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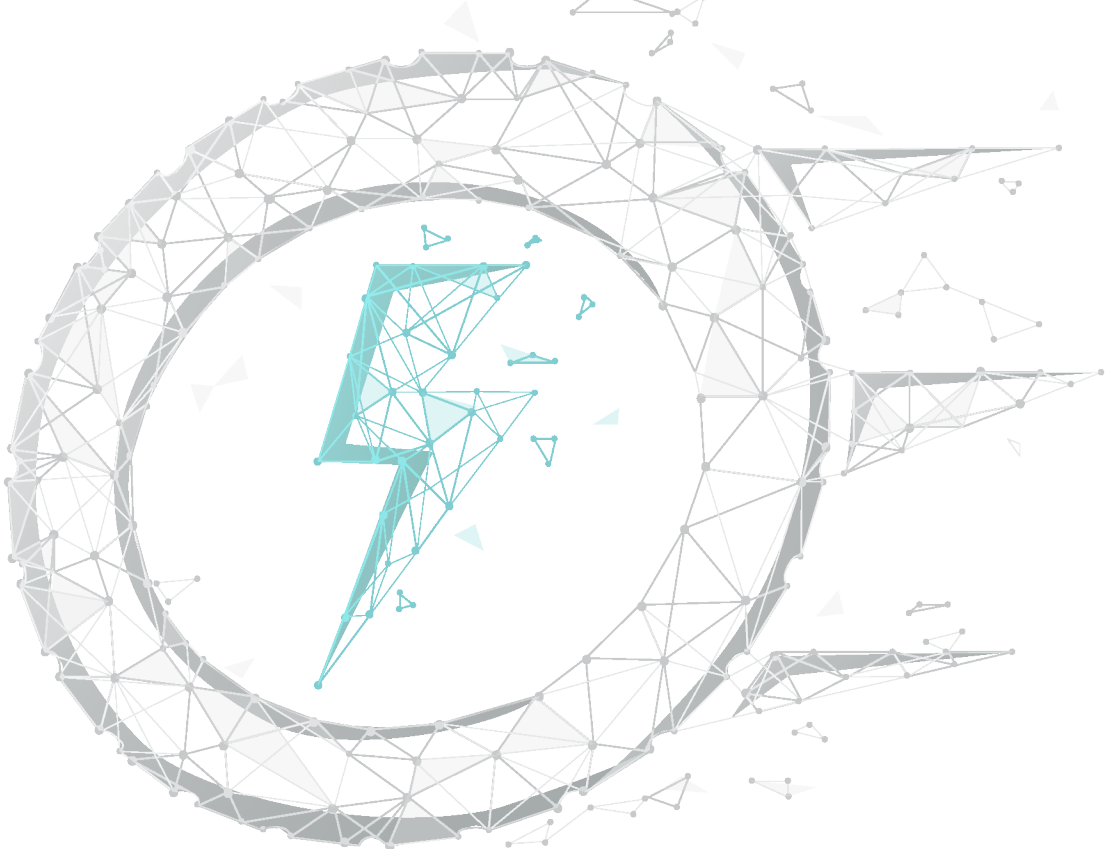
## EV WATTS WHITEPAPER SERIES

