Transportation Electrification

2022 Annual Report

Submitted to the Washington Utilities and Transportation Commission

March 31, 2023

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<u>About Avista</u>

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!

I. Executive Summary

Avista successfully expanded TE programs and activities in 2022, consistent with the Transportation Electrification (TE) Plan[1] and tariff schedule 077. The table below summarizes key results for the calendar year ending December 31, 2022.

3,314	Number of light-duty passenger and truck EVs registered in Avista's service territory in Washington State, as of December 31, 2022
$4.2 million	Regional transportation cost savings
11,348	Avoided tons of CO_2 emissions
7,872	MWh charging consumption
1.9	MW charging peak load
$791,828	Revenue from light-duty EV charging
$2,235,866	TE Capital investments
$555,089	TE Operating expenses
481	Residential AC Level 2 (ACL2) ports in service
428	Commercial ACL2 ports in service
16	DC Fast Charging (DCFC) ports in service
96%	ACL2 equipment uptime
89%	DCFC equipment uptime
98%	Customer satisfaction with Avista TE programs
25	Electric forklift incentives
5	Fleet consultation services
32,080	Customer web page visits
7	Active number of Community-Based Organization (CBO) partners
21,961	Travel services provided by CBO partners (passenger-miles)
105	Charging ports in Named Communities and CBOs
42	Community and stakeholder education and outreach engagements

Table 1: 2022 TE Results

Note that estimates for regional transportation savings, avoided CO2 emissions, electricity consumption, peak load, and revenue from EV charging are based on light-duty EVs only. Additional benefits provided by other forms of electric transportation will be reported as more data becomes available.

[1] See www.myavista.com/transportation for a web link to the TE Plan.

In 2022, light-duty EVs showed steady adoption in Avista's service territory, consistent with a high forecast scenario. Medium- and heavy-duty on-road electrification in the areas of mass-transit and school buses also showed growth, supported by state and federal grants. ACL2 charging programs for both residential and commercial customers continued to achieve high customer satisfaction of 98%, meeting cost expectations and providing lessons learned regarding equipment reliability and load management. Planned DCFC site construction was slowed by ongoing supply chain disruptions and in obtaining legal site agreements with property owners. However, solid progress is expected given the Company's experience and strong backing from local stakeholders including the Spokane Regional Transportation Council (SRTC), as well as support from a $2.5 million grant through 2025, administered by the Washington State Department of Commerce.

Important insights regarding load profiles and load management for light-duty EVs were achieved by means of programmed EV charging schedules and utility AMI data, and for forklifts utilizing data loggers. Commercial EV time-of-use (TOU) rates were also effective in shifting loads from mass transit buses and other commercial fleet vehicles. Education and outreach, partnerships with CBOs and other community support were successful overall and may be further supported per the TE plan.

As the prospect of accelerating growth becomes more probable, the Company is undertaking a detailed study of future loads on its distribution system and considering a number of TE program adjustments to best meet the changing environment, primarily in the areas of ACL2 charging programs and load management. Avista will also continue to seek grant funding opportunities and Clean Fuels Program (CFP) credits in Washington State to further support beneficial TE over the long term.

II. TE Adoption and Forecasts

Light-duty registered vehicles in Washington counties served by Avista are summarized below for the years 2018 – 2022, based on Washington Department of Licencing data.[2] Registered EVs reached 2,837 by mid-year and 3,314 by year-end, accounting for 0.5% of the 569,000 light-duty vehicles on the road.

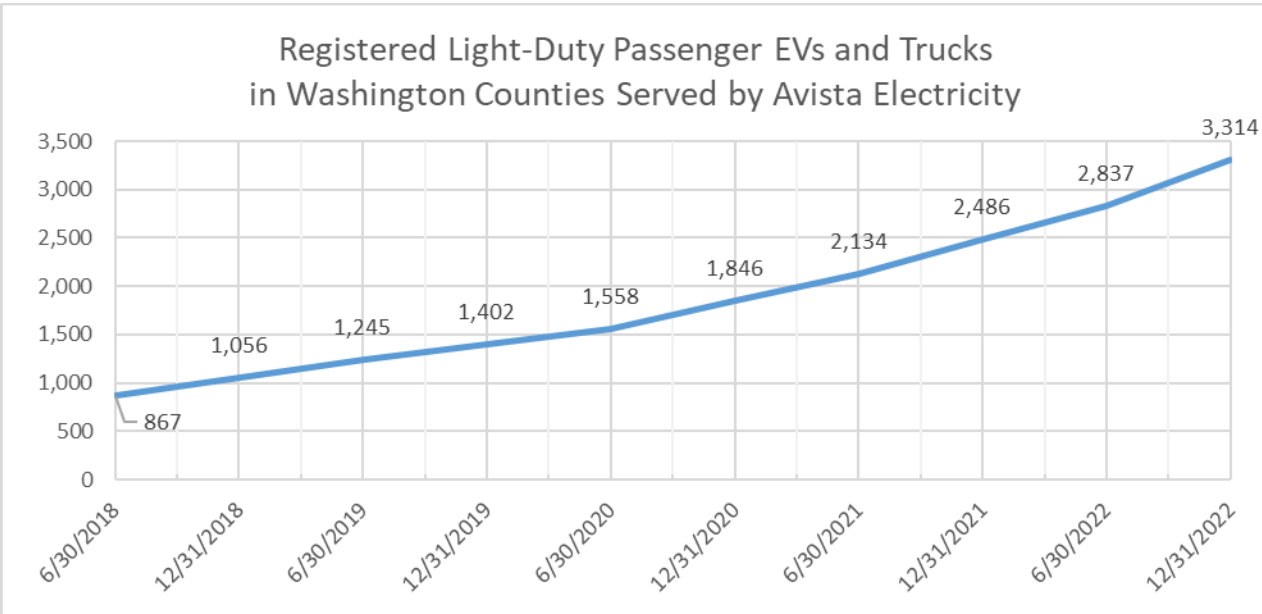


Figure 1: Light-duty Registered EVs in Washington Counties Served by Avista, 2017-2021

	2018	2019	2020	2021	2022
Total Passenger Vehicles	408,710	417,567	416,749	417,245	418,481
Total Truck Vehicles	146,074	147,845	149,724	149,698	150,458
Total All Vehicles	554,784	565,412	566,473	566,943	568,939
Total EVs	867	1,245	1,558	2,134	2,837
% EVs of Total	0.2%	0.2%	0.3%	0.4%	0.5%
% EV Growth	37%	44%	25%	37%	33%

Table 1: Comparison of EVs to all Registered Light-Duty Vehicles, as of mid-year from 2018 to 2022

[2] See https://data.wa.gov/Transportation/Electric-Vehicle-Population-Size-History-By-County/3d5d-sdqb

While the percentage of EVs on the road will remain relatively small for many years, recent trends point to accelerating growth. Nationwide, EV share of new light-duty vehicle sales reached an all-time high of 10% market share in December, and in Washington State reached 18% market share in Q4.

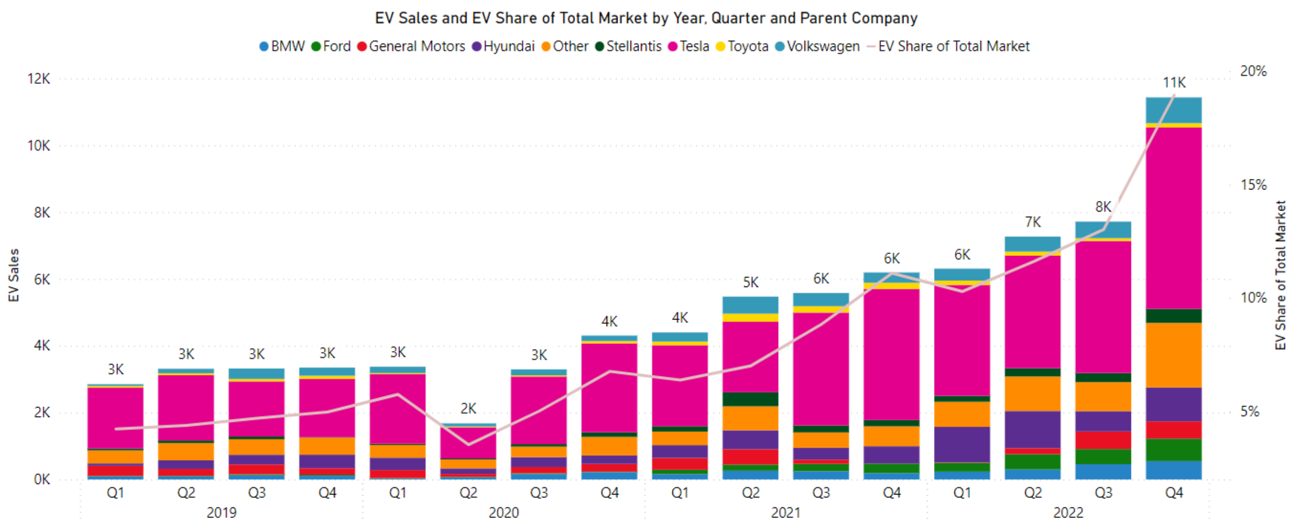


Figure 2: Light-duty EV Sales Data for Washington State (www.atlasevhub.com)

This is consistent with the transition to a higher adoption scenario as predicted by the TE Plan, in which 3,271 light duty EVs were estimated by year-end 2022. Growth rates were somewhat dampened in 2022 due to a lack of dealer inventory and long purchase lead times. However, accelerating growth may take hold as anticipated in the 2023-2024 timeframe, if significant improvements are realized in EV model variety, availability, pricing, and charging infrastructure.

Adoption in other segments such as medium and heavy duty on-road vehicles, forklifts, and other forms of electric transportation is also important, representing approximately 50% of long-term electric transportation loads on the electric grid. Currently available data sources are not comprehensive for these vehicle types, but some estimates may be made based on customer engagements. In this regard, public mass transit buses are beginning to electrify, for example with 16 or more full size coaches expected to be in-service in 2023, roughly 8.6% of the known fleet serving the Spokane metro area. Electric school buses and medium-duty delivery vans should also begin to operate in the region over the course of the next year.

Figure 3: "City Line" rapid battery-electric transit buses – Spokane Transit Authority (STA)

Based on recent research from the National Renewable Energy Lab[3] and Washington light-duty vehicle registration data, estimates regarding a high adoption scenario by 2030 were developed for on-road vehicle classes 1 through 8, as shown in the table below. A range of 51 to 191 MW of additional peak load on the system is estimated from this high adoption scenario, depending on the degree to which charging may be accomplished off-peak. This represents a peak load increase of 3% to 11% from current system peak load.

Although light duty (class 1 and 2) vehicles represent by far the greatest number of vehicles and as a group the largest potential impact by 2030, medium- and heavy-duty vehicles have a much larger impact on a per vehicle basis. As technologies and costs improve, it's reasonable to project growing and potentially rapid electrification of commercial fleets and large charging infrastructure projects, at individual locations and in aggregate for certain geographic areas with higher concentrations of fleet vehicles. For these reasons, fleet adoption of all types of vehicle classes is a growing concern in terms of potential impacts to local distribution grids. A comprehensive study is currently underway to develop more granular estimates of potential distribution impacts across Avista's system at a feeder level, the results of which will be highlighted in future reports.

[3] Ledna, Muratori, Yip, Jadun and Hoehne. "Decarbonizing Medium- & Heavy-Duty On-Road Vehicles: Zero-Emission Vehicles Cost Analysis. National Renewable Energy Lab. March, 2022. [Transportation Decarbonization Research | Transportation and Mobility Research | NREL]

	Total Vehicles	% Electrified	EVs	Peak Load (MW)	Consumption (MWh)
Passenger Cars (C1)	704,261	10%	70,426	21 – 106	260,577
Light Trucks & SUVs (C2)	264,848	7%	18,539	9 - 37	101,966
Light Medium (C3)	24,802	17%	4,216	4 – 11	34,471
Medium (C4-6)	20,360	11%	2,321	5 – 12	28,208
Heavy (C7-8)	30,375	5%	1,519	12 – 24	26,218
Total	**1,044,646**	**9%**	**97,022**	**51 - 191**	**451,440**

Table 2: 2030 High Adoption Forecast for all On-Road Vehicles (Class 1-8)

III. Expenses and Revenues

The following table summarizes TE Capital and Operations and Maintenance (O&M) spending for 2022, referenced to the targeted allocations for each category over the 5-year period of the TE Plan, from 2021 through 2025.[4]

	Capital	O&M	Total	% of Total	TE Plan 2021-2025 Target
Residential ACL2 Charging Infrastructure	$158,020	$1,556	$159,577		
Commercial ACL2 Charging Infrastructure	$608,502	$24,932	$633,434		
DCFC Charging Infrastructure	$880,454	$26,885	$907,339		
Total Charging Infrastructure Installations and Maintenance	$1,646,977	$53,373	$1,700,350	61%	45%
Community and Low-Income Support	$430,869	$117,924	$548,793	20%	30%
Education and Outreach	$0	$103,650	$103,650	4%	10%
Fleet Support Services	$0	$83,212	$83,212	3%	5%
Load Management and Grid Integration	$158,020	$41,683	$199,703	7%	5%
Market and Technology Monitoring and Testing	$0	$56,861	$56,861	2%	3%
Analysis and Reporting	$0	$98,386	$98,386	4%	2%
Totals	$2,235,866	$555,089	**$2,790,955**		

Table 3: 2021 TE Capital and O&M Spending

Overall spending was less than the estimated $2.9 million in Capital and $748k in O&M spending per the TE Plan, but was within the range of $2 million to $6 million total spending per year through 2025, commensurate with market conditions and adoption over time.

[4] Costs for residential charging installations and equipment maintenance are split 50/50 between charging infrastructure and load management categories

Avista provides electricity to approximately 88% of households in the Washington counties it serves. Taking this percentage of 2,837 light-duty EVs registered in counties served by mid-year (as an average for 2022), and $304 average utility billing revenue per EV, provides an estimate of $758,954 total billing revenue for 2022. In addition, DCFC user fee revenue of $32,874 results in total EV charging revenue of $791,828 from light-duty EVs in 2022.

IV. AC Level 2 Charging

Avista's AC Level 2 (ACL2) charging infrastructure programs expanded in 2022, meeting cost expectations and achieving high customer satisfaction. The table below summarizes ACL2 ports installed in 2022 and total cumulative ports in service, as well as the average cost and lead time for residential and commercial installations.

	Residential ACL2	Commercial ACL2
# Ports Installed	224	131
Total # Ports In-Service	481	428
Installation Cost per Port including charger	$1,863	$4,546
Lead Time	3 weeks	14 weeks

Table 4: Charging Installation Results for 2022

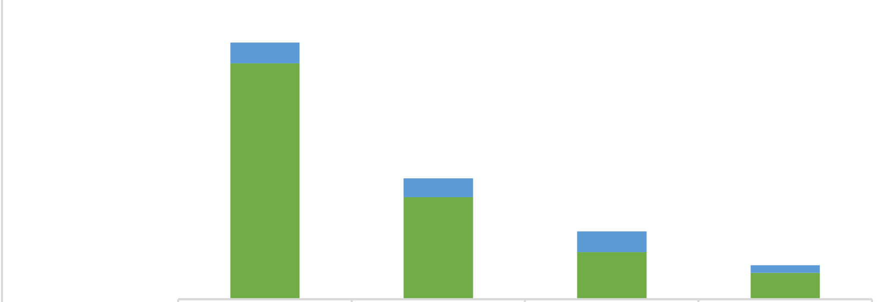
In the residential ACL2 program, Avista provides eligible customers with an Avista owned and maintained charger, pays the direct installation costs and 50% of premises wiring costs, up to $1,000. A non-networked charger is usually installed, rated at 24 amps and capable of delivering 5.8 kW (approximately 20 miles of driving range per hour of charging). As part of the program, customers agree to ongoing load management experiments, currently involving programming their EV to charge overnight with the ability to override and provide an immediate charge when necessary. They also agree to participate in periodic surveys and give feedback about the program and their experiences related to electric transportation and EV charging.

Commercial ACL2 may be used for a variety of purposes including charging for fleet, workplace, public, and/or multi-unit dwellings (MUDs). Eligible customers may select from a standard program that is very similar to the residential program, with Avista owning and maintaining the charger, and paying supply infrastructure costs up to $2,000 per port installed, or a make-ready program option, with customers owning and maintaining the charger and Avista paying for supply infrastructure up to $2,500 per port installed. Commercial customers also agree to participate in load management efforts and provide feedback through periodic surveys.

For the commercial program, discussions occur with the customer to identify the primary use of the charger and charging requirements, including power output, appropriate number of chargers, and future expansion planning. In general, non-networked chargers are preferable in terms of lower upfront and ongoing operational costs, superior reliability, and ease of use for drivers and site hosts alike. Commercial customers are often interested in networked units however, as they allow for transacting point-of-use fees and can provide detailed charging session data. Despite this initial interest, customers rarely proceed with a networked unit once the associated cost of networking fees, poor reliability, and relatively low energy costs are understood. For example, networking fees alone typically cost more than $350 annually per port, compared to less than $300 per year in electricity costs incurred by the average employee utilizing workplace charging. As a result, less than 3% of participating commercial customers elected to install networked ACL2 chargers in 2022, on-par with results in 2021 and the 2016-2019 pilot program. It appears likely the relatively low rate of networked ACL2 will continue until reliability and costs significantly improve for this type of equipment. If networked ACL2 costs and reliability do not improve sufficiently, then new innovations will be required to satisfactorily address the needs of many property and business owners – most prominently cost-effective, practical, and reliable ways to collect revenue from end-users.

