Electric School Bus Guidebook

Guide 3: Charger Purchasing

NEW YORK STATE | NYSERDA
Clean Transportation

The range of ESB chargers offers flexibility to determine how, when, and where ESBs are charged.

This chapter of the *Electric School Bus Guidebook* answers these questions:

- What does the term "EVSE" mean?
- What are the different types of ESB chargers?
- Which charger models are currently available?
- Which types of chargers should I purchase?
- What additional services are available to help with charger operations and maintenance?
- What are the different procurement methods to use with capital funding?
- What are the different financing methods?

Key Activities

Initial actions you can take after reading this chapter include:

- Identify the charger(s) that meet your needs.
- Select a procurement strategy.
- Contact your utility to discuss your infrastructure plan.

Electric Vehicle Supply Equipment Definition

Electric Vehicle Supply Equipment (EVSE) – The term "EVSE" encompasses all the equipment that helps an electric school bus (ESB) charge, including vehicle chargers and mounting systems, charging cables, and communications hardware.

EVSE Components and Terminology

When converting to electric school buses, having access to a facility with charging stations is imperative. These charging stations are often located where the vehicle is stored overnight. A bus depot or bus maintenance facility with charging capability will typically have the following components:

Transformers – Electrical devices that change electricity from one level, or voltage, to another. You may hear the term 'step-up' or 'step-down' transformer, which typically changes the voltage of the electrical service that is delivered to your facility to match that needed to charge your buses.

Access to an electric grid – An interconnected network for delivering electricity that will go to your charging stations and ultimately be delivered to your ESB's battery. In rare cases, 'closed-loop' or 'microgrid' set ups can be used where power is generated and delivered onsite or by a nearby, standalone system. However, these set ups are often also connected to the electric grid for redundancy.

Charging meter – Similar to a home electric meter, a charging meter will be used to record the amount of power flowing through a circuit to calculate your electric bill.

Charging stations – A physical station where ESBs are parked and charged. The charging station is made up of the charger and the charging port, which can be co-located or separated based on the layout of the site. The ESB will be parked in a location that is accessible to the charging port.

Level 2 chargers can be wall mounted to minimize footprint. An example installed in Croton-Harmon UFSD is mounted in the garage with a cut-through so buses can be charged inside and outside the maintenance garage.

Credit: Highland Electric

Electric School Bus Charger Types

Level 2 Chargers – Level 2 chargers provide ESBs with lower speed charging at a moderate cost. Level 2 charger loads are limited to approximately 19 kW. An ESB battery pack generally runs between 120 kWh and 210 kWh capacity. Assuming this capacity range, a Level 2 charger should take between 6 and 11 hours to fully recharge a battery. Charge time can be calculated with the following formula: Charge needed (kWh) / Charger power (kW) = Hours of charging time.

Level 3 Chargers – Level 3 chargers, also known as DC fast chargers (DCFCs), provide significantly faster charge speeds but at a higher cost than Level 2 chargers. Most Level 3 chargers require that your site has, or is upgraded to, 3 phase, 480V power. It is important to reach out to your utility in advance to determine whether your site will need upgrades to install chargers – both Level 2 and Level 3 chargers can trigger site and grid upgrades before installation. Level 3 charging loads typically range from 30kW to 350 kW, though current ESB models can only charge up to 125kW. Assuming an ESB battery pack size between 120 kWh and 210 kWh capacity (as in the above example) and a 50kW charger, a DCFC charger should take between 2.5 and 4 hours to fully recharge an ESB battery, with shorter charge times for higher speed chargers.

Although DCFCs can charge a vehicle faster, they are not necessarily needed for all school bus operations. The charger type you select will depend on your operating schedule. Level 3 chargers are best used in scenarios with long routes (routes where the mileage is close to the vehicle battery's expected range, or has challenging characteristics, such as steep hills and extended cold weather periods) and in which buses need to be charged midday between morning and afternoon routes. They can also be valuable to quickly charge buses if for some reason a bus did not fully charge overnight. Ask your ESB dealer and charger manufacturer for assistance in choosing the correct chargers based on your operations.

