Joint Office of Energy and Transportation

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Technical Assistance Case Study

Grid-Constrained Electric Vehicle Fast Charging Sites: Battery-Buffered Options

Introduction

As the build-out of America's electric vehicle (EV) charging network continues, states and other government agencies are learning how to successfully deploy chargers in locations where electric grid capacity is limited. This case study summarizes recent Joint Office of Energy and Transportation (Joint Office) technical assistance work performed by the National Renewable Energy Laboratory (NREL). This assistance involved helping a state department of transportation (DOT) analyze the feasibility of a battery energy storage system solution at a grid-constrained EV charging location.

The Joint Office **provides technical assistance** to stakeholders and programs that seek to deploy a network of EV chargers, zero-emission fueling infrastructure, and zero-emission transit and school buses. For example, Joint Office technical assistance can help evaluate whether a battery-buffered system is appropriate for a proposed EV charging station.

For more information, reach out to DriveElectric.gov/contact.

This case study can help inform states and other stakeholders interested in battery-buffered options to support direct-current fast charging (DCFC) stations in grid-constrained areas. For additional information on battery energy storage systems for EV charging, review the technical assistance help sheet Battery Energy Storage for EV Charging Stations.

Technical Assistance Case Study

Feasibility of a Battery-Buffered Energy Storage System at a Proposed EV Charging Site

A state DOT requested assistance from the Joint Office with evaluating whether the addition of energy storage could make DCFC feasible at a particular site. This site is in an area with significant grid constraints along a designated alternative fuel corridor. The Joint Office connected the state with a subject matter expert at NREL, who performed an analysis evaluating the feasibility of deploying a battery-buffered DCFC to support EV charging at this rural site.

The NREL subject matter expert met with the state DOT leads to better understand the site grid constraints, developed a method for an energy design specification for that site, and provided options for the state to consider when planning for EV charging at grid-constrained locations. This case study summarizes the methodology developed for designing an energy specification, the site limitations and challenges, proposed costs, and potential solutions.

Site Background

At the time of this analysis, an existing DCFC served by the grid at the site had 125 kilowatts (kW) of total output power. However, to meet federal requirements and to ensure an optimal consumer experience, the charging station would need to support four charging ports at a minimum of 600-kW total DC output power. To meet this power requirement, the local utility determined that the proposed charging station would require upgrades to nearby grid service equipment, including construction of a new substation.

Given the substantial upgrades that would be needed, the state DOT wished to consider additional options for this site, including the option to use battery-buffered DCFC. NREL developed an approach to assess whether relying upon a battery energy storage system would be appropriate at the proposed charging station. Major takeaways and recommendations are summarized below.

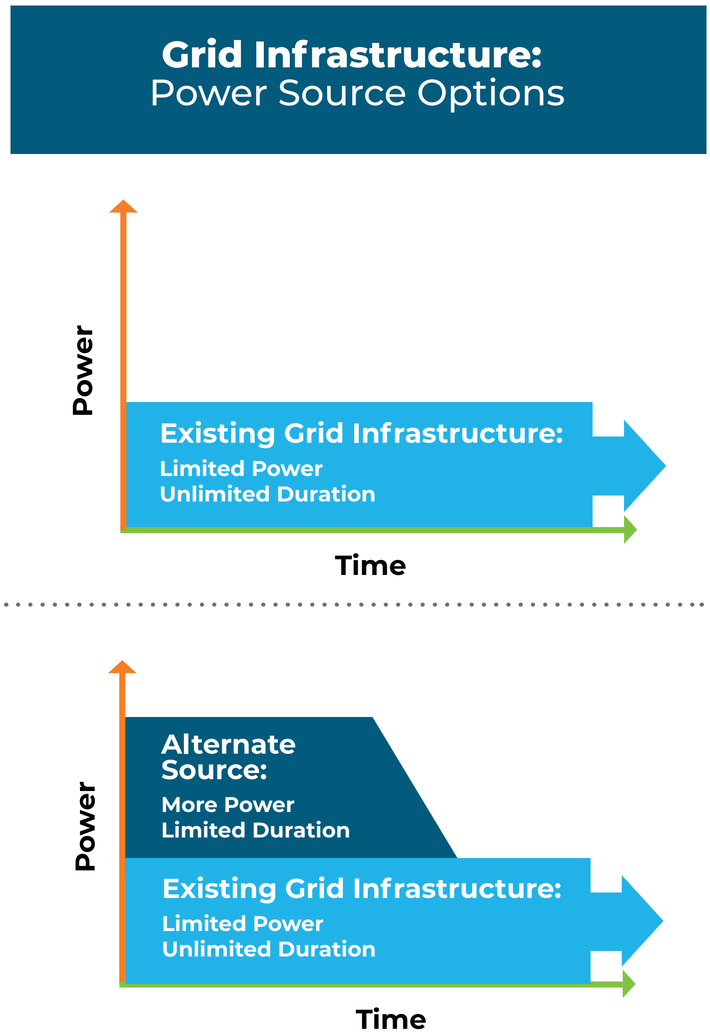
For more explanation on battery-buffered DCFC and other technical terms used in this case study, refer to the Glossary of Key Terms. For additional information on battery energy storage systems supporting EV charging, review the technical assistance help sheet Battery Energy Storage for EV Charging Stations.

