

Memorandum

Date: December 31, 2023
To: City of Shoreline
From: Fehr & Peers
Subject: City of Shoreline DC Fast Charging Prioritization Analysis Study

SE23-0906

Introduction and Purpose

The City of Shoreline is dedicated to reducing climate change-causing greenhouse gas emissions as outlined in its forward-thinking Climate Action Plan (CAP). Among the CAP goals are a commitment to reduce 60 percent of greenhouse gas (GHG) emissions by 2030 and reduce vehicle-miles traveled (VMT) per capita 20 percent from 2019 levels by 2030.

A key strategy to achieve the GHG emissions reduction target is the electrification of vehicles. The City's goal is to accelerate EV adoption so that 30 percent of light-duty VMT is electric by 2030 and 100 percent by 2050.

The purpose of this study was to identify priority locations for public EV charging infrastructure in support of CAP goals and broader policies in the recent update to City of Shoreline's Transportation Element adopted into the Comprehensive Plan.

This memorandum details the current state of EVs and charging infrastructure and the role of the City of Shoreline in advancing EV adoption by providing more DC Fast chargers, including a focus on areas that would not likely otherwise have adequate EV charging infrastructure required to meet the City's greenhouse gas reduction targets. Acknowledging the role that the City of Shoreline has in public installation of EV chargers as a strategy to increase EV adoption, the study incorporated a framework to prioritize the areas for EV charging infrastructure. The analysis involved several steps, including the development of typical "use cases" of DC fast charging, the determination of relevant data and criteria, and the spatial analysis to leverage the criteria to generate prioritization results.



Electric Vehicle Charging Context

Electric vehicles (EVs) come in various forms, primarily categorized as Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs), and traditional Hybrid Electric Vehicles, often referred to as full hybrid models. There are three types of EV chargers currently available to the public (Level 1 (L1), Level 2 (L2) and Level 3 (DC Fast chargers) with the Level 3 chargers being able to potentially charge an EV more than 10 times faster than L2 chargers. Level 3 DC Fast chargers can significantly increase charging speed compared to Level 2, potentially serving more EVs and contributing to a higher share of vehicle miles traveled by electric vehicle and avoiding more greenhouse gas emissions.

Electric Vehicle Sales Forecasts

While the rate of sales of EVs in the City of Shoreline remained relatively low over the past decade, a noticeable shift in demand has occurred in the last two years; similar to trends observed nationally¹. Forecasts of EV sales (and therefore electric VMT) both nationally and locally vary by source and are routinely updated due to several variables that may increase or decrease the rate of EV adoption. Factors that impact EV adoption trends include:

- Federal, local, and state incentives for EV purchases and at-home and/or workplace charging equipment.
- Typical fleet turnover rates (how frequently cars are bought and sold in the market).
- Overall economic conditions.
- Private sector marketing, competition, and other market trends that will impact vehicle options, prices, and availability.

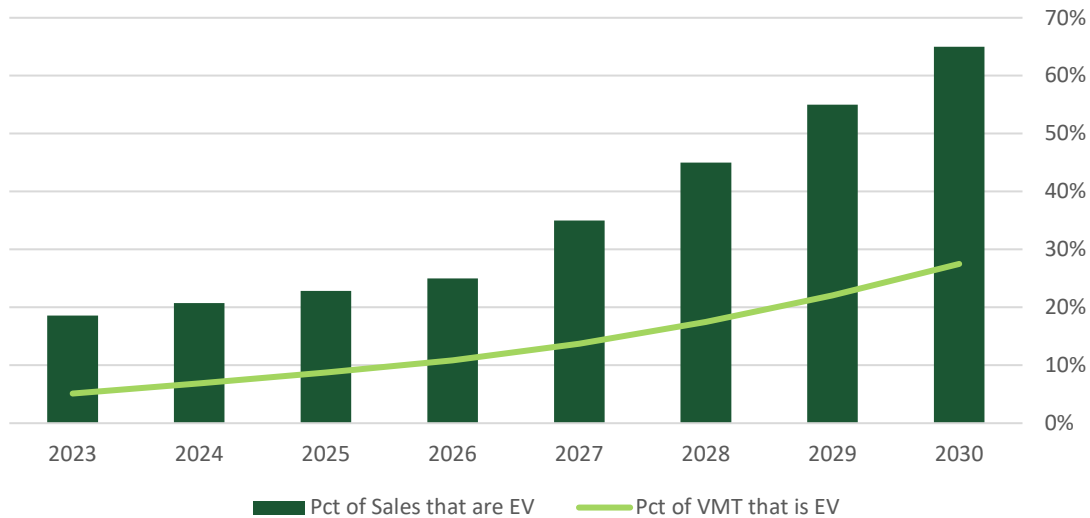
In Washington State, the legislature recently passed Senate Bill 5974 which established a target of 100 percent vehicle sales to be electric by 2030. A conservative assumption is that 65 percent of vehicle sales will be EV by 2030 and an estimate should account for typical vehicle turnover rates and growth in vehicle sales over time with population growth. **Figure 1** shows this as a forecast of EV sales percentages and the resulting VMT that would be electric for each year through 2030 for the City of Shoreline. This forecast shows that based on the current rate of change in EV sales, the target of 30 percent of VMT being electric is reasonable², assuming that the supporting EV charging infrastructure is in place.

