Implementing a Mapping and Forecasting Tool for Zero-Emission Vehicle Infrastructure in Washington

Washington State Department of Transportation
Innovative Partnerships Office

In partnership with
Washington State Department of Commerce
Washington State Department of Ecology
Washington State Office of Equity

Prepared by
WSU Energy Program
UW Sustainable Transportation Lab

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Cover photos:
WSU Energy Program, King County, NREL, WSDOT, Washington EV drivers on charging location apps

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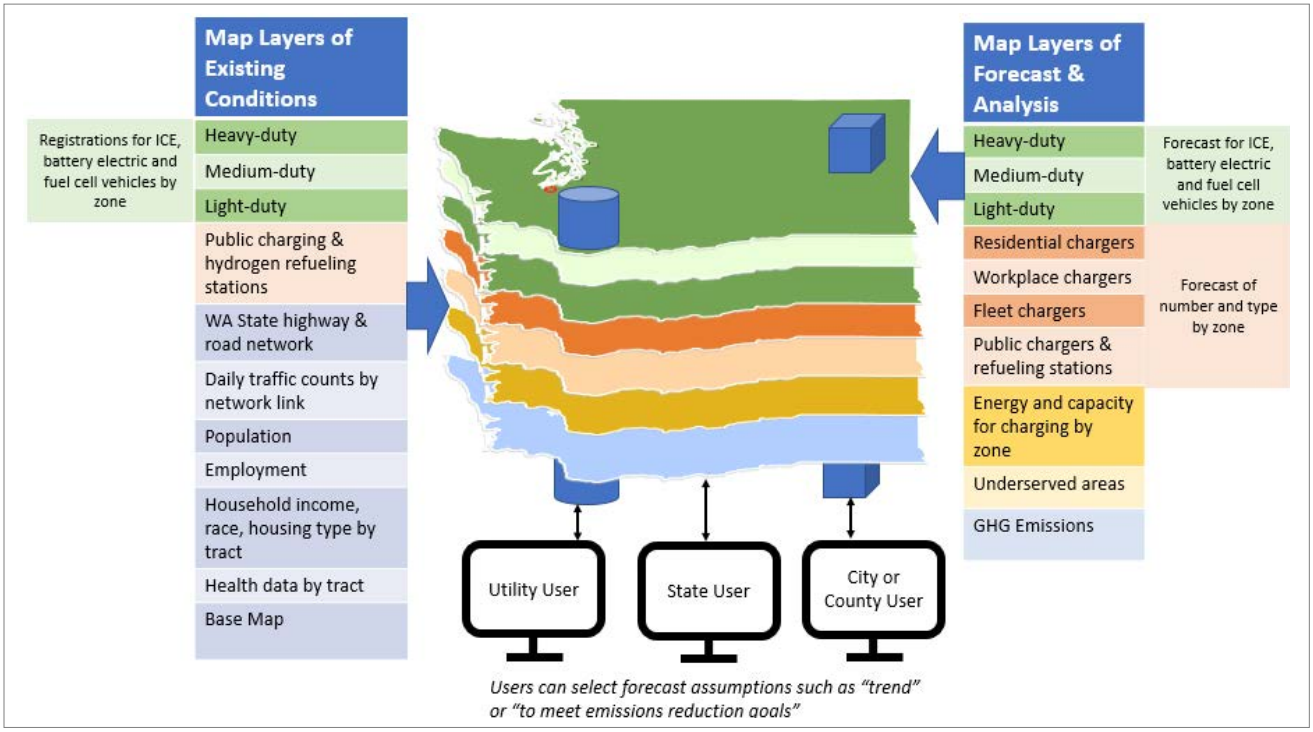
Executive Summary

In 2021, the legislature directed the Washington State Department of Transportation (WSDOT) to develop a Zero Emission Vehicle Mapping and Forecasting Tool (ZEV-MFT) "to enable coordinated, effective, efficient, and timely deployment of charging and refueling infrastructure necessary to support statewide and local transportation electrification efforts that result in emissions reductions" consistent with state goals (HB 1287).



In this effort, WSDOT is coordinating closely with the state departments of Commerce and Ecology, the Office of Equity, and the Utilities and Transportation Commission. In addition, WSDOT contracted with the University of Washington Sustainable Transportation Lab (UW) to scope the development of this tool and with the Washington State University Energy Program (WSU) to conduct stakeholder engagement activities.

This figure shows the key requirements for the ZEV-MFT. It must include data layers of existing conditions shown in the left-hand column, including the number of registered ZEV vehicles by vehicle class and the number of associated charging and refueling stations. The tool must also include the existing road network, traffic levels, population, employment, health, environmental, and socio-economic data at the level of census tracts. This tool must also forecast future quantities of vehicles and charging and refueling stations, along with the electricity needed to serve those stations under different scenarios, including a scenario in which the transportation sector meets state goals for greenhouse gas reductions.

Research Findings

WSDOT has extensive experience with online mapping systems (ArcGIS) to assemble geographic information that is accessible to the general public. California, Oregon, British Columbia, Seattle, and Colorado have all recently completed ZEV studies that relied primarily on custom analyses to forecast needed infrastructure. Though custom analysis was the predominant approach, both California and

Oregon used EVI-Pro from the National Renewable Energy Laboratory to develop forecasts of charging infrastructure for light-duty vehicles.

UW researchers reviewed 17 tools and studies related to estimating future ZEV charging and fueling needs. None of the tools reviewed could meet all of the requirements of HB 1287 alone or in combination. Most of the tools forecast light-duty EVs and related infrastructure, a few address medium- and heavy-duty EVs, but none forecast infrastructure needs of fuel-cell vehicles or the marine or aviation sectors.

WSDOT can build on this recent work of neighboring states and provinces to identify best practices to forecast charging and fueling infrastructure needs. After evaluating three options for tool procurement, the UW team recommends the following:

- Implement the ZEV-MFT on the ArcGIS Online platform that WSDOT currently licenses from ESRI because the hosted software solution has a multi-year operating history and a demonstrated capacity to serve thousands of users in local governments and utilities with flexible on-line mapping services.
- Assemble the required map layers of existing conditions from information already available at WSDOT and other state and federal agencies, in a manner consistent with guidance from the state's Geospatial Program Office.
- Contract with public or private entities that have relevant expertise for annual forecasts of ZEVs and infrastructure in a data standards-compliant format that integrates with ArcGIS Online to generate maps and related reports for Washington and its subdivisions.
- WSDOT should plan to spend approximately $8.7 million over five years to build and implement the ZEV-MFT. This includes hiring three FTE to support the project.
- The tool should be ready to deploy 12 to 18 months after the contract begins.

Stakeholder Engagement

The WSU engagement team identified key stakeholders representing state agencies, local community planners, utilities, public and private fleets, private-sector businesses, tribes, equity and environmental justice leaders, non-governmental organizations, ZEV infrastructure developers, renewable hydrogen advocates, ZEV drivers, clean air groups, and economic development organizations. The WSU team provided several channels for stakeholders to provide feedback:

- One-on-one and small-group meetings: The team had meaningful exchanges with approximately 500 people in meetings with representatives from trade associations and electric utilities, and people from similar geographic areas in Washington.
- Large group meetings: Nearly 300 people attended three public listening sessions and the regular meeting of the Alternative Fuels & Vehicles Technical Assistance Group.
- Online response form: All stakeholders were invited to provide feedback using the Mapping & Forecasting Tool: Stakeholder Request for Information. To date, 39 individuals have provided extensive comments. All respondents support continued development of the tool and anticipate that they or their organizations would use the tool and find it valuable. They provided suggestions for additional data layers and forecast modules to include, and suggested methods to assure the tool supports greater equity and inclusion in transportation planning and mobility. They also identified potential negative impacts or conflicts to be avoided.

Part 1: Background

Transportation Electrification and the Acceleration of Change

The transportation sector accounts for nearly half of Washington's greenhouse gas (GHG) emissions. In recent years, most major automotive manufacturers have announced plans to phase out the production of internal combustion engine (ICE) vehicles and replace them with zero-emission vehicles (ZEVs) over the next 10 to 15 years. This shift to clean transportation will improve air quality and reduce GHG emissions. Vehicle owners will also benefit because the new generations of EVs perform as well or better than those powered by fossil fuels – and at a lower cost.

By providing safe, reliable, convenient charging opportunities, Washington drivers and companies will be encouraged to drive as many electric miles as possible.

Car makers are investing billions of dollars in this transition to ZEVs. ZEV sales are growing quickly. The updated 2021 State Energy Strategy estimates that one million electric vehicles (EVs) will be needed by 2030 to meet Washington's pledged GHG reduction goals. By 2035, that number needs to grow to 2.3 million.

These trends combined with state goals raise important questions, including:

- What data do public fleet managers need to feel confident about purchasing ZEVs?
- How will charging/fueling infrastructure develop and change before and after the 2030s?
- How can the state support private investments and optimize the use of public dollars to replace more ICE vehicles with ZEVs, while also equitably siting infrastructure resources so historically underserved or overburdened communities will also benefit from transportation electrification?

Investing in New Charging and Fueling Infrastructure

New fueling and charging infrastructure needs to be installed at residences and workplaces, at retail and hospitality establishments, and along major highway corridors. Without ample and convenient opportunities to refuel these new vehicles, buyers may hesitate to purchase ZEVs because they fear running out of energy on longer trips.

Buses, freight, and commercial vehicles also need access to fast-charging capacity along key routes to remain productive throughout the workday. And public and private fleet owners need cost-effective ways to keep their vehicles charged.

Projections of demand for new power and capacity will be needed to inform the utilities' regular plan updates for electricity generation and distribution. Policymakers and clean energy advocates need to track the pace and locations of these charging and fueling locations to ensure that historically underserved or overburdened communities have the infrastructure needed to benefit from transportation electrification.

Legislative Direction

In spring 2021, the state legislature directed WSDOT to develop a public mapping and forecasting tool to support ZEV adoption and use across Washington (HB 1287). WSDOT, in collaboration with state, regional, and local partners, prepared this plan to develop and maintain a Zero Emission Vehicle Mapping and Forecasting Tool (ZEV-MFT) to support the buildout of infrastructure to charge and fuel battery electric and fuel cell vehicles.

Partners of WSDOT in this work include the departments of Commerce and Ecology, the Office of Equity, and the Utilities and Transportation Commission.

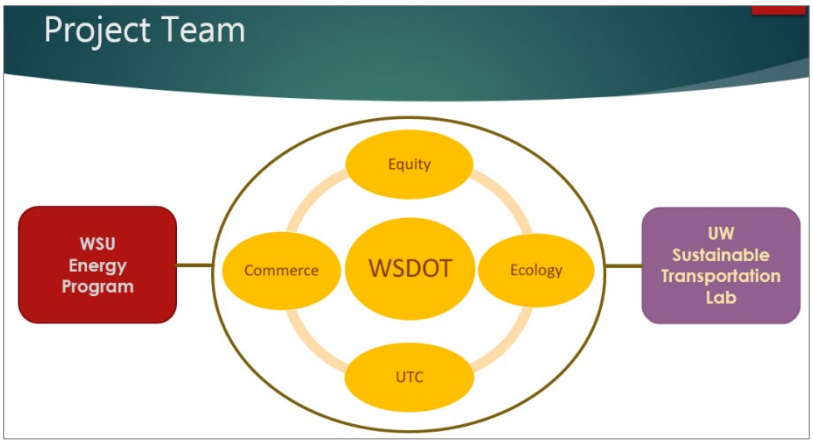


Figure 1. ZEV-MFT Project Team

The team of state agencies participated in multiple meetings, provided feedback on the plans for stakeholder engagement, and participated in stakeholder events.

