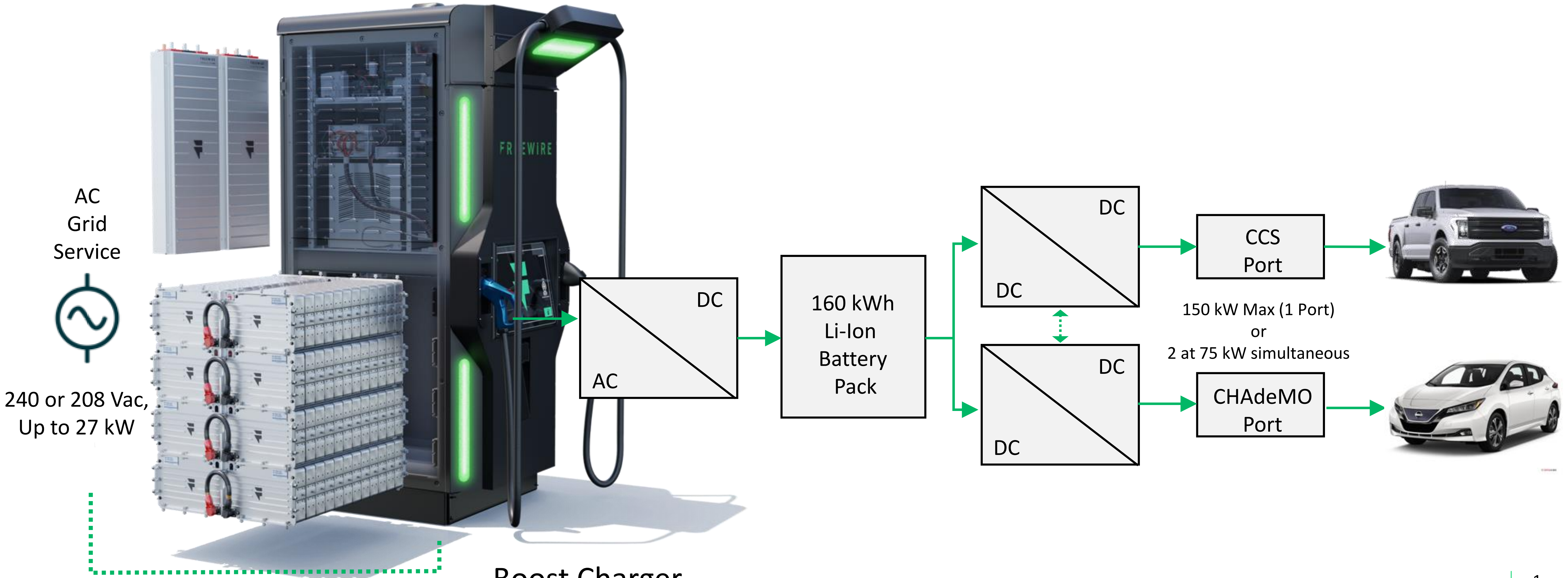
How the Boost Charger Works

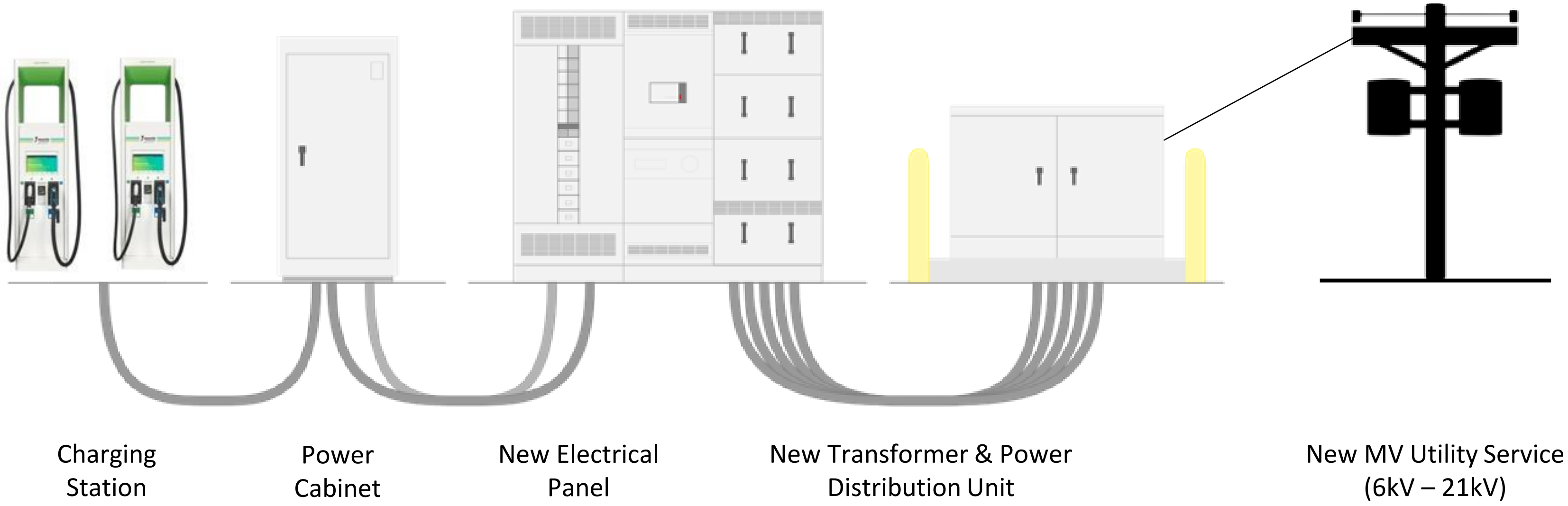
Low voltage AC power input → AC power converted to DC → Integrated battery discharges → 2 high-efficiency DC rectifiers → Dual connectors for simultaneous fast charging



Boost Charger

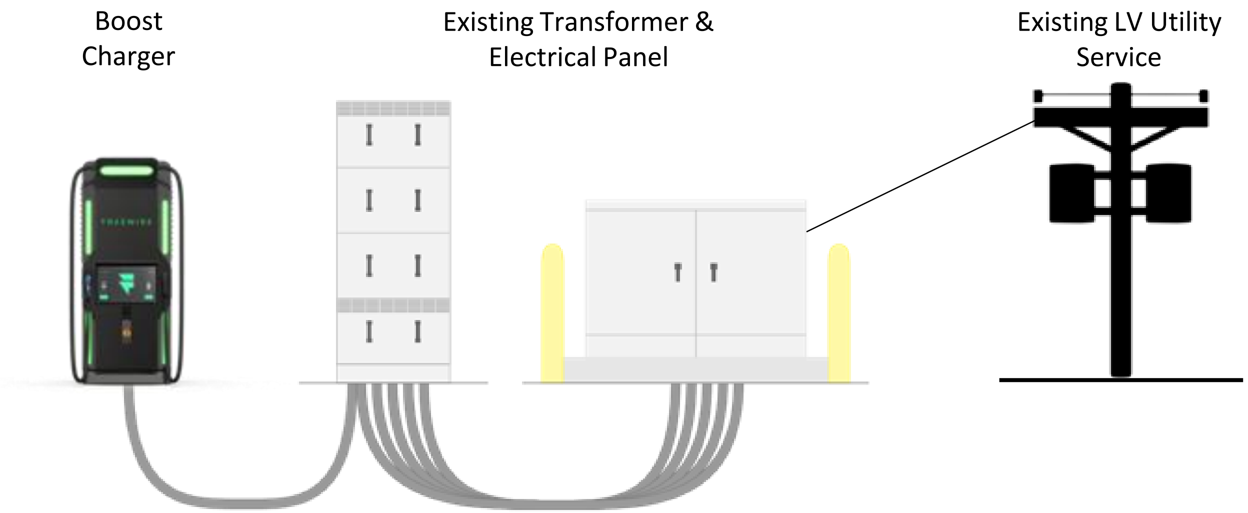
Illustrative Schematic of Make-Ready Requirements

Conventional Fast Charger

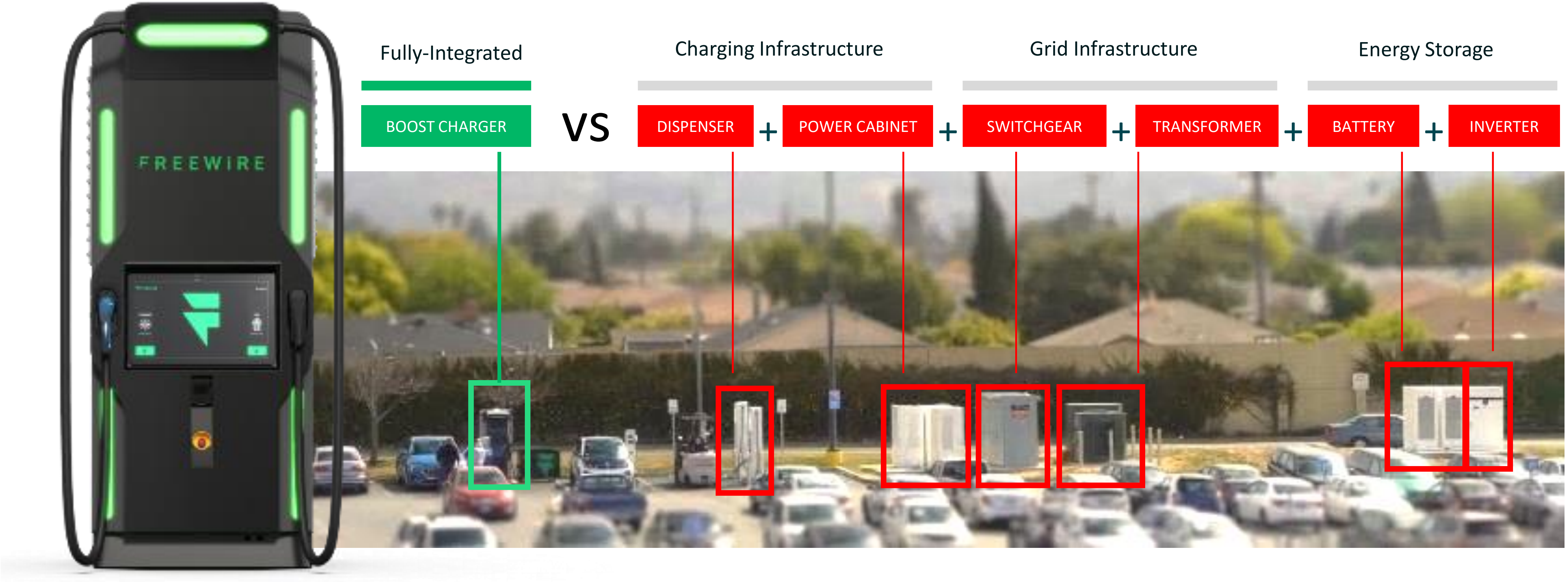


FreeWire Boost Charger

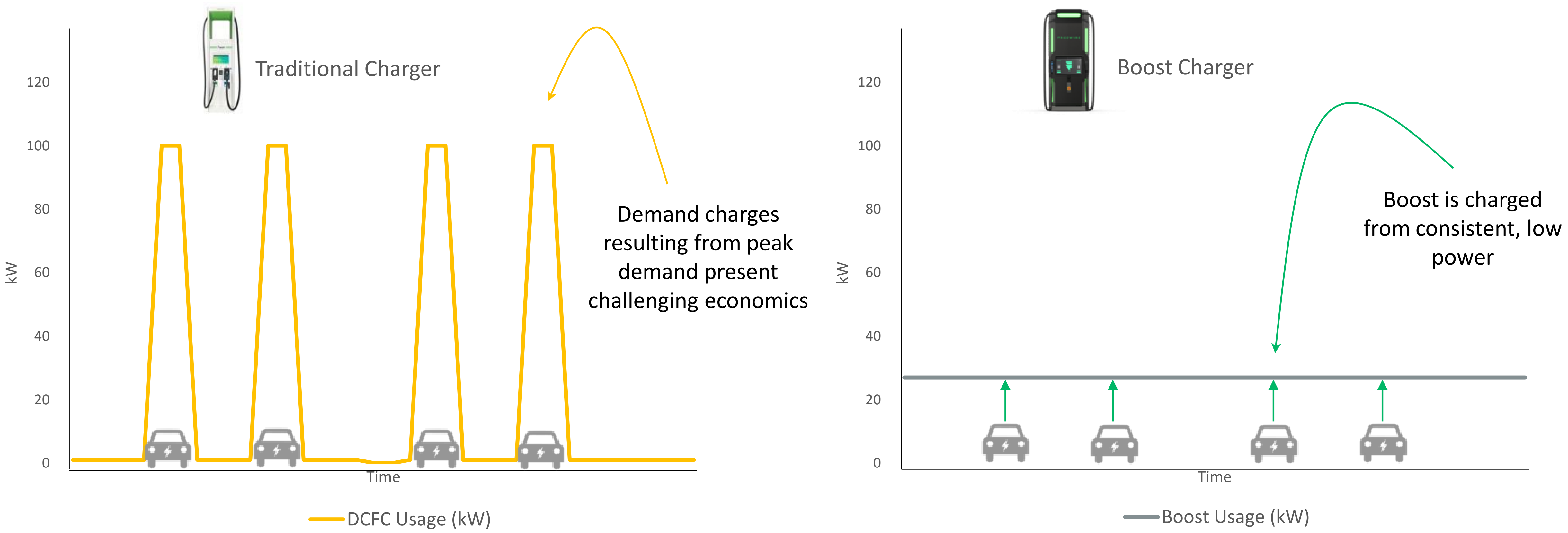
Because the Boost Charger connects to the grid at lower voltage levels, in many cases the configuration can minimize or avoid certain electrical infrastructure



Fully-Integrated Solution Eases Complexity and Cost



Technology Solution to Mitigating Demand Charges



- In the case of the Boost Charger, the station never peaks higher than 27 kW
  - 20 kW is utilized to recharge the Boost's integrated battery and 3-7 kW utilized for heating/cooling/operations
- As a result, battery-integrated EVSE can reduce demand charges and respond to TOU or other pricing mechanisms

How to Easily Upgrade Your EV Charger

Boost Charger™

DC Fast Charging Station

Prepared By:

Kimley»Horn

FREEWIRE

How to Easily Upgrade Your EV Charger

Development Guidelines for Installing Next-Generation EV Chargers Using Existing Infrastructure

Executive Summary

Electric vehicle (EV) technology is advancing at an astounding rate, with new vehicle models featuring increased range and faster-charging rates. The ratio of cars to EV charging stations is rising, meaning there are fewer stations per car. To keep pace with new EV models and driver demand for fast charging, charger hosts and fleet owners require more power to charge cars faster. The ability to provide that high power is one of the main challenges of growing EV charging. Legacy chargers may not meet the minimum power needs, or worse, may no longer work at all. Over 23,000 level 2 (L2) chargers are eligible for a power output upgrade in the U.S., and 4,300 end-of-life charging stations installed more than five years ago[1]. Most high-powered DC fast chargers (DCFCs) require three-phase 480 V input, restricting sites from installing new hardware without costly, disruptive, and time-intensive infrastructure upgrade projects. FreeWire Technologies addresses these constraints with energy storage solutions that enable ultrafast charging without electrical upgrades while controlling ongoing energy costs.

