# V2X Implementation Guide

## Implementation Guide and Mutual Aid Agreement Template for Using Vehicle-to-Everything-Enabled Electric School Buses as Mobile Power Units to Enhance Resilience During Emergencies


Electrification Coalition

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Electric School Bus INITIATIVE

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## Executive Summary

Our increasingly digital society and a transition toward a more electrified transportation future will require electric system infrastructure to be more reliable, resilient, and robust. The expected rise over time in extreme weather events as well as in cybersecurity and physical security threats that are projected to lead to more widespread and extended power outages also will require enhanced adaptation and resilience of the United States' electric system.

Electric school buses (ESBs) equipped with Vehicle-to-Everything (V2X), or bidirectional charging capability, can serve as "mobile power units" to provide backup power to emergency shelters and other critical facilities, enhancing much-needed infrastructure resilience and aiding in emergency planning, preparedness, and response efforts. Given that underserved communities often are hit the hardest by extreme weather events, such as hurricanes, floods, tornadoes, or wildfires, ESBs as mobile power units could be particularly useful in enhancing resilience in these areas.

This implementation guide (guide) describes the potential to use V2X-enabled ESBs as alternative emergency backup power sources during power outages. For instance, the average battery capacity of an ESB is about 150 kilowatt-hours (kWh), according to publicly available information by Nuvve. A report cited in the body of this guide points out the ability of a V2X-enabled ESB to provide backup power to a **critical facility for nearly two days** and to critical loads for multiple hours, if not longer. These durations might exceed stakeholders' expectations. In addition, the discharge capability of an ESB, and of light-, medium-, and heavy-duty electric vehicles, more broadly, is only expected to increase over time, as battery technologies become more effective and efficient.

The core of this guide consists of detailed steps for emergency managers and responders and other key stakeholders, such as school districts, school facility managers, and electric utilities, to take before, during, and after an emergency to deploy bidirectionally-enabled ESBs to provide emergency backup power. The guide recommends that V2X-enabled ESBs ultimately become recognized resources within the federal National Incident Management System (NIMS) and integrated into emergency plans in accordance with the Incident Command System (ICS) to expand interest in, and accelerate deployment of, these technologies.

Highlights of some of the key steps to be considered to use a V2X-enabled ESB to provide emergency backup power to a school as an emergency shelter, which is the case study example used in this guide, are as follows. That said,

V2X-enabled ESBs, and the steps contained in this guide, certainly could be used in a wide range of natural and human-caused disasters to enhance resilience during power outages and across the various geographic regions of the United States.

In the Pre-Disaster Phase, relevant stakeholders are encouraged to:

- Identify the load and duration needs;
- Ascertain requisite personnel;
- Determine the software, hardware, interconnection, and logistical needs; and,
- Develop and execute a Mutual Aid Agreement.

During the Disaster Phase:

- Identify, secure, and deploy a V2X-enabled ESB;
- Notify the local electric utility; and,
- "Island" and connect the ESB to provide emergency backup power.

In the Post-Disaster Phase:

- Coordinate with the electric utility prior to disconnecting the ESB and restoring regular power to the school building, then disconnect the ESB from the building; and,
- Determine the amount of power that was consumed for compensation purposes.

This guide's *Conclusion* and an *Appendix* identify potential federal, state, and local funding opportunities, especially those that could be combined with one another to leverage scarce resources and to facilitate the deployment of V2X-enabled ESBs for resilience purposes. *Part II* of this guide consists of a Mutual Aid Agreement (MAA) template with specific elements that are necessary to have in place and that merit agreement by relevant parties, so ESBs can be readily deployed as mobile power units during emergencies.

There are myriad ways in which ESBs acting as mobile power units could provide power to critical facilities when needed, and in emergency situations, and thereby enhance the resilience of critical infrastructure, save lives, and strengthen our energy and national security.

# Part I: Implementation Guide

## I. Introduction

Our increasingly digital society and a transition toward a more electrified transportation future will require electric system infrastructure to be more reliable, resilient, and robust. The **expected rise over time in extreme weather events as well as in cybersecurity and physical security threats** that are projected to lead to more widespread and extended power outages also will require enhanced adaptation and resilience of the United States' electric system.[1]

Underserved communities (i.e., rural, low-income, Indigenous, and/or other communities composed primarily of people of color) often bear the brunt of extreme weather events and their impacts. As just one example of these disproportionate effects, recent reports indicate that "Black and Hispanic people are 50 percent more vulnerable to the impacts of wildfires than white people, and Native Americans are six times more vulnerable."[2]

Underserved communities tend to be among the first to lose power in such disasters, because they typically lack robust housing and electric system infrastructure to withstand the worst extreme weather events that are anticipated to increase in frequency and severity in the future. In fact, research has revealed that 47 percent of diesel generators in California's Southern Coast are in communities that are considered most vulnerable; such generators pollute the environment and, as a result, can pose serious health threats, as well.[3] Underserved populations also can least afford to leave their communities when a disaster strikes. Therefore, solutions that promote an **equitable** approach will be especially important.


Photo courtesy of Lion Electric Company

Electric school buses (ESBs) continue to proliferate, boosted by unprecedented federal sums from the U.S. Environmental Protection Agency's (EPA) "Clean School Bus Program," which recently awarded funding for nearly 2,500 additional ESBs.[4] As a result, ESBs that are equipped with Vehicle-to-Everything (V2X), or bidirectional charging, capability will be all the more ready and able not just to transport children to school, but also to function in an emergency response role. ESBs have large on-board batteries, and predictable routes and schedules, the latter of which include sitting idle for many hours at a time, especially during summer months. ESBs also typically are not used during extreme weather-related emergencies. Therefore, those ESBs that are enabled with bidirectional charging capability have the potential, and are well-suited, to deliver resilience services. V2X technology exists, though it is not yet familiar to the broad public. Serving as "mobile power units," ESBs, therefore, could provide backup power in emergencies and thereby **enhance much-needed infrastructure resilience and aid in emergency planning, preparedness, and response efforts.**

This implementation guide (guide) describes the potential to use V2X-enabled ESBs as alternative emergency backup power sources during a power outage. Such services will be needed to a greater extent over time. The guide details the steps required before, during, and after an emergency to make this happen. It aims to have ESBs equipped with on-board batteries and bidirectional charging capability to ultimately become recognized resources within the federal National Incident Management System (NIMS) and to expand awareness of, and interest in, these resources for resilience-related emergency response measures.[5] The *Conclusion* identifies potential federal funding opportunities, especially those that could be layered on top of—or are complementary to—one another to further advance V2X-enabled ESBs for resilience purposes. *Part II* consists of a Mutual Aid Agreement (MAA) template with specific elements that are

[1] The increasing frequency and severity of specific extreme weather events can be attributed to climate change with a high degree of certainty." So, Kat, and Sally Hardin. "Extreme Weather Cost U.S. Taxpayers $99 Billion Last Year, and It Is Getting Worse" (based on a report by the same title). September 1, 2021 (So and Hardin "Extreme Weather" article). Also based on data from the following report: Intergovernmental Panel on Climate Change (IPCC). *Summary for Policymakers: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report. Masson-Delmotte, V., et al. Cambridge University Press. doi:10.1017/9781009157896.001.
[2] So and Hardin "Extreme Weather" article.
[3] Bloom Energy. "New Study Shows a Rapid Increase of Diesel-Fueled Backup Generators Across California." Press Release. *BusinessWire*. October 6, 2021.
[4] A ten-fold increase in the number of ESB commitments occurred between the first quarter of 2021 and that of 2022, with 12,720 ESBs across 38 states, as of June 2022. To facilitate this growth, the U.S. Environmental Protection Agency's (EPA) "Clean School Bus Program" is funded at $5 billion from 2022 through 2026. Sources: Lazer, Leah, and Lydia Freehafer. "The State of Electric School Bus Adoption in the US." World Resources Institute (WRI) (Lazer and Freehafer "State of ESB Adoption" article). September 10, 2022; and, *Infrastructure Investment and Jobs Act (IIJA), or Bipartisan Infrastructure Law (BIL).* P.L. 117-58, 135 Stat. 429 (November 15, 2021).
[5] Federal Emergency Management Agency (FEMA). *National Incident Management System (NIMS) Doctrine.* Third Edition. October 2017.

necessary to have in place and upon which to have agreement by relevant parties, so ESBs can be deployed as mobile power units during emergencies. Much of the information in this guide is derived from interviews that SAFE (formerly Securing America's Future Energy) and the Electrification Coalition (hereinafter referred to collectively as SAFE-EC) conducted with state and local emergency management personnel, ESB manufacturers, electric charging station providers, electric utilities, and other stakeholder experts.

> *"Mutual assistance is a force-multiplier."*[6]

A Mutual Aid Agreement (MAA) establishes "the terms under which one party provides"[7] assistance to another because many jurisdictions lack adequate resources to manage severe emergencies, or disasters, on their own. Resources consist of "personnel, teams, facilities, equipment, and supplies."[8] An MAA authorizes such mutual assistance "between two or more neighboring communities, between all jurisdictions within a state, and between states."[9] It also can be with and between private sector entities, NGOs, and other stakeholders.

The term, MAA, generally has a specific meaning or definition and stipulates or, at a minimum, implies that aid will be provided in a reciprocal manner between the parties, when each party needs aid at different points in time. While this document uses the term MAA to represent the nature of the agreement between the relevant parties or stakeholders, some stakeholders certainly might prefer to execute a Memorandum of Understanding (MOU) or Memorandum of Agreement (MOA), which would not implicate the reciprocity obligation. Nonetheless, these latter terms can be substitutable for (or interchangeable with) the term MAA for purposes of this document.

