

WSDOT EVIPP FINAL REPORT



December 31, 2019

I-5 Corridor Project by Forth

Agreement Number: UCB1483

Principal Investigator: Zach Henkin, Program Director, ZachH@forthmobility.org, 503-803-3036

Project Period: July 1, 2017 through June 30, 2019

WSDOT EVIPP Final Report

I-5 CORRIDOR PROJECT BY FORTH

PROJECT SUMMARY

The Washington State Department of Transportation (WSDOT)'s Electric Vehicle Infrastructure Pilot Program (EVIPP) grant funding opportunity was created to install DC fast charging stations (DCFCs) on corridors that facilitate interregional travel within Washington as well as to and from Oregon, Idaho, and British Columbia, Canada. Corridor charging gives existing and prospective electric vehicle owners the assurance that they can recharge when driving long distances along a freeway or highway. Establishing an adequate charging infrastructure will help to increase range confidence, one of the prime concerns believed to influence consumer purchase and use of plug-in electric vehicles (PEVs). The deployment of a DC fast charging network will enable interregional and interstate travel by electric vehicles and support the charging needs of local electric vehicle owners.

In the summer of 2017, Forth's final proposal for the EVIPP was designed to enable interregional and interstate travel by filling in the charging station gaps that existed along Washington's most traveled and populated corridor, Interstate 5. This portion of the West Coast Electric Highway was also in critical need of being updated to dual-capable DCFCs.

This proposal included up to eight DCFC stations in six or seven strategic locations. Due to many factors in the rapidly changing transportation electrification industry, not the least of which was the expansion of Electrify America's charging infrastructure throughout the state and their exclusive site host agreement with Walmart, Forth was required to modify its initial proposal. And while that proved to be a challenge, Forth and its partners are pleased to submit a final report that includes an increase from the proposed 8 DCFC stations to 11 DCFC stations, in six locations along the corridor.

Location	City	DCFCs	Level 2
Whole Foods	Bellingham	2	
Whole Foods	Lynnwood	2	
SeaTac Cell Phone Lot	Seatac	2	
LeMay-America's Car Museum	Tacoma	2	1
DuPont Ace Hardware	DuPont	2	1
Chehalis Commerce District	Chehalis	1	1

The project was substantially completed within the allotted construction period, with the exception of the Lynnwood Whole Foods location. The construction at Lynnwood is complete, but power was not initiated during the holiday shopping period due to site host constraints.

The overall project budget exceeded the initial projections by \$87,000, or 6%. This was largely due to EVgo's decision to increase the number of DCFCs installed at the locations. Consequently, the in-kind contribution of project partners exceeded the initial goal, accounting for 62% of overall project funding.

During the data collection timeframe, the chargers were operational 99.74% of the time, exceeding the target uptime of 95%.

Electric vehicle drivers used these chargers nearly 4,500 times between June and November. These charging sessions powered over 223,000 miles of electric vehicle travel.

In this final report, you will find:

- Individual site pages that include vital statistics, including acquisition, construction, testing, and operations information
- Maintenance report
- Final budget compliance report
- Data Collection and Analysis report

BELLINGHAM WHOLE FOODS

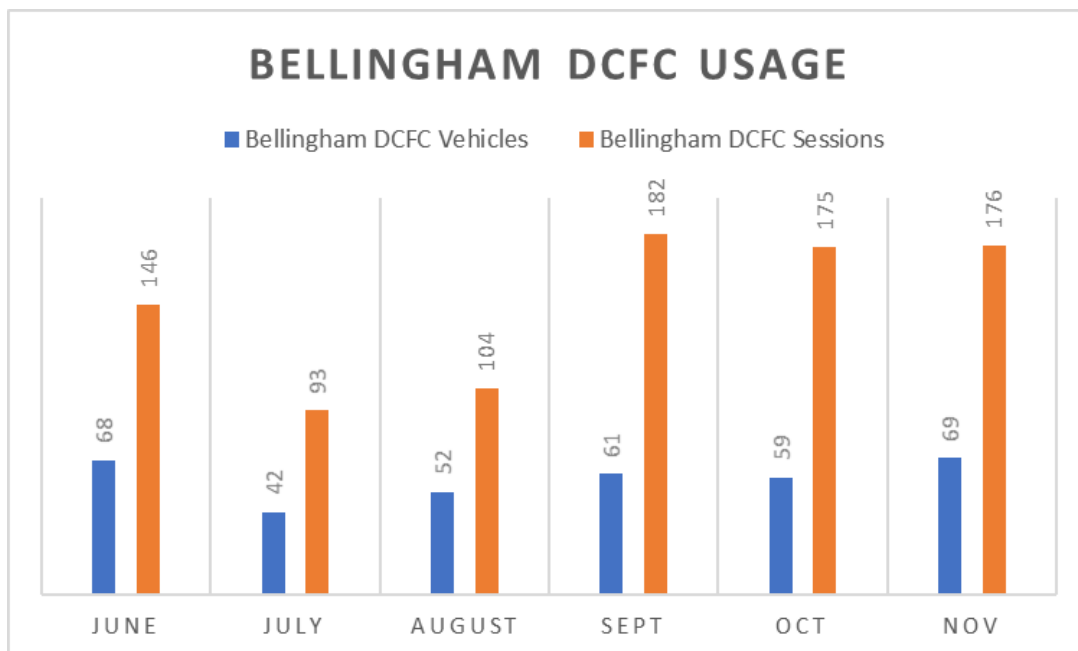
1030 Lakeway Drive
Bellingham, WA 98229

- 2 dual DCFCs (Bennu & Cygnus)
- Make and Model: BTC 50kW Slim All-in-one 480V; BTC 50kW Slim All-in-one 480V
- PlugShare link: <https://www.plugshare.com/location/185360>
- Site host: Whole Foods Market Pacific Northwest
- Utility: Puget Sound Energy
- Contractor Name(s): Nazarene Engineering, Sturgeon Electric Co Inc
- Date Commissioned: 4/8/2019
- Owner/Operator: EVgo