Installations and Costs

The chart below shows the status of completed residential applications in 2022, in driver categories of Battery Electric Vehicle (BEV) Commuter, BEV Non-Commuter, Plug-In Hybrid Electric (PHEV) Commuter, and PHEV Non-Commuter. 36 out of 254 residential applications were withdrawn (14%), mostly due to high costs in cases of more difficult installations, such as those involving long circuit distances, several wall and floor penetrations, expensive wall restorations, and/or when supply panel upgrades are required. Of the residential installations completed, 8% required a supply panel upgrade. Average residential installation costs in 2022 were $1,863 including the cost of the charger, only slightly higher than the average of $1,801 for 91 residential port installations in 2021.



	BEV Commuter	BEV Non-Commuter	PHEV Commuter	PHEV Non-Commuter
Withdrawn	11	10	11	4
Complete	125	54	25	14

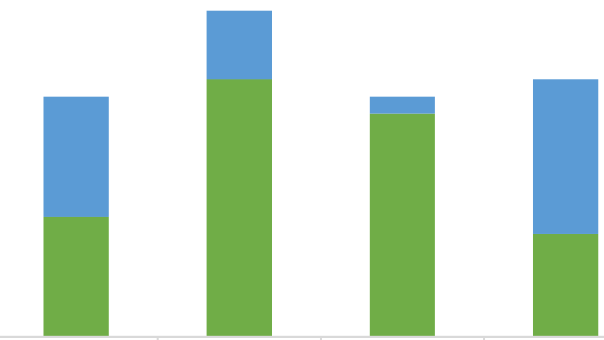
Figure 4: Residential charger installations by driver category (2022)

Purchasing chargers in bulk and having established and well-trained contractors created efficiencies in the process, allowing costs to remain stable despite the fluctuations and inconsistencies in the market the past few years. Supply chain disruptions were also less impactful in the residential sector in 2022. With close attention to inventory management, average lead time from customer application to completed residential installation was maintained under three weeks.

The large majority of residential program applicants owned a BEV (79%) and utilized their EV for commuting (68% including both BEV and PHEV drivers). This compares to 66% and 79% respectively during the 2016-2019 Pilot, indicating a trend toward more BEVs and less work commuting overall.

Figure 5: Residential charger installation

The chart below shows completed and withdrawn commercial applications for 2022, categorized by primary use type.



	MUD	Workplace	Fleet	Public
Withdrawn	7	4	1	9
Complete	7	15	13	6

Figure 6: Commercial ACL2 charging installations by use type (2022)

A total of 131 ACL2 ports were installed at 41 commercial facility locations, averaging 3.2 ports per location. This compares to 2.5 ports per commercial location during the 2016-2019 Pilot, highlighting the trend toward larger facilities that justified more than the 2 ports commonly installed.

Interest in EV charging was distributed fairly evenly across the four categories in terms of the number of applications received, however the rate of withdrawn to completed applications was clearly different. Property and business owners interested in public ACL2 and MUD charging were more often concerned with how to recover ongoing operation and maintenance costs, including networking fees, electric bills, and station repairs. Withdrawals are higher among these segments as they are unable to justify ongoing expenses compared to the benefits of hosting charging for the public, their customers, and tenants. For example, 9 out of 15 public applications were withdrawn (60%), compared to only 1 out of 14 fleet applications withdrawn (7%). In contrast, fleet and workplace customers most often do not see a need for a direct, point-of-use payment to initiate a charging session, and value the benefits of low-cost and reliable, non-networked charging installations. A charger designated primarily for workplace or fleet charging is often also available to visitors and the public as a secondary, less frequent use. Although public utilization may not be high, these charging stations still provide an important benefit in establishing a more robust distribution of public charging throughout the region, enabling confidence in making personal and business-related travel when planned dwell times at destinations allow for several hours charging on ACL2, as well as when the unforeseen need may arise – thereby alleviating range anxiety among EV drivers and supporting early market growth.

Figure 7: Workplace charging installation

Commercial installation costs averaged $4,546 per port, including the charger. This is a 22% decrease from 2021 costs and closer to the costs for non-networked commercial port installations seen during the 2016-2019 Pilot, which averaged $4,472 per port. 13% of commercial installations required a panel upgrade, and less than 2% required a new utility service. The range of commercial installation costs fluctuate more than residential depending on the size of the installation, significant infrastructure upgrades such as new service panels, and the amount of trenching and restoration work. Supply chain disruptions were somewhat mitigated by inventory management but still presented challenges in 2022 with long lead times for common electric equipment, such as supply panels.

Up to 12 ACL2 public charging sites are targeted each year per the TE Plan, equivalent to 24 public charging ports assuming an average of two ports per site. This target was not met in 2022, due to lower-than-expected interest and a high rate of application withdrawals. Five of the six completed public charging sites were in small rural towns, providing value for the local community and a beneficial geographic distribution of EVSE throughout eastern Washington. The Company intends to continue support for ACL2 in rural towns as described further in the Community and Low-Income Support section of this report. In order to achieve targets for public ACL2 in more populated areas such as in the metro Spokane area, program adjustments may be needed to increase awareness of the program and to address site host concerns.

MUDs present special challenges to determine the best options supporting the varied interests of property owners, managers and tenants in a number of different property types, ownership models and parking situations. Hotels, condos, and apartments of various sizes all offer unique situations requiring tailored evaluation, charging and payment solutions. In addition, new state building code requirements have created additional complexities in determining the best ways to support the scale of infrastructure required at some of these sites. For example, many new commercial buildings (including large apartment complexes) require charging stations in-service for 10% of available parking stalls. As mentioned previously, the need to recover electricity costs from tenants' EV charging is a top concern to many property owners and managers, and currently available networked EVSE do not lend themselves well in terms of reliable, cost-effective solutions in this regard.

Figure 8: Fleet charging installation

Customer Surveys

All ACL2 program participants receive a post-installation survey and a recurring annual survey that measures customer satisfaction and provides valuable feedback. Response rates are similar to those experienced during the 2016-2019 Pilot.

	Response Rate	**Net-promoter Score**	**Satisfied or Highly Satisfied**
Residential	32% (70 of 218)	87	97%
Commercial	22% (9 of 41)	78	100%

Table 5: 2022 post-installation customer survey results

General comments are very positive, and customers have high rates of satisfaction for both programs.
Residential customers have a net-promoter score (NPS) of 87, and 97% of customers are satisfied or highly satisfied with the program. Some constructive criticism was received related to costs, scheduling and communication challenges with contractors. Commercial customers also indicated very high satisfaction

levels (100% satisfied or highly satisfied); however, response rates to commercial surveys continues to be low.

In August 2022, Avista sent an annual survey to residential and commercial customers with an EV charger installed for six months or more.

	Response Rate	Net-promoter Score	Satisfied or Highly Satisfied
Residential	25% (67 of 263)	91	97%
Commercial	11% (9 of 79)	67	89%

Table 6: 2022 annual customer survey results

Customer engagement decreases post-installation, as seen by the decrease in response rates compared to surveys completed immediately after installation. Overall satisfaction remains high for both residential and commercial installations, however these are small sample sizes and may not be representative of all customers. Minimal feedback was received in the annual survey related to public charging locations and new program designs. Some feedback received is valuable however, and Avista will continue to survey customers online as well as look for other engagement opportunities to solicit feedback and ideas.

V. DC Fast Charging

Avista continues to work with local stakeholders and community leaders including the Spokane Regional Transportation Council (SRTC), to build out a strategic network of DCFC in eastern Washington over the next few years. This buildout of DCFC charging infrastructure, aligned with Avista's TE plan, Washington State Department of Transportation (WSDOT) guidance and established industry best practices, is an essential foundation to support accelerating EV growth benefiting all customers in the region.[5] Within Spokane County, Avista provided match funding supporting a grant application led by the SRTC, and was awarded the maximum $2.5M project funding from the Washington State Clean Energy Fund III, Electrification of Transportation Systems (ETS), administered by the Washington State Department of Commerce. In addition to the 31 DCFC locations identified in Spokane County per the ETS grant, 14 other sites are targeted in eastern Washington and 14 in north Idaho in key locations along the major travel corridors in eastern Washington,

[5] See www.myavista.com/transportation for a link to the buildout plan site listing and dynamic map

at approximately 30- to 50-mile intervals. As described in the TE Plan, Avista will own and maintain a backbone of this charging infrastructure in its Washington service territory, while applying for grant funding and encouraging private investment and grant funding to achieve strategic objectives. The table below summarizes DCFC progress in 2022.

15	Grid impact site assessments completed
6	Design and contracts in progress
3	Construction sites in progress
4	DCFC sites placed in service (8 ports total)
11	Cumulative DCFC sites in service (16 ports total)

Table 7: DCFC siting and construction progress (2022)

DCFC sites are flexibly designed to match local conditions and needs, beginning with a 1MW standard design broken down into three phases over several years. This phased construction is completed as justified by future demands and helps minimize total costs over time. Phase I includes the installation of a 500kW transformer on a concrete pad sized for a future 1MW transformer upgrade, 800A-480V three phase switchgear, step down transformer and 208V three phase panel, one 180 kW dual port DCFC, two 19.6kW ACL2 chargers as backup, and associated conduit from electrical panels to the chargers, including conduit to future charger locations in Phases II and III. Once demand justifies expansion, Phase II installs a second 180 kW dual port DCFC. This is accomplished at low cost without ground disturbance, pulling wire through existing conduit installed in phase I, and mounting and commissioning the DCFC at the predetermined location. In Phase III the 500kW transformer is replaced with a 1MW unit, 800A switch gear with 1600A equipment, and two 350 kW DCFC are installed, with replaced 500kW transformer and 800A switch gear redeployed or sold for salvage value.

DCFC at three (3) ETS grant sites were completed in 2022 including at The Hive, the Northeast Community Center (NECC), and the Indian Trail Library. The Hive and Indian Trail library were designed using the 1MW standard design. Due to parking area and distribution grid constraints, the NECC site was limited to a 500kW design, incorporating Phase 1 and 2 from the 1MW design, but not phase III.

The figures below help illustrate DCFC site design and construction at The Hive, a new and innovative library and community meeting space.

Figure 9: ABB Terra 184 DC Fast charger at The Hive – Spokane, WA (2022)

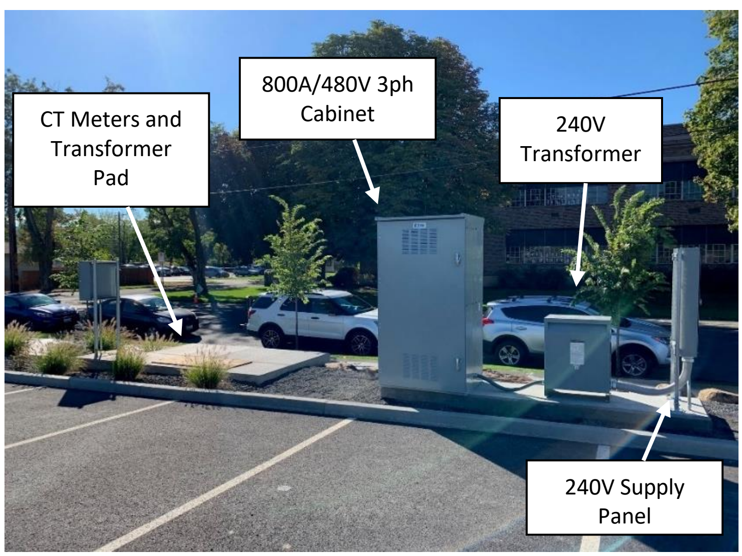


Figure 10: Electric gear and Transformer pad at The Hive – Spokane, WA (2022)

The concrete pad initially supports a 500kW transformer providing 480V 3-phase power but is sized to accommodate a future 1MW transformer in Phase III. Next in line is the 800A/480V cabinet housing the 3-phase supply panel and protective circuit breakers. Conductors run from the circuit breakers in underground conduits to each DCFC location, and to the 240V step-down transformer. Following this is the 208V distribution panel providing service to the two AC level 2 charging ports. Some DCFC installs require an area light for safety, also fed from the 208V panel (not required at the HIVE location).

Figure 11: Fencing surrounding electric gear at The Hive – Spokane, WA (2022)

Figure 12: Completed DCFC site at The Hive – Spokane, WA (2022)

In addition to the three ETS grant locations, a DCFC site in the town of Sprague was completed near the I-90 travel corridor, approximately 36 miles west of Spokane. Although a site such as this along an interstate highway would normally incorporate the standard 1MW design, it was limited to 500kW due to grid constraints, as a larger deployment would have required a substation rebuild costing several million dollars.

Figure 13: ABB Terra 184 DC Fast charger – Sprague, WA (2022)

Figure 14: DC Fast charger and AC Level 2 chargers – Sprague, WA (2022)

DCFC site costs vary considerably depending on grid constraints and local site conditions. Total costs averaging $223k per site resulted from the three DCFC sites completed in 2022, utilizing high-power DCFC and future proofed designs as described above.

Design and/or construction is underway at four additional sites, including in Spokane partnered with the Spokane County Library District and the Martin Luther King Community Center, with the Spokane Tribe in Chewelah, and with the Port of Clarkston.

In terms of 3rd party investments, Electrify America is proceeding with a DCFC site in central Spokane near I-90 in a key location established by the regional buildout plan. Also, a number of auto dealerships are in the process of installing DCFC as mandated by major auto manufacturers, with Avista providing support including eligible make-ready allowances authorized by tariff schedule 077 and time-of-use (TOU) rate schedules 013 and 023. Most of these dealer locations are not sited in locations identified in the regional build-out plan and will likely see lower utilization in the future. However, these DCFCs still provide value for general public access, with some redundant coverage in the event other DCFC are out of service and in addressing driver range-anxiety.

Supply chain delays and negotiations with property owners to obtain legal site acquisitions including property easements continue to be the most difficult issues to address, in some cases causing long delays. Supply chain issues persist, requiring large equipment over 12 months in advance to meet multi-year build schedules. Negotiations with property owners and tenants is often a long and difficult process, in some cases extending to over 18 months. However, many property and business owners see the value in hosting DCFC, and together with support from other area leaders the Company remains confident in a successful buildout of DCFC charging infrastructure in the region.

In 2023, Avista intends to develop a proposal with the support of regional stakeholders, applying directly for National Electric Vehicle Infrastructure (NEVI) program grant funds. If awarded, several sites identified in the regional buildout plan may be built to Phase II or even III levels ahead of schedule, as the NEVI program requires a minimum site capability of four simultaneous 150kW charging ports.

VI. Reliability and Utilization

A strong and dependable network of EV charging equipment is a top priority for EV drivers and critical to support growing adoption. A near term goal of 95% uptime (online and functional), with a longer-term goal of 99% uptime, is a high priority for Avista – requiring substantial capabilities and coordinated effort between equipment manufacturers, network management providers, owner-operators, local technicians, and site hosts.

EVSE Type	Ports in Service (year-end)	Uptime %
Residential ACL2	481	99.9%
Commercial Non-networked ACL2	320	95.4%
Commercial Networked ACL2	108	92.8%
Networked DCFC	16	89.0%

Table 8: Uptime by charger type (2022)

When site hosts do not require user payments or charging session data, networked ACL2 chargers may be configured to provide a charge regardless of network status or connectivity issues. This has been carried out with many of the networked ACL2 in service, resulting in uptime over 95%. This is a considerable improvement to uptime during the Pilot, which ranged from 68% - 78%. However, uptime for networked ACL2 has deceased somewhat compared to 2021, indicating the complexities of communications, software integration and reliability of various components of networked ACL2 persist. Networked stations installed during the Pilot Program are beginning to fail more frequently, both for those still communicating as a networked unit and for those configured to provide a charge regardless of connectivity.

Figure 15: ACL2 station charging error code

DCFC uptime was 89% overall in 2022, a decrease from 95% in 2021. This was due to initial problems following commissioning with newer units, and more prominently with older units from the 2016-2019 pilot that experienced repeated component failures and inadequate service support from the manufacturer. Issues with newer units have been addressed with updated firmware and some internal component replacements. Older units however, may become more problematic and some or all may require replacement earlier than planned, if uptime goals of at least 95% cannot be reasonably achieved.

Networked charger issues ranged from vandalism to poor design and to normal wear and tear, but the most common issues are related to the communications and electronic components of the stations having issues or failing completely. These problems are difficult to diagnose and resolve, requiring time intensive labor by one or more groups including utility staff, EVSE manufacturers, network operators, and field technicians. Remote monitoring, regular testing and on-site inspections is important to maintain and improve uptime. Avista staff monitors public comments on plugshare.com on a daily basis and completed 271 ACL2 and 25 DCFC field inspections in 2022. Remote monitoring and notification services by network providers also showed improvement, notifying Avista of 73% of problems which allowed for faster responses and corrective actions both remotely and in the field.

However, systematic improvements that permanently solve root cause issues are essential to dramatically reduce problem frequency. This is the key to sustainably improve uptime and customer experience to a level that enables mass-market adoption. To-date, non-networked ACL2 chargers remain the only chargers with consistent uptime at the 99% threshold required for mass adoption.

