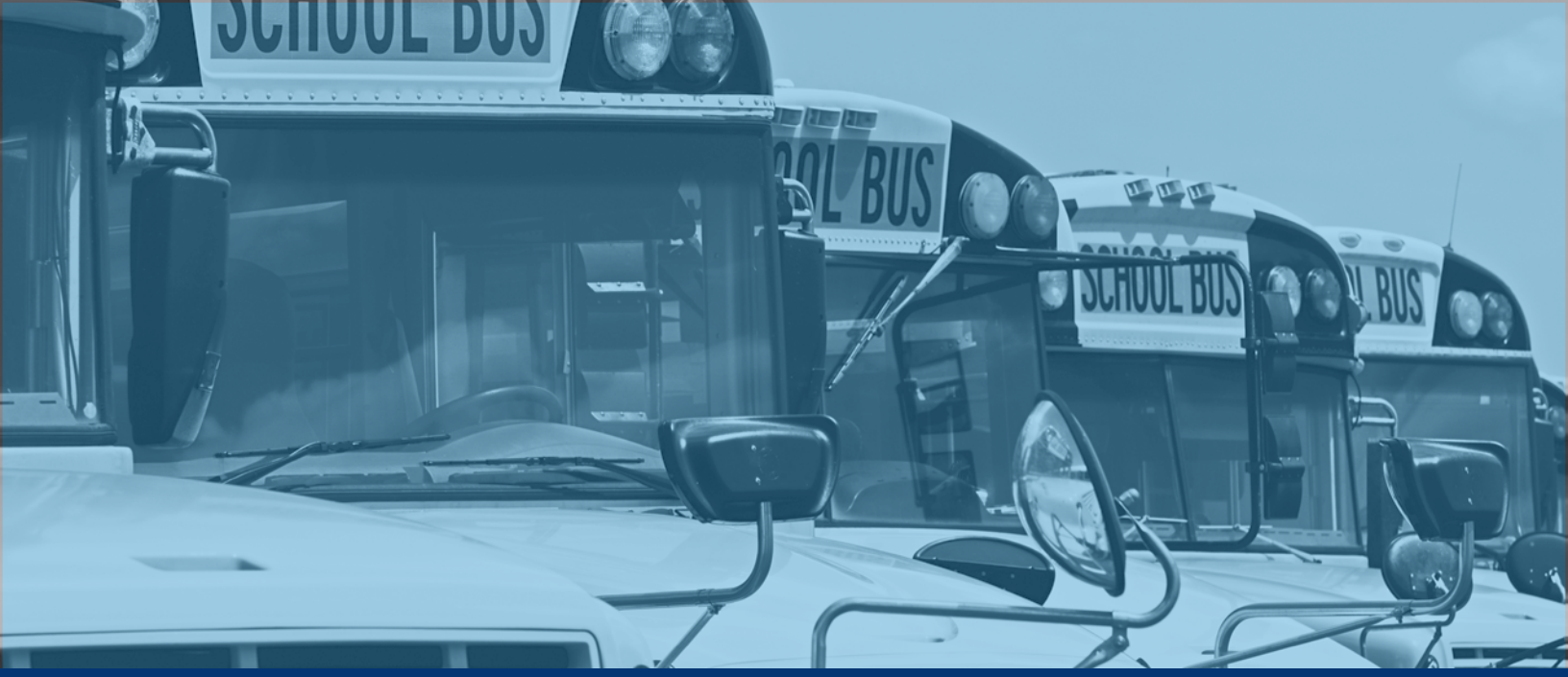

Electric School Bus Guidebook

Guide 6: Site Planning

NEW YORK STATE | NYSERDA

Site planning is a crucial step when electrifying your school bus depot.

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

- What equipment and infrastructure are required to charge ESBs?
- What information should I compile before contacting my utility about a site assessment?
- What information does a utility assessment provide?
- How do I install chargers at my depot?

Electric School Bus Charging Equipment and Infrastructure Overview

Properly installed and commissioned charging infrastructure is necessary for effective, reliable ESB operation. *Guide 3: Charger Purchasing* focuses on the chargers themselves. This chapter focuses on additional aspects of charging infrastructure equipment and installation. Charging infrastructure includes hardware, electrical upgrades, associated construction costs, and controlling software.