To complete the northern-most leg of the I-5 corridor, the initial EVIPP contract included an Everett Walmart and a provisional site at the Mt. Vernon Walmart. When Electrify America entered Washington's EV charging market, they located many of their sites at Walmart stores across the state, including both Everett and Mt. Vernon. Forth was able to successfully pivot to the popular Whole Foods in Bellingham, located in the Lakeway Shopping Center. Previously, Bellingham has only one CHAdeMO-only site. This new site, located .3 miles from I-5, includes amenities like coffee shops, restaurants, grocery stores and restrooms.

Partners at this site included EVgo, Whole Foods and Lakeway Center Properties.



Bellingham DCFC							
		Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
	June	68	146	3,902	1,928	27	13
	July	42	93	2,409	1,213	26	13
	August	52	104	3,046	1,490	29	14
	Sept	61	182	4,092	2,106	22	12
	Oct	59	175	5,846	2,534	33	14
	Nov	69	176	4,817	2,474	27	14
	Average	59	146	4,019	1,957	28	13

LYNNWOOD WHOLE FOODS

2800 SW 196th Street

Lynnwood, WA 98036

2 dual DCFCs

Make and Model: ABB T53 Dual, ABB T53 Dual

PlugShare link:

Site host: Whole Foods Market Pacific Northwest/Panos Properties LLC

Utility: SNOPUD

Contractor Name: Nazarene Engineering, Sturgeon Electric Co Inc

Date Commissioned: TBD in January 2020

Owner/Operator: EVgo

Due to Electrify America's entrance into the Washington market, Forth modified its initial site locations to fill in gaps along the corridor. With EA siting two of its locations in Everett, Forth evaluated the gaps in coverage and moved its location to Lynnwood. This site is less than half a mile from I-5 and restaurants, shopping and other amenities are all within walking distance.

Partners at this site included EVgo, Whole Foods and Panos Properties.

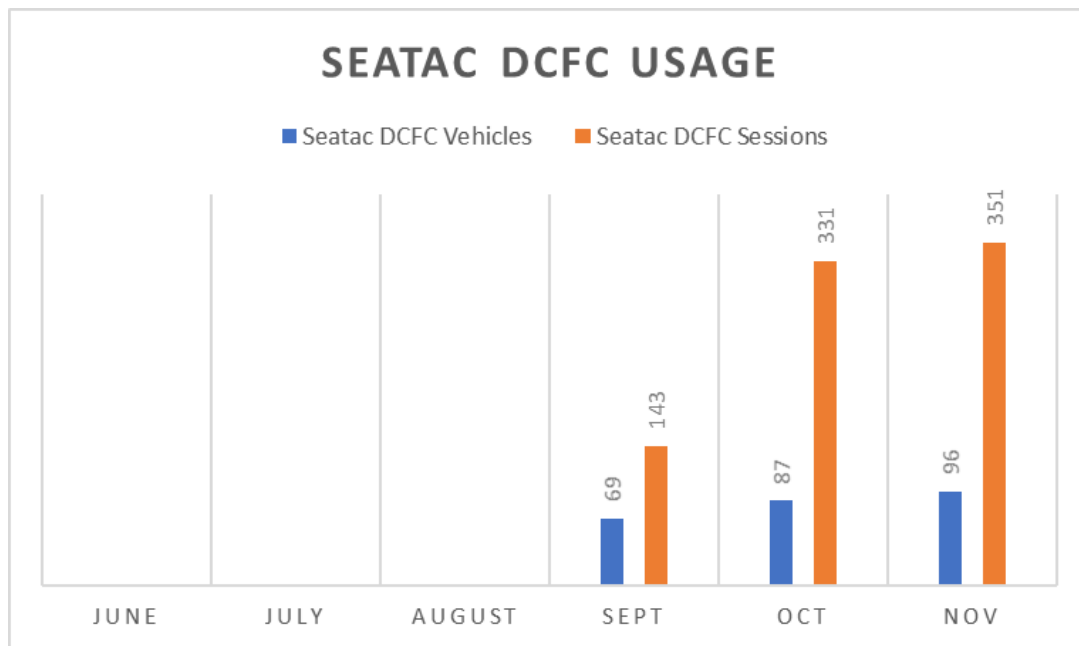
SEATAC CELL PHONE PARKING LOT

2626 S. 170th Street
SeaTac, WA 98158
2 dual DCFCs (Paloma & Nobu)
Make and Model: BTC L2, BTC 50kW 480V, BTC 50kW 480V
Site host: Port of Seattle
PlugShare link: <https://www.plugshare.com/location/205974>
Utility: Port of Seattle
Contractor Name: Puget Sound Solar/EV Support
Date Commissioned: 9/4/2019
Owner/Operator: EVgo



The process to bring the SeaTac Cell Phone Parking lot to the program was unique in that the site host was the Port of Seattle. They have their own engineering and construction team, as well as their own utility and their own processes for approval and timelines. This site fills a much-needed amenity for Washington residents who must travel longer distances to the airport and need a fast-charge to get back home.

Partners at this site included EVgo and the Port of Seattle. The Port of Seattle made a large in-kind contribution to the project by providing the electric service connection to the cell phone lot.