### A. Benefits of V2X-Enabled ESBs

The myriad ways in which EVs acting as mobile power units could provide power to a broad range of critical facilities when needed and in emergency situations are profound. When ESBs are used in these ways, V2X has the potential to improve the resilience of U.S. critical infrastructure and thereby **strengthen our energy and national security**.

Because **underserved communities** tend to be most affected by disaster impacts, they also stand to benefit most from mobile power units to enhance resilience when outages occur.[10] The growing large-scale deployment of thousands of ESBs across 38 states to date represents an important opportunity to use these buses as resilience assets that can maintain essential services during more frequent extreme weather events facing communities, helping to **protect human health and save lives**.[11]

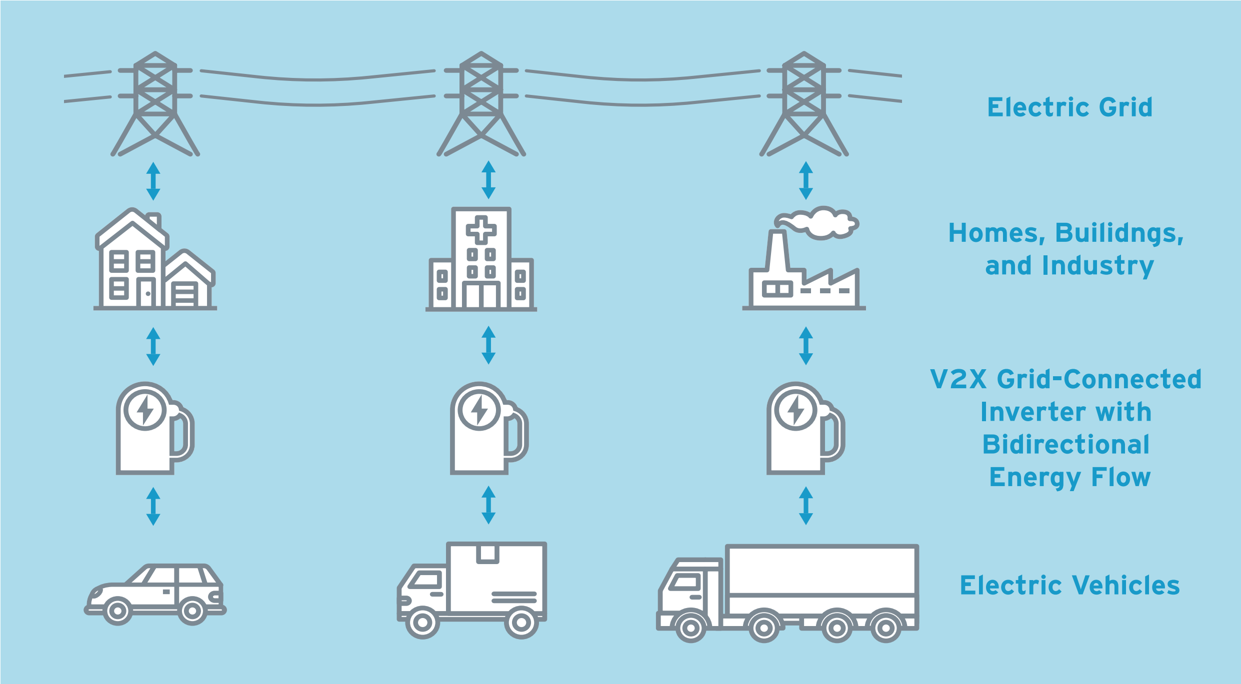
In addition, bidirectionally-enabled ESBs would offer the following additional benefits when used for resilience purposes: ESBs with on-board energy storage and bidirectional charging capabilities would reduce the need to deploy—and pay for—additional diesel generators or separate stationary energy storage units in emergency situations, because bidirectionally-enabled ESBs can move from site to site. This would reduce the costs associated with purchasing and maintaining separate backup power sources, including the cost of the diesel fuel, which has a shelf life. Supply chain interruptions could minimize the availability of diesel fuel needed to run existing generators. Avoiding the use of diesel generators also would decrease the environmental and health impacts associated with their use. As one expert interviewed for this guide noted, during widespread emergencies, traditional high-capacity mobile generators often are extremely scarce.

[6] Edison Electric Institute (EEI). "2017 Historic Storms, Historic Responses." Presentation to the U.S. Department of Energy's Electricity Advisory Committee. February 21, 2018.
[7] Federal Emergency Management Agency (FEMA). *National Incident Management System (NIMS) – Guideline for Mutual Aid*. November 2017.
[8] Lazer and Freehafer "State of ESB Adoption" article.
[9] FEMA. "NIMS Components – Guidance and Tools." October 12, 2022.
[10] Equity-oriented V2X policy and projects that have been a hallmark of every aspect of the current Administration's policies and regulations, as well as the bipartisan *IIJA* (referenced in footnote 6), will help expand such deployments.
[11] "State of ESB Adoption" article.

**B. Vehicle-to-Everything (V2X) Technology: Definitions and Technical Requirements**

Until recently, virtually all EVs and chargers on the market were unidirectional, meaning electricity flows in one direction from the grid to the charger and then to the EV. V2X capability refers to an EV and/or an EV charger equipped with bidirectional, or two-way, charging capability that enables the battery on board the vehicle to discharge power to a home, building, the electric grid, or other facility—with broad applications, thereby acting like, or creating, a "mobile power unit." The following text box contains a depiction of V2X and related terms as well as more specific definitions.

*Vehicle-to-Everything Applications and Definitions*




**Vehicle Grid Integration (VGI)**: "Any method of altering the time, charging level, or location at which grid-connected" light-, medium-, or heavy-duty EVs, or off-road EVs or electric equipment, "charge or discharge, in a manner that optimizes plug-in electric vehicle or equipment interaction with the electrical grid and provides net benefits to ratepayers by doing any of the following: (A) Increasing electrical grid asset utilization and operational flexibility. (B) Avoiding otherwise necessary distribution infrastructure upgrades and supporting resiliency. (C) Integrating renewable energy resources. (D) Reducing the cost of electricity supply."[12]

**Vehicle-to-Grid (V2G)**: Two-way, or bidirectional, charging and discharging between EVs and the grid. This enables "vehicles to discharge stored power back onto the grid or into a building or local power system," particularly in times of need, such as a natural disaster or other grid outage situation.[13]

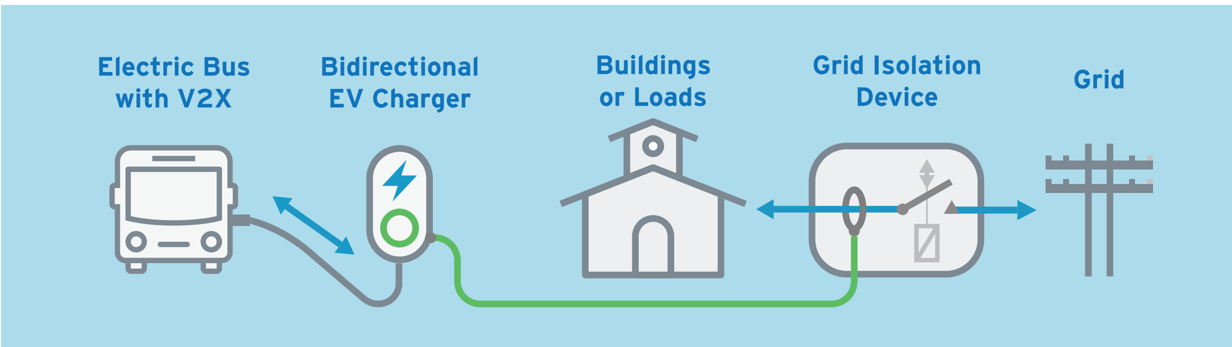
**Vehicle-to-Home (V2H) or Vehicle-to-Building (V2B)**: Despite the previous definition of V2G, most sources define V2H and V2B as situations in which the EV battery provides power to a home or building, but that power is "islanded" and not exported all the way back to the grid.[14]

**Vehicle-to-Everything (V2X)**: "An all-encompassing term for a vehicle's connected communications." It includes, for example, vehicle-to-vehicle communications as well as V2G, V2H, and V2B.[15]

[12] California Public Utilities Commission. *Order Instituting Rulemaking to Continue the Development of Rates and Infrastructure for Vehicle Electrification*. Rulemaking 18-12-006, Decision Concerning Implementation of Senate Bill 676 and Vehicle-Grid Integration Strategies, D.20-12-029. Issued December 21, 2020.
[13] California Joint Agencies Vehicle-Grid Integration Working Group. *Final Report of the California Joint Agencies Vehicle-Grid Integration Working Group*. September 11, 2020.
[14] *Ibid.*
[15] Teague, Chris "Everything You Need to Know About V2X Technology." *Autoweek*. May 3, 2021.