In partnership with Kimley-Horn, a leading multi-disciplinary engineering firm with experience installing over 1,000 EV charging sites, FreeWire Technologies developed this ebook with guidelines for the installation of FreeWire's Boost Charger™. Boost Charger is a powerful battery-integrated DCFC for electric vehicles. Boost Charger requires lower input than conventional ultrafast chargers, which means site hosts can multiply their power output while using existing infrastructure. Boost Charger fast charges two vehicles at once from its integrated battery, while recharging those batteries from an L2 power connection. For businesses such as hotels, workplaces, car dealerships, fleet operators, or parking providers, Boost Charger enables you to upgrade your power and driver charge experience without the hassle and cost of a fast charge project. In short, charger owners can increase their charge output by 10-20x in just a few weeks, at a fraction of the cost of deploying conventional fast chargers.

Boost Charger requires lower input than conventional ultrafast chargers, which means site hosts can multiply their power output while using existing infrastructure.

This ebook provides an analysis of Boost Charger installation in four common scenarios, with associated recommendations and considerations for each. The following information is based on Kimley-Horn's review of available Boost Charger materials (e.g., datasheets, specifications, and presentations) and substantial EV and energy industry experience.

[1] U.S. Department of Energy Alternative Fuels Data Center, August 2020

This ebook will cover four development scenarios. Use the table below to navigate to the situation that matches your site profile.

Each scenario consists of the following components:

- **Site Description:** A description outlining the assumptions derived from other projects or installations to determine a typical installation
- **Recommendations and Considerations:** Recommendations and considerations for converting to or installing FreeWire Boost Charger(s)
- **Probable Cost:** A detailed explanation of likely cost based on the determined assumptions and EV industry experience
- **Summary:** A summary highlighting significant components of the proposed site design compared to the original site design and an equivalent site using 150 kW chargers (e.g., changes required, conduits, equipment reused, etc.)
- **Single-Line Diagram:** A simple, single-line diagram indicating infrastructure arrangement

Technical Specifications and Nameplate Capacity

Boost Chargers have a nameplate current of 80 A at 208 V, three-phase, or 120 A at 240 V, single-phase with a maximum input power of 27 kW. The proposed installations will use up to 105% of the original design's demand power. Infrastructure will be sized to use the Boost Charger at a 100% duty cycle at the charger's nameplate current rating. The external charger control logic or software is not utilized to limit the AC system demand. Alternate scenarios may be described using less than a 100-percent duty cycle.

Electrical Specifications	
Output Power	Charge one vehicle up to 120 kW or two vehicles up to 60 kW each
Output Voltage (DC)	200 V – 500 V
Output Connectors	Dual-port: CHAdeMO and CCS
Energy Chemistry	Lithium nickel manganese cobalt oxide
Energy Capacity	160 kWh
Electrical Specifications (Input)	
Power	Up to 27 kW
Voltage (AC)	3Ø Y 208 V 1Ø 240 V
Current	3Ø: 100 A service, 80 A typical 1Ø: 150 A service, 120 A typical
Frequency	50 / 60 Hz ± 1%
Mechanical Specifications	
Dimensions	145 cm (57.2") W x 100 cm (39.3") L x 242 cm (95.2") H
Weight	1,588 kg (3,500 lbs)
Operating Temperature	-20° C (-1° F) to +55° C (131° F)
Environmental Rating	IP 54
Communications	4G LTE
Screen	61 cm (24") ruggedized LCD touchscreen

About FreeWire Technologies

FreeWire Technologies merges beautiful design with convenient services to electrify industries formerly dependent on fossil fuels. FreeWire's turnkey power solutions deliver energy whenever and wherever it's needed for reliable electrification beyond the grid. With scalable clean power that moves to meet demand, FreeWire customers can tackle new applications and deploy new business models without the complexity of upgrading traditional energy infrastructure.

About Kimley-Horn

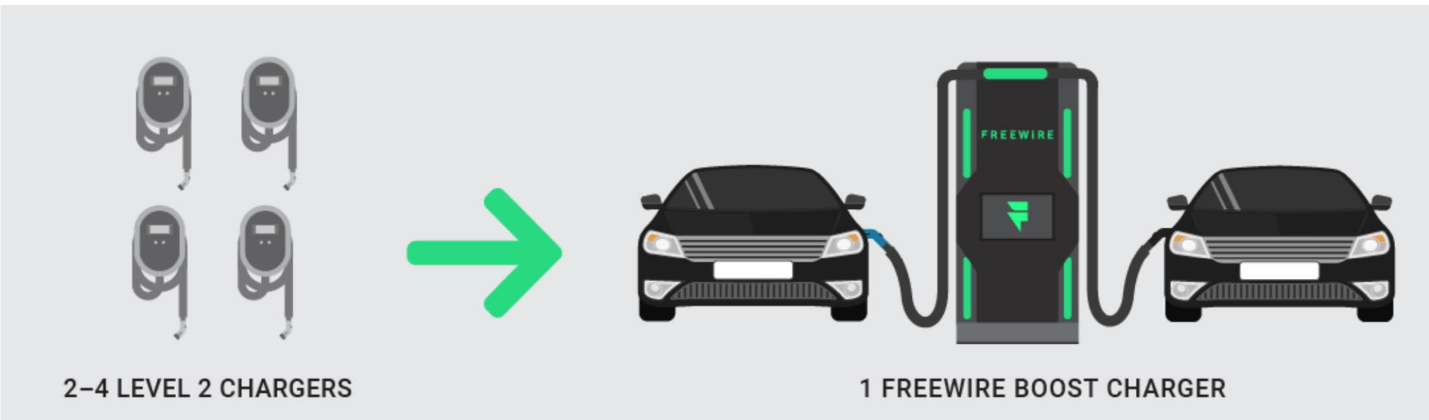
Kimley-Horn is a full-service consulting firm composed of civil engineers, electrical engineers, landscape architects, transportation planners, structural engineers, roadway engineers, environmental professionals, and construction-phase experts. They are recognized as one of the nation's premier planning and design consultants, as evident by their years on Engineer-News Record's Top Lists, including Top 500 Design Firms. Founded in 1967, they grew from a group of transportation engineers to a multi-discipline firm with more than 4,300 staff in more than 90 offices nationwide. Kimley-Horn's continued growth and stability over the past 53 years is the direct result of their commitment to integrity and dedication to providing quality services to clients nationwide.

Boost Charger can be easily installed at sites including, but not limited to, the following scenarios. For additional questions or a free assessment of upgrading your site, contact sales@freewiretech.com.

Scenario 1: Site With Existing Charging Infrastructure

Locations with existing L2 chargers will have a varying number of chargers available from site to site. To better understand Boost Charger's application, two standard L2 sites have been established— a "small site" has two to four chargers and a "large site" has six to ten chargers. To best evaluate Scenario 1, we have broken it into two subsections to assess both site types (Small Site identified as Scenario 1A and Large site identified as Scenario 1B). L2 chargers can vary widely in kW charging capacity; however, we focused on one common size: 7.2 kW at 208 V or 240 V, single-phase on a 40-A breaker.

Scenario 1A: Small Site — Replace Two to Four Existing L2 Chargers with a Boost Charger



Small Site Description

A small L2 charging site will have two to four existing chargers with 14.4 kW to 28.8 kW of power consumption. The existing power will cover 50% (two L2s) to 100% (four L2s) of the required input power for a Boost Charger. Without determining additional availability through existing as-built drawings or a load study, the Boost Charger will operate below its nameplate capacity on sites with two or three L2 chargers. Utilizing below full capacity will increase the recharge time for the internal battery, reducing the Boost Charger's available utilization in the two and three existing stations scenario; however, this is still an upgrade in charging speeds and can charge more vehicles at once compared to existing conditions. If there are four L2 chargers, the Boost Charger can be utilized at full capacity.

Benefits

- √ Lower Cost Per Charge
- √ Faster Charging Times
- √ Cost Range: $
  (Note: ± $50,000 per $)

> "The Boost Charger allows sites with this existing L2 setup to explore the option of DCFC where there may not have been a solution otherwise."

Recommendations and Considerations

The existing electrical infrastructure at small sites will require the following modifications:

- For a 208 V, three-phase input power source solution, at least one existing L2 2-pole circuit breakers will have to be removed and replaced with one 3-pole circuit breaker.
- For a 240 V, single-phase input power source solution, existing L2 2-pole circuit breakers will have to be removed and replaced with one 2-pole circuit breaker sized for the Boost Charger. If this circuit will be sized for full capacity, confirm that the panelboard can accommodate a 150 A branch circuit breaker. Some panelboards can only accommodate a branch circuit breaker of 100 A or less.
- Existing circuit conductors must be replaced to accommodate the increase in amperage.
- Existing conduits will have to be evaluated for condition and size. The size of the conductors for the Boost Charger are larger than the existing L2 conductors, but the total number of conductors in a conduit will decrease if all the existing circuits are run in the same conduit. Conduit replacement can potentially involve trenching, directional boring, interior routing, and/or roof work depending on the site.

Opinion of Probable Cost*

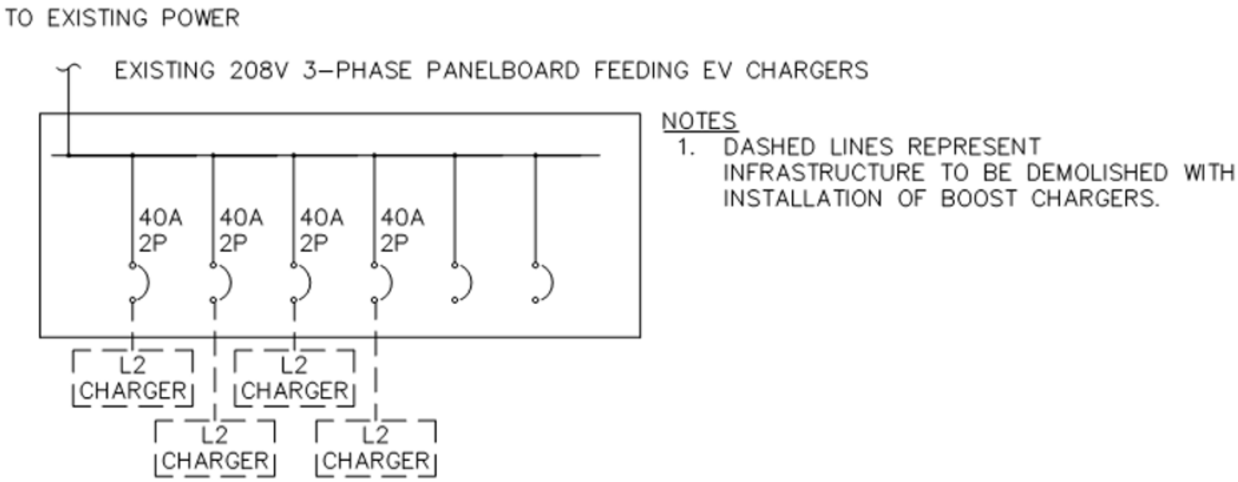
Item	Unit of Measure	Unit Cost	Scenario 1A			
			Low		High	
			Qty.	Subtotal	Qty.	Subtotal
100-A Circuit Breaker	EA	$500.00	1	$500.00	1	$500.00
#2AWG Copper Conductor	LF	$2.00	700	$1,400.00	0	-
#1/0AWG Copper Conductor	LF	$2.35	0	-	0	-
#4/0AWG Copper Conductor	LF	$3.45	0	-	2240	$7,728.00
1-1/2" PVC Schedule 80 Conduit	LF	$5.00	100	$500.00	0	-
2-1/2" PVC Schedule 80 Conduit	LF	$6.50	0	-	280	$1,820.00
1-1/2" EMT	LF	$12.00	75	$900.00	0	-
2-1/2" EMT	LF	$19.25	0	-	280	$5,390.00
Equipment Ground Conductor	LF	$1.75	175	$306.25	560	$980.00
Ground Rod	EA	$150.00	1	$150.00	1	$150.00
Bollards	EA	$500.00	0	-	2	$1,000.00
Concrete Pad	CY	$850.00	0.75	$637.50	0.75	$637.50
Surge Protection Device	EA	$350.00	1	$350.00	1	$350.00
Trenching	LF	$10.00	75	$750.00	0	-
Directional Boring	LF	$15.00	0	-	280	$4,200.00
Junction Box	EA	$1,500.00	0	-	1	$1,500.00
80- A Circuit Breaker	EA	$450.00	0	-	0	-
30-kVA Step-Down Transformer	EA	$7,500.00	0	-	0	-
45-kVA Step-Down Transformer	EA	$10,000.00	0	-	0	-
208-V, 150-A Panelboard	EA	$2,500.00	0	-	0	-
Equipment Rack	EA	$500.00	0	-	0	-
General Electrical Demolition	LS	$2,000.00	1	$2,000.00	1	$2,000.00
Permit Costs	LS	$1,000.00	1	$1,000.00	1	$3,000.00
Boost Charger Install	LS	$7,500.00	1	$7,500.00	1	$7,500.00
	Subtotal			$15,993.75		$36,755.50
	25% Contingency			$3,998.44		$9,188.88
	Total			$19,992.19		$45,944.38

