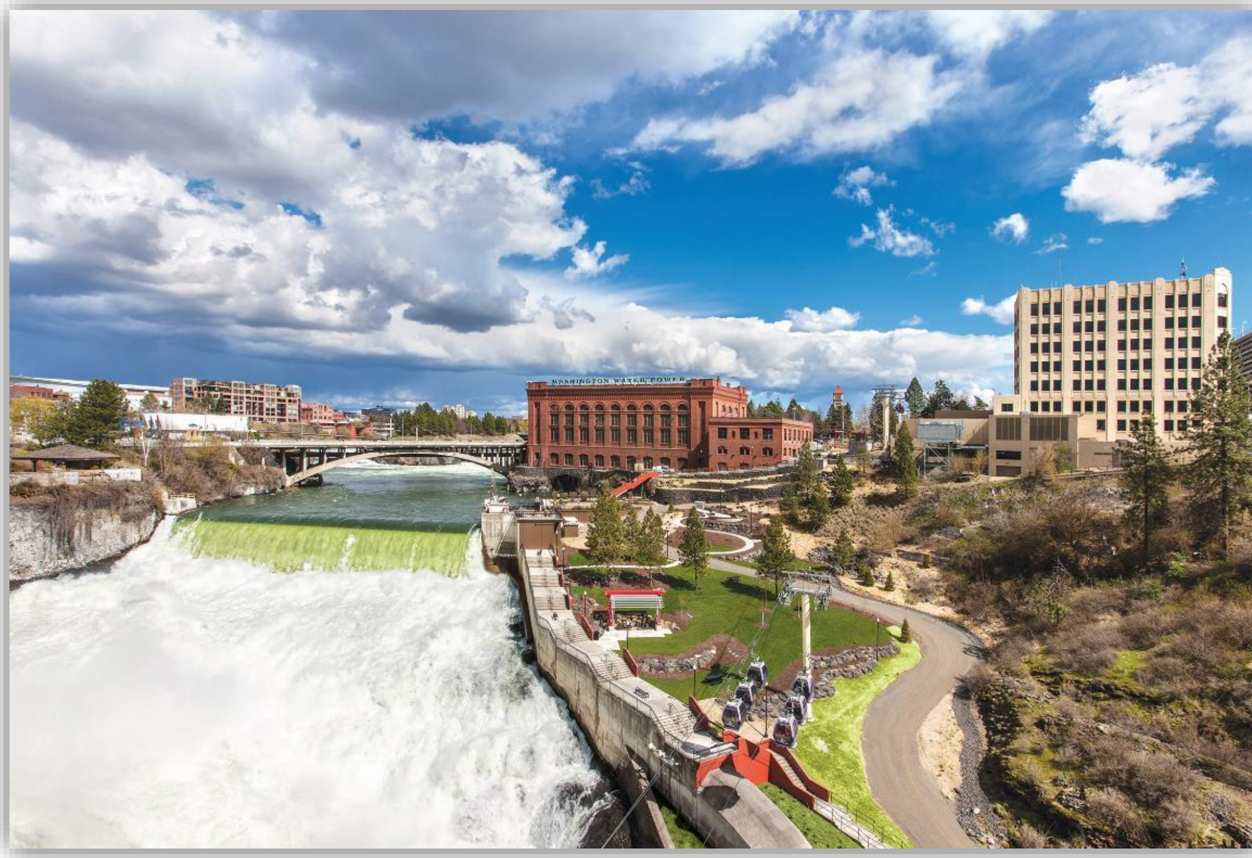
Avista Corp.

Transportation Electrification Plan (DRAFT)

2020

Front Cover – Avista's first DC fast charging site installation in partnership with the Town of Rosalia, Washington



Huntington Park, Spokane, Washington

About Avista

Avista Corporation is an energy company involved in the production, transmission and distribution of energy as well as other energy-related businesses. Its largest subsidiary, Avista Utilities, serves more than 600,000 electric and natural gas customers across 30,000 square miles in eastern Washington, northern Idaho and parts of southern and eastern Oregon.

Avista's legacy begins with the renewable energy we've generated since our founding in 1889, and grows with our mission to improve customers' lives through innovative energy solutions.
Avista – Better Energy for Life!

March 10, 2020
Draft Submitted for Stakeholder Review and Comment

Contact

rendall.farley@avistacorp.com

Acknowledgments

The following organizations are recognized and appreciated
for their collaboration and support of the Transportation Electrification Plan

Spokane Regional Transportation Council
Washington State Department of Transportation
Washington State Department of Commerce
Washington State Transportation Electrification Stakeholder Group
Spokane Transit Authority
Washington Trust Bank
Town of Rosalia
City of Liberty Lake
City of Colville
Port of Clarkston
Town of Garfield
City of Palouse
Colvico, Inc.
GEM Electric NW, Inc.
City of Spokane
City of Pullman
Spokane Regional Health District
Transitions for Women
Whitworth University
Gonzaga University
Washington State University
Alliance for Transportation Electrification
Electric Power Research Institute (EPRI)
Edison Electric Institute (EEI)
Energy + Environmental Economics (E3)
Forth
Pacific NW Utility Transportation Electrification Collaborative
Charlie Allcock Consulting, LLC

Table of Contents

Our Vision – Better Energy for Life!

Imagine an electrifying future . . .

By the year 2045, renewable and clean energy sources power the electric grid and a vibrant modern economy, including the transportation sector. Whether moving people or goods on the road, off the road, by rail, in the air, or over water, clean electricity makes it happen. The majority of transportation is electrified and the use of fossil fuels is no longer dominant. Customers have new and exciting transportation choices. Major economic benefits of over $1 billion per year in fuel and maintenance cost savings are realized in the local economies served by Avista. This is accomplished while eliminating more than 80% of harmful air pollution and greenhouse gas emissions from transportation – formerly the largest source of emissions in the region – securing a more sustainable and prosperous future for all.

Avista's Noxon Rapids Hydroelectric Generation Plant
– 562 MW of Clean Hydropower –

In this exciting future, transportation accounts for over 20% of utility electric load and revenue, helping to pay for grid costs and keep rates low for all customers. A combination of cost-effective load management and transfer technologies, energy storage, and price signals act to optimally integrate flexible transportation loads with the grid – including a wide array of new distributed energy resources. This reduces peak loads on the system, provides for better grid resiliency, and maximizes the use of renewable energy sources.

Autonomous electric transportation has also revolutionized the way we move people and goods, dramatically increasing vehicle and equipment utilization, driving down transportation costs, freeing up people's time, and saving thousands of human lives and serious injuries every year. The vehicles themselves are integral parts of a new age in communications and connection, opening the door to a wide variety of new products and services that improve people's lives.

In just 25 years, an amazing transformation has occurred – the transportation sector has converged with the energy and information technology sectors – fundamentally changing the way we live our lives and making the world a better place. Avista has played a key role in this transformation, working over several decades with industry partners, policymakers and regulators, community leaders, and customers to innovate and create a better energy future for all.

EVs Fueling Up with Clean Energy – The Future is Electric!

Executive Summary

Guided by our vision of a better energy future, Avista's Transportation Electrification Plan details strategy and planned activities in the service areas of Washington and Idaho, with an emphasis on near-term actions from 2020 through 2024. Avista's strategic approach is informed by industry and customer research, the current landscape of policy, technology and market forces, projected impacts on the economy, the environment and the grid, and the valuable experience gained through the Electric Vehicle Supply Equipment (EVSE) pilot over the last several years.

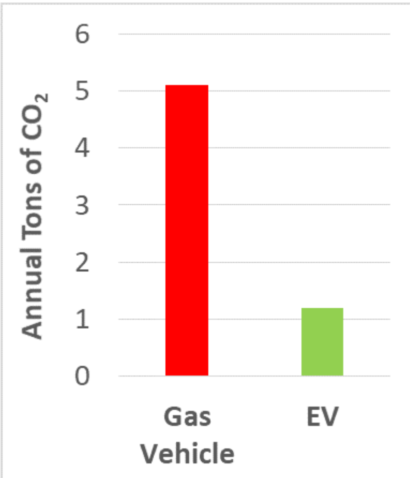


Figure 1: Annual emissions of a gas vehicle compared to an EV using Avista's electricity

Today, driving a passenger EV fueled by Avista's electricity results in zero tailpipe emissions, causes total CO_2 emissions reductions of 80%, costs less than an equivalent $1 per gallon of gasoline to fuel, and saves $300 per year in maintenance expenses.[1] If all light-duty vehicles were electric, this would result in regional savings of over $1 billion per year – creating a powerful ripple effect for the economy – and avoided annual emissions of 2.5 million tons of CO_2. Other electrified transportation beyond light-duty passenger vehicles would result in even greater reduced emissions and operational savings.

In addition, electric transportation provides grid benefits for all utility customers, in the form of net revenue that helps pay for fixed system costs. In 2025, over 6,800 EVs are expected to provide Avista with gross revenue of $2.1 million from EV charging. Subtracting an estimated $0.5 million in marginal utility costs to generate and deliver this energy results in $1.6 million in net revenue – savings which may be passed along to all utility customers in the form of decreased rate pressure. This is just the beginning. With over one million registered vehicles in the region, consider the enormous customer savings and grid benefits that a high percentage of EVs would provide, especially when charging is optimally done during off-peak times of the day and night.

[1] Estimates assume Avista's current mix of electric generation sources, 3.3 miles/kWh and $0.11/kWh for EVs, and $3/gallon, 26 mpg for conventional vehicles

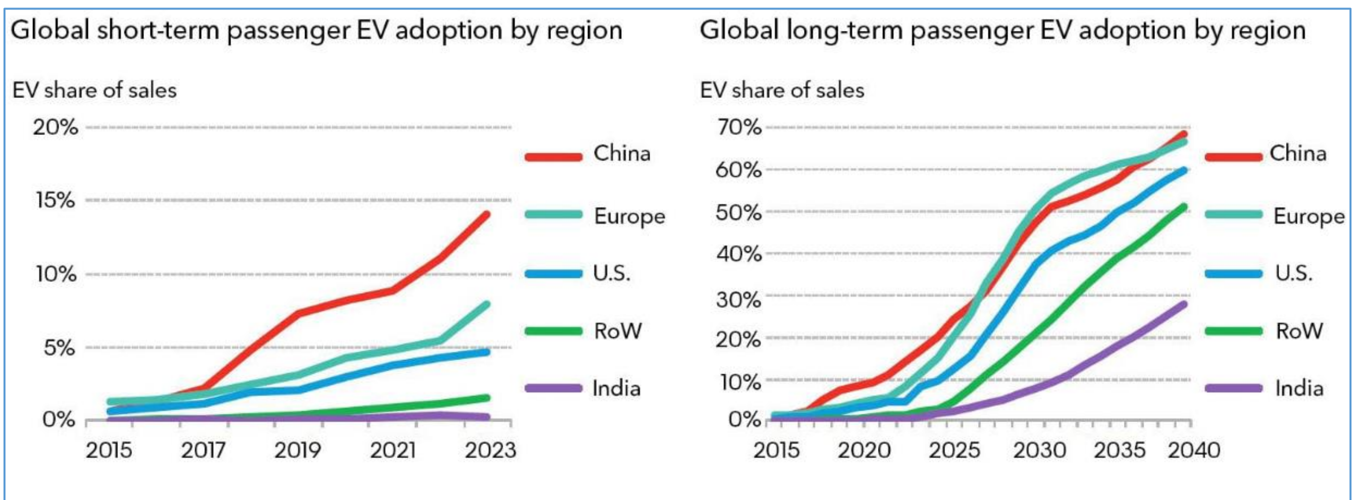
EV charging loads are very flexible, as 80% or more of EV charging may occur while the vehicle is parked at work during the day, and at home overnight. In the future, the greatest benefits may be realized by capitalizing on this flexibility, charging EVs when renewable energy resources such as solar and wind are abundant. For example, EVs could utilize more solar power on the system during the day and in the summer, as well as more wind power when it is typically more available at night and during the winter. In this way, EVs could help maximize the integration and use of an increasing amount of renewable resources on the grid.

In other words, electric transportation can benefit all customers and society as a whole – not just those using EVs and other forms of electrified transportation equipment – by using a cheaper and cleaner fuel, more efficiently utilizing grid infrastructure, and integrating renewable energy resources that energize a healthy and more sustainable economy.

Policy, Technology, and Market Landscape

Given these realities, policy support for electric transportation is strong and expected to grow with increasing climate concerns caused by greenhouse gas emissions, the recognition that transportation accounts for nearly half of all emissions in the Pacific Northwest, and that major economic benefits may be realized over the long term as the transportation sector is electrified.

While adoption forecasts are subject to uncertainty, it is clear that a major transition from fossil fuels to electrically-powered transportation is underway on a broad, global scale. This is currently led by China, followed by Europe.



Source: BloombergNEF. Note: Europe includes EU + EEA + Switzerland.

Technical advances and industry investments of over $362 billion annually[2] indicate that EV performance, features and costs will continue to improve, perhaps reaching purchase cost parity with conventional vehicles by 2025 without subsidies.[3]

In the U.S., EV sales have grown considerably for many years but contracted by 9% in 2019, compared to an overall decline in light-duty vehicle sales of 2%. This trend is expected to be short-lived as new EVs are introduced starting in 2020, and the used market provides more affordable EVs to a growing number of people. Tesla continues to dominate new EV sales in the U.S., and its announcement of the Model Y production ahead of schedule in 2020 is likely to further boost EV sales.

Annual EV registrations in Avista's eastern Washington service area grew by 23% in 2015, improving each year since then and reaching 50% in 2019, surpassing the state average. However, EVs represent less than 2% of annual fleet turnover in the region and are still in the very early stages of market growth.

Table 1: Overall Light-duty Fleet and EVs in Avista's Electric Service Area (2019) [4]

	Population in Electric Service Area	Registered Light-Duty Vehicle Fleet	Annual Fleet Growth (2%)	Annual Fleet Turnover (7%)	Total EV Registrations in Service Area	% of Fleet on road	Estimated New EV Registrations (2020)	% of Fleet Turnover / Sales
Washington	676,746	512,297	13,535	35,861	1,331	0.3%	481	1.3%
Idaho	321,415	243,311	6,428	17,032	409	0.2%	143	0.8%
Total	998,161	755,608	19,963	52,893	1,740	0.2%	624	1.2%

Product and investment commitments announced by major automakers including Ford, GM, and VW, as well as the rise of Tesla and startups such as Rivian, indicate that we can expect a growing number of electrified trucks, SUV and crossover model introductions over the next several years. Trucks and SUVs accounted for a record 69% of light-duty U.S. sales in 2019, and these vehicle types dominate sales in Avista's service territory – they are key to making serious inroads into the mass market. Even with major commitments and deliveries made good by the automotive industry, it will most likely take several years to significantly raise vehicle availability and inventory levels at price points needed to achieve substantial momentum and market transformation. Furthermore, Avista serves a population with relatively lower personal incomes, and more rural geographies with lower population densities. This may continue to dampen EV adoption in the Company's service territories.

In consideration of all these factors, we expect light-duty EV growth in our region to continue, with steady but gradual improvement for three to four years, followed by relatively strong growth starting in the 2023 – 2024 timeframe. This presents a limited window of just a few years to solidify a foundation of supporting infrastructure and programs, which will need to be in place to enable accelerated growth starting as early as 2023.

---

[2] Atlas EV Hub, see www.atlasevhub.com
[3] "When Will Electric Vehicles Be Cheaper than Conventional Vehicles?" Bloomberg New Energy Finance (2018).
[4] Sources include 2018 U.S. Census estimates released in 2019, 2017 National Transportation Statistics, Washington and Idaho state vehicle registration data

Beyond light-duty passenger EVs used for household and commercial fleets, the first deployments of mass transit buses powered by electric batteries are scheduled in 2021 by two transit agencies served by Avista. An excellent opportunity also exists today to support the local adoption of electrified lift truck (forklift) equipment, resulting in swift paybacks on investment in terms of emissions reductions, customer transportation savings, and beneficial utility revenue.

Other commercial opportunities are expected to become more viable over time such as commercial delivery vehicles, school buses, airport ground support equipment, truck stop and refrigerated freight electrification, and electrified agricultural equipment. Over the longer term, advanced technologies such as vehicles connected to homes, buildings and the grid (V2X), transactive energy systems, rail, marine, and aircraft electrification, "last mile" or micro-mobility innovations, and electrified autonomous vehicles, could further and dramatically alter both utility grid management and the transportation sector.

Avista's Electric Vehicle Supply Equipment (EVSE) Pilot

At a minimum, the electric utility has an obligation to prepare for the future of electric transportation, ensuring good stewardship of grid assets, public service, and safety levels. It also has a historic opportunity to serve its customers in new and better ways for the long term, realizing major economic and environmental benefits. In this context, the Company carried out its Electric Vehicle Supply Equipment (EVSE) Pilot from 2016 through 2019, seeking to understand costs, benefits and impacts of EVs, customer needs, testing utility program models, and to begin supporting beneficial EV adoption. This direct experience along with ongoing research and customer feedback has positioned the Company to propose informed strategies and programs as outlined in this Plan. Among many things, the EVSE Pilot demonstrated cost-effective utility programs that were well received by customers and correlated with significantly increased adoption rates. It also highlighted the value of workplace charging, a need for more public charging infrastructure, and industry improvements in networked charger costs and reliability.

Modeling and analysis showed that load growth from EVs provide net benefits to all grid customers, and that new electric loads from transportation should be manageable over the next decade. It also showed the importance of developing cost-effective load management capabilities over the longer term, as this can provide additional net benefits and will become increasingly important at higher adoption levels beyond 2030. The following chart shows a detailed load profile from residential charging of the average EV on the system, illustrating how peak loads are much higher on weekdays, and typically occur between 5pm and 6pm. Given that 75% of EV charging is expected to occur at residential locations, one key to maximizing benefits at scale is to shift this peak load as much as possible to off-peak times of the day and night – when energy is more abundant and less expensive to acquire. Eventually at high adoption levels above 30%, coincidence factors could also play a role in driving up Distribution costs associated with local transformers, feeders, and even substations, unless this peak load is shifted to off-peak.

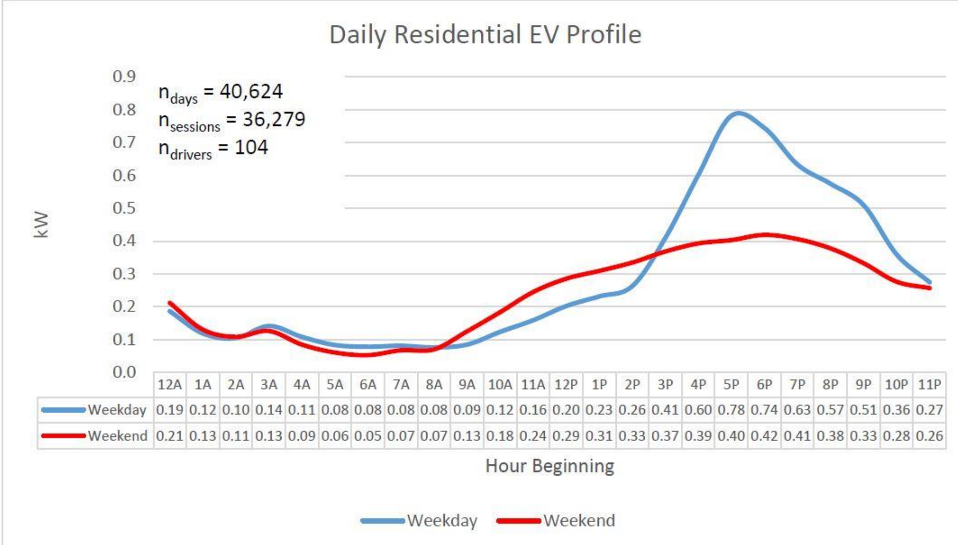


Figure 2: Residential load profile from EVSE pilot data (2017-2019)

Utility Role, Strategy and Objectives

Strategically, Avista will adopt a flexible and adaptive approach, align with policy guidance,[5] partner with industry experts and other key stakeholders, facilitate healthy market competition and improvements, and enable direct benefits for disadvantaged communities and customers. Efforts will focus on supporting cost effective, new customer choices in a variety of transportation market segments over the next several decades.

This begins with appropriate utility support that enables and accelerates sustained entry into the mass market for the light-duty EVs by 2030 or earlier, depending on the strength of products and other factors enabling mass adoption. While staying abreast of changing technologies and market conditions, utility programs will focus on overcoming critical barriers of adequate charging infrastructure and customer awareness, which Avista is uniquely positioned to address. In addition, these programs are intended to establish a foundation for load management and maximum off-peak charging at scale, which optimally integrates with the grid over the long-term.

Activities and funding levels are flexibly designed in this Plan to match technology and market conditions, transitioning from moderate to strong levels of utility support in earlier phases, to more regular and enabling programs as different market segments reach the point of transformation and the industry matures and scales in later phases.

[5] "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services." Washington Utilities and Transportation Commission, Docket UE-160799 (2017).

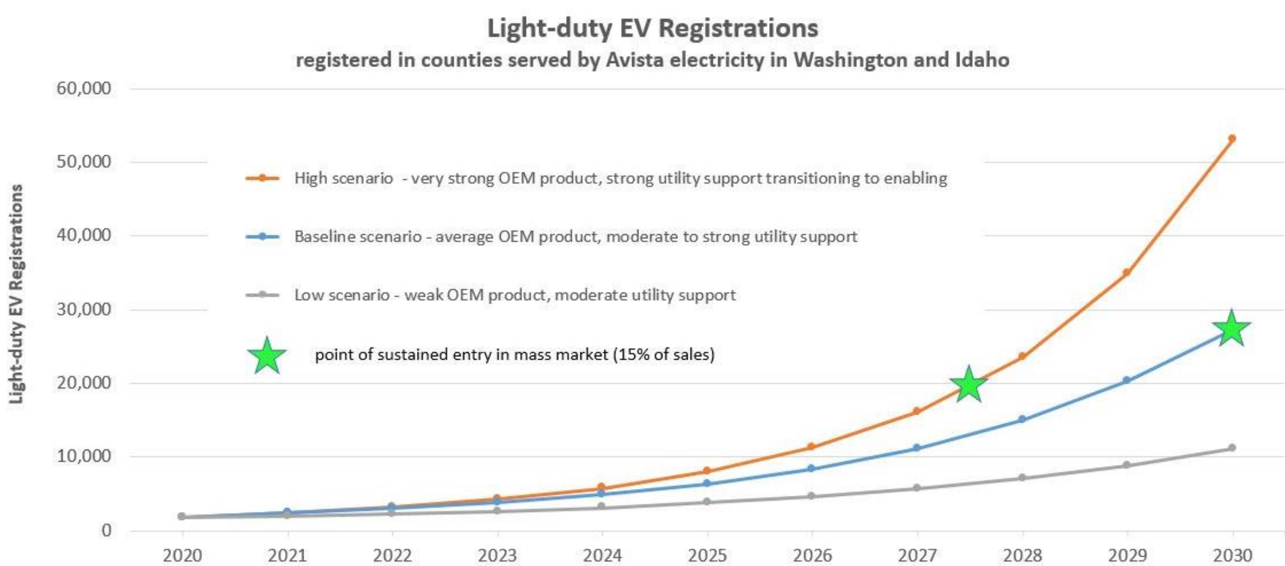
Guiding Principles

- Flexible, adaptive approach to changing market conditions and different market segments
- Early utility role supports healthy market growth and grid integration, ensuring net benefits for all utility customers over the long term
- Plan and programs align with legislative and regulatory policy
- Program focus areas: EVSE infrastructure, customer education and outreach, community and equity, fleet support, and grid integration/load management
- Utility programs support healthy market competition, innovation, and industry standards
- Customer-centric, high-satisfaction program results – provide objective information and choices that enable informed customer decisions
- Cost effective, integrated management across all programs and activities
- Regular updates to load profiles and forecasts for utility Systems Planning and the Integrated Resource Plan (IRP)
- “Walk the talk” with effective utility fleet electrification, facility EVSE, and employee engagement programs
- Partner and collaborate with key stakeholders

Much is dependent on the vehicles provided by Original Equipment Manufacturers (OEMs) in terms of price, functionality, variety, and availability, of which the utility has little influence. Given this reality, Avista's programs and activity levels will scale up from baseline support levels starting in 2020, to stronger support coinciding with improved market conditions expected in the 2023-2024 timeframe, when more competitive products are widely available including light-duty trucks and SUVs. In the near term, Avista will consider ways to effectively raise awareness levels, improve the availability of EVs in the area, and work with stakeholders to build out the EVSE infrastructure that will be needed by 2025.

In other words, a solid foundation must be set in place starting today, in order to enable strong growth in the future.

Eventually as EVs begin to make sustained entry in the mass market (at roughly 15% of total vehicle sales each year), certain education and outreach programs may no longer be necessary. Beyond this point, utility infrastructure and load management programs could play an ongoing, enabling function that is fully integrated with day-to-day utility operations. To illustrate, three plausible adoption scenarios for light-duty EVs are shown in the chart below, corresponding to OEM product levels matched with appropriate utility support programs. Note the anticipated points of sustained entry in the mass market by 2030 for the Baseline adoption scenario, and in 2027 for the High adoption scenario.



Strategic Objectives and Goals

1. **Achieve sustained entry in the mass market for light-duty EVs**
    - > 15% of annual vehicle sales by 2030 or earlier
    - Install EVSE needed by 2025 for rapid market growth, owned and maintained by Avista and 3rd parties
    - Maintain EVSE uptime > 99%
    - By 2024, raise positive awareness of EVs by 500%
2. **Support electrification of commercial and public fleets**
    - Implement a commercial EV time-of-use (TOU) rate starting in 2021
    - Invest in "make ready" utility upgrades
    - Deploy a commercial fleet program, starting with lift trucks and light-duty passenger vehicles in 2021
3. **By 2025, achieve net benefits from load management and EV TOU rates with > 50% reduction of EV peak load**
4. **Monitor new technologies and markets, implement pilot projects starting with mass transit and school buses in 2022 - 2023**
5. **Expand utility fleet electrification with 5% or more of annual fleet budgets, install EVSE at Avista facilities and by 2025 raise employee EV adoption 300%**

A flexible, adaptive utility approach is replicated in other emerging market segments, such as initiating a fleet support program for lift trucks in the near term, followed by anticipated opportunities that arise with freight delivery vehicles, school buses, and other applications in ensuing years. In the early stages of each market segment, pilot programs may be explored. For example, the value of greater community resiliency in the event of severe weather events could be tested in a pilot project, using schools with on-site renewable power generation and electrified buses providing emergency energy storage.

The utility must also monitor technology and market developments, and over the longer-term investigate and support emerging opportunities including electric micro-mobility innovations, vehicle-to-home or vehicle–to-building (V2H/V2B) as backup power, vehicle-to-grid (V2G) bi-directional power transfer, open software platforms enabling broad energy transactions, rail and aircraft applications, marine transport, and electrified autonomous vehicles.

In summary, the Plan's strategic objectives and goals follow from the Company's aspiring vision, direct experience through the EVSE pilot, and a realistic assessment of technical and market trajectories. Programs and activities planned for the 2020 – 2024 timeframe are briefly described below, designed to meet these strategic objectives and set the foundation for beneficial electric transportation growth for the long term. More details are provided in respective sections of this Plan, supplemented by information in Appendices.

EVSE Infrastructure and Maintenance

The utility is in a unique position to install EVSE infrastructure that will be needed by a growing EV market, in a way that is most cost effective for the public interest and supports off-peak charging over the long term. Charging infrastructure for public DC fast charging (DCFC), workplace charging, and fleets is a top priority, followed by public AC level 2. Workplace, fleet, MUD, and residential charging programs are essential to support early EV adoption, and may be leveraged to enable load management and reduced on-peak loads from EVs.

A portfolio of proposed programs support both Avista and 3rd party EVSE ownership, off-peak charging, and customer choice through proven cost-effective methods, "make ready" options, load management, and a pilot EV TOU rate for commercial customers. Ideally, 3rd party EVSE ownership makes up 50% or more EVSE in the marketplace through 2025. The coordinated buildout of EVSE is also intended to foster healthy market competition and growth among EVSE and electric vehicle service providers (EVSPs).