KEY TAKEAWAY
A battery-buffered DCFC may offer a path to fast charging deployment while avoiding costly and time-consuming grid infrastructure upgrades.

Existing Grid Infrastructure Limitations at the Site

There are various solutions that can bring power to grid-limited sites—including solar photovoltaics and other on-site power generation. However, the focus of this case study is limited to battery energy storage considerations.

Although the existing grid infrastructure at any site can deliver only limited power (kW) capacity without utility equipment upgrades, it can provide that power indefinitely. A non-grid power source, such as a battery energy storage system, increases the charging power (kW) available at the site but has limited energy (kWh) capacity. The figure below shows how adding an alternate source like a battery energy storage system can provide more power than the grid alone, but only for a limited time (duration).



KEY TAKEAWAY
An alternate power source can help meet power needs at a charging station, but only over a limited period of time.

Project Economics

The local utility estimated that a substation upgrade to allow 600-kW DCFC at this site would cost a site developer about $3 million. Due to the costly nature of these upgrades and the low projected EV charging utilization at this rural location, contractors had little prospect of a return on investment and would be unlikely to bid the project. If other funds were secured to cover substation costs, the lengthy construction timeline of a substation could still have delayed the state's deployment of EV charging infrastructure.

NREL estimated that using battery-buffered DCFC instead of building a new substation for this site had the potential to reduce capital costs by 65%, shorten construction time by 2–5 years, and make the project biddable without additional outside funding.

The incremental cost to add battery energy storage to DCFC may range from $400 to $1,000/kWh.[1]

Estimated Project Cost Comparison

Line Item	Substation Approach	Energy Storage Approach
DCFC	**$1 million**	**$1 million**
Battery system	–	**$0.2–$0.5 million**
Substation (small)	**$3 million**	–
Total project cost *	**$4 million**	**$1.2–$1.5 million**
Timeline	**3–6 years**	**1–2 years**

** Most federally funded programs that support EV charging do not consider grid infrastructure upgrades, such as a substation, as an eligible cost. Some federally funded programs may support energy storage systems as an eligible cost, which can reduce the total project cost.*

KEY TAKEAWAY
A battery-buffered DCFC could make the project economical by reducing overall capital costs, and allow for deployment of the DCFC 2–5 years sooner than would otherwise be possible if making grid upgrades.

Example Method for Energy Specification at Grid-Constrained Sites

This charging station was expected to meet standards for DCFC located along alternative fuel corridors, and support four ports each capable of supplying at least 150 kW, for a total of 600 kW. To help the state DOT evaluate the feasibility of battery-buffered DCFC at this location, NREL developed a method for estimating minimum energy storage capacity needed to provide reasonable assurance that the battery-buffered DCFC would support projected charging demand without running out of stored energy.

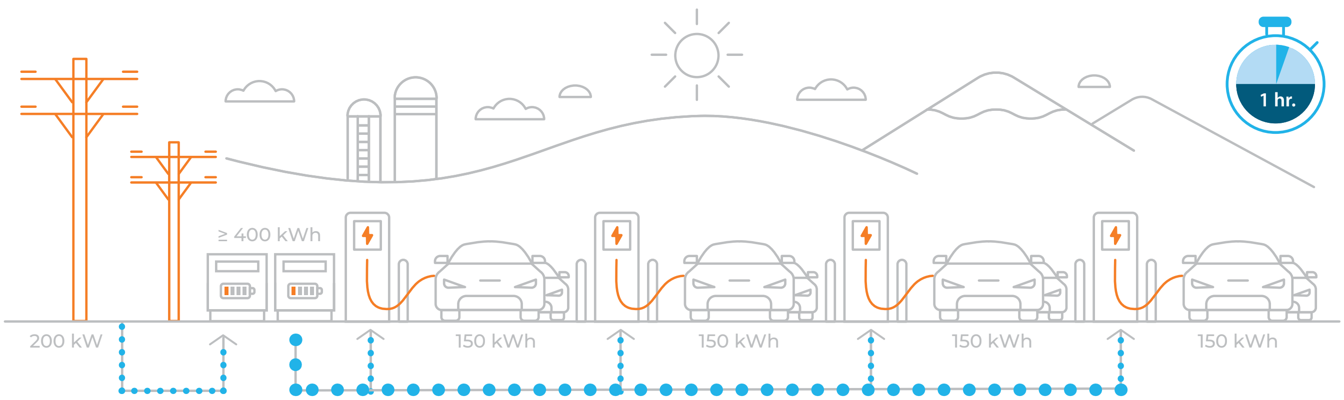
NREL's specified minimum energy storage capacity provides one possible framework to estimate if a battery-buffered DCFC can be reasonably expected to serve motorists without running out of stored energy. To help the state DOT determine if a battery-buffered DCFC would be feasible for the proposed charging station, NREL developed evaluation criteria.