The table below compares the specifications of Level 2 and Level 3 (DCFC) chargers.

Connecting with your Utility

Establishing a relationship with your electric utility early is an important step to efficiently transitioning your fleet to electric school buses. When you are ready to reach out, be sure to have information on your existing fleet and fleet operations at the ready. The Joint Utilities of New York (JU) provide a Fleet Assessment Questionnaire that is a useful resource for collating this information (even if you are not a customer of one of the Joint Utilities). As you progress through the fleet transition planning process, you will need to share updates with the utility about the quantity and types of chargers you intend to use and when you intend to charge (i.e., your 'charging plan'), and your utility will be able to provide more specific information on the utility- and customer-side equipment and upgrades that may be needed to accommodate your charging plan.

Comparison of Level 2 and Level 3 (DCFC) Charger Specifications

Category	Level 2	Level 3 (DCFC)
Voltage	208V / 240V	480V
Charger Speed	up to 19 kW	30 kW to 125 kW
Charge Time for a 150kWh battery	6–11 hours	1–5 hours

Charger Models Currently Available

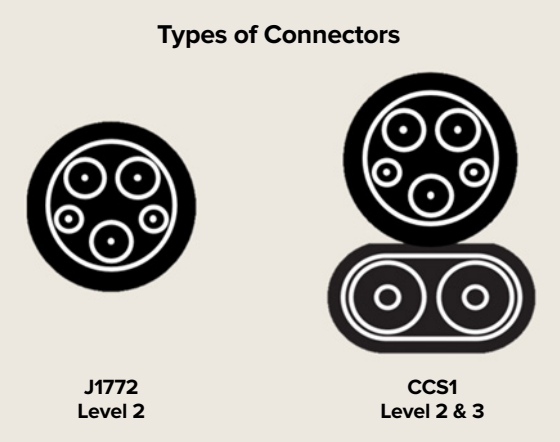
A list of currently available Level 2 and Level 3 (DCFC) charger models (from National Grid's Upstate NY Qualified EVSE List) can be accessed in the Additional Resources section below. In addition, the U.S. EPA's ENERGY STAR® program publishes and regularly updates a list of ENERGY STAR-certified electric vehicle chargers (see "Additional Resources" below).

Charger compatibility – It is essential that you confirm EVSE compatibility with your ESB and EVSE manufacturer prior to EVSE acquisition. Most U.S. ESB models come equipped with a J1772 or CCS1 charging port. However, charger cable types and ESB ports are not standardized across ESBs. It is imperative that the charge port on the ESB matches the charger cable type on the EVSE. Ask your EVSE manufacturer and ESB dealers to confirm that the vehicle and charger use the same standard.

Level 2 charging and Level 3 (DCFC) charging can use different charger cable connector types. The location and the connector port type vary based on the make and model of the ESB. The Level 2 charger cable connector is called J1772. The Level 3 (DCFC) charge port is called a CCS1 charge port and encompasses the Level 2 (J1772) charging port, with two additional contacts directly below with enhanced networking capabilities.

An additional consideration is that some ESB networking and software components are unable to communicate with certain EVSE networking and software components. It is possible (but rare) to acquire EVSE that fits the bus charging port but does not communicate with, and therefore does not charge, your ESBs. You will need to confirm the compatibility of networking and software components prior to EVSE acquisition.

Networking – Networked chargers are connected to the internet and can be managed with charge management software while non-networked chargers cannot be. Networked chargers are more complicated to install and require internet at the installation site. Level 2 chargers are available as networked and non-networked devices. Level 3 (DCFC) chargers are available only as networked devices. Networked chargers allow for data collection, energy management and demand response, payments, remote troubleshooting, reservation systems, advertising and other application add-ons.