Based on anticipated market needs, a coordinated public DCFC buildout of 60 DCFC sites in the region by 2025 will be prioritized through a deliberate process involving key stakeholders. This includes DCFC sites within 40 miles along all major travel corridors, as well as high traffic and key destination locations within more populated areas. Avista will commit to installing, owning and maintaining up to 50% of the anticipated market need, or 30 DCFC sites by 2025. A "make ready" utility extension policy and pilot EV TOU rate schedule will be applied at DCFC sites to encourage off-peak charging and 3rd party ownership to the greatest extent possible, ideally meeting or exceeding 30 DCFC sites by 2025.

Public AC Level 2 sites will be built out per stakeholder review and selection at 10 sites per year in the region.[6] AC Level 2 EVSE for workplace, fleet, MUD, and residential use will be completed on a first-come, first-serve basis subject to eligibility requirements and program limitations. Avista will own and maintain EVSE assets, covering direct installation costs and 50% of premises wiring installation costs up to $2,000 per port for commercial installations, and $1,000 for residential installations. In the future, equipment lease and/or rebate programs may also be considered for customer-owned EVSE, and coverage of premises wiring costs may be reduced as the market improves and effective load management programs are well established. Customer site agreements will include enrollment in load management programs and future TOU rates, so that off-peak charging and net benefits for all customers may be maximized over the long term.

EVSE maintenance and site uptime greater than 99% is an important priority – a high performance level that Avista will work to achieve and maintain in collaboration with industry partners.

Education and Outreach

Raising awareness through effective Education and Outreach activities is also of great importance to accelerate market adoption. Avista will engage with stakeholders in a number of activities, by 2024 raising customers' positive EV awareness by 500%. This includes a $250 dealer referral, EV education & awareness campaigns, and support for peer-to-peer interest groups and transportation network companies (TNCs). The Company will also maintain on-line information and tools, customer call center assistance, and support for local Ride & Drive events.

In addition, Avista will consider new and innovative ways to raise positive awareness and EV availability, such as with informational kiosks, training and certification programs at auto dealerships, and partnering to establish an innovative EV Experience Center delivering effective information and education, charging availability, and EV rental and purchase services.

Community and Equity

Avista is committed to help provide benefits from electric transportation to disadvantaged communities and customers, in collaboration with other service organizations and community leaders. An aspirational goal of up to 30% of overall electric transportation funding will be applied to this program category, subject to practical limitations of the market and viable, cost-effective technologies.[7]

The EVSE pilot demonstrated a successful model that will be expanded upon, providing EV and EVSE assistance for community service organizations that serve the disadvantaged, through a collaborative process and competitive proposal selections. In addition, Avista will provide additional EVSE installation

---

[6] additional public AC Level 2 sites may be installed under Community and Equity programs

[7] see UTC docket UE-190334, et. al, Partial Multiparty Settlement Stipulation, pp. 11-12

assistance for rural towns, low-income multi-unit dwellings, and residential customers receiving low-income bill assistance.

New pilot programs may be developed with public transit agencies and TNC platforms, as well as partnering with organizations such as Envoy to pilot ride-sharing and car-sharing services for disadvantaged groups.

Commercial and Public Fleets

Opportunities to support electric transportation in commercial and public fleets exist today, and will grow in the future. Avista can begin to effectively support this growth. This starts with information, tools and consulting services for light duty passenger EVs and electric lift trucks (forklifts) in 2021, followed by commercial delivery vehicles, airport ground support equipment, and refrigerated trailer units in subsequent years. A pilot EV TOU rate for commercial customers and "make ready" utility investments will further support electric fleet expansion.

A new program supporting lift trucks is modeled after other successful utility programs in the U.S. The program provides information resources, incentives of $1,000 to $750 to buyers, and $500 to $250 to dealers, that switch from fossil fuels to electrically powered lift trucks. Annually per lift truck, this will result in avoiding 16 metric tons of CO_2 tailpipe emissions, customer fuel savings of 76%, and $1,500 per year in beneficial utility revenue. EVSE consultation and load management services will also be provided.

By 2022, Avista may consider a pilot program with a transit agency and/or school district to electrify buses, in conjunction with services benefiting disadvantaged and low-income groups, as well as testing technologies and models for load management and emergency backup power.

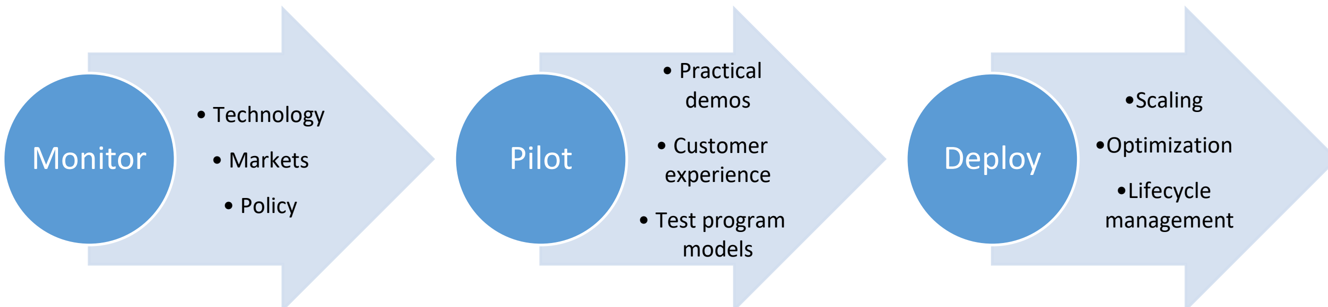
Load Management, Planning and Grid Integration

Avista will continue to monitor and document EV load profiles, using a smaller test pool of customers with vehicle telematics connectivity starting in 2021. Updated annual load profiles and forecasts for EVs will be integrated with System Planning and the Integrated Resource Plan (IRP). This will be used in conjunction with updated modeling of grid assets and conditions, other load forecasts, and the effects of distributed energy resources (DERs), providing a sound assessment of generation capacity, distribution systems, and optimized asset management.

Avista will deploy cost effective load management services leveraged with EVSE installation programs. This will initially be accomplished through vehicle programming and the utilization of programmable non-networked EVSE. Experimentation with new technologies and industry innovations will also be considered, such as the utilization of advanced metering infrastructure (AMI) and other technologies that communicate with EVs and other distributed energy resources, given the potential to optimally manage loads and integrate with the grid at scale. Residential TOU rates may also be considered and piloted with groups of customers participating in the EVSE program, starting in 2023. By 2025, the goal is to demonstrate greater than 50% peak load reduction from EVs, achieving grid benefits larger than expenses required to perform load management.

Technology and Market Awareness

Avista will utilize a deliberate process of innovation and testing of emerging opportunities in electric transportation. During the initial monitoring phase, thresholds may be identified that trigger the development of pilot programs testing technical feasibility, costs, and customer experience. Pilots may lead to informed deployments that can scale up over the long-term, achieving sustained benefits for all utility customers.



In the light-duty sector, installed battery pack price and energy density of batteries are key metrics to track, along with the number of models, charging speeds, prices, and sales penetration levels. In other sectors, various technologies and the state of the market will be monitored in medium and heavy duty applications, micro-mobility innovations, V2X and networking/control systems, autonomous EVs, aircraft, rail, and marine applications.

Rate Design

A new pilot rate schedule as proposed in this Plan is essential to support sustainable growth in fleet electrification and public DC fast charging. The proposed rate provides for reasonable recovery of utility costs based on additional time-of-use (TOU) energy charges, while eliminating demand charges that currently inhibit market growth. In this way, it establishes sensible electric billing rates for businesses that invest in electric fleets and public charging, encouraging early and sustained fleet adoption, larger workplace charging facilities, and 3rd party ownership of public DC fast charging. Through higher on-peak price signaling, it also encourages more off-peak charging which is beneficial to all customers.

The new EV rate schedules will be made available to commercial customers, provided that EV charging loads are metered separately from other loads and peak demand does not exceed 1 MW. Above this threshold, load management may be required and it must be demonstrated that all reasonable measures are being taken to mitigate impacts and required upgrades to the local distribution grid, as a condition of utilizing the pilot rate. The EV TOU energy charge on the order of $0.05 per kWh is applied in addition to regular energy charges on a seasonal basis, during the hours of 7am to 10am and 5pm to 8pm from

November through March, and 3pm to 7pm from April through October. Provisions of existing commercial rate schedules apply other than the removal of demand charges and the addition of on-peak energy charges, and the EV TOU rate will adjust commensurate with other normal adjustments to commercial rates.

Eligible customers may choose to adopt the pilot EV TOU rate starting in 2021, with open availability through 2025. At that time, the Company intends to propose a more permanent commercial EV TOU rate based on collected data and analysis completed during the 2021-2025 pilot period. Customers that initially participate in the pilot rate may then choose between the new EV TOU rate, or elect to continue with the pilot rate for another five years through 2030. Early adopters are thereby given reassurance that the pilot rate may be applied through 2030, when they consider making sizable capital investments in new electric fleets and charging infrastructure with long service lives.

A relatively small number of customers are expected to participate in the pilot EV TOU rate, so that the general body of customers are not materially affected. In addition to encouraging early adoption, the pilot TOU rate is intended to provide valuable data including local coincident loading patterns and impacts on the distribution system, enabling development of a more permanent EV TOU rate schedule.

Experience with a limited number of commercial participants will also be valuable in consideration of a pilot EV TOU rate for residential customers starting in 2023, potentially on a larger scale with the deployment of Advanced Metering Infrastructure (AMI).

Utility Fleets, Facilities and Employee Engagement

Utilities must set a good example for customers in electrifying their own fleets and facilities, as well as encouraging employee engagement around electric transportation. In addition to realizing fleet and employee benefits, through direct experience in these areas the Company is better able to advise customers, and employees that drive electric act as respected ambassadors in the community – raising positive awareness and long-term adoption of EVs in the region.

Avista has successfully electrified its small pool of passenger vehicles, and plans to continue evaluating and piloting fleet electrification, including medium and heavy duty utility vehicles and auxiliary equipment. These initiatives will be carefully considered and deployed in operational fleets, as reliable operations may not be compromised. Adequate workplace charging at Avista facilities coupled with effective employee engagement around electric transportation options can make a big difference in employee adoption, which translates to higher awareness and long term EV adoption in the community. The Company will look to partner with OEMs to offer purchase discounts to employees, and at some point may consider supplementing this with incentives funded by shareholders, when EV availability and choices in the market would yield the greatest positive effects.

Programs and Activities with Budget Ranges	
40% - 65%	EVSE Installations and Maintenance
10% - 30%	Education and Outreach
10% - 30%	Community and Equity
5% - 25%	Commercial and Public Fleets
5% - 10%	Load Management, Planning and Grid Integration
2% - 5%	Technology and Market Awareness
2% - 5%	Analysis and Reporting

Programs and Activities Summary

Programs and Activities for 2020 – 2024 are summarized below, with budget ranges to overall program funding. Activity and spending levels adjust over time with new learning and changes in technology, policy, and market conditions. For example, as viable markets develop for fleets, supportive utility programs addressing those opportunities would grow. Different program elements are related and support each other, requiring integrated management and regular adjustments in order to be most effective.

Avista plans to fund these programs and activities over the next five years with an overall capital and expense budget of $2 million to $5 million per year in Washington, and $0.5 million to $1.5 million per year in Idaho. This is the estimated level of activity required to achieve strategic objectives, adjusting to changing market conditions as appropriate.

Utility capital investments will result in an increase of less than 0.25% annual revenue requirement in Washington, net of benefits from electric billing revenue and any monetized environmental benefits that may become available.[8] Programs and activities in Idaho will be focused on early learning and limited charging infrastructure pilots that demonstrate the value of beneficial electric load growth in transportation, including mitigation of peak loads.

Over the longer term, the benefits from electric transportation are expected to outweigh utility costs, thereby providing direct and recurring net benefits to all utility customers. This outcome and the realization of major economic and environmental benefits for the region are the ultimate goals of the Transportation Electrification Plan.

[8] as directed by legislation, see Revised Code of Washington (RCW) 80.28.360 (1), https://app.leg.wa.gov/RCW/default.aspx?cite=80.28.360, Washington State HB1853 (2015), HB2042 (2019), and SB5116 (2019). https://app.leg.wa.gov/billinfo/

This Plan will be updated and re-issued in five year intervals starting in 2025, with a mid-period report by year-end 2022. The mid-period report will include updates on EV adoption and forecasts, program activities, lessons learned, adjustments, projected impacts on the environment, the economy and the grid, as well as expenses, revenues, and other realized benefits. New program filings may be submitted for regulatory review on an on-going basis and later incorporated in regular revisions of the Transportation Electrification Plan.

Table 2: Program and Activity Timeline (2020-2025)

Program/Activity	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Develop public EVSE buildout plan with stakeholders	X					
Initiate DCFC site acquisitions	X					
Solicit 1st round public AC Level 2 applications	X					
EVSE installation programs - all categories - including low-income assistance		X	X	X	X	X
Design and launch education & outreach campaigns	X	X	X	X	X	X
Solicit proposals and award EV and EVSE to community service organizations	X	X	X	X	X	X
Launch fleet support program - lift trucks and light-duty passenger		X	X	X	X	X
Extend fleet support program - airport GSE, refrigerated trailers, other commercial vehicles			X	X	X	X
Design and pilot an EV Experience Center	X	X	X			
Design and pilot a TNC program		X	X	X		
Design and pilot mass transit and school bus pilots			X	X	X	
Collect telematics and meter data, update load profiles for System Planning and IRP		X	X	X	X	X

Program/Activity (continued)	2020	2021	2022	2023	2024	2025
Perform load management experiments including telematics and programmable EV/EVSE		X	X	X	X	X
Update grid impacts, costs and benefits		X	X	X	X	X
Expand utility fleet electrification, facility EVSE, and employee engagement programs	X	X	X	X	X	X
Pilot commercial EV TOU rate		X	X	X	X	X
Post-pilot commercial EV TOU rate						X
Pilot residential EV TOU rate				X	X	X
Submit mid-period report			X			
Submit revised TE plan						X

Background

On April 28, 2016 the Washington Utility and Transportation Commission (UTC) issued Order 01 in Docket UE-160882 approving Avista's tariff Schedule 77 for its EVSE Pilot Program. The initial two-year installation term of the program began with the first residential EVSE installation on July 20, 2016.

On June 14, 2017, the UTC issued a Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Stations in Docket UE-160799. It provides background and guidance principles for utility EV charging as a regulated service, and notes that the purpose of Avista's pilot program is to obtain data and experience that will inform future programs and rate designs.

On February 8, 2018 the UTC issued Order 02 in Docket UE-160882 approving Avista's proposed revisions to tariff Schedule 77. This included extending the installation period of the program with additional EVSE installations through June 30, 2019, as well as adding a program benefiting low-income customers and a few other minor adjustments. The pilot's EVSE installations were concluded in June, 2019, and a final report was completed in October, 2019. Ongoing program management includes EVSE maintenance and data collection.

AC Level 2 EVSE owned and maintained by Avista were installed on residential and commercial sites downstream of the customer's meter and electrical supply panel, while DC fast charging sites involved full utility ownership of all equipment from the transformer to the EVSE. The figure below illustrates electrical infrastructure and four basic types of EVSE ownership models between the utility and the customer.

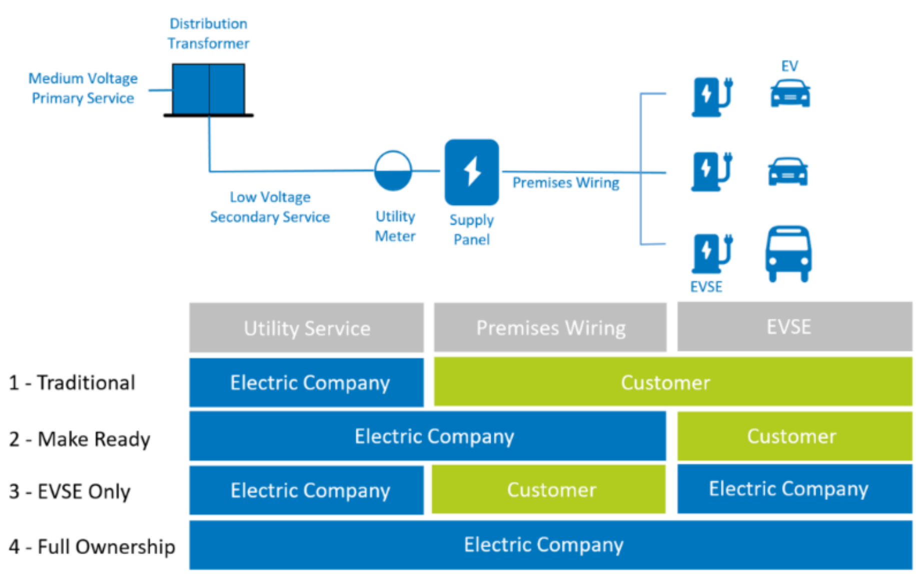


Figure 3: Ownership models for utility and customer EVSE infrastructure

Avista's AC Level 2 installations followed the "EVSE only" model in both residential and commercial locations, and DC fast charging sites followed the "full ownership" model.

A simple EVSE rebate program is an example of the "traditional" business model, where nothing is owned by the utility beyond the meter and conditional rebates from the utility are provided for EVSE purchased and installed by the customer. A "make ready" program typically involves new utility commercial service, including dedicated meters and premises wiring or supply infrastructure that is owned and maintained by the utility, stubbed out to the EVSE location. In "make ready" models, the EVSE itself is owned and maintained by the customer, and in some cases the utility may provide subsidies to the customer for EVSE purchase, installation and/or maintenance. Full ownership involves a dedicated transformer, meter, supply infrastructure and the EVSE itself, all owned and maintained by the utility. Public AC Level 2 or DC fast charging sites can fall in this category, with EVSE user fees applied and subject to regulatory oversight.

Avista chose the "EVSE Only" and "Full Ownership" models for the EVSE pilot as an alternative to other more common utility EVSE rebate and make ready programs. It was felt that by utilizing existing supply panels and other supply infrastructure in residential and commercial locations in the "EVSE Only" model, costs could be much lower than comparable "make ready" installations with new dedicated services and infrastructure. Further, it seemed possible that utility EVSE ownership and maintenance might be an effective way to provide the most value and satisfaction for customers in terms of reducing the costs, risks and difficulties of installing EVSE, while providing a means for effective DR without the need for further incentives or a time-of-use (TOU) rate to shift peak loads. Due to the more substantial investments and effort to implement DCFC sites and maintain them, the full utility ownership model was chosen to ensure long-term DCFC operability and public access.

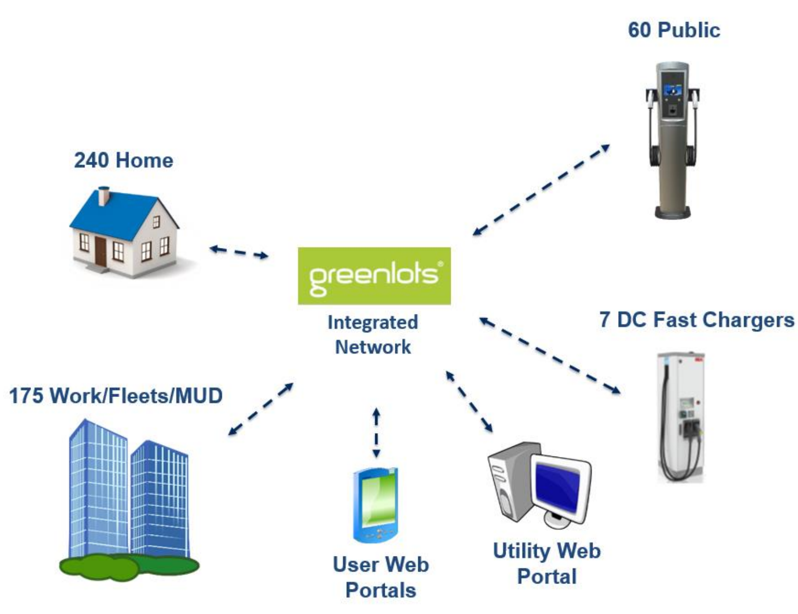


Figure 4: Integrated EVSE network design

In order to comprehensively understand EV charging behavior and electrical loads from different locations, it was necessary to build an EVSE "ecosystem" that was integrated by a single network, capturing the charging data for individual EV drivers wherever they might charge – at home, at work, or in the public, for both AC Level 2 and DC fast charging. It was important to incorporate hardware and software that was "interoperable", using industry standard communication protocols such as the OCPP standard, so that risks and operational flexibility could be well managed. This enables "plug and play" deployment of alternative EVSE or EVSP providers in the future as the competitive market and products mature. The overall design is depicted above, with the maximum allowed number of ports in each major category.

The numbers and proportions of EVSE in each category were carefully chosen to accomplish learning objectives and begin to support EV adoption in Avista's service territory, while containing costs to a modest level. Uninfluenced load profiles for different EV driver types and in different locations could be reasonably established in the first phase of the pilot, followed by direct load management of networked AC Level 2 EVSE at residential, workplace, fleet and MUD locations.[9]

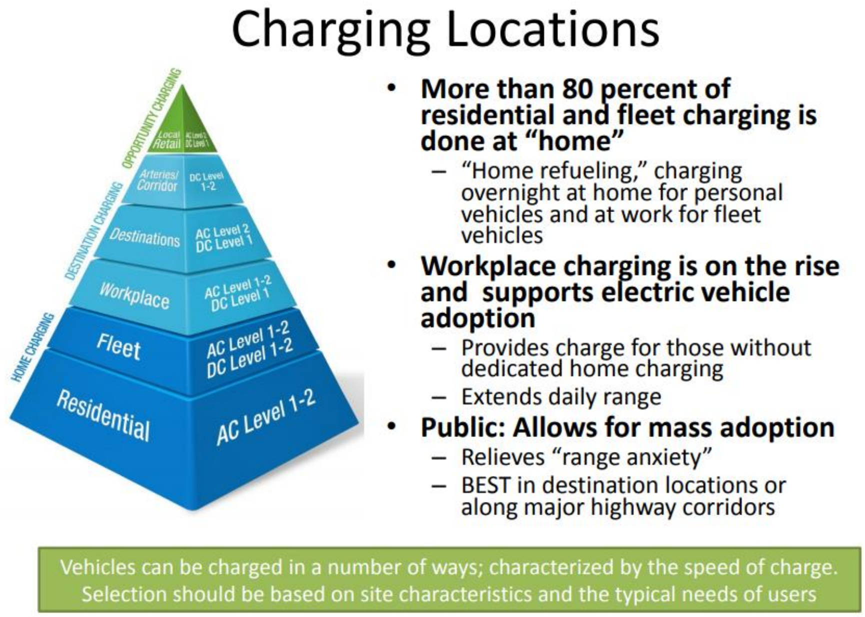


Figure 5: The Charging Pyramid (courtesy EPRI)

These comparisons allow for a better understanding of customer behaviors and more robust grid impact and economic modeling, influencing future program designs. The proportional targets were also informed by the literature, showing different volumes and supporting roles that EV charging plays in each segment. As shown by the "Charging Pyramid", all types of charging are important in the overall light-duty EV "ecosystem", but as much as 90% or more of all charging occurs at residences, fleet locations, and at the workplace, where EVs are parked for long periods of time and may charge at lower power levels and at reduced costs. This is especially so if the charging may be reliably and economically shifted to off-peak times, maximizing benefits for all utility customers.

Program design also incorporated the objective of providing support for early EV adoption. This could be accomplished by addressing the barriers of low awareness and lack of EVSE infrastructure, through initial education & outreach efforts, dealer engagement including a referral program and residential EVSE offerings, as well as commercial EVSE buildout at workplace, fleet, and public locations, all intended to help form the first substantial backbone of EVSE infrastructure in eastern Washington.

Finally, with the backdrop of legislation passed in Washington state in 2015 and 2019[10] and growing consensus and support on a global scale, a societal purpose has been established for the reduction of greenhouse gas emissions (GGEs). It is recognized that the transportation sector is the largest

[9] Load management of public AC Level 2 and DC fast chargers is not feasible as EV drivers need maximum charge for limited periods of time at public locations.
[10] See Washington State HB1853 (2015), HB2042 (2019), and SB5116 (2019). https://app.leg.wa.gov/billinfo/

contributor of GGEs and other hazardous air pollutants, that electrification of the transportation sector can provide a high return on investment in reducing emissions, and that utilities must be fully engaged to play a key role in this transformation. The EVSE pilot was therefore launched as a starting point to explore how the Company may better serve all customers, achieving major economic and environmental benefits in the long-term effort to electrify transportation, partnering with industry, customers, local governments and policymakers.

In summary, key takeaways from the EVSE pilot included the following:

1. Data and analysis show that grid impacts from light-duty EVs are very manageable over at least the next decade, net economic benefits can extend to all customers, and significant reductions of greenhouse gas emissions (GGE) and other harmful air pollutants may be achieved with EVs. However, grid impacts and costs resulting from EV peak loads could become significant over longer time horizons, with higher EV adoption, and as other loads and the grid change. The EVSE pilot represents a good start in the Company's ongoing effort to understand how EV loads may be optimally integrated and managed, in an evolving system that brings the most benefit to all customers.

2. Avista was able to cost-effectively install EVSE, resulting in high customer satisfaction, and the pilot correlated with a significant increase in the rate of EV adoption in the area. This demonstrated that utility programs can be effective in supporting and enabling beneficial EV growth. Partnerships with industry providers, a focus on providing value for the customer, and contractor performance were keys to success.

3. Workplace charging stands out as a powerful catalyst for EV adoption, while simultaneously providing grid benefits from reduced EV charging at home during the evening peak hours.

4. Low dealer engagement, a lack of EV inventories, and persistent customer awareness and perception issues continue to be a major barrier to mainstream EV adoption in the region. The utility can help overcome these issues with robust education and outreach programs, including dealer engagement.

5. Avista successfully demonstrated the use of EVs to reduce operating costs for a local non-profit and government agency serving disadvantaged customers. The Company expects local stakeholder engagement to continue in the development and expansion of similar programs, as well as other innovative ways to serve communities and low-income customers.

6. Surveys showed a widespread desire for more public AC Level 2 and DC fast charging sites, which may be supported in future utility programs and rate designs. A new rate should be developed to address operational cost barriers resulting from traditional demand charges, while reasonably recovering utility costs.

7. Networked EVSE reliability, uptime, costs, and customer experience are all important opportunities for improvement, reinforcing the importance of utilizing interoperable networked

EVSE. Non-networked EVSE are very reliable and cost effective, and should be utilized wherever possible unless data collection, user fee transactions, remote monitoring, or other requirements necessitate the use of networked EVSE.

8. Load management experiments showed that the utility may remotely curtail residential peak EV loads by 75%, while maintaining customer satisfaction and without a TOU rate or additional incentives other than the installation of the EVSE owned and operated by the utility. More DR experimentation may show the feasibility to shift an even higher percentage of peak loads. While EVSE load management utilizing DR and V1G technology appears acceptable from a customer perspective, reliability and costs must be significantly improved to attain net grid benefits and enable practical application at scale.

9. Data and analysis were somewhat limited by the available pool of participants and EVSE sites. However, results compared well with other studies using larger population samples, and EVSE data was satisfactorily replicated and verified by telematics data. As the industry evolves, light-duty EVs with larger battery packs may become the norm. In this respect, the EV load profiles developed and examined in this study may under-predict electric consumption and peak loads to some degree.

Technology and Markets

Transportation electrification is affected by a variety of technology and market forces, which Avista will closely monitor to inform the Transportation Electrification Plan. There are factual trends as noted below, but it is uncertain how these forces will shape vehicle and equipment design, production and timing decisions, and how this in turn will interact with evolving market and customer preferences. One thing that is clear – the Company must keep abreast of the changing landscape and adjust its plans accordingly on a regular basis.