[1] The incremental cost of incorporating a battery into DCFC has not been studied in detail, but battery cell and cabinet costs for a system of this scale would be approximately $350/kWh according to the latest commercial battery storage cost estimates from NREL (**atb.nrel.gov/electricity/2023/commercial_battery_storage**). Publicly available pricing for battery-integrated systems in recent years has indicated about $400/kWh in total incremental cost at the low end.

First Hour and Design Day

NREL developed two criteria to evaluate battery-buffered DCFC —First Hour and Design Day. These criteria provide just one possible method for right-sizing battery-buffered DCFC.

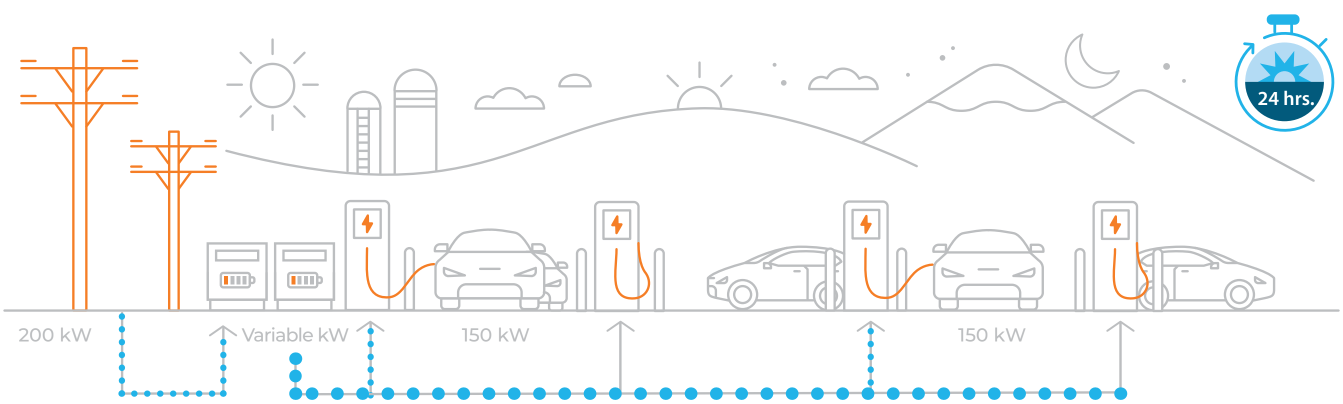
Battery-Buffered Fast Charging: First Hour



.**FIRST HOUR:** Each port at a corridor DCFC should be able to serve either a single vehicle with a large battery or a group of vehicles needing to charge in quick succession. **In the first hour of operation, each port at a charging station should be able to concurrently dispense 150 kWh of energy.** For example, with 30 kW of grid power per port, the grid could supply 30 kWh to each port in the first hour. A battery-buffered DCFC would therefore need at least 120 kWh of energy storage per port to provide 150 kWh from each port in the first hour of charging.

- As of 2024, all existing or announced consumer EVs can recharge to at least 80% state of charge under normal circumstances with 150 kWh.
- Manufacturers of battery-buffered DCFC offer product configurations that can provide 150 kWh in the first hour.

Battery-Buffered Fast Charging: Design Day



DESIGN DAY: The Design Day is the heaviest day of charging energy demand that the station is intended to serve without interruption to service due to a depleted battery—for example, the 99th percentile day in 2030. The selection of an appropriate Design Day is crucial for right-sizing an energy storage system. To reliably meet charging demand on the Design Day and recharge itself, the battery-buffered DCFC must achieve two things:

1. Have available grid power equal to or greater than the average Design Day charging demand.
2. Have enough energy storage to support periods when charging demand exceeds the power available from the grid.

While many other methods could be used to estimate Design Day charging demand, NREL used EVI-RoadTrip model outputs for this location, yielding a total design day average demand of 68 kW, equivalent to a total of 1,632 kWh dispensed on the design day, or between about 32 and 80 charging sessions.