Seatac DCFC							
		Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
	June						
	July						
	August						
	Sept	69	143	4,278	2,063	30	14
	Oct	87	331	12,714	6,443	38	19
	Nov	96	351	13,553	5,917	39	17
	Ave (Oct-Nov)	92	341	13,134	6,180	39	18

TACOMA: LEMAY-AMERICA'S CAR MUSEUM

2702 E. D Street

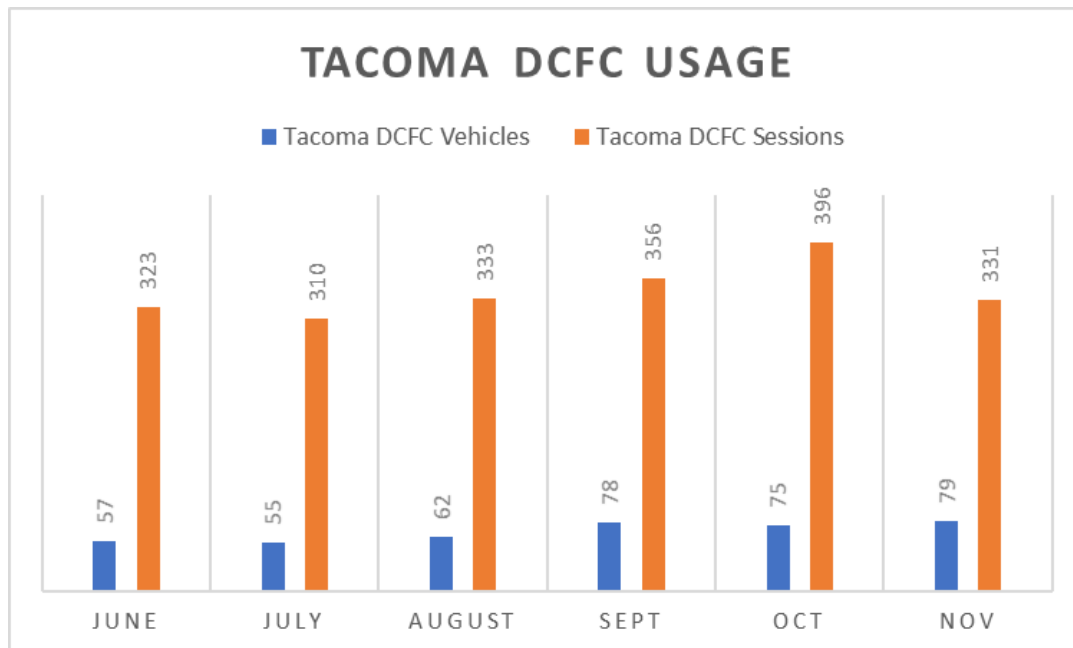
Tacoma, WA 98421

- 2 dual DCFCs (Harold & Nancy); 1 Level 2
- Make and Model: BTC L2, BTC 50kW 480V, BTC 50kW 480V
- PlugShare link:
<https://www.plugshare.com/location/162123>
- Site host: LeMay-America's Car Museum
- Utility: Tacoma Power
- Contractor Name: Nazarene Engineering, Sturgeon Electric Co Inc
- Date Commissioned: 8/6/2018
- Owner/Operator: EVgo

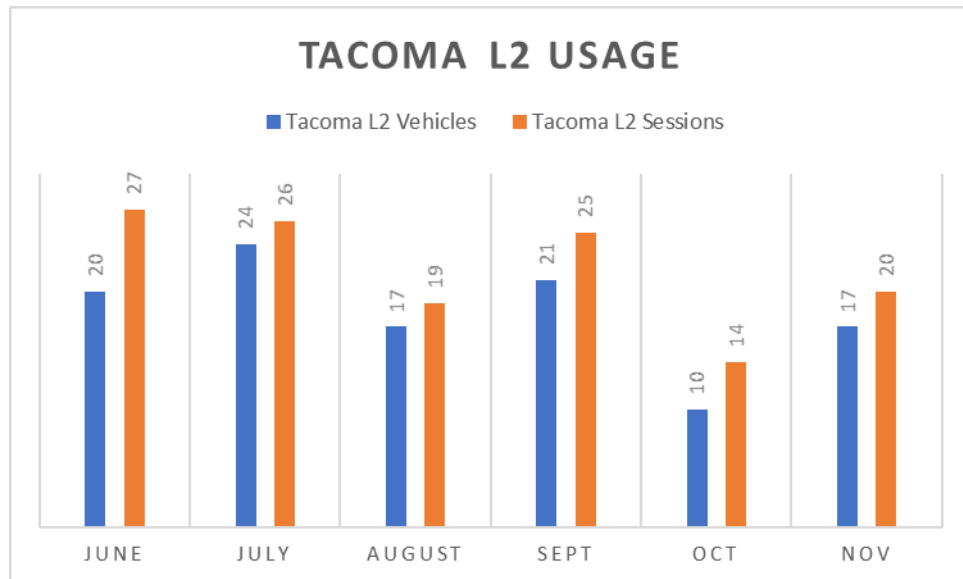


The first station completed as part of Forth's EVIPP contract, LeMay-America's Car Museum has proved to be both a very popular and signature location. Additionally, due to only 24 miles between this site and the SeaTac Cell Phone lot, it was determined and approved by WSDOT that removing the Federal Way site proposed in the initial contract was preferred (EA currently has a site under construction at that Federal Way Walmart location).

Partners at this site included EVgo, LeMay-America's Car Museum and Tacoma Power.