**See Appendix A on page 21 for About Opinion of Probable Cost*

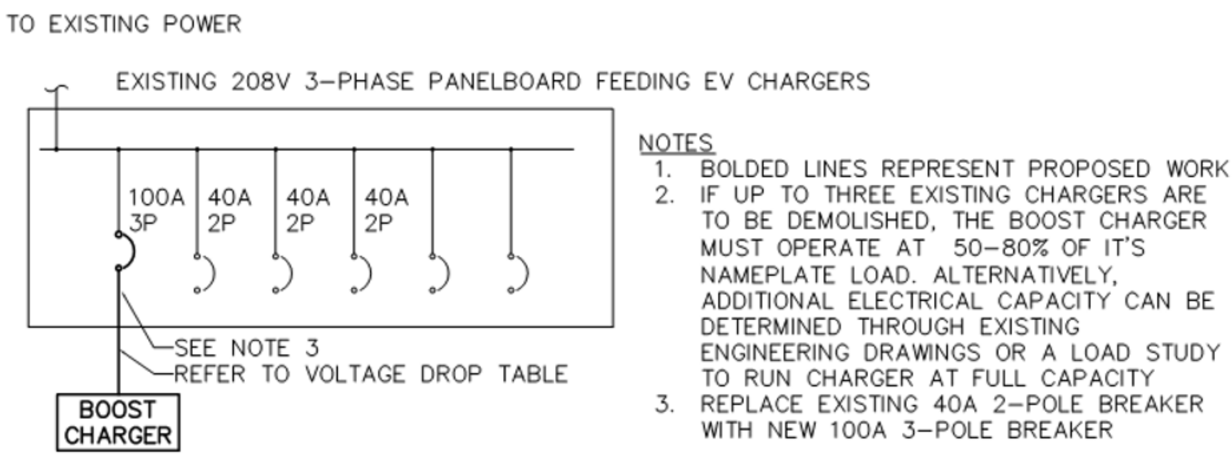
Scenario 1A Summary

FreeWire's unique Boost Charger provides a simple solution for L2 replacement at this type of site. By installing a maximum of one Boost Charger, site hosts will deliver improved charging speeds and electrical output compared to the L2 stations through the same base electrical infrastructure. A traditional 150 kW charger cannot be installed at a site like this without significant infrastructure upgrades and an increase in power supply. The Boost Charger allows sites with this existing L2 setup to explore the option of DCFC where there may not have been a cost-effective solution otherwise.

Single-Line Diagram for Scenario 1A



E 1 **EXISTING SINGLE LINE DIAGRAM**



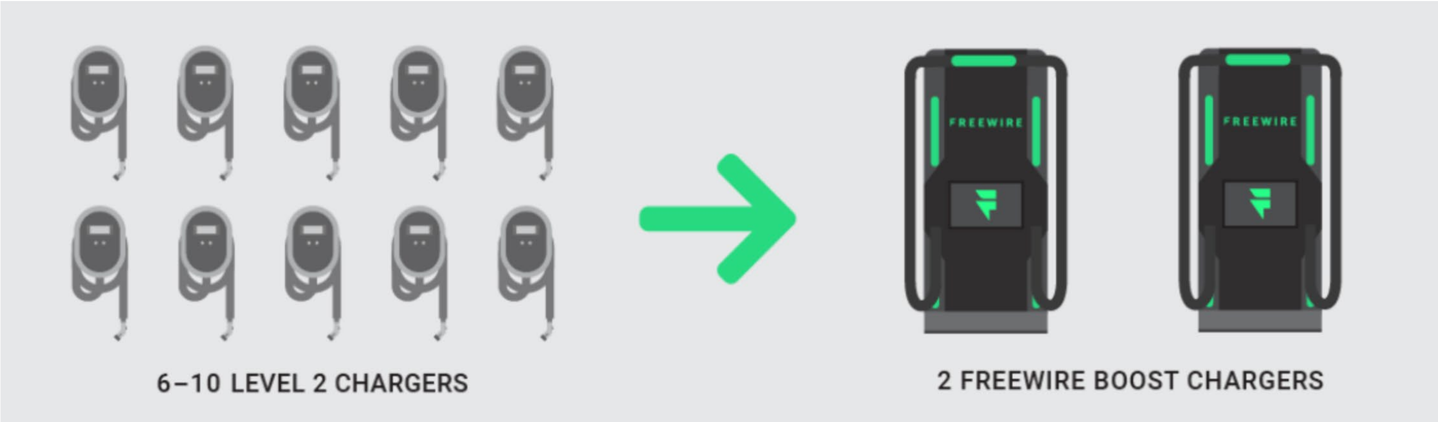
E 2 **PROPOSED SINGLE LINE DIAGRAM**

208V Conductor Voltage Drop Table Per Boost Charging Station (with max input power)					
<175FT	175FT-220FT	220FT-275FT	275FT-350FT	350FT-445FT	445FT-560FT
(4) #2 AWG + (1) #8 AWG GND	(4) #1 AWG + (1) #6 AWG GND	(4) #1/0 AWG + (1) #4 AWG GND	(4) #2/0 AWG + (1) #4 AWG GND	(4) #3/0 AWG + (1) #2 AWG GND	(4) #4/0 AWG + (1) #4/0 AWG GND

NOTE: THIS TABLE CAN BE USED TO SIZE WIRES BASED ON CONDUIT RUN LENGTH FROM ELECTRICAL CONNECTION TO BOOST CHARGER

E 3 **VOLTAGE DROP TABLE**

Scenario 1B: Large Site — Replace Six to Ten Existing L2 Chargers with Boost Chargers



Large Site Description

A large L2 charging site will have six to ten existing chargers with 43.2 kW to 72 kW of power consumption. The required power for a Boost Charger will range from 38% to 63% of the existing charging station's power. This means that with the removal of the existing L2 chargers, one to two Boost Chargers at 100% capacity can be installed. In addition, this can be completed without the need to verify existing power capacity. Alternatively, if the input power to the Boost Chargers is reduced to 67% of their maximum, then these sites can accommodate up to four Boost Chargers.

Benefits

- √ Lower Cost Per Charge
- √ Faster Charging Times
- √ More Charging Ports
- √ Cost Range: $
  (Note: ± $50,000 per $)

Recommendations and Considerations

The infrastructure replacement at the large site is similar to what is required for a smaller L2 charging site:

- For a 208 V, three-phase input power source solution, existing L2 2-pole circuit breakers will have to be removed and replaced with 3-pole circuit breakers.
- For a 240 V, single-phase input power source solution, existing L2 2-pole circuit breakers will have to be removed and replaced with 2-pole circuit breakers sized for the Boost Chargers. If these circuits will be sized for full capacity, confirm that the panelboard being used can accommodate 150 A branch circuit breakers. Some panelboards can only accommodate a branch circuit breaker of 100 A or less.
- Existing circuit conductors will have to be replaced to accommodate the increase in amperage.

> "...if the input power to the Boost Chargers is reduced to 67% of their maximum, then these sites can accommodate up to four Boost Chargers."

- Existing conduits will have to be evaluated for condition and size. The size of the conductors for the Boost Chargers will increase, but the total number of conductors in the conduits will decrease if all the existing circuits are in the same one or two conduits. Conduit replacement can potentially involve trenching, directional boring, interior routing, and/or roof work depending on the site.

Opinion of Probable Cost*

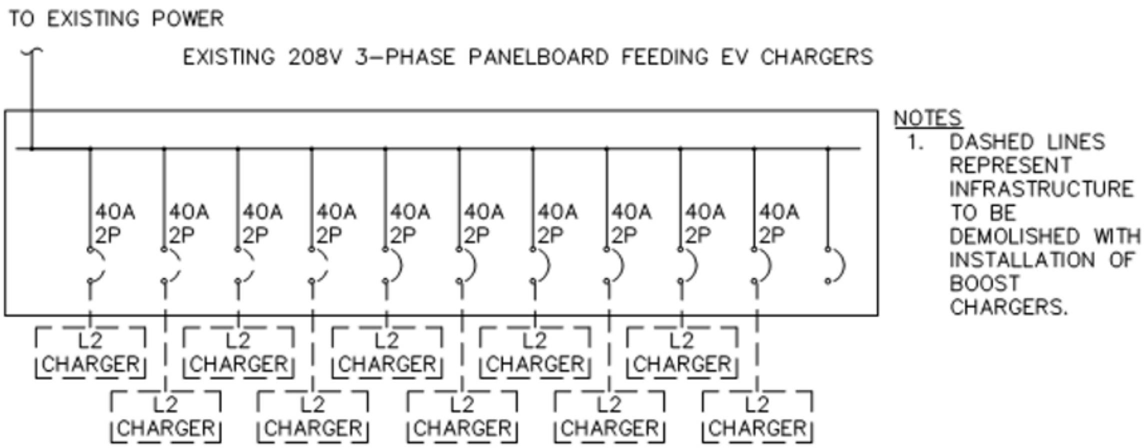
			Scenario 1B			
			Low		High	
Item	**Unit of Measure**	**Unit Cost**	**Qty.**	**Subtotal**	**Qty.**	**Subtotal**
100-A Circuit Breaker	EA	$500.00	2	$1,000.00	4	$2,000.00
#2AWG Copper Conductor	LF	$2.00	1400	$2,800.00	0	-
#1/0AWG Copper Conductor	LF	$2.35	0	-	0	-
#4/0AWG Copper Conductor	LF	$3.45	0	-	8960	$30,912.00
1-1/2" PVC Schedule 80 Conduit	LF	$5.00	200	$1,000.00	0	-
2-1/2" PVC Schedule 80 Conduit	LF	$6.50	0	-	0	-
1-1/2" EMT	LF	$12.00	150	$1,900.00	0	-
2-1/2" EMT	LF	$19.25	0	-	1120	$21,560.00
Equipment Ground Conductor	LF	$1.75	350	$612.50	2240	$3,920.00
Ground Rod	EA	$150.00	2	$300.00	4	$600.00
Bollards	EA	$500.00	0	-	8	$4,000.00
Concrete Pad	CY	$850.00	1.5	$1,275.00	3	$2,550.00
Surge Protection Device	EA	$350.00	2	$700.00	4	$1,400.00
Trenching	LF	$10.00	150	$1,500.00	0	-
Directional Boring	LF	$15.00	0	-	1120	$16,800.00
Junction Box	EA	$1,500.00	0	-	2	$3,000.00
80- A Circuit Breaker	EA	$450.00	0	-	0	-
30-kVA Step-Down Transformer	EA	$7,500.00	0	-	0	-
45-kVA Step-Down Transformer	EA	$10,000.00	0	-	0	-
208-V, 150-A Panelboard	EA	$2,500.00	0	-	0	-
Equipment Rack	EA	$500.00	0	-	0	-
General Electrical Demolition	LS	$2,000.00	2	$4,000.00	2	$4,000.00
Permit Costs	LS	$1,000.00	1	$1,000.00	1	$3,000.00
Boost Charger Install	LS	$7,500.00	2	$15,000.00	4	$30,000.00
	Subtotal			$30,987.50		$123,742.00
	25% Contingency			$7,746.88		$30,935.50
	Total			$38.734.38		$154,677.50

See Appendix A on page 21 for About Opinion of Probable Cost

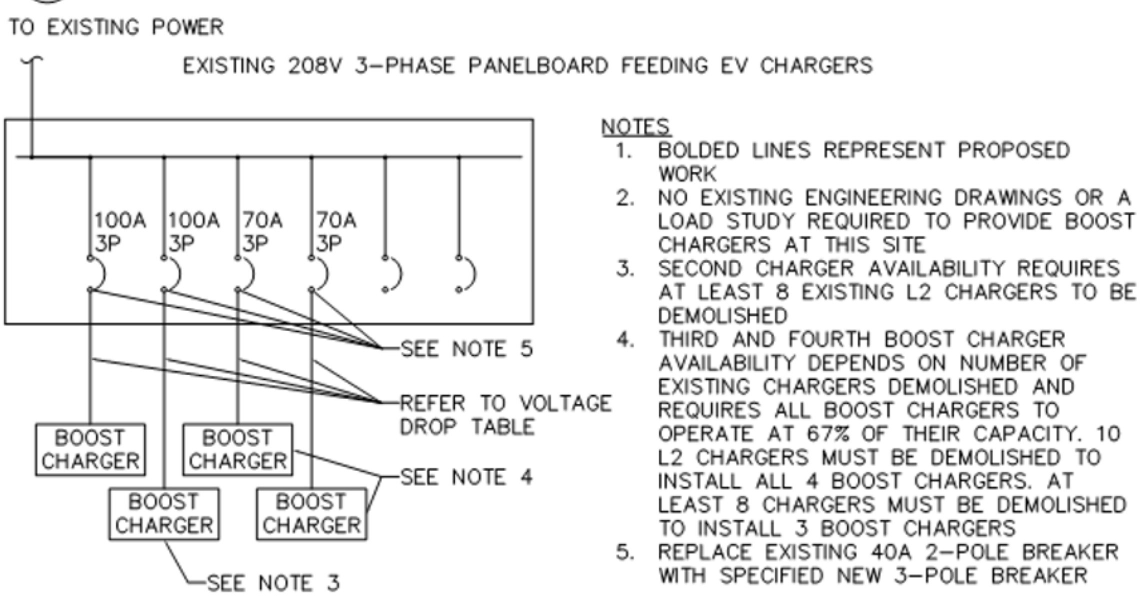
Scenario 1B Summary

FreeWire Boost Chargers are a great solution for DCFC at these sites compared to existing conditions, there is a drastic increase in charging speed and electrical output without a major reduction in charging ports. These sites accommodate the installation of one to two Boost Chargers and, if power input is reduced to 67%, even four chargers can be installed. A traditional 150 kW DCFC cannot be installed at an existing site like this without significant infrastructure upgrades and an increase in power demand; therefore, the Boost Charger offers the only DCFC without increasing existing electrical demand.