Cable management – The location of ESB charge ports and the length of charging cables vary by ESB model. An ESB's charge port location will impact where your EVSE should be installed. Level 2 chargers are typically available as either wall- or pedestal-mounted units, whereas DCFC units have a much larger footprint and are typically sited on the ground. Charging unit location will impact bus parking. Cable management is important, because a cable that is too short can make parking more challenging, while a cable that is too long might be run over by drivers. More details about cable management arefound in the Virginia Clean Cities fact sheet in the Additional Resources section below.

Vehicle-to-grid capability – Vehicle-to-grid, or V2G (sometimes also referred to as 'bidirectional charging'), supplies electricity from the ESB battery to the grid. V2G can be used during demand charge times when electricity prices are high; the ESB can then pull energy from the grid when electricity prices are lower. V2G can lower electricity costs for the operator by generating revenue from putting power back into the grid during peak times under demand response programs or New York's Value of Distributed Energy Resource tariff. To use V2G, you will need additional hardware, software, and a V2G capable bus and charger. You should assume that a charger is not V2G capable unless it is noted in the specifications sheet. Ask your charger manufacturer about V2G capable charging options and your ESB manufacturer about V2G bus capabilities. In addition, V2G programs are often utility-run and you should check with your utility to determine if programs are available in your area prior to selecting V2G capable equipment or work with your charging manufacturer and operator to determine if V2G operation is feasible.

This bus depot in Maryland shows pedestal mounted and overhead dispenser chargers. Overhead dispensers can be used when a roof structure is present to minimize the chargers' footprint. Source: Mobility House

Determining Charger Purchases

The type of charger you should purchase depends on:

- Your current needs and future fleet plan.
- Your site's available electrical service.
- Your vehicles' duty cycles.

This table provides a comparison of Level 2 and Level 3 (DCFC) chargers.

Comparison of Level 2 and Level 3 (DCFC) Chargers

Category	Level 2	Level 3 (DCFC)
Charge Time	Slower, overnight	Faster, during mid-day dwell time or overnight
Installation difficulty	Easy	More complex
Electricity Draw	Medium	High to very high
Cost	Inexpensive	More expensive
Maintenance	Low to medium	Medium to high
Footprint Size	Small to none (wall- or pedestal-mounted units)	Larger (floor units)
Can be managed remotely?	Yes, certain models	Yes
Potential V2G capability	Yes, but less common	Yes

Operations and Maintenance Services

Charger maintenance – Charger maintenance and repair can be managed by the fleet operator, the charger manufacturer as part of a warranty service, or as part of a fully managed fleet service (see Guide 2: ESB Purchasing for more information about fully managed feet services). Routine maintenance of EVSE includes storing cables securely, examining EVSE components for wear and tear regularly, and maintaining a clean charging station. Routine maintenance for charging equipment is often minimal. Repairing broken chargers and additional hardware, when needed, can be costly and time consuming. It is important to review and compare equipment warranty options and maintenance contracts with EVSE manufacturers and charging operators prior to selecting maintenance partners and equipment and operations (E&O). Charger uptime includes response time from the manufacturer or repair technician, parts availability and delivery, and repair time. When purchasing chargers, it is important to review manufacturer warranties, establish responsibility for repairs, and determine a plan in case of a long-term charger outage.

Managed charging – Charge management software is available to complement your ESB chargers. Managed charging can reduce costs by helping to ensure that your fleet is charging off-peak when electricity demand and rates are lower. It can help stagger or schedule charging to avoid drawing too much electricity from the grid at any given time. Charge management software can be purchased either from the charger manufacturer or from a separate company as "charger-agnostic" software. Charger-agnostic software is helpful if you plan to have chargers from a variety of manufacturers or do not want to commit to one charger manufacturer long-term. There are companies that can manage your fleet charging and guarantee a certain level of charge each morning. Many of these companies can also manage participation in V2G programs.

Credit: Highland Electric

Procurement Methods with Capital Funding

School districts have several procurement options to purchase EVSE. The method a district selects may depend on its procurement requirements, the number of chargers it plans to purchase, and any desired add-ons, such as maintenance services or charge management software.