# Multi-Unit Dwelling Station Utilization



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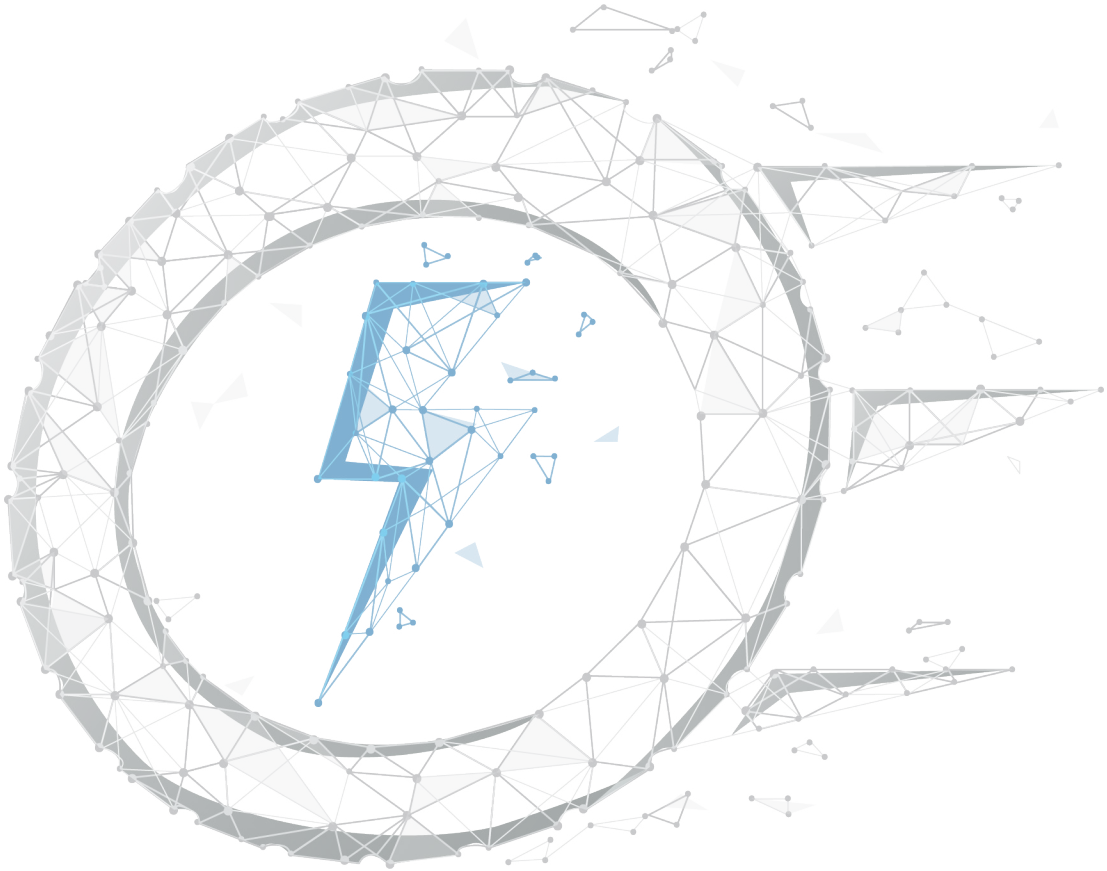


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# Multi-Unit Dwelling Station Utilization

## Overview

This study examines electric vehicle (EV) charging patterns for EV charging stations (also referred to as electric vehicle supply equipment, or EVSE) located in multi-unit dwellings (MUDs). Analysts looked at charging station utilization, port utilization, and station location. Findings indicate that MUD EV charging stations have distinct charger use patterns, showing differences not only from other charging venue categories (e.g., public parking and vehicle fleet stations) but within the MUD category. The conclusion is that the venue type MUD may be overly broad and that there is room for sub-categories or even re-categorization.

## The Significance of MUD Station Categorization Analysis

As the population of EV owners across the nation increases, so does the need to understand usage patterns, as this understanding informs decision-making on how to best serve all potential charging customers. Venue categorization is a necessary component of the analysis that provides that understanding.

The MUD category comprises apartment complexes, duplexes, high-rise apartments, townhouses, and other multi-family (MF) homes. MUD/MF venues and single-family (SF) homes are the two residential venue categories in the EV WATTS dataset. These types of stations typically show nighttime charging sessions, as most residential charging occurs at night when tenants come home.

However, that is where the similarity between MUD and SF charging patterns ends, as the EVSE setups differ greatly between MUDs and SF homes. Whereas SFs with EVs generally have personal chargers that can be used in a garage or driveway, MUD charging stations—and the parking spaces that allow access to the chargers—must be shared by multiple residents. Therefore, MUD EVSE has time and space restrictions for charging. MUD tenants

Energetics leads EV WATTS (Electric Vehicle Widescale Analysis for Tomorrow's Transportation Solutions), a multi-sector project that facilitates the nation's move toward sustainable transportation. The project is collecting real-world use data from plug-in EVs and charging stations to address a growing need for practical information about vehicle electrification. The team analyzes these data to improve our understanding of driving and charging patterns. EV WATTS is helping to demonstrate how the latest advancements in EVs and charging station technology address barriers, improve the business case for electrification, and determine what behavioral changes electrification may require.