Single-Line Diagram for Scenario 1B



E 1 **EXISTING SINGLE LINE DIAGRAM**



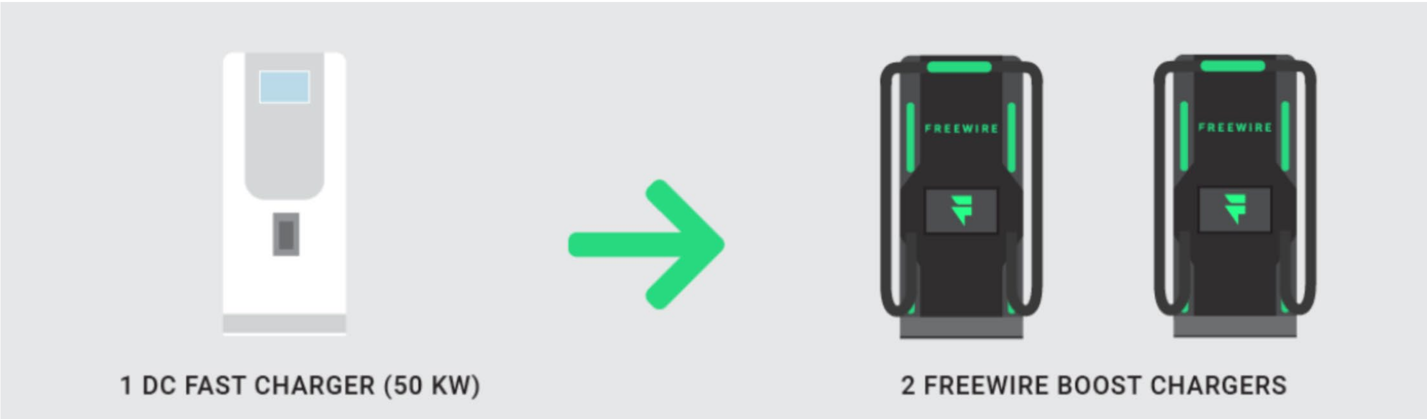
E 2 **PROPOSED SINGLE LINE DIAGRAM**

208V Conductor Voltage Drop Table Per Boost Charging Station (with max input power)					
<175FT	175FT-220FT	220FT-275FT	275FT-350FT	350FT-445FT	445FT-560FT
(4) #2 AWG + (1) #8 AWG GND	(4) #1 AWG + (1) #6 AWG GND	(4) #1/0 AWG + (1) #4 AWG GND	(4) #2/0 AWG + (1) #4 AWG GND	(4) #3/0 AWG + (1) #2 AWG GND	(4) #4/0 AWG + (1) #4/0 AWG GND

NOTE: THIS TABLE CAN BE USED TO SIZE WIRES BASED ON CONDUIT RUN LENGTH FROM ELECTRICAL CONNECTION TO BOOST CHARGER

E 3 **VOLTAGE DROP TABLE**

Scenario 2: Replace One DCFC with Two Boost Chargers



An existing site that has a 50 kW DCFC will in-turn have 50 kW of power consumption. This will allow for the installation of two Boost Chargers. The existing 50 kW DCFC is supplied by a 480 V, three-phase input power source. However, the Boost Charger operates at 208 V, three-phase which means there will need to be infrastructure modifications to serve the new equipment.

Benefits

√ **Lower Cost Per Charge**

√ **More Charging Ports**

√ **Cost Range: $-$$**
(Note: ± $50,000 per $)

It should be noted that under this scenario the Boost Chargers will have input power limited to 80% of their full capacity due to limitations of standard transformer sizes. A standard 50 kW charging station is served by an 80 A circuit breaker, which is equivalent to 66.5 kVA. This falls between a 45 kVA and a 75 kVA transformer standard size. In an effort not to increase the electrical loading on site, the 45 kVA transformer would have to be used thus limiting the input power of the Boost Charger.

In sites where multiple 50-kW chargers exist, this transformer sizing inefficiency may be eliminated as the total power usage aligns with industry standard transformer sizing.

Recommendations and Considerations

The infrastructure modifications needed to serve the new Boost Chargers include:

- The existing 480 V circuit breaker and conductors that feed the 50 kW charging station will be reused to serve a step-down transformer provided the conductors and conduits are still in good condition.
- A 208 Y/120 V, three-phase electrical panel will need to be installed to power the Boost Chargers on the secondary side of the transformer.
- New 208 V, 3-pole circuit breakers and branch circuit wiring will need to be installed to the new chargers.

> **"Just installing one new 150 kW charger would require three times the existing electric load."**

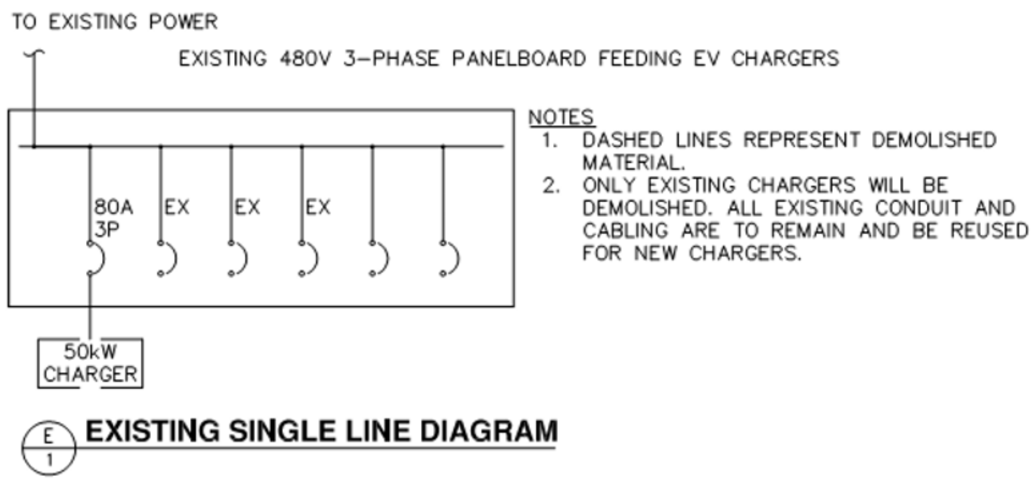
Opinion of Probable Cost*			Scenario 2			
			Low		High	
Item	Unit of Measure	Unit Cost	Qty.	Subtotal	Qty.	Subtotal
100-A Circuit Breaker	EA	$500.00	0	-	0	-
#2AWG Copper Conductor	LF	$2.00	200	$400.00	400	$800.00
#1/0AWG Copper Conductor	LF	$2.35	100	$235.00	2240	$5,264.00
#4/0AWG Copper Conductor	LF	$3.45	0	-	0	-
1-1/2" PVC Schedule 80 Conduit	LF	$5.00	50	$250.00	100	$500.00
2-1/2" PVC Schedule 80 Conduit	LF	$6.50	0	-	280	$1,820.00
1-1/2" EMT	LF	$12.00	0	-	0	-
2-1/2" EMT	LF	$19.25	0	-	280	$5,390.00
Equipment Ground Conductor	LF	$1.75	50	$87.50	660	$1,155.00
Ground Rod	EA	$150.00	3	$450.00	3	$450.00
Bollards	EA	$500.00	0	-	4	$2,000.00
Concrete Pad	CY	$850.00	1.75	$1,487.50	1.75	$1,487.50
Surge Protection Device	EA	$350.00	1	$350.00	1	$350.00
Trenching	LF	$10.00	50	$500.00	125	$1,250.00
Directional Boring	LF	$15.00	0	-	280	$4,200.00
Junction Box	EA	$1,500.00	0	-	1	$1,500.00
80- A Circuit Breaker	EA	$450.00	2	$900.00	3	$1,350.00
30-kVA Step-Down Transformer	EA	$7,500.00	0	-	0	-
45-kVA Step-Down Transformer	EA	$10,000.00	1	$10,000.00	1	$10,000.00
208-V, 150-A Panelboard	EA	$2,500.00	1	$2,500	1	$2,500.00
Equipment Rack	EA	$500.00	1	$500.00	1	$500.00
General Electrical Demolition	LS	$2,000.00	0	-	1	$2,000.00
Permit Costs	LS	$1,000.00	1	$1,000.00	1	$3,000.00
Boost Charger Install	LS	$7,500.00	2	$15,000.00	2	$15,000.00
	Subtotal			$33,660.00		$60,516.50
	25% Contingency			$8,415.00		$15,129.13
	Total			$42,075.00		$75,645.63

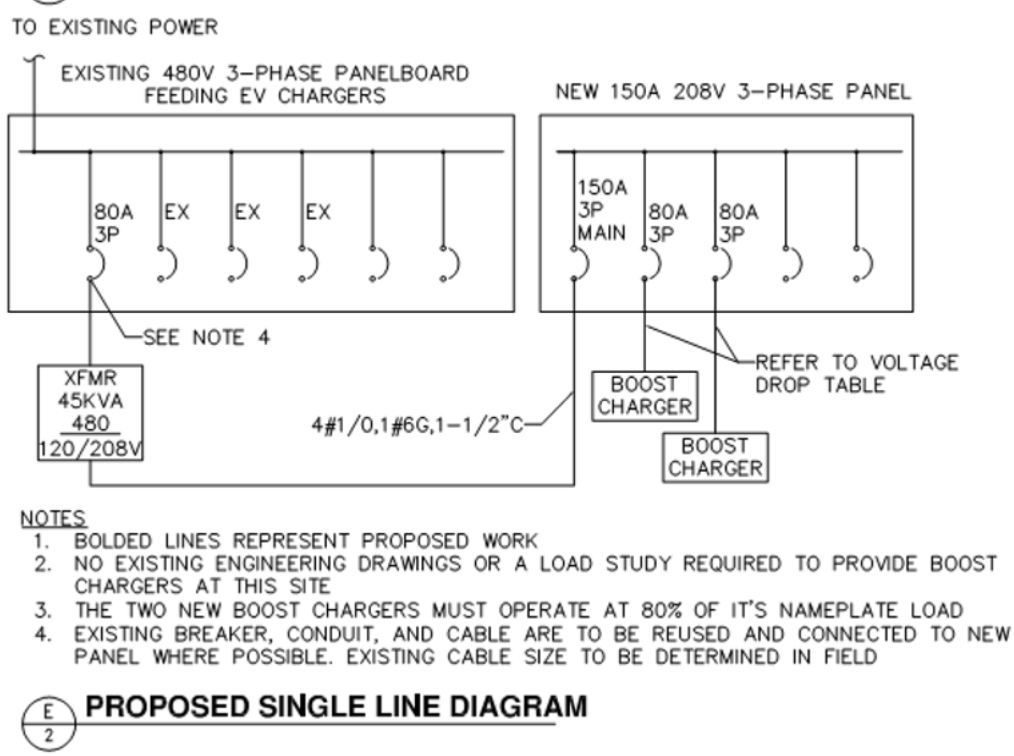
See Appendix A on page 21 for About Opinion of Probable Cost

Scenario 2 Summary

Sites with 50 kW chargers are quickly becoming a thing of the past. Most new sites have DCFC stations that are 150 kW or greater. If an existing site with one 50 kW charger is to be upgraded, options are limited. Just installing one new 150 kW charger would require three times the existing electric load and likely require significant system upgrades to install more than one charger; however, FreeWire's Boost Charger allows sites like these to have two more powerful charging stations using only the existing load and electrical system with minor upgrades. This scenario is easily scalable as well. For every additional existing 50 kW charger, there can be two Boost Chargers installed at the same capacity. FreeWire can offer these sites a unique opportunity to increase the quantity of DCFC and charging rate without the need for extensive electrical infrastructure upgrades.