¹ Bureau of Transportation Statistics

² Different assumptions of fleet turnover rates and growth in percentages of EV sales yields a range of 20 to 40 percent of VMT that is electric by 2030.



Figure 1. Forecasts of Electric Vehicle Sales and VMT Percentages for City of Shoreline



Source: Washington State Department of Licensing, Puget Sound Regional Emissions Analysis Study, and Fehr & Peers, 2023

Shoreline’s Role in Advancing EV Charging

Given the context of the EV market, the role of the City of Shoreline to advance the EV transition includes a multi-faceted approach to address barriers to EV purchasing, charging, and operation. Primary elements that the City of Shoreline can influence include:

- Municipal code updates that will specify additional EV charging infrastructure requirements in multifamily housing, including specifications for EV-readiness and EV-capability.
- Incentives and grant programs for new and retrofitted housing and commercial developments to increase the amount of EV charging infrastructure.
- Advocacy at a regional and state level to increase the amount of investment in publicly available EV charging infrastructure and additional strategies to increase EV adoption.
- Public installation of EV chargers (either directly or through public-private partnerships) to address gaps in the EV charging network and to address barriers to EV adoption for residents who don’t have access to at-home charging. **This role for the City of Shoreline was the primary focus of the analysis.**

Focus on Public Installation of DC Fast Charging

To support the adoption of EVs across all segments of the population, the provision of robust EV charging infrastructure is critically important. The City of Shoreline is committed to ensuring a robust network of DC fast chargers as part of a comprehensive set of strategies to support the



adoption of EVs. DC fast chargers offer rapid charging capabilities, capable of adding roughly 200 to 300 miles of range in just 30 to 60 minutes, making them well-suited for longer journeys, relatively quick recharges as well as increasing accessibility for EV users not able to charge at their homes. As noted previously, fast chargers can serve more than 10 times the electric Vehicle Miles Traveled and help avoid more than 10 times the greenhouse gas emissions from driving non-electric vehicles.

The Difference between Public and Private Investment in Charging Infrastructure

To date, a majority of publicly available EV chargers have been funded and installed by private companies. Typically, EV chargers have been installed in high-activity areas such as grocery stores, retail outlets, and along state highways and interstates. The private sector has prioritized areas that likely have higher demand for charging because their business models are typically based on the ability to recoup and generate a return on investment in the EV charging infrastructure³.

In general, the public sector has taken an approach to fill in the gaps in the charging network by prioritizing charging for those who may rely on it the most. In areas with more multifamily housing where many residents lack the convenience of at-home charging, accessible public and workplace charging become key determinants of EV adoption. It not only supports daily commuting needs but also facilitates long-distance travel, eliminating range anxiety and making EVs a practical choice for a broader consumer base. Programs such as the Seattle City Light Public Electric Vehicle Charging Program are examples of how public agencies are focusing their efforts to help future EV owners and support a faster transition to EVs.

Equity Considerations

Taking equity into account when prioritizing EV infrastructure is essential, especially in communities currently enduring the disproportionate impacts of transportation emissions while also facing greater barriers to EV ownership due to costs and at-home charging constraints. Priority populations⁴ face barriers to EV ownership that can be addressed in a few ways:

- EV purchasing incentives,
- Public EV charging investment,
- EV carshare services

As a first step considered in this study, the installation of EV charging stations in equity-focused areas can benefit residents of those areas by addressing EV charging constraints which could lead to an increase in the percentage of vehicles in the area that are electric while reducing local tailpipe emissions within the community. However, EV charging investments are just one part of a

³ However, some EV charging companies such as Volta do not require a fee for charging but generate revenue through marketing and partnerships at their locations.

⁴ Priority populations are defined as people of color, low-income households, limited English-speaking households, and people less than 18 or over 60 years of age.



broader set of strategies to address inequities in the transportation system, including community stabilization, workforce and wealth-building, and anti-displacement actions.

DC Fast Charger Site Prioritization

Acknowledging the role that the City of Shoreline has in public installation of EV chargers as a strategy to increase EV adoption, the study incorporated a framework to prioritize the areas for EV charging infrastructure. The analysis involved several steps, including the development of typical “use cases” of DC fast charging, the determination of relevant data and criteria, and the spatial analysis to leverage the criteria to generate prioritization results.

Factors of DC Fast Charging Demand

Determining where to prioritize DC fast chargers in the City of Shoreline required an understanding of who would use this infrastructure and why they would need it. Several factors informed the definition of use cases, including household travel patterns, demographics, charging costs, and broader citywide travel demand.

