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Analysis of Electric Vehicle Fast Charging Site Types Across the Carolinas

Trey M. Gowdy, Nicholas Institute for Energy Environment & Sustainability
Lawson Garner, Duke University

INTRODUCTION

Direct current (DC) fast charging for electric vehicles (EVs) is an option to charge EVs generally in less than an hour (DOE n.d.). These charging ports can be found at a variety of places that may have different amenities and use cases (i.e., dwell times, visit frequency, public accessibility, fees). There is limited open data analysis on the site locations of EV charging ports. This analysis provides visibility into a key feature of DC fast charging in the Carolinas by site type (i.e., facility use). We propose the methodology as a means to consider this qualitative feature of DC fast charging deployment, beyond sole geographical location, as a key item to inform EV drivers, industry service providers, and policymakers with details on site amenities, use cases, and development trends over time.

There were tens of thousands of missing site labels in the national Alternative Fuels Data Center (AFDC) dataset as of 2023 (DOT 2023), preventing a full national analysis of EV charging station site types. There are proprietary data providers that may provide these data categorizations and subsequent analyses at-cost. However, there has been little to no open, comprehensive data labeling across this geography, let alone analysis.

Where EV charging stations are located is important not only from a geographical perspective, but also the context of the site—such as the types of visits made to the site (e.g., frequency, public accessibility). As Wood et al. (2023) note, "infrastructure investment should be careful not to lead vehicle deployment to the point of creating prolonged periods of poor utilization, thereby jeopardizing the financial viability of infrastructure operators." Additionally, business establishments have boosts in annual spending at their location when an EV charging station is located nearby (Zheng et al. 2024).

This analysis highlights a process to label fast charging site types, that could also be used across Level 2 and other charging station types (DOT n.d.) using open data, across North and South Carolina to better understand this aspect of charging infrastructure. By developing a methodology using open data to understand these features, it will also inform the feasibility of future analyses, particularly at the local level.

METHODOLOGY

To access charging locations, we downloaded Alternative Fuels Data Center (AFDC) data from the US Department of Energy on currently open EV charging station locations across North Carolina and South Carolina. The AFDC dataset includes station names, addresses, and charging port counts across all locations, among other details. From our review, approximately 42% (North Carolina) and 52% (South Carolina) of stations had existing "Facility_Type" labels. Using these as a starting point, we manually reviewed all sites and labeled them to get 100% coverage for each state. This process also resolved minor inconsistencies in existing AFDC labels.

This was done first by reviewing the "Station_Name(s)" and addressing labels where reasonable (e.g., major hotel chain = *lodging*). For remaining sites where using the name was infeasible, we reviewed other sources (e.g. NC OneMap parcel data, OpenStreetMap) to determine a label. Where needed, we went directly to websites of associated locations (e.g., specific car dealerships [examples 1, 2] or fuel centers).

We created six major site type labels:

- Car Dealership
- Lodging
- Public Assembly
    - Including public parking garages, schools, parks, etc.
- Retail/Dining
    - Including shopping centers, restaurants, etc.
- Travel/Fuel Center
- Other

Labels may have some amount of subjectivity. The goal with labeling was to determine what seemed to be the primary use, but we recognize this can be complicated by mixed use developments, adjacent sites, or other site-specific details.

For mapping, some sites required collation of identical addresses from the original AFDC dataset that were listed as separate locations. Furthermore, this only includes sites that are currently open. Sites that opened and subsequently closed are not tallied here.

RESULTS

North and South Carolina have generally similar development patterns of DC fast charging by site type in the last dozen years (Figures 2 and 4). For DC fast charging stations open today, car dealerships were among the earliest adopters, with retail/dining and travel/fuel centers becoming the leading two site types in the mid- to late-2010s. Since then, growth has been concentrated in the retail/dining and travel/fuel center categories. As the leading

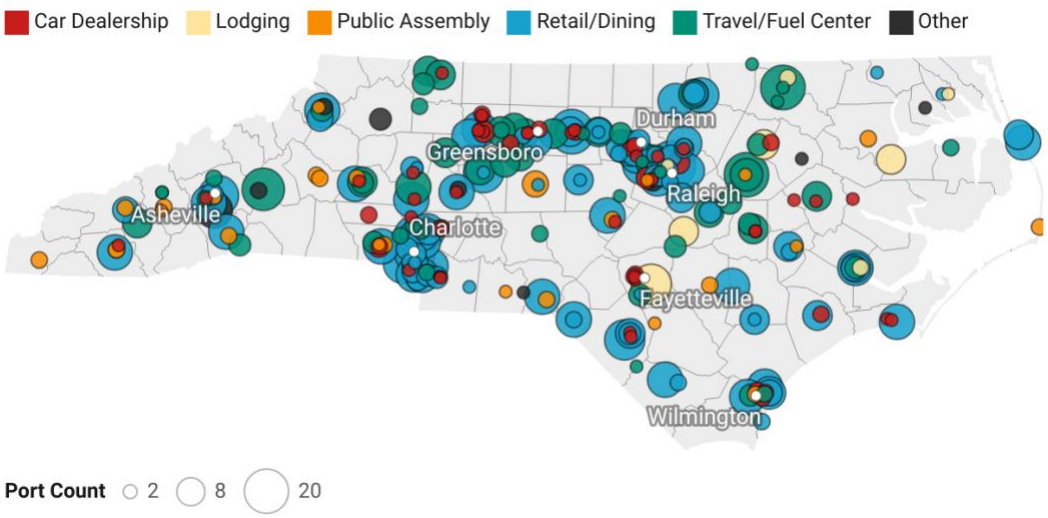
categories, this shows most fast charging stations likely have food and other convenience amenities on-site or nearby.