V2X requires a bidirectional inverter and additional controls and software functionality. If an EV (i.e., an ESB for the purposes of this guide) does not possess an on-board bidirectional inverter, then a bidirectional inverter would be required in the EV charger or in a different device located at the host site, i.e., school building premises. To isolate, or "island," a building from the grid, an automatic transfer switch (ATS) or microgrid interface/interconnection device (MID), otherwise referred to as a grid isolation device, located on the host site premises will be needed to signal to the inverter when the building has been disconnected from the grid.[16] This equipment ensures that it is safe to enable the ESB's battery to provide emergency backup power only to the school building or other critical loads, and not all the way back to the grid, so power will not be causing risks to facility employees, utility linemen, or other workers. As V2X technology is adapted for more use cases, various configurations of the ESB, charger, and grid isolation device will emerge that might require additional technical considerations. These underlying technologies are standard today for stationary battery storage devices that provide backup power, and companies could begin offering resilience services using an ESB battery, rather than a stationary battery, in combination with the technologies described on the previous page.

*Diagram of V2X with Inverter and Grid Isolation Device*




*Source:* Svarc, Jason. "Bidirectional Chargers Explained: V2G Vs V2H Vs V2L." Clean Energy Reviews. September 2, 2022.

It also is worth noting at the outset that bidirectional technology is evolving very rapidly—with respect to all aspects, from the chargers to the battery capacity and more.[17] Currently, it is considered fairly standard practice to use not more than **80 percent** of an ESB's battery capacity to power a load to preserve the battery's health, retaining 20 percent for reserve capacity.[18, 19] However, according to an industry expert interviewed in the course of developing this guide, a user could modify these capacity limits via software.

***The average battery capacity of an ESB is about 150 kWh, according to publicly-available information by Nuvve. The battery of one ESB can "power the equivalent of five operating rooms for more than eight hours, and a single operating room for 43 hours" (i.e., nearly two days).***

In the case study example herein of a school building as a shelter, estimating a school's average energy consumption per day, an ESB's battery presumably could power an average school building for about two days (or more) and, therefore, could power certain critical loads within the building, e.g., the heating or cooling and lighting for a gymnasium and the charging of local residents' laptops and/or cell phones, for multiple days.

*Source for quotation:* Environment Texas Research and Policy Center. *Electric School Buses and the Grid*. March 17, 2022. See footnote 20 for more details regarding the calculations and assumptions made here.

[16] In at least one utility's service territory, homes equipped with solar energy have a mandatory grid isolation switch for "islanding." One expert suggested that the same technology could be applied to V2X.

[17] As two expert interviewees noted, to the extent differences currently exist between bidirectional chargers, technical standards, policies, and other efforts should facilitate uniformity across all bidirectional chargers and should facilitate as many applications and uses as possible.

[18] Based on information derived from SAFE-EC interviews conducted in the development of this guide; and, Kostopoulos, Emmanouil, D., George C. Spyropoulos, and John K. Kaldellis. *Real-world study for the optimal charging of electric vehicles*. Energy Reports, Volume 6. November 2020. Pages 418-426, ISSN 2352-4847.

[19] An average school building consumes approximately 400 kWh per week, according to one study cited herein. Dividing 400 kWh by 7 days in a week yields an average of 57 kWh of electricity consumption per day. So, a 150 kWh battery could charge an entire school for more than 2 days, based on these figures. Source for the study: Koumoutsos, Kostas, et. al. *Gathering and processing energy consumption data from public educational buildings over IPv6*. Energy, Sustainability and Society, Volume 5. 2015.

V2X-enabled EVs, including ESBs, already are providing grid services in non-emergency situations.[20] For example, Highland Electric coordinated a V2X program with ESBs in Beverly, Massachusetts. During the summer of 2022, ESBs sent three Megawatt-Hours (MWh) of electricity back to the grid over nearly 60 hours, spanning 30 events. **Three MWhs is the amount of electricity equivalent to that needed to power nearly 600 homes for one day.**[21] These demonstrations have enabled bidirectional technology to be tested in low-pressure situations and prove its value and effectiveness. There also is a record amount of new federal funding to convert internal combustion engine (ICE) vehicles and fleets to electric, including $5 billion from EPA's previously referenced "Clean School Bus Program," which means there should be new opportunities to incorporate bidirectional capabilities into ESBs for the types of grid services illustrated by these examples as well as for yet-to-be-explored resilience purposes.[22]

As school districts make ESB and electric charging infrastructure purchasing decisions, they are encouraged to work to ensure this equipment is bidirectionally-enabled. Going forward, vehicle and charging equipment manufacturers should incorporate bidirectionality into ESBs and charging infrastructure as a standard practice. This would reduce the burden on the school districts to research and decide whether to include this capability as part of their ESB and charging infrastructure purchases.


Photo courtesy of Highland Electric Fleets

**This guide is all the more timely and important to help facilitate actual ESB V2X resilience-related deployments**, based on the handful of V2X pilot projects that exist and the pace at which V2X technology is evolving.

### C. Barriers to V2X Deployment

Several factors have limited the deployment of V2X technology and associated value streams. These include, but are not limited to, insufficient awareness by emergency management personnel regarding the potential to use ESBs as mobile power units, and a lack of coordination among key stakeholders. In addition, progress has been slowed by an absence of uniform national technical standards and concerns about whether charging and discharging ESB batteries for grid services would degrade the batteries beyond levels typically associated with driving and could lead to vehicle warranty issues.[23]

Fortunately, too, some policies recently have been implemented to facilitate the deployment of V2X-enabled EVs and EV charging infrastructure, such as the inclusion of bidirectional charging equipment in the extension and modification of a tax credit for EV charging and other alternative fueling infrastructure; and, inclusion of bidirectional charging capability in the National Electric Vehicle Infrastructure Formula Program as well as in the $72 billion Surface Transportation Grant Program, among others, though more work remains to be done.[24]

### D. Contents of this Guide

This document consists of two elements: first, a step-by-step implementation guide that directs communities how to use ESBs equipped with V2X technology as mobile energy storage units, including by comprising part of a stand-alone microgrid, in emergency situations. However, the ESB(s) certainly could charge off site to perform these functions. Of course, too, V2X-enabled ESBs can and should be considered to power other types of critical facilities, such as hospitals, banks, and water treatment facilities during all types of hazards.

[20] ESBs and V2X technology already are being used to support the grid during periods of stress in several pilots. For example, San Diego Gas & Electric (SDG&E) partnered with Cajon Valley Union School District and Nuvve Holding Corporation on an ESB V2X pilot project during the summer of 2022. This pilot consisted of eight bidirectional chargers and eight V2X-capable Lion Electric school buses that were discharging electricity to the grid during several Emergency Load Reduction Program (ELRP) events that arose due to historic demand for electricity driven by several extreme heat events. This project helps demonstrate the ability to use ESBs and V2X to provide resilience services and generate revenue streams. *Source:* SDG&E, "SDG&E and Cajon Valley Union School District Flip the Switch on Region's First Vehicle-to-Grid Project Featuring Local Electric School Buses Capable of Sending Power to the Grid," News Release, July 26, 2022.

[21] Highland Electric Fleets. "Highland Electric Fleets Coordinates Electric School Buses' Summer Job - Supporting Local Grid with Vehicle-to-Grid Technology." *PRNewswire*. August 25, 2022.

[22] The U.S. Environmental Protection Agency's (EPA) "Clean School Bus Program" is funded at $5 billion from 2022 through 2026 through Section 71101 of the *IIJA*, Public Law 117-58, 135 Stat. 429, (November 15, 2021).

[23] Hutton, Matthew and Thomas Hutton. *Legal and Regulatory Impediments to Vehicle-Grid Aggregation*. William & Mary Environmental Law and Policy Review, Volume 36, Issue 2, Article 3. February 2012.

[24] Section 30C of the Internal Revenue Code (i.e., tax credit), as amended by Section 13404 of the *Inflation Reduction Act of 2022* (IRA), Public Law 117-169, 136 Stat. 1818, (August 16, 2022); and, Title VIII and Section 11109, respectively, of the *IIJA*, Public Law 117-58, 135 Stat. 429, (November 15, 2021).

This document focuses on using ESBs equipped with bidirectional charging as mobile power units to serve as emergency resilience/response assets to deliver emergency backup power to a school building being used as a shelter or, for certain essential functions within a school building, such as heating or cooling, lighting, or refrigeration. It is noteworthy that in Florida, for example, **"district public schools are the primary source of public shelter during tropical weather-related emergencies, currently accounting for about 97 percent of statewide hurricane evacuation shelter space,"** and typically staffed by district personnel.

This document further assumes that the school building being used as a shelter has an on-site bidirectional charger, rather than the bus charging at an off-site depot or parking lot.

*Source:* Florida's Division of Emergency Management, 2020 Statewide Emergency Shelter Plan (SESP), January 31, 2020. The SESP notes that many school facilities are not appropriately designed or situated to meet hurricane shelter safety criteria. Thus, future schools must be constructed to meet the latest building codes to withstand hurricanes and other disasters.

More specifically, this guide highlights the key technical requirements and the major, concrete planning steps for emergency managers and other decision makers and practitioners to consider and implement well in advance of—and more immediately leading up to—an event requiring an emergency response, as well as during and after the event, to use bidirectionally-enabled ESBs for backup electricity in locations that lose power. This document also highlights the stakeholders that need to be involved in such situations and their associated responsibilities.

Second, this document contains a template for the necessary MAA that identifies the requisite elements to include in local, state, and federal emergency planning efforts and specifies the contractual requirements for interested parties to allow ESBs with V2X technology to be used as emergency mobile power units.

The MAA spells out the responsibilities and obligations of the respective parties, prioritization of equipment to be delivered and/or used in an emergency, and other important factors that will require consideration and agreement by requisite parties in advance of an emergency, so the procedures are in place to use ESBs to provide power to a school or other critical facility/critical infrastructure asset, when an actual incident occurs. The MAA will need to be executed during "normal" or "blue sky" times, so it is ready for use during an emergency.