Quote/Purchase Order

A simple approach to procuring EVSE is to reach out to a manufacturer or sales representative and request a quote for the model and specifications you would like to procure. A school district would need to follow their procurement guidelines around purchasing thresholds and number of quotes needed. If a district chooses to move forward with a quote, then it would provide a purchase order to the manufacturer or company selected.

Office of General Services: EVSE and Network State Contract

The New York State Office of General Services (OGS) Procurement Services maintains a contract (EVSE and Network Services, Award Number: PGB-23035) that school districts can use to purchase EVSE and network services at a pre-established price from a list of approved contractors. OGS will have only one provider on contract until a new contract is awarded. OGS is also working to provide access to the Sourcewell Master Contract #042221 which runs through July 2025 and includes up to 11 contractors. Purchasing from the State contract list can save school districts the step of having to seek quotes or competitive solicitations for EVSE procurement. The list of EVSE models and sales contacts can be found in the Additional Resources section. Reach out to your district procurement staff or to OGS for guidance on how to use the OGS state contract.

Office of General Services: Piggybacking Contract

The New York State Office of General Services (OGS) Procurement Services has a Piggyback Contract for EVSE, network services, and installation. Using this contract can satisfy the typical procurement process requirements for competitive bidding and therefore streamline the procurement process for the piggybacking school district. A school district might choose this option over the State contract if the pricing and/or terms and conditions are more favorable. For more information on piggybacking, refer to OGS's NYS Piggybacking Guide in the Additional Resources section below.

EVSE and State Aid

In Spring 2023, the New York State Education Department (SED) sought clarification from the Division of Budget on how electric vehicle supply equipment and chargers would be covered by State Aid. SED developed a Q&A document that provides answers to key questions including what aid source should be used to fund zero-emission bus charging, and, what charging station installation expenses are approved. The document also provides a ZEB Aid Estimator which school officials can use, along with their 'aid ratio' and 'non-allowable pupil decimal' to determine what their local share of EVSE costs would be. School officials will also need estimates for equipment and installation costs to use the estimator. Estimates can be determined with help from an engineering contractor and your utility provider. Reach out to NYSERDA at schoolbus@nyserda.ny.gov for more information on receiving Technical Assistance.

Request for Proposal

A school district can choose to issue a Request for Proposals (RFP) for EVSE purchases. This approach makes sense if the district is seeking to purchase EVSE for a larger number of buses, looking for assistance with charge or fleet management, or is seeking a vendor for assistance with the ESBs as well. An RFP typically provides more details about the school district's project, including information about the project scope, charging infrastructure needed (including speed and quantity of chargers), and services requested. It may also include ESB specifications (including range requirements and/or battery capacity needs) if the RFP will include buses as well. Reach out to your district procurement staff for more information and guidance on using this procurement method. Guidelines for EVSE RFP development can be found in the Alternative Fuel Data Center's EVSE RFP Guidelines in the Additional Resources section below.

Students from Croton-Harmon School District on their inaugural ride of the District's first electric school bus.

Cooperative Purchasing

With cooperative purchasing, multiple school districts can work together to purchase EVSE under a single contract. This method enables districts to increase their purchasing power and reduce the amount of time and effort spent on procurement. Cooperative purchasing can result in improved pricing and more favorable terms and conditions, but may require all participating entities to agree on similar EVSE specifications.

Financing Methods

The procurement methods discussed above are typically used by school districts when districts have capital and/or incentive funding available to put towards the purchase. School districts that lack upfront capital or that would prefer to spread out costs by financing them over time can use the financing methods described below. These contract types can also be used by districts who would prefer to externalize the ownership, operation, and/or maintenance of chargers and associated infrastructure.