- To receive free technical assistance with estimating future charging demand for a particular site or group of sites, submit a request to the Joint Office to receive free technical assistance at **driveelectric.gov/contact.**

KEY TAKEAWAY
Meeting the first hour criterion and selecting an appropriate design day can help in right-sizing an energy storage system to support fast EV charging.

As part of this technical assistance performed for the state DOT, NREL simulated fast charging operation at varying levels of grid power and vehicle charging demand. NREL determined that with 125 kW available from the grid and 68 kW average Design Day charging demand, a battery-buffered DCFC should be provided with at least 480 kWh of energy storage at this site. NREL's simulation yielded a series of tables that can be used to determine minimum battery-buffered DCFC energy storage capacity for various pairings of Design Day vehicle charging demand and grid capacity (Appendix: Reference Tables). Key assumptions are noted in (Appendix: Technical Considerations). Further detail is available upon request at driveelectric.gov/contact.

Potential Solutions When a Battery-Buffered System Alone is Insufficient

Conventional DCFC requires a grid connection that can support the peak charging power that the charging station can deliver to vehicles. A battery-buffered system needs much less grid capacity, but still must be provided with enough power to support at least the average charging power delivered to vehicles over the course of the Design Day. The battery will discharge to meet above-average vehicle charging demand, but grid capacity must be sufficient to allow the battery to replenish itself during periods of low vehicle charging demand. In the case of this site, existing grid infrastructure was sufficient to make battery-buffered DCFC a workable solution.

Sometimes the existing grid infrastructure at a site cannot support even the average Design Day vehicle charging demand, meaning that energy storage alone will not be sufficient to serve vehicle charging. In these cases, several strategies may be feasible to ensure that the battery can be recharged, either by increasing battery charging capacity or decreasing design day average demand.

STRATEGY 1
Add other electricity generation resources on-site to supplement grid power.

STRATEGY 2
Build more sites nearby on the corridor to reduce Design Day charging demand at the constrained charging station.

STRATEGY 3
Use the existing grid infrastructure as an interim solution, but **plan to upgrade grid infrastructure** before the target design day.

NREL's method for evaluating energy storage at fast charging stations enabled this state to find a workable specification for a battery-buffered DCFC at this grid-constrained site. By comparing projections of location-specific charging demand forecasts to NREL's design criteria, the state was able to understand the feasibility of proposed energy storage systems at several locations. The results of NREL's work are a set of criteria and reference tables that can help with evaluating the feasibility of battery-buffered DCFC. The reference tables and a discussion of NREL's methodology can be found in the Appendix: Reference Tables.

After working with the Joint Office technical assistance team, the state is moving forward with using battery-buffered systems at several DCFC stations. The state is also considering adding on-site electricity generation to supplement existing grid infrastructure.

Glossary of Key Terms

Important terms used throughout this help sheet are defined below.

Average design day charging demand: The total energy in kilowatt-hours consumed over a 24-hour design day divided by 24.

Battery-buffered fast charging: An EV fast charging station that relies upon a battery energy storage system to dispense energy to vehicles. A battery-buffered system is dependent on its battery to enable the charging station to achieve higher simultaneous power output to vehicles than would be possible with the site's utility service alone.

Charging port (port): The system within a charger that charges one EV. A charging port may have multiple connectors, but it can provide power to charge only one EV through one connector at a time. See afdc.energy.gov/fuels/electricity_stations.html for more information on charging stations, ports, and connectors.

Design Day: The heaviest day of charging energy demand that the station is intended to serve without interruption to service due to a depleted battery (e.g., the 99th percentile day in a target future calendar year). Many different methodologies and tools exist for estimating future EV charging demand.

First Hour: One hour of concurrent vehicle charging from all ports at a battery-buffered DCFC, starting with a fully charged energy storage system.

Kilowatt: A measure of power equal to 1,000 watts, which is roughly the power of a typical household toaster.

Kilowatt-hour (kWh): A measurement for electricity use. A measure of electricity defined as a unit of work or energy, measured as 1 kW (1,000 watts) of power expended for 1 hour. Light-duty EVs can typically go 2–4 miles using 1 kWh.

Utilization: In this document refers to "energy-based" or "infrastructure maximization-based" utilization of an EV charger. This is a measure of how much energy is dispensed to vehicles by an EV charger relative to the maximum energy that the charger could have dispensed over that time given its power capacity. For example, a 200-kW DCFC that dispenses 2,400 kWh in 24 hours has 50% utilization for that period.

Appendix: Technical Considerations

The following considerations were compiled and used to help develop the analysis performed for the state DOT.