Tacoma DCFC							
		Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
	June	57	323	11,238	5,824	35	18
	July	55	310	10,460	5,338	34	17
	August	62	333	11,015	5,608	33	17
	Sept	78	356	11,665	5,808	33	16
	Oct	75	396	13,099	6,444	33	16
	Nov	79	331	11,098	5,715	34	17
	Average	68	342	11,429	5,789	33	17



Tacoma L2							
		Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
	June	20	27	4,094	360	152	13
	July	24	26	2,684	237	103	9
	August	17	19	2,102	155	111	8
	Sept	21	25	3,542	267	142	11
	Oct	10	14	1,813	84	130	6
	Nov	17	20	2,455	203	123	10
	Average	18	22	2,782	217	127	10

DUPONT ACE HARDWARE

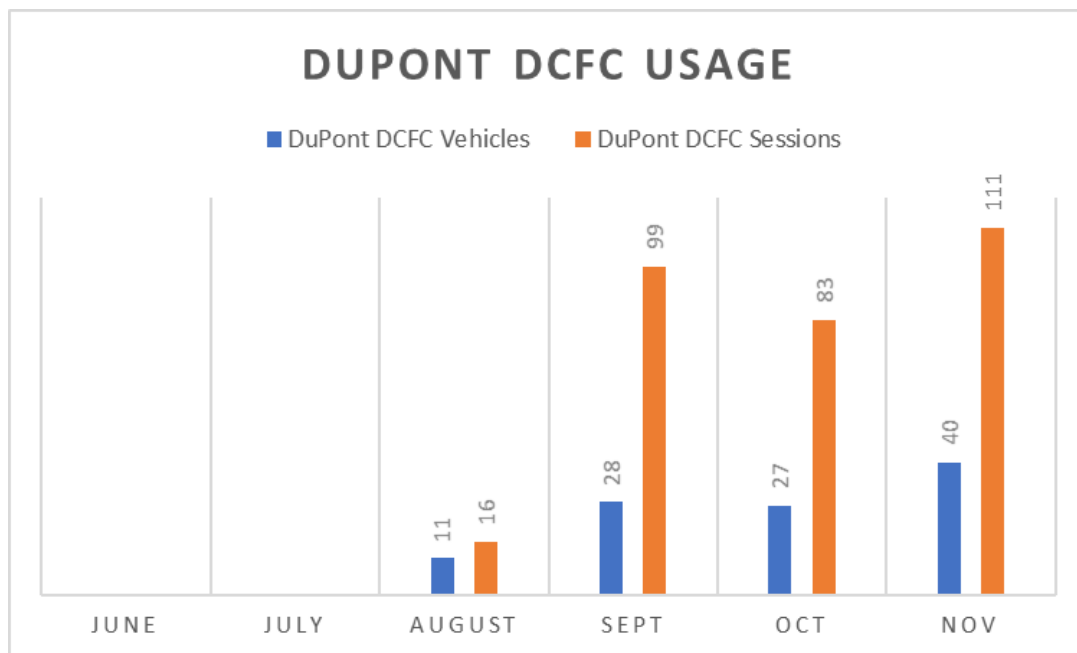
1585A McNeil Street
DuPont, WA 98327

- 2 dual DCFCs (Acheron & Nostromo); 1 Level 2
- Make and Model: BTC L2, BTC 50kW 480V, BTC 50kW 480V
- PlugShare link:
<https://www.plugshare.com/location/198930>
- Site host: WCSS DuPont Washington, LLC
- Utility: Puget Sound Energy
- Contractor Name: ACK Electric, Bowlds Construction LLC
- Date Commissioned: 8/21/2019
- Owner/Operator: EVgo

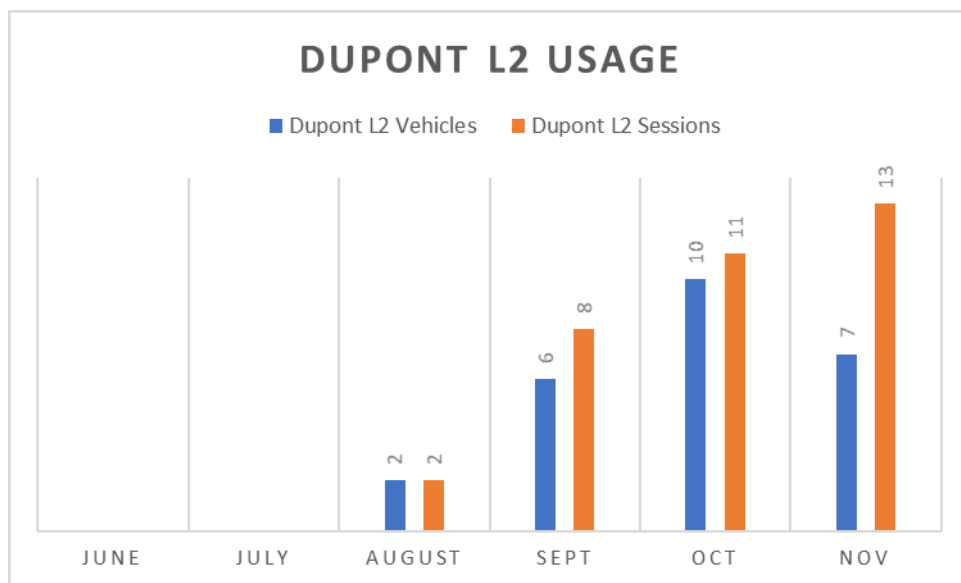


The initial EVIPP contract identified the Lacey Walmart as a potential location. However, due to high utility construction costs (a new transformer), as well as EA's now-opened site at that location, Forth identified a preferred alternative in DuPont. This site is .5 miles from I-5 and sits within walking distance of several restaurants, coffee shops, and other amenities.