Household Travel: Understanding household characteristics and individual travel behaviors is essential to gauge the demand for EV charging stations. Two key factors that influence EV charging needs are the distance traveled per trip and the average VMT generated per household. Currently, the average trip distance for trips that either start or end in the City of Shoreline is approximately four to five miles⁵. In the future, while the number of trips is expected to increase with the growing number of households, per capita VMT is projected to decrease by 2030. This shift implies a growing number of people living in higher density areas closer to services and therefore a higher prevalence of shorter trips, which has implications for likely EV charging needs within the city.

Demographics: Over 80 percent of current EV owners nationwide⁶ reside in single-family housing that allows them to install and utilize at-home charging.⁷ However, certain demographic groups, particularly those residing in multifamily housing units, often have limited at-home charging options and therefore are more inclined to utilize public charging stations. With substantial growth in multifamily housing occurring in the City of Shoreline, addressing the needs of these groups is essential for equitable charging access and to support a broader transition to EVs for all residents.

Charging Costs: Charging costs can vary considerably depending on the chosen charging option. At-home L1 or L2 charging costs between \$.10 to \$.15 per kilowatt-hour (kWh), while L2 public

⁵ Based on analysis of the Shoreline Travel Demand Model

⁶ PlugInAmerica EV Driver Survey, 2022

⁷ This high proportion may also be due to the higher relative costs of EVs and the relatively higher incomes of single-family households.



charging typically costs between \$.20 to \$.25 per kWh. Public DC fast charging is the costliest form of charging, typically in the range of \$.35 to \$.50 per kWh, equivalent to roughly four dollars per gallon of gasoline. Due to its cost efficiency and ease of charging, most people would prefer charging their EVs at home. Therefore, relying solely on DC fast charging as a solution to address barriers to EV adoption for multifamily residents may incur inequitable costs and further support a multi-faceted approach to increasing EV adoption as noted in the previous section that includes code updates, building retrofits, and public L2 chargers.

Travel Demand Analysis: While the average trip length that starts or ends in the City of Shoreline is between four to five miles, over 50 percent of travel demand in Shoreline consists of residents traveling outside the city or visitors traveling into the City of Shoreline. Visitors include people who work in the City of Shoreline, people visiting businesses such as grocery stores and retail locations, or travelers stopping in the City of Shoreline while on a longer distance trip in the region. Each of these visitors will have different charging needs based on their vehicle, their trip distance, and their expected dwell time (how long they stop or “dwell” at a particular location) within the city. While people who work in the City of Shoreline likely would be able to leverage slower L2 chargers due to their longer dwell times at one location, visitor trips have shorter dwell times in general and may travel via privately-owned EVs or shared mobility services such as ride-hail platforms (Uber, Lyft, etc.). Ride-hail operators often travel substantial distances each day and they may require charging within the City of Shoreline as part of their daily operations. Additionally, residents (even those with at-home L2 charging) with longer travel outside of the City of Shoreline may also want public DC fast charging as a convenience to quickly recharge their vehicle as part of their daily travel needs.

Certain patterns and use cases emerged when assessing the factors associated with public DC fast charging needs. While a primary need for public DC fast charging is to support individuals without access to at-home charging infrastructure and City visitors, additional support is warranted for EV owners with at-home charging but who may require DC fast charging less frequently as a means of convenience to overcome potential barriers to EV ownership.

Use Cases for EV Charging Needs

To address different user types and to ensure adequate EV infrastructure is in place by 2030 to not only reach targets by 2030 but also ensure equitable access in the City of Shoreline, three use cases were identified to support the prioritization effort:

Necessity Charging + EV Carshare – This use case focuses on serving multifamily housing residents without access to at-home charging. It is part of a broader strategy to address barriers to EV ownership, particularly for equity-priority populations. Additionally, this use case considers the charging needs of an EV carshare service (generally membership based, carshare allows rental



of vehicles for short periods of time); a solution that could be deployed for residents with barriers to at-home charging and cost barriers to purchasing an EV.⁸

Convenience Charging – While most EV owners in single-family homes have the capability to charge at home, an additional use case focuses on EV owners who would benefit from having DC fast charging available as a convenience to address range anxiety and improve the experience of EV ownership. Even if barriers to at-home charging for multifamily housing can be addressed through code updates and other strategies⁹, public DC fast charging would support the varying travel needs of all residents in the City of Shoreline.

Visitor and Ride-hail Trips – This use case recognizes the EV owners that likely would generate one of the largest demands for public DC fast charging due to their travel patterns. Visitors to retail locations or other businesses may have longer trip distances while also having shorter dwell times (as compared to work or home) and therefore may have a significant need for accessible DC fast charging. While the private sector has traditionally been addressing the needs of users with longer trip distances, filling gaps in the DC fast charging network through public investment can be a way to support the EV transition and help address one of the largest sources of VMT in the City of Shoreline¹⁰ based on an analysis of the Shoreline Travel Demand Model.