Given these changes and historical examples of technology adoption, it seems likely that the transportation sector is on the cusp of a major transition toward electrification. To illustrate, the chart below shows the rate of new technology and product adoption in U.S. households over the last century.[11]

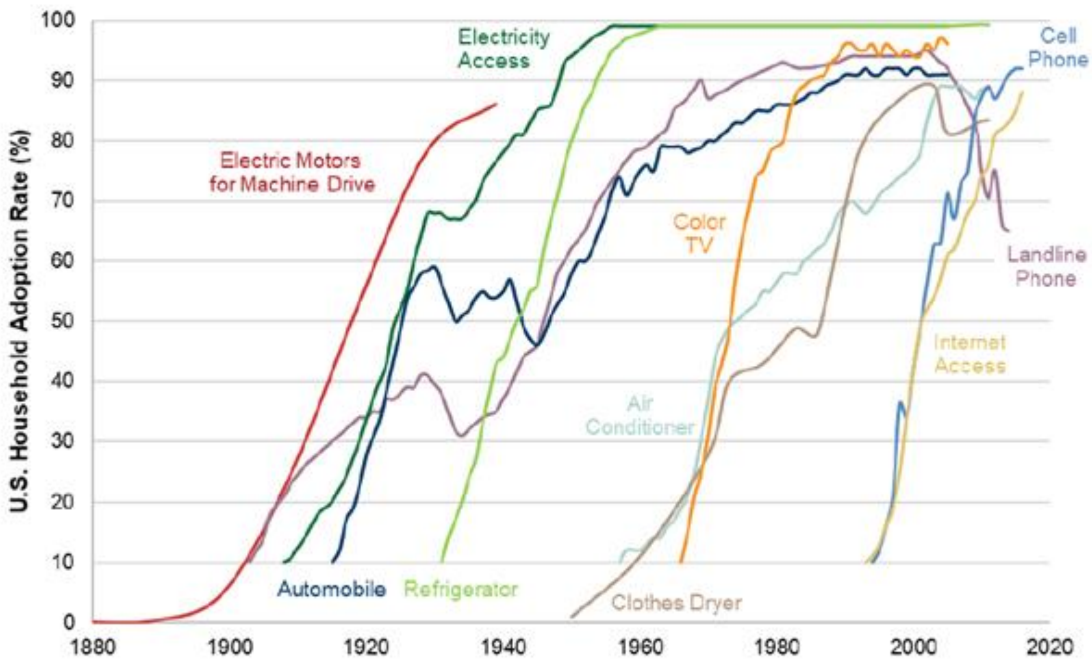


Figure ES-1. Diffusion of various technologies in U.S. households

Data Sources: Du Boff 1964 in Devine 1983 for electric motors; Ritchie and Roser 2018 for all others

Note that adoption rates for new technologies typically follow an S-curved shape. A period of initial slow growth is followed by rapid acceleration, before flattening out with market saturation and in some cases eventually declining, such as that for landline telephones. While these examples cannot be used to reliably predict the adoption curves for various forms of electrified transportation, they do provide insight and highlight the importance of monitoring technology and market trends in a rapidly changing environment. Due to a number of complex and interactive factors, adoption of a given set of technologies and products may suddenly surge unexpectedly, such as the case for cellular phones. To

[11] "Electrification Futures Study", NREL 2018 (p. 16)

help explain this, as the market and technologies developed for cellular phones, they could increasingly be used for more than just telephone conversations – they could be used to send text messages, take pictures, store, play and share music and other media, and connect with the internet and its myriad of expanding, derivative services. Beyond the advantage of mobility, cellular phones opened up a whole new world of possibility that the landline telephone could not compete with. In similar ways, electric vehicles may become a platform for greater connectivity, functionality, and access to other services and benefits that gasoline-powered vehicles cannot offer – in addition to tremendous operational savings and a superior driving experience. Together with supportive policy and societal factors, this could strongly influence customer preferences and adoption rates beyond first-order economics. On the other hand, considerable technological and market development remains to be done, and transportation electrification could be severely dampened by existing fleets and infrastructure with long service lives, as well as powerful influence by incumbent interests and the status quo.

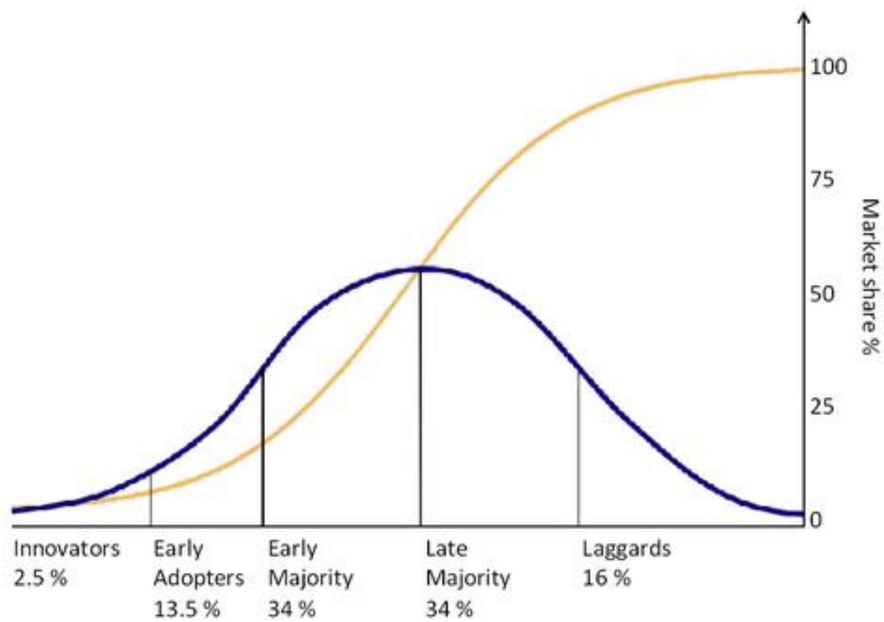


Figure 6: The Diffusion of Innovations (Rogers)

Another useful framework to consider is the Technology Adoption Lifecycle for disruptive products as originally described by Everett Rogers and later expanded upon by Geoffrey Moore in his classic work, "Crossing the Chasm." [12,13,14] As explained by Moore, when a new disruptive technology enters the market, first adopters known as "innovators" and "early adopters" are most interested in new technology and performance. These two groups represent about 15% of the total market assuming a bell-curve distribution, and they are willing to deal with some inconvenience and price premiums as a trade-off to using a new and exciting innovation. 2019 saw U.S. sales of plug-in EVs at 325,000 vehicles, about 2% market share in a new-car market of 17 million vehicles – clearly still in the early stage of market adoption. In order to sustainably gain entry into the mass market beyond this level, a "chasm" must be crossed whereby the product appeals to the "early majority" – typically when it is able to be sold on a more practical basis to non-technologists, less willing to tolerate inconvenience and high price premiums.

[12] Everett, Rogers. "Diffusion of Innovations." 1st Ed. (1962).
[13] Moore, Geoffrey A. "Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers." Harper Business, 3rd Ed. (2014).
[14] UTC (p. 29)

The challenges of crossing the chasm are often considerable – many disruptive innovations never cross it and remain confined to a small segment of the market, or decline into obscurity. However based on the level of global investment, the march of technology advances and cost reductions, and supportive policy based on rising concerns of climate change, we can reasonably expect an inflection point in the light-duty EV market in the 2023-2024 timeframe, and possibly some other market segments as well, such as battery electric transit buses. Assuming OEMs deliver strong product and critical market barriers such as charging infrastructure and awareness issues are removed, EVs appear likely to cross the "chasm" soon thereafter, and sustainably make inroads into the early mass market at the 15% penetration level sometime between 2026 and 2030.

In this timeframe, Avista can play a strong role in addressing a number of market barriers – particularly EVSE infrastructure and customer awareness – while paying close attention to key technologies and changing conditions as noted below.

Battery Technology

Falling battery costs and improved performance are key trends to monitor as they represent a significant cost item in electrified vehicles. Average market prices for battery packs have fallen from $1,100/kWh in 2010 to $156/kWh in 2019, and are projected to fall to around $100/kWh by 2023, according to a report by Bloomberg New Energy Finance (BNEF). Ongoing price reductions will be driven by battery purchases at scale and the utilization of high energy density cathodes that store energy more efficiently. Further price reductions are not "impossible," but will be more complicated because "there are a variety of options and paths that can be taken," such as standardizing battery pack designs across different EV models or introducing new technologies to improve the batteries themselves, like new cathode materials.[15]

Changing Battery Chemistries & Thermal Management are two areas where the most cutting-edge R&D work is happening. While lithium-ion (Li-ion) batteries are expected to continue as the predominant EV battery technology in the near-term, various other chemistry combinations with Li-ion are advancing, and solid-state batteries are also expected to emerge as cost-viable options. Newer cell chemistry, and different materials in battery cathodes and anodes, are expected to result in higher energy densities and lower reliance on rare materials such as cobalt.

Rising Battery Voltages. Current vehicles powered by internal combustion engines (ICE) use a 12V battery for starting the engine and supplying auxiliary loads. By comparison, early EV models such as the Nissan Leaf, GM Bolt, Tesla Model S, and Audi e-Tron all have battery voltages at the pack level between 300 to 400 volts. Next-generation EV models such as the Porsche Taycan have pack voltages at 800 volts and as high as 1200 volts,[16] which will allow for much faster charging times as EVSE power capacities rise from 50kW to 350kW and possibly higher, without increasing electric current. This is necessary to minimize heat and maintain conductor size and weight within limits for human use. In addition to overcoming the issue of charging infrastructure availability, these higher power levels will reduce refueling time by 67% to 86%, making it much more convenient to charge an EV in public.

[15] 2019 Battery Price Survey, Bloomberg New Energy Finance
[16] Batteries and Electrification R&D Overview. Steven Boyd, Program Manager, US Department of Energy, June 18, 2018

Battery Management Systems, impacts on battery life and OEM warranties. Automakers typically cover the lithium-ion battery pack under warranty for an extended period. In recent years the standard offer has been at least eight years or 100,000 miles, whichever comes first. Some manufacturers will cover the battery pack against total failure, while others will replace it if the battery's capabilities fall below a certain level, such as 60-70% of the battery's original capacity. More recently, the state of California mandated automakers extend the battery coverage for EVs sold within that state to 10 years or 150,000 miles. Other OEMs have gone further, for example Hyundai has increased its battery warranty to lifetime coverage on the Kona Electric. Battery performance and warranty concerns were a significant unknown when the first EVs began to be sold in the 2011-16 time frame. Batteries lose capacity over time due to factors including the number of discharge / recharge cycles, depth of discharge, and ambient operating and storage temperature – all of which can exacerbate degradation depending on cathode and anode chemistry.[17] Through improvements in chemistries and robust battery thermal management systems, significant long term degradation can be minimized while operating applications can expand.[18] A GM battery engineer recently noted that they had conservatively treated the battery's capabilities in the Volt and Bolt vehicles.[19] We are now seeing EVs sold in the last four to five years driven well over 100,000 miles, and it is becoming clear that battery management systems will enable EVs to travel at least this far and possibly much further before there is a significant reduction in battery performance and driving range.

Battery Degradation and 2nd Life Use. EV battery packs tend to degrade slightly with each charge and discharge cycle, eventually losing their ability to fully charge. Draining most or all of a battery's charge on a regular basis tends to cut into its capacity more quickly over time. For this reason, older EVs with shorter operating ranges can suffer incrementally faster deterioration than newer EVs with 200+ miles of range, as they can be drained more deeply and frequently to meet driving range requirements. Until recently, EV batteries were best maintained by avoiding deep discharges and frequent DC fast charging. Today, thanks to more advanced battery management systems, these concerns are gradually being eliminated. The inherent chemistry and design of an EV battery varies from one make and model to another. EV battery packs generally contain a series of connected individual cells, perhaps several hundred of them depending on the model, instead of a single massive unit. It is often difficult, if not impossible, to combine cells from different manufacturers and different chemistries in 2nd life applications.

As long as detailed battery charging history at the cell level is available, battery re-manufacturers (such as 4R Energy, Spiers New Technologies, and others) have expressed a willingness to take less degraded cells from an EV battery pack and "repackage" them for other applications, including use in another vehicle and for stationary storage applications. One such application is the secondary use of batteries originally in Class 8 heavy-duty trucks, deployed for 2nd life use in smaller, lighter-duty vehicles for local deliveries where required travel distances are not as long. This use case is facilitated when both the first and second vehicle are from the same manufacturer. However, it is possible that advanced, new battery costs may approach "refurbished" battery costs when this market materializes, probably in the 2030

[17] https://www.researchgate.net/publication/335672438_A_Wide_Range_of_Testing_Results_on_an_Excellent_Lithium-Ion_Cell_Chemistry_to_be_used_as_Benchmarks_for_New_Battery_Technologies
[18] https://www.energy.gov/sites/prod/files/2017/10/f38/XFC%20Technology%20Gap%20Assessment%20Report_FINAL_10202017.pdf
[19] https://electrek.co/2020/02/10/gms-director-of-battery-cell-engineering-were-nowhere-near-the-bottom-of-the-price-curves/

timeframe. Other stationary applications may someday extend the use of batteries beyond their first applications, such as for traffic lights, streetlights, and home energy storage. American Electric Power is currently testing this application using batteries from older-model Nissan LEAFs.

Today, the market is hesitant to commit to acquisitions of 2nd life batteries at some future date, mainly due to rapidly falling battery prices and the challenges involved with “mixing-and-matching” batteries from different manufacturers. Second-life battery uses may become more feasible when a change in battery ownership does not occur, i.e. the battery continues to be owned by the same party that bought the original vehicle. In this case, the owner can confidently know the battery history and condition, and its suitability for future use. Owners and operators of future electric fleets in the tens or hundreds of thousands of vehicles are a natural market for refurbished batteries uses, as their vehicles and business use cases have varying performance and range requirements. Fleet owners at some point will also likely need to add local energy storage at their depots, in order to reduce demand on the local distribution grid, and to acquire and store energy when utility TOU rates are lowest. In this respect, 2nd life use of fleet batteries may become a viable option.

Much has been written in the industry media about the possibilities of utility purchases of 2nd life batteries for smart grid deployments. Recent utility RFPs for energy storage applications at generation and substation sites require large volumes of identical cell technologies, which the current “refurbished” battery supply chain cannot meet. This is because battery chemistries are unique to each OEM, and in many cases, to each vehicle model and model year. In general, the financial viability of 2nd life battery use in utility applications remains elusive today, but this could eventually change in the future and therefore progress in this area should be monitored.

Battery Recycling. Once the primary (in an electric vehicle) and secondary (stationary storage applications) uses have expired, the battery can be recycled to obtain reusable materials, such as lithium, cobalt, nickel and other metals. Advanced processes are still in development to make recycling these materials more economical, with several companies currently working on the technology. However, if the electric vehicle market grows as expected, significantly increased demand for battery materials may become a major challenge. Avista plans to monitor battery recycling developments, but the current assumption is that the market will be able to successfully recycle large numbers of EV batteries when they reach end-of-life, estimated to be at least a decade away. New chemistries that are currently in development may further mitigate the issue, for example reducing the need for rare materials such as cobalt.

EVSE Technology

Smaller footprint and higher power output. 50kW is the current baseline for DCFC connected to light-duty (Class 1) passenger EVs, using both the CHAdeMO and CCS-1 charging protocols. While still an industry mainstay, the 50kW platform is quickly being overtaken by fast charging at the 100kW to 150kW level. Many Tesla Supercharger sites, for example, currently offer fast charging at 120kW and higher. Within the next few years, the 50kW “standard” will be superseded by 150kW as the de facto standard, and the subsequent “standard” after that will be 350kW. Electrify America is already installing 350kW DCFC at some of its locations, such as the current site in the Spokane Valley near I-90. In the heavy-duty vehicle space (Class 6 and above), a number of vehicle and EVSE manufacturers are working through a

CharIN committee to develop an industry-wide set of specifications for charging at the 1MW to 2MW level and above.[20] According to CharIN, the High Power Charging for Commercial Vehicles (HPCCV) standard will be used for charging in the range of 200 to 1500 volts and up to 3000 amps. That should be enough to address the needs of heavy-duty electric vehicles with very large battery packs of 1 MWh.[21]

Communications Interoperability. There is a clear global movement among EV charger manufacturers and software providers to make their equipment and capabilities comply with the Open Charge Point Protocol (OCPP).[22] Current compliance is at the entry 1.6 level, with the industry moving toward the more complex and sophisticated 2.0 level that provides additional security, functionality, transactions handling and smart charging capabilities. Innovative Charging Protocol ISO/IEC 15118 is mostly about communications standards between the EV, EVSE, and the cloud. It's important to stay aware of developments in this area and ensure compatibility with other smart grid initiatives that Avista may undertake in the future.

EVSE interchangeability is an important capability when owning and operating a portfolio of EV chargers from different manufacturers and vintages. To manage this diverse portfolio, it will be important to adopt open standards such as OCPP as much as possible, for several reasons including minimizing operational and financial risks associated with adopting proprietary products and services. In other words, EVSE that are fully compliant with OCPP may be more readily swapped out with other EVSE or switched to another EVSP, in the event of performance issues or business failure with either EVSE or the EVSP. This also has the added benefit of supporting healthy competition in the marketplace.

Connector standards are another aspect of interoperability that must be monitored. While the EV industry was able to broadly adopt a common plug configuration for AC Level 1 and Level 2 charging using the J1772 standard, there are now de facto three plug configurations for DCFC in North America - CHAdeMO, CCS-1 and Tesla. CHAdeMO and CCS are not compatible. Tesla vehicles cannot be fast charged using the CCS connector in North America. It is possible to purchase a special cord/adapter[23] for a Tesla driver to use a CHAdeMO charger, but this adapter is often out of stock, and CHAdeMO currently limits power output to 50kW, well below the 120kW or higher capability of the Tesla Supercharger network. Given the three different DCFC connector standards, two developments have occurred which merit attention. One is the co-location of CHAdeMO, CCS and Tesla chargers in the same location. The Marengo Charging Plaza in Pasadena, CA is an example.[24] EVGo and Tesla have entered into an agreement offering Tesla's proprietary connectors at EVGo DCFC sites, which previously offered only CHAdeMO and CCS connectors. Similarly, Avista should consider partnering with Tesla to allow for additional investment by Tesla to install their chargers at DCFC sites, providing for greater utilization and beneficial utility revenue.

Inductive Charging. Much of recent charging technology development has involved conductive charging for both passenger and heavier-duty vehicles, with less attention to inductive charging despite the early lead it enjoyed with inductive "paddle" chargers in the late 1990s. A number of wireless charging companies and auto OEMs have worked on making inductive charging more viable over the last decade,

[20] https://insideevs.com/news/372749/charin-hpccv-over-2-mw-power/
[21] https://www.charinev.org/fileadmin/HPCCV/High_Power_Commercial_Vehicle_Charging_Requirements_v2.0.pdf
[22] https://www.openchargealliance.org
[23] https://shop.tesla.com/product/chademo-adapter
[24] https://cleantechnica.com/2020/02/17/largest-ev-fast-charging-station-in-the-us-opens-in-pasadena-california/

but aside from a few demonstration projects, commercial scale projects have been limited. Most recently, however, the Antelope Valley Transit Authority (AVTA) in California installed inductive chargers for in-route charging of its electric fleet of 50 buses including both 40-foot and 60-foot articulated buses, in daily operations. Many inductive chargers have been installed, with a total of fifteen (15) 250kW wireless charger installations expected by April, 2020. Clearly, if this technology works well at 250kW, it will become a viable option for charging smaller vehicles as well, but requires the inductive charging mechanisms to match on both the vehicle and the charger embedded in the ground. As such, the initial applications for inductive charging are likely to occur where both decisions are made by a single decision maker (such as public and private fleets). Initial concerns include higher power losses when compared to conductive charging, and its durability and performance in harsher weather climates, including colder temperatures and snow/ice. Avista will monitor the progress of inductive charging closely as it could affect EVSE deployments needed in the marketplace, as well as to inform and assist potential commercial customers as appropriate where opportunities emerge.

Light-duty EV Market and Consumer Preferences.

Key considerations for passenger vehicle buyers include the items listed below. Each of these considerations is probably a “gating” factor – if each item can’t be met satisfactorily, car buyers are not likely to proceed with an EV purchase.

- No range anxiety. Over 300 miles of range on a full charge probably eliminates most concerns over range.
- Charging locations - at home, at work, in the community near home, and in other destinations in the area as well as along longer trip routes
- Style of vehicle – sedan, crossover, SUV, truck etc.
- First Cost (purchase price) of an EV compared to an equivalently sized and featured ICE vehicle
- Fuel and maintenance costs for electricity compared to gasoline/diesel

There are currently over 40 passenger EV models available in US markets (including both PHEV and BEV). Another 20 different models are expected in the next two years, including more light duty passenger, and pickup trucks.[25] More delivery vans, transit and school buses, and heavier duty (Class 6-8) vehicles are being either prototyped or placed in commercial service.

[25] https://www.latimes.com/business/story/2020-01-17/ev-sales-fizzle

In the passenger market, almost all traditional OEMs have limited EV production runs and have not made great strides increasing EV sales recently. Tesla, coming from a technology background, is a noticeable exception. They successfully captured the "EV lifestyle" attractive to key early adopter customer segments with a product line that fundamentally started fresh, as opposed to electric versions of ICE models offered by legacy auto OEMs. About half of the 325,000 U.S. EV sales in 2019 occurred in California. Of total EV sales in the U.S., Tesla's three models accounted for 192,500, of which the Model 3 accounted for 158,925 vehicles.[26] While not a traditional OEM, Tesla is clearly the market leader with a 59% market share of all new EVs sold in 2019. Utilities cannot ignore the fact that among their customers choosing to buy an EV, a large majority are buying Tesla products. In the case of Spokane County, 70% of new EVs were Tesla models, with customers buying these vehicles online, accepting delivery outside the Spokane area, and driving them back home.

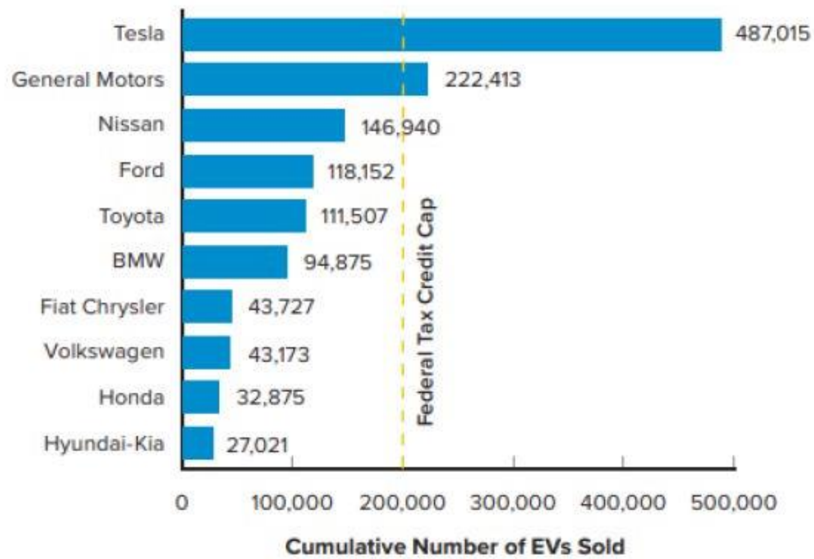


Figure 7: Total EV sales in the U.S by manufacturer, through 2019 (source: EEI)

Announced Investments by Auto OEMs in Electric Vehicles. Many auto OEMs have announced a significant increase in the number of electrified models made available over the next 5 years, such as the Tesla Model Y compact SUV, Ford's new Mustang Mach E, the Volvo XC40 compact SUV, a plug-in version of Toyota's best-selling RAV-4 compact SUV, and an electric SUV from Rivian, a U.S. startup that is also working on custom-designed delivery vans for Amazon. Of particular interest to Avista's customers more interested in pickup trucks are Ford's plans for an electric version of its F-150 pickup truck on sale starting in 2021, General Motors plans to offer a Hummer electric pickup truck starting in 2022, and Tesla's Cybertruck with orders being taken now for deliveries starting in late 2021.

First Cost. There have been a variety of studies published over the years on when EVs will be sold at the same initial cost as their ICE counterparts. In a March 2019 study, McKinsey estimated a $12,000 cost difference between an average EV and comparable vehicles powered by internal combustion engines in the small- to midsize-car segment.[27]

[26] https://insideevs.com/news/392372/us-tesla-sales-graphed-through-q4-2019/
[27] "Making electric vehicles profitable", McKinsey & Company, March 2019.

McKinsey further identifies cost-reduction measures that could achieve relative cost parity in 2025. ICCT, in a 2019 study, concluded electric vehicle initial cost parity coming within 5-10 years, with 2024-25 for shorter range and 2026-28 for longer range electric vehicles, applying to typical electric cars, crossovers and SUVs.[28]

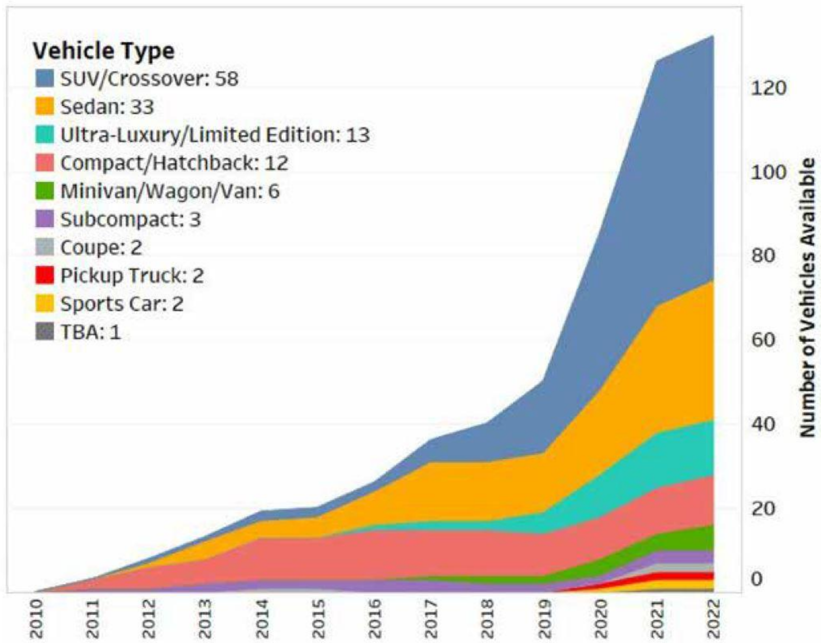


Figure 8: EV model availability (source: 2019 EPRI consumer guide to EVs)

While most consumers consider initial cost as the key factor when acquiring a personal vehicle, the economic comparison between an EV and its ICE counterpart is clearer when the total cost of ownership (TCO) is considered. For drivers with high mileage driving, there is probably total cost parity already today for drivers with over 30,000 miles annually; in the 2022-24 timeframe for drivers averaging 20,000 miles/year; and clearly by 2025 for almost all other drivers. Avista customers that drive for Transportation Network Companies (TNC) such as Lyft and Uber typically drive a higher number of miles, and they may be a strong initial market for EVs if these drivers see robust charging infrastructure in place.

New vehicles, particularly EVs, have significant communications and computational technology in them, allowing for more connectivity with consumer's other electronic devices such as mobile phones, home energy management and security systems, electronic calendars, etc. In some ways EVs are like a powerful new mobile communications platform with a motor and wheels.

More vehicle OEMs are expected to offer information on their EVs and market directly to consumers via web and social media. Tesla only offers direct sales to consumers, and Ford recently took the same approach to accept on-line reservations for the upcoming Ford Mustang Mach-E. Consumers appear to be more willing to order or place a deposit for new EVs on-line. If this trend continues, the primary consumer engagement and education touchpoint will shift away from the dealership. Avista will be monitoring this trend along with EV inventory and sales at area dealerships to help identify the most cost-effective methods to share information on electric vehicles with its customers.

[28] Update on electric vehicle costs in the United States through 2030. Nic Lutsey and Michael Nicholas. Working Paper 2019-06. The International Council on Clean Transportation.

Other consumer and market trends of interest include the rate of driver licenses among younger generations, which has been declining in recent years, and the growth of car-sharing services such as ReachNow or car2go, and of ride-sharing such as with Uber and Lyft software platforms.[29,30]

Medium- and Heavy-duty Vehicle Electrification

Avista intends to monitor industry adoption of medium- and heavy-duty electric vehicles, learn from other utilities serving these applications, build on this information with pilots when appropriate, and adopting best practices as they become known and feasible. Amazon is a good example of public corporate commitments to fleet electrification, which recently pledged to purchase 100,000 electric delivery vans by 2030.[31] Amazon's initiative is part of a plan to convert its entire delivery fleet to using 100% renewable energy by 2030. Upfront costs associated with electric trucks and buses are expected to decline significantly through 2030 as battery prices fall, making them competitive on a total cost of ownership (TCO) basis.[32] According to Atlas Public Policy, estimated parity timelines are imminent for electric transit buses, in the 2025-30 timeframe for electric school buses, and after 2025 for electric trucks. Key factors influencing these timelines include battery costs, availability of public incentives and fuel cost savings over significant annual distances travelled compared to their ICE counterparts.