The project uses charging station data and vehicle usage data to build one of the largest datasets of its kind. The data collected for EV WATTS is aggregated and anonymized so that it can serve as a resource to researchers, policymakers, and other stakeholders. Using the data, the team has created interactive dashboards that display statistics and findings from EVs and charging stations. The dashboards allow users to explore this anonymized dataset, looking at energy demand, use patterns, charging details, and more. The most recent EV WATTS dashboards are available at EVWATTS.org.

EV WATTS is sponsored by the U.S. Department of Energy (DOE). Input and other assistance is provided by DOE national laboratories, Clean Cities Coalitions, fleets, state and local governments, vehicle manufacturers, utilities, EV drivers, and charging station providers.

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may not be able to plug in at their convenience (i.e., when they get home from work) or to leave their EVs plugged in throughout the time spent at home. For example, residents who leave their vehicles to charge overnight may incur idle fees.

Therefore, it is expected that MUD EVSE and SF EVSE would show different time-of-day utilization and charging frequency, and the EV WATTS team of analysts confirmed those differences. What analysts did not necessarily anticipate was that MUD EVSE would also be different from one MUD to another. The analysis showed a variety of charging patterns, based largely on region and population density.

## Study Methodology and Data

The EV WATTS team conducted an investigation comparing MUD charging infrastructure in different parts of the United States with regard to energy usage, time-of-day usage, charging duration, and connection duration. The results of this investigation were used to determine significant differences between MUD station use based on location.

The study used three data sources: EV WATTS,[1] the National Association of Home Builders (NAHB),[2] and the U.S. Department of Agriculture (USDA) Economic Research Service (ERS).[3]



### Outside Data

Analysts gathered data on varieties of MUDs from the NAHB, which provides information on differences between six categories of MUDs and statistics on the proportion of U.S. residents who reside in MUDs. The study also uses "urbanicity," a metric adopted from the USDA ERS that categorizes counties by population size. An urbanicity categorization of 1 indicates a heavily populated area, while an urbanicity of 9 indicates an area with low population density.

### EV WATTS Data

Stations in the EV WATTS dataset are labeled with a venue type as a tool to determining organization-specific usage patterns. The EV WATTS dataset includes 11 venue types (see **Table 1**). The venue types are reported by the charging stations' network service providers.

**Table 1:** Venue Types in the EV WATTS Dataset

| | |
|---|---|
| • Fleet | • Municipal |
| • Hotel | • Office |
| • Leisure | • Public Parking |
| • Medical/Education | • Retail |
| • Mobility Hub | • Single Family (SF) |
| • Multi-Family (MF) | |

Analysts examined data for all MUD (labeled in the database as Multi-Family, or MF) locations in the EV WATTS dataset. This specific subset contains 1,769 MUD station locations, 3,532 MUD EVSE, and 6,384 MUD ports, representing a total of over 30,000 MWh of energy discharged over 1.5 million sessions. The EVSE is labeled as being housed in one of nine different regions of the United States. The EV WATTS database also leverages the USDA ERS metric of urbanicity to characterize station locations.

1 EV WATTS Station Dashboard – Energetics

2 Multifamily – NAHB

3 Rural-Urban Continuum Codes – USDA ERS

EV WATTS data relevant to this study include:

- Ports per region
- Station location
- Urbanicity
- Venue type
- EVSE charging frequency
- Average sessions per day
- Average sessions per week
- Time of use
- Energy use (in kilowatt-hours) per session

## Findings

Data points that segregate MUD charging patterns include region and urbanicity, indicating that MUD charging stations perform differently in different regions of the United States. These differences are seen when looking at port usage, utilization trends, and connection duration compared to charging duration. Port usage, in particular, differs significantly between regions.



### Region

Though every region displayed a distinctive use pattern, the largest differences are between the Mountain region (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming) and the New England region (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont). Therefore, this section highlights findings from these two regions.