Partners at this site included EVgo and Bowld's Construction.



DuPont DCFC						
	Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
June						
July						
August	11	16	428	219	27	14
Sept	28	99	3,460	1,355	35	14
Oct	27	83	2,424	1,332	29	16
Nov	40	111	3,802	1,915	34	17
Average	27	77	2,529	1,205	31	15



Dupont L2						
	Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh
June						
July						
August	2	2	256	24	128	12
Sept	6	8	743	49	93	6
Oct	10	11	1,069	73	97	7
Nov	7	13	673	45	52	3
Average	6	9	685	48	92	7

CHEHALIS COMMERCE DISTRICT

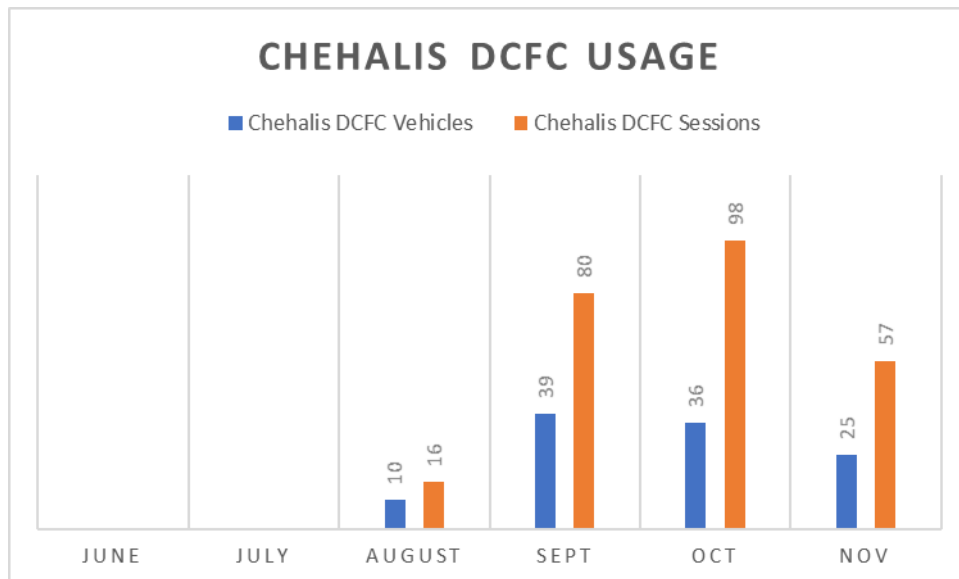
1701 NE Louisiana Avenue
Chehalis, WA 98532

- 1 dual DCFC (Wallace); 1 Level 2
- Make and Model: BTC L2, BTC 50kW Slim All-in-one 480V
- PlugShare link:
<https://www.plugshare.com/location/190518>
- Site host: City of Chehalis
- Utility: Lewis PUD
- Contractor Name: Nazarene Engineering, Sturgeon Electric Co Inc
- Date Commissioned: 8/16/2019
- Owner/Operator: EVgo

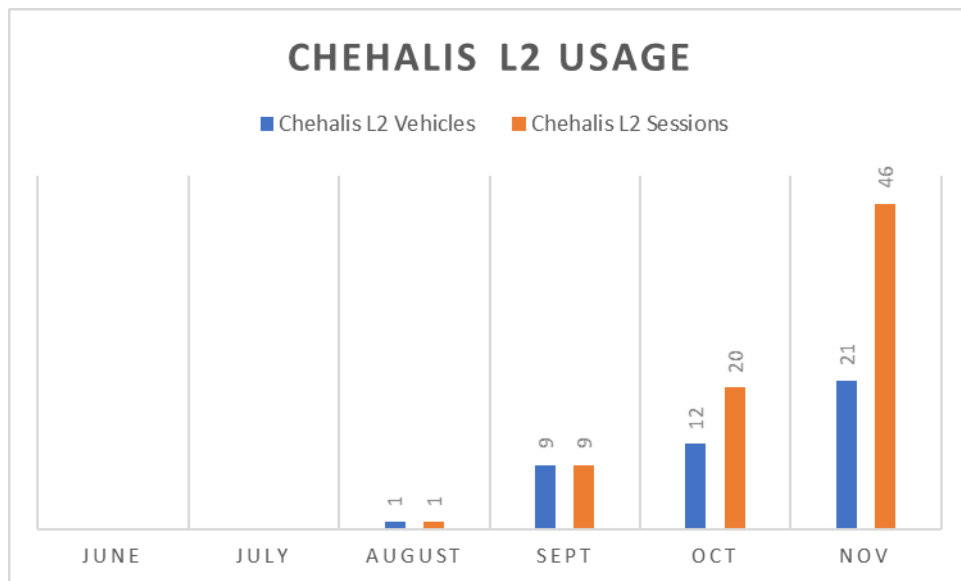


As the southern-most site in the Forth EVIPP proposal, the Chehalis site provides I-5 corridor travelers reliability and redundancy during their travel between Seattle and Portland. This site adds a halfway-point in the West Coast Electric Highway's previous 109-mile gap between Woodland and Tacoma. This site was able to open prior to construction beginning on the proposed Children's Museum and now sits conveniently between Walmart and The Home Depot and within .5 miles of several restaurants and other amenities.

Partners at this site included EVgo and the City of Chehalis.