Transition Planning

Transitioning an entire school bus fleet to ESBs is a big undertaking. It is important to take the following initial steps to develop a plan to meet the transition requirements:

- **Gather current fleet data.**
- **Conduct a Utility Assessment.** Your utility provider is an essential part of your transition to ESBs. You will need to include them in your planning process as early as possible.[1] Establish a working relationship with your utility provider and have them perform a Utility Assessment.
- **Develop a Fleet Electrification Plan.** A Fleet Electrification Plan (also referred to as Fleet Transition Plan) is a comprehensive evaluation of existing fleet operations, analysis of current site electrical capabilities, and a plan for electrifying the entire fleet to ESBs by 2035. The plan will serve as a guide, or action plan, that identifies and prioritizes recommendations to assist fleets with making informed decisions. Typically, this plan is developed by, or in partnership with, an engineering contractor.

Key Activities

Initial actions you can take after reading this chapter include:

- Compile initial information about your school bus fleet and available funding.
- Contact your local utility early and arrange for a detailed Utility Assessment as soon as possible to determine necessary charging infrastructure upgrades.
- Contact NYSERDA to get assistance developing a Fleet Transition plan.
- Familiarize yourself with the steps required to install charging infrastructure at your depot(s).

[1] *Note: The address of your depot or planned charging location will determine who provides electrical service. If it is an existing facility, your Facilities Director should be able to provide this information from an existing utility bill. If unsure, the federal NEVI U-finder resource may be helpful https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fdriveelectric.gov%2Ffiles%2Fnevi-u-finder.xlsx&wdOrigin=BROWSELINK.*

Current Fleet and Depot Data

When preparing to install charging infrastructure you will need to answer some important questions. NYSERDA and your ESB dealer are resources that can help you answer the following questions:

Fleet-Related Questions

- What is the total number of buses currently in the fleet?
- What are the current buses' operational schedules and routes?
- What is the replacement schedule for these buses?
- Have you selected specific ESB models?
- What chargers are compatible (and available) with your selected ESB models?

Site-Related Questions

- Do you have a preferred site for charging your buses? Do you have any other sites available if your preferred site is not feasible?
- Have you determined, with your utility provider, what capacity upgrades are needed to charge buses at your site?
- Have you determined the space necessary to install new chargers?
- Are any site modifications necessary, such as relocating existing infrastructure?
- Have you reviewed NYSED guidance about project planning and permitting processes?
- Will the buses fit in the parking spaces with the chargers installed with appropriate clearance?

Charging Infrastructure-Related Questions

- Have you reviewed available charging options and costs (e.g., Level 2 vs. DC Fast Charging systems, use of Charge Management Systems)?
- Have you confirmed compatibility between your preferred buses and preferred chargers (Refer to *Guide 3: Charger Purchasing* and check with your bus dealer)?
- Have you confirmed the appropriate charger power for your ESBs (Refer to *Guide 2: ESB Purchasing*)?
- Will the charging cables reach the buses' charging ports?

Funding-Related Questions

- Have you identified potential funding sources for charging infrastructure installation?
- Have you applied for funding, or do you plan to apply soon?
- Do you have existing funding for a specific number of buses and chargers?
- Have you reviewed NYSED's PDF documentation on eligible State Aid costs?

Utility Assessment

Before finalizing specifications and purchasing your chargers, it is important you work with your utility provider to complete an assessment of how much additional electrical capacity is required for different levels of charging demand. Providing your utility provider with your current fleet data will help the utility to outline the overall equipment needs, upgrades, and costs to meet the required demand. It is highly recommended that you complete this utility engagement as part of the Fleet Electrification Plan process. That way you can give the utility provider a more accurate and complete picture of your fleet electrification process (including the timing of adding buses, the maximum power needed to charge over time, and if any demand-reducing tools such as Charge Management Software are being utilized). If you have more than one site where you are considering installing chargers, your utility provider may also give a comparative analysis and help determine which site would offer the most economical investment.

Your utility provider may determine that updates are required on the Utility-Side and Customer-Side of the electrical meter as shown in Figure 1. Utility-Side infrastructure upgrades may include a new transformer and additional electrical service capacity. Required upgrades on the Customer-Side usually include a modified or additional circuit breaker or main service panel with upgraded wiring, and new conduit to protect the upgraded wiring. In some cases, a step-up or step-down transformer, which increases or decreases electrical voltage, may be needed on the Customer-Side to ensure the voltage from the Utility-Side matches that required by the chargers.

The design, delivery, and construction of these upgrades can take several months and vary based on the size of your project and the specific equipment you may require. A phased approach to purchasing ESBs may be recommended so that power capacity can align with anticipated power demand increases (refer to Phasing Plan. Where Utility-Side upgrades appear to make a project infeasible, it is recommended to explore other locations for charging infrastructure and/or consider spreading chargers across other sites (such as school buildings).