Considerations	NREL's Analysis
Port power output	NREL's specification was created for 150-kW ports. • **Corridor ports with less than 150-kW DC output capacity** need *less energy storage* for any given amount of grid power. • **Corridor ports with more than 150-kW DC output capacity** *may* need *more energy storage* at any given amount of grid power. For sites that are limited by the first hour criterion, higher-power ports should not require more energy storage. Because charging power is limited by the vehicle acceptance rate as well as the port power, higher-power ports are less likely to be fully utilized, so increases to energy storage needs would not necessarily be proportional to increases in port power, even at a site with high utilization.
EV charge acceptance rates	NREL's analysis assumed a future condition in which EVs charge at an average of 150 kW through each charge cycle. • While many EVs in 2024 cannot achieve an average of 150 kW through a typical fast charging cycle, enough vehicles can achieve this rate to make it a reasonable assumption for edge-case planning purposes, particularly for a future state. • Many DCFC allocate power dynamically between ports such that the site energy output can remain at an average of 150 kW per port even when one or more vehicles are requesting less than 150 kW.
Charging load shape	• NREL's analysis is based upon data from the EV WATTS project. • NREL chose a selection of data that approximates the utilization curve of many corridor fast chargers, which typically see charging demand that peaks in the afternoon and early evening hours. • Some locations with utilization that has a less dramatic afternoon peak may be able to operate effectively with less energy storage per port.

Appendix: Reference Tables

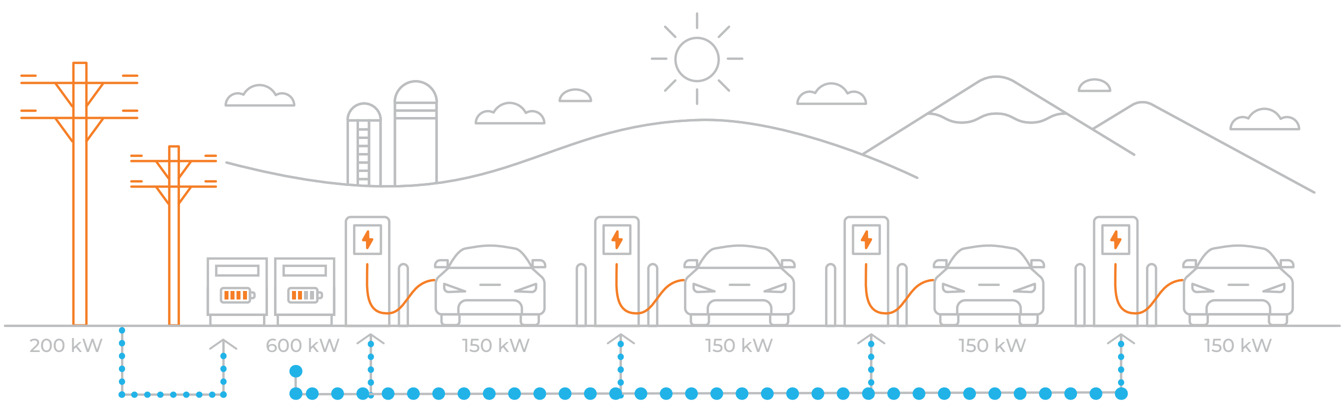
The following tables provide recommended minimum energy storage (kWh) capacity for a corridor charging station with 150-kW DCFC at combinations of power grid-supported power (kW) and Design Day average demand (kW).

When all ports have access to a pool of stored energy, this pooling allows for the most efficient utilization of power grid capacity. This document refers to this scenario as a “pooled” system. In contrast, “separate” systems have a dedicated energy storage system for each port, requiring more energy per port to ensure that no individual port fully depletes its battery. Each table cell contains kilowatt-hour values for a pooled system (e.g., “480”) and separate systems (e.g., “155*4”).

The proposed charging station in this case study consisted of four 150kW ports with 125kW (DC) available from the power grid to charge the battery. The total average Design Day kW DC for the site was 68kW.