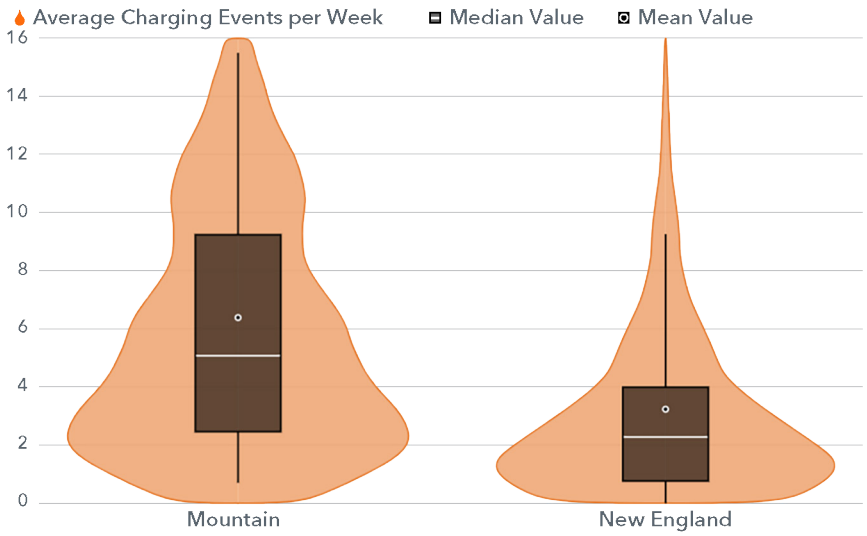


**Figure 1:** Average Charging Events per Week per Station at MUDs in Two Regions

The EV WATTS dataset contains 698 MUD ports in the New England region and 519 in the Mountain region. In the Mountain region, stations have an average of 6.38 charging sessions per week, while in the New England region, the average is 3.23. The distribution of average sessions per week per MUD station for the two regions can be seen in **Figure 1**.

The EV WATTS team needed to determine whether this significant difference was due to an inherent difference in EV drivers in the two regions. To this end, analysts determined the distribution of average charging for SF homes in these regions. The averages were similar, with an average session per week per station of 4.46 in the Mountain region and 4.12 in the New England region, as seen in **Figure 2**.

Analysts also sought to determine whether EV drivers in New England were more likely to charge their vehicles near their workplaces, rather than overnight at their residences. Accordingly, the EV WATTS team looked at the time of day that the chargers were used. There were no significant differences in time of day for charging events, so the data did not support that theory.

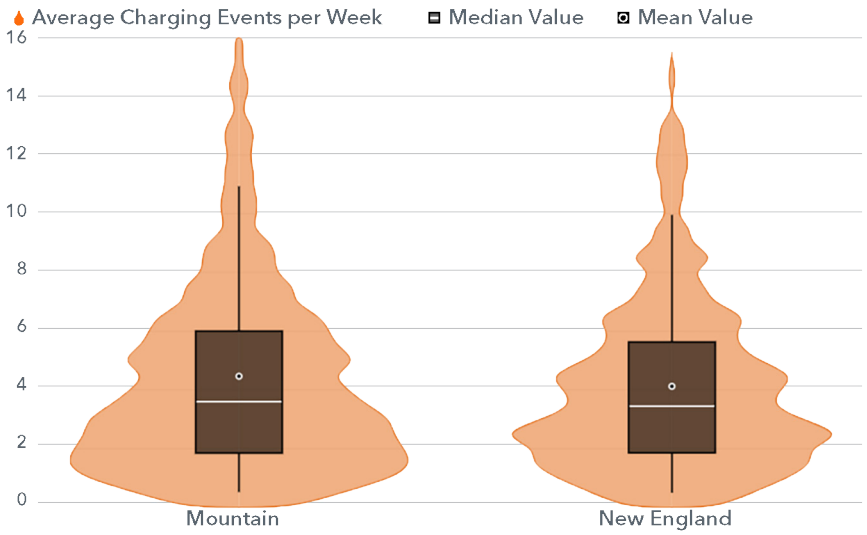


**Figure 2:** Average Charging Events per Week per Station in Single-Family Homes in Two Regions

Combined, these sets of findings indicate that MUD station averages in the Mountain region differ from those in New England region because of differences between the MUDs. Looking at NAHB data, analysts found that townhomes are popular in New England, while apartment complexes are more common in the Mountain region. Therefore, the discrepancy in average charging sessions could be attributed to different classes of MUDs. Similarly, different classes of MUDs could lead to different proportions of residents who are EV owners, as some MUD configurations are more EV-friendly (e.g., by providing better accessibility).