Single-Line Diagram for Scenario 2



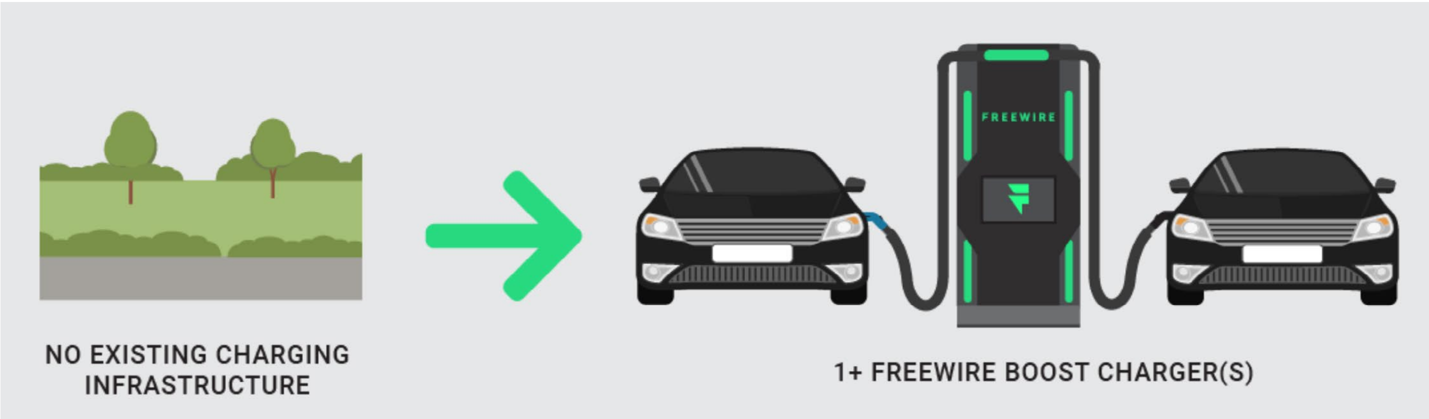


208V Conductor Voltage Drop Table Per Boost Charging Station (with max input power)					
<175FT	175FT-220FT	220FT-275FT	275FT-350FT	350FT-445FT	445FT-560FT
(4) #2 AWG + (1) #8 AWG GND	(4) #1 AWG + (1) #6 AWG GND	(4) #1/0 AWG + (1) #4 AWG GND	(4) #2/0 AWG + (1) #4 AWG GND	(4) #3/0 AWG + (1) #2 AWG GND	(4) #4/0 AWG + (1) #4/0 AWG GND

NOTE: THIS TABLE CAN BE USED TO SIZE WIRES BASED ON CONDUIT RUN LENGTH FROM ELECTRICAL CONNECTION TO BOOST CHARGER

E 3 **VOLTAGE DROP TABLE**

Scenario 3: Greenfield Installation of Boost Chargers



This scenario envisions a brand-new installation at an existing building. This site would have no existing charging infrastructure but could use the power from the existing building. The existing electrical capacity on a building would need to be determined before installation. This can be done using a load study or existing engineering drawings. If there is capacity, no new electrical service or infrastructure will be needed, saving substantial time and money. However, it may make sense to install a new service depending on the desired number of chargers.

To obtain power from the existing building, the first step is to verify whether the building's electrical system has capacity on the 208 V side or the 480 V side. The most cost-effective, time-efficient way to verify capacity is to use as-built plans and panel schedules. If those are not available, obtain real-demand data through a load study or utility meter data, which will take more time and incur additional cost. Most medium- to large-footprint commercial buildings will have capacity for at least one Boost Charger. If the building's electrical system does not have capacity on the 208 V or the 480 V side, coordinate with the local electric utility provider to obtain a new service for the Boost Charger or Chargers.

Benefits

- √ Lower Cost Per Charge
- √ Faster Charging Times
- √ Quicker Installation
- √ Faster Permitting
- √ More Charging Ports
- √ Cost Range: $
  (Note: ± $50,000 per $)

Recommendations and Considerations

The likely required improvements to the existing building's electrical infrastructure are:

- For a 208 V solution, provide a 3-pole circuit breaker on the selected panel, conductors, and conduits to the Boost Charger.
- For a 480 V solution, provide a 3-pole circuit breaker on the selected panel, then run conductors in conduit from the breaker to a new step-down transformer.
- For a 480 V solution, install a step-down transformer downstream of the new 3-pole circuit breaker. It is preferable that this transformer be located close to the Boost Charger so that the length of the secondary conductors can be minimized.

- For a 480 V solution, provide a disconnect switch (if powering one Boost Charger) or small panelboard (if powering multiple Boost Chargers) on the 208 V side of the transformer.
- For a 208 V or 480 V solution, install conduits inside and outside of the building as required to reach the Boost Charger(s).

Opinion of Probable Cost*

Item	Unit of Measure	Unit Cost	Scenario 3 Low Qty.	Scenario 3 Low Subtotal	Scenario 3 High Qty.	Scenario 3 High Subtotal
100-A Circuit Breaker	EA	$500.00	1	$500.00	1	$500.00
#2AWG Copper Conductor	LF	$2.00	700	$1,400	100	$200.00
#1/0AWG Copper Conductor	LF	$2.35	0	-	840	$1,974.00
#4/0AWG Copper Conductor	LF	$3.45	0	-	0	-
1-1/2" PVC Schedule 80 Conduit	LF	$5.00	100	$500.00	0	-
2-1/2" PVC Schedule 80 Conduit	LF	$6.50	0	-	280	$1,820
1-1/2" EMT	LF	$12.00	75	$900.00	0	-
2-1/2" EMT	LF	$19.25	0	-	280	$5,390.00
Equipment Ground Conductor	LF	$1.75	175	$306.25	585	$1,023.75
Ground Rod	EA	$150.00	1	$150.00	2	$300.00
Bollards	EA	$500.00	0	-	2	$1,000.00
Concrete Pad	CY	$850.00	0.75	$637.50	1	$850.00
Surge Protection Device	EA	$350.00	1	$350.00	1	$350.00
Trenching	LF	$10.00	75	$750.00	0	-
Directional Boring	LF	$15.00	0	-	280	$4,200
Junction Box	EA	$1,500.00	0	-	1	$1,500
80- A Circuit Breaker	EA	$450.00	0	-	1	$450.00
30-kVA Step-Down Transformer	EA	$7,500.00	0	-	1	$7,500.00
45-kVA Step-Down Transformer	EA	$10,000.00	0	-	0	-
208-V, 150-A Panelboard	EA	$2,500.00	0	-	0	-
Equipment Rack	EA	$500.00	0	-	1	$500.00
General Electrical Demolition	LS	$2,000.00	0	-	0	-
Permit Costs	LS	$1,000.00	1	$1,000.00	1	$3,000.00
Boost Charger Install	LS	$7,500.00	1	$7,500.00	1	$7,500.00
	Subtotal			$13,993.75		$38,057.75
	25% Contingency			$3,498.44		$9,514.44
	Total			$17,492.19		$47,572.19

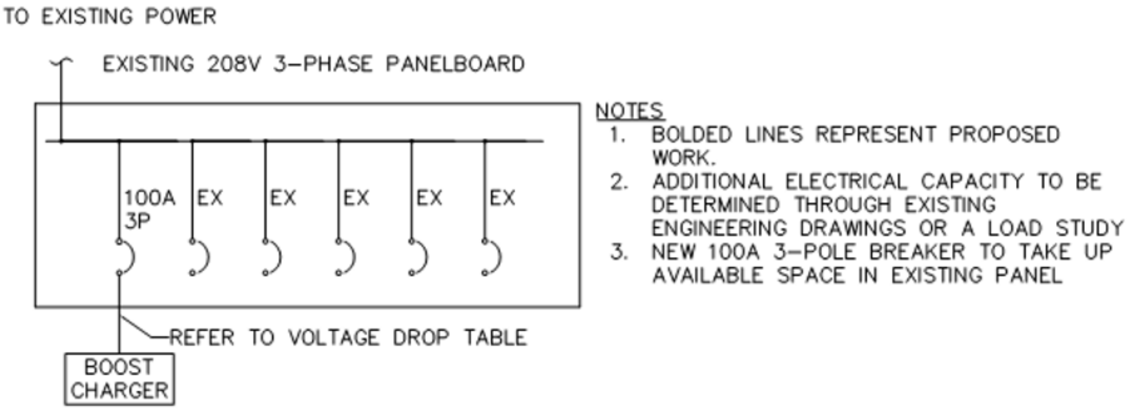
**See Appendix A on page 21 for About Opinion of Probable Cost*

> In the end, the Boost Charger will always allow for more chargers to be installed at a site compared to traditional 150 kW chargers.

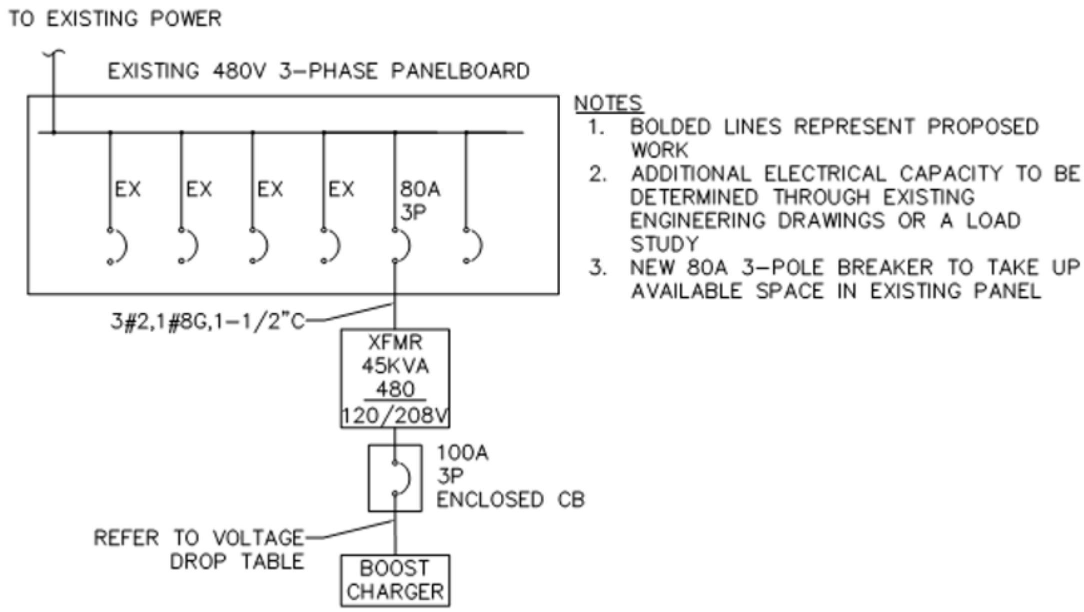
Scenario 3 Summary

A greenfield installation of new DCFC includes many different configurations and site-specific challenges. This includes the desired number of chargers, available electrical load, and the existing voltage and infrastructure available at the site. In the end, the Boost Charger will always allow for more chargers to be installed at a site compared to traditional 150 kW chargers. Due to the Boost Charger's lower power demand, a site host can choose to install roughly four times as many Boost Chargers as traditional 150 kW chargers, or they can choose to limit the electrical demand they are putting on the system. Utilizing Boost Chargers can reduce installation costs and may be the difference between having to install a new electric service or not. The Boost Charger offers flexibility in a number of ways that traditional EV charging dispensers do not.

Single-Line Diagram for Scenario 3



E1 **PROPOSED SINGLE LINE DIAGRAM W/208V AVAILABLE**



E2 **PROPOSED SINGLE LINE DIAGRAM W/480V AVAILABLE**

208V Conductor Voltage Drop Table Per Boost Charging Station (with max input power)					
<175FT	175FT-220FT	220FT-275FT	275FT-350FT	350FT-445FT	445FT-560FT
(4) #2 AWG + (1) #8 AWG GND	(4) #1 AWG + (1) #6 AWG GND	(4) #1/0 AWG + (1) #4 AWG GND	(4) #2/0 AWG + (1) #4 AWG GND	(4) #3/0 AWG + (1) #2 AWG GND	(4) #4/0 AWG + (1) #4/0 AWG GND

NOTE: THIS TABLE CAN BE USED TO SIZE WIRES BASED ON CONDUIT RUN LENGTH FROM ELECTRICAL CONNECTION TO BOOST CHARGER

E3 **VOLTAGE DROP TABLE**

Additional Recommendations for All Scenarios

In addition to the scenarios evaluated above, Kimley-Horn would like to share some other recommendations. These recommendations are for you to explore further and apply to all four scenarios described. These items will make for a more flexible, efficient, and complete deployment of the FreeWire Boost Charger. We've built this list based on experience from past projects.

- Use a Type-1 surge protective device that is UL 1449 listed.
- Install 6-inch bollards rated for vehicle impact to protect the stations. If bollards are not installed for physical protection of the Boost Charger, consider breakaway fuse holders for phase conductors entering the Boost Charger.
- You should verify if there are any existing EV contracts that need buyout or termination to install the Boost Charger. Confirmation will avoid unexpected costs resulting from a terminated contract.
- A new concrete pad will be required in all scenarios because it will need to be larger than those currently being used. A structural design and calculation package will be needed to verify size based on the local wind, soil, and seismic requirements.
- Boost Charger terminals can only accept up to #2AWG wires. If voltage drop is an issue, the installing contractor will need to tap trunk conductors at the disconnecting means.
- Currently, California and Texas have statewide Accessibility Codes relating to EV charging stations. Scores of Cities, Counties, and other Authorities Having Jurisdiction (AHJ) around the country have similar codes. For these areas, the pavement slope will need to be verified as less than 2% for the required parking space size and access aisle provided. In addition, reach ranges and other specific requirements must be met in order to install a Boost Charger. Due to these restrictions, additional cost and consideration will need to be made during the design, permitting, and installation phases of applicable projects.

For additional questions or a free assessment of upgrading your site with Boost Charger, contact sales@freewiretech.com.

Appendix A

About Opinion of Probable Cost

These costs do not include the cost of the FreeWire Boost Charger and are meant to approximate the installation costs for each scenario. Extensive pavement work associated with accessibility requirements such as patching, mill/overlay, or full-depth replacement are excluded. The opinions of probable cost for installing the Boost Chargers have been tabulated in the tables shown for each scenario to give an estimated price range. The cost has been complied using "low" and "high" conditions to determine the associated cost range for each of the given scenarios. The assumptions used for these estimates are shown in the table below. In addition, these scenarios assume the existing infrastructure can be utilized. If a new service and associated infrastructure is required, additional time and potentially cost will be added. Cost data was generated using national averages for material and labor costs; however, it should be noted that these costs will vary regionally. In addition, there are considerations and variables on a site-specific basis that will need to be included to further refine the accuracy of the estimates. Access and distance to power, available power, and location of power (on the customer or utility side of the meter) have the ability to dramatically increase or decrease estimates. While a 25% contingency has been applied to capture some regional increases, it would be expected that some areas may exceed that value. In regions where labor or material costs are high, it is recommended to add an additional contingency to the values show in the table. These costs should be used for high-level budgeting purposes only. It's always recommended to request site-specific cost estimates from a registered contractor for the highest degree of accuracy.