Site Prioritization for DC Fast Chargers

Data Sourcing and Metrics Definition

The prioritization process involved a spatial analysis of several datasets to determine prioritization scores for each of the three use cases. Potential data sources and metrics to support the prioritization were identified through research on EV user characteristics, travel demand factors, and the local context of the City of Shoreline. **Table 1** provides a summary of the selected metrics in each use case scenario.

Data Organization and Analysis

Following the definition of the three use cases and associated metrics in Table 1, a GIS spatial analysis provided the development and compilation of the metrics into a composite score for each of the three use cases. The analysis used a standardized geometry of 10-acre hexagonal

⁸ While EV carshare services utilize both L2 and DCFC charging, this study evaluated the siting prioritization for DCFC chargers as part of an EV carshare use case.

⁹ For example, L2 chargers would be more appropriate at workplace locations and areas with longer average dwell times.

¹⁰ Visitor trips via private vehicles are the majority of trips, with a much smaller proportion served by ride-hail.



grids¹¹ to develop a “heat map” of composite scores across the City of Shoreline. Each metric included data at different geographic scales (census block groups, tracts, traffic analysis zones, etc.) and the data from these metrics were summarized in the hexagonal grids using an “intersect” function in ArcGIS Pro.

For point-based and line-based data (EV charging locations, retail locations, etc.), the near-distance analysis tool was utilized to compute the distances from each hex grid centroid (geometric center) to the nearest location of the relevant point-based or line-based variable.

Composite Scoring

Once the metrics were associated with each hex grid, a Composite Index tool was used to create a ranking score by combining the selected metrics for each of the three use cases. In this procedure for each hex grid, the tool produced a composite score for each of the use cases based on the sum of the variable rankings. Some metrics or similar metrics are used in more than one use case as they may have overlapping needs.

¹¹ Research suggests that people parking their vehicles are willing to walk up to 600 feet to access destinations (TCRP 153 and stakeholder interviews with potential EV owners conducted during a prior study). Therefore, the 10-acre hexagons were based on a 600-foot radius.



Table 1. Use Case and Selected Metrics Summary Table

| Use Cases | Metrics | Data Source | Rationale for the Inclusion of the Metric |
|---|--|---|--|
| Use Case 1: Necessity Charging + EV Carshare | EV ownership per capita | Department of Vehicle Licensing | Focuses on prioritizing DC fast charging in areas with relatively lower rates of EV ownership on a per capita basis |
| | Multifamily housing unit density | Census | Identifies current areas with likely higher needs of public DC fast charging due to existing at-home charging barriers |
| | Distance to frequent transit | King County Metro and Sound Transit | The distance from frequent transit is used as a proxy to prioritize the areas with less transit service where people may be more dependent on their vehicles for mobility |
| | Proximity to DC fast charging stations | Alternative Fuel Data Center (AFDC) and City of Shoreline | Prioritizes areas that are further away from existing and planned DC fast charging stations to fill in the gaps in the DC fast charging network |
| | Equity-focused populations | Census | Address barriers to EV ownership and/or supports EV carshare opportunities for priority populations (people of color, low-income households, limited English-speaking households, and people less than 18 or over 60 years of age) |
| Use Case 2: Convenience Charging | Proximity to DC fast charging stations | AFDC and the City of Shoreline | Prioritizes areas that are further away from existing and planned DC fast charging stations to fill in the gaps in the DC fast charging network |
| | Household growth | Shoreline Transportation Master Plan | Focuses DC fast charging stations where the largest growth in housing is planned in the City of Shoreline |
| | Employment growth | Shoreline Transportation Master Plan | Focuses DC fast charging stations where the largest growth in employment is planned in the City of Shoreline |
| | Proximity to grocery stores | SafeGraph | Considers the convenience for residents to use DC fast chargers while they shop at grocery stores even if they have at-home charging available |
| | Proximity to parks | King County | Similar to the grocery stores metrics, this metric considers the convenience for residents to use DC fast chargers while they visit local parks |
| Use Case 3: Visitor + Ride-hail Trips | Proximity to the Alternate Fuel Corridor (I-5) | AFDC | Supports federal and statewide objectives for AFCs and the provision of EV stations along those corridors |
| | Future travel demand | Shoreline Transportation Master Plan | Prioritizes areas where forecasts suggest the largest number of trips will end in the City of Shoreline, suggesting these are the areas with the greatest number of visitors |
| | Proximity to retail locations | SafeGraph | Focuses charging at areas that are likely to generate the greatest number of frequent trips from visitors and to have short dwell times that would benefit from DC fast charging |