The Office of Equity ("the Office") assisted the team in applying an equity lens to achieve equitable policies, practices, and outcomes. For example, to ensure maximum authentic engagement of all groups of people, the Office advised adding a third public listening session on a day and time outside of normal working hours and any religious or cultural day of observance. They also invited their extensive list of state employees, community members and organizations who will most likely be impacted by this policy, and partners in equity and social justice to attend the public listening sessions and provide feedback to the project.

At the request of WSDOT, the University of Washington Sustainable Transportation Lab (UW) was tasked with scoping the development of this mapping and forecasting tool, and the Washington State University Energy Program (WSU) was tasked with conducting stakeholder engagement activities (Figure 1).

Initial Objectives

This initial scoping process for the ZEV-MFT requires several steps:

- Establish what existing data and sources are available and relevant to this tool development.
- Undertake a stakeholder engagement process to gather comments from agencies and companies that could provide data and technical support, and others that might use the tool to forecast EV infrastructure needs.
- Present the results of the stakeholder process and tool scoping activities in a clear, concise report to the Legislature.
- Provide legislators, state agencies, and stakeholders with a solid plan and budget to develop the tool and improve it over time.

These steps have been organized into two parallel efforts: tool development and stakeholder engagement, undertaken by UW and WSU, respectively.

Part 2: Tool Development

Mapping and Forecasting Tool Requirements

In spring 2021, the state legislature directed WSDOT to develop a Zero Emission Vehicle Mapping and Forecasting Tool (ZEV-MFT), "to enable coordinated, effective, efficient, and timely deployment of charging and refueling infrastructure necessary to support statewide and local transportation electrification efforts that result in emissions reductions." ZEV-MFT will allow WSDOT and stakeholders across Washington (specified in Part 3: Stakeholder Engagement) to plan ZEV charging and fueling infrastructure, and track progress toward meeting emission-reduction targets.

The federal infrastructure bill signed by President Biden on November 15, 2021, includes billions of dollars to fund infrastructure for ZEVs. ZEV-MFT would help stakeholders plan for using these federal funds and deliver value to Washington's citizens by helping to identify the best locations for ZEV infrastructure. The tool would help support grant applications, program design, and project development funded by federal programs, including:

- U.S. Department of Transportation (USDOT) electric vehicle formula funds: $5 billion
- USDOT ZEV discretionary grants: $2.5 billion
- USDOT reduction of truck emissions at port facilities: $250 million
- Federal Transit Administration low-no grants for buses and bus facilities: $5.2 billion
- U.S. Department of Energy (USDOE) state energy program formula funds: $500 million
- USDOE alternative fuel public school facilities: $500 million
- U.S. Environmental Protection Agency clean school bus program: $5 billion

Dollar figures show total budgeted federal spending.

Figure 2 shows some of the key requirements for ZEV-MFT detailed in HB 1287. The mapping tool must include data layers of existing conditions shown in the left-hand column, which includes the number of registered ZEV vehicles by vehicle class and the number of their associated charging and refueling stations. The tool must also include the existing road network, traffic levels, population, employment, health, environmental, and socio-economic data at the level of census tracts.

In addition to characterizing present conditions, ZEV-MFT:

- Must forecast the number of vehicles and charging/refueling stations, and the electricity needed to serve those stations under different scenarios, including a scenario in which the transportation sector meets state goals for GHG reductions.
- Should allow electric utility users to generate reports on future EV charging demand to enable effective planning of generation, transmission, and distribution capacity, and aid in siting charging facilities.
- Should allow cities and advocacy groups to analyze existing and projected conditions by subareas to enable timely and equitable distribution of public investments in ZEVs, and in charging and refueling stations.
- Should allow state-level users to evaluate progress toward GHG reduction goals and provide information on the consequences of potential changes to public policy related to ZEVs.

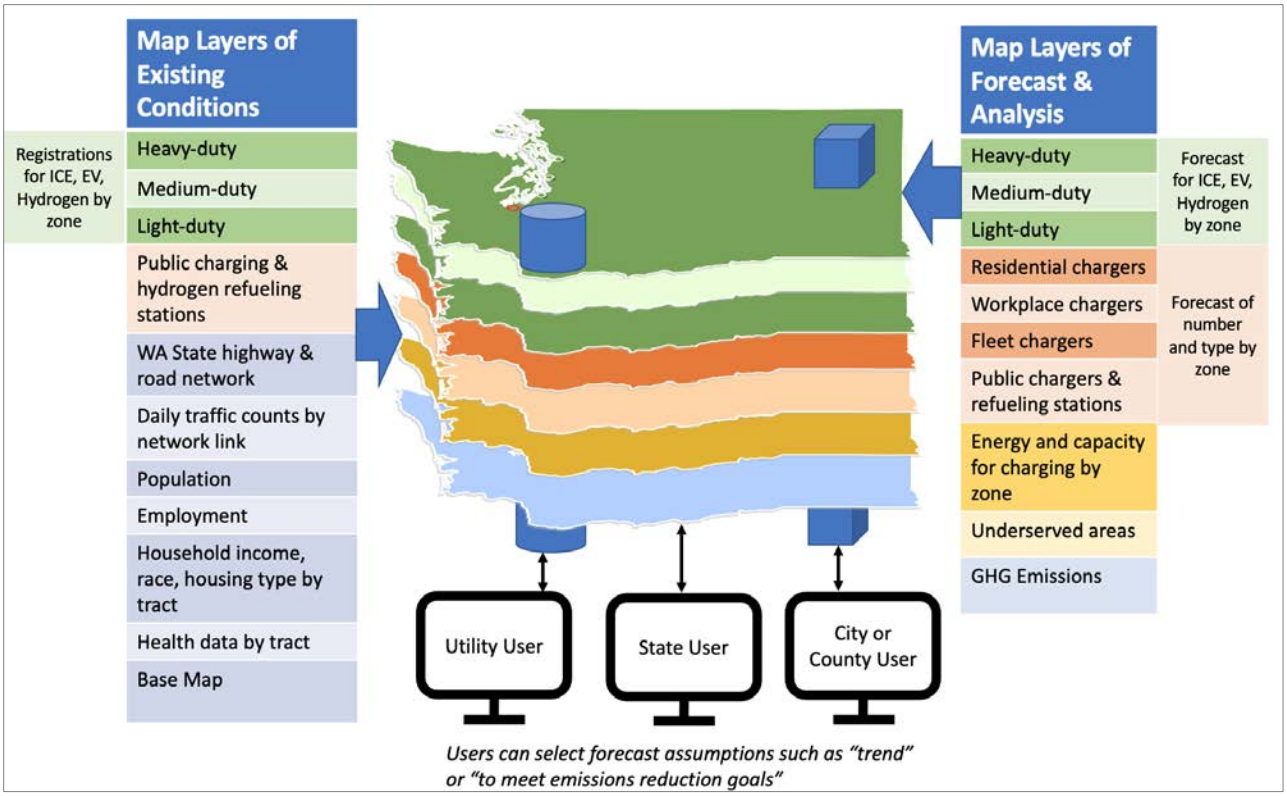


Figure 2. Schematic Diagram of Requirements for the Mapping and Forecasting Tool

Research Approach

The Innovative Partnerships Office at WSDOT contracted with researchers at the UW Sustainable Transportation Lab to research and recommend how best to implement the ZEV-MFT required by House Bill 1287. The UW team set out to answer three related research questions:

1. What tools and approaches to forecast ZEVs and their related infrastructure requirements have California, Oregon, and other jurisdictions used to develop policies and plans?
2. Do any of the existing tools offered in the market have a track record of meeting requirements close to those in HB 1287, either alone or in combination?
3. What options does WSDOT have for meeting the mapping and forecasting requirements of HB 1287 with high confidence and at reasonable cost?

In fall 2021, the research team evaluated 17 tools related to ZEV forecasting and planning, and reviewed 13 studies that estimated future needs for charging and refueling infrastructure. The team also met with leaders in the WSDOT information technology group to discuss their capabilities, experience with geographic information system (GIS) platforms, and recommendations for implementing ZEV-MFT.

Reviewing Recent Studies to Plan for ZEV Infrastructure Needs

Washington's state and provincial partners on the Pacific Coast (California, Oregon, and British Columbia) each issued reports in 2021 that projected the need for EV charging infrastructure within their boundaries. These three studies, along with similar reports from Colorado, City of Seattle, Princeton University, and a consultant team working on behalf of the three Western states along the Interstate 5 corridor (Table 1) provide a snapshot of the current practice for mapping and forecasting the demand for ZEV infrastructure in 2021. Several key insights emerged from a review of these reports:

- All of the studies relied primarily on custom analysis to estimate future demand for ZEV infrastructure.
- EVI-Pro from the National Renewable Energy Laboratory was used by Oregon and California to forecast infrastructure needed for light-duty EVs.
- Most of the studies focused on light-duty EVs; California and the consortium of Western states also estimated demand for medium- and heavy-duty EVs.
- None of the studies specifically forecast demand for public transit agencies, maritime, or aviation – uses that HB 1287 directs Washington's state agencies to consider as potential applications of the tool.
- Washington's neighbors focused their infrastructure forecasts on electric rather than hydrogen vehicles. Given current trends, hydrogen will lag behind electricity for on-road uses but hydrogen may gain market share over time for on-road, maritime, and aviation uses.

Table 1. Recent ZEV Infrastructure Needs Assessments in Western Jurisdictions

***Study Name*, Date**	**Forecasting Tools Used**
Assembly Bill 2127-Electric Vehicle Charging Infrastructure Assessment Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030. California Energy Commission, July 2021.	EVI-Pro, EVI-RoadTrip, HEVI-LOAD
British Columbia Public Light-Duty Zero-Emission Vehicle Infrastructure Study. Province of British Columbia, May 2021.	Custom analysis
Colorado charging infrastructure needs to reach EV goals. International Council on Clean Transportation, February 2021.	Custom analysis
City charging infrastructure needs to reach EV goals: The case of Seattle. International Council on Clean Transportation, January 2021.	Custom analysis
Net-Zero America: Potential Pathways, Infrastructure, and Impacts. E. Larson, et al., Princeton University, October 29, 2021.	Custom analysis
Transportation Electrification Infrastructure Needs Analysis (TEINA) for Oregon. Kittleson, RMI, HDR and Forth, June 2021.	EVI-Pro, Custom analysis
West Coast Clean Transit Corridor Initiative, Interstate 5 Corridor, California, Oregon, Washington. HDR, et al., June 2020.	Custom analysis

Evaluating Existing Mapping and Forecasting Tools

Table 2 presents summaries of the capabilities of existing tools reviewed by UW. In Table 3, the UW team presents an evaluation of each tool against some of the key requirements from HB 1287 and in stakeholder conversations conducted for the project.

This list of potential tools reflects a high level of innovation and a large number of recent entrants typical of an emerging market. National labs and universities are conducting research and developing tools that are making their way into the private market of consulting firms and non-profits that provide planning and program services to state and local governments. Because of the early stage of the market, all of the tools currently available carry some risk that the sponsoring entity may not support them over time because no clear market leaders have yet emerged. If there were a market leader for forecasting charging infrastructure for light-duty vehicles, it would be EVI-Pro, the tool developed by the National Renewable Energy Laboratory (NREL) and used by California and Oregon. But, according to staff at NREL, even this tool has not yet been formally licensed to any entities outside the national labs for commercial use.