Figure 16: ACL2 station with both ports faulted (red indicator lights)

The chart below represents the top 10 problem types accounting for 88% of the 398 problems that were identified and tracked in 2022, for all EVSE owned and maintained by Avista, ACL2, DCFC, networked and non-networked included. Networked EVSE representing 13% of the total ports in service disproportionately exhibited 87% of the problems tracked.

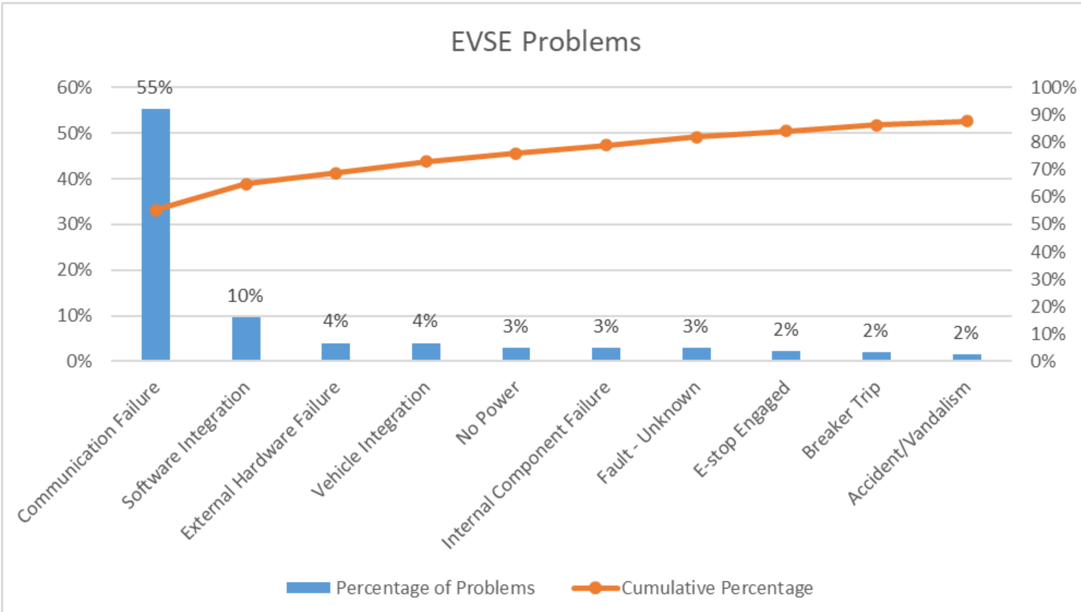


Figure 17: Pareto chart of combined ACL2 and DCFC problem types (2022)

By far the most common issue for EVSEs are communication failures, accounting for 55% of the problems identified in 2022. Communication failures are typically caused by temporary losses in cellular signal strength or modem malfunctions, often self-resolving after some period of time but then reoccurring over several days, weeks or months. Frequently, an EVSE is capable of delivering a charge for the customer in the event of communication failure, if the software is configured to default to a "free vend" mode, meaning the charging session is provided without a user fee.

The next most frequent problems include software integration issues, external hardware component failures such as user interface screens and credit card readers, and vehicle integration issues, which together account for another 18% of problems. Root cause is often difficult to determine and isolate among several parties including EVSE manufacturers, network providers and vehicle OEMs. The persistence of EVSE problem frequency and complexity makes it clear that much work remains to establish reliable compliance with clear and effective standards that integrates EV battery management systems, EVSE and network communications protocols and interoperability, as well as testing and certification processes across the industry.

In addition, equipment manufacturers and network providers – particularly those involving DCFC – must provide improved reliability and service capabilities, in order for accelerated EV adoption to occur in the mainstream market. The table below shows the number of problems tracked in 2022 and resolved by the end of the year according to severity, as well as the average and mean number of days to resolve for each. Average days to resolve is significantly longer than the mean, as a result of a relative few problems taking a very long time compared to the rest.

Problem severity	Number of occurrences	Number resolved	Median days to resolve	Average days to resolve	% improvement
Urgent	55	52	2	6	60%
High	244	218	2	8	56%
Medium	77	70	3	25	48%
Low	20	20	22	33	68%

Table 9: ACL2 and DCFC problems by severity and time to resolve (2022)

Average resolution times have also improved significantly since the conclusion of the Pilot in 2019, across all categories. This is due mainly to sustained, continuous improvement effort and learning over several years, and is reflected in the uptime of most networked EVSE. Again, much remains to be done however, to reach a level that may be reliably scaled up to meet the needs of the mass-market. For example, equipment uptime performance must be properly measured to include problems identified in the field by customers and owner/operators, not just those visible by means of remote monitoring – and with support capabilities to rapidly correct, learn and solve for root cause, thereby preventing recurrence. Furthermore, uptime performance alone is not sufficient to measure customer experience and quality. New measurements are needed, such as the percentage of successful first attempts to initiate a charging session, as on many occasions a customer fails to initiate a charge for a variety of reasons on the first attempt, succeeding on the second, third or even fourth attempt.

Figure 18: DCFC station with payment error displayed on user interface (U/I) screen

Charger Utilization

The table below shows the level of utilization by station type for networked ACL2 in 2022. While these averages provide some value in terms of capturing the current state in the early market, future utilization and energy consumption is expected to increase as the market matures. In particular, MUD and Fleet utilization data is limited by a relatively small data set. The range of fleet utilization and energy consumption is expected to vary considerably between different customers, depending on the number, type and driving patterns of electrified fleet vehicles.

	Number of ACL2 Ports	Annual Sessions per Port	kWh per Session	Annual kWh per Port
Public	43	171	11.3	1,936
Workplace	60	93	15.4	1,435
MUD	13	110	17.3	1,900
Fleet	28	65	11.5	749

Table 10: Networked ACL2 session data (2022)

Public and workplace ACL2 have the highest number of networked units still in service as well as the highest utilization. These networked units are generally capable of delivering 7.7 kW power output, indicating that the average charge session durations are less than two hours for all use types, similar to results from Avista's 2016-2019 Pilot. Vehicle dwell times for workplace, fleet, and MUD locations are usually much longer than two hours, indicating charging output power could be reduced for most EVSE and still allow vehicles to fully recharge, or if feasible more than one vehicle could utilize a common charger port, e.g. if charge cords are swapped between vehicles midday in the case of workplace charging.

EVSE network and AMI data indicates the following utilization for DCFC in the area, expected to continue to increase over time. A new Tesla supercharger site located on the I-90 travel corridor immediately saw strong utilization, indicative of what may occur at other corridor sites such as NEVI-funded sites, as the availability and adoption of other long-range BEVs increases. Based on a data sample of 766 charging sessions across the DCFC network, 50% of DCFC charging session times ranged from 12 to 41 minutes, with an average of 29 minutes and a median of 25 minutes. Given the average kWh per session and an estimated 3.3 miles per kWh, the data indicates drivers are on average acquiring 50 to 120 miles of range per DCFC charging session depending on the site.

	In-Service Date	# DCFC ports per site	kW per port	Annual Charging Sessions per Site	Average kWh per Session	Annual kWh Per Site
The HIVE	9/1/2022	2	50-180	325	27	8,766
Sprague	5/17/2022	2	50-180	507	15	7,610
Pilot DCFC Sites (7)	2017-2019	1	50	443	15	6,644
Large Corridor Site (Tesla)	5/1/2022	12	120-250	9,317	36	335,395
Small Corridor Site (CCS)	6/1/2015	1	50	432	32	13,839
Large Corridor Site (CCS)	3/22/2020	8	50-350	2,667	34	90,680
Auto Dealership	9/28/2021	1	90	47	29	1,349

Table 11: DCFC site utilization and energy consumption (2022)

VII. Community and Low-Income Support Programs

TE programs benefiting communities and low-income customers include partnerships with community-based organizations (CBOs), charging infrastructure at CBOs and in low-income and underserved communities, and in areas of emerging opportunities such as school buses, mass-transit, ride/car sharing, and micro-mobility. Per the TE Plan, an aspirational goal of 30% of overall TE spending from 2021 through 2025 is targeted for Community and Low-Income Support Programs.

Partnerships with Community Based Organizations

Each year, Avista engages a local network of CBOs, soliciting proposals utilizing electric transportation to serve communities in need. CBO proposals include a variety of transportation services such as non-emergency medical appointments, food deliveries, and shelter transport. In this program, Avista provides resources such as an EV and charging infrastructure tailored to the CBO's needs. The CBO is responsible for managing transportation services as well as EV insurance, fuel, maintenance, and utilizing volunteer and/or staff resources as drivers. This model effectively leverages resources of the CBO, providing expanded clean transportation services to disadvantaged groups at lower operating costs. It also provides an added benefit of education and outreach for CBO management, staff, and passengers, increasing positive awareness of electric transportation and support for broader electrification of passenger fleets as well as personal vehicles. Annual reports and feedback are provided by the CBO, including narratives such as the following example from Compassionate Addiction Treatment in Spokane:

> "The electric vehicle we received has improved our team's ability to transport individuals experiencing homelessness to a variety of appointments and needs. Team members that do not have adequate transportation are now able to provide transportation, which has significantly increased our impact due to increased access to appointments and outings . . . Having a car for our nonprofit has also had the added benefit of decreasing the amount of mileage that we have to pay to provide necessary services. We're very grateful for this opportunity to improve our impact within our community, while also decreasing our negative footprint on the environment."

The CBO program was expanded in 2022, resulting in two additional partnerships, for a total of seven active CBO partnerships to-date. Approximately 21,961 passenger-miles were provided in 2022, with significant growth expected in the future. Engagement with local CBOs has increased in outreach to over 100 organizations and will continue. The program may be further expanded with the potential of using credits from the Clean Fuels Program administered by the Washington State Department of Ecology.

CBO Partnership	Year Started
Transitions for Women	2018
Spokane Regional Health District	2018
Asotin Co. Health District	2021
Rural Resources	2021
Whitman Community Action Center	2021
Compassionate Addiction Treatment	2022
COAST Public Transportation	2022

Table 12: Active CBO partnerships utilizing EVs and charging provided by Avista (2022)

Charging Infrastructure

Support for communities and low-income customers includes charging installed at public libraries and community centers, underserved rural towns, CBO partnerships, low-income MUDs, and for customers receiving low-income assistance.

By year-end 2022, 18 charging ports were installed at CBOs, and 105 charging ports in Named Communities. ACL2 public charging was installed in several small rural towns including Creston and Reardan on US Hwy 2, Fruitland on SR 25, Odessa on SR 28 and SR 21, and Tekoa on SR 27 and SR 274. The Company intends to conduct further outreach and engage with site hosts in other rural towns across its service territory in eastern Washington. DC fast charging sites were installed at several library and community center locations in the City of Spokane, and in the small town of Sprague on I-90. Future siting of DCFC will be prioritized at other locations that benefit communities and low-income areas, partnering with libraries, community centers, and local Tribes. Where feasible, charging infrastructure installed at CBOs and in Named Communities will be leveraged with emerging opportunities to support innovative community transportation options including ride hailing, ride and car sharing, and micro-mobility.

To date, charging has not been installed at low-income MUDs or for low-income customers receiving bill assistance. This is expected to change in the future as the used EV market develops and more affordable EVs are made available in the marketplace.

Public Transportation

Electrification of public transit buses continues at STA, with fleet expansion plans proceeding at a rapid pace. Four 40 ft BEV transit buses are currently in operation, expanding to at least fourteen buses in 2023 and up to 40 in 2024. Pullman Transit continues to operate two BEV buses two buses in service. Avista's commercial EV TOU rates are instrumental in addressing the adoption barrier of high demand charges for transit buses, while promoting off-peak charging benefiting all customers. In addition, the Company collaborates and supports transit agencies in grant applications to procure buses, develop fleet electrification plans, and to install charging infrastructure that minimizes local grid impacts. In the future, transit shuttles and carpool vans may be electrified as well as vehicles operated by smaller transit services and Tribes, with Avista's collaboration and support that may include appropriate charging infrastructure investments and grant application partnerships.

Electric school buses are also gaining traction with improving technology, vehicle availability, and the support of state and federal grants. Avista was able to provide outreach awareness to a large number of school districts in its service territory, as well as comprehensive fleet advisory services and grant application support for several districts. In 2022, two applications were awarded grant funding, one from the Washington state grant managed by the Department of Ecology, and another managed by the U.S. Environmental Protection Agency (EPA). In both cases, Avista was able to provide a full range of services including grid capacity assessments, in-depth route analysis and consultation, as well as tailored, multi-year plans for charging infrastructure expansion.

Emerging Opportunities

Other innovations are taking place in areas such as ride- and car-sharing, as well as mini- and micro-mobility serving "last mile" transportation needs. Where feasible, charging infrastructure installed with partners serving local communities may be leveraged to support demonstration projects in these areas. This may provide low-income and underserved communities with new and exciting transportation options while testing the feasibility of scaling for the future. Avista is currently soliciting for partnerships in developing proposals and submitting grant applications to support these efforts.

VIII. Education and Outreach

Avista's education and outreach efforts supporting TE are aligned with the overarching goal of acting as a trusted energy advisor, providing unbiased information that can help customers make informed decisions benefiting themselves and their communities.

The TE website at myavista.com/transportation was updated in 2022 to reflect changes in tax incentives and incorporating advanced fleet electrification tools.

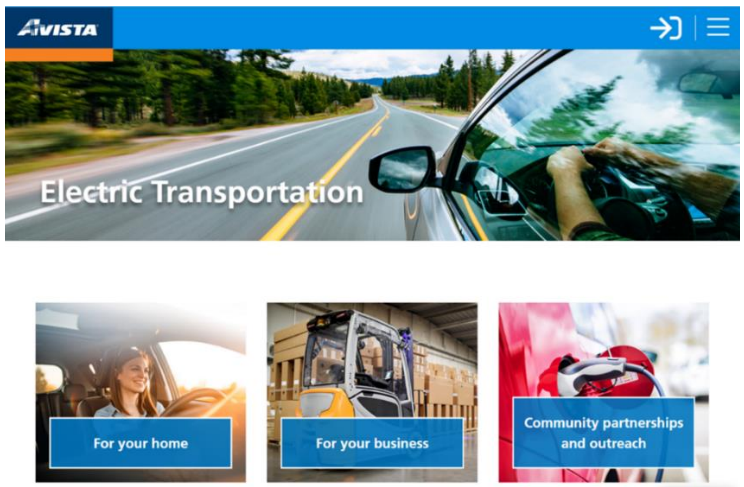


Figure 19: Electric Transportation Website at myavista.com/transportation

The online fleet tool provides useful insights for the growing commercial fleet segment including medium and heavy-duty applications, allowing a commercial customer to select from available EVs, enter duty-cycle scenarios, and evaluate resulting net cost savings, emissions reductions and charging requirements. Most prominent is the cost savings that result from off-peak charging under commercial EV TOU schedules 013 and 023. Residential customers may also explore program options and helpful information about electric transportation on the website tailored to their interests, and submit online program applications as a convenience for both the customer as well as Avista staff.

Media placement for Avista's programs resulted in a large increase in web page visits to 32,080 in 2022 compared to 1,805 in 2021. Online program signups did not commensurately increase, however, as most customers need an extended period of time to consider an EV purchase. Still, the information is valuable in terms of presenting helpful information that can help customers make informed decisions if and when the time is appropriate for their unique situation.

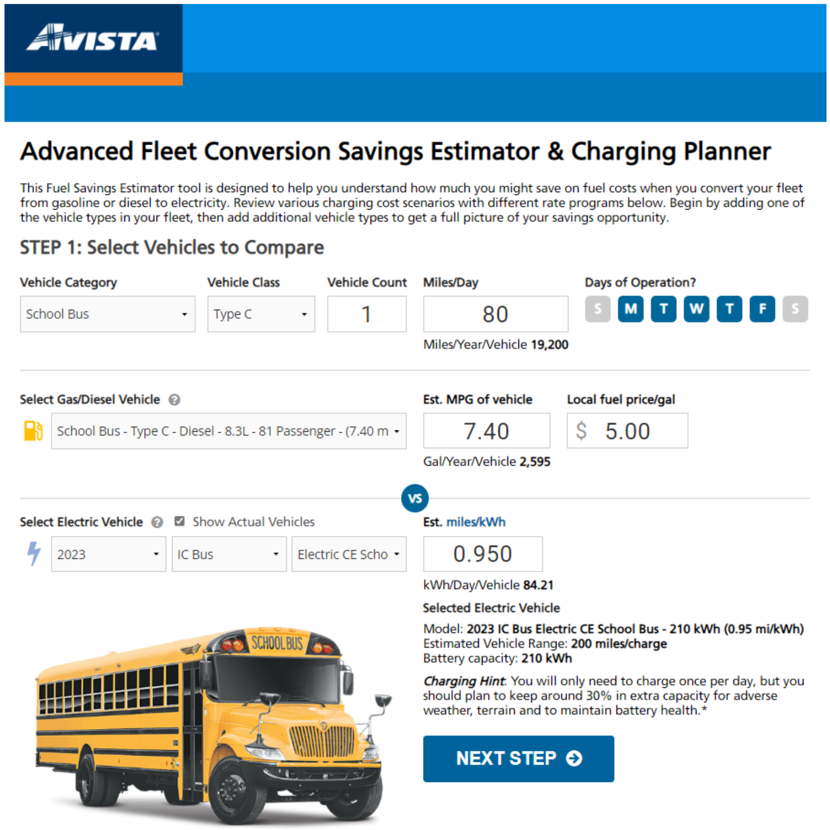


Figure 20: Advanced fleet electrification tool at myavista.com/transportation

The research survey completed in 2021 was not replicated in 2022, however its insights will continue to guide education and outreach efforts. When asked about the main benefits or advantages of EVs, most customers mentioned environmental benefits (50%), followed by quieter operation (34%). A lower percentage mentioned EVs as less expensive to drive (22%) and that they accelerate and perform well (16%). This demonstrates a low awareness of the most important factors that will drive future adoption in the mainstream customer segment. Short driving range (53%) and high purchase cost (42%) were perceived as the main disadvantages. These insights point to focus areas both positive and negative, that should be factually addressed in ongoing education and outreach activities.