Mass-transit battery electric buses (BEBs). A number of transit agencies have adopted plans to switch to a zero-emission vehicle fleet by the 2030-40 timeframe. In addition to "brand new" buses, several mass transit districts are converting used buses from diesel to electric, leveraging existing bus chassis, and reducing the cost of an electric bus. In Avista's service territory, STA and Pullman transit have initiated the deployment of BEBs. Avista will work closely with these and other transit agencies to understand the realities of technology and operational limitations, trends, and market barriers that the Company can help address. This includes load management technologies, optimal rate design, and charging technologies including overhead conductor and underground inductive power transfer.

Electric School Buses. Dominion Energy is currently implementing a program to bring 50 electric school buses to 16 localities within Dominion's Virginia service area.[33] Locations were selected on the basis of benefits the batteries in the buses could bring to Dominion's distribution grid. Thomas Built buses were chosen as the supplier in phase one of the project. These 50 buses will be configured with 220 kWh of battery energy capacity each, and an operating range of up to 134 miles, charged overnight using a 60kW DC fast charging system.[34] The buses are expected to provide environmental and health benefits through reduced emissions and reduce operation and maintenance costs for schools by up to 60 percent. In subsequent phases, Dominion plans to expand the program to bring at least 1,000 additional electric school buses online by 2025. Once phase two is fully implemented, the buses' batteries could provide enough energy to power more than 10,000 homes. Phase three would set the goal to have 50 percent

---

[29] Recent Decreases in the Proportion of Persons with a Driver's License across All Age Groups, Michael Sivak and Brandon Schoettle. University of Michigan Transportation Research Institute, January 2016.
[30] Cracks in the ridesharing market—and how to fill them." McKinsey & Company, July 2017. Available at: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/cracks-in-the-ridesharing-market-and-how- to-fill-them
[31] https://sustainability.aboutamazon.com/sustainable-transportation
[32] Electric Trucks and Buses Overview - The State of Electrification in the Medium- and Heavy-Duty Vehicle Industry. Conner Smith. Atlas Public Policy. July 2019.
[33] https://news.dominionenergy.com/2020-01-16-Dominion-Energy-Moves-Forward-with-Electric-School-Bus-Program?printable
[34] https://thomasbuiltbuses.com/bus-news-and-events/news/thomas-built-buses-jouley-selected-for-2019-12-17/

of all diesel bus replacements in Dominion Energy's footprint be electric by 2025 and 100 percent by 2030.

Electrification of other medium- and heavy-duty vehicles is increasing in the United States, particularly in California. High upfront costs and lower levels of commercialization for all vehicle categories other than transit buses and have limited deployment to date. Increasing investment in the sector from public and private sources, however, is expected to generate growth and significantly increase the number of commercial electric vehicles of these higher classes in the near term. Initial deployments of heavy-duty electric trucks (Class 6-8) will have a 150-250 mile range, with use cases characterized by dedicated, known routes, consistent charger locations, and relatively predictable environments. It is unlikely the first round of heavy-duty electric trucks will be used in long-haul (cross-country) applications. Class 3-5 markets may be well suited for electrification, as these vehicles are used primarily for deliveries with a larger number of stop-and-go events. Also, the elimination of idling (less exhaust and noise) may be desirable benefits for certain applications. For similar reasons, truck stop and refrigerated trailer electrification may grow substantially over the next decade, and may be appropriate areas for extending utility fleet support programs in the future.

Other Technologies and Market Opportunities

Eventually, OEMs may deliver electrified vehicles that go beyond basic transport needs, such as providing grid benefits in the form of emergency back-up power, and possibly bi-directional power transfer or vehicle-to-grid (V2G) capability, economically deployed at scale. Combined with advanced software platforms, hardware and standards enabling efficient transactions and holistic management of local distributed energy resources (DERs), energy storage, and other flexible power demands, a much more resilient and integrated grid of the future could be realized.

Micro-mobility or "last mile" innovations such as the Lime electric scooters and bicycles could continue to grow, providing a good opportunity to partner with local government in reducing traffic congestion and local air pollution.

R&D associated with aircraft, rail, and marine electrification is also on the rise, with longer timeframes anticipated for commercial deployments. However, these areas may also present a good opportunity for a pilot test in the 2025 – 2030 timeframe. For example, smaller electrified passenger aircraft may help expand regional air transportation, relieve traffic congestion at larger hub airports, and improve travel times, costs and reduce pollution from air transportation before the end of the decade.[35] In this area, Avista has been involved with the Washington State Electric Aircraft Working Group and will continue to monitor developments and provide support as requested.

[35] "Washington State Electric Aircraft Working Group Report." Washington State Department of Transportation (2019).

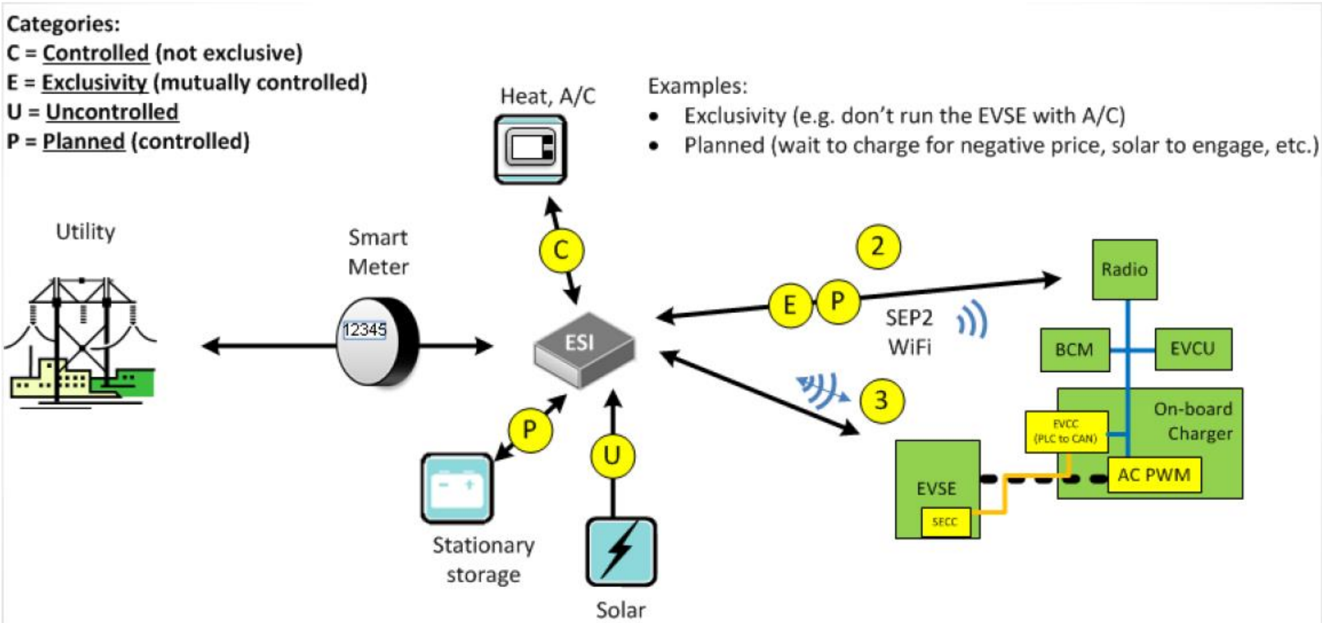


Figure 9: Home or building area network integrated with the grid (Society of Automotive Engineers, SAE J2836/1)

Finally, large global investments in autonomous electric vehicles (A-EVs) may eventually result in profound disruptions in the transportation sector. AVs are present today in limited applications, however a number of major challenges remain to achieve fully autonomous vehicles including advanced sensors, communications, and artificial intelligence, which can reliably perform in the full spectrum of operational conditions. If successful, fully autonomous A-EVs could dramatically change the way we carry out our daily lives – reducing vehicle ownership, freeing up personal time, saving overall energy consumption, and avoiding major human injuries and fatalities – while significantly reducing transportation costs.[36,37] In this area, Avista will continue to monitor developments including the Autonomous Vehicle Workgroup in Washington State, providing support as requested.

[36] Arbib, J. and Seba, T. "Rethinking Transportation 2020 – 2030: The Disruption of Transportation and the Collapse of the Internal-Combustion Vehicle and Oil Industries." Rethink X (2017).
[37] "Autonomous Vehicle Work Group 2019 Annual Report." Washington State Transportation Commission (2019).

Environmental, Economic and Grid Impacts

The transportation sector distinguishes itself in that it uses petroleum as a nearly exclusive source of energy, and has the highest rejected energy to useful energy ratio of all major sectors of the economy. As a result, a very high percentage of overall air pollution and greenhouse gas emissions (GGEs) originate from transportation. This is depicted in the following illustration, showing overall energy sources and consumption in the U.S. economy.

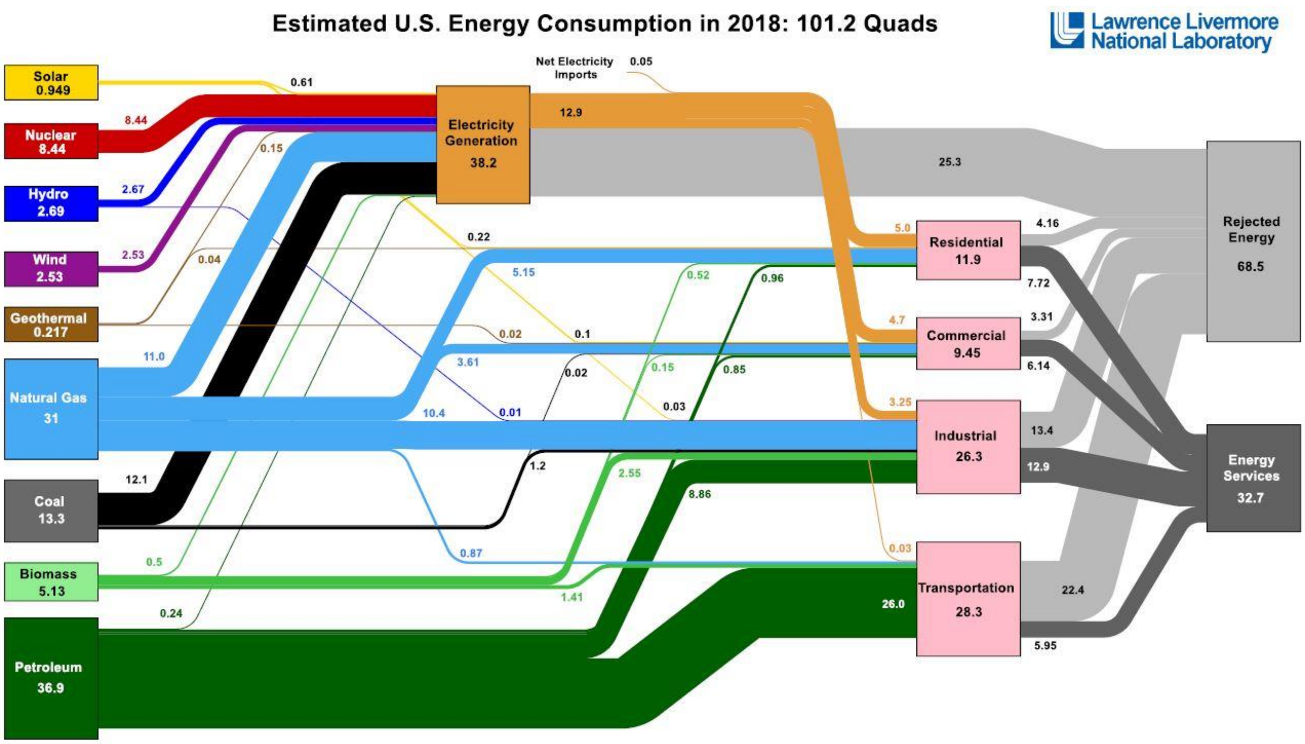


Figure 10: U.S. Energy Consumption - the transportation sector is powered almost exclusively by petroleum, with a high percentage of rejected energy (source: Lawrence Livermore National Laboratory)

In the Pacific Northwest, hydropower is readily abundant and used to a much larger extent than the average depicted above for electric generation. Avista's electricity is generated from a mix of resources, mostly hydropower for base load and natural gas during times of peak load demand. These relatively clean sources of energy result in 565 lbs CO_2 emissions per MWh and about an 80% reduction in air pollution and GGEs for electrically powered transportation in our area, compared to petroleum fueled transportation. As coal is phased out and more renewables are added to the generation mix, emissions from electricity generation may be expected to be reduced even further in the future. Overall, given that close to 50% of CO_2 emissions originate from the transportation sector in the Pacific Northwest, transportation electrification may be the most impactful of all efforts in reducing GGEs in our area.

But how might transportation electrification affect the utility grid? Can the utility keep pace with this new demand, and extend benefits to all customers? These questions are explored below, starting with a basic introduction to the electric utility grid.

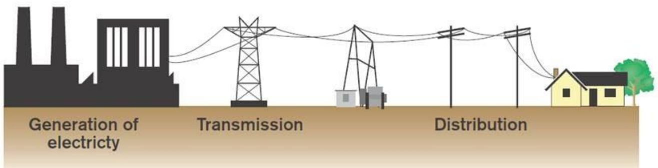


Figure 11: Utility grid - generation, transmission, and distribution systems (source: USDOE)

The grid is delineated by three major systems – generation, transmission, and distribution. On Avista's grid, generation power is stepped up to high AC voltages of 115kV or more, traveling long distances on the transmission system before the voltage is stepped down in distribution substations, typically to 13.5kV using 30MVA transformers. Each substation commonly has one to three feeder distribution lines that each usually run 3 to 5 miles in urban areas and 15 to 20 miles in rural areas. Power is distributed on these feeders from the substation to service transformers that step down voltage again and supply one or more service points, which are defined as the connection point at the customer meter. Most service transformers on Avista's system serve one to ten service points in residential neighborhoods, with an average of four.

Modeling by E3 for the Pacific Northwest region and independently by Avista for its service territory indicates that light-duty EV adoption at baseline or higher levels over the next 20 years will provide net benefits over costs, in terms of both regional economic and utility customer perspectives. Regional economic benefits are mostly due to major fuel savings of EVs. Both regional and utility customer costs are dominated by the additional generation capacity required to serve new EV loads, compared to very small distribution costs. No impact is expected on the transmission system due to EVs in the foreseeable future. The analysis that follows includes details of distribution grid impacts, the results of E3s Pacific Northwest economic modeling, and Avista's economic modeling.

Peak Native Load	1,716 MW
Total Generation Capability	1,858 MW
Circuit miles of Transmission Lines	2,770
# of Distribution Substations	170
Circuit Miles of Distribution Feeders	5,429
# of Service Transformers	88,783
# of Retail Electric Meters	384,838
Annual kWh per Residential Customer	10,658

Table 3: Avista's Electric Grid - Quick Facts

Distribution Grid Impacts

A first order analysis of light-duty EV loads on distribution transformers was conducted for three different scenarios. The first scenario assumed a single EV load of 6.6kW serviced by each transformer in addition to existing loads, which equates to a roughly 25% EV adoption rate. The second scenario assumed 50% of service points with an added EV load of 6.6kW, and the third with 100%.

The electrical power demand on a service transformer from EVs is modeled as:

$$P_{EV\_aggregate} = n_{EV} * EV_{SE} * CF$$

Where:

$P_{EV\_aggregate}$ = Additional power demand created by simultaneous EV charging

n_{EV} = number of EVs downstream of a given service transformer

EV_{SE} = Power required to charge a single EV = 6.6 kW
CF = coincidence factor = 0 to 1

The CF is the percentage of simultaneous EV loads on a given transformer, compared to the sum of all potential loads. As more EVs are served by a single transformer, the maximum load on the transformer increases up to a limit governed by the CF. The CF curves used for transformer loading are based on industry and utility standards, and are directly related to the number of service points with EVs served by the transformer.

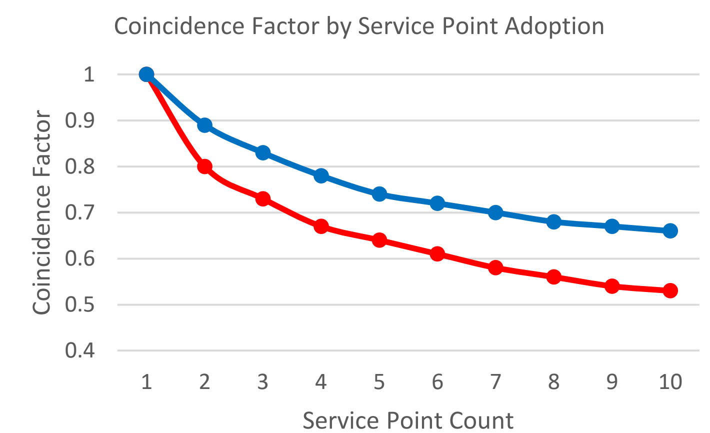


Figure 12: EV charging coincidence factor used in economic modeling

Estimated transformer replacement costs of $3,516 for underground transformers and $2,318 for overhead transformers include material and labor costs but do not include additional costs such as replacing or installing new pole arms, cutouts, arrestors, brackets or upsized distribution poles which may occur depending on the situation.

In the first scenario, a single EV load of 6.6 kW during peak hours was appended to each transformer's existing peak load, for 88,783 transformers sized between 15 to 100 kVA, each with 10 or fewer service points. A single EV served by each transformer is equivalent to an overall EV adoption rate of 23% of vehicles in service (as distinguished from the % of sales). As a result of this load which represents a high adoption level forecasted to occur many years after 2030 even in a high adoption scenario, only 5.9% (5,280 of 88,783) of residential transformers exceeded their overloading limits as determined by IEEE Std C57.91.[38]

In the second and third scenarios, applying EV loads to 50% of service points on all transformers caused the peak load to exceed the failure threshold on 19.7% of transformers, compared to a 30% failure rate for the scenario with 100% EV service points. Upgrade costs for the 50% and 100% adoption scenarios were $46.9 million and $72.6 million, respectively.

[38] IEEE C57.91-2011 – Guide for Loading Transformers and Step-Voltage Regulators. https://standards.ieee.org/standard/C57_91-2011.html

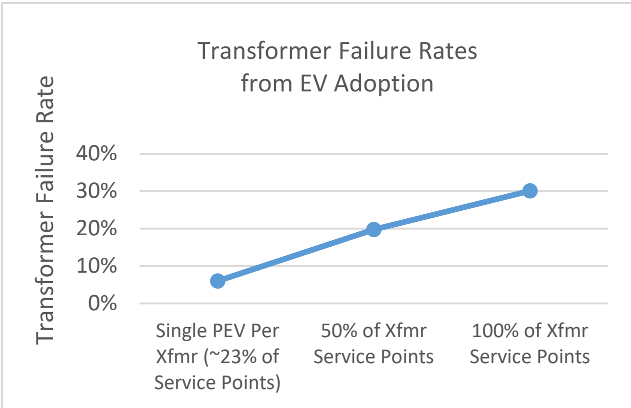


Figure 13: Failure rate of residential transformers from EV loads

Note that unusual situations that could alter charging behavior were not modeled. For example, a higher level of EV charging might occur before a major storm if customers felt there was a risk of pending power outages, which could cause additional transformer overloads and failures. Also, it was assumed that only one EV will charge at a time at a given residence, even though at high EV adoption rates many households would have more than one EV, and some of them may choose to install multiple EVSE so that both EVs could charge simultaneously.

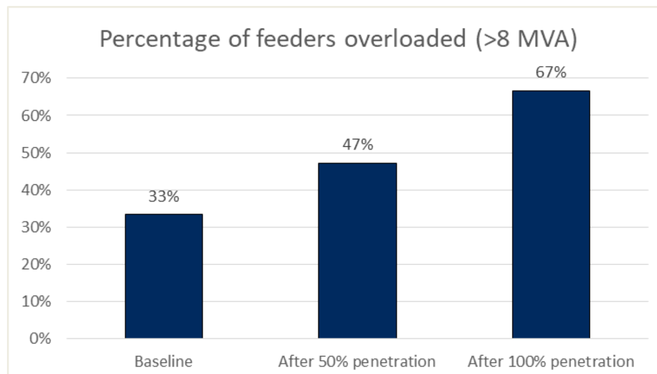


Figure 14: Distribution feeder overloads from EV loads, assuming all other loads held constant

Feeders are typically designed and built with 10 MVA capacity, ideally operating at 6 MVA with overload concerns at 8 MVA. Assuming uninfluenced EV load profiles, first-order analysis of a sample of Avista's feeders showed 33% were overloaded assuming baseline EV adoption and all other existing loads held constant, rising to 47% overloaded with 50% EV adoption, and 67% with 100% adoption. Reconductor costs for urban feeders average $400k per mile, compared to $300k per mile for rural feeders. In turn, impacts to feeders can result in impacts to substations, with the need to increase the number of feeders or in some cases build a new substation, at an average cost of $2.5M per substation.

Note that second-order effects arising from the system's ability to "backfeed" distribution feeders in the event of issues and repairs is very important in determining actual overloads and projected costs, which requires a more sophisticated level of modeling. In addition, detailed information at many points in the distribution system for existing loads and forecasts are needed to project feeder and substation impacts from EVs with more certainty.

Based on analysis of detailed feeder-level data for four utilities in the Pacific Northwest, E3's study showed an average distribution cost of $27 net present value (NPV) per EV over the 20-year timeframe from 2017 to 2036. In other words, an NPV of $27 represents the total additional costs to the distribution system over the 20-year time frame of the study, for each EV during that time. Avista's independent analysis indicates an average distribution cost of $38 NPV per EV over a similar 2019-2038 time period. In both studies, similar assumptions were used for baseline EV adoption, EV purchase costs, fuel costs, etc. However, the model's calculation methods and algorithms were developed independently. Please see the EVSE Pilot final report for more details on modeling assumptions.

The relatively low EV impacts on the distribution grid as predicted by both models reflect the assumptions of modest baseline EV adoption, and reduced distribution peak loads as a result of ongoing energy efficiency and conservation of other loads on the system.[39,40] Higher levels of EV adoption and the sensitivity to energy conservation assumptions could be further explored, as well as important second-order effects on the distribution system beyond a first-order analysis.

E3's Pacific Northwest EV Study (2017 – 2036)

In 2017, E3 completed a detailed study of EV grid and economic impacts in the Pacific Northwest, sponsored by six regional utilities. The study's objectives were to support an understanding of how EV adoption could result in costs and benefits from both a "regional" and a "utility customer" perspective, sensitivity to assumptions, the value of managed charging, CO_2 reductions, and implications for utility planning. In the "regional" perspective, monetized EV costs and benefits that flow in and out of the region are considered, while in the "utility customer" perspective the marginal EV costs and benefits are isolated to the effects on customer utility rates. Over the study's 20-year time horizon, calculated cash flows for each year are translated to an equivalent net present value (NPV) in 2017, using a discount rate of 4.9%. When the NPV of total costs is less than the NPV of total benefits for a given scenario, a net benefit results, and vice versa. Utility costs associated with investments in transportation electrification and load management are not included in these analyses. For more detail including the analytical approach, input variables, and how they are applied in the regional and ratepayer perspectives, please see the E3 report and the EVSE pilot final report.

From a regional perspective, E3 concluded that all regions in the Pacific Northwest showed a net benefit from EV adoption, calculated at $1,941 NPV per EV for the regional base case scenario. These net benefits were also shown to be most strongly influenced by assumptions of EV adoption, EV purchase costs relative to gasoline vehicles, and gasoline prices. These assumptions result in the largest cost component of incremental vehicle cost, and the largest benefit component of gasoline fuel savings. The analysis further showed that generation capacity cost was nearly equal to energy cost, and distribution costs

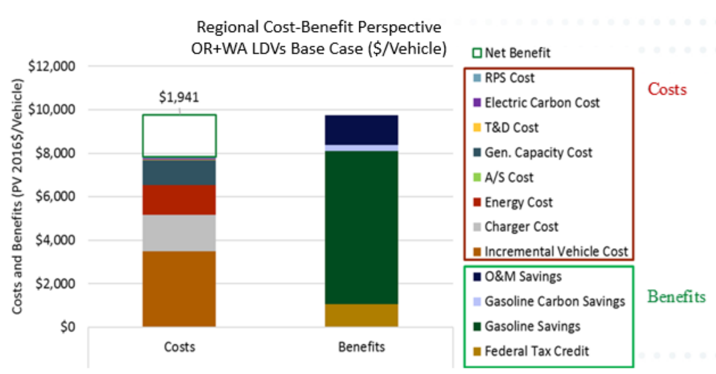


Figure 15: E3 Regional Cost-Benefit

[39] E3 (p.54)
[40] Avista Electric Integrated Resource Plan (2017)

were insignificant. When examining the benefits of managed charging, E3 estimated an additional $500 to $1,700 regional net benefit per EV, with 70% to 90% of the added value from reduced generation capacity costs, and the smaller remainder from energy cost savings. Note that the E3 model is linear and therefore does not include important "interactive" or dynamic effects between input variables, i.e. feedback loops. For example, lower EV purchase costs and higher gas prices would result in higher EV adoption, and vice versa, which greatly affects the cost-benefit result. In reality, these feedback loops are asymmetric in that negative effects such as utility energy and generation capacity costs are mitigated by lower EV adoption, while positive effects such as the benefits of gasoline fuel savings are amplified by higher adoption.

In the "utility customer" perspective, E3 showed that EV adoption would create net benefits for the Pacific Northwest overall, but that results could vary greatly from one utility service territory to the next depending mostly on the particular utility's reserve generation capacity. Wholesale electricity prices were also found to have a significant influence on net results, as they impact generation capacity cost. Utility revenue from the additional metered billing of EVs results in a net benefit over total costs of $387 NPV per EV. When considering the potential value of managed charging, E3 calculated an additional NPV of $400 to $1,600 per EV, as a result of reducing EV loads that occur during "peak" hours, causing increased generation capacity costs. Distribution costs were insignificant in both cases, as modeled in the base case adoption scenario from 2017 through 2036.

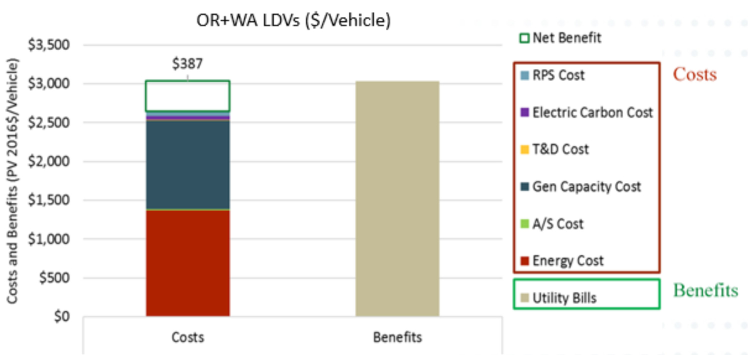


Figure 16: E3 Utility Customer Cost-Benefit

Avista's Study (2019 – 2038)

Following E3's study for the Pacific Northwest, Avista independently developed an economic model that would also calculate EV costs and benefits for the regional and utility customer perspectives, but specific to Avista's grid and service territories, and with the flexibility to alter inputs such as the EV load profiles gathered from the EVSE pilot.

E3 was consulted to confirm input variables over a 20-year time horizon for the Avista model, analogous with the baseline input variables used in E3's Pacific Northwest EV study where EVs reach 15% of light-duty vehicle sales in 2030. A discount rate of 6.58% was used to model Avista's weighted cost of capital.

In this way, Avista's results may be compared to E3's, using similar inputs and independent modeling methods. If the model outputs are reasonably matched, then a form of independent replication is achieved, establishing additional confidence in both E3's and Avista's modeling and results.