The MAA template follows the elements and requirements provided within the **NIMS *Guideline for Mutual Aid*** and the existing federal **Incident Command System (ICS)**, so it can be more readily integrated into local, state, and federal emergency plans.[25] This guide, particularly in Section II B and in the MAA template, contemplates using V2X-enabled ESBs across different geographic regions of the United States where the types of severe weather events vary, ranging from hurricanes to floods, wildfires, and droughts, to extreme heat or cold.

While not the focus of this document, the guidance herein certainly could apply to electric transit buses or other electrified fleets in certain situations and should be interpreted accordingly. This guide does not discuss how to procure electric school buses, as there are already a number of resources that exist to help begin the **ESB procurement process**.[26] However, as noted elsewhere in this guide, when school districts make ESB and electric charging infrastructure purchasing decisions, they should work to ensure this equipment is bidirectionally-enabled. Then, doing so should become standard practice.

### E. Background on National Incident Management System and Incident Command System

The United States' **National Preparedness System** consists of multiple operational documents, structures, emergency planning, preparedness, response, and recovery efforts to help prepare for a range of natural and human-caused disasters.[27] This guide and MAA template aim to track and fit in with the NIMS, which is part of the National Preparedness System.[28] NIMS guides how emergency response personnel at all levels of government, as well as non-governmental entities and the private sector, are supposed to work together when responding to incidents. It achieves this by defining "operational systems, including the ICS, Emergency Operations Center (EOC) structures, and Multiagency Coordination Groups (MAC Groups) that guide" this process.[29] Not only does NIMS apply to all incidents, but it also helps make the ICS guidance applicable to all incidents and hazards, as well.[30] The NIMS and ICS aim to provide common terminology and to standardize operational procedures, while also providing flexibility for different circumstances, types of incidents, and so forth. The federal Stafford Act generally governs disaster and post-disaster recovery mechanisms and procedures, including reimbursements for the use of equipment during disaster emergencies and reimbursements for property loss.

[25] FEMA. *NIMS – National Incident Management System Guideline for Mutual Aid*. November 5, 2017; for more information on the Incident Command System (ICS), please see *Section E* below and: FEMA. Emergency Management Institute (EMI). *ICS Resource Center*.
[26] WRI's Electric School Bus Initiative, "Get the tools you need for your electric school bus journey," 2022.
[27] FEMA. *NIMS Doctrine*. Third Edition. October 2017.
[28] *Ibid.*
[29] *Ibid.*
[30] FEMA, EMI. *ICS Review Document*. EXTRACTED FROM - E/L/G 0300 *Intermediate Incident Command System for Expanding Incidents*. ICS 300. March 2018.

To elaborate on these structures and the stakeholders involved, NIMS and ICS have formal incident command structures with an Incident Commander in charge. Emergency Operations Centers (EOCs) are staffed with key personnel who are identified during planning processes well in advance of incidents. These generally include utility representatives, staff from other emergency response organizations (e.g., Federal Emergency Management Agency [FEMA] and state and local emergency managers), and relevant Department personnel with substantive expertise (e.g., Department of Energy [DOE] and/or state energy officers) that report to these EOCs during an incident. More details about the formal structures the federal government has created to plan for and respond to emergency incidents can be found in the *ICS Review Document*, the link to which can be found in Appendix D.[31]

One of the key functions of NIMS is **resource typing**, i.e., "defining and categorizing, by capability, the resources requested, deployed, and used in incidents. Resource typing definitions [further] establish a common language and defines a resource's (for equipment, teams, and units) minimum capabilities. **NIMS** resource typing definitions serve as the common language for the mobilization of resources."[32] (Emphasis added.) FEMA has established an online tool, called the **Resource Typing Library Tool**, that contains all of the different types of resources across personnel and equipment that exist, and the potential use for, or application of, each resource.[33] This implementation guide, with its MAA template, and the uses of ESBs discussed herein are intended to be compatible with the NIMS and the ICS, so they ultimately can be implemented as part of these larger organizational and operational structures. This guide and MAA employ the basic steps and nomenclature of the NIMS and ICS where applicable.

Because ESB V2X resilience applications are still being developed and deployed, it will take time for ESBs to be designated as recognized resources and incorporated into the NIMS and ICS systems. To avoid potential incompatibility between a bidirectional charger and an ESB(s), it would ultimately be worth providing as much technical information as possible in the resource typing systems. As detailed in *Section II*, related potential equipment, software, and/or hardware compatibility and requirements, including interconnection and charging hookup requirements, should be addressed well in advance of an emergency. However, ultimately including such information in the resource typing tool also merits consideration.


Photo courtesy of Steamboat Springs School District

As at least one expert reiterated it should not be essential for bidirectionally-enabled ESBs to be part of a resource typing system, particularly in the near term. ESB V2X opportunities should be supported, regardless. Best practices should be applied to expedite the process of incorporating ESB V2X technology into resource typing systems to expand awareness of such resources, where they are available.

## II. Advance Steps Needed to Use V2X-Enabled ESBs as Mobile Power Units in an Emergency to Enhance Infrastructure Resilience (Pre-Disaster Phase)

This section highlights the key steps that merit consideration by relevant stakeholders in advance of an emergency outage resulting, for example, from an anticipated extreme weather event, which is the use case for this guide, so that ESBs and V2X can be used to provide backup power in such situations. Of course, V2X-enabled ESBs could be used to provide emergency backup power to other critical facilities and for outages caused by physical security or cybersecurity events, as noted in the Introduction. The steps highlighted herein apply broadly to a wide range of natural disasters that can lead to power outages, such as wildfires, floods, extreme heat or cold, and so forth, and pertain to the various geographic regions of the United States.

Knowing in advance the relevant procedures, personnel, and stakeholders that must be involved will facilitate the processes for deploying ESBs as backup power resources during an emergency. In addition, implementing such steps will ensure the requisite mechanisms are in place, including to compensate (or reimburse) the personnel and

[31] *Ibid.*
[32] FEMA. "NIMS Components – Guidance and Tools." October 12, 2022.
[33] FEMA. "Resource Typing Library Tool."

equipment used in an emergency. This ESB V2X guide is intended to be compatible with the existing NIMS and ICS structures described in the *Introduction* and should be adapted accordingly. A link to NIMS guidance is provided with the template MAA in *Part II* of this document to help this process. These steps are elaborated on below and in the MAA template included in *Part II* of this document.

Because federal, state, and local emergency managers are tasked with conducting emergency management planning, executing existing operational plans, and performing other duties before, during, and after an incident, they are familiar with these planning and operational procedures. However, considering that ESBs and V2X technologies are still nascent, these officials and other key stakeholders will need to be educated about the potential emergency response capabilities of V2X-enabled ESBs to ascertain whether, where, and how to incorporate these resources into emergency response procedures.

As part of the NIMS and ICS processes, stakeholders are encourage to consider working with FEMA to ensure that V2X-enabled ESBs, and charging infrastructure, are integrated as resources at the federal level into FEMA's **Resource Typing Library Tool** (described in *Section E* of the *Introduction*).[34] Being a part of this Resource Typing Library is vital to V2X-enabled ESBs becoming a known resource that can be requested and deployed during an emergency, as resource considerations are identified and evaluated, including cost considerations. The ESB drivers, i.e., "equipment operators," also should be included in the Resource Typing Library Tool, particularly if any specialized knowledge or training is required to connect the bus to a charger (or eventually, perhaps, directly to a school building to provide emergency backup power).

Most, or all, states have similar resource typing catalogs that contain all deployable resources in a database system. A number of cities and counties have similar online resource typing library tools. To ensure a cohesive emergency response system across all levels of government, it is crucial to get ESBs, drivers, and any other necessary equipment operators (e.g., charging providers, engineers, school facility managers) added to these state and local resource tools, as well.

Following are the additional specific steps needed for bidirectionally-enabled ESBs to be used as mobile power units.

### A. Identify the Resource Needs (Load and Duration of Backup Power)

The first step is to determine the load that must be served.

> **As a reminder, this document assumes that a single ESB will be used to provide emergency backup power to a school serving as an emergency shelter or to a partial load within that school building, such as heating/cooling and lighting for a gymnasium that is the shelter within that school building. This guide also assumes that the bidirectional charger is on site at the school building.

While some locations and incident personnel will indicate somewhat generically that they have a need for electric power over a certain period of time, emergency managers and the federal government instead are increasingly moving toward identifying the specific function(s) or load(s) that must be covered to ensure the power capability exists to meet those functional needs and over the requisite time duration.[35]

> As noted in the *Introduction*, one ESB's battery likely could provide enough power for an entire average school building for more than 2 days and, therefore, could power certain critical loads within the building, e.g., the heating or cooling, lighting, and the charging of local residents' laptops and/or other devices, for multiple days.

- It also will be important to assess the suitability of the school building for use as an emergency shelter, which likely will have already been accomplished.
- In addition, the types of circumstances in which ESBs would be deployed, e.g., different types of weather events, also should be determined in advance.

  For instance, as noted above, ESBs could be well suited to certain types of emergencies, e.g., extreme heat during the summer, when school is not in session and ESBs tend to sit idle for days at a time.
- The parties to the MAA will need to coordinate with emergency officials at the local level, and possibly also at the state level, to ensure in advance that an ESB will be an available emergency resource. They also will need to stipulate the instances in which this resource will be used, as elaborated on in the MAA template in Part II.