Table 2. Existing ZEV Forecasting Tools

Tool Sponsor/Developer	**Key Characteristics**
BEAM Lawrence Berkeley National Laboratory (LBNL)	• Agent-based, regional transportation model that can site charging infrastructure based on projected per-hour and per-county demand • So far only applied on the scale of a metropolitan region (e.g., San Francisco Bay Area) • Free access to software repository; usage is non-interactive and requires executing software code
Caret Center for Sustainable Energy	• Platform to forecast and evaluate the impacts of different user-defined EV incentive programs • Applied in several incentive programs of states and regions around the world • Proprietary software and modeling approach; online user interface
Charge4All Arup	• Suitability software that identifies high-level prioritization areas for EV supply equipment (EVSE) and street-level curbside suitability • So far only applied to southern California • Proprietary software and modeling approach; online GIS-based user interface
ChargEVal University of Washington	• Decision support system for public fast-charging EVSE for Washington • Estimates the potential utilization for a chosen charging location and predicts other key metrics • Free access to software repository; restricted access to online user interface
E-DRIVE M.J. Bradley & Associates, Georgetown Climate Center, Ceres	• Prioritization tool that identifies the suitability of all census tracts in the U.S. for public fast-charging EVSE deployment • Estimates based on user-defined weights applied to several metrics • Free access; online interactive user interface
Electric Bus Planning Framework M.J. Bradley & Associates	• Framework to determine the capital and operating requirements for the electrification of transit buses, included necessary charging infrastructure • Applied to several public metropolitan transit agencies • Proprietary modeling approach used for consulting to transit agencies; extent and design of user interface not reviewed
Energy Zones Mapping Tool Argonne National Lab (ANL)	• Mapping tool to identify energy resource areas and corridors in the U.S. based on 360 layers that include various demographic and environmental data • Recently added exemplary EVSE models (corridor, urban transportation network companies, rural) that output suitability scores for 250 x 250m areas • Free access (after registration); online GIS user interface
EV-CB Framework M.J. Bradley & Associates	• Framework to project societal costs and benefits of EV adoption and charging pattern scenarios • Applied to several states • Proprietary modeling approach used for consulting purposes; spreadsheet-based tool, extent and design of user interface not reviewed

Tool Sponsor/Developer	**Key Characteristics**
EValuateCO Atlas Public Policy	• Dashboard on the current and past market within the state (EV adoption, demographics, and charging infrastructure) • So far only applied to Colorado • Free access; online dashboard
EVI-X/EVI-Pro National Renewable Energy Laboratory (NREL)	• Comprehensive modeling suite to inform the development of large-scale EVSE deployment on a city level or county level • Applied by California and Oregon for their recent EV charging needs assessments • Proprietary software available under public license; requires executing software code
GIS EV Planning Toolbox UC Davis	• Forecasting tool to provide workplace and public charging demand on a census block group level based on user-defined EV market sizes • Applied by metropolitan planning organizations in California and Pennsylvania/New Jersey • Restricted access to modeling approach; GIS-based user interface
HEVI-LOAD Lawrence Berkeley National Laboratory (LBNL)	• Model to project regional charging infrastructure needs for public, shared private, and private charging of medium- and heavy-duty EVs • Applied in California for their 2030 EV charging needs assessment (for the medium- and heavy-duty sector) • Software under development and not available online; extent and design of user interface not reviewed
ILIT M.J. Bradley & Associates, Georgetown Climate Center	• Prioritization tool that identifies the suitability of all census tracts in 14 northeastern states for public fast-charging EVSE deployment • Estimates based on user-defined weights applied to several metrics • Free access; online user interface and interactive GIS data visualization
PEV-CDM University of Vermont	• Research-focused framework aiming to produce hourly EV charging demands based on real-world travel patterns • Result of research at the University of Vermont, so far only applied to Quebec • Restricted access to software; usage is non-interactive and requires executing software code
REVISE-II Oak Ridge National Laboratory (ORNL)	• Optimization tool on where and when new charging stations should be deployed, including the allocated capacity • So far only reflects inter-city (county-to-county) highway travel • Free access to software repository; usage is mostly non-interactive and requires executing software code
StreetLight Data StreetLight Data	• Data provision software to analyze and rank charger site selections on a city level (or smaller) based on travel, traveler, visibility, and charging load metrics • So far only applied to a city (Santa Clara, CA) • Proprietary software; online user interface
UrbanFootprint UrbanFootprint	• Data provision software to quantify and analyze various impacts of user-defined land use scenarios in cities • No direct forecasts of EV charging demand • Proprietary software; online GIS-based user interface

A quick scan across the rows in Table 3 reveals that none of the tools reviewed meet all requirements of HB 1287 alone or in combination. Light-duty vehicles are just one of four vehicle types for which HB 1287 requires mapping and forecasting. Most of the tools forecast light-duty EVs and related infrastructure and a few address medium- and heavy-duty EVs; none forecast hydrogen vehicles and refueling infrastructure, nor do they forecast maritime and aviation needs.

WSDOT's Existing Online Mapping Platform

WSDOT, in coordination with the state's Office of the Chief Information Officer, has adopted ArcGIS as its standard geographic information system or electronic mapping platform. WSDOT has a license from ESRI to operate the ArcGIS Online system for a wide range of public uses, as displayed on the WSDOT Online Map Center.

Many of the data layers of existing conditions shown on the left side of Figure 1 are already available on WSDOT's mapping sites, including the state highway network, traffic counts, public health data, city and county boundaries, and population. Other ArcGIS map layers of existing conditions are readily available from other jurisdictions such as the U.S. Census and the U.S. Department of Energy. ArcGIS Online is a proven platform for WSDOT. Applications like WSDOT's Community Planning Portal are accessed thousands of times each month by planners and analysts in local government.

Procurement Options

The UW team identified three options for WSDOT to procure ZEV-MFT:

- **Option 1**: Contract for a turnkey solution hosted by the vendor.
- **Option 2**: Host the tool using WSDOT's ArcGIS Online license and contract for the annual forecast layers on the right side of Figure 1.
- **Option 3**: Host the tool using WSDOT's ArcGIS Online license and hire new WSDOT staff to generate the annual forecast layers on the right side of Figure 1.

The UW team compared these options across five evaluative criteria shown in Table 4. Option 1 would have the highest vendor costs and the lowest staff costs; Option 3 would have the highest staff costs and the lowest vendor costs. UW cannot say which option would have the lowest combined vendor and staff costs. The risk of vendor lock-in and getting stuck with a stranded mapping and forecasting technology is highest with Option 1, though vendor selection criteria could mitigate this risk. UW scored Options 2 and 3 high on the platform's track record, given the proven success of ArcGIS Online across state and local government in Washington.

The UW team recommends Option 2 because it builds on WSDOT's existing ArcGIS Online platform and data sets, and then allows WSDOT to periodically contract for forecasts from the country's leading experts on ZEV infrastructure requirements. The UW team acknowledges that Option 1 may prove more attractive to WSDOT, especially if the IT personnel and institutional resources to support Option 2 are scarce.

Table 3. Existing ZEV Forecasting Tools Scored on HB 1287 Requirements

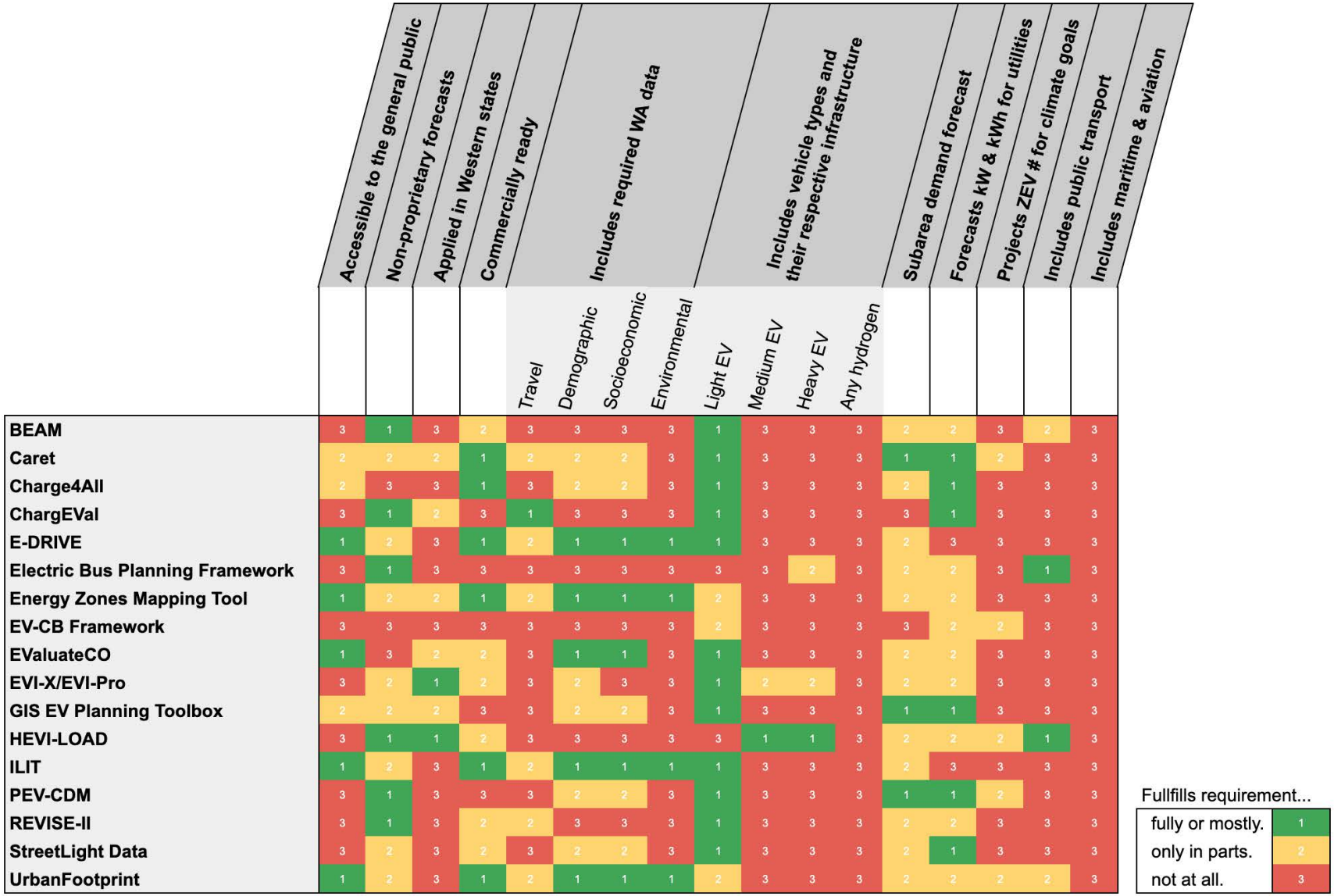


Table 4. Procurement Options Scored on Evaluative Criteria

Option	Vendor Costs	WSDOT Staff Costs	Vendor Lock-In Risk	Stranded Technology Risk	Platform's Track Record
1. Turnkey	High	Low	High	High	Short
2. Contract for Forecasts	Medium	Medium	Low	Low	Long
3. Staff for Forecasts	Low	High	Low	Low	Long

Recommended

Cost Estimates

To estimate the costs of delivering ZEV-MFT over five years, the team spoke with representatives from Oregon and California about their costs to develop recent reports on ZEV infrastructure needs and with WSDOT IT staff. They also spoke with potential private vendors willing to provide a turnkey solution for the tool. They considered that neither Oregon nor California developed infrastructure forecasts for hydrogen, public transportation, aviation, or marine uses in their reports, nor did they produce a public-facing mapping tool with subarea forecasts. They also noted that some of the required data for developing useful forecasts might have to be purchased from private data sources.