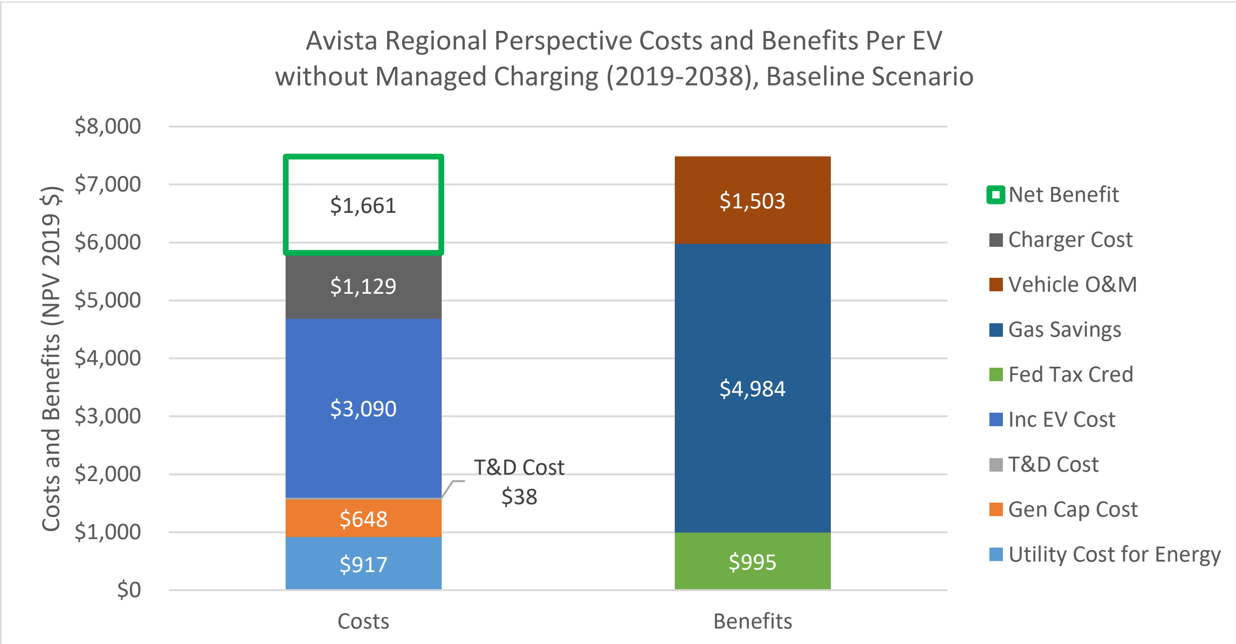


Figure 17. Regional perspective costs and benefits per EV without managed charging 2019-2038

In the regional perspective, Avista's model results in a net benefit of $1,661 per EV without managed charging, comparable to the E3 result of $1,941 per EV for the Pacific Northwest region. Note that in Avista's model, costs for renewable portfolio standards (RPS), electric carbon cost, and ancillary services (A/S) are not considered, as they were shown to be negligible in E3s results. Similar to the E3 study, Avista's regional costs are dominated by the incremental EV cost, and benefits from fuel savings. In addition to the embedded utility energy costs consistent with Avista's IRP assumptions, additional utility costs to serve the new EV loads come primarily from generation capacity costs at $648 per EV, with only $38 per EV from distribution costs. Note that while they are tangible and important benefits to the region, this study does not include a monetized value for societal and health benefits resulting from reduced GGE emissions and local air pollutants.

When managed charging is included, regional net benefits increase $464 per EV to a total benefit of $2,125 per EV. This assumed 75% of the residential peak load was shifted to off-peak from the hours of 4pm to 8pm year round, as was demonstrated in the EVSE pilot. Most of the additional benefit comes from reduced generation capacity costs. This is comparable but slightly below the range of E3's regional net benefit from managed charging, at $500 to $1,700 additional benefit per EV. Additional benefits in the Avista model could be realized with more peak load shifting, as may be possible. Nominally divided by an assumed 10 year life of an EV, these results mean that the cost to implement load management per EV over the 20-year timeframe considered, must be less than $46 per year using Avista's result, or between $50 and $170 per year using E3's results, in order to achieve additional regional net benefits from managed charging.

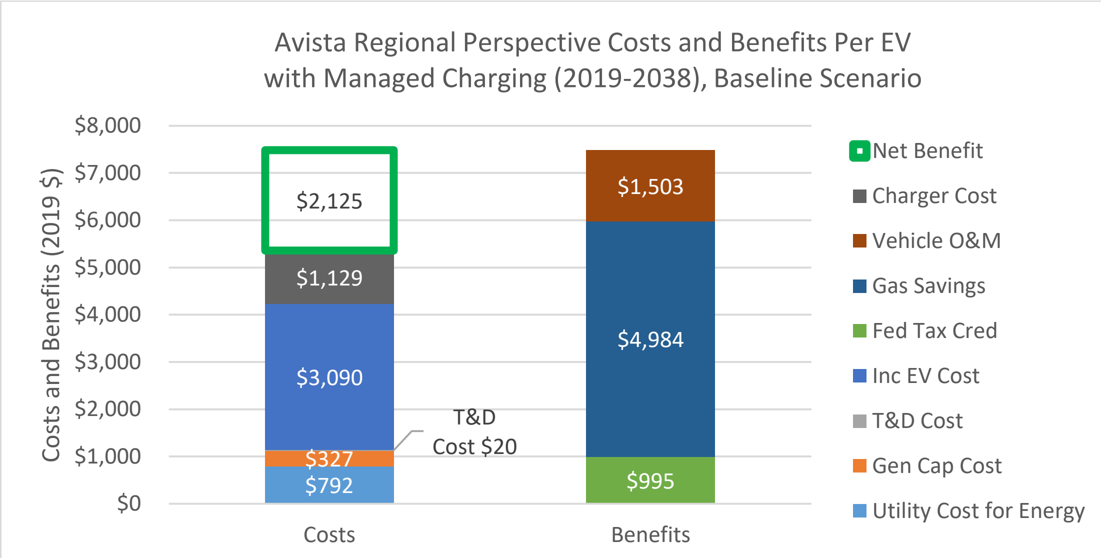


Figure 18: Regional perspective costs and benefits per EV with managed charging 2019-2038

Using Avista's model for the Utility Customer Perspective baseline scenario without managed charging, a net benefit of $1,206 per vehicle is realized, significantly higher than E3's result of $387 per vehicle. This is due mostly to the lower generation capacity costs in Avista's model, where Avista is long on generation capacity until 2027.

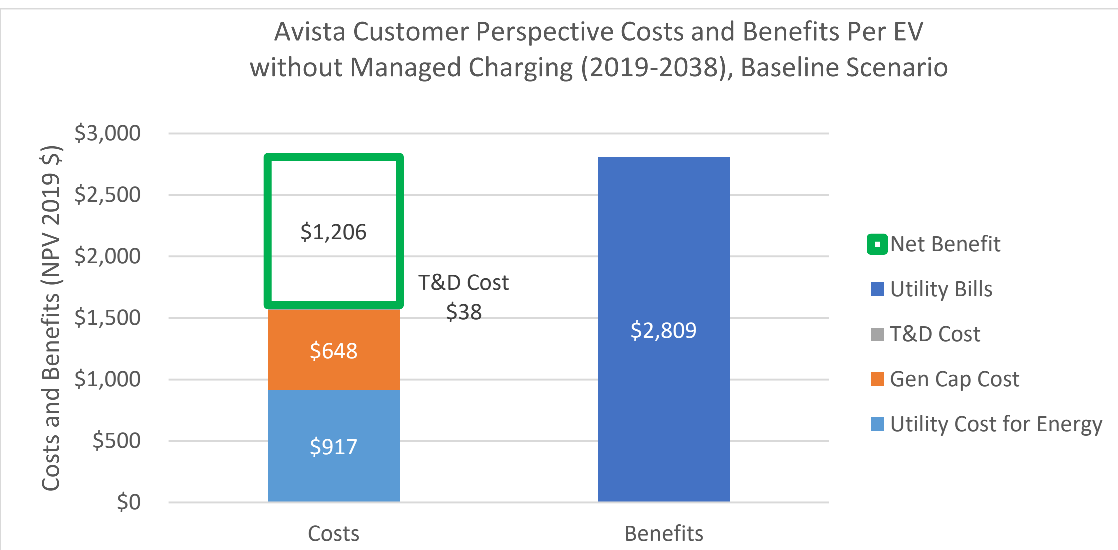
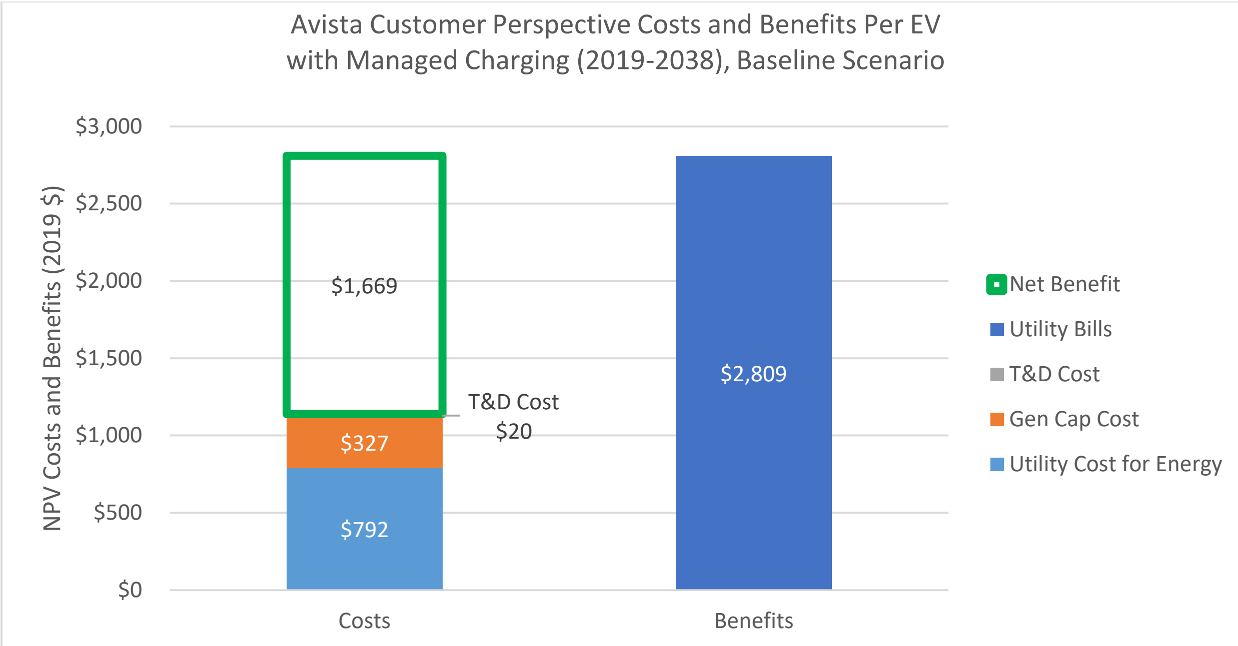


Figure 19: Utility Customer Perspective costs and benefits per EV, without managed charging 2019-2038



Considering the Utility Customer Perspective with managed charging, Avista's model results in additional net benefits of $463 per EV. Again, this is mostly due to reduced costs of generation capacity, assuming 75% reduction of residential peak loads from 4pm to 8pm. Given the assumed 10-year service life of EVs, actual costs to implement load management would reduce the net benefit, and would need to be less than $46 per EV per year, to result in a net benefit increase. Note that similar cost reductions that could result from implementing a TOU rate, would also have the effect of reducing benefits from utility billing revenue and corresponding net benefits.

In summary, this analysis indicates that grid impacts from light-duty EVs are very manageable over at least the next decade, net economic benefits can extend to all customers not just to those driving EVs, and significant reductions of greenhouse gas emissions (GGE) and other harmful air pollutants may be achieved with electric transportation. Significant additional benefits may be realized by shifting peak loads in the longer term with higher EV adoption, probably through a combination of TOU rate design and effective load management programs. However, results also show that the costs to implement load management must be on the order of $50 to $150 per EV, per year, in order to result in additional net benefits over at least the next decade. Beyond this timeframe as EVs represent 30% or more of vehicles on the road, the impacts of peak load could become more significant, making effective load management more important. Therefore, it is prudent for the utility to continue developing load management capabilities in order to cost-effectively mitigate EV peak loads and resultant costs in the future.

This analysis represents a good start in the evaluation of long-term environmental, economic and grid impacts. Further monitoring, data collection and analysis will refine and adjust estimates as the market, technologies, and the grid evolve, including utility costs to utilize more renewables. The next section on Costs and Benefits will more closely evaluate utility expenses and revenues over the 2020 – 2030 timeframe, which include utility investments in Transportation Electrification according to this Plan.

Costs and Benefits

This section provides estimates of Avista's costs to implement the Transportation Electrification (TE) Plan, and benefits in the form of utility revenues from EV charging, net of expenses to generate and deliver electricity. Estimated benefits are also summarized for customer transportation cost savings and avoided CO_2 emissions.

The table below lists the estimated costs to implement the TE Plan over the next ten years. This follows from the strategy and approach explained in previous sections, where a baseline level of supporting programs ramp up initially and are assumed to increase at approximately 15% per year to match an expected market transition in the 2023-2024 timeframe, leading to stronger EV adoption thereafter. Please note that these figures are estimates and will vary from actuals depending on a number of factors including EV adoption, customer participation rates, and regular program adjustments to market conditions, especially for later years in the 10-year time horizon as shown.

Table 4: Estimated Transportation Electrification Plan Costs from Utility Capital Investments and Operation & Maintenance Expenses, 2020 - 2029

Year Ending	Capital Investments	Allowed Capital Investment Return	O&M Expenses	Total
2020	$300,000	$32,720	$150,000	$482,720
2021	$2,269,000	$276,920	$620,000	$3,165,920
2022	$2,909,350	$566,214	$713,000	$4,188,564
2023	$3,645,753	$904,094	$819,950	$5,369,796
2024	$4,192,615	$1,261,855	$942,943	$6,397,413
2025	$4,821,508	$1,733,934	$1,084,384	$7,639,826
2026	$5,544,734	$2,337,481	$1,247,041	$9,129,256
2027	$6,376,444	$3,092,213	$1,434,098	$10,902,755
2028	$7,332,910	$4,020,810	$1,649,212	$13,002,933
2029	$8,432,847	$5,149,351	$1,896,594	$10,329,441

These calculations assume an 8.18% rate of return on capital investments. This is based on a weighted cost of capital that includes the 2% incentive rate of return on equity, as authorized in Washington for capital investments in Transportation Electrification.

The following table summarizes estimated utility costs on a per MWh basis, according to the 2020 Electric Integrated Resource Plan (IRP).[41] This shows that starting in 2026, projected capacity will be short of demand and will at that point incur additional costs starting at $108/kW-year. In addition, the "clean premium" is the estimated incremental cost to comply with the Clean Energy Transformation Act (CETA) in Washington.

Table 5: 2020 IRP Energy Costs

Year	Energy Flat (MWh)	Energy On-Peak (MWh)	Energy Off-Peak (MWh)	Clean Premium (MWh)	Capacity ($/kW-Yr)
2021	19.67	22.64	15.71	0.00	0.0
2022	19.98	22.75	16.28	11.75	0.0
2023	20.44	23.05	16.98	11.99	0.0
2024	21.61	24.09	18.28	12.23	0.0
2025	22.76	25.19	19.50	12.47	0.0
2026	24.27	26.40	21.43	12.72	107.7
2027	23.57	25.27	21.30	12.97	109.9
2028	25.02	26.26	23.35	13.23	112.1
2029	25.92	26.80	24.73	13.50	114.3
2030	26.72	27.08	26.25	13.77	116.6

From these values, utility costs to generate and deliver electricity may be derived given EV load profile data obtained from the EVSE pilot. In addition, benefits in the form of net utility revenues may be calculated, as well as customer fuel and maintenance savings, and avoided CO_2 emissions. These calculations are tabulated below, assuming baseline and high adoption scenarios in Washington for light-duty passenger EVs only. Over time as more information is gathered, this may be supplemented by additional cost and benefit estimates from other transportation electrification loads such as mass transit buses, lift trucks, and other market segments. Values are shown for the estimated number of EV customers in Washington for purposes of clarity in calculating costs, benefits, and net revenue requirements for Washington customers. Note that additional utility costs and benefits result from EV customers in Idaho, but are not shown here. Additional net revenue from EVs that are registered by non-Avista electric customers in the company's service territories, and an unknown number of EVs from outside the area that utilize EVSE in Avista's service territory are also not included.

[41] see www.myavista.com/IRP

Table 6: Key characteristics per light-duty EV (average annual figures)

3,153 kWh	electric energy consumption
0.78 kW	coincident peak demand at 6 pm in January
$304	utility billing revenue
$1,183	customer fuel cost savings
$300	customer maintenance cost savings
4 tons	avoided CO_2 emissions

Note that coincident peak demand at 6pm in January is the governing peak for the year, which drives system generation capacity and delivery costs to meet maximum peak demand. Please also note that these calculations are derived from the uninfluenced average load profile obtained from EVSE pilot data from 2017 – 2019. In the future, EV load profiles may increase both in total energy consumed and in peak demand per EV, as the market trends toward a larger proportion of EVs with larger battery packs. On the other hand, peak loads may be mitigated by a combination of residential EV TOU rates, as well as effective load management programs which continue to be developed and tested according to Plan. Avoided emissions per EV currently stands at 4 tons CO_2 per year, given an electricity generation mix producing 565 lbs of CO_2 per MWh. This should improve over time beyond what is stated below, as coal generation is eliminated and more renewables are used to generate electricity.

Table 7: Baseline EV adoption, annual costs and benefits for Avista Washington customers

Year Ending	# EVs (WA)	Billing Revenue	kWh	coincident kW (January 6pm)	Utility Generation and Delivery Cost	Net Revenue (Offsetting Benefit)	Avoided CO_2 emissions (tons)	Customer transportation fuel and maintenance savings
2020	1,605	$487,814	5,059,470	1,252	$99,534	$388,281	6,419	$2,379,700
2021	2,104	$639,530	6,633,019	1,641	$130,490	$509,040	8,415	$3,119,812
2022	2,737	$831,997	8,629,227	2,135	$172,412	$659,585	10,947	$4,058,720
2023	3,604	$1,095,637	11,363,632	2,811	$232,272	$863,365	14,416	$5,344,835
2024	4,811	$1,462,652	15,170,208	3,753	$327,787	$1,134,866	19,245	$7,135,242
2025	6,504	$1,977,097	20,505,880	5,073	$466,707	$1,510,390	26,014	$9,644,853
2026	8,868	$2,695,754	27,959,585	6,917	$1,423,800	$1,271,954	35,470	$13,150,670
2027	12,135	$3,689,051	38,261,765	9,465	$1,941,717	$1,747,334	48,540	$17,996,257
2028	16,411	$4,988,922	51,743,650	12,801	$2,728,997	$2,259,925	65,644	$24,337,404
2029	21,760	$6,615,031	68,609,191	16,973	$3,718,324	$2,896,708	87,040	$32,270,038

Table 8: High EV adoption, annual costs and benefits for Avista Washington customers

Year Ending	# EVs (WA)	Revenue	kWh	coincident kW (January 6pm)	Utility Generation and Delivery Cost	Net Revenue Offsetting Benefit	Avoided CO_2 emissions (tons)	Customer transportation fuel and maintenance savings
2020	1,678	$510,178	5,291,422	1,309	$104,097	$406,081	6,713	$2,488,798
2021	2,311	$702,678	7,287,975	1,803	$143,375	$559,303	9,246	$3,427,868
2022	3,115	$946,884	9,820,809	2,430	$196,218	$750,666	12,459	$4,619,175
2023	4,262	$1,295,610	13,437,696	3,324	$274,663	$1,020,947	17,048	$6,320,363
2024	5,958	$1,811,376	18,787,072	4,648	$405,934	$1,405,442	23,834	$8,836,419
2025	8,468	$2,574,194	26,698,798	6,605	$607,652	$1,966,542	33,871	$12,557,665
2026	12,179	$3,702,402	38,400,242	9,500	$1,955,470	$1,746,932	48,716	$18,061,389
2027	17,857	$5,428,560	56,303,451	13,929	$2,857,294	$2,571,265	71,428	$26,482,086
2028	26,545	$8,069,581	83,695,360	20,705	$4,414,145	$3,655,436	106,179	$39,365,753
2029	40,235	$12,231,567	126,862,270	31,384	$6,875,379	$5,356,188	160,942	$59,669,123

From these values and estimates for utility capital investments in transportation electrification (TE), revenue requirements may be calculated and compared against the 0.25% annual revenue requirement limit. These calculations also assume an 8.18% rate of return based on a weighted cost of capital including the 2% incentive rate of return on equity authorized in Washington for capital investments in Transportation Electrification. For purposes of meeting the 0.25% limit as defined by law, capital investment depreciation and allowed return on capital investment including the incentive rate of return on equity are included in the revenue requirement calculation for each year, but O&M expenses are not.[42] The Company recognizes that additional TE capital investments that do not receive the incentive rate of return could be pursued, however such additional investments are not proposed at this time.

Assuming that strong utility support and OEM product results in a transition from baseline to high adoption starting in 2023, the corresponding net revenue requirements (RevReq) from TE investments fall well under the 0.25% limit for all years in the 10-year timeframe, as shown in the table below.

[42] Revised Code of Washington (RCW) 80.28.360 (1), https://app.leg.wa.gov/RCW/default.aspx?cite=80.28.360

Table 9: Revenue Requirement from Capital Investments in Transportation Electrification, compared to 0.25% limit

Year Ending	Capital Investments	TE RevReq without offsetting benefits	Offsetting utility customer benefits	TE RevReq after offsetting benefits	TE incremental % RevReq with offsetting benefits	0.25% WA Electric Revenue Requirement Limit
2020	$300,000	$64,320	$388,281	-$323,961	**-0.06%**	$1,327,500
2021	$2,269,000	$515,922	$509,040	$6,882	**0.00%**	$1,373,963
2022	$2,909,350	$872,666	$659,585	$213,081	**0.04%**	$1,422,051
2023	$3,645,753	$1,288,113	$942,156	$345,957	**0.06%**	$1,471,823
2024	$4,192,615	$1,703,477	$1,270,154	$433,323	**0.07%**	$1,523,337
2025	$4,821,508	$2,241,800	$1,966,542	$275,258	**0.04%**	$1,576,654
2026	$5,544,734	$2,921,526	$1,746,932	$1,174,594	**0.18%**	$1,631,836
2027	$6,376,444	$3,763,865	$2,571,265	$1,192,600	**0.18%**	$1,688,951
2028	$7,332,910	$4,793,210	$3,655,436	$1,137,773	**0.16%**	$1,748,064
2029	$8,432,847	$6,037,611	$5,356,188	$681,423	**0.09%**	$1,809,246

Additional offsetting benefits in the form of monetized revenues or credits from emissions reductions may become available at some point, and if so will be included in future cost and benefit calculations. At higher adoption levels beyond 2030, additional distribution costs in the form of service transformer and feeder upgrades may also become more apparent, at a level of significance to include with the figures indicated above.

Please note that these figures represent only light-duty EV forecasts, cost estimates, and assumptions that are subject to uncertainty. Actual costs and benefits will vary depending on market conditions and commensurate adjustments to program spending. Costs and benefits from other market segments beyond light-duty EVs – such as mass transit buses – are also expected and will be included in future updates to this Plan as more information and experience is gained in these areas.

Analysis and Reporting

This Plan will be updated and re-issued in five year increments, starting in 2025. New program filings may be submitted for regulatory review on an on-going basis and later incorporated in regular revisions of the Transportation Electrification Plan.

A mid-period report will be issued by year-end 2022. Report information will include updates on customer adoption and forecasts, program activities, lessons learned, adjustments, grid impacts, and costs and benefits.

Key metrics and other information will be monitored and reported including:

1. Customer satisfaction
2. Number of EVs by type (light passenger, forklifts, buses, etc) in Washington and Idaho service territories
3. Adoption projections
4. Customer operating cost savings & avoided CO_2 emissions
5. Load profiles for cases of uninfluenced, load management and TOU rates
6. Electric consumption (kWh) and peak load (kW)
7. Grid impacts integrated with overall System Planning and Integrated Resource Plan
8. EVSE installations, costs and % uptime
9. EV TOU rate participation and results
10. Utility spending, revenue, and net benefits including any monetized environmental benefits

Programs and Activities

EVSE Installations and Maintenance

In support of light-duty EV adoption, the measured buildout of EVSE infrastructure is a top priority, especially in workplace, fleet and public DC fast charging (DCFC) sites. This is because of the powerful support for adoption and inherent grid benefits that workplace and fleet charging provide, and the increasing need for public DCFC as the light-duty market develops.

In addition to public DCFC and AC Level 2, workplace, and fleet, Avista's EVSE portfolio is rounded out by residential and MUD programs that support adoption, dealer engagement, and equitable access to EVSE. Residential programs lay a critical foundation for effective load management and grid benefits, in locations where the large majority of EV charging is expected to occur in the future.

Avista can play an essential role to ensure that the right type and amount of charging infrastructure is in good working order, in the right place and at the right time, relative to market needs. This is absolutely critical to enable unimpeded, beneficial market growth. EVSE buildout must be accomplished with a cost effective, portfolio approach – utilizing low-cost and reliable non-networked EVSE where possible – and scaling with market conditions over time so that adequate supporting infrastructure is in place as the market grows, while avoiding over-investment.

In addition to Avista ownership of EVSE, 3rd party ownership is encouraged with supportive utility policies including "make ready" options, and a pilot commercial EV rate applying time-of-use (TOU) energy charges. Ideally, 3rd party ownership will make up 50% or more of EVSE installations. "Make ready" options are available to commercial customers that wish to own and operate EVSE themselves, or act as a site host for other 3rd party ownership. Avista will install required infrastructure to an agreed location for the meter connection, with the utility investment limited to $20,000 per public DCFC site, and $2,500 per commercial AC Level 2 port connection intended for fleet, workplace, public, or MUD primary utilization, in addition to the servicing transformer. This should cover the utility costs for most installations sited reasonably close to required utility power, thereby encouraging cost-effective installs. In these cases, the customer agrees to maintain access and operability of the EVSE for at least 10 years, and may charge a user fee at their discretion. Avista will offer consultation on the user fee which balances owner cost recovery and user acceptance. Until conditions change that warrant reconsideration, Avista will recommend applying the rate of $0.35/kWh as set by the Washington UTC for DCFC owned by Avista.

For details on the commercial EV TOU rate that also supports 3rd party ownership of EVSE, please see the Rate Design section.

EVSE uptime is of major importance to customer satisfaction and mass adoption, at > 99% per charging site. Avista will work with industry partners and contractors to achieve and maintain this performance benchmark.

Public DCFC

Public DCFC will play an increasingly important role for reliable and fast public charging of light duty vehicles, for both longer distance and intra-city travel. Building upon the success of the EVSE pilot, Avista will continue to build out DCFC sites along major travel corridors and in urban areas for public charging. This will be accomplished in partnership with local stakeholders, and in alignment with state agency guidance and the degree to which EV adoption requires support, reviewed on an annual basis. DCFC owned and maintained by Avista will complement DCFC installed outside of Avista's network, in a coordinated way that avoids overlapping coverage and appropriately supports EV adoption, while mitigating the costs and risks of overbuilding too far ahead of market needs and/or risks technology obsolescence and stranded assets.

Prioritized locations for public DCFC sites will be made through a deliberate process involving the WSDOT, regional transportation planners, community leaders, customer feedback, and other key stakeholder collaboration. Siting identification and selections for public EVSE will be prioritized according to assessed criteria including cost, accessibility, nearby amenities, site host commitment, and utilization. Reputable evaluation methods and tools for DCFC siting prioritization will be considered and tailored for use as appropriate, with stakeholder engagement.[43]

Benchmarks for adequate EVSE infrastructure by 2025 include DCFC sites along travel corridors every 40 miles, and in prioritized urban locations for intra-city use at 1 DCFC port per 150 BEVs.[44] Longer term, as markets mature this ratio may be increased to 1 DCFC port per 200 BEVs or more. Based on these benchmarks and baseline EV adoption forecasts, the table below shows the estimated DCFC infrastructure needed by 2025, when the EV market is expected to have reached an inflection point and a lack of public DC infrastructure would seriously impede market growth. This is on the order of 60 new DCFC sites, or 12 DCFC sites per year on average for the five year period from 2020 through 2024.

At an estimated total cost of $150,000 per DCFC site, this equates to an investment of $1.8 million per year and a total of $9 million over five years for 30 DCFC sites. In comparison, Avista installed 7 DCFC sites at an average cost of $128,000 during the three-year EVSE pilot from 2016 to 2019.

---

[43] for example, see "Electric Program Investment Charge (EPIC) Final Report." Pacific Gas and Electric Company (2016).
[44] see Nicholas, et all (p. 13), Wood, et al (p. xi), and "Considerations for Corridor DCFC Infrastructure in California", (p. 11).