Chehalis DCFC							
	Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh	
June							
July							
August	10	16	580	184	36	12	
Sept	39	80	2,562	1,395	32	17	
Oct	36	98	3,250	1,649	33	17	
Nov	25	57	1,797	948	32	17	
Average	28	63	2,047	1,044	33	16	



Chehalis L2							
	Vehicles	Sessions	Minutes	kWh	Ave time	Ave kWh	
June							
July							
August	1	1	44	5	44	5	
Sept	9	9	524	46	58	5	
Oct	12	20	681	67	34	3	
Nov	21	46	2,072	196	45	4	
Average	11	19	830	78	45	4	

MAINTENANCE REPORT

Over the 6 months of data collections, the I-5 Corridor stations were operational 99.74% of the time, exceeding the 95% uptime requirement for the grant. The following list includes maintenance issues that required some kind of escalation and could not be remedied pretty nearly immediately with things like remote restart.

Site Name	Charger Name	Major Repair Issues
Chehalis	C6843	No major issues
Chehalis	WALLACE	Offline as of 12/13/19 with error on MCU. Probable replacement of MCU (12/20/19). 24 Volt Power Supply issue previously corrected 11/22/19.
Dupont	ACHERON	Offline as of 12/11/19, parts replacement for full repair scheduled for 12/19/19.
Dupont	C6689	No major issues
Dupont	NOSTROMO	No major issues
LeMay	C6654	No major issues
LeMay	HAROLD	No major issues
LeMay	NANCY	No major issues
Seatac	NOBU	MCU rebooted 12/03/19, no replacement required. No other issues.
Seatac	PALOMA	MCU and SECC rebooted 12/03/19 and 11/01/19 respectively, no replacement required. No other issues
Whole Foods Bellingham	BENNU	MCU issue identified 12/13/19, BTC to dispatch diagnosis and repair team NLT 12/20/19.
Whole Foods Bellingham	CYGNUS	No major issues

BUDGET COMPLIANCE REPORT

Forth's I-5 corridor project was projected to cost \$1.46 million to install 8 DCFCs between Chehalis and Bellingham. The final project installed 11 DCFCs at a total cost of \$1.55 million. Forth, along with its public and private partners, exceeded the in-kind budget of \$866,689, contributing over \$950,000 to the project. The WSDOT grant of \$595,000 provided 38% of the overall project funding, leveraging \$1.60 of partnership funding for every dollar of WSDOT investment. The project partners contributed 62% of the project cost, exceeding the initial in-kind budget by \$87,000.

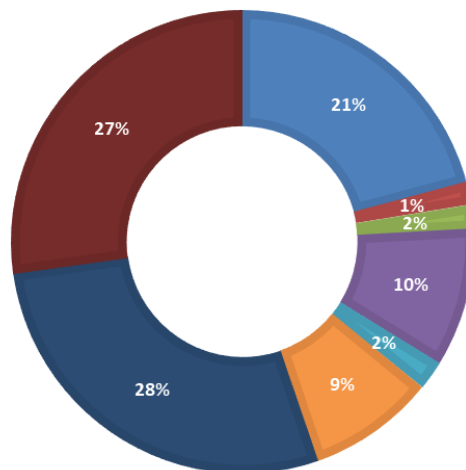
Project Activity	EV Infrastructure Pilot Funds	Chehalis	Dupont	Tacoma	Federal Way	Seatac	Lynnwood (replaces Everett)	Bellingham (replaces Mt. Vernon)	Total Expended Through 12/31/19	In-Kind
Project Development (Preliminary Engineering)	\$ 45,000	\$ 8,412	\$ 2,654	\$ 6,725	\$ 750	\$ 10,225	\$ 11,778	\$ 7,209	\$ 47,753	
Land Acquisition / Right of Way (ROW)	\$ 45,000	\$ 7,500	\$ 7,500	\$ 7,500		\$ 7,500		\$ 7,500	\$ 37,500	
Utilities	\$ 51,500	\$ 28,550		\$ 26,034		\$ 199,024			\$ 253,608	\$ 253,608
Permits									\$ -	
J1772 compliant	\$ 16,350	\$ 5,000	\$ 5,000	\$ 5,000					\$ 15,000	\$ 5,091
Dual CHADEMO/SAE CCS	\$ 199,500	\$ 29,971	\$ 59,467	\$ 59,506	\$ -	\$ 58,992	\$ 59,472	\$ 59,472	\$ 326,880	\$ 159,930
Construction/Installation	\$ 175,150	\$ 148,206	\$ 87,856	\$ 74,500		\$ 14,095	\$ 98,996	\$ 100,149	\$ 523,803	\$ 190,915
Electrical conduit for 150KW expansion	\$ 2,500								\$ -	
Operations	\$ 60,000								\$ -	
Through 11/30/19		\$ 962	\$ 6,206	\$ 14,726		\$ 9,019		\$ 1,626	\$ 32,539	\$ 32,539
Through project completion		\$ 32,542	\$ 35,373	\$ 73,830	\$ -	\$ 73,830	\$ 52,474	\$ 43,627	\$ 311,676	\$ 311,676
Total project Cost	\$ 595,000	\$ 261,144	\$ 204,056	\$ 267,821	\$ 750	\$ 372,685	\$ 222,720	\$ 219,583	\$ 1,548,759	\$ 953,759

Major project partners include:

- Port of Seattle. The Port of Seattle utility district provided the electrical make-ready work for the SeaTac cell phone lot site.
- BTC. BTC provided rebates for 9 DC fast chargers and three level 2 chargers.
- ABB. ABB provided rebates for 2 DC fast chargers.
- City of Chehalis. The City provided a \$16,000 contribution to the utility make-ready work for the Chehalis site.
- Tacoma Power. Tacoma Power provided a \$15,000 contribution to the utility make-ready work for the Tacoma site.
- EVgo provided over \$265,000 of capital to the project and will provide over \$250,000 of operational support to the project over the five-year implementation period.