The five-year budget for Option 2 is $8.7 million, which includes hiring three new full-time equivalent positions at WSDOT (Table 5). WSDOT should expect the tool setup and forecasting services to take 18 to 24 months after contract signing to complete the first version of the tool, which is unlikely to include all of the features called for in the legislation.

The Princeton University Net Zero America report published in October 2021 estimated that Washington will need to invest $856 million in public charging stations in the 2020s and 2030s to achieve net zero emissions by 2050 under a high electrification scenario. The five-year cost of the ZEV-MFT is 1% of this projected investment in public charging stations. By helping stakeholders make better decisions about infrastructure location that results in faster adoption of ZEV vehicles and higher utilization of public charging infrastructure, ZEV-MFT would more than pay for itself.

Table 5. Five-Year Budget for ZEV-MFT Using Option 2

Cost Categories	FTE	FY 23	FYs 23-25	FYs 25-27	5-Year Total
Detailed vendor scope of work with contract IT business analyst		75,000			75,000
Develop long-term data management plan with contract IT business analyst		75,000			75,000
Contracted Services to deliver M&F Tool over 24 months		1,500,000	1,500,000		3,000,000
Contracted Services to update M&F Tool every year			750,000	1,500,000	2,250,000
WSDOT ArcGIS Seat seats		1,000	2,000	2,000	5,000
Annual cloud/hosting costs		75,000	150,000	150,000	375,000
License data from private vendors		100,000	200,000	200,000	500,000
WSDOT Staffing					0
Transportation Specialist 4	1.0	144,517	296,259	303,665	744,441
Transportation Technical Engineer	1.0	168,009	344,419	353,030	865,458
IT Data Management - Journey	0.5	79,697	163,380	167,464	410,541
IT System Admin - Journey	0.5	79,697	163,380	167,464	410,541
Total	3.0	2,297,921	3,569,437	2,843,623	8,710,981

Additional budget detail is provided in Appendix C.

Work Plan

WSDOT's work plan to implement the ZEV-MFT should include the steps listed in Table 6.

Table 6. One-Year Work Plan

Tasks	Time Frame
1. Use WSDOT's existing research contract with UW to prototype forecast elements of the ZEV-MFT.	Spring-Summer 2022
2. Hire project staff.	Spring 2022
3. Contract with IT business analyst to help develop scope of work for contracted services.	Spring 2022
4. Contract with IT business analyst to develop long-term data management plan.	Spring 2022
5. Select Option 1, 2 or 3 to implement the tool	Summer 2022
6. Acquire additional ArcGIS seats and services from ESRI to implement the tool.	Summer 2022
7. Develop RFQ/RFP to select one entity to provide forecast and analysis layers and develop routines that generate custom reports for different user types from those layers. The RFP should require the forecasting entity to conform with WSDOT standards for schema, include complete metadata, and document their analysis processes so others can replicate them.	Summer 2022
8. Select entity to provide annual forecasts of on-road light-, medium-, and heavy-duty vehicles and their composition by ICE, electric, and hydrogen; their associated charging and refueling infrastructure; the associated GHG and criteria pollutant emissions; spatial analysis of underserved areas; electric energy and capacity required by subarea; and potentially also ZEV infrastructure requirements of public transit, marine, and aviation uses.	Fall 2022
9. Develop an advisory working group including representatives from Commerce, Ecology, Office of Equity, UTC, PUD association, investor-owned utilities, private charging network operators, public fleet operators, and clean transportation advocates to help establish priorities for which features of ZEV-MFT to implement first and provide feedback on early implementations of the tool.	Summer 2022
10. Develop a technical working group that includes representatives from universities, national labs, and consulting firms to review and comment on forecast methods and results.	2023
11. Develop and implement a regular schedule of stakeholder outreach and engagement.	Fall 2022

Conclusion

The Legislature gave WSDOT an unprecedented assignment in HB 1287. None of the existing tools that help states plan for ZEV infrastructure come close to providing the functionality envisioned in the bill's description of the ZEV-MFT. Fortunately, WSDOT can build on the recent work of its neighboring states and province to identify the best practices to forecast charging and refueling infrastructure. WSDOT can also leverage its own experience with online mapping systems to assemble geographic information that is accessible to the public.

By making information available to a wide range of stakeholders, including utilities, cities, counties, tribes, and community groups, WSDOT's ZEV-MFT will help inform public investment decisions as Washington's transportation system shifts away from fossil fuels toward low-carbon alternatives. Additional details that support UW's tool evaluation and development process are provided in the Appendices A, B, and C.

Part 3: Stakeholder Engagement

The project's initial stakeholder engagement effort occurred in an accelerated timeframe, with all outreach activities reported here taking place during an eight-week period between mid-October and mid-December 2021. WSDOT has committed to continue stakeholder engagement through the tool development process. Any future stakeholder engagement efforts will be defined based on feedback received to date.

Process and Methods

During the initial stakeholder engagement effort, the WSU team completed the following tasks:

- Identified stakeholder interests and groups.
- Identified communication channels and objectives.
- Conducted outreach and educational activities.
- Gathered initial stakeholder feedback.

Stakeholder Interests and Groups

The project team identified many individuals and groups who could be contacted as key stakeholders with potentially important perspectives. The Office of Equity is a key partner, advising the state team to analyze equity conditions and share in decision-making with communities impacted by proposed actions.

Who else should we talk to?

If you have suggestions for engaging additional stakeholders, please email us:

— Jim Jensen, Green Transportation Program, jensenj@energy.wsu.edu
— Tonia Buell, WSDOT, tonia.buell@wsdot.wa.gov

The groups and interests represented by these key stakeholders included state agencies, local communities, municipal and transportation planners, utilities, public and private fleets, private-sector employers and businesses, tribes, equity and environmental justice leaders, non-governmental organizations, ZEV infrastructure developers, renewable hydrogen advocates, ZEV drivers, clean air groups, and economic development organizations. Examples of participating stakeholder groups are provided in Appendix D.

Communication Channels and Objectives

The following opportunities were provided for stakeholders to share their thoughts about the ZEV-MFT:

- One-on-one interviews with key informants.
- Small-group meetings, typically within the same company or organization.
- Large group meetings, often involving multiple organizations with similar interests or in a common geographic area.
- Large public listening sessions open to the general public.
- Online response form: All stakeholders and meeting attendees were invited to provide feedback using the Mapping & Forecasting Tool: Stakeholder Request for Information.
- Email channel: greentransportation@energy.wsu.edu.

To generate interest in the project, the engagement team assembled an email list with approximately 1,550 contacts from the groups and interests viewed as potential stakeholders. The people on this list received notices and announcements, especially about the public listening sessions. The project team was able to leverage support from key stakeholders who distributed invitations to the listening sessions to their own stakeholders.

The objectives of outreach activities were to:

- Create awareness of the ZEV-MFT
- Share EV trends to demonstrate the need for future charging to interest groups
- Show and describe the desired functioning of the ZEV-MFT
- Identify shared priorities or any conflicting interests among stakeholders
- Build an alliance of supporters, public spokespersons, and legislative liaisons
- Make sure any media coverage was positive and forward-looking
- Gain legislative support for the ZEV-MFT

Outreach Activities

Stakeholder engagement efforts aimed to inform and engage stakeholders about the ZEV-MFT, provide an opportunity for stakeholders to share how they might provide data to support the tool, and learn how stakeholders would use the tool once it is available.

These efforts initially focused on how the ZEV-MFT would be used:

- By state and local government agencies for public investments
- For electric utility system planning
- For community planning and engagement
- To address equity and environmental justice concerns about access to charging and refueling stations

After consultation with the state agency team and input from the Office of Equity, the WSU engagement team presented a ZEV Mapping & Forecasting Tool discussion at three public listening sessions, the November meeting of the Alternative Fuels & Vehicles Technical Assistance Group (AFV-TAG), and in small group meetings to make sure stakeholders were aware of the ZEV-MFT development process. Different presenters from among the state project team described the basics of ZEV infrastructure and the accelerating trends of ZEV adoption, how issues of equity and environmental justice intersect with transportation electrification, and the results of the tool scoping study done by the UW team.

One-on-One and Small-Group Meetings

The engagement team had meaningful exchanges with approximately 500 people in meetings with representatives from trade associations, electric utilities, and people from similar geographic areas in Washington.

Large Group Meetings

Nearly 300 people attended three public listening sessions and the regular AFV-TAG meeting in November. Moderators encouraged and solicited feedback and comments from participants throughout each event. Feedback from these meetings will be combined with other stakeholder input in a later report.

Listening sessions: These sessions provided opportunities for any person to participate even if they did not belong to a targeted group or association. These sessions were scheduled at different times on the afternoons of December 1, 6, and 13. Invitations were sent to more than 1,550 individuals on the project contact list and to supportive organizations who then shared the invitation with their stakeholders. Almost 300 people attended these sessions; attendees' affiliations and answers to polling questions are summarized below.

Agenda for Public Listening Session
State ZEV Mapping & Forecasting Tool
December 13, 2021

1) Introduction
Meeting/GoToWebinar format and logistics
Today's Agenda
Jim Jensen, Host, WSU Energy Program

2) Welcome and Thank You
Representative Alex Ramel (D, 40th District)

3) Equity and Justice for All
Dr. Karen Johnson, Director
Washington State Office of Equity

4) Zero Emission Vehicle (ZEV) Basics
Zack Aemmer – UW Sustainable Transportation Lab

2) Zero Emission Vehicles in Washington State
Tonia Buell – Washington Department of Transportation

4) Transportation Electrification is Accelerating
Jim Jensen – WSU Energy Program

5) Equity, Environmental Justice and Transportation Electrification
Michael Breish – Washington Department of Commerce

6) Implementing a ZEV Mapping & Forecasting Tool
Daniel Malarkey - UW Sustainable Transportation Lab

7) Washington Needs Your Expertise: Discussion with Stakeholders
Jim Jensen - WSU Energy Program

Figure 3. Agenda for the Third Public Listening Session, December 13, 2021.

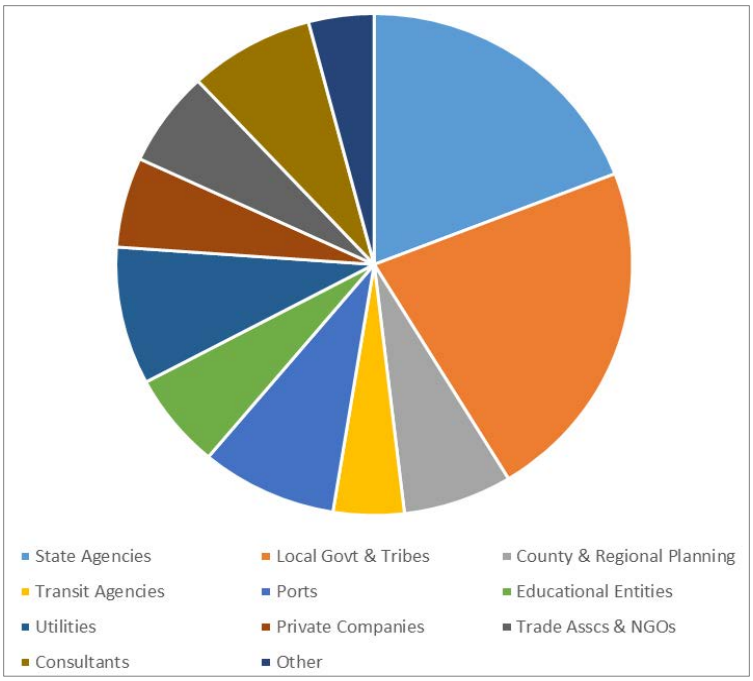


Figure 4. Affiliations of Listening Session Participants

Attendees of the public listening sessions came largely from state and local government with strong participation from utilities, transit agencies, trade associations, NGOs, private companies, and consultants. The answers these participants gave to select polling-type questions are tabulated below. Additional polling results are included in the stakeholder feedback section.