[34] *Ibid.*
[35] Federal government information provided by a National Laboratory official (in a conversation on September 27, 2022).

- Once the parties determine how much emergency backup power they need, they also can assess the number of ESBs it will take to meet this requirement. If multiple ESBs will be used, then the parties can establish whether these will be used sequentially or simultaneously. The number of ESBs needed and whether ESBs will be used sequentially or simultaneously will depend, at least in part, on charging infrastructure availability or planning for anticipated chargers.

When selecting appropriate resources, it is important for emergency officials to be aware that different sizes and types of school buses exist.

- Type A is a relatively smaller vehicle that is typically used to transport children with special needs or those in remote or underserved areas;
- Type C buses are "typical" school buses; and,
- Type D buses are nearly the same size as Type C school buses but have a flat front, so they have a little more capacity and other capabilities.[36]

This information, once known, is then combined with the knowledge of the battery capacity, which is known for each sized ESB, bearing in mind that 80 percent of an ESB's battery typically can be discharged to preserve battery health.[37]

The World Resources Institute (WRI) has published an **ESB purchasing guide** that offers further basic technical features for different types of buses.[38]

One expert suggested building on a current utility best practice of integrating backup resources or systems into daily operations, or at least on a "one-off" basis, to the extent practicable. Doing so would enable operators to become familiar with the use of such resources and would help address any potential issues prior to an emergency. Then, the resources, i.e., ESBs and associated equipment, in this instance, would, in fact, be performing well and able to provide emergency backup power, when needed.

If more power is needed for a given emergency situation than that which one fully charged ESB can provide, then there might be a need for multiple ESBs to be used sequentially. Alternatively, if needed, several ESBs—or a fleet—could be used simultaneously to provide more power and/or to provide power over a longer duration.

*This information will help incident personnel determine whether or when to deploy one or more ESBs; the capacity each ESB has to provide emergency power (i.e., the amount of power each bus can provide); and the duration over which such power can be provided.*


Photo courtesy of Nuuve

### B. Specify the Requisite Personnel and/or Other Stakeholders

The requisite personnel resources and/or stakeholders must be identified to ensure: they are aware of V2X-enabled ESBs' resilience capabilities, including as an emergency backup power resource, and they have met, are familiar with one another in advance of an emergency, and that they develop or facilitate lines of coordination and communication. In doing so, they will select those stakeholders that will be parties to implementing a Memorandum of Understanding (MOU) or Mutual Aid Agreement (MAA), among other needs.

In some parts of the United States, counties and school districts are managed separately. In addition, not all school districts own school buses; often, the buses and the hiring of drivers, maintenance, and other functions are fulfilled by contractors. Bus depots or lots also might be leased rather than owned. These factors could change the nature of, or parties involved in, an MAA.

The parties to an MAA likely will consist of a relatively small number of stakeholders, but the range of stakeholders to consider in such emergency situations consists of:

- School district official(s);
- School building facility manager, custodian, or administrator(s);
- First responders, e.g., local fire and police departments;

[36] Type B school buses are not built any longer; these were "purpose built" Type A buses, meaning the body and chassis were specifically built for a school bus.
[37] One expert interviewed for the development of this guide noted that these capacity limits likely could be modified via software, as also mentioned in Section B of the Introduction.
[38] WRI. *Electric School Bus U.S. Market Study and Buyer's Guide: A Resource for School Bus Operators Pursuing Fleet Electrification (Buyer's Guide)*. June 10, 2022.

- Incident facility manager, e.g., at the school (in this instance) that will be the site for which a V2X-enabled ESB will provide backup power;
- State and/or county and/or city emergency manager–in many instances, the county or city does not manage the school district;
- ESB manufacturer/provider (original equipment manufacturer);
- Charging station provider;
- Service provider (aggregator using the ESB to provide emergency backup power);
- Electric utility;
- Local electrical contractor; and,
- In certain use cases and surrounding conditions, the state Public Utility Commission (PUC) and the Regional Transmission Organization (RTO), i.e., regional grid operator, also known as an Independent System Operator, where these exist, also might need to be involved or at least notified.

### C. Determine Software, Hardware, and Interconnection Needs and Other Logistical Priorities[39]

To be able to use ESBs as backup power at a pre-selected school building, the associated hardware and software must be identified and installed well in advance of an emergency.

- Once a facility has been identified, and a V2X-enabled ESB has been selected as a potential power resource, the school district will need to work with the school facility manager, the charging station provider, electric utility, electrical engineers, and any other partners or stakeholders, which might include the bus manufacturer, to **ascertain and install the additional hardware (e.g., wiring, distribution lines, switch gear) and software**. This equipment will be needed at the school, so ESBs and bidirectional chargers can be used to provide emergency backup power. Ideally, these considerations would be taken into account in advance of a school district designing its charging infrastructure. It will be less expensive to plan for backup power functionality in advance of building the charging infrastructure, rather than retrofitting the site after the charging infrastructure has been installed.

- In most current circumstances, chargers, rather than ESBs, are equipped with bidirectional inverters. The inverter could be integrated into the charger or located on the host site premises (as noted in the *Introduction*).

- Depending on the circumstances, the local electric utility might need to be notified and/or verify that the ESB and charger can be safely and reliably "islanded," i.e., equipped with an inverter and a grid isolation device, so that power can be routed to the school building/shelter during a power outage but isolated from the rest of the grid for safety purposes. The electrical connection to the building must include an ATS or MID that signals to the inverter when it is safe to begin providing backup power to the building, once an outage has occurred.

- Other technical changes might need to be made to the building or part of a building or load within it, such as a separate critical load panel.

- As noted above, this guide assumes that the ESB will be parked at the location where it would be providing backup power during outages.

If the ESB will not be on site at the location where it will be used as a mobile power unit, the relevant incident personnel/parties will need to determine how the ESB will get to the location, ensuring sufficient charge remains for the return route to charge again (re-charge), including identifying the shortest and other potential travel routes. They also generally will need to maintain a 20 percent battery reserve capacity margin, as this is fairly standard, though this might change over time and with software management capabilities. Regardless of whether the ESB typically is parked at the location where it is providing backup power during an outage, the bidirectional charging equipment, including the bidirectional inverter and the islanding hardware mentioned above, will need to be installed at the school, i.e., the site that will require backup power during an emergency.


Photo courtesy of Highland Electric Fleets

[39] The Parties involved will deal with potential higher costs of electricity, if they try to quickly pre-charge an ESB before an extreme weather event. Some locations could have demand charges and/or time-of-use tariffs that could drastically increase the cost of the electricity to charge the ESB prior to an emergency resilience event. Coordination between the utility and the charging infrastructure/management company(ies) will be vital to make sure the ESB is charged (as quickly as possible) prior to an event, and as cost-effectively as possible. Utilities are encouraged to consider waiving demand charges or tariffs for ESBs charging for emergency resilience purposes.

## D. Develop and Execute a Mutual Aid Agreement

Typically, there are state-wide and local agreements for mobilizing resources. Typically, too, a county or local emergency manager acts as the intermediary to activate or execute an MAA. A county emergency manager would work with the state emergency manager and resource tools, such as those identified at the beginning of this section, and with the school district in the instance at hand to identify and assess available resources and to mobilize those resources.

An MAA would establish procedures between counties and/or between states to reserve and deploy ESBs as mobile power units for emergency backup power purposes.

If a school district has an ESB, then an MAA could detail:

- The circumstances under which a county would require the use of this ESB as an emergency resource and associated logistical details;
- The parameters of use;
- The daily rate for the ESB operator;
- Resilience services contract terms, including the ability to use the ESB and its battery capacity in an emergency situation for backup power, as well as the reimbursement rate and structure for charging and using the ESB's battery capacity; and,
- Any other specific requirements or considerations that need to be determined in advance.

The MAA also would contain the contact information of all relevant parties and stakeholders (that would be verified or updated on a routine basis, e.g., annually, per *Subsection E* that follows). A template of an MAA is provided in *Part II* below.

## E. Undertake Coordination Efforts

Familiarity among the relevant parties and stakeholders is essential prior to an emergency so that once an emergency occurs, the parties can call one another or take the requisite steps required in the MAA and implementation phase (see *Section III* below). Identifying roles and establishing direct personal relationships can be invaluable in saving time and facilitating coordination and collaboration when an emergency arises.

It is important for contact lists to be verified, maintained, and updated regularly, e.g., at least annually, so that this information is readily available when an emergency occurs.

Coordination efforts similarly must occur prior to an emergency, so that each party knows their role and responsibilities, including vis-a-vis other parties, stakeholders, and partners. Training and exercises are an important part of such coordination efforts. Experts recommended that training and exercises be provided not only for those who would be involved in the emergency operation phase but also to stakeholders who would be involved in other phases and aspects of such efforts, including, for example, those who would be involved in the preparatory phase as well as site and equipment maintenance.

It is critical to prepare in advance as many potential facilities and/or loads to be able to use ESBs as "mobile" generators when emergency circumstances arise.

## F. Analyze Additional Potential Needs

The next step is to ascertain whether and how this plan will fit with other emergency planning, preparedness, and response plans (hazard mitigation plans), energy security plans, resilient infrastructure plans, and so forth.

With respect to emergency planning and resource management, resources are identified within a state's resource planning and management system. Local resources typically are exhausted—at the city or county level—before going to the state level with requests for additional resources. As part of this process, emergency managers would assess the array of tools or equipment that could be available to best meet their needs (e.g., stationary diesel generators or bidirectionally-enabled ESBs) and to help locate and deploy those assets. Resources are exhausted within a state before requesting mutual aid from another state or region.