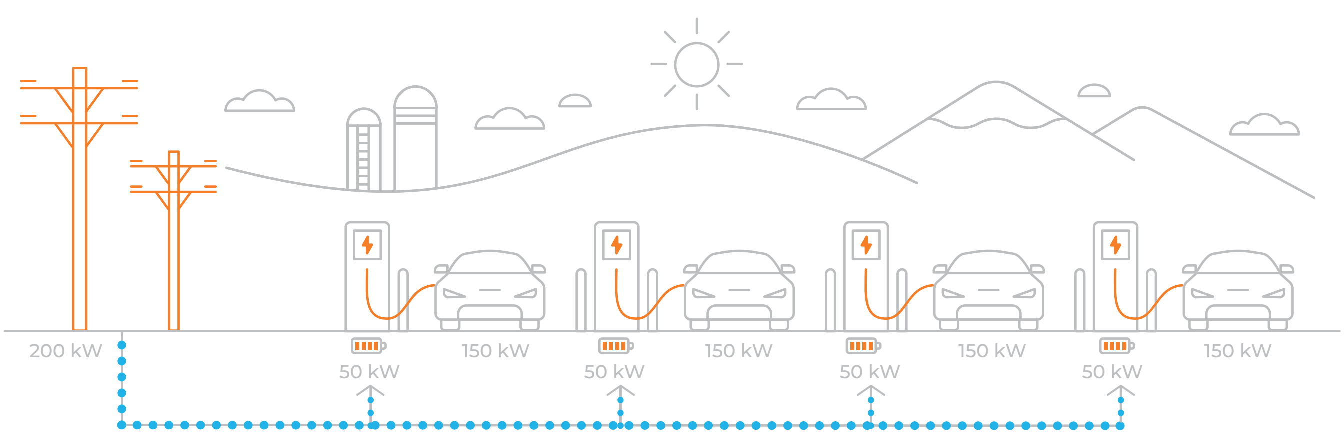
Battery-Buffered Fast Charging: Pooled Systems

All ports have access to a pool of stored energy



Battery-Buffered Fast Charging: Separate Systems

Separate systems have a dedicated energy storage system for each port



Four-Port Corridor Site

Minimum Recommended Energy Storage Capacity (kWh) [**Pooled System** or Separate Systems]

Design Day Utilization (%)		10%	13%	17%	20%	23%	27%	33%	40%
Design Day Energy Need (kWh)		1,440	1,920	2,400	2,880	3,360	3,840	4,800	5,760
Design Day Average Charging Demand (kW)		60	80	100	120	140	160	200	240
Existing Grid Capacity at Site (kW DC)	**520 or** 130×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4	**80 or** 20×4
	480 or 120×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4	**120 or** 30×4
	440 or 110×4	**160 or** 40×4	**160 or** 40×4	**160 or** 40×4	**160 or** 40×4	**160 or** 40×4	**160 or** 40×4	**160 or** 50×4	**160 or** 55×4
	400 or 100×4	**200 or** 50×4	**200 or** 50×4	**200 or** 50×4	**200 or** 50×4	**200 or** 50×4	**200 or** 50×4	**200 or** 70×4	**200 or** 95×4
	360 or 90×4	**240 or** 60×4	**240 or** 60×4	**240 or** 60×4	**240 or** 60×4	**240 or** 60×4	**240 or** 65×4	**240 or** 90×4	**360 or** 135×4
	320 or 80×4	**280 or** 70×4	**280 or** 70×4	**280 or** 70×4	**280 or** 70×4	**280 or** 70×4	**280 or** 95×4	**280 or** 135×4	**580 or** 200×4
	280 or 70×4	**320 or** 80×4	**320 or** 80×4	**320 or** 80×4	**320 or** 80×4	**320 or** 100x4	**320 or** 130×4	**460 or** 190×4	**880 or** 280×4
	240 or 60×4	**360 or** 90×4	**360 or** 90×4	**360 or** 90×4	**360 or** 105×4	**360 or** 135×4	**360 or** 170×4	**740 or** 270×4	**1,280 or** 385×4
	200 or 50×4	**400 or** 100×4	**400 or** 100×4	**400 or** 110×4	**400 or** 145×4	**400 or** 185×4	**560 or** 240×4	**1,120 or** 365×4	
	160 or 40×4	**440 or** 110×4	**440 or** 110×4	**440 or** 150×4	**440 or** 200×4	**640 or** 265×4	**940 or** 340×4		
	140 or 35x4	**460 or** 115×4	**460 or** 130×4	**460 or** 180×4	**560 or** 240×4	**840 or** 315×4			
	120 or 30×4	**480 or** 120×4	**480 or** 155×4	**480 or** 220×4	**760 or** 295×4				
	100 or 25×4	**500 or** 130×4	**500 or** 190×4	**660 or** 265×4					
	80 or 20×4	**520 or** 160×4	**560 or** 235×4						
	60 or 15×4	**540 or** 205×4							

Transportation Demand Scenarios

Existing Grid Capacity at Site (kW DC)

Minimum Recommended Capacity (kWh)

Five-Port Corridor Site

Minimum Recommended Energy Storage Capacity (kWh) [**Pooled System** or Separate Systems]