DISTRUBUTION OF IN-KIND CONTRIBUTIONS

■ Port of Seattle
 ■ Tacoma Power
 ■ Chehalis
 ■ BTC
 ■ ABB
 ■ Site Hosts
 ■ EVgo Capital
 ■ EVgo Operation



DATA AND ANALYSIS

Over the six-month period, from June 1 through November 30th, EVgo had five stations operating during some or all of the timeframe.

- The Bellingham and Tacoma stations were open during the entire six months.
- The Chehalis and DuPont stations operated for three and one-half months.
- The SeaTac station operated for just over two months.

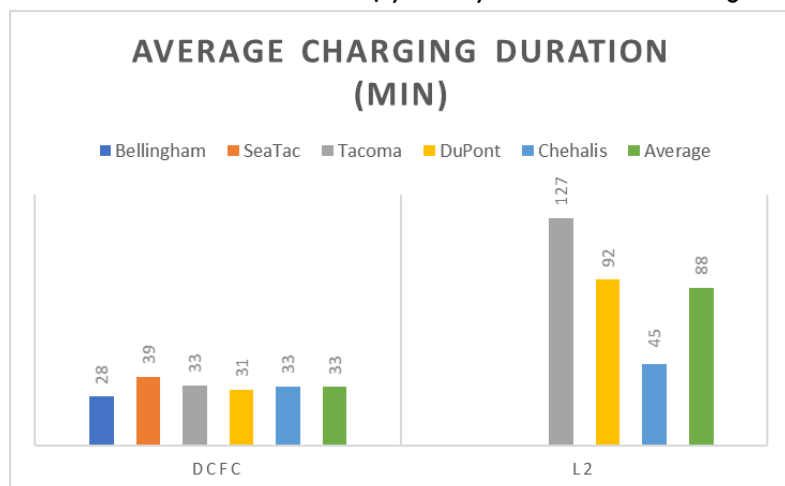
The data below show the actual usage data and project both a six-month and a 5-year period with full operations at all six locations. Between June and November, there were 4,492 charging sessions, powering over 223,000 miles of electric vehicle travel. This elimination of nearly 9,000 gallons of gasoline resulted in the reduction of nearly 80 metric tons of carbon emissions¹.

Over the five-year period of operations of these stations, it is projected that electric vehicle drivers will eliminate the use of over 150,000 gallons of gasoline, reducing 1,365 MTCO_{2e} while powering nearly 4 million EV miles of travel on Washington's I-5 corridor.

Metric	June-Nov Actual	6-Month Projection	5-Year Projection
# Sessions, total	4,492	7,701	77,006
# minutes	162,390	278,383	2,783,829
# kWh	71,623	122,782	1,227,823
# unique vehicles	1,023	1,754	17,537
# miles powered	223,822	383,695	3,836,949
Avoided GHG emissions (metric tons)	79.6	136	1,365
Avoided Gasoline (<i>gal: avg 25 mpg</i>)	8,953	15,348	153,480

Usage Information

The I-5 stations in service during the data gathering period included 11 dual-capable DCFCs and 3 L2 chargers. Fast-charging stations accounted for 78% of the installations, yet they were utilized during 95% of the charging sessions. Charging sessions at DCFCs averaged 35 minutes in duration, while charging events on the L2s averaged 88 minutes. DCFC charging times were relatively consistent ranging from 28 to 39 minutes on average. The L2 charging events, however, had an average range between 45 minutes in Chehalis to 127 minutes in Tacoma. This variance is most probably attributable to the lack of amenities at the Chehalis site before the construction of the Children's Museum.



¹ GHG emissions are calculated as 8,887 grams of CO₂ reduction per gallon of gasoline (EPA)

Usage by Type of Charger

Electric vehicle owners using the CCS Combo chargers generated 60% of all of the charging sessions, 72% more than sessions on the CHAdeMO standard. Drivers using L2 chargers made up just 5% of the sessions.

Drivers spent more time at L2 stations than at DCFCs. Fourteen percent (14%) of charging time was completed at L2 chargers. Sixty-two percent (62%) of time, vehicles were using the CCS Combo chargers and twenty-four percent (24%) of time was spent at CHAdeMO chargers.

CCS Combo charging events used the most energy, representing 72% all of kilowatt hours consumed. CHAdeMO charging sessions represented 26% of all energy consumed, and L2 charging events utilized just 2% of kilowatts.

Usage by Location

Electric vehicle drivers utilized stations in the urban core more often than those stations outside of King and Pierce counties. The Tacoma location had consistent charging above 300 sessions per month through the six-month data gathering period. The SeaTac station demonstrated quick uptake after the installation, generating over 300 sessions per month in its first full month of operations.

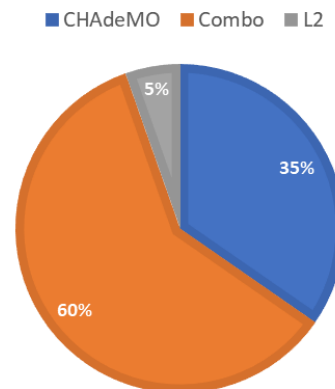
The Bellingham station experienced the next level of utilization, ranging from 93 to 182 sessions per month.

Lower utilization was recorded at the DuPont station, ranging from 83 to 111 during months of full operations.