Substantial growth in DC fast charging infrastructure began appearing around in the 2018–2020 timeframe and accelerated from there. Charging at retail/dining and travel/fuel center locations generally have the highest number of ports per location (Figures 1 and 3) across both states.

North Carolina Results

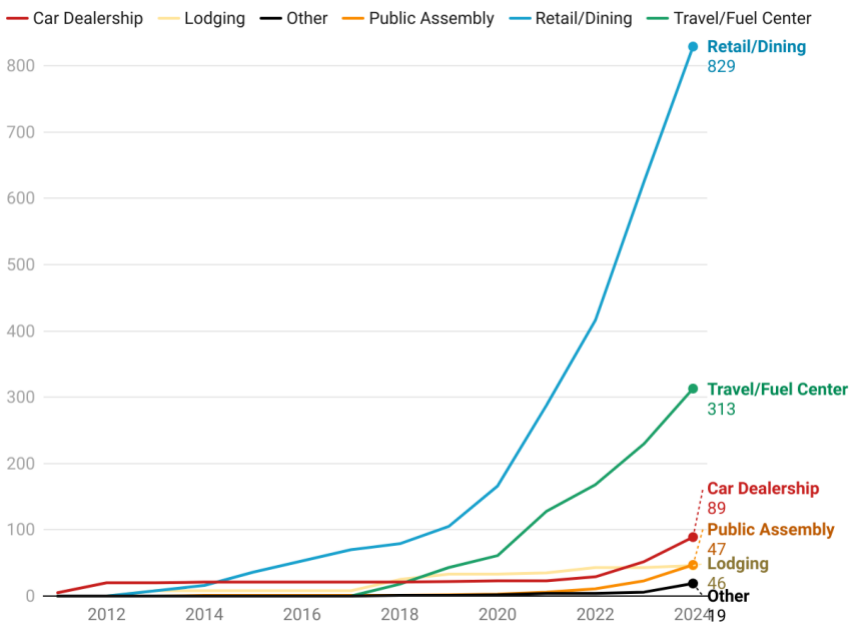
Through the end of 2024, North Carolina had 1,343 DC fast charging ports. Of these, 85% were present at either retail/dining or travel/fuel centers (Figure 2).

Figure 1. Map of North Carolina DC Fast Charging Ports by Site Type as of December 2024



Note: This only includes public DC fast charging stations. Level 2 stations are excluded.
View interactive map.

Figure 2. Timeseries of North Carolina DC Fast Charging Ports by Site Type (2011–2024)