Table 10: Projections for light-duty EVs in Avista's service territory and required DCFC in 2025

	BEV	PHEV	Total EVs	EVs owned by Avista electric customers	Corridor DCFC sites	IntraCity DCFC sites	Total DCFC sites needed by 2025	DCFC installed as of 2019	New DCFC Required by 2025
Washington	3,764	2,509	6,273	5,521	25	25	50	9	41
Idaho	1,129	923	2,052	1,313	13	8	21	1	20
Total	4,893	3,433	8,326	6,834	38	33	71	11	60

Avista will plan to install 5 new DCFC sites in 2021 owned and maintained by the Company, ramping to 7 DCFC sites in 2022 and 9 sites in 2023 and 2024 – a total of 30 out of an estimated 60 required sites, or 50% of the estimated market requirement by 2025. Plan adjustments to the number of new sites and expansion of existing sites will be made with stakeholder involvement, based on annual evaluations of EV adoption, respective EVSE market needs, and the number of DCFC installations owned by 3rd parties. Ideally, 3rd party ownership makes up 50% or more of the regional installations, with the support of the "make ready" policy and the pilot EV TOU rate schedule used for public DCFC.

Effective buildout along major travel corridors including I-90, I-95, US 395/195, US 2 and US 12 in Avista's service territory requires extending the initial DCFC network in eastern Washington to target sites in Sprague, Clarkston, Chewelah, Colville, Deer Park, Davenport, Airway Heights, Cheney, south Spokane, and Newport in Washington, as well as Post Falls, Coeur d'Alene, Sandpoint, Bonners Ferry, Spirit Lake, Hayden, Rathdrum, Orofino, and Grangeville in Idaho. The maps below show existing DCFC and a preliminary DCFC buildout plan along major travel corridors in the region and in the Spokane metro area. Note that this is relative to higher traffic patterns shown by red "heat" marks correlating with greater than 25,000 average daily vehicle traffic, and does not include DCFC sites available only to Tesla vehicles.

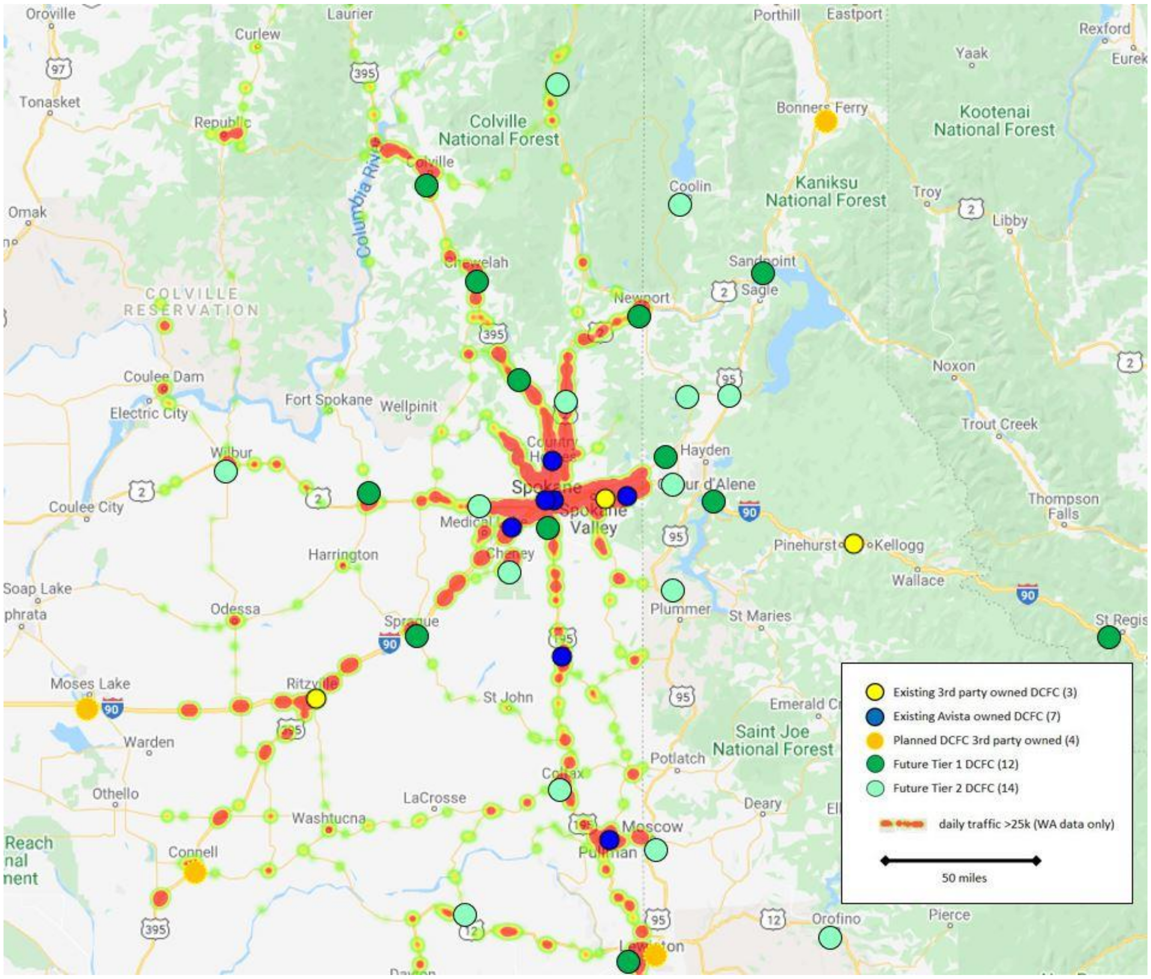


Figure 20: Preliminary DCFC buildout plan for regional travel corridors (2020-2024)

In more populated areas, DCFC buildout is targeted at 1 DCFC site per 150 BEVs registered in each zip code, including DCFC sited at locations supporting TNCs and high-traffic locations, such as at the Spokane International airport and major shopping centers. The map below shows the preliminary buildout plan for the Spokane metro area.

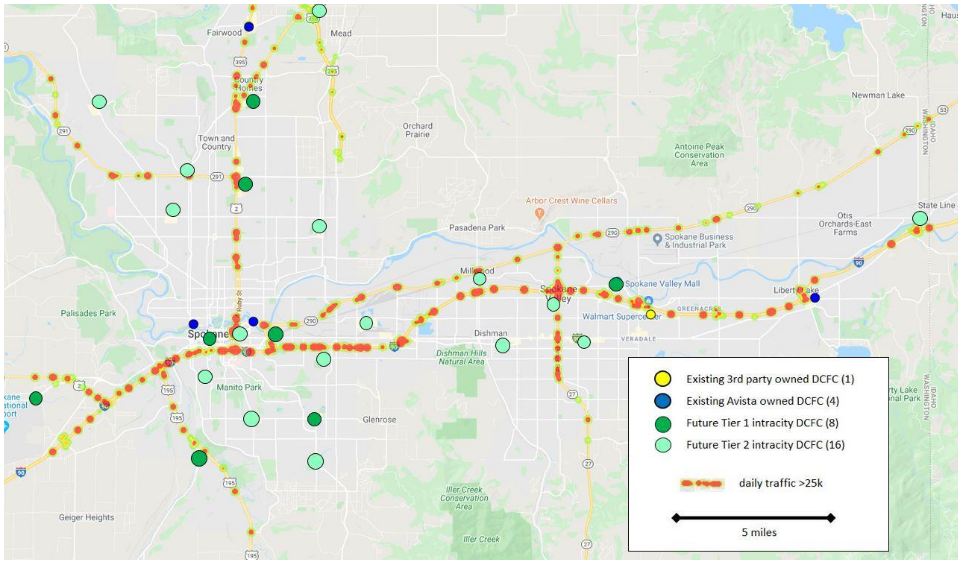
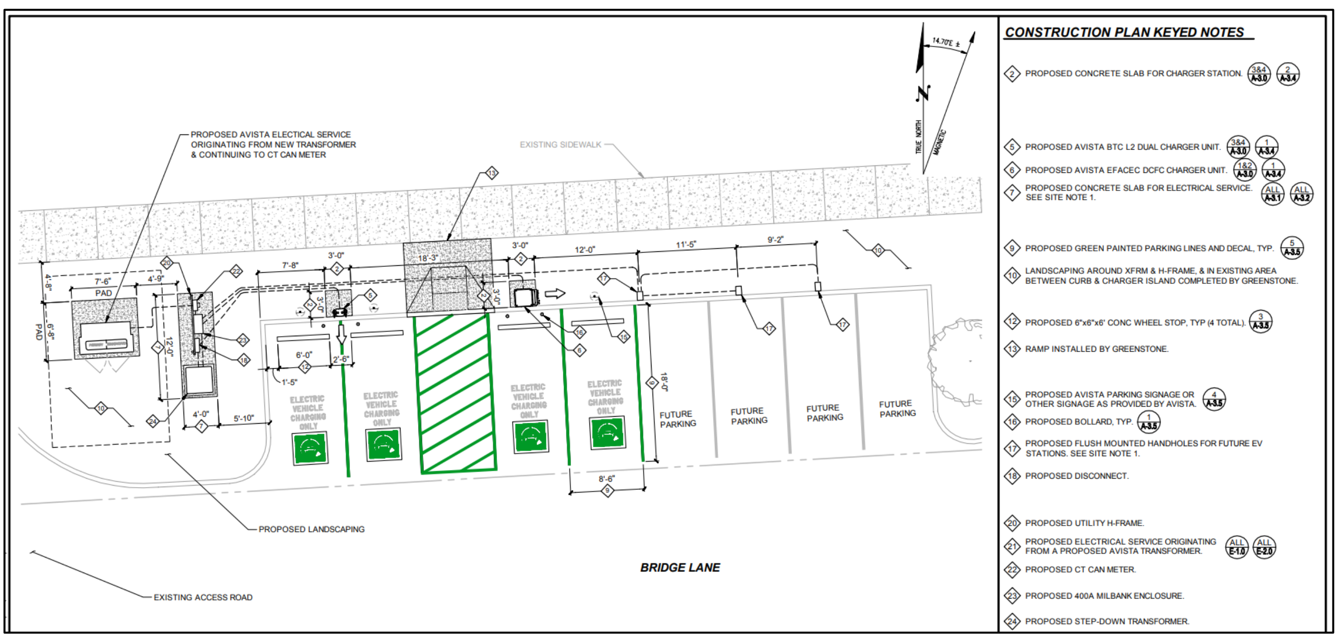


Figure 21: Preliminary Spokane metro area DCFC buildout plan (2020-2024)

DCFC sites should be “future proofed” where practical, with additional capacity allowing for low-cost expansion as EV demand grows. The illustration below shows standard plans for the DCFC sites installed in the EVSE pilot, allowing for low-cost expansion from 50 kW DCFC to 150 kW DCFC, and additional dispenser units and parking stalls in two construction phases.



Standard DCFC installations in the EVSE pilot included a dedicated 225kVA transformer, 50 kW DCFC and a dual-port AC Level 2 backup EVSE in the first phase of construction, serving four parking stalls. Additional infrastructure capacity allows for low-cost expansion in the second phase of construction with an additional 150 kW DCFC, up to three dispenser units, and four additional parking stalls. DCFC sites require both CHAdeMO and CCS combo port connections, allowing for all drivers with different DC port connection standards to use the EVSE (Tesla drivers can use the DCFC with a purchased adapter for the CHAdeMO connector only in North America). DCFC owned and maintained by Avista require a user fee, currently set at $0.35/kWh in Washington state and regulated by the Washington UTC. A property easement or access agreement with the property owner is necessary for DCFC sites, for a period of at least 10 years correlating with the estimated service life of the DCFC equipment. All DCFC will meet network interoperability requirements to help mitigate long-term operational risks, and will include payment capability through credit-card readers so that customers may easily and seamlessly access all DCFC in the network without mandatory network memberships or subscriptions.

For planning purposes through 2025, average cost for DCFC sites is estimated at $150,000 per site, assuming DCFC power delivery at 150 kW or higher, and 225 kVA to 1500 kVA transformer capacity depending on site conditions.

Public AC Level 2

AC Level 2 EVSE are very different from DCFC. They typically deliver less than 7.2 kW of power per port compared to 50kW or more for DCFC, and as a result charging sessions are often much longer than the 30 minute average charging sessions for DCFC. Installation costs are also much lower, at an average of $12,000 per public ACL2 site compared to $128,000 for DCFC in the EVSE pilot.

The appropriate quantity of public AC Level 2 EVSE to support the market over the next five years appears to be on the order of one port per 25 EVs.[45] Given an estimated 8,326 EVs in the region in 2025, this equates to 333 AC Level 2 ports. Subtracting the 78 public ports currently installed in the area yields 255 ports for buildout, or 51 ports per year on average over the five year period from 2020 – 2024. Assuming an average of 2 ports per AC Level 2 installation, gives an estimate of roughly 25 new public AC Level 2 sites needed per year.

Another helpful guideline for public AC Level 2 buildout is related to the geographic distribution and coverage of high-traffic site locations with available EVSE. Customer feedback indicates that public AC Level 2 at all major shopping centers and large grocery stores, as well as major parks and other destinations would be beneficial. Public AC Level 2 EVSE spread throughout the area in smaller rural towns could also provide a beneficial charging network that enables regional EV trips where the user intends to stop for several hours at a given location. This may be accomplished at relatively low installation cost compared to DCFC, and provides more equitable access for early adoption in these areas.

Avista will plan to support up to 12 sites per year for public AC Level 2 buildout in the region, from 2020 through 2024 – roughly 50% of the estimated market need. Application and selection rounds will be made each year, involving local stakeholders including regional transportation planners and community leaders. Selection criteria will be based on factors including cost, access, geographic diversity, nearby driver amenities, projected utilization, and site host commitment. Avista will coordinate installations, covering 50% of premises wiring installation costs up to a maximum of $2,000 per port, similar to the

[45] see Nicholas, et all (p. 13) and Wood, et al (p. xi)

installations completed in the EVSE pilot. This amount may be reduced in the future as market conditions change. Additional conduit allowing for low-cost future expansion will be included where practical.

Non-networked EVSE will be encouraged due to their proven higher reliability and lower costs. However, some site hosts may require the EVSE to transact a user fee or collect data. In these cases, site hosts may choose from networked EVSE certified as meeting interoperability standards, but will be responsible for fees and maintenance associated with the network service provider (EVSP). Site hosts may also set the user fee at their discretion, with consultation available from Avista and the EVSP. This is commonly on the order of $1 to $2 per hour of charging at AC Level 2.

Workplace, Fleet and MUD AC Level 2

Workplace, fleet and multiple-unit dwelling (MUD) EVSE installations are critical to support adoption and provide net grid benefits. Workplace charging in particular is of major importance as it has been shown to be a cost-effective, powerful catalyst for EV adoption, while providing grid benefits by reducing the amount of charging that would otherwise occur during evening on-peak periods.

Avista will support EVSE installations in this category owned and maintained by the utility, accepting customer applications on a first-come, first-served basis subject to eligibility requirements. Avista will cover 50% of premises wiring costs up to a maximum of $2,000 per port, similar to the installations completed in the EVSE pilot. This amount may be reduced in the future as market conditions change. The number of ports and configurations are dependent on site-specific conditions, limited according to the number of existing EVs that will utilize the EVSE and assessments of near-term and long-term adoption potential according to the size of the organization and facility. Where feasible, additional conduit will be installed enabling low-cost future expansion.

Avista will offer a reliable and low-cost non-networked EVSE, typically delivering between 3.3 kW and 7.2 kW per port. In most cases, EVs in these locations may be expected to charge for longer periods of time at lower power levels. Off-peak charging will be maximized by enrollment in load management programs including vehicle programming, non-networked programmable EVSE, and to a more limited degree experimentation using vehicle telematics. In all cases, the customer agreement allows the utility to perform load management where practical for workplace, fleet and MUD sites, and the customer agrees to future application of TOU rates to encourage off-peak charging. In most cases it is expected that lower costs will result from utilizing available capacity in existing supply panels, however those sites with segregated meter service to EV charging loads will be eligible for the pilot EV TOU rate.

In the case of workplace, fleet or public installations, if the customer desires a networked AC Level 2 EVSE that enables user payments, they may choose from certified EVSE that have passed interoperability and reliability testing. The customer will be responsible for any EVSP fees and maintenance, and may set the user fee at their discretion.

Alternatively, customers in these locations may choose to own and operate their own AC Level 2 EVSE, or act as site host for other 3rd party ownership. "Make ready" utility investments as previsously described, and a commercial EV TOU rate are intended to help support and encourage 3rd party ownership.

Residential AC Level 2

The residential EVSE program supports adoption and dealer engagement, and provides a pathway to develop cost-effective load management, where the large majority of charging will occur. Avista will support EVSE installations in this category owned and maintained by the utility, accepting customer applications on a first-come, first-served basis subject to eligibility requirements. Avista will cover 50% of premises wiring costs up to a maximum of $1,000 per port, similar to the installations completed in the EVSE pilot. This amount may be reduced in the future as market conditions change.

For residential installations, a reliable and low-cost non-networked EVSE is installed, with load management achieved by programming the vehicle or the EVSE to charge during off-peak hours. A smaller subset of customers will be enrolled in telematics data collection and load management tests, which will allow for ongoing load profile monitoring and new load management experiments communicating directly with the EV, rather than through a networked EVSE.

Customers may choose a certified EVSE of their choice, but will be responsible for any additional costs including EVSP fees that may apply. In all cases, customers agree to participate in future TOU rates and replacement of the EVSE at Avista's discretion with new products enabling robust load management experimentation.

In the future, Avista may consider a lease and/or rebate program offering for residential customers. For at least the near term, the proposed residential program achieves desired outcomes at least cost, for greater EV adoption, dealer engagement, and load management benefits.

Summary – EVSE Installations and Maintenance

- 40% to 65% budget range
- > 99% EVSE uptime
- Programs support both Avista and 3rd party EVSE ownership, off-peak charging, and customer choice through "make ready" options, load management, and a pilot EV TOU rate.
- Coordinated public DCFC buildout, prioritized and selected with stakeholder engagement – goal is to install 30 new sites owned by Avista by 2025, another 30 owned by 3rd parties. Pilot EV TOU rate schedule applied in all cases.
- Public AC Level 2 selected with stakeholder engagement at 12 sites per year. Avista covers 50% of premises wiring costs up to $2,000 per port, with EV TOU rate applicability.
- Workplace, Fleet and MUD installations on a first-come, first served basis. Avista covers 50% of premises wiring costs up to $2,000 per port, with load management requirements and EV TOU rate applicability.
- Residential installations on a first-come, first served basis. Avista covers 50% of premises wiring costs up to $1,000 per port, with load management requirements and future EV TOU rate applicability.

Education and Outreach

With respect to light-duty passenger vehicles, low awareness of EVs continues to pose significant market barriers, for both residential and commercial customers. This is exacerbated by a persistent lack of new and used EV inventory, and generally low (although improving) interest and engagement of auto dealerships. In 2019, while most area dealerships carried minimal to zero EV inventory, over 50% of EV sales in the region occurred outside traditional dealer channels, through online sales dominated by Tesla, and other used EV sales between private parties. While regional EV adoption rates have increased considerably in recent years, EVs are still less than 2% of new vehicle registrations – far short of entering the mass market at the 15% level.

Customer surveys and interviews showed that Avista's efforts to provide objective information about EVs and charging during the pilot were appreciated, with many suggestions and encouragement to increase these efforts in the future. Consultation with Plug-In America and interviews with area dealerships showed that Avista's dealer referral and EVSE installation pilot programs were well regarded and gaining traction in the dealer community, by the time these programs were concluded in June of 2019. A request for new and similar programs were universally requested among interviewed dealers, along with a strong desire to partner with Avista in the future to increase customer awareness and EV adoption.

The customer purchase journey starts with awareness, proceeding to the critical consideration stage, and closing with the purchase decision. Beyond awareness, customers often need trusted referrals and direct experience with riding, driving and charging an EV to overcome perception issues at the consideration stage and make a good purchase decision. It is clear that as a trusted energy advisor with strong customer relationships, Avista is in a unique position to address awareness issues, and to some degree EV availability and experiential opportunities, to help customers make well informed transportation choices. This may be accomplished in a variety of ways, including continued customer support functions, new programs based on proven pilot successes, strengthened partnerships with dealerships, and exploration of new education and outreach efforts, as follows:

1. Provide supportive customer programs and engage with automotive dealers, original equipment manufacturers (OEMs), and local interest groups to improve vehicle inventory levels, EV awareness and demand, and the customer purchase experience. This will include a $250 dealer referral per customer (limited to 100 referrals per year), a program offering installation of residential, fleet and workplace charging subject to load management requirements, and periodic visits with area dealership management and sales staff. Within budget constraints, the Company plans to pursue EV and education campaigns in partnership with area dealers and local media channels. Support and engagement of local peer-to-peer interest groups leveraging social media may provide the most effective results in terms of raising public awareness and local demand for EVs. Depending on the results of further research, Avista may support informational kiosks such as the Chargeway Beacon at area dealerships, as well as dealer EV training and certification programs.

2. Continue installs of public AC Level 2 EVSE across Avista's service territory, in partnership with local government and businesses. This will help provide a backbone of regional public charging infrastructure at low cost, and at the same time increase education and awareness due to public visibility and promotion, as well as provide benefits to disadvantaged individuals and communities in these areas.

3. Consider establishing an EV Experience center in the Spokane metro area, where the public could learn in a hands-on environment about EVs, charging, incentives and utility programs – similar in some respects to the Forth showcase in Portland, Oregon. This could conceivably be combined with a check-in and check-out service for EVs available for rent through Turo, a charging hub for EV drivers using transportation network company (TNC) platforms such as Uber and Lyft, and purchase of used and new EVs in partnership with an experienced auto broker and/or dealers. If successful, this could provide substantially greater visibility and access to local and more remote EV inventories, as well as direct ordering channels, and effectively raise public awareness on a larger scale.

4. Support EV drivers using transportation network company (TNC) platforms such as Uber and Lyft. This may include installing DC fast charging stations at key locations, reduced charging fees, and possibly assistance with vehicle leases and/or financing, in partnership with TNCs. This program could also be leveraged to benefit disadvantaged communities and individuals.

5. Continue customer support functions and activities in the following areas:

    a. Maintain Avista's electric transportation webpage with the latest information and tools, including state and federal incentives, utility programs, cost calculators, program information and application links, and FAQs.

    b. Promptly respond to customer inquiries via phone calls and email through the call center, and with more experienced staff as needed for more detailed questions involving vehicles and equipment, charging options and requirements, utility infrastructure, etc. Increasingly, this may involve inquiries about commercial fleet opportunities.

    c. Support community events such as locally sponsored EV Ride and Drives during National Drive Electric Week.

    d. Provide informative presentations in a variety of forums including community events and meetings with local government, industry groups and non-profit organizations, and public webinars.

    e. Promulgate important information about the benefits of electric transportation through various media channels, including earned news and trade media interviews, social media, bill inserts, newsletters, and public signage.

Summary – Education and Outreach

- 15% to 30% budget range
- By 2023, raise positive customer EV awareness by 500%
- $250 dealer referrals, limited to 100 per year
- EV education & awareness campaigns
- Peer-to-peer interest group and TNC support
- Consider informational kiosks, training, and certification programs at auto dealerships
- Consider partnering to establish an EV Experience Center, providing education, charging, rental and purchase support
- Continue customer support functions, including on-line information and tools, call center support, and sponsorship of local Ride & Drive events

Community and Equity

Electric transportation has the potential to deliver improved transportation services to communities and individuals most in need, with economic cost savings as well as environmental benefits. Avista is committed to help provide these benefits for the disadvantaged communities and individuals it serves.

According to a United Way report, 47% of Avista's residential customers in Washington are living in poverty or struggling with basic living costs.[46] In 2019, the Spokane Transportation Collaborative was formed, convening area service organizations around the issue of access to mobility resources – recognized as the most serious issue following the lack of adequate housing. Electric transportation can make a difference in alleviating this problem.

The Company believes that programs and strategies for disadvantaged customers are best designed in collaboration with stakeholders. Through traditional low-income assistance and outreach programs over many years, Avista has established strong partnerships with community service organizations throughout its service territory. These partnerships proved to be very valuable in swiftly designing and implementing new and effective programs in the EVSE pilot. The company will continue to convene established community partners as well as others that may provide access to broader networks, as appropriate. In particular, Avista intends to partner with the Spokane Transportation Collaborative to most effectively understand transportation issues and how they may be addressed with future electric transportation and mobility programs supported by Avista. Additionally, Avista will work with local government and non-profits outside of the Spokane area and in more rural areas, tailoring programs to their specific needs and opportunities. Internally, administrative support will be provided by the Consumer Affairs Program Manager that regularly oversees traditional low-income assistance, education and outreach programs.

In the EVSE pilot, Avista successfully worked with two different community service organizations, providing EVs and EVSE utilized for a variety of beneficial purposes including transport to critical medical services, job skills training, shuttle services for overnight shelter, and food deliveries. Each organization secured insurance and accepted responsibility for vehicle maintenance and operational costs. In both cases, the volume of transportation services was substantially increased while realizing transportation cost savings of 57% and 82%. Educational and awareness benefits for staff and management may further result in expanded EV adoption for personal and organizational use. Building on the success of the EVSE pilot, a similar approach will be used in partnership with the Spokane Transportation Collaborative and other service organizations in the region.

As the used EV market develops, lower-cost options for reliable and inexpensive electric transportation will grow. The EVSE pilot showed that public EVSE installed in smaller rural towns may be broadly supported by the local community and are felt to provide benefits in terms of public visibility, access, and business development as part of the regional public EVSE infrastructure, as well as in many cases

[46] 2016 United Way Asset Limited, Income Constrained and Employed Report

the lone public EVSE available for early EV adopters in those municipalities. Leveraging EVSE infrastructure programs available to all customers, Avista will provide additional installation assistance to low-income communities and service organizations for public, fleet and workplace AC Level 2 EVSE, multiple-unit dwelling installations, and for residential customers receiving low-income bill assistance. This can take the form of the utility covering EVSE installation costs that would normally fall under the customer's responsibility in these programs.

Research shows that transportation provided by TNC platforms such as Uber and Lyft, are widely used by customers with limited transportation resources.[47] Exploring this opportunity, Avista will deploy a pilot program supporting TNC drivers serving disadvantaged communities, through partnerships providing a combination of public EVSE utilized by TNC drivers, EV purchase or leasing, and discounted rides. This effort may also be used to provide easier "last mile" access to public transportation.

Additional pilots may be designed and implemented with public transportation agencies that work in coordination with the TNC pilot or in a stand-alone capacity, provide "make ready" utility investments, and/or EVSE installations for transit fleets serving the disadvantaged.

Ride-sharing and car-sharing services appear to have some potential, but can pose significant administrative burdens that reduce effectiveness.[48] In this area, Avista will consider partnering with an experienced organization such as Envoy, to pilot ride-sharing and/or car-sharing services, for example in a housing development serving customers with limited incomes.

[47] Brenneis, M. "TNC revolution may improve access for low-income communities." SSTI (2020). https://www.ssti.us/2018/07/tnc-revolution-may-improve-access-for-low-income-communities/

[48] Diaz, A. and Teebay, C. "The Future of Car Sharing: Electric, Affordable, and Community-Centered." Forth (2018).

Summary – Community and Equity

- 10% to 30% budget range
- Provide EV and EVSE for community service organizations, through collaborative and competitive proposals
- Provide EVSE to disadvantaged communities including rural towns, low-income multi-unit dwellings, and to residential customers receiving low-income bill assistance
- Develop and implement pilot programs with public transit agencies and TNC platforms as early as 2022
- Consider partnering with Envoy and/or other organizations, piloting ride-sharing and car-sharing services

Commercial and Public Fleets

Opportunities to support beneficial electric transportation in commercial and public fleets exist today, and will grow in the future. Avista can begin to effectively support this growth with information, tools and consulting services for commercial customers in their consideration of fleet electrification, including vehicle and charging information, utility rates and load management options, total cost of ownership (TCO) comparisons, available incentives, and referrals. This may be provided now for light duty passenger vehicles and lift trucks (forklifts), followed by commercial delivery vehicles, airport ground support equipment, and refrigerated trailer units in the future. The Company also intends to develop pilot programs working with transit agencies and school districts, in order to better understand the costs, benefits, grid impacts, and feasibility of electric mass transit buses, vans, and school buses, in conjunction with services to disadvantaged and low-income groups, and how the utility may best serve customers in these areas for the future.