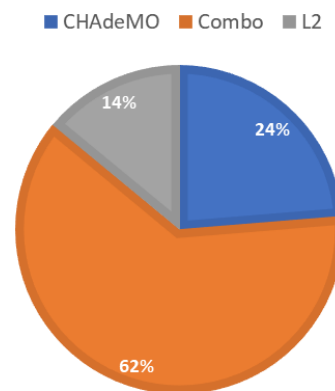
The Chehalis station ranged from 57 to 98 charging events during its operating time.

These data align with the general distribution of electric vehicles on the road in Washington State.

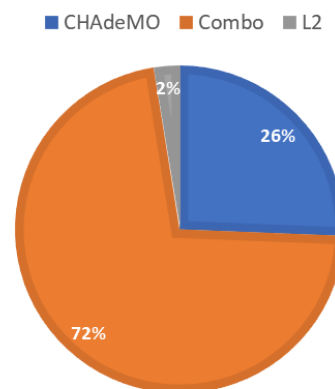
SESSIONS BY TYPE OF USE

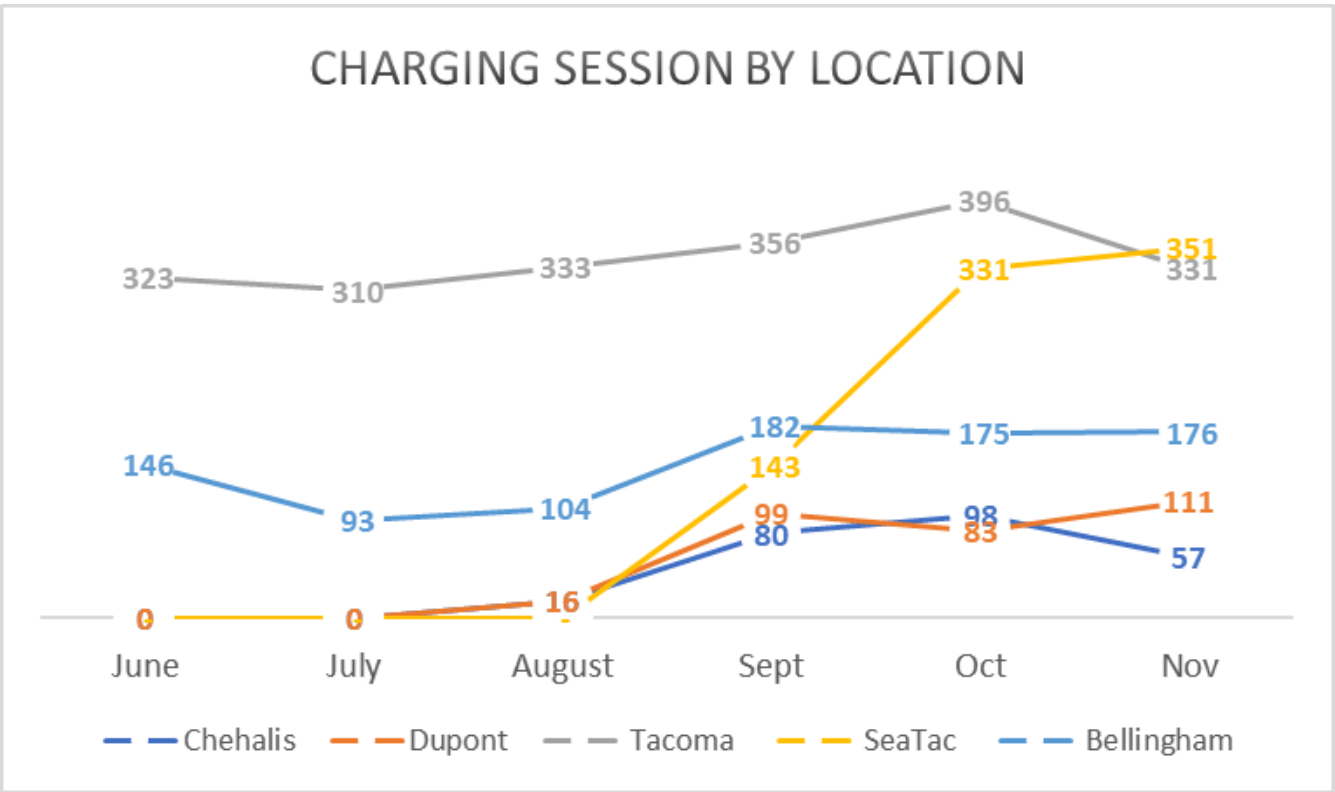


TIME BY TYPE OF USE



ENERGY BY TYPE OF USE





Usage by Day of Week and Time of Day

The heat map of charging events during the data gathering periods demonstrates highest usage during the mid-day (10am – 5pm), especially during the weekends.

Week Day	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM
Monday	12	12	6	9	10	10	12	15	23	35	31	46	47	36	39	43	46	37	19	29	26	18	17	14
Tuesday	8	9	4	7	9	10	10	18	26	35	42	43	44	40	41	38	40	29	31	28	24	21	19	18
Wednesday	8	7	5	5	9	10	12	20	29	28	29	42	58	43	23	36	38	35	40	20	29	12	23	15
Thursday	8	8	5	9	11	6	15	18	23	31	33	33	49	45	36	36	44	41	43	34	28	22	23	20
Friday	10	6	6	7	9	10	15	26	25	25	38	43	46	46	53	50	42	49	36	35	37	25	21	14
Saturday	7	12	11	12	4	6	11	21	22	37	39	55	59	57	51	50	56	53	41	42	24	33	15	11
Sunday	16	7	8	13	8	8	21	14	27	38	48	46	54	58	53	57	48	48	31	33	27	22	21	16