Cost Assumptions Per Scenario	
Scenario 1A — Low	< 175 feet from 208-V power source, no bollards, no junction boxes, half indoor and half underground conduit install by trenching
Scenario 1A — High	560 feet from 208-V power source, bollards, junction box, half indoor and half underground conduit install by boring
Scenario 1B — Low	Two chargers installed < 175 feet from 208-V power source, no bollards, no junction boxes, half indoor and half underground conduit install by trenching
Scenario 1B — High	Four chargers installed 560 feet from 208-V power source, bollards, junction box, half indoor and half underground conduit install by boring
Scenario 2 — Low	Reuse 480 V infrastructure, no bollards, no junction boxes, underground conduit install by trenching
Scenario 2 — High	Can't reuse 480 V infrastructure, replace 480 V for 560 feet, bollards, junction box, half indoor and half underground conduit install by boring for 480 V, trenching for 208 V
Scenario 3 — Low	One charger installed < 175 feet from existing 208 V power source, no bollards, no junction boxes, half indoor and half underground conduit install by trenching
Scenario 3 — High	One charger installed 560 feet from existing 480 V panel, install transformer and 208 V disconnect, bollards, junction box, half indoor and half underground conduit install by boring

www.freewiretech.com

Any additional questions please contact:

(415) 779-5515
sales@freewiretech.com

1933 Davis St. Suite 301A
San Leandro, CA 94577

Boost Charger 150

Ultrafast EV Charging with Integrated Energy Storage

The FreeWire Boost Charger™ is an ultrafast DC charger for electric vehicles (EVs). The battery-integrated design enables Boost Charger to easily connect to existing electrical infrastructure without costly construction and complex permitting. Boost Charger has a 160 kWh battery capacity with 150 kW output and only 27 kW or less input, making it ready for current and next generation EVs.

TURNKEY INSTALLATION

Plug & Play: battery-integrated design connects to the existing low-voltage grid, enabling cost efficient installation in hours

Small Footprint: space efficient design means no unsightly and expensive electrical infrastructure

Lower Operating Costs: energy buffering technology limits input from the grid, reducing costly demand charges

PREMIUM CHARGING

Ultrafast Charging: charges EVs up to 100 miles in 10 minutes

Dual Charging: provides simultaneous charging that's universally compatible with all EV models

Customizable Design: option for custom branded unit including point-of-sale integration for retailers

FUTURE-PROOF

Smart & Connected: integrated energy management software and OCPP communications compatible with any charging network

Flexible Deployment: easy to relocate depending on charging demand and site access limitations

ENERGY STORAGE

Energy Chemistry	Lithium-ion (NMC)
Energy Storage Capacity	160 kWh

ELECTRICAL SPECIFICATIONS (OUTPUT)

Supported Connector Types	CCS1 / CCS2 CHAdeMO
Charge Ports	2
Max Output Power (DC)	CCS: 150 kW CHAdeMO: 100 kW Combined: charge 2 vehicles simultaneously at up to 75 kW each

ELECTRICAL SPECIFICATIONS (INPUT)

Power (AC)	≤ 27 kW
Voltage (AC)	U.S./Canada: 208 Vac 3-phase, or 240 Vac split-phase U.K./E.U.: 400 Vac 3-phase Japan: 200 Vac 3-phase
Current	U.S./Canada: 208 Vac: 100 A service, 80 A typical; or 240 Vac: 150 A service, 120 A typical U.K./E.U.: 400 Vac: 60 A service, 40 A typical Japan: 200 Vac: 100 A service, 80 A typical
Frequency	50 / 60 Hz ± 1%

MECHANICAL SPECIFICATIONS

Dimensions	109 cm (43") L x 101 cm (40") W x 243 cm (96") H
Cable Reach from Station	340 cm (134")
Weight	1,720 kg (3,800 lbs)

ENVIRONMENTAL SPECIFICATIONS

Installation Location	Outdoor
Enclosure Protection Rating	IP 54
Operating & Storage Temperature	-20° C (-4° F) to +55° C (131° F)

NETWORK & USER INTERACTION

Network Connection	4G LTE, Ethernet
Communications	OCPP 1.6-J
User Interface Screen	61 cm (24") ruggedized LCD touchscreen
Credit Card Reader	Standard
Payment Methods Accepted	Credit cards, NFC, MIFARE, FeliCa
Access Control & Authentication	RFID: ISO 15693, ISO 14443, NFC
Safety & Compliance	U.S.: UL2202, UL2231-1, UL2231-2, UL991, UL1973 (battery), FCC Part 15 Class A Canada: CSA No 107.2, CAN/UL1973, ICES-001 Class A U.K/E.U.: IEC 61851-1, IEC 61851-23, IEC 61851-21-2

v.1.150kW-4.29.2022

Boost Charger™ Product and Service Guide

FreeWire's Boost Charger is a powerful battery-integrated electric vehicle charger. With 160 kWh of battery capacity and 150 kW output, Boost Charger is ready for current and next generation EVs. Deliver ultrafast charging with minimal upfront cost with the Boost Charger.

This document contains information on the following:

- Product pricing
- Warranty coverage
- Additional options
- Preventative maintenance
- Proactive monitoring

FreeWire Service and Support

Backing every Boost Charger is FreeWire's service and maintenance network. FreeWire technical support and local service providers ensure a successful deployment and worry-free operations. Service and maintenance may be provided at your site or diagnosed and repaired remotely. Boost Charger system health and charging session data is monitored in real-time including proactive status notifications.

Boost Charger Pricing

Product	MSRP
Battery-backed Ultrafast EV Charger 160kWh Capacity, 150kW Output Dual-Port Remote Commissioning	$135,000.00
3-Year On-Site Warranty Proactive Monitoring, Performance Data Analysis & Reporting, Annual Preventative Maintenance and Over the Air Software Updates	$27,350.00
Boost Charger + 3-Year On-Site Warranty and Maintenance Bundle	$162,350.00

Warranty

Items
Covered
Parts
Workmanship
Battery: 70% Energy Retention After Lesser of: 2,000 Cycles or Warranty Term (Whichever Comes First)

Other Options

Product	MSRP
Custom Co-Branding	$4,000.00
On-Site Commissioning and Validation Includes Training Upon Request	$200/hour + Travel & Lodging Costs 4-Hour Minimum
3rd Party Network and Software Tier 1+2 Driver Support	Network Dependent
Post-Warranty Proactive Monitoring, Performance Data Analysis, Reporting, and Over the Air Software Updates	$1,100.00/year

Planned Maintenance and Service

Items
Annual Preventative Maintenance
Full System Diagnostics and Inspection
Input Air Filter Replacement
Top-Off Radiator Fluid & HVAC Coolant
Flush Radiator (if Needed)
Inspect Coolant Pump and Replace (if Needed)
Inspect Low Voltage Battery and Replace (if Needed)

Proactive Monitoring

Items
Data Monitoring and Alerts
Real-time system health data including station activity, battery, and component functionality
Charging session data* including duration of charge, power, vehicle SOC and energy delivered
Proactive status notifications

* no personally identifiable user information is collected

Finance Your EV Charging Infrastructure

FreeWire Technologies has partnered with Macquarie Capital to offer competitive financing for qualified customers. Financing covers everything you need to launch an EV charging project including warranty as part of a turnkey offering. Boost Charger can be installed for low- to no-cost upfront by combining financing with available federal tax credits and state and local incentives.

FREEWIRE

FreeWire Technologies, Inc.

1933 Davis Street, Suite 301A
San Leandro, CA 94577

Contact Us

Call: 415.779.5515
Email: sales@freewiretech.com
Visit: www.freewiretech.com

Boost Charger 200

Ultrafast EV Charging with Integrated Energy Storage

The Boost Charger™ 200 is an ultrafast and flexible DC fast charger for electric vehicles (EVs). The battery-integrated design enables Boost Charger to easily connect to existing electrical infrastructure without costly construction and complex permitting. Boost Charger has a 160 kWh battery capacity with 200 kW output and only 27 kW or less input, making it ready for all EVs including light to heavy-duty models.

HIGH PERFORMANCE

Utrafast Charging: adds up to 200 miles of range in 15 minutes

Dual Charging: provides simultaneous charging and customizable port configurations including CCS1/CCS2 and CHAdeMO

High Power: outputs up to 950 V for charging light to heavy-duty EVs

FLEXIBLE PLATFORM

Plug & Play: battery-integrated design connects to the existing low-voltage grid, enabling cost efficient installation in hours

Small Footprint: space efficient design means no unsightly and expensive electrical infrastructure

Flexible Deployment: easy to relocate depending on charging demand and site

FUTURE-PROOF

Smart & Connected: flexible management platform allows you to integrate charger with your business or any third party charging software

Lower Operating Costs: energy buffering technology limits input from the grid, reducing costly demand charges

ENERGY STORAGE

Energy Chemistry	Lithium-ion (NMC)
Energy Storage Capacity	160 kWh

ELECTRICAL SPECIFICATIONS (OUTPUT)

Supported Connector Types	CCS1 / CCS2 CHAdeMO
Charge Ports	2
Max Output Power (DC)	CCS: 200 kW CHAdeMO: 100 kW Combined: charge 2 vehicles simultaneously at up to 100 kW each
Voltage	200-950 Vdc

ELECTRICAL SPECIFICATIONS (INPUT)

Power (AC)	≤ 27 kW
Voltage (AC)	U.S./Canada: 208 Vac 3-phase, or 240 Vac split-phase U.K./E.U.: 400 Vac 3-phase
Current	U.S./Canada: 208 Vac: 80 amps continuous, or 240 Vac: 120 amps continuous U.K./E.U.: 400 Vac: 40 amps continuous
Frequency	50 / 60 Hz ± 1%

MECHANICAL SPECIFICATIONS

Dimensions	109 cm (43”) L x 101 cm (40”) W x 243 cm (96”) H
Cable Reach from Station	340 cm (134”)
Weight	1,720 kg (3,800 lbs)

ENVIRONMENTAL SPECIFICATIONS

Installation Location	Outdoor
Enclosure Protection Rating	IP 54
Operating & Storage Temperature	-20° C (-4° F) to +55° C (131° F)

NETWORK & USER INTERACTION

Network Connection	4G LTE, Ethernet
Communications	OCPP 1.6-J
User Interface Screen	61 cm (24") ruggedized LCD touchscreen
Credit Card Reader	Standard
Payment Methods Accepted	Credit cards, NFC, MIFARE, FeliCa
Access Control & Authentication	RFID: ISO 15693, ISO 14443, NFC
Safety & Compliance	U.S.: US:UL2202, UL2231-1, UL2231-2, UL991, UL1973 (battery pack), FCC part 15 Class A (U.S.) Canada: CSA 107.2 CE & IEC expected complete 2022

FreeWire Technologies, Inc. | www.freewiretech.com
sales@freewiretech.com | 415.779.5515

FREEWIRE

Boost Charger™ 200 Product and Service Guide

FreeWire's Boost Charger 200 is a powerful battery-integrated electric vehicle charger. With 160 kWh of battery capacity and 200 kW output, Boost Charger is ready for current and next generation EVs. Deliver ultrafast charging with minimal upfront cost with the Boost Charger.

This document contains information on the following:

- Product pricing
- Standard and extended warranty coverage
- Additional options
- Preventative maintenance
- Proactive monitoring

FreeWire Service and Support

Backing every Boost Charger is FreeWire's service and maintenance network. FreeWire technical support and local service providers ensure a successful deployment and worry-free operations. Service and maintenance may be provided at your site or diagnosed and repaired remotely. Boost Charger system health and charging session data is monitored in real-time including proactive status notifications.

Boost Charger Pricing

Product	MSRP
Battery-backed Ultrafast EV Charger 160kWh Capacity, 200kW Output Dual-Port Remote Commissioning	$142,000
3-Year On-Site Warranty Proactive Monitoring, Performance Data Analysis & Reporting, Annual Preventative Maintenance and Over the Air Software Updates	$30,000
Boost Charger + 3-Year On-Site Warranty and Maintenance Bundle	$172,000
On-Site Warranty Extension to 5 Years	$19,245

Warranty

Items
Covered
Parts
Workmanship
Battery: 70% Energy Retention After Lesser of: 2,000 Cycles or Warranty Term (Whichever Comes First)

Other Options

Product	MSRP
Custom Co-Branding	$4,000
On-Site Commissioning and Validation Includes Training Upon Request	$200/hour + Travel & Lodging Costs 4-Hour Minimum
3rd Party Network and Software Tier 1+2 Driver Support	Network Dependent
Post-Warranty Proactive Monitoring, Performance Data Analysis, Reporting, Over the Air Software Updates	$1,100/year

Planned Maintenance and Service

Items
Annual Preventative Maintenance
Full System Diagnostics and Inspection
Input Air Filter Replacement
Top-Off Radiator Fluid & HVAC Coolant
Flush Radiator (if Needed)
Inspect Coolant Pump and Replace (if Needed)
Inspect Low Voltage Battery and Replace (if Needed)

Proactive Monitoring

Items
Data Monitoring and Alerts
Real-time system health data including station activity, battery, and component functionality
Charging session data* including duration of charge, power, vehicle SOC and energy delivered
Proactive status notifications

* no personally identifiable user information is collected

FREEWIRE

FreeWire Technologies, Inc.