WRI Case Study – Three Rivers Community Schools, MI

WRI profiled Three Rivers Community Schools (Three Rivers) in Michigan to learn from a school district operating in extreme cold weather conditions, with 152 ESBs committed. Three Rivers established a collaborative relationship with their utility by communicating early and often. Three Rivers brought their utility's engineers in for a site visit prior to purchasing equipment and met regularly with their utility representatives for two years to ensure both sides were on the same page.

Timely and effective communication with your utility is critical to successful ESB adoption, especially given the long lead times for both customer-side and utility-side upgrades.

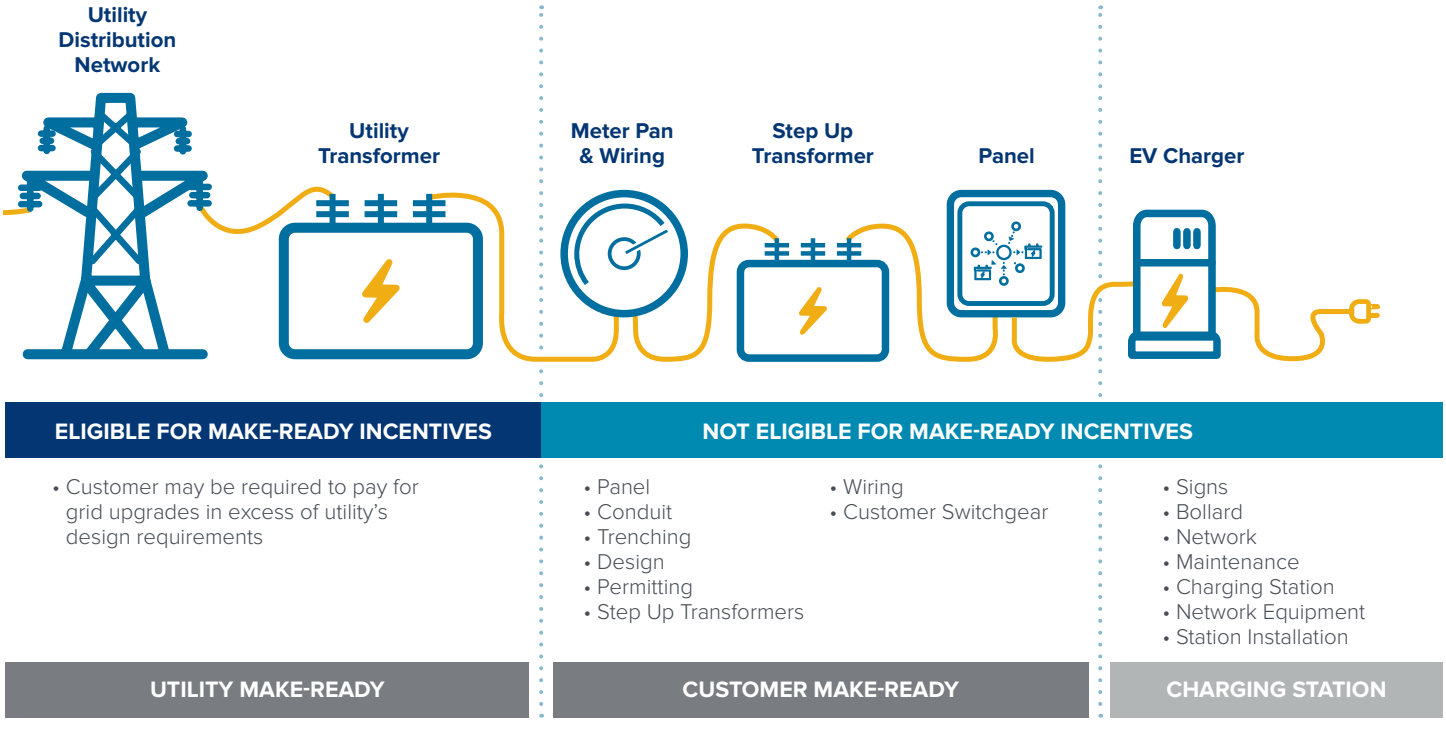

Figure 1: Electrical distribution diagram for ESB charging equipment and infrastructure.

