staff.

Building eligibility: Create a more formal process for recruiters to determine building eligibility. Developing a screening instrument for recruiters to complete before moving forward with recruitment would save recruiter time and ensure there was no participation from ineligible buildings. The many facets of CBSA building eligibility were cumbersome and confusing for many recruiters

Remote recruitment: Future CBSA cycles should plan for the primary recruitment mode to be in person. Remote recruitment proved challenging, particularly for identifying an appropriate respondent, eliciting potential respondent attention, and addressing concerns about legitimacy—and yielded very few participating buildings. The shift to in-person recruitment produced immediate positive results over remote recruitment, and as more in-person recruiters were deployed, it became clear that an in-person–first approach was needed.

11.6 Billing Data Collection

Utility bill collection: To ascertain more accurate utility information from building respondents, consider asking respondents to upload a utility bill to a secure website or allow field technicians to take photos of bills during site visits. When reporting utility information, respondents commonly made one or more of the following errors: misidentified utility names, misidentified energy types (e.g., incorrectly listing natural gas as one of the building's energy sources), or mistyped account numbers. These errors caused confusion when attempting to link buildings to utility companies, which required considerable time for Westat and participating utilities to resolve.

11.7 QC

Improving QC: Future CBSA cycles would benefit from a more holistic approach to QC that begins with establishing clear analytic goals and guidelines during early stages of planning. Then QC can be built to accommodate these goals by tracking specific metrics and key data fields to monitor for high levels of nonresponse, outliers, and other unexpected responses that would hinder analysis. Westat recommends that data monitoring and QC begin very early in data collection, so that there is as much opportunity as possible to retrieve critical missing data and to develop and deploy mitigation measures while data collection is still in progress.

11.8 Comparability Between the CBSA Waves

Improving comparability: Due to the changes in study design and methods between the 2019 CBSA and the 2025 CBSA, when making comparisons on the key metrics of interest between the two waves of data collection, it can be difficult to tease out if the differences observed were due to an actual change in the population or changes in the design and methods. To increase the comparability between the 2025 CBSA and the next wave of data collection, Westat recommends maintaining the following aspects of the 2025 CBSA design in the next wave:

- Maintain the 2025 CBSA definition of an eligible commercial building.
- Maintain the 2025 CBSA building use definitions as described in Table 2.
- Implement a well-documented probability sample design and report American Association for Public Opinion Research response rates both overall and at the key subgroup level such as state, geographic subregion, building size, and urbanicity.
- Use virtual listing (or a similar process) to ensure that the building-level data purchased from vendors or acquired through public use sources accurately reflects the commercial buildings in the selected first stage units.
- Maintain the 2025 CBSA question wording wherever possible, unless pretesting shows a change in question wording will improve respondent comprehension.
- Implement textbook weighting processes appropriate for a probability sample.

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