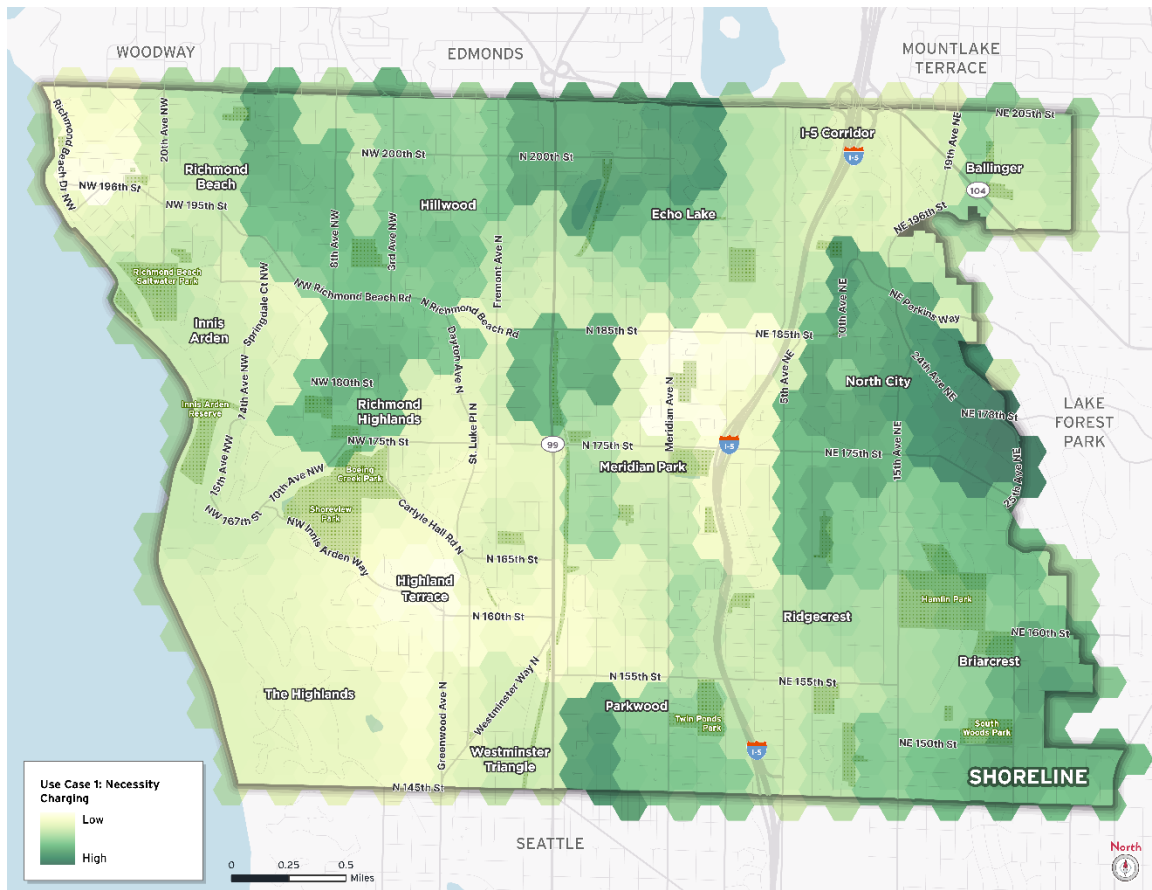


Site Prioritization Results

Use Case 1: Necessity Charging + EV Carshare

This use case is based on prioritizing areas with lower per capita EV ownership, higher density of multifamily housing, longer distances from frequent transit, fewer existing and planned DC fast charging stations, and higher percentages of priority populations. Darker shades in **Figure 3** indicate higher scores for this use case, such as the areas east of the North City neighborhood, along with areas between Aurora Avenue N and I-5 – namely Echo Lake to the north and parts of the Parkwood Neighborhood to the south. This use case primarily emphasizes the current unmet demand for EV charging in these locations with a focus on supporting EV ownership and the availability of EV carshare for priority populations.