Design Day Utilization (%)		10%	13%	17%	20%	23%	27%	33%	40%
Design Day Energy Need (kWh)		1,800	2,400	3,000	3,600	4,200	4,800	6,000	7,200
Design Day Average Charging Demand (kW)		75	100	125	150	175	200	250	300
Existing Grid Capacity at Site (kW DC)	**650 or** 130×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5	**100 or** 20×5
	600 or 120×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5	**150 or** 30×5
	550 or 110×5	**200 or** 40×5	**200 or** 40×5	**200 or** 40×5	**200 or** 40×5	**200 or** 40×5	**200 or** 40×5	**200 or** 50×5	**200 or** 55×5
	500 or 100×5	**250 or** 50×5	**250 or** 50×5	**250 or** 50×5	**250 or** 50×5	**250 or** 50×5	**250 or** 50×5	**250 or** 70×5	**250 or** 95×5
	450 or 90×5	**300 or** 60×5	**300 or** 60×5	**300 or** 60×5	**300 or** 60×5	**300 or** 60×5	**300 or** 65×5	**300 or** 90×5	**450 or** 135×5
	400 or 80×5	**350 or** 70×5	**350 or** 70×5	**350 or** 70×5	**350 or** 70×5	**350 or** 70×5	**350 or** 95×5	**350 or** 135×5	**725 or** 200×5
	350 or 70×5	**400 or** 80×5	**400 or** 80×5	**400 or** 80×5	**400 or** 80×5	**400 or** 100×5	**400 or** 130×5	**575 or** 190×5	**1,100 or** 280×5
	300 or 60×5	**450 or** 90×5	**450 or** 90×5	**450 or** 90×5	**450 or** 105×5	**450 or** 135×5	**450 or** 170×5	**925 or** 270×5	**1,600 or** 385×5
	250 or 50×5	**500 or** 100×5	**500 or** 100×5	**500 or** 110×5	**500 or** 145×5	**500 or** 185×5	**700 or** 240×5	**1,400 or** 365×5	
	200 or 40×5	**550 or** 110×5	**550 or** 110×5	**550 or** 150×5	**550 or** 200×5	**800 or** 265×5	**1,175 or** 340×5		
	175 or 35×5	**575 or** 115×5	**575 or** 130×5	**575 or** 180×5	**700 or** 240×5	**1,050 or** 315×5			
	150 or 30×5	**600 or** 120×5	**600 or** 155×5	**600 or** 220×5	**950 or** 295×5				
	125 or 25×5	**625 or** 130×5	**625 or** 190×5	**825 or** 265×5					
	100 or 20×5	**650 or** 160×5	**700 or** 235×5						
	75 or 15×5	**675 or** 205×5							

Transportation Demand Scenarios

Existing Grid Capacity at Site (kW DC)

Minimum Recommended Capacity (kWh)

Six-Port Corridor Site

Minimum Recommended Energy Storage Capacity (kWh) [**Pooled System** or Separate Systems]

Design Day Utilization (%)	10%	13%	17%	20%	23%	27%	33%	40%
Design Day Energy Need (kWh)	2,160	2,880	3,600	4,320	5,040	5,760	7,200	8,640
Design Day Average Charging Demand (kW)	90	120	150	180	210	240	300	360
Existing Grid Capacity at Site (kW DC)								
780 or 130×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6	**120 or** 20×6
720 or 120×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6	**180 or** 30×6
660 or 110×6	**240 or** 40×6	**240 or** 40×6	**240 or** 40×6	**240 or** 40×6	**240 or** 40×6	**240 or** 40×6	**240 or** 50×6	**240 or** 55×6
600 or 100×6	**300 or** 50×6	**300 or** 50×6	**300 or** 50×6	**300 or** 50×6	**300 or** 50×6	**300 or** 50×6	**300 or** 70×6	**300 or** 95×6
540 or 90×6	**360 or** 60×6	**360 or** 60×6	**360 or** 60×6	**360 or** 60×6	**360 or** 60×6	**360 or** 65×6	**360 or** 90×6	**540 or** 135×6
480 or 80×6	**420 or** 70×6	**420 or** 70×6	**420 or** 70×6	**420 or** 70×6	**420 or** 70×6	**420 or** 95×6	**420 or** 135×6	**870 or** 200×6
420 or 70×6	**480 or** 80×6	**480 or** 80×6	**480 or** 80×6	**480 or** 80×6	**480 or** 100x6	**480 or** 130×6	**690 or** 190×6	**1,320 or** 280×6
360 or 60×6	**540 or** 90×6	**540 or** 90×6	**540 or** 90×6	**540 or** 105×6	**540 or** 135×6	**540 or** 170×6	**1,110 or** 270×6	**1,920 or** 385×6
300 or 50×6	**600 or** 100×6	**600 or** 100x6	**600 or** 110×6	**600 or** 145×6	**600 or** 185×6	**840 or** 240×6	**1,680 or** 365×6	
240 or 40×6	**660 or** 110x6	**660 or** 110x6	**660 or** 150×6	**660 or** 200×6	**960 or** 265×6	**1,410 or** 340×6		
210 or 35×6	**690 or** 115×6	**690 or** 130×6	**690 or** 180×6	**840 or** 240×6	**1,260 or** 315×6			
180 or 30×6	**720 or** 120×6	**720 or** 155×6	**720 or** 220×6	**1,140 or** 295×6				
150 or 25×6	**750 or** 130×6	**750 or** 190×6	**990 or** 265×6					
120 or 20×6	**780 or** 160×6	**840 or** 235×6						
90 or 15×6	**810 or** 205×6							