FEMA requires every state and local jurisdiction to have a Hazard Mitigation Plan (HMP) to receive any disaster- or hazard mitigation-related funding. Redundant (or backup) power often is the highest priority need identified in a state or local HMP—to be addressed as additional financial resources become available. These planning approaches provide a systemic way in which to identify and minimize vulnerabilities. Such opportunities also might be tied to climate change mitigation, adaptation, resilience, and/or sustainability plans or goals. Note that some pre-hazard or hazard mitigation planning efforts and funds have been subsumed into the Building Resilient Infrastructure and Communities (BRIC) program. Funding resources for schools, school districts, and other stakeholders are elaborated on in the *Conclusion*.

### G. Conduct Education and Outreach; Build Support

Increasing awareness regarding the ability to use one or more ESBs as mobile power units is an important priority. Recognizing the benefits of using bidirectionally-enabled ESBs as mobile power units will help to create awareness among school districts and emergency managers. Such benefits are highlighted at the beginning of the *Introduction* to this guide, though, to underscore, these include the potential to avoid the need for having to install—and pay for—stationary backup power sources (e.g., generators) at multiple facilities within a given area because bidirectionally-enabled ESBs can move from site to site. Additional use cases are provided in *Appendix C*. As such, these ESBs also might be able to be used to power multiple sites during an emergency outage. Creating awareness and building additional support from the community and schools, e.g., teachers, parents, and students, due to the environmental and public health benefits, should facilitate and accelerate ESB adoption and their deployment as emergency assets as well.

Raising awareness regarding the related ability to potentially tap into multiple funding "pots" or opportunities to help make the case for using ESBs as mobile power units for resilience is discussed in the conclusion.

## III. Steps Involved in Deploying V2X-Enabled ESBs as Mobile Power Units During an Emergency Outage (Disaster Phase)

Once a disaster or emergency has struck a community or an area, the bulk of the work to be able to deploy a V2X-enabled ESB already will have been accomplished during the aforementioned preparatory steps (i.e., Part II above). At this stage, the process becomes a matter for local, city, and/or county emergency management personnel to manage, e.g., in terms of identifying and securing the resources needed for the disaster or emergency at hand.

The relevant steps of the MAA will guide this phase of the implementation or deployment process.

### A. Identify and Secure V2X-Enabled ESBs for the Disaster at Hand

As noted in the prior Sections, emergency managers tend to indicate the amount of power needed or a function for which power is needed. Assuming V2X-enabled ESBs have been included in the relevant databases and lists of resources, a school district could request from a city or county emergency manager emergency backup power for a particular load or building and perhaps also could specifically request a V2X-enabled ESB from among the available resources—or coordinate with the local, city, and county personnel to try to secure a V2X-enabled ESB.

With natural disasters that emergency management personnel can see coming, such as hurricanes or snowstorms, they can coordinate with bus manufacturers (referred to herein as original equipment manufacturers [OEMs]), charging-related service providers (software-as-a-service [SaaS]), the school district, and others to ensure that ESBs are fully charged prior to an emergency. For those natural disasters or emergency scenarios that emergency management personnel cannot see coming, it still is highly likely that an ESB will not be in use and will be charged or able to be charged fairly quickly for backup power deployment purposes.

Resources should be reserved for a specific emergency purpose, such as for backup power for a shelter, and the relevant aspects of an MAA should stipulate the steps to deploy the V2X-enabled ESBs to the shelter.

Photo courtesy of Highland Electric Fleets

### B. Deploy V2X-Enabled ESBs

Assuming the parties are acquainted with one another and aware of the requisite coordination steps and mechanisms, these steps would be undertaken to implement the steps of the MAA that are relevant to the actual disaster implementation phase.

This would include communication between the parties to the MAA, and the deployment of the ESB to the pre-determined emergency site.

The timelines for the use of an ESB as the emergency management resource should already be written into the MAA or MOU. These time frames likely would be broken down into stages—typically focused on the first 72 hours (and likely also the first 24 and 48 hours) from the time the disaster strikes and/or an ESB as an emergency resource is requested, and the period that follows the initial 72-hour period. School districts and emergency management personnel should be cognizant of these time frames during an emergency because the first function of the ESBs is to transport children to school, and the ESBs likely need to be available to resume their transport duties following an emergency. However, should an ESB still be in use as a resource in an emergency/disaster situation, the emergency management staff should be able to provide other school buses (internal combustion engine or other alternative-fueled school buses) back to the local school district should schools resume their normal operations.

### C. Notify Utility of Use of V2X-Enabled ESB for Backup Power

Utilities, of course, typically are aware of the resources on their systems. Yet, several experts noted the importance of making the local utility aware of backup power resources being deployed, though they are in "islanded mode," so the utility can work with the school facility manager and its own personnel to prevent accidents when the grid goes back up ("live"), as needed. When a system is installed, the utility will inspect the automatic transfer switch and other components to make sure they are functioning and will avoid power possibly being able to be inadvertently routed back to the grid (referred to as "back-feeding" of power to the grid) during an outage, which could be dangerous from a load management perspective and, most especially, from a worker safety perspective.

### D. Island ESB: School Facility Manager/Electrical Engineer Islands ESB and Connects ESB to Building for Backup Power

This final step involves islanding the ESB and making sure the ESB is properly connected to the charger and the building.


Photo courtesy of Lion Electric Company

## IV. Steps Involved Following the Disaster (Recovery or Post-Disaster Phase)

Once the disaster is over and the power grid comes back "on line," the parties move into the recovery phase. This consists of the following steps:

### A. Notify Utility that the ESB is Being Disconnected from the School Building

With the example at hand, this step might not be necessary, but several interviewees noted the importance of providing such notification to the utility to ensure maximum safety for all involved. The person in charge of this step will be identified in the MAA.

### B. Disconnect the School Bus from the Building

Ensure there is no more discharging of power from the ESB to the school building and no "backflow" of power to the grid. Disconnect the ESB from its "islanded" mode.

### C. Determine the Amount of Power Consumed

The school facility manager or electrical engineer and/or ESB driver should determine how much electricity was used during the emergency for reimbursement purposes.

Photo courtesy of Highland Electric Fleets

### D. Recharge and Park the ESB (or Return to the School District or Contractor, If Necessary); Conduct Safety Check

If not already done, the ESB's battery must be fully recharged before or after being returned to the school district or contractor.

The ESB driver then parks the ESB at the school (in certain circumstances, the ESB driver might need to return the ESB to a different location, such as a school district lot or contractor lot).

The school's fleet operator should perform a safety check of the ESB, including a standard routine vehicle inspection, such as noting the tire pressure and general cleanliness of the ESB, before it embarks on a school route to pick up children.

This common-sense step ensures the vehicle operates as it did prior to the emergency. The charging infrastructure and school building also should be checked—in coordination with the local utility—to ensure the islanding, power restoration, and equipment functions all work as they did prior to the emergency.

### E. Compensation/Reimbursement

This step concludes the activity between the parties on the MOU or MAA for the particular disaster or emergency response situation. For local emergencies or disaster situations, the contract terms and payment, including the daily or per event rate for usage of the ESB as a resource, already will have been specified on the resource list and/or elsewhere in the MAA, so all that remains is for the emergency management staff to compensate the school district or ESB owner for the use of the ESB and the electricity consumed from its battery. This can be accomplished based on pre-determined rates or rate structures, which will be established in the MAA (for instance, based on kilowatt-Hours (kWh) used or on the percentage of decrease in the battery's charge (which can be determined when the battery is recharged). FEMA or a state's database also will provide the hourly or daily rate for personnel required to drive or operate the ESB and other requisite personnel to deploy and use the ESB as a mobile power unit.

### F. Assessment

Following the disaster and emergency response, the parties to the MAA should assess the efforts that worked well, and potential areas for improvement, including any outstanding needs and areas for improved coordination. The specifications for ESBs and associated equipment and personnel should be updated on the emergency resource list, if necessary.

## V. Conclusion

As the United States experiences more extreme weather events and plans for greater infrastructure resilience, ESBs should be one of the top resources federal, state, and local emergency management staff consider as a replacement for stationary diesel generators to provide emergency backup power during grid outages, including as part of a microgrid. ESBs have large batteries, predictable routes and usage times, and their mobility makes them even more well-suited to provide backup power during emergency situations.

To facilitate the widespread deployment of bidirectionally-enabled ESBs for resilience purposes, significant time and effort will be needed to educate federal, state, and local emergency managers, as well as school districts, electric utilities, transportation managers, and other relevant stakeholders regarding the potential for such uses. This guide and the MAA intend to educate and encourage stakeholders to consider ESB and V2X for emergency response situations and to lead to the adoption of the policies and structures necessary for their future use in such roles.

Given that federal funding for ESBs is increasing substantially, school districts, emergency management staff, and city and county officials are encouraged to work together to make agency staff responsible for distributing these funds aware that V2X-enabled ESBs can add value with their resilience capabilities. In doing so, the officials could help leverage the federal dollars, so they maximize ESB-related opportunities to deploy bidirectionally-enabled ESBs, particularly for resilience purposes. These funds also could go toward preparing shelters, hospitals, and other critical facilities and loads to accept V2X-enabled ESBs as backup power sources. This includes ensuring the relevant bidirectional charging capabilities and any additional software, hardware, or other equipment and services are installed and ready for use. Not only can ESBs provide a safe and healthy ride to school for the current and future generations, but these vehicles also can help all communities better withstand future disasters.