How would you describe the county where you live/work?	Mostly urban	35%
	Mostly rural	20%
	Mixed urban and rural	45%
		N=199
Have you been able to drive an electric vehicle more than once?	Yes	49%
	No	51%
		N=170
How likely will we see 1 million zero-emission vehicles on Washington's roads by 2030?	Greater than 90%	15%
	75-90%	21.5%
	50-75%	27%
	25-50%	25%
	Less than 25%	11.5%
		N=182

AFV-TAG: This group includes dozens of state and local fleet operators, sustainability coordinators, and planners. At the regular quarterly meeting held on November 19, 2021, the second half of the meeting was devoted to a discussion of the ZEV-MFT. Targeted presentations by members of the WSDOT team provided information and resources about the process for planning and assessing needs for ZEV charging and refueling infrastructure, as well as an introduction to the mapping and forecasting tool. This presentation was interspersed with opportunities to comment, and several poll-type questions were asked and responses collected. A total of 74 stakeholders attended, representing public fleets and communities across Washington.

Online Response Form

All stakeholders were invited to provide feedback using the Mapping & Forecasting Tool: Stakeholder Request for Information. To date, more than 100 individuals have opened the response form link and at least reviewed the requests made in the form; 36 people have provided complete responses.

All of the individuals who completed the form view themselves or their organizations as potential users of the tool.

The vast majority of respondents feel they understand what the tool is intended to do. Respondents support continued development of the tool and want to continue to receive updates about tool development. Some would be interested in serving in an advisory capacity during tool development. All but one respondent anticipated that they or their organizations would use the tool and find it valuable. They provided suggestions for additional data layers and forecast modules to include, and suggested methods to assure the tool supports greater equity and inclusion in transportation planning and mobility. They also identified potential negative impacts or conflicts to be avoided.

Initial Stakeholder Feedback

The engagement team received stakeholder feedback and comments in a variety of ways: through the online response form, via email, and directly during interviews, small and large group meetings, and in public listening sessions. The feedback received to date is grouped into the following major topic areas:

- Data sources and suggested additions
- Centering the tool and process on issues of diversity, equity, and inclusion
- The value of the tool
- Tool outputs - forecasts
- Assumptions for forecasting
- Zones (granularity) for forecasting
- Tool optimization
- Electricity sources/utility considerations
- Renewable hydrogen and infrastructure for fuel cell vehicles
- Potential for conflicts or negative impacts
- EVSE locations, equipment, and applications
- Environmental considerations
- Workforce considerations

Specific stakeholder feedback is provided in the sections that follow.

Data sources and suggested additions

Listed below are additional data that stakeholders suggested could be valuable as inputs to the mapping and forecasting tool. Feedback was received as brief phrases, longer comments, and questions. Each suggestion is listed only once here, even if the same idea was repeated by multiple stakeholders.

- Demographic details.
- Residential and housing details, perhaps with zoning overlays.
- Single-family homes with driveways and garages versus garage orphans and multi-family residences without assigned parking.
- Employment and workplace data details, maybe from ACS (American Community Survey 5-Year Data), to look at types of jobs, commute burdens, times, costs.
- Assumed load profiles for various vehicles.
- Besides residences, is there data to suggest where cars are parked longest – suitable for L2 charging – workplaces, retail shopping, etc.
- How would you use the health disparities data to inform EVSE placement for non-fleet vehicles that pass through the overburdened community but aren't going to or from community?
- Ages in households to better understand the driving population.
- Health impact data cross-referenced with pollution data, especially in overburdened communities.
- Data from the 2020 decennial census, and how it differs from ACS 5-year data set.
- Commuting data.
- Micro-mobility data.
- Data from the EV Watts Project could be useful.
- Current VMT (vehicle miles traveled) and AADT (annual average daily traffic) data.
- Public transit routes and ridership details.
- Energy costs and energy source should be included in a forecast.
- Census tract data about transportation burden by race, income, and location.
- Is there data about languages spoken?
- Requests for charging infrastructure by future or current EV owners.
- Missing data: construction projects, such as I-5 in the Tacoma area. Construction backs up traffic. Idling vehicles = increased emissions.
- Tool requires constantly refreshed data. Do we envision the tool will be subscribing to data sources from charging networks and telematics data providers for multiple years?
- List of inputs does not reflect impact that shared and micro-mobility will have on ZEV adoption. That is, ride as a service, car rental by trip, and e-bike/scooters/ tricycles, etc.
- Include layer showing locations of 3-phase power.
- Need a super-user data layer and data ensuring that focus is on drivers who drive the most.
- Need a layer for existing heavy-duty gas and alt fueling depot data.
- Basic questions on West Coast Electric Highway and upgrades planned.
- Will tool include data from Plug Share and other networks?
- Consider finding or developing an emissions per vehicle data point for all vehicle classes.
- Include a weather component – heating degree days, rain, wind – for impact to EV driving.
- Department of Licensing data about freight trucks may be fuzzy – the license may be an HQ address while the truck is located somewhere across the state.
- For freight data, it would be good to know where trucks are going and the time (miles) to get there.

- Certainly there are freight zones or hubs. Include data about logistics warehousing and distribution (zoning overlays) (ask folks at ProLogistix, one of the biggest lease facilities for warehouses).
- More data about where trucks park (parking = charging), including truck stops.
- Map rail and river freight traffic.
- PSE and Seattle City Light network data from stations that are already active.
- Consider looking at existing transportation electrification plans by utilities (e.g., Puget Sound Energy and Seattle City Light) for the kinds of data they used and forecasts they produced.
- Integrate with data from the new EVSE regulations being developed now by WSDA (the Washington Dept. of Agriculture). Perhaps include data requirements as part of the registration process, especially with regard to how people access charging.
- Data about charging standards in use; what vehicles use which standards could be useful to forecast the types of charging needed and levels of interoperability.
- Integrate data and information from the West Coast Clean Transit Corridor Initiative by multiple utilities.
- Government data about freight is not intended for forecasting; better for big-picture analysis.
- There is lots of data in utility IRPs (integrated resource plans) that could be valuable.
- Will the developer use INRIX transportation data? Might consider that.
- Data quality will be critical, including data from the Dept. of Licensing, which needs to regularly update and clean up their vehicle data.
- Data about power capacity available at charging facilities to predict additional power demands.
- The tool will need data about charging station utilization. How can that be obtained from public and private station owners. Consider requiring some data – charging station capacity, etc. – as part of station registration process and require data reports for stations receiving public dollars.
- Collect charging station data as part of the Clean Fuel Program crediting process.
- Include data about existing, conventional gasoline and diesel fueling stations and truck stops; think about people's fueling patterns (maybe with WSDA data about existing fuel sales at existing stations).
- Cross reference local traffic and freight data with existing fuel station locations.
- Rest area use data.
- What NAICS (North American Industry Classification System) data could be helpful for employment or current fueling patterns?
- Small business data, especially in rural communities.
- Share and compare data inputs and forecasts with the NW Power and Conservation Council (i.e., the NW Power Plan).
- Include data and mapping resources about the GHG emissions per capital at the ZIP code level from www.coolclimate.org/maps (see also their data request page).
- Consider if there would be benefits from coordinating the data or mapping functions included in the Compatible Energy Siting Assessment (CESA) Mapping Tool at the Dept. of Commerce.
- Map auto/vehicle repair facilities (NAICS data).

Centering the tool and engagement process on issues of Diversity, Equity, and Inclusion

In coordination with the state project team, including the Office of Equity, the engagement team sought ways to involve diverse communities. The team also looked for ways to engage with stakeholders to consider issues involving equity and environmental justice as they considered tool development. Throughout the stakeholder involvement process, four types of issues came to light:

- Data and mapping inputs
- How can the tool support equity and environmental justice?
- Universal user access
- Expanded stakeholder engagement

The stakeholder feedback and comments received is distributed among these categories.

Data and mapping about transportation impacts, especially on overburdened communities:

- Key information must be obtained from the Washington Tracking Network, specifically the Dept. of Health (DOH) Health Disparities Map.
- Get detailed housing data, as much as possible about single-family-owned homes versus rented homes (with or without garages or parking spaces versus multi-unit dwellings (condos and apartments) versus shared housing, etc.
- Incorporate data and mapping resources from the Washington Dept. of Commerce's Low-Income Home Energy Assistance Program (LIHEAP).
- Another opportunity may be to include transportation in any future Affordable Housing Needs Survey by the Dept. of Commerce.
- Connect with the federal Low-Income Affordability Data (LEAD) Tool.

How can the ZEV-MFT support equity and environmental justice?

- Look at ways to integrate data and mapping from municipal and utility equity tools – the City of Tacoma's Equity Index and map is a good example. Look also toward Seattle and Denver. Rocky Mountain Institute has looked at "charging gentrification."
- Include measures of Energy Burden and Transportation Burden; see the example provided by the Housing & Transportation (H&T®) Affordability Index by the Center for Neighborhood Technology.
- Another example of mapping transportation burdens is provided by the Transportation Burden layer on the Affordable Housing Assessment map posted by Oregon Housing and Community Services agency.
- In development, think about ways the tool can support shared vehicle modes – transportation network companies (TNCs), such as Lyft and Uber; low-income ZEV-share programs, such as those demonstrated by the Puget Sound Clean Air Agency and Forth Mobility; and car rental companies.
- Equity in charging for car owners means don't forget that with density, multifamily property residents don't have garages. One city is planning a 75-charger project to accommodate residential overnight access, and daytime use for business and visitors in the downtown area.
- How does this work on the local level? Such as City of Seattle doesn't encourage building developers to have parking garages, and is moving toward a city that is centered on equity for all people to have access to public transportation. Will there be fewer charging stations in urban cities?
- Wouldn't we expect severe impacts of climate change on populations in eastern Washington that may have jobs that involve working outdoors in the heat? There may be increasing incidence of heat-related injuries and possible deaths. This might impact the Hispanic community so although they may be less impacted by air pollution, they will be impacted by climate change.
- How could the tool be used for charging partnerships within regional area, rural and suburban divide?

- In Oregon's TIENA study, a common refrain was to ensure interoperability and consistent charging to make electric vehicles accessible to all.
- The urban and rural EV experience could be very different, with very different needs; need to create solutions for all areas.
- Use the forecasting and tool to support workforce development to upskill current workers and train new workers for this new transportation system. (See also the Centralia Center of Excellence.)

Universal user access to the tool, data, and results:

- Is ArcGIS usable to all types of computers and operating systems?
- What is being done to train users of the mapping tool for quality assurance and to ensure that the mapping tool is used effectively and ethically?
- Tool should have an excellent user interface with good-quality documentation, instructions, and tutorials in multiple languages with subtitles to provide maximum access to any person.