As part of the ETS grant and in partnership with SRTC and Spokane Public Library, two EV Experience displays were implemented at public library branches. Display materials and an interactive information kiosk allow the public to explore TE areas of interest and links to more information. This also provides a backdrop for educational presentations and panel discussions. Grant funding opportunities and partnerships to provide a shared EV check-out service are currently being explored, utilizing innovative technology platforms. If successful, this could provide the public with a free and/or low-cost way not just to read or hear about an EV, but to actually experience driving one – a most effective form of EV education.

Figure 21: EV Experience Displays and Informational Kiosk at the Spokane Public Library, Shadle Branch

Auto dealerships in the area are generally aware of Avista's programs and with the sustained increase in EV demand, the dealer referral program is no longer of great value and should be discontinued. Avista will continue to provide information to dealers as programs are adjusted, which may be conveyed for the benefit of mutual customers and to support load management objectives.

Other ongoing education and outreach efforts include case studies, webinars, bill inserts, and presentations in a variety of forums with interested community groups, as listed in the table below.

Case studies	3
Webinars	1
Bill inserts	1
Educational presentations	25

Table 13: Completed education and outreach activities (2022)

IX. Fleet Support Services

For inquiring commercial customers, Avista provides helpful information and in some cases more detailed consultation including analysis of fleet routes and duty cycles, EV availability and incentives, charging requirements, long-term planning, utility rates and load management, total cost of ownership (TCO) comparisons, and referrals to additional technical resources. This is an area of increasing opportunity and growth for light-, medium- and heavy-duty (MHD) on-road vehicle fleets, as well as off-road vehicles such as forklifts and other industrial transport equipment. Consultation services are focused on smaller commercial businesses with more limited means and fleets operated by local municipalities, public and CBOs. Larger commercial customers typically have sufficient resources to properly evaluate fleet electrification options, leaving the issues of optimal rate schedules and off-peak charging, electric grid capacity and planning as primary discussion topics with the utility.

In 2022, comprehensive consultation services were provided to five organizations, with an additional 17 educational meetings primarily involving school bus districts. As described in the Community and Low-Income Support section of this report, electric school buses are a fast-growing segment of electrified MHD fleets. Avista is in a unique position to provide fleet advisory services that help customers design, plan and implement a practical fleet electrification plan that is cost-effective, reduces risks and maximizes off-peak charging for the benefit of all customers. With large federal and state grants available, this segment promises to expand in future years and is an excellent opportunity for Avista to provide valuable assistance that benefits school districts and the communities they serve. The Company also meets regularly and consults with the Spokane Transit Authority (STA) and the City of Spokane as those organizations continue to pursue fleet electrification. In the future, more fleet advisory services may be provided to public organizations, small businesses, CBOs and Tribes as various types of EVs become more viable and commercial awareness and interest grows.

Electric Forklift Program

In addition to on-road vehicle electrification, electric forklifts represent an important opportunity to realize significant benefits from operational cost savings and reduced emissions. Avista's electric forklift program provides purchase incentives for Class 1 forklifts powered by either traditional lead-acid ($2,000) or lithium-ion batteries ($3,000), in order to support beneficial adoption, load profiling, and off-peak charging objectives. In 2022, incentives for 25 electric forklifts were processed (15 lead-acid and 10 lithium-ion). Dealer interviews indicate the incentives are effective in achieving growth in market share, in several cases making the critical difference in the customer's purchase decision over a propane-fueled forklift. The table below summarizes results based on the Industrial Trucking Association Annual Sales Report (ITA) for Eastern Washington and North Idaho, comparing a three-year span from 2019 to 2022.

	2019	**2022**
Annual new lift truck sales, not including leases (all classes)	400	400
Average Service Life	10	10
Total New & Used lift trucks in service (not including leased units)	4000	4100
Additional leased lift trucks in service	1000	1100
Total lift trucks in service, including leased units	5000	5200
Total lift trucks in service in Eastern Washington	3250	3380
Total lift trucks in service in Northern Idaho/Western Montana	1750	1820
Electric rider (Class 1) lift truck new sales	105	133
ICE rider lift truck new sales	185	200
Electric percent of total rider lift truck new sales	**36%**	**40%**

Table 14: Class 1 Electric Forklift Market Summary (2022)

These results show the market share of new electric forklifts sales has improved from 36% to 40% but continues to lag the national market which stands at over 60%. Dealers indicate the main reasons include lower customer awareness in the region, a higher percentage of businesses with less discretionary income to afford higher upfront purchase costs, as well as more industries requiring heavy-duty lift trucks (over 12,000 pounds lift capacity). As of 2023, electric heavy-duty lifts are still not widely available. However, many manufacturers such as BYD and Toyota, are now offering most or all of their Class-1 forklifts as lithium-ion models and ramping up production, gradually improving local inventories.

In addition to supporting beneficial adoption, the forklift program allows Avista to develop load profiles for grid impact modeling and to experiment with load management techniques that maximize off-peak charging. Especially in the case of lifts powered by lithium-ion batteries, the ability to charge 100% off-peak is feasible with all but those businesses running 24/7 shifts, as a full charge may usually be achieved in under 90 minutes of charging. Even with these types of operations, battery swapping may prove effective in eliminating on-peak loads.

Further details on forklift load profiling and off-peak charging are provided in the following section of the report. Results to-date indicate many forklifts are highly utilized, consuming nearly 20,000 kWh per year. This provides a payback period of less than one to two years to the utility, in terms of gross revenue received from electric billing compared to the purchase incentives of $2,000 and $3,000, respectively.

X. Load Management and Grid Integration

This section focuses on three areas of inquiry: (1) a residential charging analysis comparing whole-house load data before and after customers acquired an EV, (2) fleet vehicle charging under commercial EV time-of-use (TOU) rate schedules 013 and 023, (3) forklift load profiles, and (4) DCFC load profiles and demand response (DR).

Residential Charging Analysis

A pool of 144 residential customers were included in a study utilizing Advanced Metering Infrastructure (AMI) data, collected in 5-minute intervals for at least one year prior to charger installation under Avista's program. In this customer pool, 71 had chargers installed for over a year and another 73 for a minimum of 6 months, so that individual household loads could be compared for an extended period both before and after EV charging began. Goals of the study included developing a number of load profiles based on vehicle and driver types, load management controls, and daily and seasonal variations, in order to better understand EV grid impacts and the degree to which off-peak charging may be best achieved.

The following chart helps illustrate the process that was undertaken to develop insights for each individual customer in the dataset. Individual customers were then aggregated together into various groups with similar characteristics such as driver type, vehicle type, and load management control.

Note that as defined here, daily household peak demand is not necessarily coincident to times of peak demand on the grid either locally or system-wide – that determination requires more detailed analysis throughout the course of each day and will be subsequently addressed.

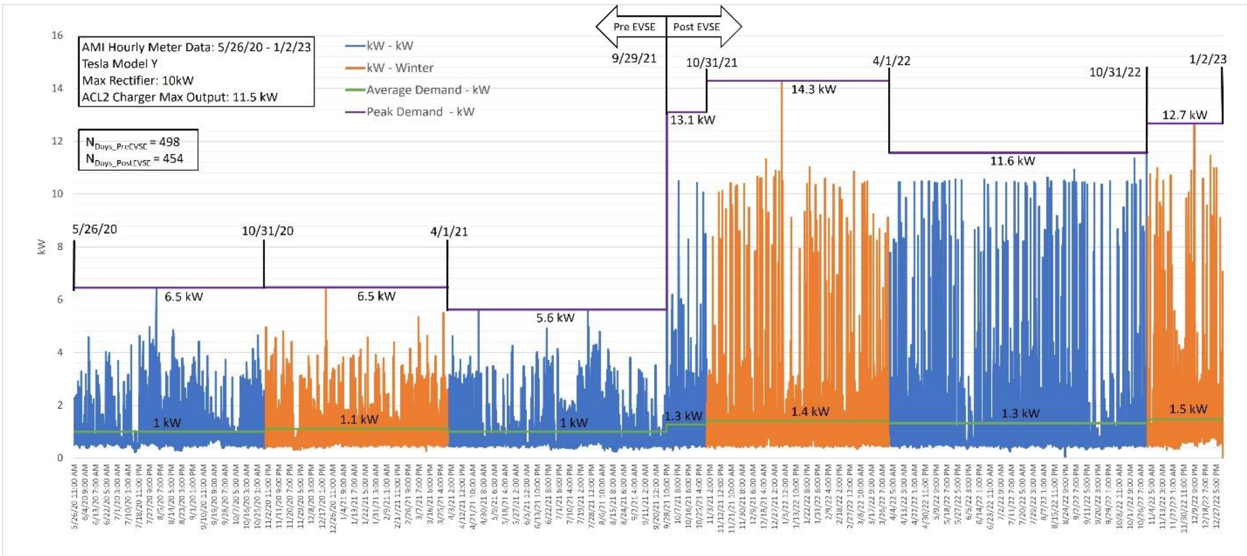


Figure 22: Residential AMI Data – Pre- and Post- EVSE (Single Customer from 5/26/2020 to 1/2/2023)

In this individual case, household kWh for each hour of each day starting May 26, 2020, is plotted for 498 days over two summers and one winter before a 11.5 kW ACL2 charger is installed September 29, 2021, at the customer's residence in Spokane. Hourly kWh for each day continues for another 454 days, through a full winter and summer, and finally the early part of winter ending January 2, 2023. The customer's EV is a Tesla Model Y, with an internal rectifier capable of 10 kW charging. This is higher than the common 6.6 kW rectifier of many current EVs but may be more representative of future EVs with larger battery packs (e.g., Tesla offers an optional 20 kW rectifier). Maximum charging power is also dependent on the rating of the electrical circuit and charger that is installed, in this case 11.5 kW, which is also higher than the 30A/240V circuit and 24A rated charger regularly installed in Avista's residential program, delivering a maximum 5.8 kW.

For this customer, the average and peak hourly energy consumption do not differ much between summer and winter seasons, which is typical of customers that utilize natural gas heating instead of electricity. After the charger was installed however, hourly peak consumption increased from 4kWh to over 11 kWh. Following the charger installation, absolute peak demand per 5-minute interval data showed eight instances of 27 kW to 29 kW demand, and one instance of 35 kW demand, compared to the maximum capacity of a 200A/240V supply panel of 48 kW.

By summing hourly kWh according to peaks across the dataset, we develop the aggregated "average" peak load profile before and after charger installation as illustrated in the chart below.

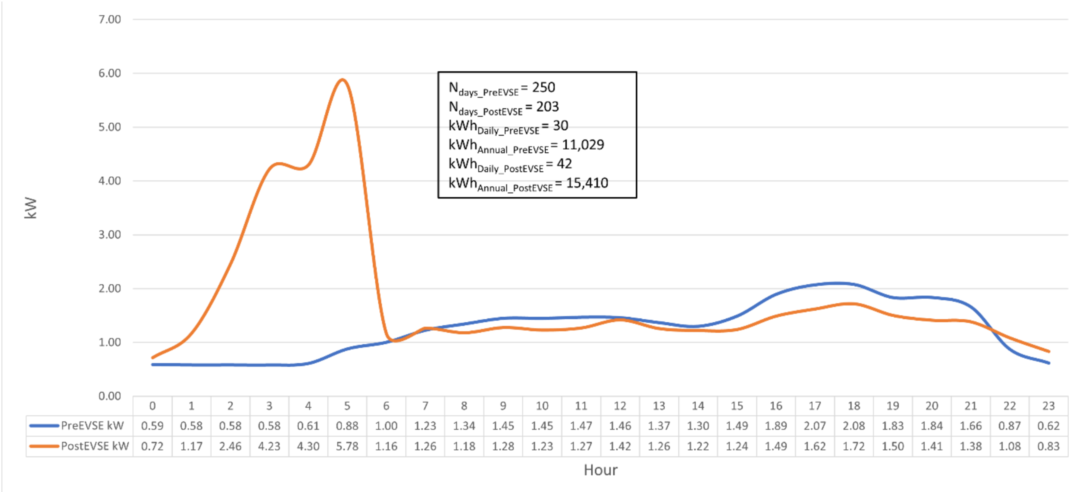


Figure 23: "Ready-by" Programmed – Single Customer Whole-house Peak Load Profile

This shows that virtually all EV charging is occurring in the very early morning hours, peaking between 4:30 and 5 am, and that the household load profile changes very little pre- and post- charger (EVSE) installation. Through a customer survey it was confirmed the customer has programmed their EV with a 6 am "ready by" setting, at which time the battery reaches 80% or full (depending on whether the customer wishes to take a long trip that day), the battery conditioned to a temperature optimal to begin driving, and the passenger cabin pre-conditioned to a comfortable temperature setting. Based on the state-of-charge (SoC) of the battery and the known kW charging power, the EV will work backwards from the "ready by" setting to determine the time the EV should begin charging and automatically initiate charging. Given an average driving distance of under 40 miles per day and an efficiency of 3.3 miles per kW, we would expect the typical customer to use between 9 kWh and 12 kWh on average for daily charging energy consumption, plus some additional fractional amount for pre-conditioning the battery and cabin. In this case, integration of the dataset shows very close to this result, with 12 kWh difference between the average 30 kWh pre- and 42 kWh post- charger installation load profiles. Charging at 10 kW power, we would expect most charging session to start an hour to 1.5 hours to achieve 12kWh, which is what the plotted data shows, with a peak load occurring between 4:30 am and 5 am.

By subtracting the pre- from the post- curves, we get the isolated differential that represents the average daily charging load profile at this household, as shown below. Note that the reason we see a peak of 5 kW in this profile rather than 10 kW, is because the EV does not charge every day. The load profile shown here is an averaged load curve representing both days with and without EV charging. In fact, as the peak is 5kW for this aggregated profile, a good estimate for the percentage of charging days is 5/10 = 50%, i.e. this customer likely charges on average, every other day.

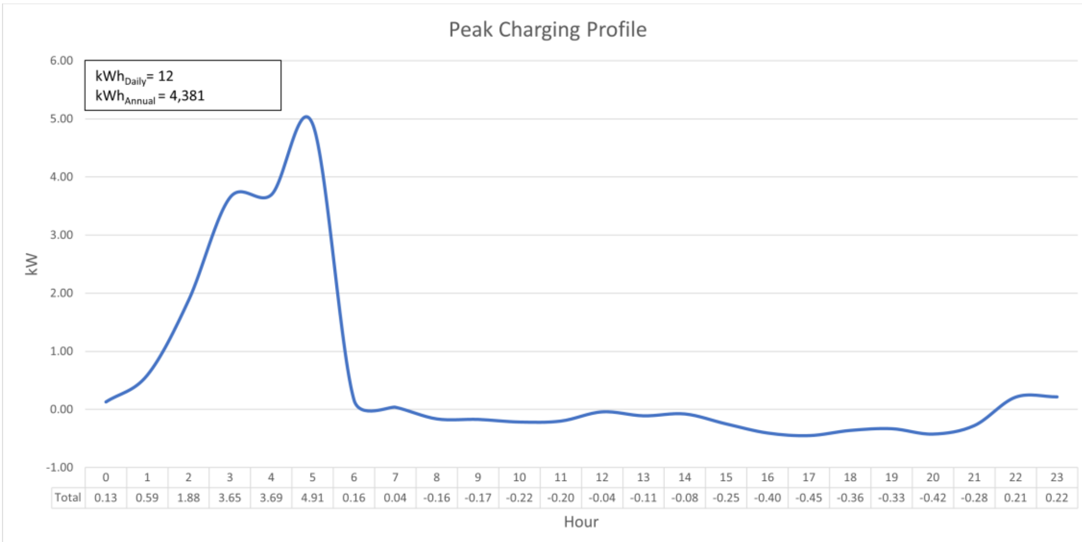


Figure 24: "Ready-by" Programmed – Single Customer Charging Load Profile

Additional load profiles are included in Appendix A exploring weekday -vs- weekend charging, seasonal charging differences, vehicle type and load management control, the results of which are summarized in the tables below starting with charging profiles for winter -vs- summer seasons.

		Daily kWh	On Peak kWh	% On Peak	Off Peak kWh	% Off Peak
Annual	Pre EVSE	44.10	11.39	25.8%	32.71	74.2%
	Post EVSE	56.58	13.32	23.5%	43.26	76.5%
	Charging	12.48	1.92	15.4%	10.55	84.6%
Summer	Pre EVSE	44.27	10.34	23.4%	33.93	76.6%
	Post EVSE	54.01	11.22	20.8%	42.78	79.2%
	Charging	9.73	0.88	9.1%	8.85	90.9%
Winter	Pre EVSE	43.84	12.86	29.3%	30.98	70.7%
	Post EVSE	60.16	16.24	27.0%	43.92	73.0%
	Charging	16.32	3.38	20.7%	12.94	79.3%

Table 15: Charging Summary – Seasonal

During the colder winter months, batteries are less efficient, and the dataset showed a considerable daily charging increase from 9.7 kWh in the summer to 16.3 kWh in the winter (40% increase). On-peak charging as a percentage of charging load also increased from 9.1% in the summer to 20.7% in winter.