Funding Site Upgrades

Each of the independently-owned utilities in New York[2] has its own EV "Make-Ready" program that can help cover Utility-Side "Make-Ready" infrastructure costs. For more information, individual utility contacts, and program eligibility, visit the Joint Utilities of New York's EV Make-Ready Program website.[3]

There are additional funding programs like the EPA's Clean School Bus Grant, which allow fleets to use awards for some Customer-Side Infrastructure equipment or installation costs such as design, engineering, labor, installation, additional hardware, and charger permitting. Refer to *Guide 4: Financial Incentives* for additional information.

Fleet Electrification Plan

A Fleet Electrification Plan is an action plan that identifies and prioritizes recommendations that will assist in the decision-making process of an ESB transition. Fleet Electrification Plans generally include Route Analysis, Conceptual Charging Strategy, Electric Utility Analysis, and Phasing Plans. The Route Analysis component of a Fleet Electrification Plan is covered in *Guide 5: Electric School Bus Routing and Range Requirements*.

Conceptual Charging Strategy

The goal of a Charging Strategy is to ensure ESBs will be adequately charged for daily routes, while minimizing infrastructure upgrades and charging costs. Your Charging Strategy will depend on your site capacity, number of ESBs, charger power rating, overall power demand and electricity rates, and any additional charger components, such as network and vehicle-to-grid (V2G) capabilities.

It is recommended that fleets consider purchasing network capable chargers. Networked chargers are connected to the internet, which enables them to receive software updates and certain maintenance repairs remotely. Additionally, networked chargers can be controlled using charge management software, which helps fleets reduce costs by ensuring ESBs are charging off-peak, when electricity demand and rates are lower, and stagger or schedule charging to avoid drawing too much electricity from the grid at any given time. There are companies that can manage your fleet charging and guarantee a certain level of charge each morning. Refer to *Guide 3: Charger Purchasing* for more information about charger components and manage charging.

NYSERDA Fleet Electrification Plan Assistance

NYSERDA provides technical assistance for school districts in developing ESB Fleet Electrification Plans through the P-12 Clean Green Schools Initiative and FlexTech Program. NYSERDA works with engineering contractors to provide school districts with an assessment that determines the requirements to conform to the 2027 and 2035 ESB transition requirements. NYSERDA also provides a sample Statement of Work outlining the components and steps needed to complete a Fleet Electrification Plan. A case study detailing this process is included at the end of this chapter.

Example – Charging Strategy Calculation

If your utility provider determines that your site's capacity is limited to a 1,000 kW maximum available load and you have 50 ESBs to charge simultaneously, you will have to limit your power level to the 19.2 kW drawn by standard Level 2 Chargers for each bus, making your maximum power demand 50 x 19.2 kW, or 960 kW (less than the 1,000 kW available). If your contractor determines that higher power charging is needed, your utility provider will need to make infrastructure upgrades to bring additional power to the site.

[2] *Central Hudson, Con Edison, National Grid, NYSEG, Orange & Rockland, and Rochester Gas & Electric*

[3] *Not every school bus fleet owner will have access to these programs. PSEG-Long Island Customers should monitor the Make-Ready Incentive Program page.*

Phasing Plan

A Phasing Plan combines the necessary capital works projects, ESB procurement schedule, and charger installation requirements that are needed for a phased approach to the transition. Each phase should include cost estimates for Utility- and Customer-Side infrastructure upgrades, the number of ESBs and chargers to acquire, as well as a comparison of operating costs.

Resilient Charging Systems

Extreme weather, natural disasters, and technical failures can pose a threat to your charging infrastructure. Before finalizing your Phasing Plan, consider ways to improve the resiliency of your fleet charging systems by considering the following options:

- **Mobile charging**. Consider investing in a mobile charging system. These systems are available from multiple vendors and can be deployed on short notice to provide roadside and fast charging for stranded ESBs with depleted batteries.
- **Additional chargers.** As you electrify additional school buses it is advisable to have one or more spare chargers installed in case a charger goes out of service.
- **Battery storage/on-site generation.** A spare source of electrical power such as a battery storage system or microgrid can provide operational resiliency in case of a power outage.

Futureproofing

Physically moving chargers in the future, even by a few feet, might require expensive construction such as pavement demolition, trenching, and repaving. If you are planning a multi-phase project, you can save time and money in the future if your site is designed to accommodate your current and future electrification needs. For example, oversizing the electric meter, wiring, and conduit during the first phase of installation saves time and money in future phases. To this end, ensure your project manager, engineering contractor, utility provider, and/or a charging service company are in communication during the initial design.