Expand stakeholder engagement:

- Partner with more Black, Indigenous, and People of Color communities and historically overburdened communities in planning and development of the tool (be prepared to offer stipends to support participation on committees).
- Establish the appropriate level of communication and consultation with tribal governments, non-federally recognized tribes, and American Indian organizations.
- Continue outreach to community groups representing transit riders, renters, and CAP (community action program) agencies, especially any with transportation services.
- Work with people in highly impacted communities in urban areas along interstate highways and major truck corridors.
- Continue to look for ways to involve rural communities with high transportation burdens.
- What are the strategies and plans for connecting and engaging with immigrant and refugee communities in making sure this population is not left out of the electrification priorities?
- How could the tool be used for charging partnerships within regional area, specifically addressing the rural and suburban divide?
- Connect to private sector, especially current fuel providers/stations.
- More ZEV education to the general public is needed as part of deployment – broader education, geographic education.
- There is a disconnect at play in discussions about equity in relation to electric vehicles and infrastructure because for people in many communities in Washington, these clean vehicles are too expensive and out of their reach. Meet with people most impacted to address this.

Value of the tool

Some values of a mapping and forecasting tool shared with stakeholders during presentations were:

- Facilitate statewide planning and deployment of ZEV infrastructure in a transparent, effective, and equitable manner.
- Ensure utility resource planning analyzes the impacts on electricity generation and delivery from growing adoption and usage of ZEVs.
- Forecast possible impacts – benefits and costs – to communities throughout the state.

Whether in the online response form or during public meetings, this gave stakeholders the opportunity to see how they, their organizations, and others might also find value from using the ZEV-MFT.

How valuable would the data mapping and forecasting provided by this tool be to you (or your organization)? Not valuable 1%, Neutral 24.5%, Somewhat valuable 25.5%, very valuable 49%, n = 106

Here is more of what we heard.

- Communities doing transportation electrification planning (cities, counties, tribes, etc.).
- Community planning can be done better with good siting criteria and data.
- Utilities deciding how to invest their resources, especially relevant after passage of the Clean Fuels Program, which is likely to send millions to utilities for ZEV infrastructure.
- Utility can definitely see this tool used for public charging and MUD (multi-unit dwelling) charging.
- This will be valuable for solving complicated infrastructure puzzles.
- More potential end users:
  - MPOs/RTPOs (Metropolitan Planning Organization or Regional Transportation Planning Organization)
  - TNC (transportation network companies).
  - Freight and logistics trucking companies, especially for first & last-mile deliver needs.
  - Drayage trucking for ports.
- Value of this tool may be at the 40,000-foot level, such as how many chargers are needed to meet state or local climate goals.
- Assumptions may be too broad or too general for the tool to be useful at neighborhood levels.
- Probably not helpful for large national infrastructure companies or developers, as they have their own tools that may be more sophisticated with greater internal value – "light years ahead."
- Most value may be at the government level for investment planning and gap analyses.
- Use the tool to identify charging deserts.
- Value for estimating power demands and locations for medium- and heavy-duty fleets, maritime, and aviation demands.
- For transit and logistics trucking, which is mostly base charging, the tool could help them calculate emissions reductions or equity impacts.
- Helping small businesses develop the business case for charging investments (e.g., lots of convenience stores in suburban and rural areas).
- For renewable hydrogen advocates, the tool could explore duty cycles, especially where current vehicles have no battery or fuel cell equivalent. Think also about off-road, construction, maritime, and aviation sectors.
- Instead of the individual efforts currently undertaken by utilities and ports, the tool would help with coordinated planning efforts.

- For freight and logistics, the tool may provide information to advocate for more charging in particular areas – more about planning than as a day-to-day operating tool. For example, planning charging if a carrier wants to put in a new yard.
- How to use the tool to keep freight moving and not parked for charging.
- Support for implementation of the Advanced Clean Truck Rule.
- Another value of the tool may be in predicting where maintenance issues could develop with charging equipment. Keep track of equipment type, use, and age.

Tool outputs – forecasts

The tool may provide a variety of output forecasts or provide methods for users to develop their own outputs. Provided below are questions and suggestions from stakeholders about the forecasts.

- Will tool show forecasted kW (peak demand) as well as kWh (energy consumption over a given time period) at granular geographic area? If the area is too large, the tool will not be very valuable for utilities to plan for capacity and distribution investments.
- Forecast gas, diesel, and other fuel prices and compare cost per mile to electricity.
- How will this tool differ from Gap Map?
- The tool is needed to forecast requirements for meeting GHG emission goals (public and private).
- The tool need to support meeting the ACT (advanced clean truck) regulations
- Public access to the tool is essential so it can be used for grant applications (state and federal programs, etc.).
- This multi-dimensional issue must be looked at from multiple different angles. Contingencies should be put in place to mitigate risks and unintended consequences.
- Will the model be able to predict the minimum quantity/threshold of a given charging scheme to achieve a self-sustaining marketplace?
- Would new forecasted electric load be available on an hourly level?
- Do you have locations where some of the estimated data can be found for estimating future charging needs?
- Finding a vendor qualified to do accurate forecasting will be challenging, especially for fuel cell vehicle adoption.
- Make sure the forecasts for vehicle adoption, especially medium- and heavy-duty vehicles, considers whether OEMs (original equipment manufacturers) really have the capacity to manufacture the battery capacity required for all the classes by 2030 or 2040.
- Apply sensitivity tests to the model outputs to improve accuracy and usefulness.
- Tool should stay high level for state agencies and utilities; major private-sector companies and charging providers have their own tools.
- If the development of the tool must be staged, some stakeholders offered this approach:
  - First, light-duty BEVs (battery electric vehicles) with particular focus on workplaces, multi-unit dwellings and public corridors.
  - Next, medium- and heavy-duty BEVs with focus on first- and last-mile delivery logistics.
  - Then FCVs (fuel cell vehicles) fueling with renewable hydrogen.
  - Then specific user needs, such as transit, maritime, and aviation.
- There will be big challenges forecasting adoption of fuel cell vehicles; consider involving heavy-duty truck OEMs to ask about their internal estimates/predictions.
- Use the tool to estimate impacts to WSDOT revenues (reduced gas taxes) and the increasing need for road usage charges.
- Some communities can use the mapping and data to consider opportunities to use renewable natural gas (RNG) for transportation.

Assumptions for forecasting

Various assumptions will be applied to the mapped data to develop the forecasts about ZEV adoption and the need for ZEV infrastructure. Stakeholders were asked about different types of assumptions and which might be most important to change or modify so the tool is more valuable. These types of assumptions included:

- Population and employment
- ZEV adoption: light-, medium-, and heavy-duty
- Percent share of private vs. public charging and refueling stations
- Changes to vehicle miles traveled (VMT)
- Changes to transportation modes: transit, biking, walking, car share, etc.

Choosing one, which of the following assumptions would be most valuable for you (or your organization) to modify? Population and employment 13%, levels of ZEV adoption 30.5%, private versus public charging stations 30.5%, vehicle miles traveled 12%, shifts among various transportation modes 14%, n = 124

Additional comments from stakeholders are included below.

- The assumptions used and the forecasting are at the heart of the tool and can be very complex.
- Current information is focused on light-duty vehicles. Medium- and heavy-duty vehicles will be very difficult to assess.
- Make sure that any vendor chosen has strong capabilities for both battery electric and fuel cell vehicles.
- For one utility, maybe offer a High or Low choice for ZEV adoption. Use generally agreed forecast for population, employment, and VMT. Allow some modulation about private and public charging and shifting modes of transportation.
- Challenge of including market dynamics in the assumptions for forecasts; can't simply using linear adoption as the basis.
- Assumptions about the private (home) versus public charging demand is very important.
- It will be a challenge to map and forecast home charging, especially mapping out the charging needs and solutions for multi-unit dwellings.
- Study forecasting of solar adoption for how the "experts" got it wrong.
- Concern that forecasts will be based on historical data, which will disproportionally forecast urban and wealthy consumer adoption.
- Community planners will be very interested in the last two (assumptions), which are likely to flex rapidly: changes to VMT and to modes of transportation.
- Don't allow too many toggles; allowing too much manipulation of assumptions by end users may be troublesome.
- Use the assumptions to "set the roadmap" so to speak for the state.
- Allow local governments to modify or add layers to the tool for their local use.
- Policy and economics drive vehicle adoption and infrastructure deployment. Consider options to adjust adoption trends based on variables of these elements.

Zones (granularity) for forecasting

The engagement team requested feedback from stakeholders about what level of granularity in data was required for them to make best use of the tool. Choices included county-level data, followed by utility service area, ZIP code level, and census tract level. Demand for different levels of granularity were pretty well spread among the options.

What is the widest possible scale of data available that would still meet your needs (or of your organization)? County 30%, Utility 17%, ZIP code 26%, census tract 27%, n = 126

Comments and questions from stakeholders are provided below.

- Would be helpful to have the tool available to use at all levels to meet different needs.
- Will tool show forecasted kW (peak demand) as well as kWh (energy consumption over a given time period) at granular geographic area? If the area is too large, the tool will not be very valuable for utilities to plan for capacity and distribution investments.
- On census tract level data, with more precise information, we can look at avoided air pollution data in specific neighborhoods or legislative districts.
- Anything but ZIP codes.
- ZIP code data is already large; no wider than that.
- Census tract data is necessary to make the tool useful for community planning.
- The question about granularity may be different for urban and rural situations. More dense urban areas may require greater granularity. In rural zones, county or ZIP code data may be sufficient.
- Census tract data may be more detailed than justified since cars move around so much.
- Grid infrastructure barriers are more granular than service territory.

Tool optimization

Many stakeholders shared opinions about how and for whom the tool should be optimized.

- Optimize the tool investment by using or building on existing tools.
- Optimize the tool for drivers; that is, focus on forecasting the needs of residents and their ZEVs.
- Optimize for EV charging. Avoid the real potential that there won't be enough charging capacity for the number of vehicles required to meet our goals. Optimize charging so it is affordable to overbuild.
- Optimize the tool for state agencies to make smart investments of public dollars, for utilities to prepare wisely for the required increases in overall capacity and localized impacts, and for local communities to do the best job planning for public charging resources in their communities, including solving gaps in capacity and benefits.
- Think about consumers' needs. Don't give in to barriers set by the EVSE industry and developers. Make assumptions that prioritize the end users of the tool.
- Focus on different sectors gradually; even mapping just light-duty vehicles can be daunting.
- Focus forecasting on major highways and corridors rather than city streets.
- Logistics and freight provide unique challenges – BEVs are not a 1:1 replacement for diesel because of the time to charge relative to truck hours of operation, driver schedules/limits and range. Some long-distance trucks run 24 hours with different drivers.
- Public charging may be vital in some areas for freight. For example, at ports many drayage trucks are owned by small operators that do not have their own yard. They will require public charging options.
- What about error analysis; need to do validation for the forecasts using different methods.
- What are the error bounds (±5% or ±10%)?
- It's hard to make money with DCFC stations. Time will come when all the good sites are gone. Who pays then for the less desirable location – the next person in line?

Electricity sources/utility considerations

Because of the central role that electric utilities do and will play in the transition to electric vehicles, stakeholders from inside and outside the utility industry shared information and comments about ways to make the ZEV-MFT more valuable to utilities and by utilities. Here is what we heard.