Next, we consider charging profiles by vehicle type. There are three main types of plug-in EVs: plug-in hybrid (PHEV), battery electric (BEV), and long-range battery electric (LRBEV). The PHEVs have a small battery pack that allows for a limited range of all electric driving (typically less than 50 miles) before an internal combustion engine fueled by petroleum takes over. BEVs are 100% battery-electric EVs with ranges less than 200 miles on a charge, and LRBEVs have ranges over 200 miles on a single charge. In this dataset, LRBEVs make up 60% of the sample, BEVs 15%, and PHEVs 25%. This reflects the industry trend toward LRBEVs in recent years. The table below summarizes results of this group.

		Daily kWh	On Peak kWh	% On Peak	Off Peak kWh	% Off Peak
PHEV	Pre EVSE	43.98	17.71	40.3%	26.27	59.7%
	Post EVSE	51.36	20.45	39.8%	30.91	60.2%
	Charging	7.38	2.74	37.1%	4.64	62.9%
BEV	Pre EVSE	42.97	16.75	39.0%	26.22	61.0%
	Post EVSE	51.49	18.56	36.0%	32.93	64.0%
	Charging	8.52	1.81	21.2%	6.71	78.8%
LRBEV	Pre EVSE	44.39	17.22	38.8%	27.17	61.2%
	Post EVSE	60.15	20.17	33.5%	39.98	66.5%
	Charging	15.76	2.95	18.7%	12.81	81.3%

Table 16: Charging Summary by Vehicle Type

Consistent with the results of the 2016-2019 Pilot, the daily kWh of PHEVs and BEVs are similar in magnitude, with BEVs at 8.5 kWh and PHEVs at 7.4 kWh daily charging at home, with an average peak load of 0.8 kW near 10pm and 1 kw near midnight. LRBEVs however, showed a much higher daily average at 15.8 kWh, and while only demanding 0.6 kW on average at 10pm, peaked at 1.4 kW at 4 am.

Finally, we consider the differences between groups of customers according to load management control. Customers either had their EV programmed to charge off-peak by the contracted electrician installing the charger (28%), programmed the vehicle themselves (45%), or had no off-peak programming (28%). As shown in the table below, off-peak charging load increased from 66% in the case of unprogrammed EVs, to 74% off-peak for programmed vehicles by the contractor and 88% for customer programmed. This represents a significant improvement from the 2016-2019 Pilot, in which the uninfluenced load profile of a BEV was

		Daily kWh	On Peak kWh	% On Peak	Off Peak kWh	% Off Peak
Contractor Programmed	Pre EVSE	51.91	13.63	26.3%	38.28	73.7%
	Post EVSE	61.98	16.23	26.2%	45.75	73.8%
	Charging	10.07	2.60	25.8%	7.46	74.2%
Customer Programmed	Pre EVSE	39.79	11.08	27.9%	28.70	72.1%
	Post EVSE	49.97	12.32	24.7%	37.65	75.3%
	Charging	10.18	1.24	12.2%	8.94	87.8%
Not Programmed	Pre EVSE	44.58	17.20	38.6%	27.37	61.4%
	Post EVSE	57.67	21.71	37.6%	35.96	62.4%
	Charging	13.09	4.51	34.4%	8.58	65.6%

Table 17: Charging Summary by Load Management Control

Overall, these results showed that AMI data may be used to disaggregate ACL2 charging loads from overall household loads, and that the great majority of residential EV charging may be accomplished off-peak – by as much as 88%, through built-in programming features in the EV. The EV's "ready by" functionality in particular can improve customer experience by preconditioning the battery and cabin temperature, extending the vehicle's driving range, and increasing the longevity of the battery by normally charging to 80% SoC, only charging to 100% when a longer trip is planned. This method if widely utilized also has the effect of staggering charging start times in a given service area, however could still result in a large percentage of EVs charging simultaneously in the morning hours if customers commonly set "ready by" times at 6am to 7am, for example, as seems possible.

However useful this method was in accomplishing the recent study, using the EV's onboard programming features to schedule off-peak charging is difficult to manage as a condition of participating in a utility's charging program, and does not appear realistic as a scalable methodology for the future. Some customers may refuse to allow their EV to be programmed, the EV may not be present at a scheduled time to program the vehicle by a contractor requiring a return trip, or over time a customer may change the program or no longer utilize programming altogether without notifying the utility.

Residential charging represents 70% to 80% of total charging expected in the future, with another approximately 10% to 15% coming from ACL2 workplace charging and 5% to 10% from public charging, primarily DC fast charging. Vehicle telematics is required to develop a more accurate load profile encompassing all charging locations and to better understand customer behaviors and needs. This was successfully demonstrated in the 2016-2019 Pilot, in which the installation of after-market hardware devices was required in each EV. New and low-cost technologies are commercially available that allow highly accurate and reliable telematics communications without hardware devices, communicating over-the-air directly with the EV. A new data collection and load management program should be considered that utilizes this technology, in order to improve customer experience, optimize charging for battery longevity and electric bills when tied to a TOU rate, and maximize automatic, off-peak charging for the benefit of all customers.

Commercial EV Time of Use Rates

Avista's optional commercial EV TOU rate schedules 013 and 023 became effective April 26, 2021. These rate designs replace high demand charges with on-peak and off-peak rates for separately metered EV charging loads. This can be a valuable option supporting investments in public DCFC as well as larger ACL2 installations for workplace and fleet uses, achieving required fuel savings using electricity instead of petroleum for owner-operators.

	Schedule 013	Schedule 023
Basic Charge	$21	$600
On-Peak Energy Charge, per kWh	$0.21637	$0.16130
Off-Peak Energy Charge, per kWh	$0.08653	$0.06274

Period	Morning Peak	Afternoon-peak
Apr 1 – Oct 31	NA	3pm – 7pm
Nov 1 – Mar 31	7am – 10am	5pm – 8pm

Table 18: Commercial EV Rate Parameters

As of December 31, 2022, nine customers with a total of sixteen meters adopted one of the two optional rates, an 80% increase compared to 2021. Two customers operate public transit, three are for commercial fleet use, one is for workplace charging, two are for a third-party owned public DCFC, and the remainder are for public DCFC sites owned and operated by Avista. All meters use rate schedule 013, with the exception of one public transit customer that utilizes schedule 023 for three meters, each at separate facility locations.

Early load profile data collection through AMI and analysis indicates the EV TOU rate is very effective in achieving off-peak charging. A load profile is shown below for two customers operating mass transit buses, during the period between December 2021 and December 2022.

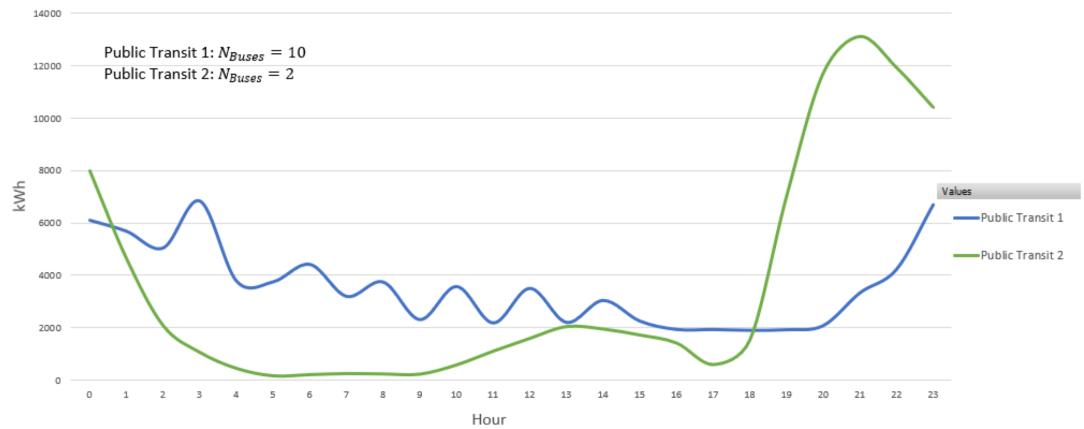


Figure 25: Mass Transit Bus Facility Charging of Two Customers – Public Transit 1 Using Rate Schedule 023 and Public Transit 2 Using Rate Schedule 013

Analysis of Public Transit 2 shows 90.9% of total charging occurring off-peak, and is solely from overnight depot charging with no en-route charging for the two electric buses in service.. Much of the on-peak charging occurs in the winter – about 19.1% of all winter charging occurs from 5pm to 8pm. Charging equipment does have a minimal amount of "always on" load, thus 0% on-peak usage is not expected. For this customer, monthly on-peak "always on" load is currently 0.4%.

Public Transit 1 shows 82.9% of charging occuring off-peak, also a high percentage. Similar to Public Transit 2, much of the on-peak charging occurs in the winter, about 23.4% of winter charging occurring between 7am to 10am. This customer's data represents en-route bus testing loads, which are likely to shift in the future as more buses are placed in regular service.

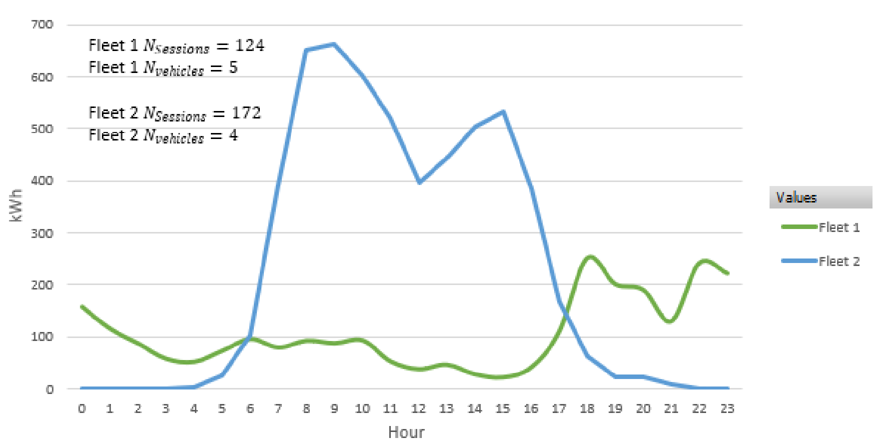


Figure 26: Private ACL2 Charging for Fleet of Two Customers Using Rate Schedule 013 (2022)

The above figure shows two customers with differently used charging habits under the same rate schedule. Fleet 2 chargers are also used for workplace charging, so the charging mostly takes place between 7am and 4pm, during peak hours. Fleet 1 charges mostly off-peak from 6pm to midnight.

Overall, early results are encouraging regarding the EV TOU rates. They are effective in removing barriers to EV fleet adoption and DCFC investment, expected to grow with the market in future years. AMI load data also shows they are very effective in shifting commercial fleet charging loads to off-peak. No changes to the current rate schedules are warranted at the present time.

Demand Response for DCFC

Next generation DCFC planned for installation have DR capabilities built-in, which may be implemented in two ways. The first and easiest method to setup initially, uses the network provider's web platform and Open Charge Point Protocol (OCPP) to control DCFC output remotely. This function may be setup for a minimal fee and provides access to all DCFC connected to the providers network. Command signals may be sent manually to individual DCFC and take effect within seconds. The second option is more involved, integrating a dedicated (Avista owned) DR server with the network provider server through OpenADR (Automated Demand Response) protocols. Longer term, the OpenADR option is the preferable solution from an automated capability and security standpoint across the full network of DCFC.

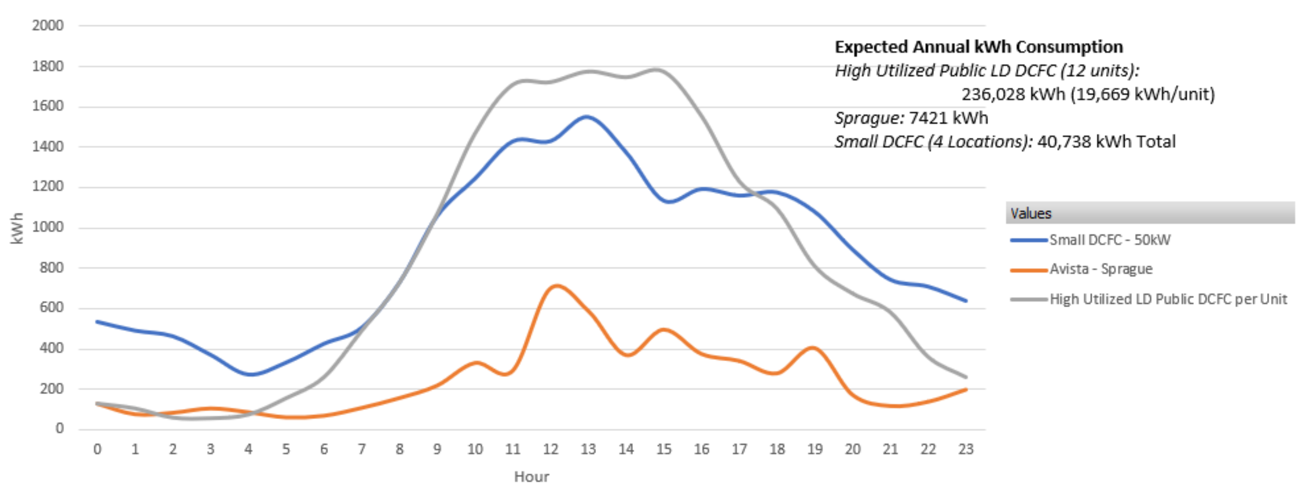


Figure 27: Load Profiles for Public DCFCs

Grid impact studies evaluate a specific feeder capacity to handle new loads during peak loading conditions. In some cases, DCFC loads of 150 kW or more may not be installed without reliable DR capability, i.e. the ability to remotely curtail charger output up to 100%.

Initial DR testing of first-deployed DCFC is planned in Q4 2022 using the OCPP option. Through this process a numberof important concerns will be tested and validated, including DR command response time, effectiveness of powering down the station vs. curtailing output, reliability and time to power up after the DR event, and effective customer communications. Concurrently, Avista intends to develop a dedicated DR server for longer term benefits, allowing Avista's system operators to access and implement DR commands across the DCFC network. The end result is a robust network of public DCFC that avoids costly grid upgrades and protects assets during extreme events, through the use of effective and reliable DR technology.

Forklift Load Profiles

Unlike residential load profiling using AMI data, the forklift load profile study isolates the forklift charger by installing a data logger at the electric panel. This provides direct measurement of forklift charging loads, as in most cases the forklift charging loads are relatively small and may not be accurately disaggregated from the meter's overall loads using AMI data.

After an initial logging period of three weeks, data is downloaded and analyzed. This analysis reveals the frequency of charging events, duration, kW peak demand and kWh consumption, as well as percent of on-peak charging. After the data is analyzed, a report is presented to the customer summarizing charging information and grid impacts during peak periods. A revised charging schedule is also presented, maximizing the shift from on-peak to off-peak charging based on operating hours and observed charging requirements. The schedule may be implemented by programming the charger or the forklift to initiate charging during off-peak periods. Alternative solutions are currently under consideration utilizing a separate timing device, in some cases where chargers are not capable of programming. Customers use the revised charging schedule on a trial basis for an additional 3 weeks, followed by analysis to determine the effectiveness and feasibility of sustained off-peak charging.

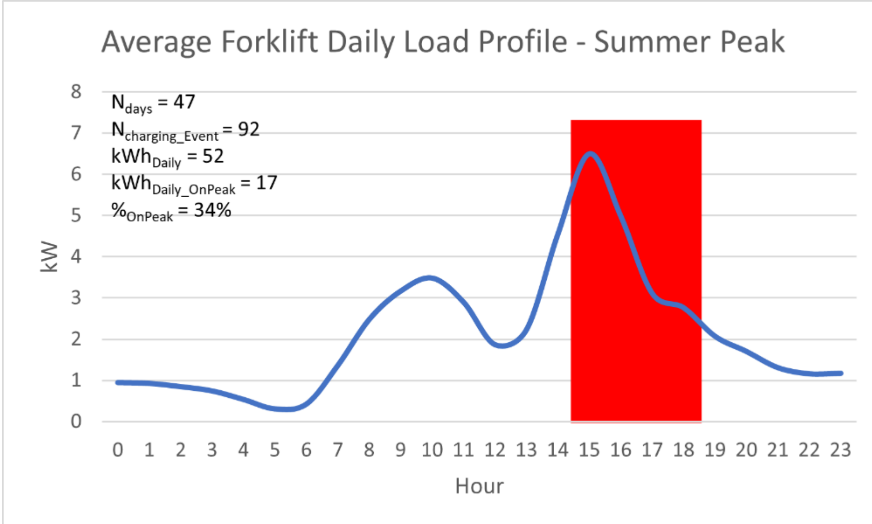


Figure 28: Forklift Load Profile Compared to Summer Peak 3pm - 7pm – Food Distributor

The chart above shows forklift charging profiles for two food distribution warehouses. These customers run multiple operational shifts and must charge their lifts when necessary to keep product moving, in many cases unavoidably during on-peak times of the day. The use of forklifts powered by lithium-ion batteries could be an improvement in this case, enabling faster charging times and reduced on-peak charging compared to the current forklifts powered by lead-acid batteries. However, customers that run multiple shifts will in most cases require some off-peak charging to meet operational needs, even with lifts powered by lithium-ion batteries.