In addition to fuel and maintenance savings, zero tailpipe emissions, quiet operations, and beneficial utility revenues, commercial and public fleet electrification results in significant reductions in greenhouse gas emissions, as shown in the following table.

Table 11: Avoided CO_2 reductions from electric transportation, net of grid emissions in the Pacific Northwest (McKenzie, p. 18)

	Avoided Emissions (metric tons CO_2)	
	High grid emissions at 0.5 lbs CO_2/kWh	Zero grid emissions (100% renewable sources)
Personal Light-duty EV	13	21
Taxi and TNC EV	34	44
Electric Lift Truck (Forklifts)	42	52
Electric Parcel Delivery Truck	62	88
Electric Transit Bus	650	910

Despite electric lift truck sales of over 60% of total sales in the U.S., local electric sales are on the order of 25% in Avista's service territory – presenting an opportunity to effectively increase electric lift truck sales and benefits in the region. A new program supporting lift trucks is proposed, modeled after other successful utility programs in the U.S. The program provides information resources, incentives of $750 to $1,000 for buyers, and $250 to $500 for dealers, for customers that purchase electric lift trucks. This will result in avoiding 16 metric tons of CO_2 tailpipe emissions, customer fuel savings of 76%, and $1,500 per year in beneficial utility revenue. Load management services and consultation on EVSE installations will also be provided. In the future, the program may be expanded to include electrified airport ground support equipment and truck refrigeration units as shown below.

Table 12. Proposed incentives for lift truck, ground support equipment, and truck refrigeration unit electrification

Electric equipment type	Additional annual utility revenue per vehicle	Customer rebate	Dealer referral	Cost premium for electric equipment	Annual fuel savings from electric	Potential for load shifting
Lift truck class 1	$1,500	$1,000	$500	$5,000	$2,600	Moderate to High
Lift truck class 2	$1,500	$1,000	$500	$5,000	$2,600	Moderate to High
Lift truck class 3	$1,000	$750	$250	$3,000	$1,700	Moderate to High
Ground support equipment	$1,000-$3,500	$1,500	$500	varies	varies	Moderate
Truck refrigeration unit	$1,100	$1,000	$100	$3,000	$1,600	Low

Fleet managers often choose to convert to electric for economic reasons, since operating an electric lift typically saves over 76% in fuel costs and roughly 40% in annual maintenance costs compared to gas lifts. However, electric lifts have an upfront premium cost of 30% to 40% compared to a gas lift. This premium imposes a market barrier for many organizations that would otherwise benefit from the residual cash flow and employee health benefits of switching to electric over the equipment's lifetime.

For example, a local foundry served by Avista uses 60 forklifts around the clock on three shifts, all powered by propane. According to this customer, propane-powered forklifts are what they are accustomed to and there is uncertainty as to whether a switch to electric forklifts would be worth the effort and expense. The primary concern in this case is not the additional electricity expense, but rather the upfront cost of the equipment and the operational feasibility and risk associated with making the change. According to a local dealer, an average forklift rated at 5,000 lbs costs between $26,000 to $35,000, compared to an electric forklift that costs between $32,000 and $39,000, plus the cost of the EVSE at close to $3,000 prior to any rebates or incentives. Fuel cost savings vary but can often provide a payback period in a few years, however many businesses require paybacks of less than two years in order to justify capital investments.

From a TCO perspective, an electric lift would have a payback period of approximately two years and over the course of seven years would cost 32% less than a gas lift, and 38% less than a diesel lift, as shown by the TCO comparison tool developed by the Electric Power Research Institute (EPRI).[49] There are also a variety of applications where electric lifts are superior to gas lifts, such as in operating environments that are indoors or have poor ventilation, and where the risk of exhaust contaminants prevents the use of gas lifts. Under regular use conditions, a gas lift will emit over 16 metric tons of CO2 tailpipe emissions annually.

[49] see https://et.epri.com/LiftTruckCalculator.html

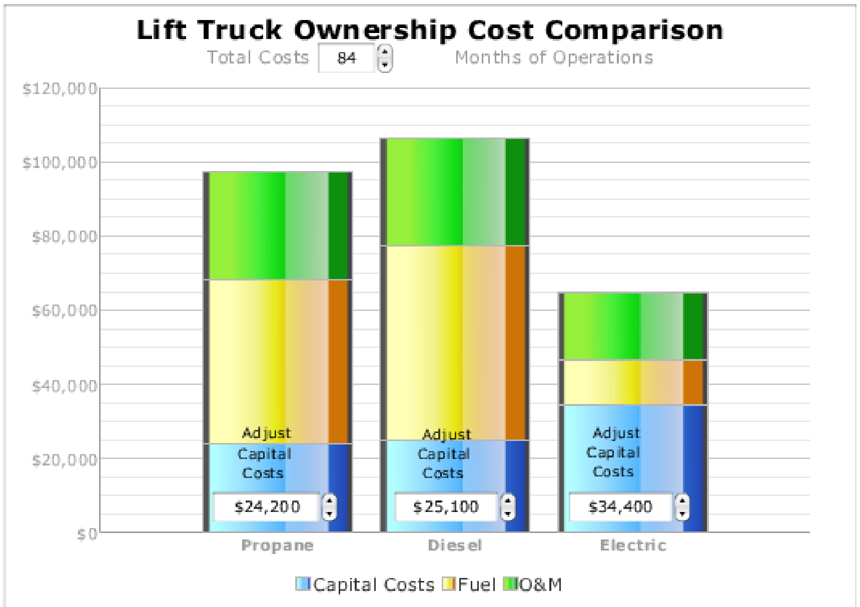


Figure 22: Total Cost of Ownership (TCO) for propane, diesel, and electric lift trucks (courtesy EPRI)

An electric lift produces no tailpipe emissions, resulting in zero local emissions of air pollutants. Even after factoring in Avista's combined emissions from its mix of electric generation sources, an electric lift produces only four metric tons of CO_2 annually – a 74% decrease of emissions compared to a gas lift.

Due to flexible battery capacities, lifts are capable of operating multiple shifts back-to-back without recharging or swapping their battery. Fully charged batteries can be swapped into lifts in a process that takes about 15 minutes when downtime needs to be minimized. Batteries can be fast or slow charged using single or three phase power up to 10 kW, although usually charging is done between shifts at consistent intervals. As a result of this beneficial and often flexible load, the consistency of charging between shifts, reduced carbon emissions, and the ability to model other proven utility programs, electric lift trucks are an ideal candidate for Avista's first fleet electrification program.

Light-duty passenger vehicles may also be included for fleet electrification support, leveraging available EVSE installation programs as applicable. Similar programs may be proposed for other vehicle types in the future as the market continues to mature and attractive opportunities present themselves.

For both lift trucks and light-duty fleet EVSE installations, the commercial EV TOU rate may be applied with dedicated meter service. Load management consultation services will also be provided as part of the fleet support program.

Summary – Commercial and Public Fleets

- 5% to 25% budget range
- Initiate a fleet support program starting with light duty passenger vehicles and forklifts
- Provide information and consulting services including vehicle and charging information, utility rates and load management options, total cost of ownership (TCO) comparisons, available incentives, and referrals
- Provide dealer and customer purchase incentives for electric lift trucks
- Enroll participants in the pilot EV TOU rate to encourage off-peak charging
- Consider expanded fleet support services to other vehicle types in the future, including airport ground support equipment and truck refrigeration units as early as 2022

Planning, Load Management and Grid Integration

Avista will continue to monitor and document EV load profiles, using a smaller test pool of customers with vehicle telematics connectivity starting in 2021. Updated EV load profiles and adoption forecasts will be integrated on a regular basis with System Planning and the Integrated Resource Plan (IRP). This will be used in conjunction with updated modeling of grid assets and conditions, other load forecasts, and the effects of distributed energy resources (DERs), providing a sound assessment of generation capacity and distribution systems for optimized asset management.

Avista will deploy cost effective load management services leveraged with EVSE installation programs. This will initially be accomplished through EV programming and the utilization of low-cost, programmable, non-networked EVSE. Experimentation with new technologies and industry innovations will also be considered, such as the utilization of advanced metering infrastructure (AMI) and other technologies that communicate with EVs and other distributed energy resources, given the potential to optimally manage loads and integrate with the grid at scale. After careful consideration, Avista may elect to support EVSE hardware and software development, if the market is slow or unable to deliver needed products and services that are cost effective. Residential TOU rates may also be considered and piloted with groups of customers participating in the EVSE program, starting in 2023. By 2025, the goal is to demonstrate greater than 50% peak load reduction from light-duty EVs, achieving grid benefits larger than expenses required to perform load management.

Developing scalable and cost-effective load management solutions for a large number of light-duty EVs is important over the longer term, particularly as adoption levels reach approximately 30% of vehicles on the road at which point the distribution system may begin to see material impacts. In the nearer term, the adoption of medium- and heavy-duty EVs for mass transit and other commercial fleet applications could impact local distribution grids much sooner, given power demands greater than 1 MW. As such, Avista will monitor developments closely and work with customers such as STA to better understand operational needs and limitations, as well as opportunities to optimally integrate with local grid conditions in terms of minimizing infrastructure costs.

Other topics of interest include how expected adoption in each market segment may influence transformer and feeder conductor sizing, as well as feeder dynamics and voltage control requirements. The Company intends to study potential impacts via experimental pilots and solutions on a small scale, in order to develop scalable, cost-effective deployments on a larger scale.

Summary – Planning, Load Management and Grid Integration

- 5% to 10% budget range
- Collect telematics data and analysis to provide updated light-duty EV profiles
- Leverage EVSE installation programs to continue load management testing and validation
- Achieve 50% peak load reduction from light-duty EVs, with net grid benefits by 2025
- Support load management for medium- and heavy-duty electrified fleets, such as with mass transit agencies

Technology and Market Awareness

Avista will utilize a deliberate process of monitoring and validation of emerging technologies and market opportunities in electric transportation. During the initial monitoring phase, thresholds may be identified that trigger the development of pilot programs testing technical feasibility, costs, and customer experience. Pilots may lead to informed deployments that can scale up over the long-term, achieving sustained benefits for all utility customers.

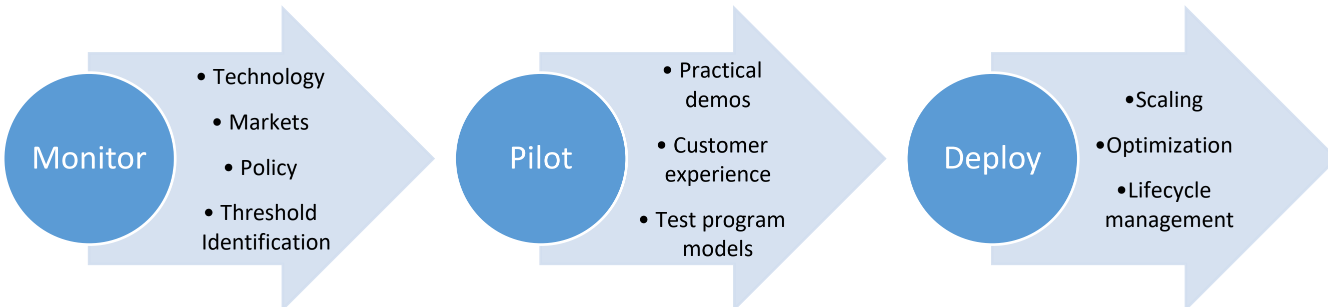


Figure 23: Technology and Market Awareness Process

Rapid changes in a number of key areas are expected, as described in the previous Technology and Markets section, which Avista will continue to monitor. These areas include the following:

Batteries

- $/kWh
- Chemistry and thermal management
- Voltages
- Battery life and OEM warranties
- Recycling and 2nd use for grid storage

EVSE

- Power output
- Communications interoperability
- Connector standards
- Inductive charging

Light-duty EV Market and Consumer Preferences

- Light-duty EV % of total vehicle sales
- % on-line sales
- EV vs ICE vehicle costs
  - Up-front purchase
  - Fuel and maintenance
  - Total Cost of Ownership (TCO)

- Model availability and OEM announcements
- Auto dealer lot inventory
- Used market, private-party inventory

Medium- and Heavy-duty Vehicle Electrification

- Mass transit BEB adoption and TCO
- Electric lift truck % of sales
- Electric school bus TCO and pilot opportunities
- Electric commercial delivery vehicle availability and TCO
- Other electric heavy-duty vehicle availability and TCO
- Electrified truck stop deployments and results
- Electric refrigerated trailer deployments and results

Other Technologies and Market Opportunities

- Vehicle-to-home (V2H), –to-building (V2B), and –to-grid (V2G) deployments and results
- Micro-mobility deployments and results
- Load management software platforms and network deployments and results
- Monitor and support regional working groups studying electrified aircraft, rail, and autonomous EVs

Summary – Technology and Market Awareness

- 2% to 5% budget range
- Follow deliberate process of monitoring and pilots to validate and design scalable deployments
- Key monitoring areas include:
    - Battery technology
    - EVSE
    - Light-duty market and consumer preferences
    - Medium- and heavy-duty vehicle electrification
    - Other technologies and market opportunities

Rate Design

Residential EV Time-of-Use (TOU) Pilot Rate

In the long term, an EV TOU rate for residential customers may be one of the more effective ways to shift peak loads from light-duty EVs, maximizing net benefits for all customers. In this regard, experience with participants in the commercial EV TOU rate as explained below, should be helpful in implementing a pilot EV TOU rate for residential customers. This rate may be proposed in 2023, eventually applied on a larger scale utilizing Advanced Metering Infrastructure (AMI) that is now being deployed in Washington State.

Commercial EV Time-of-Use (TOU) Pilot Rate

Major barriers to increasing commercial electric transportation include high purchase costs of vehicles and charging infrastructure, limited vehicle models and availability, low consumer awareness, and high utility bills driven primarily by demand charges.[50] Although the utility has little influence on vehicle models and availability, it can help address charging infrastructure and low awareness, as detailed in other sections of this Plan. Through new rate designs, it may also address the issue of high demand charges for commercial fleets and DC fast charging sites, while encouraging more off-peak charging.[51]

As an example, consider the case of the Spokane Transit Agency (STA), the main provider of public transit in the greater Spokane metro area. STA is in the process of purchasing four battery-electric buses (BEBs) for a new route serving the Moran Prairie and Monroe Street areas, placed in service in 2021 and if successful followed by another five to seven BEBs on this route. In addition, another ten BEBs will be purchased and operational beginning in 2022, serving a new central "City Line", connecting the urban core with rapid, zero-emission mass transit. All of these BEBs will be housed in a new depot facility near downtown Spokane. Given the state of current technology, plans are to charge the BEBs for up to ten minutes at one end of the route using a high powered 450 kW overhead charger, and staggered at the depot with additional DC fast chargers each providing 450 kW. Purchase premiums are still very high for electric buses, typically $250,000 or more than the base cost of $500,000 for a diesel bus that may serve most routes in the Spokane area, plus additional EVSE costs, utility service upgrades, and backup generation facilities that may be advisable. STA has estimated these additional costs to serve up to 20 buses at over $2 million, or approximately $100,000 per bus. With lower projected costs for diesel fuel at $2.37 per gallon, STA projects monthly diesel fuel expenses for nine BEBs on the new Moran Prairie to Monroe St. route at $18,100. This compares to $15,300 monthly electricity bills for BEBs, approximately 45% of which come from demand charges. With savings of nearly $3,000 per month in fuel costs, payback for the large upfront cost premiums does not occur under current electric rate schedules. Federal and state grants have mostly enabled early electrification plans at STA, however the

[50] EEI citation
[51] "Peak Demand Charges and Electric Transit Buses." CALSTART. US Dept of Transportation, Federal Transit Administration (2014).

business case must be dramatically improved in order to fully electrify the entire fleet of over 140 coaches and many other smaller passenger vehicles.

The path to full electrification at STA will depend on technology and cost improvements that eventually allow for greatly reduced purchase costs and batteries with sufficient energy to operate a full day without in-route charging. At that point, economical depot charging may occur mostly overnight, without the need for in-route charging that adds significantly to overall expenses. Additionally, more substantial operational cost savings could be realized by STA if a new rate schedule provides relief from demand charges while encouraging off-peak charging. This is in fact a necessity to enable an expanded and sustained electrification of STA's fleet.

In another example, the important buildout of DC fast charging infrastructure and investment by 3rd parties is inhibited by high operating costs, particularly in the early stages of market growth where utilization is low. A DC fast charger with only 2% load factor is effectively billed $0.41/kWh under current rate schedules, making it impossible to recover these costs from competitive user fees of $0.35/kWh which are roughly equivalent to the alternative of gasoline at $3 per gallon. In addition, as discovered in the EVSE pilot, DCFC typically require $1,500 per year in other operational expenses including site inspections and maintenance, EVSP networking fees, communication fees, and planned and unplanned EVSE maintenance expenses.

In a recent study of 51 EV rate options from 21 electric utilities in the U.S., it was found that relatively few rate options were available to commercial customers, and that TOU energy charges without demand charges, combined with monthly fixed charges and seasonal differences were most common.[52] In Washington State, Pacific Power was approved for an optional TOU rate applicable to public DCFC sites with less than 1 MW maximum demand. Pacific Power's Schedule 45 includes a TOU energy charge between 6am-12pm and 5pm-9pm in winter, and 1pm-8pm in summer. TOU energy charges are gradually reduced and demand charges reinstated over a 13 year period in this optional rate schedule.

Based on these assessments, Avista proposes a pilot EV TOU rate for commercial customers that is essential to support sustainable growth in fleet electrification and public DC fast charging. The proposed rate provides for reasonable recovery of utility costs based on time-of-use (TOU) energy charges, while eliminating demand charges that currently inhibit market growth. In this way, it establishes sensible electric billing rates for businesses that invest in electric fleets and public charging, encouraging early and sustained fleet adoption, larger workplace charging facilities, and 3rd party ownership of public DC fast charging. Through higher on-peak price signaling, it also encourages more off-peak charging which is beneficial to all customers. The intent is to encourage early commercial EV adoption in the Company's service territory, while providing a means to acquire usage and cost data that may be used to conduct more comprehensive analysis and a post-pilot EV TOU rate in 2025.

[52] "Review and Assessment of Electric Vehicle Rate Options in the United States." EPRI Report 3002012263 (2018).

The new EV rate schedules will be made available to commercial customers, provided that EV charging loads are metered separately from other facility loads and peak demand does not exceed 1 MW. Above this threshold, load management may be required and it must be demonstrated that all reasonable measures are being taken to mitigate impacts and required upgrades to the local distribution grid, as a condition of utilizing the pilot rate. The TOU energy charge on the order of $0.05 per kWh is applied in addition to regular energy charges on a seasonal basis, during the hours of 7am to 10am and 5pm to 8pm from November through March, and 3pm to 7pm from April through October. Provisions of existing commercial rate schedules apply other than the removal of demand charges and the addition of on-peak energy charges, and rates will occasionally change slightly in accordance with regular system-wide adjustments.

For DC fast charging sites, assuming 2% load factor this will result in an all-in rate per kWh of approximately $0.16 in contrast with $0.41 under current rate schedules. Compared to the competitive market-based user fee of $0.35/kWh which approximates $3/gallon of gasoline, the owner of a DCFC may then begin to recover operational costs for electric billing and maintenance costs. In the case of a transit agency such as STA operating 10 BEBs, assuming 19% load factor results in an all-in rate per kWh of $0.09 compared to $0.12 under current rate schedules. This provides for approximately 26% fuel cost savings on an order necessary to initiate pilot deployments of electric buses and the viability of more widespread fleet electrification.

Eligible customers may choose to adopt the pilot TOU rate starting in 2021, with open availability through 2025. At that time, the Company intends to propose a more permanent EV TOU rate based on collected data and analysis completed during the 2021-2025 pilot period. Customers that initially participate in the pilot rate may then choose between the new EV rate, or elect to continue with the pilot EV rate for another five years through 2030. Early adopters are thereby given reassurance that the pilot rate may be applied through 2030, when they consider making sizable capital investments in new electric fleet and charging infrastructure with service lives of ten years or more.

A relatively small number of customers are expected to participate in the pilot TOU rate, minimizing risks while providing valuable data to study effects on local coincident loading patterns and impacts on the distribution system, enabling development of a more permanent EV TOU rate schedule.

Utility Fleet Electrification, Facilities and Employee Engagement

Utilities must set a good example for customers in electrifying their own fleets and facilities, as well as encouraging employee engagement around electric transportation. Long-term, the utility can greatly benefit from transportation electrification in terms of reduced costs and greater reliability. By 2025, the Company's goal is to expand utility fleet, facility and employee engagement levels by 300%. In addition to realizing fleet and employee benefits, through direct experience in these areas the Company is better able to advise customer. Also, employees that drive electric act as respected ambassadors in the community, raising positive awareness and adoption of EVs in the region.

<u>Utility Fleets</u>

Avista's fleet of over 700 vehicles is a strategic asset that ensures we enable reliable energy to our customers. Every year Avista's vehicles drive more than 7 million miles, fulfilling our mission of delivering safe and reliable energy. The mix of vehicles includes class one automobile through class eight heavy tractors weighing in at over 105,000 lbs.

In 2010 Avista's fleet began the journey of transportation electrification with the purchase of two Toyota Prius PHEV conversions. That effort expanded to bring a Nissan LEAF into the fold when it arrived on the market in 2011. In 2011 we also began to invest in an electric Power Take-Off (ePTO) system. In 2014 Avista joined other utility fleet leaders in the development of Edison Electric Institute's (EEI) Transportation Electrification Initiative. That initiative won the commitment of over 77 investor owned utility fleets to invest five percent or more of annual fleet spending on electrified transportation alternatives. To date that effort has doubled the goal of five percent with an average investment of over $95 million dollars per year over the last four years.

Fleet Electrification Initiative

- **Achievable:** commitment is on *total cost* of vehicle (including plug-in electric technology):
  - Example: a $100,000 truck with a $20,000 plug-in system counts as $120,000 toward the 5% goal
- **Sustainable:** ongoing commitment. New vehicles and technologies provide new opportunities to further electrify our fleets
- **Flexible:** goal is on investment, not number of vehicles. Cumulative effect will grow over time

Figure 24: EEI utility 5% fleet electrification pledge

Since making that commitment in 2014, Avista has invested in an expanding range of technologies aimed at demonstrating and proving out the best possible business cases for electrification in the fleet. These efforts include the expansion of EV, PHEV and Range Extending PHEV technology in passenger vehicles. Next the Company has looked to the significantly larger fleet of work trucks to identify vehicles where proven technology can meet required duty cycles.

Avista's testing and use of work platform systems has taken a number of forms. On large construction aerials a full ePTO system was used with great success. This has been our most successful implementation by eliminating over 90% of the vehicle's monthly idle time. However this system is expensive and packs a significant amount of weight on a unit that has very stringent state weight limits. With this in mind, Avista initiated trials using electrified idle mitigation technology on small service body trucks and large aerials. Results with this technology have been less than what was modeled by initial analysis, as user adoption and technology gaps have created the most challenges in operating such systems in the fleet. This included issues with getting operators to consistently charge at home even when compensated for the electricity consumption, and avoid system over-rides when it should have been engaged. On the positive side, the systems did eliminate battery issues on single battery service trucks. Another lesson learned was the technical difficulty in integrating an idle mitigation system with a complex cab chassis that already has many other chassis integrations, foremost among these the starting and stopping of a chassis, and secondary cooling and heat.

The future of fleet electrification is dependent on the development and the availability of cost-effective electrified class 1-3 pickup trucks that meet emergency response requirements. Passenger vehicles are the most widely available EV type, but make up a small fraction of the company's fleet. At this time there is no cost effective solution available from any of the three domestic truck manufactures and conversion solutions have many issues.

Looking ahead, for the large trucks that have mounted equipment such as bucket trucks, the duty cycle of most of that fleet makes sense for electrification. These units, location dependent, tend to have a significant amount of idle time which can be reduced or eliminated. However, cost and weight as well as form factor impact that deployment today.

Here at the close of the second decade of the 21st century multiple technology advances appear to be near and ready for market. The roll out of both light and heavy duty EVs have a future in the market place. However, as a utility fleet our requirements are different from that of a typical fleet operator. We can never forget that our trucks and crews respond to emergencies across our service territory and now the nation. With crews working 16 hours a day during these instances and up to 36 hours initially, we have to have power systems that can meet that demand. Our efforts will be focused on enabling our workers to respond day in and day out in support of Avista's core mission.

<u>EVSE Facilities</u>

Adequate workplace charging at Avista facilities coupled with effective employee engagement on electric transportation options can make a big difference in employee adoption, which translates to higher awareness and long term EV adoption in the community.

EVSE installed at Avista facilities throughout the region can provide charging availability for visiting members of the public, as well for use by utility fleet vehicles and employees commuting with an EV. This has been successfully demonstrated by EVSE installed at the Company's headquarters in Spokane, Washington, as well as a few other outlying offices. Avista will continue to install EVSE at facilities throughout its service areas, at an appropriate level that allows employees commuting with an EV to charge at work, as well as for use by an expanded EV passenger fleet and the public at Company facilities.

Employee Engagement

In addition, Avista will provide information and resources for employees to better understand the benefits of EVs and to help make informed transportation choices, similar to education and outreach resources available to customers. EEI provides a wealth of knowledge and resources to help utilities in engaging their employees around the topics of electrification, which may be put to good use.

Finally, the Company will look to partner with OEMs offering EV purchase discounts to employees. At some point Avista may consider supplementing this with additional purchase incentives funded by shareholders, when EV availability and choices in the market would yield the greatest positive effects.

References

"Avista Low Income Needs Assessment – Final Report." Evergreen Economics (2020).

"Electric Program Investment Charge (EPIC) Final Report." Pacific Gas and Electric Company (2016).

"Electric Vehicle Supply Equipment (EVSE) Pilot Final Report." Avista Corporation (2019).

Cherif, R., Hasanov, F., and Pande, A. "Riding the Energy Transition: Oil Beyond 2040." International Monetary Fund (2017).

"Comparison of Medium- and Heavy- Duty Technologies in California." ICF International, Inc. (2019).

"Considerations for Corridor Direct Current Fast Charging Infrastructure in California." Alternative Energy Systems Consulting, Inc. (2015).

Crowe, Cailin. "New York MTA to Invest $1.1 B for zero-emission bus fleet." Smart Cities Dive (2019).

Diaz, A. and Teebay, C. "The Future of Car Sharing: Electric, Affordable, and Community-Centered." Forth (2018).

Francfort, J. et al. "Considerations for Corridor and Community DC Fast Charging Complex System Design." Idaho National Laboratory (2017).

Francfort, J. et al. "The EV Project." Idaho National Laboratory (2015).

Gerdes, J. "Why Is It So Hard to Buy an Electric Car in Many Parts of America?" www.greentechmedia.com, downloaded January 29, 2020.

Grant, C. et al. "Transportation Electrification Strategies for Electric Utilities." Forth (2019).

"Guidelines for Infrastructure Planning: An Explanation of the EPRI Red Line/Blue Line Model." Publication No. 3002004096. Electric Power Research Institute (2014).

Hledik, R. and Weiss, J. "Increasing Electric Vehicle Fast Charging Deployment: Electricity Rate Design and Site Host Options." Edison Electric Institute (2019).

Herter, K. & Okuneva, Y. "SMUD's EV Innovators Pilot – Load Impact Evaluation." Sacramento Municipal Utility Distric (2014).

Howell, D. & Boyd, S. & Cunningham, B. & Gillard, S. & Slezak, L. "Enabling Fast Charging: A Technology Gap Assessment." U.S. Department of Energy (2017).

"Interoperability of Public Electric Vehicle Charging Infrastructure." Electric Power Research Institute (2019).

Jones, P. et al. "The Future of Transportation Electrification: Utility, Industry and Consumer Perspectives". Future Electric Utility Regulation, Report No. 10 (2018).

Location Allocation of Electric Vehicle Fast Chargers – Research and Practice. Idaho National Laboratory (2019).

Lowell, D. et al. "Accelerating Investment in Electric Vehicle Charging Infrastructure." Ceres (2017).

Lutsey, N. & Nicholas, M. "Update on electric vehicle costs in the United States through 2030." ICCT, (2019).