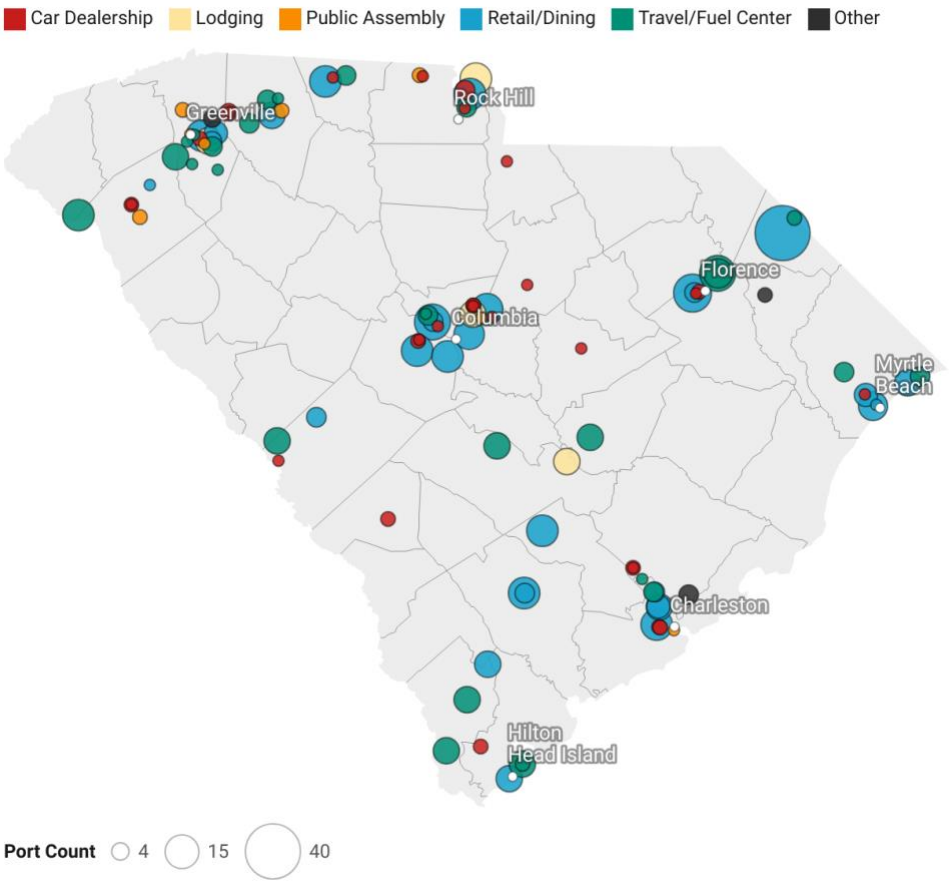


Note: This only includes public DC fast charging stations. Level 2 stations are excluded. Stations that opened and subsequently closed in the examined timespan are not included.
View interactive map.

South Carolina Results

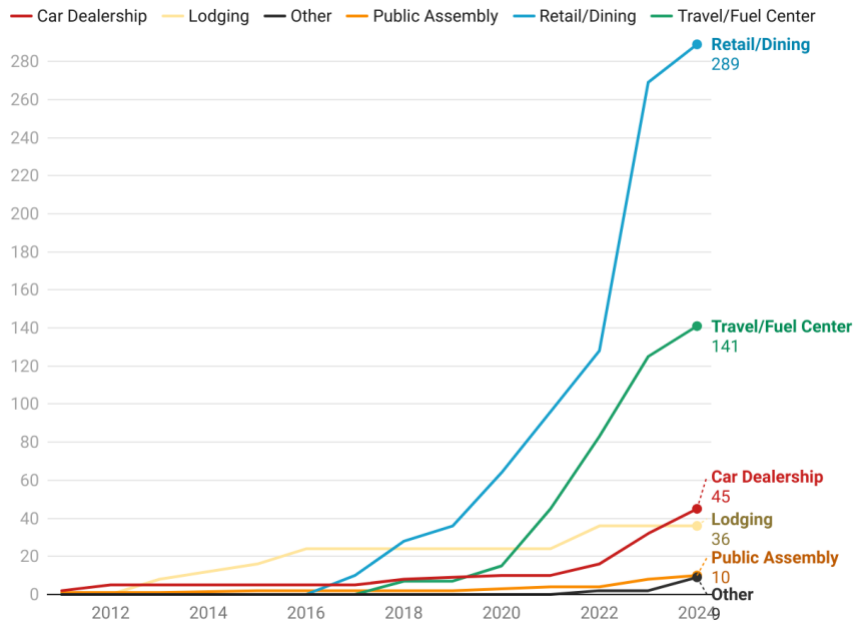
Through the end of 2024, South Carolina had 530 DC fast charging ports. Over 81% of these were present at either retail/dining or travel/fuel centers (Figure 4).

Figure 3. Map of South Carolina DC Fast Charging Ports by Site Type as of December 2024



Note: This only includes public DC fast charging stations. Level 2 stations are excluded.
View interactive map.

Figure 4. Timeseries of South Carolina DC Fast Charging Ports by Site Type (2011–2024)



Note: This only includes public DC fast charging stations. Level 2 stations are excluded. Stations that opened and subsequently closed in the examined timespan are not included.
View interactive map.

CONCLUSION

This analysis provides an outline to develop an EV charging station inventory that covers site types.

Future work could include analysis of both Level 2 charging ports (which are more plentiful) and DC fast charging ports for a more complete picture of EV charging infrastructure and unique use cases.

Local analysis, such as at the municipal level, may both be more feasible for charging port types and more actionable. For local jurisdictions seeking to advance EV adoption in their areas, we recommend they conduct inventories of EV charging site types in their communities to understand where investments are happening, where gaps exist, and where opportunities may be overlooked. A new metric could include chargers per capita—by [site type]—and could be compared across communities. Those conducting local analysis may find the need to consult additional data sources for their inventory. By improving EV charging infrastructure qualitative analysis to include site types, planners and drivers can benefit from better understanding of current infrastructure and gaps.

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Contact

Nicholas Institute | Duke University | P.O. Box 90467 | Durham, NC 27708
1201 Pennsylvania Avenue NW | Suite 500 | Washington, DC 20004
919.613.1305 | nicholasinstitute@duke.edu