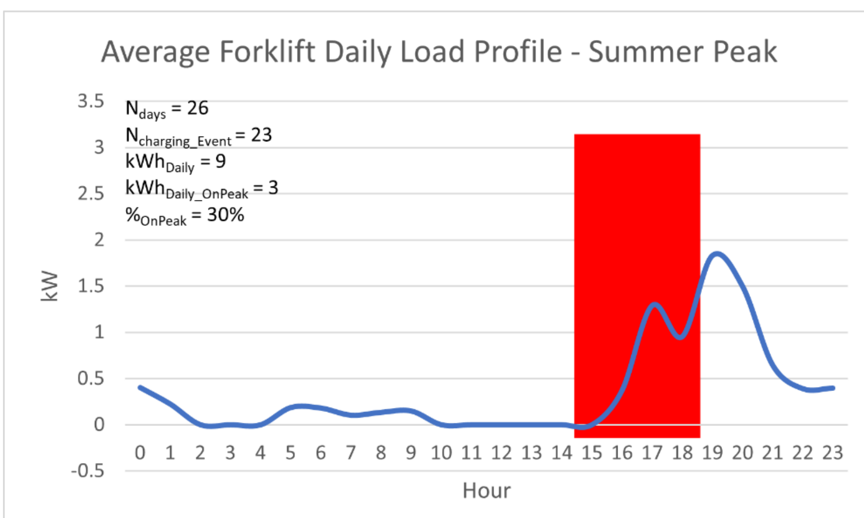


Figure 29: Forklift Load Profile Compared to Summer Peak 3pm - 7pm – Retail

The retail customer's load profile shown above uses their lift throughout the day and then charges at the end of the workday. The duration of these charging cycles suggests that there would be adequate time in the late night and early morning to fully charge the lift and have it ready for business. A charging plan has been developed and sent to the customer. This plan suggested that either the forklift or the charger be programmed to delay the start of charging until after our evening peak period.

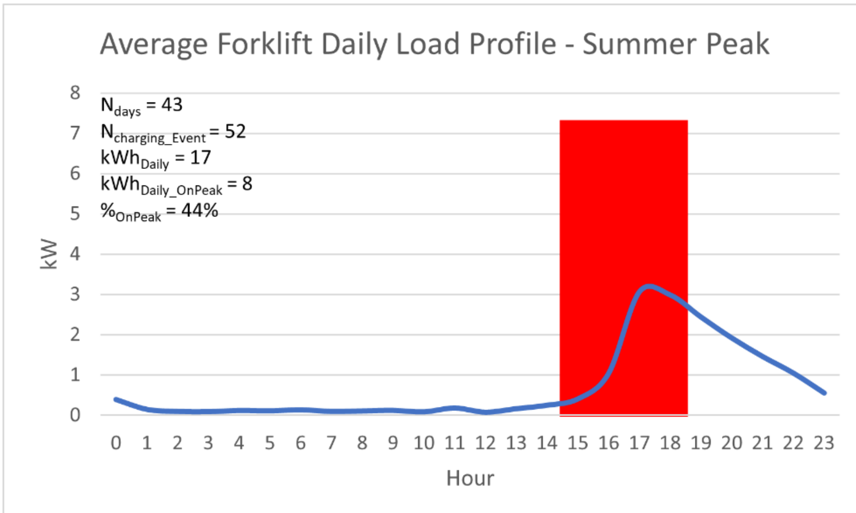


Figure 30: Forklift Load Profile Compared to Summer Peak 3pm - 7pm – Warehouse

The load profile above shows a forklift used in two warehouses. Like the retail customers, they use their lift throughout the day and then plug it in at the end of the workday. The duration of these charging cycles suggests that there is adequate time in the late night and early morning to fully charge the lift before the start of business. A charging plan has been developed and sent to each customer to this effect.

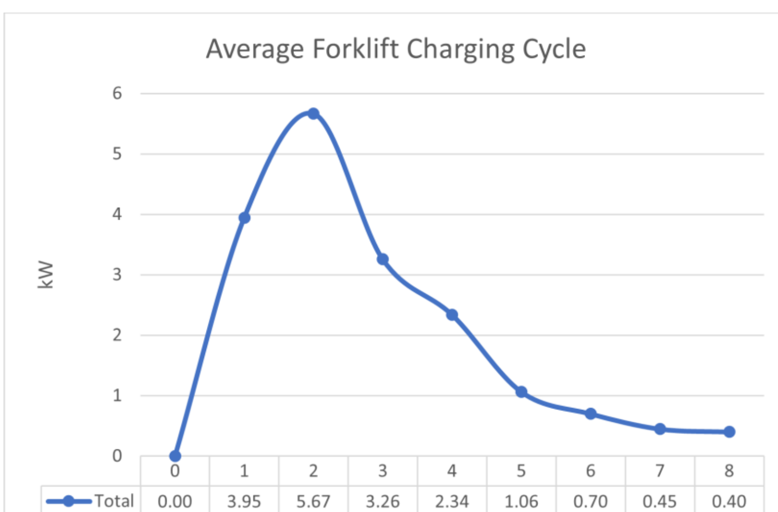


Figure 31: Average Forklift Charging Profile

The chart above shows the average charging cycle for the forklifts studied to-date. These cycles have a duration of 8 hours with a total of 18 kWh delivered. Over 70% of the total energy is delivered to the battery in the first 3 hours of the charging session. All the customers in this study, with the exception of the food distribution warehouse, could move their charging to close to 100% off-peak hours with no adverse operational impacts. Of the customers studied, two thirds have purchased chargers capable of being programmed, and utilizing these programmable chargers is the most cost effective and reliable method to shift charging to off-peak periods. As mentioned above, each customer has been given a charging plan in their report, and the Company is working to engage these and future customers to modify their charging behaviors as a condition of the forklift incentive program.

XI. Future Direction

Overall, Avista's TE programs continue to demonstrate success and the Company intends to build on this momentum as the market grows, coordinated with partners and stakeholders across eastern Washington. A consistent emphasis on charging infrastructure, community and low-income support, fleet services and load management activities including new telematics technologies will be implemented in 2023. In addition, a comprehensive study and forecasting of distributed energy resource impacts on the grid will include detailed residential and commercial TE loads at the feeder level. This should provide an early indication of where the Company may likely see disproportionate impacts on its electric distribution system through 2050, enabling improved system planning and optimized infrastructure investments.

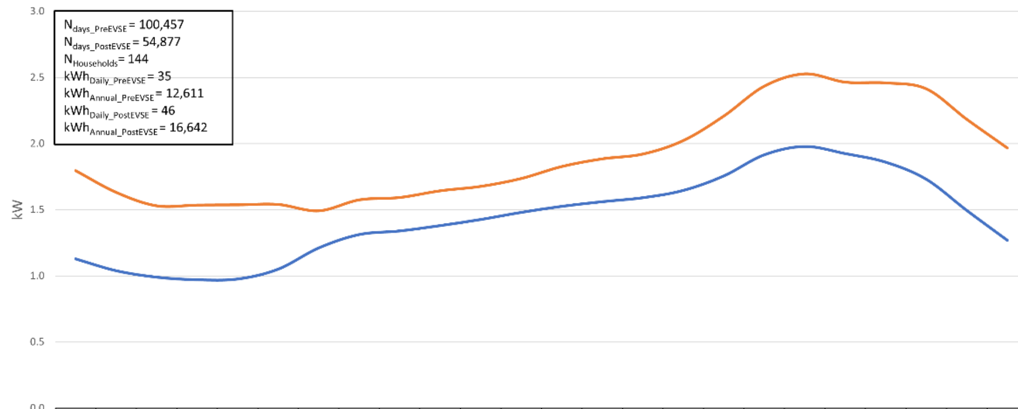
As the scope and scale of market growth accelerates, some program adjustments are necessary and prudent. Regarding the residential program, customer satisfaction is very high and at this point has provided a valuable and statistically significant pool of customers for detailed load profiling and load management studies, which will continue. In the future, these customers will be solicited to participate in residential time-of-use (TOU) rate options, providing additional learning and value for new rate designs beneficial to the general body of customers. Nevertheless, a new program design is required to enable cost-effective scaling-up of residential charging installs coupled with maximum off-peak charging for the long term, achieving the strategic goal of cost-effectively shifting 50% or more of EV charging off-peak. Highly accurate charging data in all charging locations is also desirable, particularly for new and larger EVs, which may be compared to estimates from disaggregated AMI data and utilized for grid impact studies. In this regard, emerging opportunities to utilize telematics technologies are very promising, as they reliably communicate and schedule off-peak charging directly with the EV at low cost, while providing the customer with insightful energy reports and lower energy bills when participating in a TOU rate. In addition, incorporating cost-effective telematics with load management capabilities and TOU rates as a condition of receiving an attractive incentive, could be an effective program design well suited for funding from Clean Fuels Program (CFP) credits.

Regarding commercial ACL2 programs, public rural access and support for CBOs will continue and grow, as well as the standard program available for workplace and fleet customers which has proven popular and effective. However, some adjustments are needed to the make-ready program, in order to make it more desirable to a wider spectrum of commercial customers. ACL2 program application withdrawals for MUD and public categories were much higher than workplace and fleet, and only 16 ports out of 131 (12%) were installed under the make-ready option in 2022.

Regarding DC fast charging, additional effort is needed to obtain timely legal agreements with site hosts, to meet the ambitious construction schedule required by the ETS grant and achieve the regional buildout of this critical charging infrastructure over the next few years. No adjustments appear necessary to the DCFC make-ready program to-date but will be monitored for effectiveness as the market evolves and more 3rd party interest materializes.

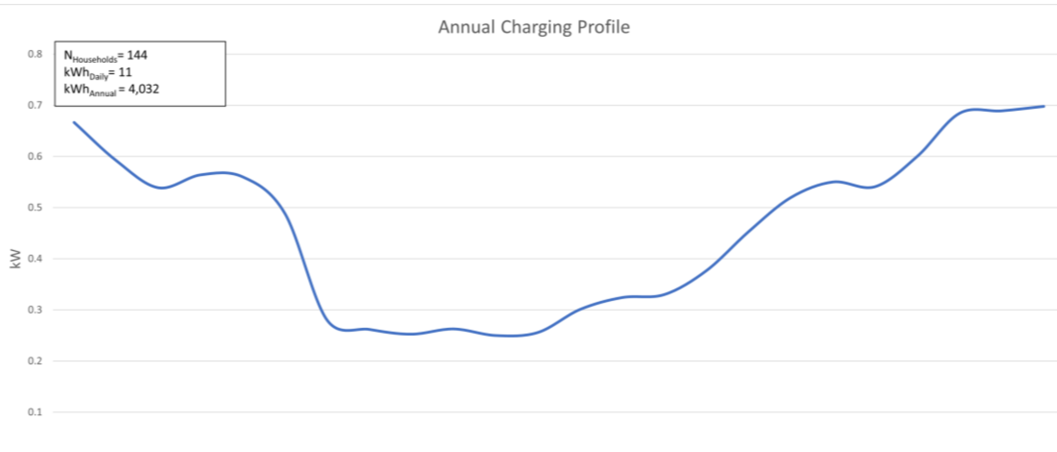
Planned investments may be used as matching funds to secure additional grant funding from state and federal sources for charging installations, which may help accelerate beneficial charging buildout in the next few years and reduce overall TE capital investments through 2030. In addition, credits from the CFP in Washington state will be banked in 2023 and may be used to fund future programs accelerating beneficial electrification, primarily as a supplement to the programs outlined in the TE Plan. However, CFP credit revenues shall be kept clearly separate and not co-mingled with rate-based expenditures under tariff schedule 077. The amount and timing of CFP credit revenue that may be utilized is to be determined as more detailed guidelines are issued by the Washington State Department of Ecology, which administers the CFP.

Appendix A – Residential AMI Data and Load Profiles



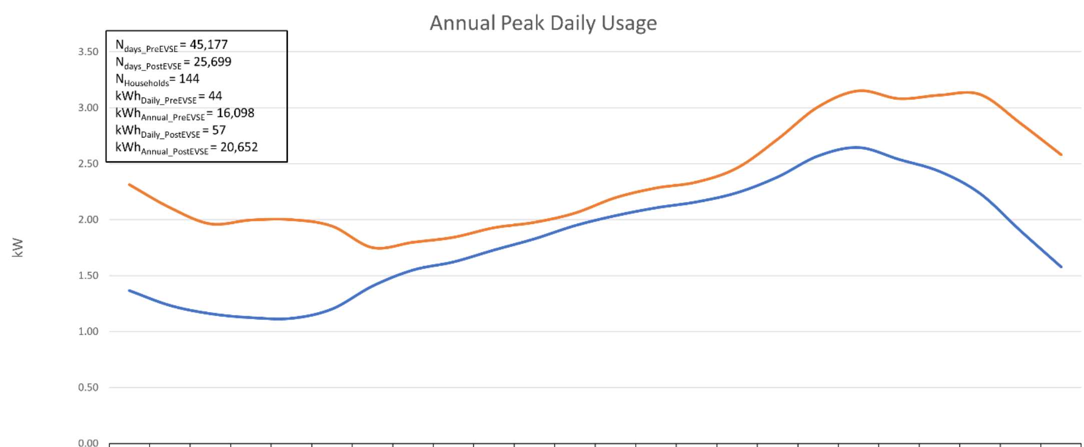
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE kW	1.13	1.04	0.99	0.97	0.98	1.05	1.21	1.31	1.34	1.38	1.43	1.48	1.53	1.56	1.59	1.65	1.75	1.91	1.98	1.92	1.86	1.73	1.49	1.27
PostEVSE kW	1.80	1.63	1.53	1.54	1.54	1.54	1.49	1.57	1.59	1.64	1.68	1.74	1.83	1.88	1.92	2.02	2.21	2.43	2.53	2.46	2.46	2.41	2.18	1.97

Figure 32: Residential whole-home load profile, average daily kWh



Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.67	0.59	0.54	0.56	0.56	0.49	0.28	0.26	0.25	0.26	0.25	0.26	0.30	0.32	0.33	0.38	0.45	0.52	0.55	0.54	0.60	0.68	0.69	0.70

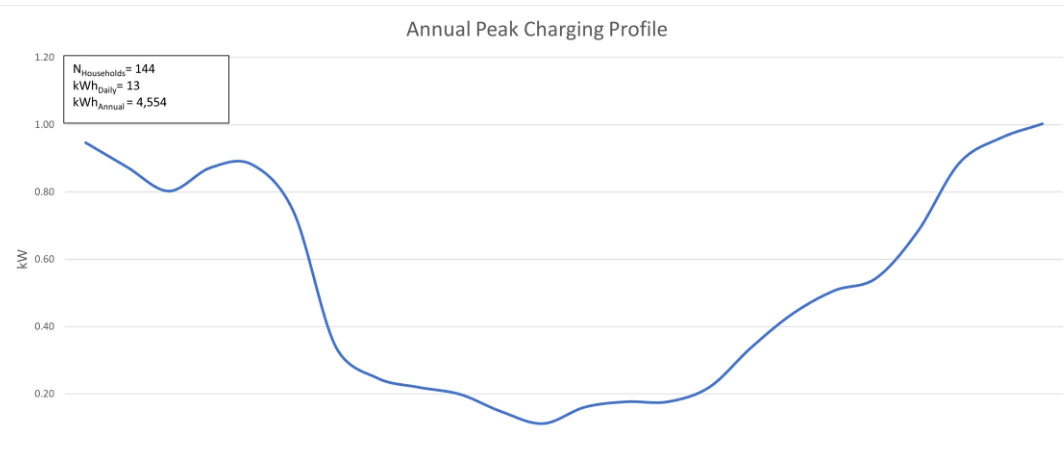
Figure 33: Average Daily Residential Charging Profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE kW	1.37	1.23	1.16	1.12	1.12	1.20	1.41	1.55	1.62	1.73	1.83	1.95	2.04	2.11	2.16	2.24	2.38	2.57	2.64	2.54	2.43	2.23	1.90	1.58
PostEVSE kW	2.31	2.11	1.96	2.00	2.00	1.94	1.75	1.80	1.84	1.93	1.98	2.06	2.20	2.28	2.34	2.46	2.72	3.01	3.15	3.08	3.11	3.12	2.86	2.58