## Urbanicity

Of the 3,532 stations in this subset of the EV WATTS database, 3,055, or 86%, are in cities with an urbanicity measure of 1, indicating a highly populated city. Stations in these areas had average sessions per week of 4.73, while areas with urbanicity of 2–5 had average sessions per week of 3.01, and areas with urbanicity of 6–9 had average sessions per week of 2.32 (see **Figure 3a**).

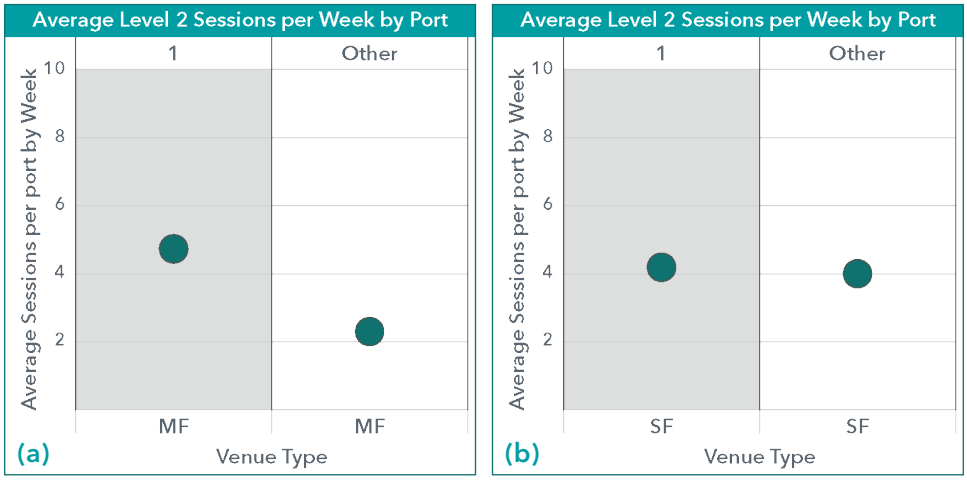


**Figure 3:** Average Sessions per Week per Port by Urbanization for Multi-Family (MF) and Single-Family (SF) Venues, Respectively

As with the regions, the EV WATTS team also looked at the average sessions per week per station for SF homes in the EV WATTS dataset. Again, the statistics for SF homes were similar across urbanicity ratings. Average sessions per week per station were 4.22 in areas with urbanicity of 1 and 4.44 in areas with urbanicity 2–9 (see **Figure 3b**).

Again, the implications are that MUD classes in densely populated cities are different from those in suburban and rural areas, resulting in different charging patterns. A MUD charger in the garage of a New York City high-rise apartment building is likely used differently from a MUD charger in a small-town apartment duplex. For example, buildings in highly populated cities generally have parking garages, whereas rural apartment complexes are usually paired with parking lots; and parking garages and parking lots generally have different numbers of, access to, and fees for EV chargers.

## Conclusion – Implications and Recommendations

MUD is a broad classification that comprises varying housing (and even parking) options. Different structures that are classified as MUDs may exhibit very different charging use patterns. For example, notably high EVSE utilization takes place at MUDs in the Mountain region and at MUDs in densely populated cities, whereas lower EVSE use occurs at MUDs in New England and in rural areas. Therefore, MUD locations could be better categorized or broken down into sub-categories, each with its own usage pattern.

While this document provides possible reasons for the variation, a deeper investigation, ideally with more information about these specific MUD sites, is likely warranted to determine key differences. Additionally, a more granular categorization of MUD sites based on the type of unit and additional access (e.g., public and multi-use facilities) would be helpful for future analyses.



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