Figure 3. Spatial Results of Use Case 1: Necessity Charging + EV Carshare



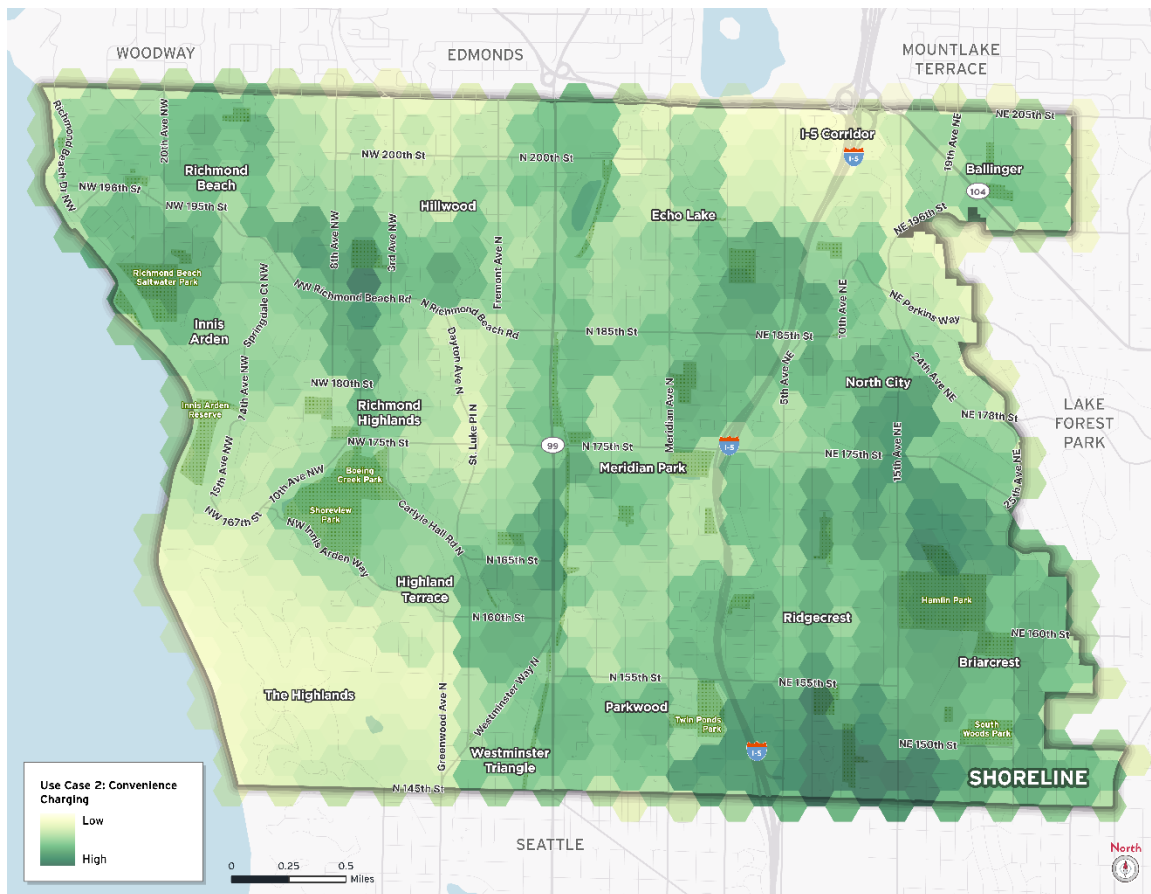
Use Case 2: Convenience Charging

This use case is based on prioritizing areas with fewer DC fast charging stations, higher rates of household and employment growth, and closer proximity to grocery stores and parks. As shown



in **Figure 4**, higher scores are observed along N 145th Street within the Ridgecrest neighborhood and along portions of the 15th Avenue NE corridor. Additionally, pockets with higher priority scores for this use case are in the 4-Corners area and along Aurora Avenue near N 155th Street. In general, the difference between the higher and lower scoring areas is less pronounced compared to the differences observed in Use Case 1.