Hour

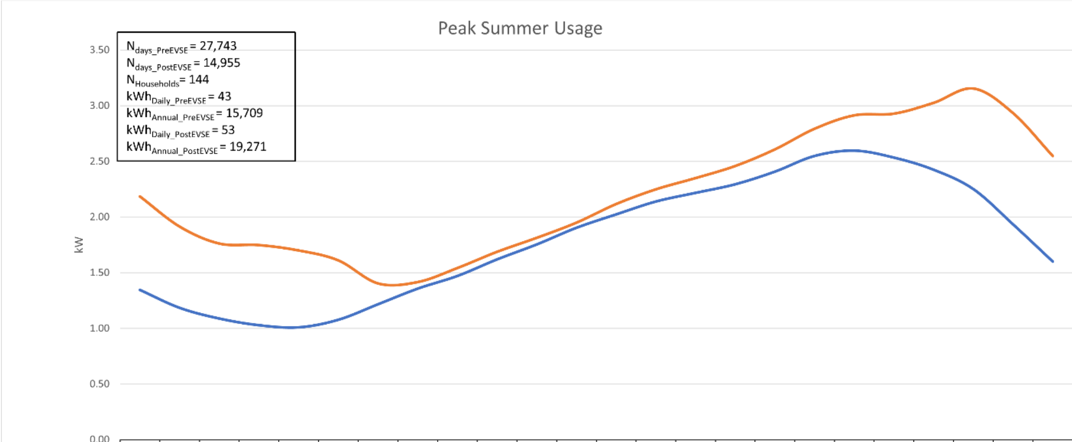
Figure 34: Residential Whole-house Peak Load profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.95	0.87	0.80	0.87	0.88	0.74	0.34	0.25	0.22	0.20	0.15	0.11	0.16	0.18	0.18	0.22	0.34	0.44	0.51	0.54	0.68	0.89	0.96	1.00

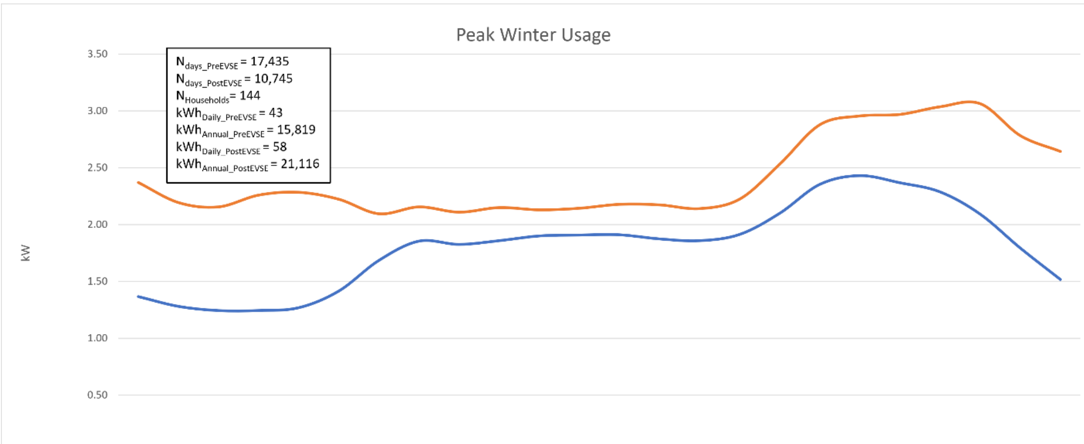
Hour

Figure 35: Residential Peak Charging Profile



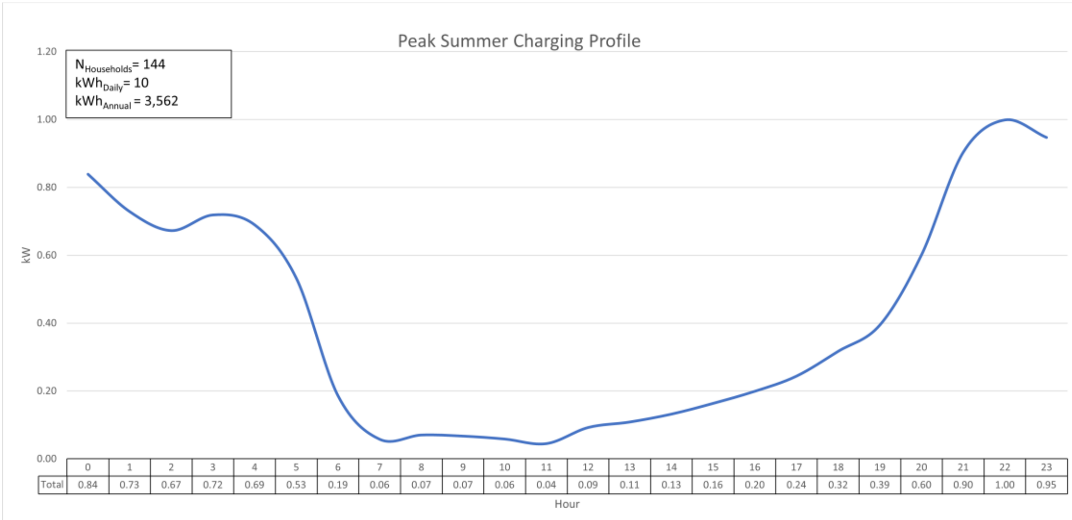
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE kW	1.35	1.18	1.09	1.03	1.01	1.08	1.22	1.36	1.47	1.62	1.75	1.90	2.02	2.14	2.22	2.29	2.41	2.55	2.60	2.53	2.43	2.25	1.93	1.60
PostEVSE kW	2.18	1.91	1.76	1.75	1.70	1.61	1.40	1.41	1.54	1.69	1.81	1.95	2.12	2.25	2.35	2.46	2.61	2.79	2.91	2.93	3.03	3.15	2.93	2.55

Figure 36: Residential Whole-house Peak Summer Load profile



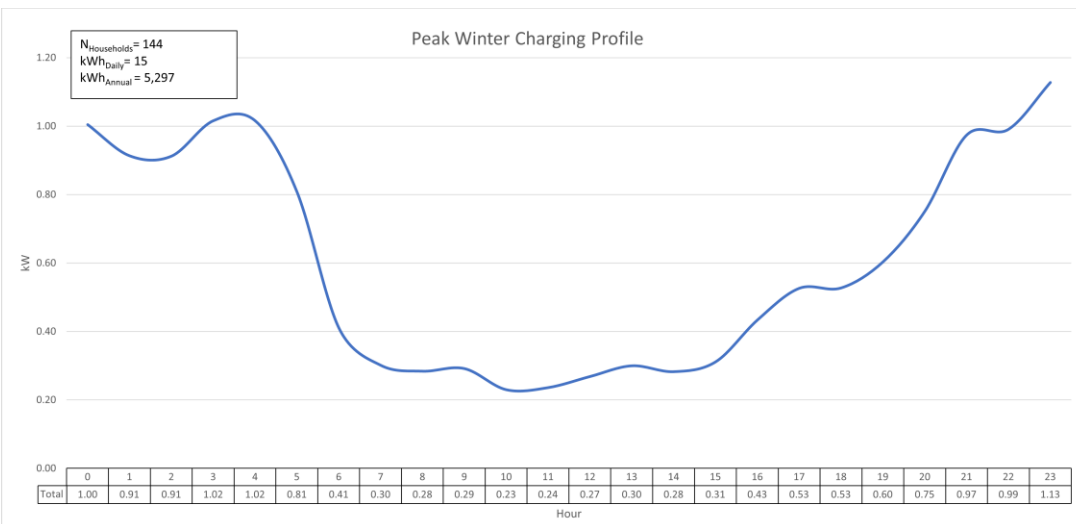
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE kW	1.37	1.28	1.24	1.24	1.27	1.41	1.68	1.85	1.83	1.86	1.90	1.91	1.91	1.87	1.86	1.91	2.10	2.35	2.43	2.37	2.29	2.09	1.79	1.52
PostEVSE kW	2.37	2.19	2.16	2.26	2.28	2.22	2.09	2.16	2.11	2.15	2.13	2.14	2.18	2.17	2.14	2.22	2.53	2.88	2.96	2.97	3.04	3.07	2.78	2.64

Figure 37: Residential Whole-house Peak Winter Load profile



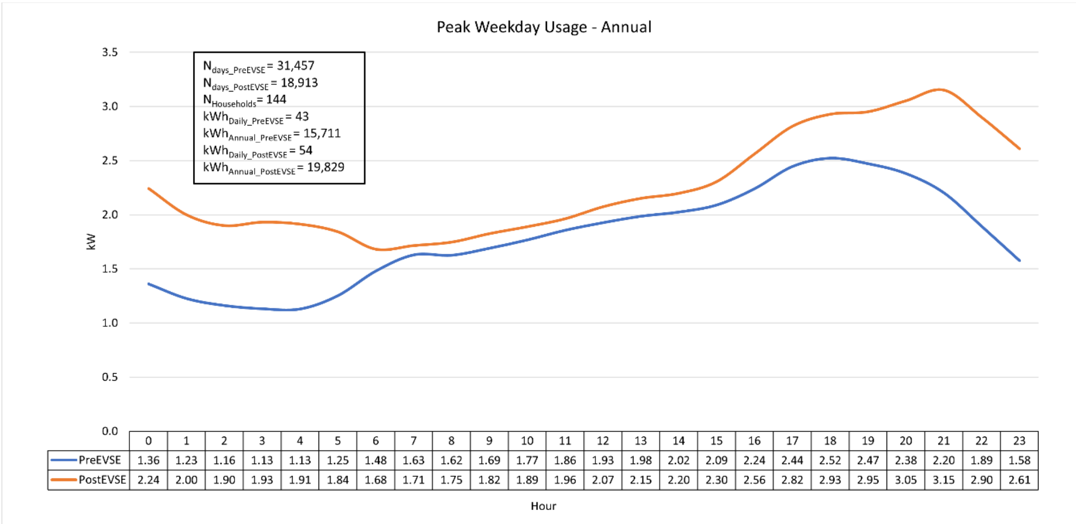
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.84	0.73	0.67	0.72	0.69	0.53	0.19	0.06	0.07	0.07	0.06	0.04	0.09	0.11	0.13	0.16	0.20	0.24	0.32	0.39	0.60	0.90	1.00	0.95

Figure 38: Residential Peak Summer Charging Profile



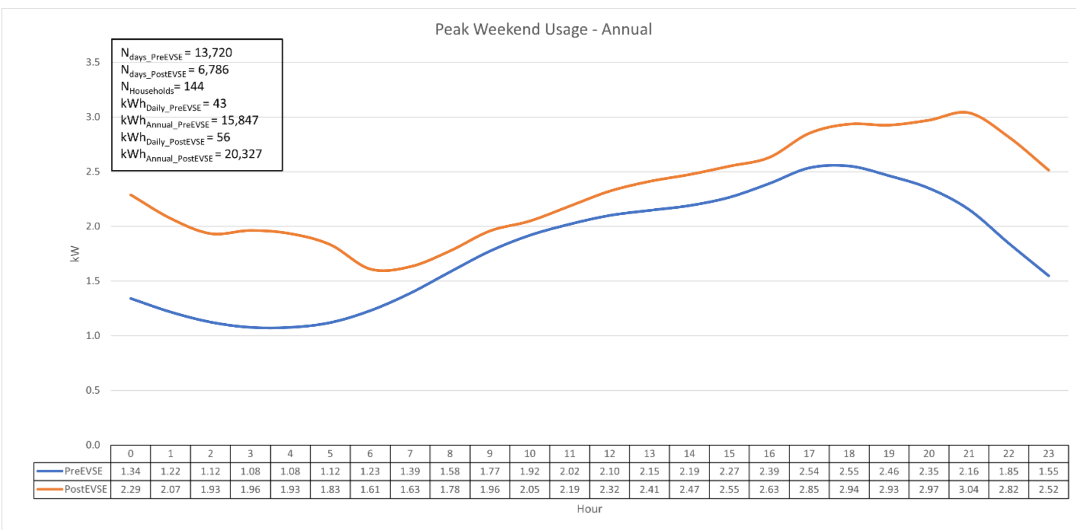
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	1.00	0.91	0.91	1.02	1.02	0.81	0.41	0.30	0.28	0.29	0.23	0.24	0.27	0.30	0.28	0.31	0.43	0.53	0.53	0.60	0.75	0.97	0.99	1.13

Figure 39: Residential Peak Winter Charging Profile



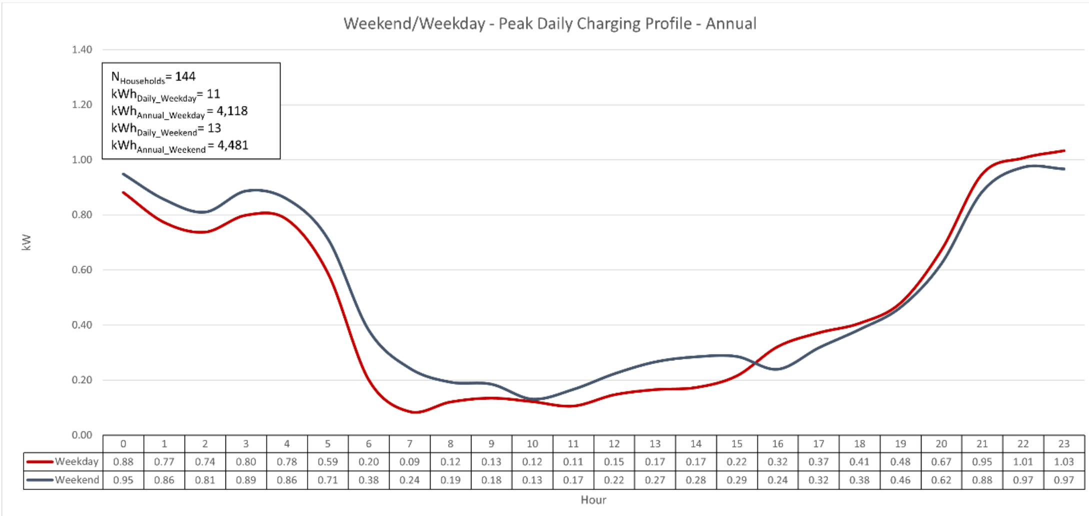
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE	1.36	1.23	1.16	1.13	1.13	1.25	1.48	1.63	1.62	1.69	1.77	1.86	1.93	1.98	2.02	2.09	2.24	2.44	2.52	2.47	2.38	2.20	1.89	1.58
PostEVSE	2.24	2.00	1.90	1.93	1.91	1.84	1.68	1.71	1.75	1.82	1.89	1.96	2.07	2.15	2.20	2.30	2.56	2.82	2.93	2.95	3.05	3.15	2.90	2.61

Figure 40: Residential Whole-house Peak Weekday Load profile



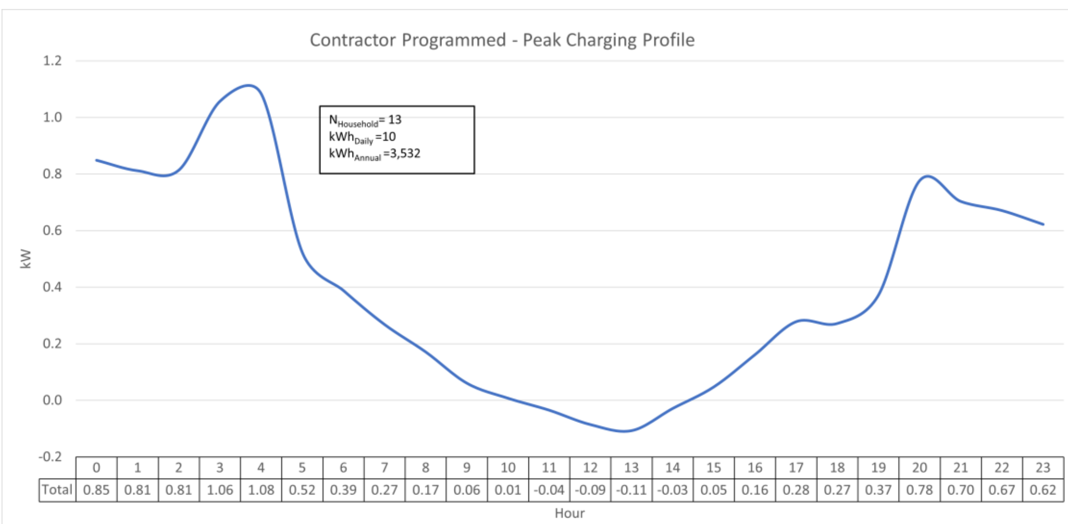
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE	1.34	1.22	1.12	1.08	1.08	1.12	1.23	1.39	1.58	1.77	1.92	2.02	2.10	2.15	2.19	2.27	2.39	2.54	2.55	2.46	2.35	2.16	1.85	1.55
PostEVSE	2.29	2.07	1.93	1.96	1.93	1.83	1.61	1.63	1.78	1.96	2.05	2.19	2.32	2.41	2.47	2.55	2.63	2.85	2.94	2.93	2.97	3.04	2.82	2.52

Figure 41: Residential Whole-house Peak Weekend Load Profile



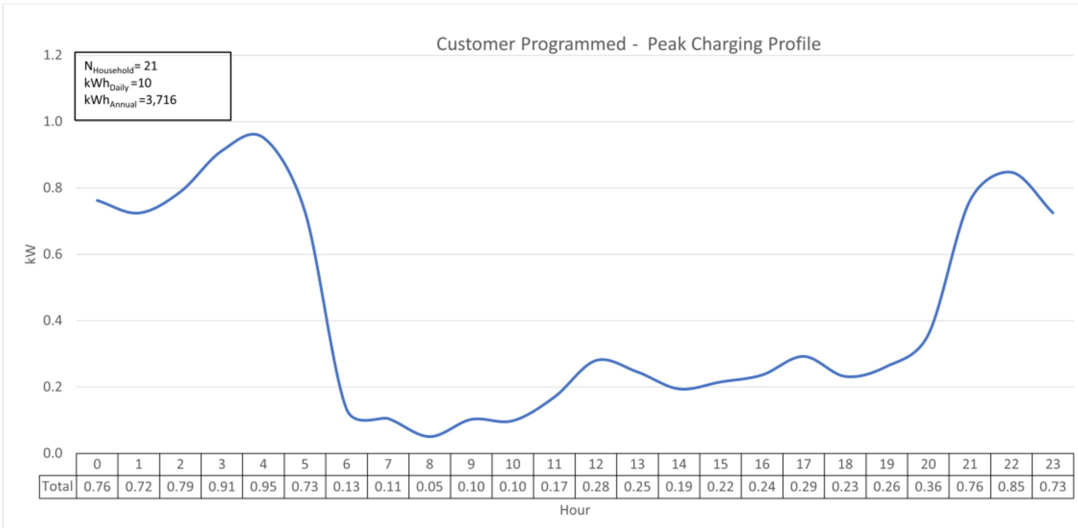
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	0.88	0.77	0.74	0.80	0.78	0.59	0.20	0.09	0.12	0.13	0.12	0.11	0.15	0.17	0.17	0.22	0.32	0.37	0.41	0.48	0.67	0.95	1.01	1.03
Weekend	0.95	0.86	0.81	0.89	0.86	0.71	0.38	0.24	0.19	0.18	0.13	0.17	0.22	0.27	0.28	0.29	0.24	0.32	0.38	0.46	0.62	0.88	0.97	0.97