Transportation Demand Scenarios

Existing Grid Capacity at Site (kW DC)

Minimum Recommended Capacity (kWh)

Eight-Port Corridor Site

Minimum Recommended Energy Storage Capacity (kWh) [**Pooled System** or Separate Systems]

Design Day Utilization (%)		10%	13%	17%	20%	23%	27%	33%	40%
Design Day Energy Need (kWh)		2,880	3,840	4,800	5,760	6,720	7,680	9,600	11,520
Design Day Average Charging Demand (kW)		120	160	200	240	280	320	400	480
Existing Grid Capacity at Site (kW DC)	**1,040 or** 130×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8	**160 or** 20×8
	960 or 120×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8	**240 or** 30×8
	880 or 110×8	**320 or** 40×8	**320 or** 40×8	**320 or** 40×8	**320 or** 40×8	**320 or** 40×8	**320 or** 40×8	**320 or** 50×8	**320 or** 55×8
	800 or 100×8	**400 or** 50×8	**400 or** 50×8	**400 or** 50×8	**400 or** 50×8	**400 or** 50×8	**400 or** 50×8	**400 or** 70×8	**400 or** 95×8
	720 or 90×8	**480 or** 60×8	**480 or** 60×8	**480 or** 60×8	**480 or** 60×8	**480 or** 60×8	**480 or** 65×8	**480 or** 90×8	**720 or** 135×8
	640 or 80×8	**560 or** 70×8	**560 or** 70×8	**560 or** 70×8	**560 or** 70×8	**560 or** 70×8	**560 or** 95×8	**560 or** 135×8	**1,160 or** 200×8
	560 or 70×8	**640 or** 80×8	**640 or** 80×8	**640 or** 80×8	**640 or** 80×8	**640 or** 100×8	**640 or** 130×8	**920 or** 190×8	**1,760 or** 280×8
	480 or 60×8	**720 or** 90×8	**720 or** 90×8	**720 or** 90×8	**720 or** 105×8	**720 or** 135×8	**720 or** 170×8	**1,480 or** 270×8	**2,560 or** 385×8
	400 or 50×8	**800 or** 100×8	**800 or** 100×8	**800 or** 110×8	**800 or** 145×8	**800 or** 185×8	**1,120 or** 240×8	**2,240 or** 365×8	
	320 or 40×8	**880 or** 110×8	**880 or** 110×8	**880 or** 150×8	**880 or** 200×8	**1,280 or** 265×8	**1,880 or** 340×8		
	280 or 35×8	**920 or** 115×8	**920 or** 130×8	**920 or** 180×8	**1,120 or** 240×8	**1,680 or** 315×8			
	240 or 30×8	**960 or** 120×8	**960 or** 155×8	**960 or** 220×8	**1,520 or** 295×8				
	200 or 25×8	**1,000 or** 130×8	**1,000 or** 190×8	**1,320 or** 265×8					
	160 or 20×8	**1,040 or** 160×8	**1,120 or** 235×8						
	120 or 15×8	**1,080 or** 205×8							

Transportation Demand Scenarios

Existing Grid Capacity at Site (kW DC)

Minimum Recommended Capacity (kWh)

Photo from Getty Images 91768461

How Can Joint Office Technical Assistance Help?

The Joint Office provides technical assistance to a multitude of stakeholders and programs that seek to deploy a network of EV chargers, zero-emission fueling infrastructure, and zero-emission transit and school buses. Joint Office technical assistance can help evaluate whether a battery energy storage system is appropriate. Contact us at DriveElectric.gov/contact and review the Joint Office technical assistance case study Grid-Constrained Electric Vehicle Fast Charging Sites: Battery-Buffered Options to learn more.

Joint Office of Energy and Transportation

The Joint Office of Energy and Transportation is a collaboration between the U.S. Department of Energy and U.S. Department of Transportation to support the buildout of a nationwide network of EV chargers, zero-emission fueling infrastructure, and zero-emission transit and school buses.

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