Charging Infrastructure Installation Process

Before, during, or after Utility-Side infrastructure upgrades have taken place, Customer-Side infrastructure equipment and installation can begin, generally following these steps:

Step 1 – Obtain Required Permits

You may need to obtain building, electrical, and/or environmental permits before initiating electrical upgrades and construction activities. These permits are often required by local authorities to ensure compliance with safety and other standards. Your utility provider and NYSED can help you identify the relevant permitting agencies and points of contact. This process may take a few weeks to several months to complete.

New York State Education Department Permitting Procedures

1. Regardless of funding source, any work that requires a permit from NYSED's Office of Facilities Planning (OFP) must be submitted for review, approval, and the permit issued prior to the work being bid. The process begins with submission of a Letter of Intent. Refer to OFP's main page for submission procedures. Projects will not enter the review queue until receipt of a physical copy of the paperwork, as well as paper or electronic submission of drawings and specifications which are 100% bid-ready.
2. Projects utilizing State Aid require the Transportation Aid eligible components be submitted under a separate project number for accounting purposes. To learn more about the division of Transportation Aid and Building Aid for Charging infrastructure projects, refer to the NYSEDA's Zero Emission Bus Charging Infrastructure: State Aid Q&A.

Review times for OFP permits vary throughout the year, but typical ranges are listed on NYSED's website. Make sure to allow for sufficient time to receive a permit prior to bidding since Education Law requires that bidding shall not occur before NYSED approval. Also factor in additional time for delivery, processing, and OFP Fiscal Associate review.

Step 2 – Procure Equipment

Contact charger manufacturers and charge management companies to obtain information about available charger models and manage charging systems to meet your needs. This process can be completed in a few weeks. For more information on how to select your chargers, refer to *Guide 3: Charger Purchasing*.

Step 3 – Perform Upgrades and Install Equipment

Prepare and issue a request for quotes (RFQ) from licensed electricians and qualified construction contractors with prior experience working with EV charging systems to conduct the necessary Customer-Side infrastructure upgrades. (Please refer to WRI's Electric School Bus Initiative's model RFP). Your RFQ should provide details about all project requirements, schedule, and key operational deadlines (e.g., work must be completed over summer break when schools are not in session). The fleets are responsible for confirming all Utility- and Customer-Side upgrades are accurately specified.

Once Customer-Side infrastructure upgrades are made, it is time to hire an electrician to install the chargers. Some charger manufacturers have their own installers. If opting for a different installer, look for an electrician certified by the Electric Vehicle Infrastructure Training Program (EVITP) to perform the upgrades. An EVITP-certified electrician will be familiar with local codes and necessary permits. (See the EVITP's Find a Contractor webpage for further details.) This step may take between a few weeks to several months to complete, depending on the complexity of the work, the availability of qualified local labor, and any equipment supply chain bottlenecks.

Step 4 – Testing and Commissioning of Chargers

Once your chargers are installed, they must be tested and commissioned by an EVITP-certified electrician, but only after Utility-Side infrastructure upgrades are complete. This step is needed to ensure that the charger(s) is set to the correct amperage and voltage for your site and that it can properly communicate with any necessary servers. The charger manufacturer and/or contractor will arrange for this testing. Commissioning may take a few days to several weeks to complete, depending on how many chargers are installed and the complexity of the charging system overall. It is important to test the charging system and bus functionality together.

Step 5 – Operational Testing

Operators will often test run chargers and ESBs on routes for days or weeks before putting them into regular service. This testing period allows operators to become familiar and comfortable with the new technology and associated operational changes.

Sweet Home Case Study – Fleet Electrification Plan

Sweet Home Central School District (Sweet Home) elected to prepare for the NYS transition to all ESBs by developing a Fleet Electrification Plan that would provide the district with the planning tools and flexibility necessary to ensure a seamless transition by 2035. In September of 2022, Sweet Home Central Schools contracted with Wendel through NYSERDA's P-12 Clean, Green Schools Initiative program, to receive technical assistance in developing a Fleet Electrification Plan. The Fleet Transition Plan included Route Analysis, Utility Analysis, Conceptual Charging Strategy, and Phasing Plan. The Route Analysis completed as part of this project is covered in *Guide 5: Electric School Bus Routing and Range Requirements*. Sweet Home's full Electrification Plan is available in the Additional Resources section below.