Figure 42: Residential Peak Weekday/Weekend Charging Profiles



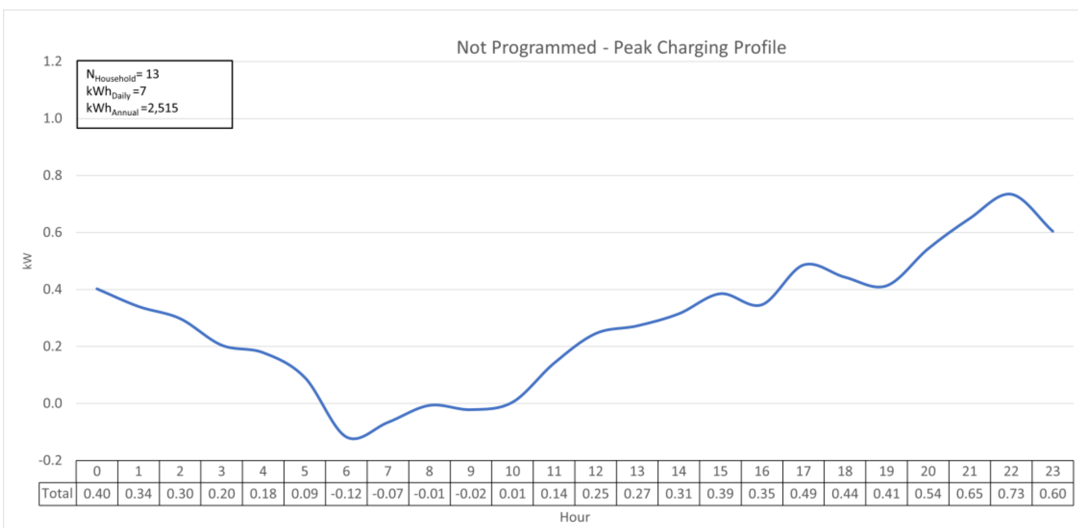
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.85	0.81	0.81	1.06	1.08	0.52	0.39	0.27	0.17	0.06	0.01	-0.04	-0.09	-0.11	-0.03	0.05	0.16	0.28	0.27	0.37	0.78	0.70	0.67	0.62

Figure 43: Contractor Programmed Off-Peak Charging – Charging Load Profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.76	0.72	0.79	0.91	0.95	0.73	0.13	0.11	0.05	0.10	0.10	0.17	0.28	0.25	0.19	0.22	0.24	0.29	0.23	0.26	0.36	0.76	0.85	0.73

Figure 44: Customer Programmed Off-Peak Charging – Charging Load profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	0.40	0.34	0.30	0.20	0.18	0.09	-0.12	-0.07	-0.01	-0.02	0.01	0.14	0.25	0.27	0.31	0.39	0.35	0.49	0.44	0.41	0.54	0.65	0.73	0.60

Figure 45: Not Programmed – Charging Load profile

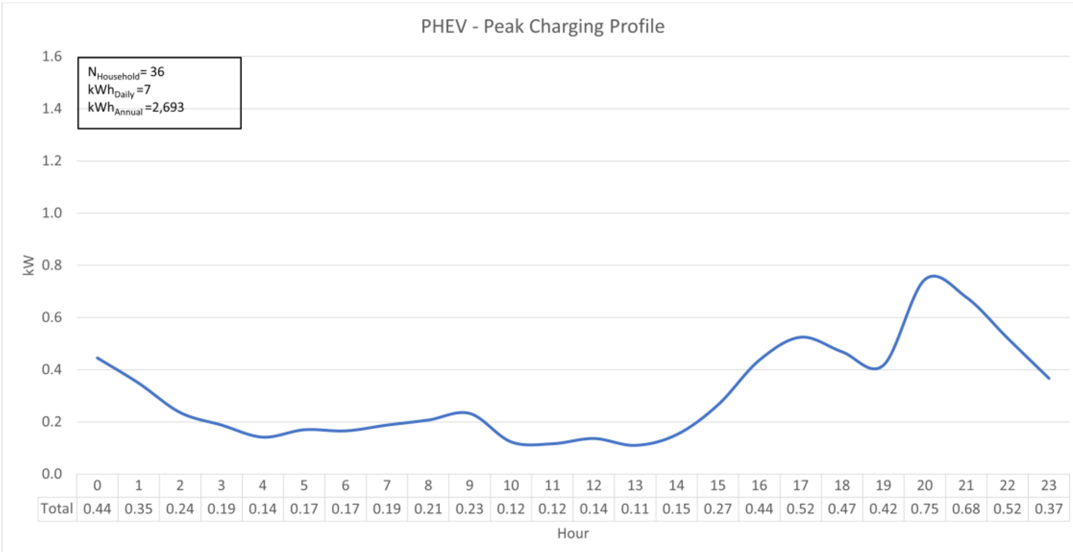


Figure 46: PHEV – Charging Load Profile

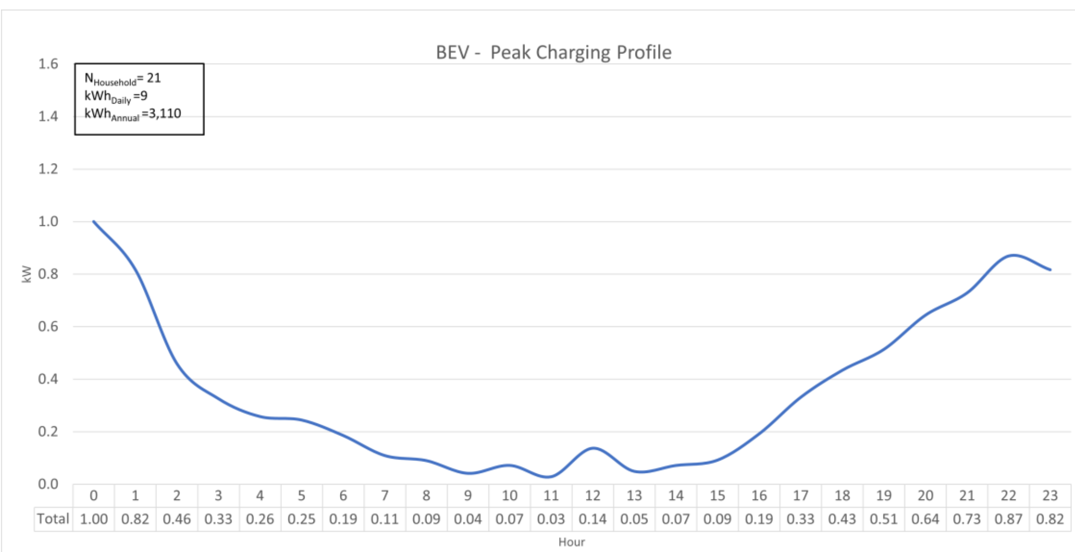
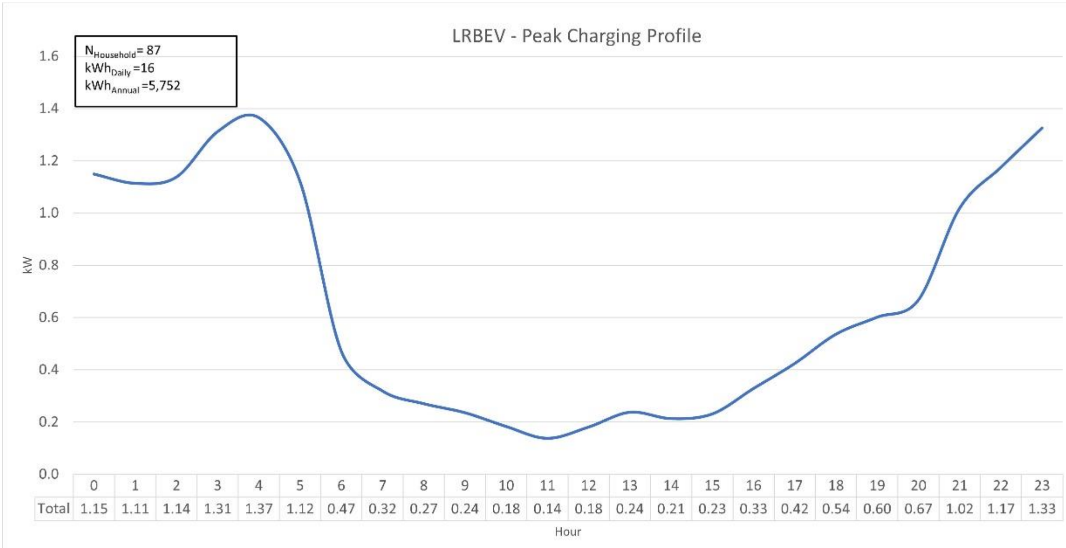
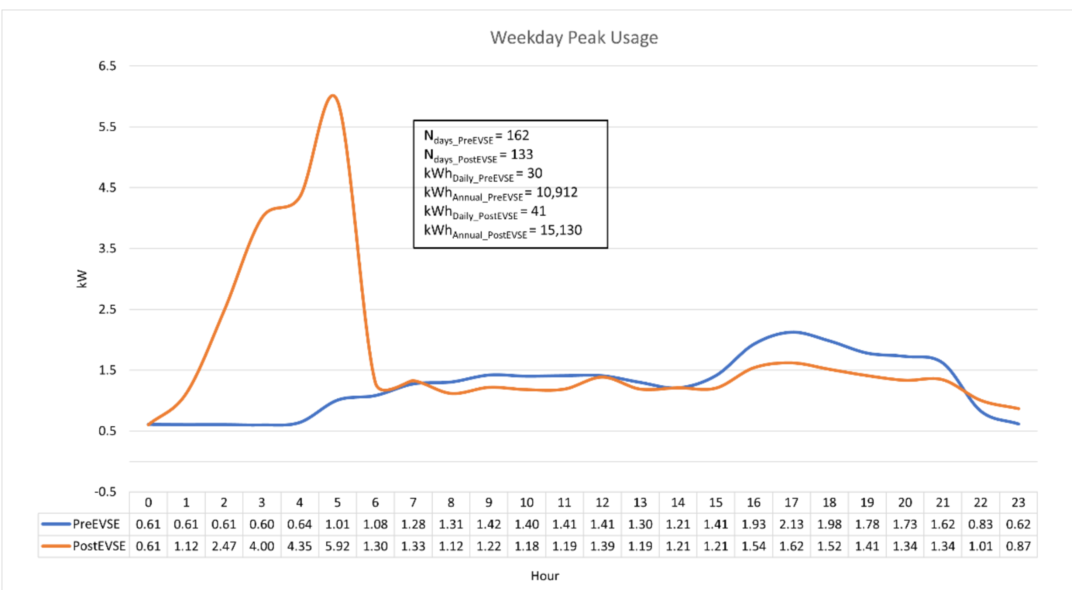


Figure 47: BEV – Charging Load Profile



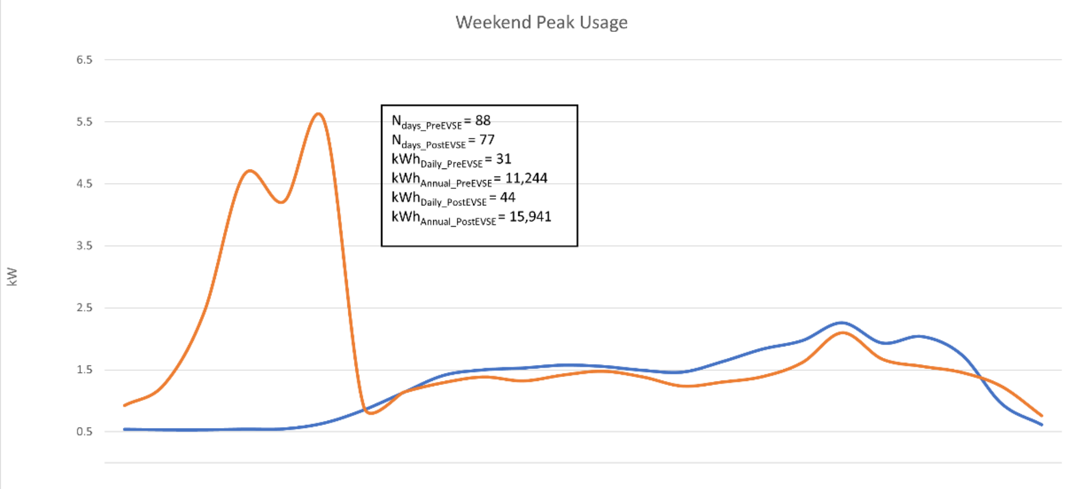
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Total	1.15	1.11	1.14	1.31	1.37	1.12	0.47	0.32	0.27	0.24	0.18	0.14	0.18	0.24	0.21	0.23	0.33	0.42	0.54	0.60	0.67	1.02	1.17	1.33

Figure 48: Long-Range BEV (200+ mile range) – Charging Load Profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE	0.61	0.61	0.61	0.60	0.64	1.01	1.08	1.28	1.31	1.42	1.40	1.41	1.41	1.30	1.21	1.41	1.93	2.13	1.98	1.78	1.73	1.62	0.83	0.62
PostEVSE	0.61	1.12	2.47	4.00	4.35	5.92	1.30	1.33	1.12	1.22	1.18	1.19	1.39	1.19	1.21	1.21	1.54	1.62	1.52	1.41	1.34	1.34	1.01	0.87

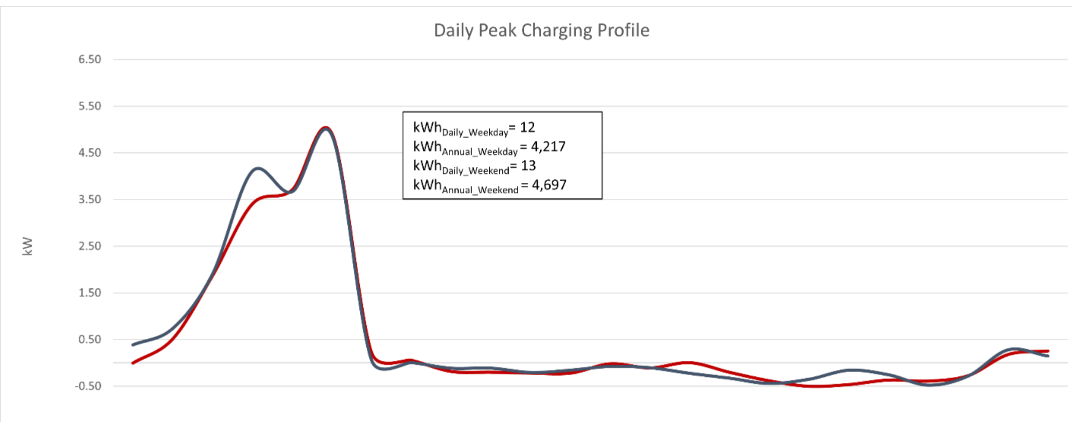
Figure 49: "Ready-by" Programmed – Single Customer Peak Weekday Load Profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PreEVSE	0.5408	0.5328	0.5323	0.5429	0.5477	0.6413	0.852	1.1346	1.4096	1.4985	1.5287	1.574	1.5533	1.4908	1.4626	1.6324	1.8333	1.9705	2.2565	1.93	2.0354	1.7386	0.9517	0.6154
PostEVSE	0.93	1.27	2.43	4.65	4.21	5.52	0.91	1.14	1.29	1.39	1.32	1.42	1.48	1.39	1.24	1.30	1.39	1.62	2.10	1.67	1.56	1.46	1.23	0.76

Hour

Figure 50: "Ready-by" Programmed – Single Customer Peak Weekend Load Profile



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Weekday	-0.01	0.51	1.87	3.40	3.71	4.92	0.21	0.05	-0.19	-0.20	-0.22	-0.22	-0.02	-0.11	0.00	-0.20	-0.39	-0.50	-0.47	-0.37	-0.39	-0.27	0.18	0.25
Weekend	0.38	0.74	1.90	4.11	3.67	4.88	0.05	0.01	-0.12	-0.11	-0.21	-0.16	-0.08	-0.10	-0.22	-0.33	-0.44	-0.35	-0.16	-0.26	-0.48	-0.28	0.28	0.15

Hour

Figure 51: "Ready-by" Programmed – Single Customer Weekday/Weekend Charging Profiles