Using V2X-enabled ESBs for resilience purposes could, in turn, create additional opportunities for school districts, emergency managers, and/or other stakeholders involved or interested in leveraging such resilience efforts to pursue potential funding streams directed toward clean transportation, sustainability, and the use of resilient infrastructure for disaster preparedness, response, and recovery and toward the associated agencies, e.g., FEMA, via its HMP or BRIC programs that are designated for pre-hazard or hazard mitigation and enhanced resilient infrastructure. Examples also could include federal, state, and/or local funding programs, such as those created or modified in the Infrastructure Investment and Jobs Act (IIJA) or Inflation Reduction Act (IRA), some of which are mentioned throughout this guide, e.g., the U.S. Environmental Protection Agency's (EPA) Clean School Bus Program; and, the community portion of U.S. Department of Transportation's (DOT) National Electric Vehicle Infrastructure (NEVI) funding directed toward electric charging infrastructure. The IIJA also establishes several Department of Energy (DOE) grid resilience grant programs. In addition to serving as great facilitators, state energy offices also are possible avenues for ESB funding (depending on state priorities), and state and local transportation departments and environmental agencies also are potential sources for providing clean or resilient project or technology-related funds.

To elaborate further, ways in which the funds, including but not limited to those mentioned in the previous paragraph, could be "layered on top of" one another or used in a complementary manner also merit consideration. Doing so would create another "multiplier" effect that would leverage scarce public funds. For instance, federal, state, or local school bus funding could be "layered" with a DOE grid resilience grant and/or with FEMA funds. In addition, such funds could be combined with less commonly-considered funding sources by the stakeholders at hand, such as those available through the Department of Defense (DoD). One or more of these programs also might help serve as the required source of matching funds for another program. For example, DoD has program funding designated to increase the resilience of the communities that surround and support its military facilities, such as the Office of Local Defense Community Cooperation's (OLDCC) Defense Community Infrastructure Pilot (DCIP)[40] and Installation Resilience[41] programs. Adding or combining such DoD funds with funding from one or more of the aforementioned sources could not only leverage scarce resources but could unleash additional public-private partnership opportunities, as well. Such efforts could help accelerate the deployment of bidirectionally-enabled ESBs by reducing the total cost of ownership, which is a key concern for school districts contemplating fleet electrification. *Appendix E* discusses these and other funding opportunities in greater detail.

[40] Marine Corps Installations Command. "The Defense Community Infrastructure Program Invests Funds in Projects that Benefit Service Members and their Families." U.S. Department of Defense Press Release. March 7, 2022.
[41] Office of Local Defense Community Cooperation. "Installation Resilience." U.S. Department of Defense. 2021.

## Part II: Mutual Aid Agreement

Mutual aid agreements (MAAs) establish the terms under which one party provides resources—personnel, teams, facilities, equipment, and supplies—to another party. This MAA is intended to be the agreement between the electric school bus (ESB) owner (likely a school district) and the local city or county in charge of deploying emergency resources.

NIMS has issued guidance that enables many different partners and stakeholders to collaborate and coordinate to systematically manage resources—personnel, teams, facilities, equipment, and supplies. This guidance also facilitates the development of MAAs. It should be noted that mutual aid does not include direct Federal assistance or Federal response assistance provided under other department-/agency-specific authorities.

This framework below includes a template of an MAA that contains the elements that should be considered between the ESB owner and the local city or county. This template is illustrative. It should be modified to meet the needs of the parties involved. This template does not provide legal authority, advice, or direction and does not supersede any applicable legal authorities and constraints at any jurisdictional level. Entities should consult with their respective legal authorities or advisors before entering into a mutual aid agreement or compact.

*****In the roman numeral sections on the next page, template contractual text is in black; explanatory text is in *gray italics*; and gray fields in the template indicate where parties should fill in the details specific to themselves and their circumstances. Of course, parties must tailor the template to their particular needs and circumstances.**

## I. Purpose and Scope

A. Parties to the MAA

This Agreement is entered into between the [NAME PARTIES: __________ *(PARTY A - county or local emergency management office and/or school district official)*, __________ *(and PARTY B - ESB owner or contractor)*] hereinafter referred to as the "Parties," according to the terms and conditions set forth below.

B. Purpose

WHEREAS __________ *(PARTY A)* acknowledges grid vulnerabilities to natural disasters;
WHEREAS, the Federal Emergency Management Agency (FEMA) has recognized the importance of the concepts of State and local coordination, and all levels of government know the importance of emergency planning, preparedness, response, and recovery and coordination thereof;
WHEREAS, this Agreement may include provisions for the furnishing and exchanging of supplies, equipment, facilities, personnel, and services from __________ *(PARTY B)* to __________ *(PARTY A)*; and,
WHEREAS, the Parties to this Agreement wish to provide mutual aid and assistance to one another at appropriate times;[42]
WHEREAS, the intended purposes of this MAA are to:
(1) Reduce the vulnerability of people and property of this jurisdiction to damage, injury, and loss of life and property; and,
(2) Provide for cooperation and coordination of activities relating to emergency and disaster mitigation, preparedness, response, and recovery.[43]

Subject to the terms, conditions, and duration of this Agreement, the Parties agree to the following:

i. General scope of Agreement

ii. Top-line services being provided

iii. Benefits to participating Parties

[42] Some language is based on a "NORTH CAROLINA STATEWIDE EMERGENCY MANAGEMENT MUTUAL AID AND ASSISTANCE AGREEMENT," Revised May 2014.
[43] *Ibid.*

## II. Duration of MAA

This Agreement shall commence on ______ *(DATE)* and shall continue in effect through ______ *(DATE)*. Either Party has the option to terminate this Agreement with ______ *(NUMBER OF)* days' notice.

## III. Governing Law/Authorities

In providing the services hereunder, ______ *(PARTY B)* to this Agreement agrees to comply with all applicable laws and regulations.

A. Reference to the Relevant Legal Basis for the MAA

*Stipulate state laws, regulations, or local ordinances that will provide for/protect the general welfare of residents (could also reference the city or county sustainability or resilience plans).*

## IV. Relationships and Responsibilities of Parties

A. No Partnership, Joint Venture, or Employment Relationship

It is understood and agreed with respect to all services provided by ______ *(PARTY B AND ANY OTHER RELEVANT PARTIES)* that the services herein are performed not as an agent or employee of ______ *(PARTY A)* and that this Agreement does not represent a partnership or joint venture.

B. Operations for the Planning and Implementation of the Disaster Response Plan - "In Advance"

i. Provide ESB specifications: ______ *(PARTY B)* agrees to:

*Provide specifications for the ESB manufacturer, model and serial number, dimensions of buses available, available electric load and capacity, number of ESBs available for use, and other critical information as required by NIMS guidelines and/or state/local jurisdiction resource typing guidelines.*

ii. Update resource inventory: ______ *(PARTY A)* agrees to: Update emergency management resource inventory with information from ______ *(PARTY B)*.

iii. Establish charging terms: ______ *(PARTY B)* agrees to terms for charging the ESB ahead of any emergency/mutual aid response.

iv. Determine resource availability and logistics:

*The Parties determine the site where the ESB is parked; (routes to the school shelter location, if needed;) availability for deployment; and, guidance on maximum deployment time,[44] including any limitations on resource use, deployable area, state of charge, and need for availability to transport school children. The Parties also determine the estimated time needed to charge and otherwise prepare the vehicle for deployment.*

v. Establish compensation scheme:

*The Parties agree to the hourly or daily rates according to existing schedules or determine such schedules and agree to the terms for payment following an emergency as further outlined in Section VII.*

vi. Identify Key Personnel; Compile Contact Information and Means of Communication:

*The Parties formalize the personnel involved, provide contact information, means of communication before, during, and after an event, and other potential federal, state, or local requirements.*

C. During a Disaster

i. ______ *(PARTY A)* and/or (or through) a city or county emergency provider requests an ESB/emergency backup power.

ii. ______ *(PARTY B)* secures a driver, ensures the ESB is fully or sufficiently charged, and sends the ESB to the emergency shelter location.

iii. ______ *(PARTY A)* and/or the city or county emergency manager (or school facility manager) reaches out to the local utility to notify them of the use of the resource.

*(The ESB driver coordinates with the school facility manager or electrical engineer to connect the ESB to the building or load at the emergency shelter site.)*

D. Recovery Phase

i. The Parties coordinate the disconnection of the ESB with the local utility as a backup power resource.

ii. The Parties ensure safety checks and inspections are conducted.

[44] How much time the resource is needed, yet ensuring the resource is available to transport children, when that need arises post emergency; also relates closely to limitations on resource uses, including load drawn on the battery and reserve capacity needed; and likely will change over time.

iii. The ESB must be recharged and, if necessary, returned to its original location.

iv. Compensation or reimbursement occurs according to the pre-determined rates and terms.

E. Contacts/Authorized Parties

*Stipulate here or in an Appendix all relevant contacts and their contact information (recommended to use a chart format).*

## V. Deployment Notification Protocols/Procedures for Requesting Assistance

When ____________ *(PARTY A)* becomes affected by a disaster and deems its resources inadequate, it may request mutual aid and assistance by communicating the request to ____________ *(PARTY B)*, indicating the request is made pursuant to this Agreement. The request shall be followed as soon as practicable by a written confirmation of that request, including the transmission of a proclamation of local state of emergency under ____________ *(NAME STATE OR OTHER APPLICABLE LAW)* and a completed form describing ____________ *(PARTY A's)* projected needs, in light of the disaster. All requests for mutual aid and assistance shall also be in line with Section IV of this MAA.