As-a-service contracts

With as-a-service contracts, also known as fleet-as-a-service or electrification-as-a-service contracts, school districts pay a monthly or annual fee to a provider that finances and manages the district's transition to electric school buses. This approach enables school districts to treat the costs of electric school bus adoption as an ongoing operating expense rather than a capital expense. As-a-service models also allow school districts to transfer the responsibility of ESB and EVSE procurement, installation, and in some cases operation, onto another party (i.e., the "as-a-service contractor"). The as-a-service contractor will typically leverage its experience and buying power to provide school districts with some or all of the following: electric school buses, chargers and charging infrastructure, utility interconnection, managed charging, and/or operational services. As-a-service providers can often provide this equipment and services at a lower total cost of ownership over time than the school district would be able to do on its own. Ongoing costs to the school district vary based on the number of buses, the number of chargers, additional services needed, and ownership.

NY Green Bank

NY Green Bank is a New York State-sponsored investment fund that helps finance projects that advance clean energy within the state. NY Green Bank can provide financing for electric school bus projects (including EVSE). To apply, submit a response to NY Green Bank's open RFP at any point throughout the year. Visit NY GreenBank to apply.

Additional Resources

Alternative Fuel Data Center — Developing Infrastructure to Charge Electric Vehicles – A general 101 overview of EVSE and electric vehicle charging by the Alternative Fuel Data Center.

AFDC's RFP Guidelines – An RFP Guideline for any district or operator that is interested in putting out an RFP to procure EVSE.

CALSTART's ESB Network Charger Selection Working Group Slide Deck – The slide deck from CALSTART's ESB Network Working Group focuses on topics related to charger selection.

CALSTART's Infrastructure Insite Tool – A tool that guides users through the infrastructure development process, recommends the appropriate equipment, and provides cost and time estimates.

ENERGY STAR's Certified Electric Vehicle Chargers – A complete list of ENERGY STAR certified EVSE products including Level 2 and Level 3 chargers.

National Grid's Upstate New York Qualified EVSE List – Also available here under "EV Equipment List." This is a list of National Grid's approved EVSE with short descriptions of each option.

NY Green Bank's Open Solicitation – NY Green Bank's open solicitation page seeking proposals and input from qualified parties for both investment opportunities and procurement needs. All investment activities are driven by transactions proposed through open solicitations. Information about all current solicitations—including details on submission—is available on this page.

OGS's Electric Vehicle Supply Equipment and Network Services – A list of EVSE models that have been approved by the State of New York and their respective prices under the NYS Contract. The list also provides approved dealers and their contact information.

OGS's Electric Vehicle Supply Equipment and Network Services (Statewide Piggyback) – A piggybacking contract scope that sets forth the terms and conditions governing acquisitions under this Piggyback Contract for use by school districts.

OGS's NYS Piggybacking Guide – A guide to piggybacking in New York State. OGS publishes official information on how to piggyback, including the forms needed and how to submit the request.

School Transportation News: What You Need to Know about ESB Charging Infrastructure – An article from School Transportation News on EVSE, including a useful list of Key Tips.

USTA's EV Charging Speeds – A succinct description of Level 1, 2 and 3 chargers, along with connector types and power outputs

Virginia Clean Cities' ESB Projects Planning for Charging Stations at Your Facilities – A guide to cable management co-authored by VEIC and Virginia Clean Cities.

VEIC's Electric School Bus Charging Station Planning Considerations – A slide deck from Mid-Atlantic ESB Experience Project and VEIC about ESB charger options. Includes pros and cons of different charger types.

VEIC's Working with Your Utility to Electrify your School Bus Fleet – A guide from VEIC about how to work with your utility company to electrify your school bus fleet.

WRI's 3 Design Considerations for ESB V2G Programs – A guide to help determine if it's worth it to include V2G- capable charging equipment.

WRI's Power Planner for ESB Deployment – Nine key steps for school districts to take to prepare for and engage in discussions with electric utilities about the electrification of school bus fleets, including EVSE considerations.

WRI School Bus Electric-as-a-Service (EaaS) Directory – This directory includes firms that offer services that can aid school districts in the transition to ESB fleets. The directory characterizes the firms according to the services they can provide as well as their geographic reach.