Utility Analysis - National Grid, Sweet Home's Utility, conducted a feasibility study, which determined that Sweet Home's site capacity is 7.5 MW, with 3.93 kW available load. When all 67 buses are electrified, Sweet Home will require 4.7 kW of additional power, which is 0.8 kW more than they currently have. To supply the additional power that Sweet Home needs, a new service feed and additional transformer must be installed. Up to 90% of the Utility-Side costs could be covered by National Grid's Make-Ready Program, with Sweet Home paying the remainder, since Sweet Home is purchasing buses through the New York Truck Voucher Incentive Program (NYTVIP).

Conceptual Charging Strategy - The goal of the Charging Strategy was to determine the smallest available Charger that meets the district's route needs. The Charging Strategy identified:

- Number, types, and sizes of Chargers required to charge the fleet in the allotted time frames
- Anticipated peak demand during both on-peak and off-peak utility periods.
- Optimum Charger size and configuration – 1-to-1 or 1 Charger to many ESBs

Wendel's Charging Strategy for Sweet Home focused on charging for long periods of time at low charging speeds, with a 1:1 ratio of Chargers to ESBs. Wendel recommended that Sweet Home utilize sixty (60) of the Proterra 60kW Chargers and seven (7) 120 kW Chargers to charge their 67 ESBs. The Proterra 60 kW Chargers were selected because most of the ESBs utilize a Proterra drive train and battery system, which should limit issues between the ESB and Charger manufacturer. The Chargers were also chosen because they are V2G capable, which could help the school generate revenue in the future. See *Guide 3: Charger Purchasing* to learn more about V2G technology.

Phasing Plan - Wendel recommended a phased approach, based on a projected bus procurement plan, which shows the anticipated ESB purchases each year leading up to the 2035 deadline to transition their fleet.

ESB Procurement Schedule

	Existing	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Procured	0	0	3	8	9	9	8	6	6	6	4	4	4	0	**67**
Fleet Size	0	0	3	11	20	29	37	43	49	55	59	63	67	67	**67**

Based on the projected ESB procurement schedule, Wendel recommended a phased approach to Charger Installation so that power capacity could align with Sweet Home's anticipated power demand increases. The phasing plan includes work to be done and the cost estimate of each phase.

Phase	Estimated Costs	Description
ESBs Procured	$960k	Temporary charging phase for the three ESBs that were awarded to Sweet Home from NYTVIP. This phase requires a new 400A panel board and 150 kW FreeWire wireless Charger.
Phase 4 (optional)	$5.5M	This is the most robust of the four phases because it futureproofs for the following phases. New National Grid service required, primary cable trench from new service to power distribution equipment, power feeds, fire protection upgrades, and charging equipment required (32 – 60 kW Chargers, 2 – 120 kW Chargers)
Phase 4 (optional)	$2.2M	Additional power feeds and Charger equipment required (20 - 60 kW Chargers)
Phase 4 (optional)	$840k	Additional power feeds and Charger equipment required (8 - 60kW Chargers)
Phase 4 (optional)	$1.2M	Additional power feeds and charging equipment required (5 -120 kW Chargers)
Total Project Estimate		**$10.7 Million**

Today, Sweet Home has started implementing their Fleet Electrification Plan. They have applied for 4 Thomas Built Buses through the NYS Truck Voucher Incentive Program, which will be delivered in early 2024. Phase 0, the temporary charging phase, is underway. Sweet Home expects to have the ESBs and EVSE in operation for the 2024-2025 school year.

Additional Resources

The World Resource Institute's Power Planner for Electric School Bus Deployment provides resources to help fleets coordinate with utilities in preparation for school bus electrification.

The Alternative Fuel Data Center's Infrastructure Planning and Solutions Module includes webinars on topics such as "Determining Charging Needs and Selecting a Charger," "Installation Considerations," and "Interconnection Challenges and Solutions."

EVITP's "Find a Contractor" webpage provides a list of EVITP-certified contractors in New York State for installing EVSE.

The Joint Utilities of New York's EV Make-Ready Program Website lists all New York State make-ready programs, provides websites and contacts, includes a make-ready program overview, and provides information about how to apply.

The World Resources Institute's profile of Three Rivers Community Schools in Three Rivers, Michigan provides a case study of a school district effectively deploying over 152 ESBs.

NYSED's Office of Facilities Planning provides an Instruction Guide for Public School Districts and BOCES Obtaining Building Permits for Capital Construction Projects.

The World Resources Institute's Electric School Bus Initiative Model Request for Proposal provides a template for school districts and contractors to use when going out for bid for a range of products and services related to school bus electrification.

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