Figure 4. Spatial Results of Use Case 2: Convenience Charging



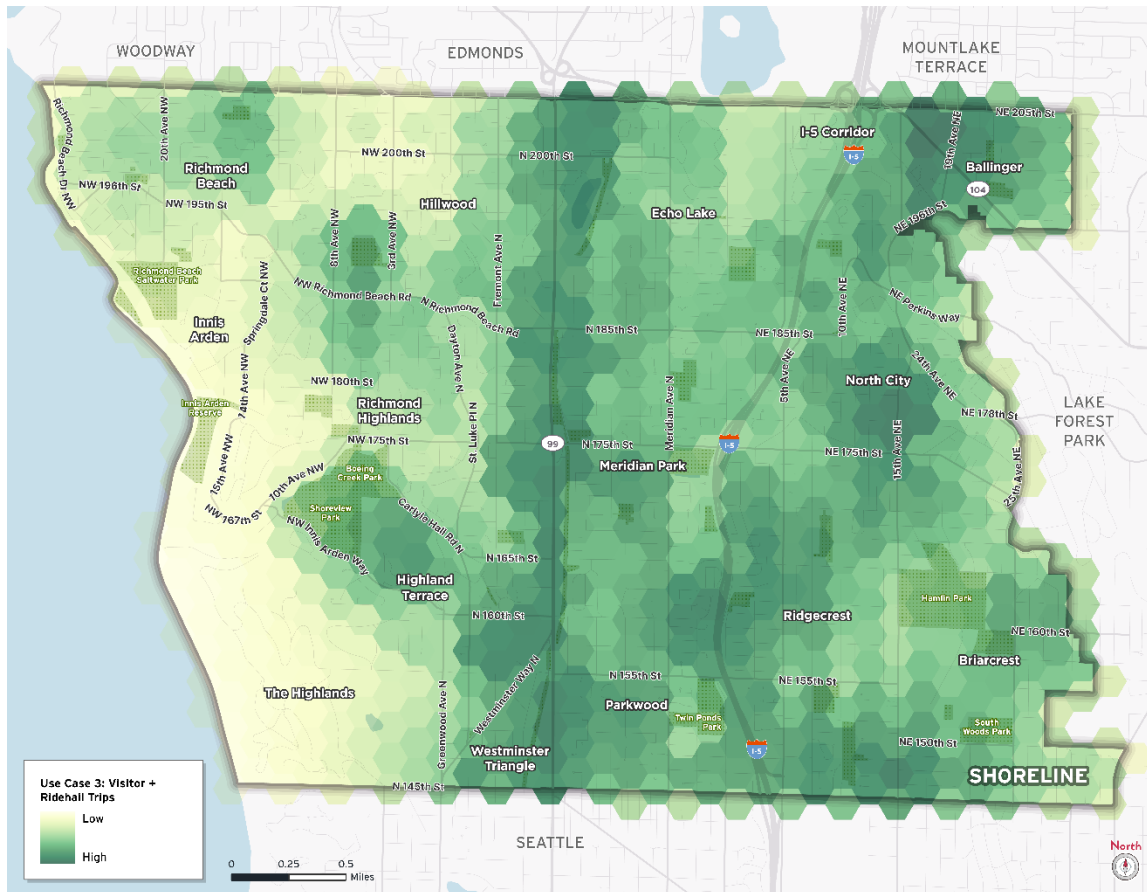
Use Case 3: Visitor + TNC Trips

This use case (which represents a high proportion of VMT in the city) is based on prioritizing areas with higher rates of future trip ends, proximity to the Alternative Fuel Corridor (I-5), and proximity to retail locations. As shown in **Figure 5**, higher scores are along the Aurora Avenue N corridor along with pockets in several neighborhoods, including Ballinger, North City, Aurora Square, and near the Shoreline Community College. This pattern is likely driven by the concentration of retail



stores and future trip ends along major corridors such as Aurora Avenue N, 15th Avenue NE and Ballinger Way.¹²

Figure 5. Spatial Results of Use Case 3: Visitor + Ridehail Trips



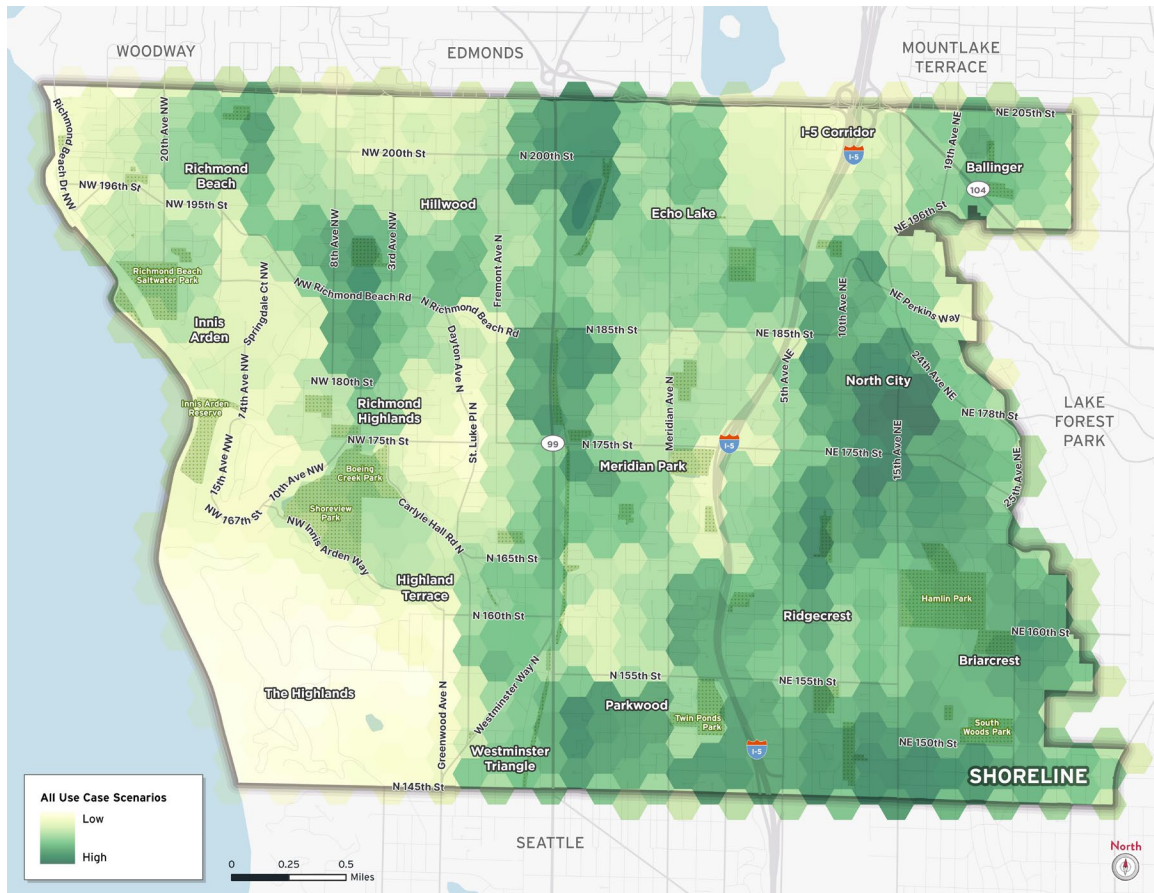
Composite of the Use Cases

A final composite is based on combining the rankings for all three use cases for each hex grid. This composite is meant to convey the overarching priority based on incorporating all of the metrics associated with each use case. As shown in **Figure 6**, higher scores exist along portions of Aurora Avenue, near North City, 4-corners, and near locations along N 145th Street.