- Can there be a utility service overlay to the tool maps? How detailed can it be?
- Maybe consider doing heat map overlays about power capacity in various utility service areas.
- How can there be integration with the various utility transportation electrification plans?
- With increased numbers of EVs comes increased strain on our energy grid. This could result in increased energy costs on consumers. Moreover, renewable energy sources are unlikely to be able to keep up with the increased demand resulting from large numbers of EVs. This could result in having to rely on coal and natural gas.
- The fuel demand for medium- and heavy-duty vehicles is a much larger proportion than their share of vehicle registrations, meaning much more power demand for these vehicles.
- Will the energy resource mix include renewables?
- What data are utilities likely to share?
- Might the tool benefit from integration with CETA (Clean Energy Transformation Act) compliance?
- Has there been any discussion about the role of nuclear energy, which could be critical to ensure increased numbers of EVs don't result in more carbon emissions from energy producers?
- Will there be any focus on forecasting tools for onsite DER (distributed energy resource) solutions (e.g., solar, batteries, etc.) to alleviate any grid capacity constraints or demand/peak demand charges?
- Will the power grid support charging from highly sustainable energy sources?
- How do you anticipate small municipal utilities participating?
- Can there be information in the tool or a map overlay showing what kind of financial resources each utility will receive from the future Clean Fuel Program?
- Optimize the tool for smaller utilities: municipalities, PUDs, and co-ops. They need the help.
- Considering the effect of EV owners who do not invest in at-home charging. Doesn't this issue have significant impact on grid capacity and utility's existing electrical production capacity? That is, opportunistic daytime charging for non-home chargers vs. managed nighttime charging for at-home charger will change the electrical load timing significantly.
- Could EV implementation out-scale current grid availability in certain areas of the state? If so, are utility providers aware of this and prepared to upscale to provide adequate support moving forward?
- What types of benefits can utilities gain/develop from the electrification of transportation systems in support of utility grid services? How can utilities use the mapping & forecasting tool to support those efforts?
- A good use of the tool will be to cross-reference where the infrastructure needs are located with the utilities and the Clean Fuel funds.
- The cost of the massive charging that will be required for medium- and heavy-duty trucks is quite high and it will likely require additional costs for more power storage at these sites.
- Coupling the electric grid to transportation requires multi-sectoral change; active planning doesn't necessarily overcome the grid costs.

Renewable hydrogen and infrastructure for fuel cell vehicles

How the ZEV-MFT could/should support infrastructure development for fuel cell vehicles (FCVs) was a topic of conversation during small group meetings and interviews with renewable hydrogen (RH2) advocates, and at public listening sessions. Here's what we heard from stakeholders.

- FCV and RH2 advocates point to the challenges of electrifying the MD and HD (medium-duty and heavy-duty) sectors, considering the energy requirements and impacts on localized grid infrastructure along major freight corridors. RH2 may be produced more efficiently at central facilities and delivered to spots along freight corridors.
- BEV advocates point out that very few, if any, FCVs are on the roads in Washington so they urge focus on the needs of infrastructure for all classes of BEVs before taking on more sectors. More data about technology advances for MD and HD BEVs would be valuable.
- The comments of both BEV and FCV advocates suggest a lack of reliable data and analysis about the potential market impacts related to the production and distribution of renewable hydrogen and the competitiveness of transportation uses for the fuel.
- A representative from Toyota expressed support for sharing market and FCV adoption data with the state.
- Without sufficient consideration of renewable hydrogen use in transportation, the risk is that the state misses their goals.
- Recommend that the legislature fund a detailed analysis about the potential for producing and distributing renewable hydrogen fuels in all areas of the state and the competitiveness of transportation uses compared with industry, power generation, and other possible uses of renewable hydrogen (examples: roadmap studies in Oregon and British Columbia).
- Fueling with renewable hydrogen will be very different; it will require a much more public (not home-based) fueling system, not dissimilar from the current model.
- Limits of BEVs and some of the advantages of renewable hydrogen for MD and HD sectors.
- It's interesting that hydrogen has not been included in the discussion. Local transit agency is going all in on hydrogen.
- Encourage consideration of using existing gas stations for high-speed EV charging and for fueling fuel cell vehicles. Also consider using rest areas for EV charging. They already have parking and restrooms and other amenities.
- The hydrogen pathway needs to be in its own bucket. There may be some overlap, but it will be a stretch to include it in this modeling tool. For example, the fleet stuff to be done is very different and harder to forecast; same with maritime and aviation.
- Renewable hydrogen should be focused toward industry not transportation.
- Mention other types of hydrogen-fueled vehicles like the 2022 Prius with a hydrogen combustion engine, or a Plug-In Hydrogen Fuel Cell Vehicle (that uses both plug-in battery and fuel cell). Not just bigger batteries, but also bigger hydrogen tanks that can go very far.
- Please try to avoid not just social bias, but technology bias (BEV vs FCEV) as well.
- How do those infrastructure costs compare to hydrogen fueling infrastructure on cost per mile?
- People underappreciate the fact that battery electric vehicles will not do the same job in many cases. Look at the limitations of BEVs for transit agencies. This is a transferrable theme to many duty cycles. BEVs are not the answer to everything.
- Wouldn't a reasonable strategy be to invest scrupulously to determine the most appropriate technology between hydrogen fuel cell and battery electric for vehicle sectors in a broad study with a long-term view? We seem to be diving into a massive effort identifying and solving problems around BEVs that may not even exist given the vast difference in the implementations and operation

of the two zero-emission alternatives. It would be a shame to spend extravagantly on investigating and solving issues that we may not have because one technology right now seems to have a four- or five-year head start on the other.

- Renewable hydrogen has its own issues for freight trucks – on-site production and storage requires lots of space versus the challenges of just-in-time fuel delivery.
- BEVs may be great for 90% of people's trips, but people often make their buying decisions based on the 10% of outlier needs.

Potential for conflicts or negative impacts

To avoid potential bias about the positive value of the ZEV-MFT, the engagement team invited stakeholders to share possible negative impacts. They asked, "Can you imagine any negative impacts of this tool, whether to your organization or to others?" Here is what we heard.

- Utilities may use their own forecasting services, which might cause conflicts with forecasts produced by the state's approach, especially if the state requires utilities make plans based on the results.
- There is value to vast, crowdsourced solutions, especially among utilities; there is some worry this will be a conflict to the bigger picture provided by many sources.
- Battery electric bias. Focus on BEVs could discourage other solutions. Renewable hydrogen for fuel cell transportation won't happen if the state is not supportive. The state will need to be proactive.
- Forecasting is so complicated. How can we really predict now beyond light-duty adoption? Can't really predict OEM production paths for medium- and heavy-duty vehicles.
- Is it fair to say that based on current information, an all-EV fleet is only feasible if fewer Americans own cars and instead rely on mass transit?
- Beware of possible conflicts between the state's forecasts and private forecasts, which are often used by investor-owned utilities for their own use.
- Consider conflicts among state and private forecasts when considering how utilities must use forecasts in their IRP (integrated resource planning) processes.
- Potential for negative or unintended results if there is not enough stakeholder involvement by rural and environmental justice representatives; many challenges to getting their interest and involvement.
- Potential for having people or organizations use it incorrectly or for other unintended purposes.
- Planners would not want this ZEV-MFT to become "law" or the basis for regulations. These tools are never 100% accurate or matching with reality. State needs to stay in their lane and not push costs to local governments.

EVSE locations, equipment, and apps

During the three public listening sessions, stakeholders shared comments about desired locations for more EV charging, electric vehicle service equipment (EVSE), and online apps used by EV drivers.

- How does the density of home charging stations affect the perceived need for public charging, or does the density of multifamily buildings inform the planning tool?
- Standardization of the plugs.
- I don't see SR 20 or Hwy 97 on the list of priorities. We have a large region in NCW (north central Washington) that appears to be underserved but we have lots of EVs here.
- Do these vehicles have different adaptors for different plugins so I can charge from my house to the interstate charging stations? Most public DCFC chargers allow both CHAdeMO and Combo charging, though this may change in the future. Tesla have adapters to use public chargers but it doesn't work the other way.

- Are there plans to partner with State Parks to offer charging stations at parks? National Parks too– these seems like good destinations where people spend time and could use charging infrastructure, and are often located far from other charging options.
- Are there plans to partner with tribes or give special consideration to tribes to get EV charging infrastructure on reservations? Many of these are in rural areas where there are few other charging options.
- EV charging and RH2 fueling are needed in rural areas of the state.
- Charging availability is inaccurate. Need better directions to stations.
- Apps need to include station reliability (up-time vs down-time), current status of chargers (in-use, down, open and available).

Environmental considerations

During the public meetings, some stakeholders shared comments about possible environmental concerns.

- Will the supply of rare earth metals be able to keep up with the increased demand of EVs?
- What is being done to mitigate the environmental impact of mining rare earth metals that are needed to manufacture EVs?
- Are there risks that the environmental impact to mine those materials will exceed the benefits?
- EV battery recycling.
- Are the environmental issues and social justice consequences regarding lithium extraction for electric vehicle batteries being considered and addressed?

Workforce considerations

During the public meetings, some stakeholders shared comments about possible implications for workforce development to support this transition in Washington.

- Who is servicing the EVs and charging stations, and how is the workforce being trained?
- Very interested in workforce forecast and skills standard for manufacturing, maintenance, operations, infrastructure installation, etc.

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Appendix B: Method for Evaluating and Scoring Existing Tools

The UW team reviewed 17 different tools that aim to support ZEV infrastructure planning on the national, state, county, sub-county, city, or sub-city level.

Tasked to evaluate the capability of these existing commercial and research tools, the UW team began by gathering all relevant tools and frameworks in this field from various sources. The project's Scope of Work highlighted some of the tools to be considered, namely Caret, EVI-X/EVI-Pro, and M.J. Bradley & Associates as a consulting firm. The latter company provides four different relevant tools (E-DRIVE, Electric Bus Planning Framework, EV-CB Framework, and ILIT).

In addition, EVI-X/EVI-Pro and HEVI-LOAD were used as the primary tools in recent EV infrastructure needs assessments conducted for neighboring states. Literature searches for related keywords (such as electric vehicle charging stations, charging infrastructure, planning, mapping, forecasting etc.) resulted in adding BEAM, Charge4All, GIS EV Planning Toolbox, PEV-CDM, and REVISE-II to the list of tools to be evaluated. Some tools were pointed out to the UW research team by individuals at WSDOT. This includes the Energy Zones Mapping Tool, EvaluateCO, StreetLight Data, and UrbanFootprint. ChargEVal as a relevant tool developed at UW was already known to the team.

The UW team gathered and documented all information on the tools that were available online, including links to websites, tool descriptions, documentations, user guides, associated research papers, repositories with the source code, news articles, and any studies that used one or more of the tools. For tools that are freely available online, the direct use of the tools supported the evaluation process further, especially with respect to user-friendliness and how feasible it would be for the general public to use it. The UW team also sought direct conversations with vendors and experts, including lead development staff of EVI-Pro at NREL, representatives for Caret from the Center for Sustainable Energy, and staff from the California Energy Commission. Broken down by all individual requirements stated in HB 1287, the team evaluated each of the tools with respect to these requirements as well as required input and output data in a spreadsheet-based format.

The following table, Tool Scoring Criteria, reports how the UW team scored the tools on their ability to fulfill key characteristics of HB 1287. To provide full transparency and reproducibility of these results, a table with descriptions of what each tool needs to provide to reach one of the three scores in Table 3 is provided below. Generally, the scores correspond to the tool fulfilling the stated requirements fully or to a large extent (1, green), only in parts (2, yellow), or not at all (3, red). Specifics are presented in the right column of the following table.