7200 Gateway Blvd
Newark, CA 94560

Contact Us

Call: 415.779.5515
Email: sales@freewiretech.com
Visit: www.freewiretech.com

Asset Management Platform: AMP™

Advanced cloud-based EV charger management and reporting software

FreeWire's Asset Management Platform (AMP™) is an advanced software platform for control, optimization and reporting of your battery-integrated electric vehicle (EV) charging assets. AMP provides you with the data and tools necessary to easily manage your Boost Charger deployment of any size, from a single unit to multiple units across many sites.

Remotely track utilization and performance, manage chargers by groups, optimize energy consumption to reduce operational expenses, and even customize on-screen displays to promote brand awareness and drive revenue. FreeWire's integrated software platform provides you full access and control of your charger deployments in one place.

Full Control of Your EV Charging Locations

BUILD A NETWORK OF SMART EV CHARGERS

Organize Boost Chargers individually or in Boost Groups to tailor pricing, power consumption, touchscreen display, external lighting, and more!

MEASURE UTILIZATION AND PERFORMANCE

Charts and custom reporting to easily analyze energy usage with real-time data insights to understand energy costs, charger utilization, customer behavior, and utilization forecasting.

SUPERCHARGE YOUR CUSTOMER EXPERIENCE

Increase digital engagements with EV drivers through the charger's 24″ touchscreen; promote products, and even integrate with your existing loyalty programs and mobile apps.

Power Your Boost Charger Network with AMP Cloud-Based Software

MANAGE THE POWER OF EACH BOOST CHARGER

AMP enables even more control over Boost Charger's already low power requirements. Manage consumption, control costs, and minimize risk through scheduled charging when electric rates are at their lowest.

ENHANCE YOUR BRAND AND CUSTOMER LOYALTY

Remotely customize and promote your brand and product offerings through control of LED status indicator light color, and on-screen display.

DISPLAY ADVERTISEMENTS AND PRODUCT PROMOTIONS

Customize Boost Charger's 24" touchscreen remotely to establish your brand and drive in-store sales through a positive customer experience. Share product promotions, store locations, customer loyalty programs, and more!

OPTIMIZE YOUR BOOST CHARGER REVENUE

Remotely control your fee structure and pricing, or configure charger availability for public use.

CONNECT AMP WITH THIRD PARTY NETWORKS

AMP makes it easy to analyze individual to multiple Boost Chargers. With a simple click, you can gain insight on energy and charger utilization for internal optimization or external reporting requirements.

CONNECT BOOST CHARGERS WITH THIRD-PARTY NETWORKS

Boost Charger is Open Charge Point Protocol (OCPP) 1.6 compatible enabling secure communication between EV charging stations and charging networks. AMP's back-end charger management platform can be paired with major EV charging networks.

evconnect

bp pulse

greenlots A Member of the Shell Group

Learn how AMP can power your EV charging management and data reporting.

Contact a FreeWire energy expert: sales@freewiretech.com

v.1-2.17.2022

June 28, 2022

<u>Submitted via email</u>

Paul Baker
State Purchasing Administrator
Florida Department of Transportation
605 Suwanne Street, MS20
Tallahassee, Florida 32399

RE: FreeWire Technologies' Response to DOT-RFI-22-9114-PB

Dear Mr. Baker,

On behalf of FreeWire Technologies, please find below and attached our response to the Department of Transportation's ("DOT") RFI pertaining to direct-current fast charging ("DCFC") electric vehicle supply equipment ("EVSE"). We appreciate the opportunity to provide this response to help inform Florida DOT's development of their plan and solicitations related to the National Electric Vehicle Infrastructure ("NEVI") Formula Program. We are available at your convenience to answer any questions or provide additional information and welcome the opportunity to discuss the NEVI program with you and your colleagues further. We look forward to working with Florida DOT and market participants to help build out the state's electric vehicle ("EV") charging network.

Sincerely,

Peter Olmsted
Director of Regulatory Affairs
FreeWire Technologies
717.305.0045
polmsted@freewiretech.com

General

1. ***Please describe your organization's involvement and experience with DCFC infrastructure. What are your long-term EV plans? How many chargers and/or charging stations are you able to build, install, and/or maintain on an annual basis?***

Founded in 2014, FreeWire is a leading U.S. based provider of turnkey & fully integrated electric vehicle charging solutions. Since 2020, FreeWire has been manufacturing and providing DCFC equipment to its customers across the U.S. as well as internationally. FreeWire is dedicated to accelerating the deployment of EVSE by reducing the barriers to installation and the high energy cost of operating chargers.

FreeWire accomplishes this by integrating battery storage technology into its DCFC Boost Charger, which reduces the need for electrical and grid infrastructure and reduces the grid impact of charging vehicles. Boost Charger provides a charge to the vehicle directly from the FreeWire battery using a low power input, as opposed to conventional chargers, which pull power directly from the grid at high power. This enables Boost Charger to deliver high power output to vehicles while dramatically lowering the energy costs of charging - a significant benefit to site hosts, grid operators, ratepayers, and EV drivers alike.

FreeWire's solution has been deployed in 12 states and in 3 countries (U.S., UK, Japan), and key customers include bp, Google, LinkedIn, Netflix, LADWP, SMUD, SRP, AEP and many others. By the end of 2022 Boost Charger will be deployed in more U.S. states, Canada, Australia & New Zealand, and other European countries. Boost Charger and its integrated battery are fully UL certified and have undergone testing with EPRI, which has verified the performance and cost reduction benefits of the technology.

Currently, FreeWire is delivering its battery-integrated Boost Charger 150 and taking orders for its battery-integrated Boost Charger 200. The Boost 150 is a 150 kW output charger capable of charging one vehicle up to 150 kW or two vehicles simultaneously at up to 75 kW each. The Boost 200 will be capable of charging one vehicle up to 200 kW or two vehicles simultaneously at up to 100 kW each. Each Boost unit is equipped with 160 kWh battery storage capacity. As a result of this configuration, FreeWire's DCFC equipment is able to connect to the grid to the same low-voltage input power that typically supports Level 2 charging stations. Standard input power for Boost Charger is 3 phase 208v/80A or single phase/split phase 240v/120A service, as compared to traditional DCFC which requires 480v service. FreeWire's DCFC configuration therefore not only expands charging locations but reduces construction costs by requiring less utility infrastructure and expediting the installation process.

FreeWire has grown rapidly thanks to high demand for its products in the EV charging and energy infrastructure industry. The company has grown from two employees at the start of

2014 to over 200 employees today. FreeWire was previously headquartered in a former Dodge/Chrysler manufacturing facility in San Leandro, CA. In the past year, FreeWire has expanded its manufacturing footprint and output, and more than doubled the size of its offices and R&D facilities. FreeWire is backed by world-class venture capital firms and global Fortune 500 companies, including Blackrock, Riverstone Capital, bp, ABB, Macquarie Capital, Volvo, and several others.

At current capacity, FreeWire can produce 30 Boost Chargers per month, and we have the ability to ramp this up to 53 units per month using our existing facilities. Beginning in 2023, FreeWire intends to ramp this production up even further and establish the ability to produce over 100 Boost Chargers per month.

2. ***Where does your organization see the biggest opportunities for the utilization of NEVI funds? This could be in terms of innovative technology solutions, partnerships, and/or targeting geographic locations.***

FreeWire believes there is a unique and distinct opportunity to deploy innovative DCFC configurations, such as our battery-integrated Boost Charger, to overcome traditional barriers to the installation and operation of ultrafast EV charging. In both rural and urban locations where the time, cost, or space required to plan for and construct grid and electrical infrastructure is prohibitive, battery integrated DCFC equipment offers a solution to overcome these barriers. Boost Charger is able to achieve this as a result of connecting to the grid at lower power levels and therefore being able to minimize or avoid certain electrical infrastructure requirements, thereby offering the opportunity for quicker and more cost-effective deployment.

In addition, the costs associated with the purchase of electricity for DCFC can often undermine the economic viability owning and operating ultrafast charging, especially in instances where DCFC stations are billed on demand-based electricity rates and where utilization of charging equipment remains low. Battery-integrated EVSE such as the Boost overcome this barrier by utilizing battery storage technology to minimize peak grid power demand thereby avoiding or minimizing demand charges. Whereas conventional charging configurations pull high power from the electric grid to provide a fast charge directly to vehicles, battery integrated DCFC, such as Boost Charger, pull power at low and steady demand from the grid to recharge the integrated battery unit. As a result, Boost Charger avoids the high and often unpredictable peak demand spikes that conventional chargers experience and accordingly, can minimize or avoid demand charges, which often erode the economics of operating a conventional DCFC system, especially in cases of low utilization.

In short, FreeWire believes that there is a significant opportunity to prioritize innovative technology solutions in locations where upgrading grid and electrical infrastructure is prohibitive and/or where electricity costs are not able to be fully recovered by revenue generated by EV charging. FreeWire believes that these barriers pose a distinct threat to making progress under NEVI and we recommend that Florida DOT design their NEVI strategy in a manner that can overcome these challenges through technology innovation or otherwise.

3. ***What are the biggest challenges or barriers that should be addressed to expedite reaching the goals of the NEVI program?***

FreeWire has developed its technology solution and approach to DCFC precisely to help its customers overcome installation and operational barriers. Our experience demonstrates that the time and cost necessary to upgrade grid and electrical infrastructure as well as high electricity costs pose significant barriers to the installation and operational of traditional DCFC configurations. These are the same barriers that will hinder progress towards reaching the goals of the NEVI program.

In a recent white paper published by FreeWire, we discuss and highlight evidence showing that the time and cost associated with upgrading electrical infrastructure to accommodate traditional DCFC solutions is already having an impact on the time and cost to deploy DCFC.[1] For example, current timeframes for installing traditional DCFC systems are frequently ranging up to 18 months or even longer. Addressing these barriers will be critical for Florida to successfully build out a network of DCFC through the NEVI program. As discussed in the previous response, FreeWire believes that prioritizing innovative technology solutions and business models are one way in which Florida DOT can overcome these barriers.

As detailed in the Federal guidance pertaining to the NEVI program, the pairing of energy storage technologies with DCFC offers a strategy to reduce the installation and operational challenges associated with EV fast charging, including:

- Reducing grid impacts
- Long project development cycles
- Construction costs
- Energy Costs (Demand charges)
- Designing for future EV charging demand

FreeWire therefore recommends the Florida DOT develop a specific strategy in their NEVI plan to prioritize and encourage the adoption of technology innovation such as battery integrated DCFC. Such as strategy could entail one or more of the following concepts:

---

[1] Driving EV Adoption: Program Recommendation for the Next Generation of EV Charging Deployment, FreeWire Technologies, April 22. Available at: https://info.freewiretech.com/hubfs/FreeWire_Driving%20EV%20Adoption_White%20Paper.pdf

- Prioritizing the selection, through solicitation scoring or otherwise, of DCFC + storage projects where electrical and grid upgrades would be avoided and / or project timelines would be expedited
- Providing additional incentives for projects that incorporate energy storage technologies
- Designing specific solicitations for grid constrained areas of the state where energy storage technologies would reduce the infrastructure costs required to install DCFC and expedite project timelines

Finally, an additional barrier unique to Florida is the challenge related to installing and operating DCFC in a manner that will provide reliable and resilient charging service in instances of natural disaster and/or evacuation. We are aware that this has been an issue of focus for the State of Florida as represented through a variety of forums and reports. Not only is the location of DCFC critical to ensure the safe evacuation of EV drivers, but the manner in which DCFC is able to maintain reliable operation during natural disasters and evacuation is also paramount. The pairing of energy storage with DCFC offers a distinct strategy for ensuring that DCFC is up and running during these instances. In the case of FreeWire, beginning in 2023, our Boost Charger will be capable of offering DCFC even in cases of grid outages. We therefore encourage Florida DOT to also prioritize these types of technology configurations under their NEVI plan to help to establish safe and reliable charging to EV drivers during natural disasters and evacuation.

<u>Site Location</u>

4. ***Please describe what you believe makes an ideal DCFC location including amenities as well as any risk factors that should be considered. How would you rank the relative importance of these factors?***

FreeWire's perspective is that ideal DCFC locations fall into at least three distinct categories - EV corridors (i.e., normally highways), destinations, and community hubs (rural, urban, and suburban). Key amenities at DCFC sites include well lit, safe charging stalls (including in some cases covering to protect customers), restrooms, food amenities ranging from in-store and take away, and other services and products of value to the consumer. Amenities not on a site should be within less than one mile of the charging location. Location of the charging service can vary based on the location - but in the case of large-scale deployment on major EV highway corridors the service should typically be located less than 1/2 mile of the major highway interchange.

As stipulated under the NEVI program, each charging location is required to host a minimum of four charging ports capable of simultaneously charging four vehicles at levels up to 150 kW. As a general matter, FreeWire believes that this is an appropriate level for these charging locations. However, FreeWire anticipates that finding suitable sites that can support a minimum of 600 kW will be challenging, especially in rural locations. There may also be sites that do not currently support a three-phase electrical connection and upgrading to this service may be impracticable. We therefore recommend that the Florida DOT request flexibility under the NEVI program to build towards the target of four 150 kW ports every 50 miles along designated corridors and allow for a fewer number of ports to be deployed initially with opportunity to build out. Given the early days of EV fast charging deployment, not all locations and site-hosts will be prepared to make a commitment to installing and maintaining four 150 kW ports.

In addition, focusing on upgrading or expanding existing sites (i.e., adding two new ports to an existing site that currently has two) is also an important strategy for supporting optionality and scalability through the NEVI program. With respect to power levels, we believe that the minimum of 150 kW per port is appropriate given the state of vehicle battery technology. Rather than requiring higher power levels (e.g., 350 kW), states should let the market discover the need and demand for these configurations and to bring forward such proposals as they are discovered and demanded in the market.