¹² Additionally, there are more defined “nodes” of higher scores with less gradation likely due to Use Case 3 only having three variables as compared to the five variables used for both Use Case 1 and Use Case 2.



Figure 6. Spatial Results of the Composite of the Three Use Cases



Next Steps

Immediate next steps for the City of Shoreline to support their goals of electrification of vehicle travel include the identification of funding, stakeholder and community outreach, and coordination with utility providers and potential partners for implementation.

Funding Resources

Opportunities exist to support funding for the design and installation of public DC fast chargers. Below are some of the funding resources currently available.

- **WSDOT:** Washington State Department of Transportation offers Zero-Emission Vehicle Infrastructure Partnerships (ZEVIP) grant funding for the installation of new and upgraded EV charging equipment along priority corridors. Funding may be used for site design,



equipment purchases, electrical upgrades, installation, signage, operations, and maintenance.

- **NEVI:** As part of the Bipartisan Infrastructure Law, the National Electric Vehicle Infrastructure (NEVI) Formula Program provides funding to strategically deploy EV charging infrastructure along the Alternative Fuel Corridors by covering up to 80 percent of acquisition, installation, operation, and maintenance costs.
- **Electrification of Transportation Systems Program:** The Washington State Department of Commerce funds this program in areas to prioritize the communities disproportionately impacted by climate change and pollution from transportation systems. The program focuses on installations for multifamily housing, publicly available charging, and tribal locations.

Implementation and Partnership Opportunities

Implementing DC fast charging at the prioritized locations may incorporate several partners, both public and private depending on the preferred option for implementation listed below:

- Fully owned and operated by the City of Shoreline or another public agency,
- Designed, installed, and maintained through a contracted third-party, such as an EV charging provider,
- A combination of the two options with different revenue sharing and leasing alternatives

City of Shoreline

City of Shoreline can act as a coordinator or project manager to work with other partners such as Seattle City Light, an EV charging provider, and other potential city partners. The implementation of EVSE will require strong collaborative partnership, where City of Shoreline should clearly distinguish the roles and responsibilities, scope, and deliverables for the project partners.

EV Charging Providers

An EV charging provider could be responsible for the design, installation, and maintenance of the charging stations at the selected shared use mobility hubs in the City of Shoreline. They would work in collaboration with other parties and the city to ensure seamless implementation and operation of charging stations, making certain that the infrastructure meets the necessary standards and requirements.

Seattle City Light (SCL)

Coordination with the electric utility plays an important role to provide insight into the electrical capacity within the grid, to determine optimal site placement based on infrastructure availability, and to identify potential grant funding and support.



Other City Partners

Shoreline's Public Works Department may contribute by allotting designated EV parking in the public right-of-way for the desired sites for EV charging stations and providing coordination with other city-led infrastructure projects. Other departments that may provide support for outreach, planning, and other needs include the Community Services, Parks, Recreation, and Cultural Services, and Planning and Community Development departments.

Community Engagement

Working with organizations and key stakeholders, the implementation will involve engaging with nearby property owners and local residents during site selection and construction. Transparent communication and active participation will foster understanding, address concerns, and build a sense of community ownership. This collaborative approach will ensure a smooth installation process and create a positive impact on the local community.

Additional Opportunities

As previously mentioned, while the focus of this work was on the identification of public EV charging infrastructure, additional opportunities and next steps for the City of Shoreline to advance vehicle electrification include:

- **Code Updates:** Evaluate potential municipal code updates that can specify additional EV charging infrastructure requirements in multifamily housing, including specifications for EV-ready, EV-capable parking facilities. Supporting material can be found at the MRSC site¹³.
- **Incentives:** Identify potential city-funded grant programs that could support new and retrofitted parking facilities to construct additional EV charging infrastructure at housing and commercial developments.
- **Advocacy:** Engage with regional and state-level agencies to build support to increase the amount of investment in publicly available EV charging infrastructure and to collaborate on actions and strategies to increase the adoption rate for EVs within the City of Shoreline.

While this study provided an initial equity-based analysis and prioritization, next steps to advance EV adoption should include a comprehensive equity assessment to identify the potential benefits or impacts to priority populations; an assessment that can leverage regional and statewide tools in addition to a robust outreach effort.

¹³ <https://mrsc.org/explore-topics/environment/sustainability/planning-for-electric-vehicles>