Tool Scoring Criteria

Characteristic	Specification	Scoring criteria
Accessible to the general public		(1) The tool is accessible over the internet, user-friendly, and easy-to-use (i.e. it is feasible to be used by the general public). (2) The tool is accessible but not easy-to-use for the general public (3) The tool is only accessible by experts or the developers themselves or it is not easy-to-use (e.g. needs compiling of software).
Transparent, non-proprietary forecasts		(1) The tool is transparent as to how it derives its EV and EVSE projections and forecasts, and there are no proprietary formulations included. (2) The tool's developers provide a high-level explanation of its functionalities, the leveraged methods, and metrics, but it does not allow for a third-person to replicate the tool's exact outputs with the same input data. (3) The tool is not or very poorly documented or the forecasts, if existing, lack explanation how certain numbers are derived.
Applied in Western states		(1) The tool has been applied in Oregon and/or California to support their recent forecasts and/or projections of needed charging infrastructure. (2) The tool has been applied in Oregon and/or California to support EV programs but not forecasts or has only been applied in other states for transportation electrification efforts. (3) The tool has not been applied in the EV instrastructure studies we reviewed.
Commercially ready		(1) The forecast tool has (paying or non-paying) customers and is commercially available as of November 2021. (2) The forecast tool has completed its first stages of development and is available as of November 2021. (3) The tool is not a finished product or doesn't appear to be actively maintained and supported
Includes required WA data	Travel	(1) The tool incorporates travel data (e.g. traffic counts, peak traffic demands) for Washington State, taken from official Washington State sources, into its forecasts and projections. (2) The tool incorporates travel data for Washington State, taken from national data sources. (3) The tool has not been incorporating travel data for Washington State or does not incorporate any traffic data.
	Demographic	(1) The tool incorporates demographic data (e.g. on population density, sex, race, or ethnicity), taken from sources that cover Washington State. (2) The tool incorporates demographic data, taken from sources that do not cover Washington State (e.g. other states' offical data or regional surveys' data). (3) The tool does not incorporate any demographic data.
	Socioeconomic	(1) The tool incorporates socioeconomic data (e.g. on employment, health, household type), taken from sources that cover Washington State. (2) The tool incorporates socioeconomic data, taken from sources that do not cover Washington State (e.g. other states' offical data or regional surveys' data). (3) The tool does not incorporate any socioeconomic data.
	Environmental	(1) The tool incorporates environmental data (e.g. on overall air quality or toxicity, particulate matter), taken from sources that cover Washington State. (2) The tool incorporates environmental data, taken from sources that do not cover Washington State (e.g. other states' offical data or regional surveys' data). (3) The tool does not incorporate any environmental data.

Tool Scoring Criteria (continued)

Characteristic	Specification	Scoring criteria
Includes vehicle types and their respective infrastructure	Light EV	(1) The tool includes the derivation of forecasts and/or projections for light-duty EVs (<10,000 lbs, e.g. passenger cars) and related infrastructure. (2) The tool includes light-duty EVs and/or related infrastructure, but does not produce direct forecasts or projections for their charging infrastructure. (3) The tool does not include light-duty EVs.
	Medium EV	(1) The tool includes the derivation of forecasts and/or projections for medium-duty EVs (10,000-26,000 lbs, e.g. vans or shuttle buses) and related infrastructure. (2) The tool includes medium-duty EVs and/or related infrastructure, but does not produce direct forecasts or projections for their charging infrastructure. (3) The tool does not include medium-duty EVs.
	Heavy EV	(1) The tool includes the derivation of forecasts and/or projections for heavy-duty EVs (>26,000 lbs, e.g. city transit buses, heavy freight trucks, garbage trucks) and related infrastructure. (2) The tool includes heavy-duty EVs and/or related infrastructure, but does not produce direct forecasts or projections for their charging infrastructure. (3) The tool does not include heavy-duty EVs.
	Any hydrogen	(1) The tool includes the derivation of forecasts and/or projections for any type of hydrogen vehicles (light-duty, medium-duty, or heavy-duty) and refueling infrastructure. (2) The tool includes hydrogen vehicles, but does not produce direct forecasts or projections for their refueling infrastructure. (3) The tool does not include hydrogen vehicles.
Subarea demand forecast		(1) The tool forecasts charging demands at a disaggregate geographic level (sub-city, i.e. ZIP code, census tract, or similar) to help find possible future charging station locations. (2) The tool forecasts charging demands at county-level or larger or outputs priority areas (on county-level or finer) for future EVSE based on estimated suitability. (3) The tool does not forecast charging demands.
Forecasts kW & kWh for utilities		(1) The tool forecasts electricity demand at a disaggregate geographic level (sub-city) for both energy (kWh) and capacity (kW), based on an assessment of the local EV charging needs/demands. (2) The tool forecasts electricity demand only at county-level or coarser or, with some adaptation, the tool allows for the evaluation of electricity demand scenarios. (3) The tool does not forecast electricity demand for local EV charging needs/demands.
Projects ZEV # for climate goals		(1) The tool projects the level of ZEV adoption required to meet emission reduction goals, both on state level as well as in each utlity service's area. (2) The tool provides some functionality that estimates greenhouse-gas emissions and savings thereof, which could be adopted to project the level of ZEV adoption required to meet emission reduction goals. (3) The tool does not project how large ZEV adoption has to be to meet emission reduction goals.
Includes public transport		(1) The tool includes public transport as part of the transportation electrification efforts. (2) The tool includes public transport to some extent, but does not provide direct or indirect support for its electrification. (3) The tool does not include public transport as part of the transportation electrification efforts.
Includes maritime & aviation		(1) The tool includes maritime transport and aviation as part of the transportation electrification efforts. (2) The tool includes maritime transport and aviation to some extent, but does not provide direct or indirect support for its electrification. (3) The tool does not include maritime transport and aviation as part of the transportation electrification efforts.

Appendix C: Project Budget Worksheet

Assumptions								
			Annual cost increase for FTE	2.50%				
Cost Categories	FTE	Annual	Notes					
Detailed scoping with contract IT business analyst		75,000	500 hours of contract IT business analyst at $150 per hour to assist with scope of work and RFP development.					
Develop and implement a long-term data management plan		75,000	500 hours of contract IT business analyst at $150 per hour to establish 1) data update / refresh cycles, 2) records retention schedules for source and result data, and 3) data source service level and/or data use agreements.					
Contracted Services to deliver M&F Tool over 24 months		1,500,000	$3,000,000	Total includes developing all forecast and analysis layers and writing ArcGIS scripts that will generate custom reports for subareas for in 2023				
Contracted Services to update M&F Tool every year		750,000	Annual forecasts of on-road light-, medium-, and heavy-duty vehicles and their composition by ICE, electric, and hydrogen, their associated charging and refueling infrastructure, the associated greenhouse gas and criteria pollutant emissions, spatial analysis of underserved areas, electric energy and capacity required by subarea, and potentially the ZEV infrastructure requirements of public transit, marine, and aviation uses					
ArcGIS Seat seats		1,000	Additional WSDOT On-Line GIS seats					
Annual cloud/hosting costs		75,000	Average annual cloud / hosting costs					
License data from private vendors		100,000	Includes providing missing elements of WSDOT road map network, trip orgin and destination data and vehicle type data from vendors like Inrix, and charging data from private network operators					
Transportation Specialist 4	1.0	144,517	Primary liason to stakeholder groups and agencies that will use the tool for planning. Coordinates regular stakeholder meetings					
Transportation Technical Engineer	1.0	168,009	Primary technical liaison to the selected forecasting entity. Develops RFP, manages contract and provides technical oversight on modeling choices. Convenes technical advisory group.					
IT Data Management - Journey	0.5	79,697	Provide maintenance and user support services					
IT System Admin - Journey	0.5	79,697	To integrate with the hosted solution and maintain data schemas, data feeds, and web services					
			Job Title	Annual Salary	Benefits (37%)	Standard Costs	Annual Total	Notes
			Transportation Specialist 4	90,888	33,629	20,000	144,517	Step L
			Transportation Technical Engineer	108,036	39,973	20,000	168,009	Step L
			IT Data Management - Journey	101,748	37,647	20,000	159,395	Step L
			IT System Admin - Journey	101,748	37,647	20,000	159,395	Step L

Appendix D: ZEV-MFT Stakeholder Groups

ABB
ACES NW Network/Discovery Center
Affiliated Tribes of NW Indians
Alliance for Automotive Innovation
Alliance for Transportation Electrification
Alternative Fuel-Vehicle Technical Assistance Group
Apparent.com
Association of Washington Cities
Atlas Public Policy
Auto Innovators Coalition
Avista
Blue-Green Alliance
Bonneville Environmental Foundation
Bureau of Indian Affairs – NW Region
California groups (AB 2127 effort)
Center for Regional Disaster Resilience
Center for Resource Solutions
Center for Sustainable Energy
Center for Sustainable Infrastructure
Center for Transportation and the Environment
ChargerHelp
Chargeway
Chehalis Tribe
City of Everett
Clean and Prosperous Washington
Clean Cities Coalitions (CWCCC, WWCCC)
Climate Solutions
Columbia Hydrogen
Community action partner agencies
Conservation Biology Institute
Convoy
DKS
Drive Electric WA
Drive Electric Washington
Duwamish Riverkeepers
ECOSS
Edison Energy
El Centro de La Raza
Energy Northwest
ETP- Eastside Transportation Partnership
EV Noire
EVGo
Flow - Corey
Forth Mobility
Freight Policy Institute (WSU)
Front and Centered
Frontier Energy
Got Green
Greenlining
GreenLots
Homestead Community Land Trust
ICCT
INRIX
IRTPO (Island County)
K4C
King County Fleets and Energy Committee
MD & HD truck OEMs (Paccar, Kenworth, etc)
Metropolitan Planning Organizations (MPOs)
MJ Bradley
Municipal Research and Services Center of Washington
NAFA-Pacific chapter
National Car charging
National Renewable Energy Lab
National Rural Electric Co-op Association
Natl Assoc. of Convenience Stores (NACS)
NW Energy Coalition
NW Indian Transportation Planning Group
NW Seaport Alliance
Office of the Superintendent of Public Instruction - Student Transportation
OneAmerica
OptConnect
Oregon Department of Transportation
Pacific Northwest National Labs
PacificCorp
Planning Association of Washington
Plug-In America
Ports of Seattle, Tacoma, and Vancouver
Public Fleet Managers Association
Puget Sound Energy
Regional EV Collaboration (PSCAA & PSRC)
Regional Transportation Planning Organizations
Renewable Hydrogen Alliance
Renewable Hydrogen Association
Seattle City Light
Seattle EV Association

SemaConnect
Small Urban and Rural Center on Mobility
Snohomish County
Snohomish PUD
Stillaguamish Tribe
Tacoma Public Utilities
TESIAC
Thurston Climate Action Team
Transportation Choices Coalition
Twin Transit
Washington Association of School Administrators
Washington Automobile Association
Washington Build Back Black Alliance
Washington Car Dealers Association
Washington County Administrators
Washington Dept. of Health
Washington Economic Development Association (WEDA)
Washington Food Industry Association
Washington Public Ports Association
Washington Public Utility Districts Association
Washington Rural Electric Coop Association
Washington State Association of Counties
Washington State Auto Dealers Association
Washington State Transit Association
Washington Trucking Association
WashingtonTribes.org
West Coast Collaborative
Western States Hydrogen Alliance
Western Washington Clean Cities Coalition
WSU Office of Tribal Relations
WSU-JCDream-CHARGE
Zero Emission Transportation Association
ZUM