Mai, T. et al. "National Economic Value Assessment of Plug-In Electric Vehicles." National Renewable Energy Laboratory (2016).

Mai, T. et al. "Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States." National Renewable Energy Laboratory (2018).

McKenzie, L. et al. "Economic & Grid Impacts of Electric Vehicle Adoption in Washington & Oregon." Energy and Environmental Economics (2017).

Morris, Charles. "Tesla on a roll, shorts in the hole as record earnings and Model Y news send stock soaring." Charged Electric Vehicles Magazine - Newswire. www.chargedevs.com accessed January 30, 2020.

Myers, Erika H. "A Comprehensive Guide to Electric Vehicle Managed Charging". Smart Electric Power Alliance (2019).

National Transportation Statistics. U.S. Department of Transportation, Bureau of Transportation Statistics. (2017).

Nicholas, M., Hall, D., Lutsey, N. "Quantifying the Electric Vehicle Charging Infrastructure Gap Across U.S. Markets." The International Council on Clean Transportation, (2019).

Nigro, N. et al. "Assessing the Electric Vehicle Charging Network in Washington State." Center for Climate and Energy Solutions, (2014).

Schwartz, Hart. "America's Aging Vehicles Delay Rate of Fleet Turnover." The Fuse (2018). Accessed January 16, 2020 at http://energyfuse.org/americas-aging-vehicles-delay-rate-fleet-turnover/

Singer, M. "Consumer Views on Plug-in Electric Vehicles – National Benchmark Report." National Renewable Energy Laboratory (2016).

"Siting and Design Guidelines for Electric Vehicle Supply Equipment." New York State Energy Research and Development Authority, Transportation and Climate Initiative (2012)

"Summary Report on EVs at Scale and the U.S. Electric Power System." U.S. Drive Partnership (2019).

"U.S. National Electrification Assessment." Electric Power Research Institute (2018).

"Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services." Washington Utilities and Transportation Commission, Docket UE-160799 (2017).

Reichmuth, David. "Are Electric Vehicles Really Better for the Climate? Yes, Here's Why." Union of Concerned Scientists, (2020). Accessed Feb 13, 2020, https://blog.ucsusa.org/dave-reichmuth/are-electric-vehicles-really-better-for-the-climate-yes-heres-why

Washington Utilities and Transportation Commission (UTC). "Policy and Interpretive Statement Concerning Commission Regulation of Electric Vehicle Charging Services." Docket UE-160799 (2017).

Wood, E., et al. "National Plug-In Electric Vehicle Infrastructure Analysis." U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy (2017).

Yearick, K., Henkin, Z. "Energy Provider Actions on Electric Transportation." 32nd Electric Vehicle Symposium (EVS32), (2019).

Appendix A: Glossary of Terms

Sources: Altas HUB, Alliance for Transportation Electrification, Wikipedia, and from SEPA as adapted from the California Public Utilities Commission (CPUC) Vehicle Grid Integration Communications Protocol Working Group Glossary of Terms (http://www.cpuc.ca.gov/vgi/), 2017. These definitions are "working definitions" and are not meant to be formal or conclusive, with some editing by the authors.

AC, DC: alternating current, direct current. The U.S. electricity grid generally operates on AC. A typical household outlet is 110–120 VAC (volts alternating current). Larger home appliances use 240 VAC. Electric car batteries operate on DC.

AC Level 2 Charger: An AC Level 2 (L2) charger can be found in both commercial and residential locations. They provide power at 220V-240V and various amperages resulting in power output ranging from 3.3kW to 19.2kW.

AFDC: U.S. DOE Alternative Fuel Data Center website containing a wealth of information on alternative fuels and vehicles.

Aggregator: An aggregator is a third party intermediary linking electric vehicles to grid operators. Increasingly, aggregators are stepping into a role of facilitating interconnections to entities that provide electricity service. Broadly, aggregators serve two roles: downstream, they expand the size of charging networks that electric vehicle (EV) customers can access seamlessly, facilitating back-office transactions and billing across networks; upstream, they aggregate a number of EVs and Charging Station Operators (CSO) to provide useful grid services to Distribution Network Operators (DNO) and Transmission System Operators (TSO).

AV: Autonomous Vehicle is a vehicle that can guide itself without human input. There are various levels of autonomous technology as defined by SAE from level 0 (no driving automation) to level 5 (full driving automation).

BEV (Battery Electric Vehicle): Battery Electric Vehicle is a vehicle with a drivetrain that is only powered by an onboard battery and electric motor(s).

CAV: Connected Autonomous Vehicle is an autonomous vehicle that has vehicle-to-vehicle or vehicle-to-infrastructure capabilities.

C2 Device - a telematics hardware device, from FleetCarma, that is capable of logging driving and charging data from electric vehicles.

CCS: The Combined Charging System is a charging method for electric vehicles from the SAE J1772 connector. The plug contains a DC and AC option and is also referred to as a Combo connector. The automobile manufacturers supporting this standard include BMW, Daimler, FCA, Ford, General Motors, Hyundai, Jaguar, Tesla, and Volkswagen.

Charger: A layperson's term for the on-board or off-board device that interconnects the EV battery with the electricity grid and manages the flow of electrons to recharge the battery. Also known as Electric Vehicle Supply Equipment (EVSE).

Charge Session: A charge session is period of time an electric vehicle (EV) is actively charging its battery through the connection with a charger (EVSE).

Charging: Charging is the process of recharging the onboard battery of an electric vehicle.

Charging Level: The terms, AC Level 1, AC Level 2, and DC Fast describe how energy is transferred from the electrical supply to the car's battery. Level 1 is the slowest charging speed. DC Fast is the fastest. Charging rate varies within each charging level, depending on a variety of factors including the electrical supply and the car's capability.

Charging Station: The physical site where the Electric Vehicle Supply Equipment (EVSE) (also known as the charger) or inductive charging equipment is located. A charging station typically includes parking, one or more chargers, and any necessary "make-ready equipment" (i.e., conduit, wiring to the electrical panel, etc.) to connect the chargers to the electricity grid, and can include ancillary equipment such as a payment kiosk, battery storage, or onsite generation.

Charger: A layperson's term for on-board or off-board device that interconnects the EV battery with the electricity grid and manages the flow of electrons to recharge the battery. Also known as Electric Vehicle Supply Equipment (EVSE).

CHAdeMO: "CHArge de MOve" is the trade name of a quick charging method formed by Tokyo Electric Power Company, Nissan, Mitsubishi, Fuji Heavy Industries, and later joined by Toyota.

Connector: The plug that connects the electricity supply to charge the car's battery. J-1772 is the standard connector used for Level 1 and Level 2 charging. CCS or "Combo" connectors are used for DC Fast charging on most American and European cars. CHAde-MO is the connector used to DC Fast charge some Japanese model cars.

Demand Response (V1G, direct load management, controlled charging, intelligent charging, adaptive charging, or smart charging): Central or customer control of EV charging to provide vehicle grid integration (VGI) offerings, including wholesale market services. Includes ramping up and ramping down of charging for individual EVs or multiple EVs whether the control is done at the EVSE, the EV, the EV management system, the parking lot EV energy management system or the building management system, or elsewhere.

DER: Distributed Energy Resource

DERMS: Distributed Energy Resource Management System

Direct Current Fast Charger (DCFC): Direct Current Fast Charging equipment is designed to rapidly deliver direct current to a vehicle's onboard battery. DCFCs commonly have power ratings of 50kW or higher.

Direct Install Costs: Corresponding to the direct costs associated with the installation of an EVSE. These costs include labor and materials for mounting the EVSE, wiring connections, network connections, signage, EVSE testing, and work to complete required permitting and inspections.

DOE: Department of Energy is commonly used to refer to the U.S. energy agency or a State energy agency.

DOT: Department of Transportation is commonly used to refer to the U.S. Dept of Transportation or a State transportation agency.

DR: Demand Response (see Demand Response)

DRMS: Demand Response Management System

E&O: Education and Outreach

Electric Vehicle Service Provider (EVSP): Electric Vehicle Service Provider also known as a Network Service Provider (NSP), provides services related to chargers, such as data communications, billing, maintenance, reservations, and other non-grid information. The EVSP sends grid commands or messages to the EV or EVSE (e.g., rates information or grid information based on energy, capacity or ancillary services markets; this is sometimes called an electricity grid network services provider). The EVSP may send non-grid commands (e.g., reservations, billing, maintenance checks), and may receive data or grid commands from other entities, as well as send data back to other entities.

Electric Vehicle Supply Equipment (EVSE): Electric Vehicle Supply Equipment, also often called an EV charger, is standalone equipment used to deliver power to the input port connection on an EV. This device includes the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets or apparatus associated with the device, but does not include Premises Wiring.

ENERGY STAR for EVSE: Compliance standards for electric vehicle supply equipment to receive ENERGY STAR certification.

EPA: Environmental Protection Agency is commonly used to refer to the U.S. environmental protection agency or a State environmental protection agency

EPRI: Electric Power Research Institute conducts research, development, and demonstration projects to benefit the public in the United States and internationally.

EV: Electric Vehicle is the commonly used name for vehicles with the capability to propel the vehicle fully or partially with onboard battery power and contains a mechanism to recharge the battery from an external power source. EVs can include full battery-electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

EVSE: see Electric Vehicle Supply Equipment

EVSP: see Electric Vehicle Service Provider

Fleet EVSE: EVSE for use by business owned vehicles.

GGE: Greenhouse Gas Emissions

GHG: Greenhouse Gas

GMS: Grid Management System is based on an architecture and guiding principles to proactively support changing requirements while minimizing disruption to existing operations, consumer commitments, and regulatory requirements.

GSE: Ground Support Equipment is equipment used in airports such as belt loaders, luggage tags, and water trucks.

HDV: Heavy-Duty Vehicles have a gross vehicle weight above 26,000 pounds.

ICE (Internal Combustion Engine): ICE is an acronym for Internal Combustion Engine. ICE vehicles typify the majority of gasoline/diesel/natural gas vehicles that make up the majority of automotive fleet.

ICCT: International Council on Clean Transportation. ICCT is a research group and has published several reports transportation electrification

IEEE: Institute of Electrical and Electronics Engineers is a professional association whose objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering and allied disciplines.

IEEE 2030.5: IEEE 2030.5 is a standard for communications between the smart grid and consumers. The standard is built using Internet of Things (IoT) concepts and gives consumers a variety of means to manage their energy usage and generation.

IEEE P2690: This standard defines communications between Electric Vehicle Charging Systems and a device, network, and services management system, which is typically based "in the cloud" but could also include interfaces to site-specific components or systems (e.g., building energy management systems).

IGP: Integrated Grid Planning

Interoperability: The ability of devices, systems, or software provided by one vendor or service provider to exchange and make use of information, including payment information, between devices, systems, or software provided by a different vendor or service provider.

IOU: Investor-Owned Utility

ISO 15118-1:2013: ISO 15118 specifies the communication between EV and the EVSE.

J1772: also known as a "J plug", is a North American standard for electrical connectors for electric vehicles maintained by the Society of Automotive Engineers (SAE) International, and has the formal title "SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler". It covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler.

L2 Station: See AC Level 2 Charger.

LBEV (Long Range Battery Electric Vehicles): LBEVs are BEVs (see BEV) that have an average driving range greater than 200 miles for a full battery charge.

LDV: Light-Duty Vehicles have a gross vehicle weight at or below 14,000 pounds

Level 1: Level 1 is part of the charging standard defined by the SAE for charging equipment using standard 120V household electricity.

Level 2: Level 2 is part of the charging standard defined by the SAE for charging equipment using 208V or 240V electricity, similar to the power level used for ovens and clothes dryers.

Load Curves: A load curve or load profile is a graph of electrical load over time. This is useful for utilities to determine how much electricity will need to be available at a given time for efficiency and reliability of power transmission.

Make-ready: Make-ready describes the installation and supply infrastructure up to, but not including the charging equipment. The customer procures and pays for the charging equipment, which could be funded by a separate rebate or other incentive by the electric company or other entity.

Managed Charging: Managed charging allows an electric utility or a third-party to control the charging of an EV remotely. This entity could enable or disable charging, or could control the power level for charging.

MDV: Medium-Duty Vehicles have a gross vehicle weight more than 14,000 and less than 26,001 pounds.

MUD: Multi-Unit Dwellings are a type of residence in which multiple housing units are located within a single building or building complex (e.g., an apartment complex, duplex, condos, etc). This is synonymous with a multi dwelling unit (MDU). EVSE at MUDs are intended for use by MUD residents. EVSE located on hotel or motel properties are also included within MUD session data in this report.

NEMA: National Electric Manufacturers Association

Networked EVSE: These devices are connected to the Internet via a cable or wireless technology and can communicate with the computer system that manages a charging network or other software systems, such as a utility demand response management system (DRMS) or system that provides charging data to EV drivers on smartphones. This connection to a network allows EVSE owners or site hosts to manage who can access EVSE and how much it costs drivers to charge.

NGO: Non-Governmental Organization

Non-networked EVSE: These devices are not connected to the internet and provide basic charging functionality without remote communications capabilities. For example, most Level 1 EVSE are designed to simply charge a vehicle; they are not networked and do not have additional software features that track energy use, process payment for a charging session, or determine which drivers are authorized to use the EVSE. Secondary systems that provide these features can be installed to supplement non-networked EVSE.

NREL: National Renewable Energy Laboratory

NPV: Net Present Value is the sum of future cash flows using a discount rate, such that it takes into the account of the time value of money.

OATI: Open Access Technology International, Inc.

OEM: Original Equipment Manufacturer, commonly used to refer to automobile manufacturers.

OpenADR 2.0b: Open Automated Demand Response (OpenADR) is an open and standardized way for electricity providers and system operators to communicate DR signals with each other and with their customers using a common language over any existing IP-based communications network, such as the Internet.

OCPP: The goal for the Open Charge Point Protocol (OCPP) is to offer a uniform solution for the method of communication between charge point and central system.

PEV (Plug-in Electric Vehicle or PEV): see EV

PHEV (Plug-in Hybrid Electric Vehicle): Plug-in Hybrid Electric Vehicle is a plug-in electric vehicle that can be powered by either or both a gasoline/diesel engine or an onboard battery.

Platform: The base hardware and software upon which software applications run.

Port: see Connector

Premises Wiring: electrical supply panel and dedicated 208/240VAC circuits that suppy electricity directly to EVSE. This includes the protective breaker at the supply panel, wiring, final junction box, receptacle and all attachments and connections.

Proprietary Protocol: A protocol that is owned and used by a single organization or individual company.

Protocol: Set of rules and requirements that specify the business process and data interactions between communicating entities, devices, or systems. Most protocols are voluntary in the sense that they are offered for adoption by people or industry without being mandated in law. Some protocols become mandatory when they are adopted by regulators as legal requirements. A standard method of exchanging data that is used between two communicating layers.

Public EVSE: Public EVSE can be found in multiple types of locations including but not limited to business parking lots, public buildings, or adjacent to public right-of-way. Public AC Level 2 EVSE have a standard J1772 connector, while DCFC have a CHAdeMO and/or CCS connectors. Tesla vehicles may utilize public EVSE with an adapter, however other EVs cannot use Tesla EVSE, as no adapters are available.

Residential EVSE: located within a person’s home, most often in a garage, residential EVSE are usually used by 1 or 2 EVs intended only for use by the home owner.

Ride and Drive: Event where individuals are given the opportunity to look at EVs, talk with EV drivers, and ride in or drive an EV.

RPS: Renewable Portfolio Standard

OCPP (Open Charge Point Protocol): An application protocol for communication between EVSEs and EVSP servers.

Standard: An agreed upon method or approach of implementing a technology that is developed in an open and transparent process by a neutral, non-profit party. Standards can apply to many types of equipment (e.g., charging connectors, charging equipment, batteries, communications, signage), data formats, communications protocols, technical or business processes (e.g., measurement, charging access), cybersecurity requirements, and so on. Most standards are voluntary in the sense that they are offered for adoption by people or industry without being mandated in law. Some standards become mandatory when they are adopted by regulators as legal requirements.

Standardization: Process where a standard achieves a dominant position in the market due to public acceptance, market forces, or a regulatory mandate.

State of Charge (SOC): The level of charge of an electric battery relative to its capacity.

TCO: Total Cost of Ownership is a financial estimate that accounts for both purchase price and continued, variable operating costs of an asset.

TE: Transportation Electrification

Telematics: In the context of EV charging, including managed charging, telematics refers to the communication of data between a data center (or "cloud") and an EV, including sending control commands and retrieving charging session data.

TNC: Transportation Network Company is a company that connects passengers with drivers via a mobile app or website. Example companies include Uber and Lyft.

TOU (Time of Use) Rate: Time-of-use often refers to electricity rates that can vary by the time of day. TOU rates can also be structured to vary by season.

TRU: Truck Refrigeration Unit is a device that is installed in a truck to refrigerate a truck's storage compartment.

Use Case: Defines a problem or need that can be resolved with one or more solutions (technical and/or non-technical) and describes the solutions. The use case is a characterization of a list of actions or event steps, typically defining the interactions, describing the value provided and identifying the cost.

Uptime: Defines the amount of time an EVSE is functionally able to provide a charge when requested, as opposed to a faulted state where no charge may occur. Depending on configuration settings, networked EVSE may still be able to provide a charge and maintain uptime status when offline from the network connection.

Workplace EVSE: Workplace EVSE are located on business property, primarily intended for use by employees. However, often the business owner will allow use by visitors or the public, if it is located in an accessible location.

V1G: V1G refers to vehicles only capable of receiving power from the electrical grid to the onboard battery. This can also commonly be referred to as demand response for EVs

V2B: Vehicle-to-Building refers to vehicles capable of sending power from the onboard battery to a building.

V2G: Vehicle-to-Grid refers to vehicles capable of receiving power to the onboard battery from the electrical grid and vice-versa.

V2H: Vehicle-to-Home refers to vehicles capable of sending power from the onboard battery to a home.

VMT: Vehicle Miles Traveled

VPP: Virtual Power Plant (VPP) is a cloud-based distributed power plant that aggregates the capacities of heterogeneous energy resources for the purposes of enhancing power generation, as well as trading or selling power on the open market.
ZEV: Zero Emission Vehicle is a vehicle with no tailpipe emissions and includes battery electric vehicles and hydrogen fuel cell electric vehicles.

Appendix B: Light-Duty EV Adoption Forecasts

Based on estimates of population and vehicle statistics, the tables below show underlying assumptions and the total number of light duty registered vehicles (not including motorcycles), as they grow over time in the counties served by Avista electricity in Washington and Idaho.

Table 13: Statistical assumptions for light-duty vehicles

0.757	estimated light-duty highway vehicles per person, excluding motorcycles
2%	annual growth rate of light-duty vehicle registrations
15	average vehicle age (years)
6.7%	annual vehicle stock turnover rate

Table 14: Total light-duty highway registered vehicles in counties served by Avista (not including motorcycles)

Year Ending	Washington	Idaho	Total	Annual Vehicle Stock Turnover
2019	512,297	243,311	755,608	50,374
2020	522,543	248,177	770,720	51,381
2021	532,994	253,141	786,135	52,409
2022	543,654	258,204	801,857	53,457
2023	554,527	263,368	817,894	54,526
2024	565,617	268,635	834,252	55,617
2025	576,930	274,008	850,937	56,729
2026	588,468	279,488	867,956	57,864
2027	600,238	285,078	885,315	59,021
2028	612,242	290,779	903,022	60,201
2029	624,487	296,595	921,082	61,405

Based on state registration data for 2019, total vehicle stock turnover each year, and assumed sales rates through year-end 2029, the following tables show the estimated number of EVs in the counties served by Avista electricity in Washington and Idaho for Baseline, High, and Low adoption scenarios.

In the baseline adoption scenario, average OEM product and strong utility support programs result in a sales rate of 15% by 2030 in Washington, at this level sustainably reaching the early mass market. A damper of 25% is assumed for Idaho in the baseline scenario, given the current state of lower support levels and a more rural, less populated service territory.

Table 15: Baseline EV Adoption Scenario - EVs registered in counties served by Avista electricity

Year Ending	Washington	Idaho	Total
2019	1,331	409	1,740
2020	1,812	569	2,381
2021	2,339	744	3,083
2022	2,951	948	3,899
2023	3,728	1,206	4,934
2024	4,792	1,560	6,352
2025	6,273	2,052	8,326
2026	8,350	2,742	11,092
2027	11,250	3,707	14,957
2028	15,259	5,040	20,299
2029	20,505	6,784	27,289

In the high adoption scenario, strong OEM product is matched with strong utility support programs that result in a sales rate of 15% in 2027, at this level sustainably reaching the early mass market several years earlier than the baseline scenario, and reaching a sales rate of 40% by 2030.

Table 16: High EV Adoption Scenario - EVs registered in counties served by Avista electricity

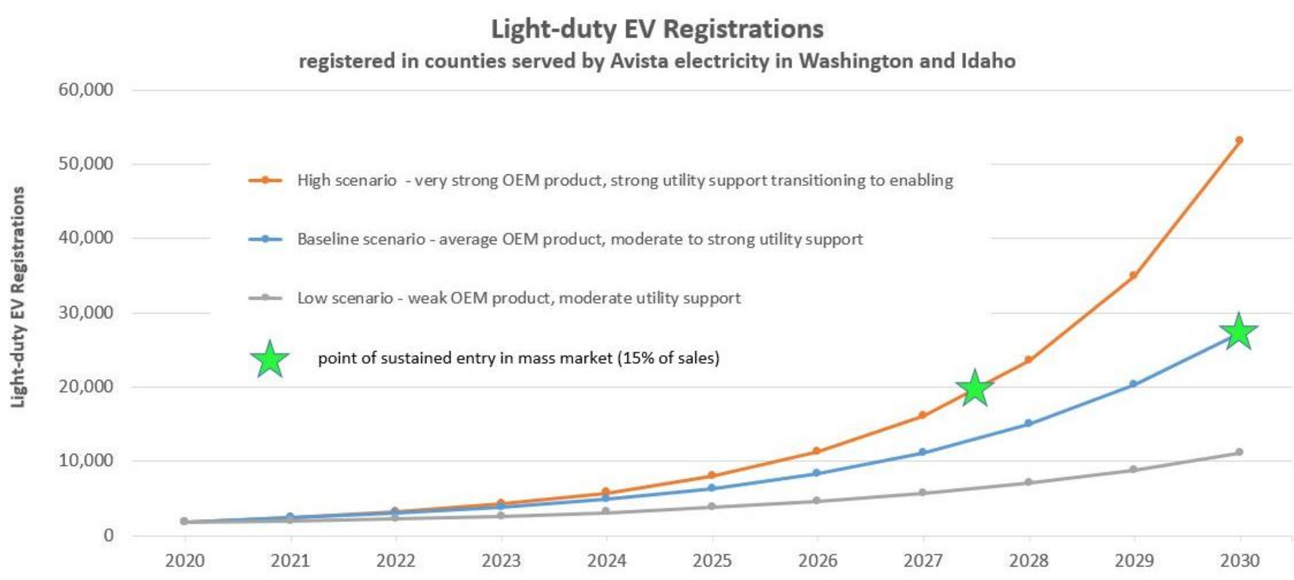
Year Ending	Washington	Idaho	Total
2019	1,331	409	1,740
2020	1,834	564	2,398
2021	2,467	758	3,226
2022	3,271	1,005	4,276
2023	4,418	1,358	5,775
2024	6,114	1,879	7,993
2025	8,624	2,650	11,274
2026	12,335	3,790	16,125
2027	18,013	5,535	23,548
2028	26,701	8,205	34,905
2029	40,610	12,479	53,090

In the low EV adoption scenario, relatively weak OEM product is appropriately supported by scaled-back utility programs, only reaching a 5% sales rate by 2030.

Table 17: Low EV Adoption Scenario - EVs registered in counties served by Avista electricity

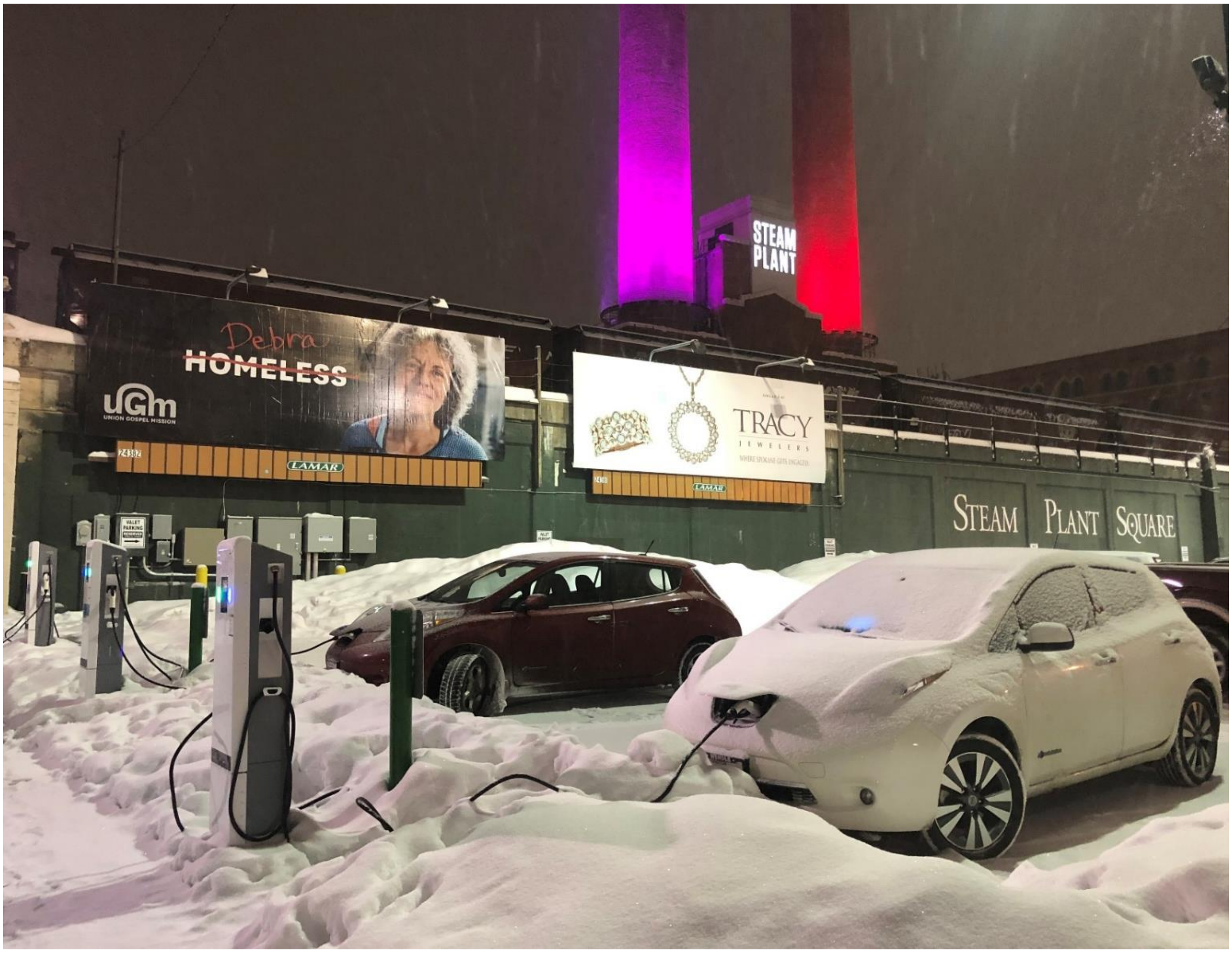
Year Ending	Washington	Idaho	Total
2019	1,331	409	1,740
2020	1,455	447	1,902
2021	1,695	521	2,216
2022	2,002	615	2,618
2023	2,396	736	3,132
2024	2,899	891	3,790
2025	3,543	1,089	4,632
2026	4,368	1,342	5,710
2027	5,424	1,667	7,091
2028	6,776	2,082	8,858
2029	8,506	2,614	11,120

These tables are summarized in the chart below, for total EVs registered in Washington and Idaho counties served by Avista electricity. An estimate of the number of EVs registered by Avista electric customers may be made by applying an approximate percentage of households served in each county to the total EVs registered. This percentage is currently estimated at 88.3% for Washington and 64.2% for Idaho counties served.



Appendix C: Stakeholder Engagement and Letters of Support

< describe process, input and revisions following draft submission, attach letters of support >



Public AC Level 2 Charging Stations near the Steam Plant in Downtown Spokane