5. ***Please describe your process, including market research, land use requirements, and business development opportunities for determining a DCFC site location.***

FreeWire considers a variety of factors when determining site viability. Primary factors include power availability, EV adoption rates, average daily traffic patterns, proximity to other DCFC stations, electricity costs and partnership potential with site hosts, rideshare, fleets, and other commercial entities.

6. ***What do you think the DCFC site of the future looks like? Will location to amenities be as important or will micromobility be used to get to the amenities? What innovations/disrupters are coming?***

FreeWire believes that the DCFC site of the future will comprise a combination of "nose in" and "travel island" solutions that support a variety of vehicle types. Amenities will vary based on location - but will be a range of "rest stop" to advanced convenience/retail stores, while others will be designed to support fleets and commercial drivers. The overall driver experience will continue to become increasingly more "digital" and provide easy access/ordering of charging and non-charging products and services that are pertinent to EV drivers. We also believe that DCFC power solutions will continue to evolve based on the types of EVs being served, including variation of power levels both between sites and within a site that are tailored to address the specific driver’s needs.

<u>Partnerships and Business Models</u>

7. ***Please explain any previous partnerships regarding EV infrastructure your organization has had including which parties initiated the outreach and what, if any, contracting mechanisms were used. These should include public and private entities as well as utility owners***

FreeWire has had a number of partnerships with public and private entities, including both utilities and fuel providers. Of particular note is FreeWire recent partnership with Phillips 66 through which we will partner together to explore and pursue opportunities to deploy FreeWire's Boost Charger throughout the Phillips 66 footprint.[2] In addition to providing unique terms to Phillips 66 retail providers, FreeWire will bring its expertise to bear in help with strategic deployment and operation of DCFC at sites across the country. Our partnership with bp pulse and bp more broadly has also been a strategic partnership for FreeWire through which we have been able to establish unique terms and conditions for site hosts.[3]

8. ***Describe what makes a successful business model and partnership. Also, please describe threats that can lead to a business and partnership's failure. These can be examples from current and/or previous partnerships.***

FreeWire has found that successful business models and partnerships are those that are typically based on shared investment combined with a reasonable rate of return on investment. The major issue at this time in the EV charging market is the ability for a site to be profitable on the transaction of energy given low level of utilization. Without sufficient support or technology solutions to increase levels of profitability, the value proposition with owning and operating DCFC stations is challenging. The other major factor that impacts EV charging business models and partnerships relates to lack of adequate site analysis and lengthy processes related to permitting and interconnection resulting in prolonged deployment timelines.

9. ***Please provide your organization's viewpoints on contracting methods for DCFC infrastructure, including leasing and/or revenue sharing agreements. Have you implemented any cost/revenue sharing models for the operation of DCFC EVSE? If yes, please share what you can about the terms of those partnerships.***

FreeWire is currently pursuing three core contracting and business strategies, which include direct sale and deployment by individual site owners, lease to own models enabling sites to quickly deploy while mitigating out of pocket costs and charging as a service option where capital investment is not currently possible for the site owner. With such a rapidly evolving and scaling market for EV charging, FreeWire believes that each of these options serves a valuable role in the market. We would be glad to provide additional information on our experience with these options and provide an assessment in terms of the viability of each for the Florida market and DOT's objectives and program design for its NEVI program.

10. ***Does Florida have the workforce required to operate and maintain DCFC EVSE charging sites? If not, please describe what you think is required to develop it.***

---

[2] Phillips 66 Taps FreeWire for EV Charging, CSP Daily News, June 23, 2022. Available at: https://www.cspdailynews.com/fuels/phillips-66-taps-freewire-ev-charging

[3] bp pulse and FreeWire Technologies sign exclusive MOU for battery-powered ultra-fast charging in the UK, December 10, 2020. Available at: https://freewiretech.com/bp-pulse-and-freewire-sign-exclusive-mou-for-battery-powered-ultra-fast-charging-in-the-uk/

Under the NEVI program, projects are required to be installed, operated, and maintained by contractors that are certified under Electric Vehicle Infrastructure Training Program ("EVITP") or an equivalent apprenticeship training program that is certified by the Federal Department of Labor. According to the EVITP website, there are 26 contractors that are qualified under this training program to install, operate, and maintain DCFC sites. While it is unclear exactly how active these contractors are in Florida as well as what services they provide, FreeWire and others in the EV charging industry remain concerned about the training requirements stipulated under NEVI.

Specifically, we are concerned that there is not a sufficient workforce available to install the level of charging infrastructure called for under NEVI and that significant training requirements will impede the ability to scale up this workforce to necessary levels. In addition, FreeWire is concerned about the requirement of substantial training and certification and the requirements around master electricians related to the operation and maintenance of DCFC stations, especially in instances where such maintenance is routine or does not require the expertise of certified and trained electricians.

FreeWire and our colleagues in the EV charging industry are concerns that without flexibility around the training requirements under NEVI that the rate of deployment will lag, as will routine maintenance, and that these requirements will unnecessarily increase overall cost. As Florida DOT develops their NEVI program, we encourage engagement of industry stakeholders for deriving an effective and workable workforce development plan that can support the installation and operation of DCFC in all parts of the state.

<u>Equipment</u>

11. On average, how long does it take to install a DCFC from start to finish? This includes site determination, design, permitting, site preparation, utilities, and installation.

For traditional DCFC, the time to install is currently taking upwards of 12-18 months, and in some cases much longer. Upgrading of grid and electrical service, permitting, construction and interconnection are time intensive and frequently cause projects to be delayed. As highlighted previously, given that FreeWire's approach does not require the same amount of electrical infrastructure, FreeWire is able to deploy its Boost Charger much more quickly and is typically able to install within 6 months or less.

In any event, FreeWire believes that state NEVI programs should prioritize shovel ready projects that can be deployed within 6 months. Indeed, the Federal guidance on the NEVI program encourages states to design and implement their program and strategies, related to aspects such as interconnection and permitting, that can support deployment of DCFC within 6 months.

By awarding projects that can demonstrate the ability to achieve commissioning within 6 months of award or in the quickest time practicable, Florida will be able to ensure immediate progress under NEVI, pull forward private investment, and deliver fast charging to drivers sooner. As part of program solicitation, Florida DOT can prioritize shovel ready projects by including project maturity requirements in their selection criteria, such as:

- Confirming sufficient power at the site, and or assess timeline for power needed
- Lead time for proposed project components
- Commitment from site host/owner to meet milestones

12. Are you currently able to meet the requirements of Buy America for DCFC infrastructure projects? If not, please explain your plans to meet the requirements and any potential issues.

FreeWire's Boost Charger is currently compliant with Buy America requirements as stipulated by the Federal Highway Administration ("FHWA"). The total cost of non-domestic steel or iron used in FreeWire's Boost Charger is below the $2,500 threshold stipulated in the FHWA regulations for Buy America. That said, it remains unclear whether modifications will be made Buy Requirements resulting from the Bipartisan Infrastructure Law.

13. Are there any components required for DCFC infrastructure that are in short supply that could delay the goals of the NEVI program? Please describe what steps you have taken or what processes you have implemented to ensure the continuity of your supply chain.

FreeWire's experience is that charging cables and subcomponents that comprise semiconductors are the most constrained in the market. FreeWire would be glad to discuss supply chain issues in more detail with Florida DOT.

14. Please describe how your organization mitigates cybersecurity vulnerabilities. Is this consistent with industry standards? If not, where are the differences? Do you follow national cybersecurity standards including National Institute of Standards and Technology (NIST) Cybersecurity Framework? Do you comply with Florida's 60GG-2 for ensuring the security of your infrastructure? What other technologies do you offer for an end-to-end secured operation?

FreeWire refrains from responding at this time.

<u>Operation, Maintenance and Data Sharing</u>

15. What are your current or planned fee structures (time-based, energy-based, power-based, etc.) and what payment mechanism do you accept? Please explain any issues you have encountered or identified.

FreeWire's Boost Charger is capable of charging vehicles based on time or energy. Boost Charger supports multiple forms of payment to provide site hosts and EV drivers the most options to pay. Boost Charger is equipped with a credit card reader which enables payment by card mag swipe, EMV chip, or contactless payments such as Apple and Google Pay, and all major payment providers are supported. When integrated to an EV charging network, authentication of a Boost charging session can also be made by network RFID card, or via mobile application.

In addition, FreeWire has developed proprietary software, Asset Management Platform ("AMP"), that can be used by a site host to monitor and manage Boost Chargers. AMP can be used in conjunction with or in leu of an EV Network. AMP) enables Boost Charger owners to interact with, configure and track performance of their units in the field. The features available to Boost owners include account management, Boost Charger configuration, customization, performance reporting, and a dashboard to visualize all units.

The Boost Charger's 24" LED touchscreen serves as the point of interaction for drivers and can be customized via FreeWire's AMP software platform. The language displayed on the screen can easily be toggled between English, Spanish, and Japanese. Support for additional languages is available upon request. Station owners also have the ability to customize the content displayed on the touchscreen, creating branding opportunities, or the ability to show coupons or promote products that deliver incremental revenue to the station owner's core business.

In addition, FreeWire supports direct integration of the charger to other existing business programs, such as loyalty programs or point-of-sale systems. Possible integrations range from identifying a driver as a loyalty customer to deliver discounts or target marketing content to the driver, to a complete integration of the charger with the store's POS system to enable all transactions to be processed and recorded in one place, and even control the charger from the in-store terminal. Integration to POS systems requires a modern POS system with a cloud-based architecture (examples include Verifone, NFC Radiant, and Square, among others)

<u>Authentication & Payment Options Supported</u>

- OCPP 1.6 third party network
- Credit Card (Mobile App CC Readers supported: Nayax; Payter)
- RFID
- NFC (Near Field Communication)
- QR code support to be enabled in 2022

16. Describe the typical maintenance for your organization's EVSE infrastructure as well as the maintenance schedule including any required hardware and software updates. Please include the typical lifecycle for your DCFC and what performance measurements are monitored.

FreeWire Technologies, through a network of certified trained technicians provides planned preventative/reactive maintenance services to customer sites. Preventative maintenance is included with FreeWire's 3- and 5-year warranty and maintenance programs.

FreeWire's contractors perform annual preventative maintenance tasks described and in accordance with the following schedule:

Annual Service

- Diagnostics / Inspection
- Input Air Filter Replacement
- Flush Radiator (if needed)
- Inspect Coolant Pump and Replace (If needed)
- Inspect Low Voltage Battery and Replace (If needed)

Year 5 Service (in addition to the above)

- Replace Cooling Pump, 1/3 HP, 120 / 240 VAC
- Replace Battery, Lithium, 25.6V (Low Voltage) 1 Service Technician

Remote Monitoring

- Proactive Monitoring
- Performance Data Analysis & Reporting
- Annual Preventative Maintenance
- Over the Air Software Updates
- 4G/5G LTE Connection

One of the key components of FreeWire's Boost Charger is its 160kWh battery pack. FreeWire has performed rigorous modeling on the expected energy retention of the battery pack and believes the charger will have a useful life of up to 10 years. This is based on the specifics of how Boost's battery pack is utilized, and assumes medium to high utilization of the charger for the entire 10 years. One of the most important factors in the longevity of a battery pack is how quickly it is recharged, and because the Boost Charger's battery pack is recharged at a very slow rate (C = 0.125), the degradation on the pack over a 10 year period is minimal.

17. How would your EVSE share data to a FDOT sponsored central data repository? What type(s) of data can you provide?

Boost Charger is capable of sharing non-proprietary data via a secured network connection. Typical data that we would be able to provide related to charging activity and includes total output power, duration, price/total cost, type of vehicle charged, state of charge (beginning and end) for the EV charged, and output power profiles (i.e., min, max and transition). Boost Charger does not collect any specific personal information of the EV driver

18. What should FDOT do to ensure the end-users of EVSE infrastructure have the most convenient and reliable charging experience? Please include how emergency evacuations and power outages should be addressed.

As previously discussed, FreeWire believes that EV drivers should be provided with ultra-fast charging where and when they demand it, not only where the electric grid is able to accommodate it. Technology and business model innovation is critical to achieving this objective and FreeWire recommends that Florida DOT design their NEVI program accordingly. With respect to emergency evacuations, as mentioned, FreeWire recommends that Florida DOT prioritize and consider the usage of energy storage paired with DCFC in order to fulfill this need.

Strategies for Low Utilization

19. FDOT is looking to provide DCFC in rural and disadvantaged communities that may have a lower return on investment and is interested in how to make these projects more desirable to potential applications. What strategies can FDOT utilize to encourage deployment of DCFC EVSE into rural, underserved, or disadvantaged communities? When answering please include information on driving factors.

- ***a. Guaranteed number of projects for economies of scale***
- ***b. Short term operation and maintenance agreements (5 years or less)***
- ***c. Long term operation and maintenance agreements (longer than 5 years)***
- ***d. Any others?***

As detailed throughout our response to this RFI, FreeWire encourages Florida DOT to explore and prioritize technology and business model innovation in order to improve project economics and open up more locations to DCFC. FreeWire would welcome the opportunity to work with Florida DOT to develop programs and strategy in this regard.

20. To increase utilization rates to rural, underserved, or disadvantages communities what considerations or innovation solutions should be considered?

Please refer to response to Question 19.

Specific Information Requested

Summary of Experience

Please see response to Question 1.

System Block Diagram

Please see Attachments 1 and 1a.

Hardware Information

Please see Attachments 2-5.

Software Information

Please see Attachment 6.

Maintenance Plan

Please see response to Question 16.