A. Method of Request for Mutual Aid and Assistance

i. Requests routed by ____________ *(PARTY A)* (or through local agency): ____________ *(PARTY A)* may directly contact ____________ *(PARTY B)*, in which case it shall provide ____________ *(PARTY B)* with the information in paragraph B of this section. ____________ *(PARTY A)* shall then contact other parties (other county officials requesting aid or state emergency management personnel requesting aid) on behalf of ____________ *(PARTY B)* to coordinate the provision of mutual aid and assistance.

B. Required Information

Each request for assistance shall include the following information, in writing or by any other available means, to the extent known:

1. Stricken Area and Status:

*A general description summarizing the condition of the community (i.e., whether the disaster is imminent, in progress, or has already occurred) and of the damage sustained to date.*

2. Infrastructure Systems:

*Identification of the type(s) of public infrastructure system for which assistance is needed (i.e., electric power and load).*

3. Aid and Assistance:

*The number of ESBs and associated equipment, as outlined and pre-determined in Section IV (B) of this MAA.*

4. Meeting Time and Place:

*An estimated time and a specific place for a representative of Recipient to meet the personnel and resources of any Provider, as outlined and pre-determined in Section IV (C) of this MAA.*

C. State and Federal Assistance

______ *(PARTY A)* shall be responsible for coordinating requests for state or federal assistance with ______ *(PARTY B)*.

D. ______ *(PARTY A)* and ______ *(PARTY B)* shall comply with the pre-determined plans for using the ESB as a state and federal resource, as outlined in Section IV (B) of this MAA.

## VI. Reimbursement

This section should provide the terms of the compensation for the use of the ESB and associated equipment (i.e., EV charging station or use thereof) for emergency backup power and the payment mechanisms and structures by which ______ *(PARTY A)* will pay ______ *(PARTY B)*.

The Parties select from among the following options and agree to use the chosen payment structure(s) according to:

A) *An annual (subscription) fee for the use of the ESB; or*
B) *The duration of time that the ESB is used; and/or,*
C) *The cost associated with the amount of electricity discharged/used, including the up-front charging and re-charging during and/or after an emergency event.*

The Parties select from among the following options and agree to use the chosen payment structure(s) according to:

- *Conditions that would trigger the start of reimbursable time for the use of the ESB.*
- *Payment to the driver, i.e., at an hourly rate and/or as determined within this MAA.*
- *Payment to the driver, i.e., at an hourly rate and/or as determined within this MAA.*
- *Documentation requirements for all expenses.*
- *Other: these are costs that do not fall into one of the above categories.*

**VII. Confidentiality/Intellectual Property**

- *For security purposes, not all information within the MAA and emergency response plan should be shared publicly.*
- *This provision protects the ownership rights, including copyrights, patents, trademarks, etc. to the effort especially as V2X technology is developed.*

The Parties agree that any and all information, expertise, and data, whether written, oral, or graphical, which may be provided, created, or developed by either Party, pursuant to this Agreement (hereinafter collectively referred to as "Information") shall be used only for the purposes of carrying out the services hereunder and shall be treated as confidential and proprietary, unless developed for, or already in, the public domain. Such Information shall only be disclosed to persons or entities for the purposes herein.

In the event that either Party is required by judicial or administrative process to disclose any Information, the Party shall immediately notify the other Party before disclosing such Information.

**VIII. Dispute Resolution**

This Agreement shall be governed by, and construed in accordance with, the laws of ____________________ *(NAME GOVERNING STATE)*. If a dispute arises out of, or in connection with, this Agreement, the Parties agree to resolve it according to arbitration in the relevant court of jurisdiction.

**IX. Tort Liability and Indemnification/Hold Harmless Clause/Insurance/ Workers' Compensation**

A. Certification of Requisite Insurance Obligations

The Parties certify that they have the requisite insurance policies, such as liability insurance, workers' compensation, and other requisite coverages.

B. Hold Harmless Clause

The Parties shall indemnify and hold each other harmless from and against any damages, expenses, costs, and liabilities arising out of each other's negligent acts, omissions, or wrongful conduct in the course of performance of this Agreement, including, without limitation, the breach or failure of the warranties and representations set forth herein.

### X. Clause to Allow Modification or Amendment to the MAA

This Agreement represents the entire agreement between the Parties with respect to the subject matter hereof and supersedes all prior negotiations, representations, or independent agreements, whether written or oral. This Agreement may be amended only in writing, and any such amendment must be signed by both Parties.

Parties will deliver communications via electronic mail, certified mail, ____________________
*(AND/OR OTHER METHODS DETERMINED BY THE PARTIES)*.

### XI. Survivability Clause

If any provision contained herein is determined by an arbitration tribunal to be invalid or unenforceable, said determination shall not affect the validity and enforceability of the remaining provisions hereof. The Parties represent that they are not aware that any provision of the Agreement is invalid or unenforceable.

| PARTY A | PARTY B |
|---|---|
| | |
| Name | Name |
| | |
| Signature | Signature |
| | |
| Date | Date |

### ***Addendum:*** Emergency Response Plan—Operational Plan and Procedures

A. Emergency Response Plan
*Supplemental information based on the type of disaster, such as floods, heat, hurricanes, and so forth, are to be included here.*

B. Timeline for Implementation, Training, and Exercises

C. Mobilizing Resources

D. Performance Criteria and Metrics

# Appendices

## Appendix A: List of Organizations that Assisted with this Project

- Amply Power
- Beverly Public School District, Beverly, Massachusetts
- California Governor's Office of Emergency Services, Preparedness Branch
- City of Philadelphia's Office of Emergency Management
- Clean Energy Works
- Dominion Energy
- Energy New England
- Fermata Energy
- First Student, Inc.
- Generation 180
- Highland Electric Fleets
- Lion Electric
- North Carolina's Office of Emergency Management (Former Official)
- National Association of State Energy Officials (NASEO)
- Nuvve
- Oregon State Energy Office's Schools Program
- City of Phoenix, Arizona
- Proterra
- A Regional Transmission Organization/Independent System Operator
- Rhombus Energy Solutions
- Summit County, Colorado, Emergency Management Office
- U.S. Department of Transportation and Its Volpe National Transportation System Center
- Vehicle-Grid Integration Council
- World Resources Institute Electric School Bus Initiative Utility Engagement Pillar and Working Group

## Appendix B: List of Key Acronyms Used in This Guide

ESB: Electric School Bus
EV/BEV: Electric Vehicle/Battery Electric Vehicle
EVSE: Electric Vehicle Supply Equipment
NIMS: National Incident Management System
MAA: Mutual Aid Agreement
V2B: Vehicle-to-Building
V2G: Vehicle-to-Grid
V2H: Vehicle-to-Home
V2L: Vehicle-to-Load
V2X: Vehicle-to-Everything

## Appendix C: Uses for V2X-Enabled ESBs Other Than for Emergency Backup Power at a School as a Shelter

Bidirectionally-enabled ESBs also might be able to be used to power multiple sites during an emergency outage. The ability to have ESBs transporting students during normal, or "blue sky," days and then being available to serve as an emergency backup power resource during emergencies for resilience purposes further adds to their value.

Additional opportunities or use cases exist for deploying ESBs as mobile power units, notably including the following. These mobile power units could be used in conjunction with stationary backup generators to diversify and multiply the number of backup power resources available in emergencies. ESBs as mobile power units likely will serve as one of several backup power options to be considered for use in an emergency in addition to other more conventional solutions, such as stationary

V2X-enabled ESBs also could be used to power other critical infrastructure during an emergency. For example, they could be used to provide backup power to a hospital or other critical facility during an emergency for resilience purposes. In addition, they could be used to provide backup power to traffic signals at an intersection; at gasoline stations to power gasoline pumps for vehicles or to help provide fuel for other stationary generators; or, for other emergency backup power microgrid use cases.[45] V2X-enabled ESBs also could be used to support a mobile emergency response center serving plug loads, including power tools, lights, communications equipment, and so forth. Electric utilities (engaging additional partners as needed) also could use V2X for backup generation, such as during public safety power shut-off (PSPS) events that have occurred to prevent fires, and continue to occur, in California.

Other potential uses include the following:

- One or multiple bidirectionally-enabled ESBs could themselves be used as a "shelter," i.e., to provide heat and/or air conditioning as well as light to citizens experiencing an emergency;[46] and,
- ESBs also could be used to evacuate citizens out of a community or area that is experiencing, or is forecast to experience, a weather-related emergency.

Consequently, ESBs could be extremely beneficial in supporting overall emergency preparedness goals in a range of events that require backup power.

## Appendix D: Additional Resources

- WRI, Database of Electric School Buses
- Massachusetts Department of Energy Resources, *Mobile Energy Storage Study*
- VGIC, *V2X Bidirectional Charging Systems: Best Practices for Service Connection or Interconnection*
- WRI's Electric School Bus Initiative, "All About Managed Charging and 'Vehicle-to-Everything'" | WRI's Electric School Bus Initiative
- SAFE-EC, *Advancing Vehicle-to-Grid Technology Adoption: Policy Recommendations for Improved Energy Security and Resilience* report
- U.S. Department of Energy, EV Grid Assist Program
- California Public Utilities Commission, Vehicle Grid Integration Working Group
- WRI, Electric School Bus Initiative

Resources related to Mutual Aid Agreements:

- FEMA, *National Incident Management System Guideline for Mutual Aid*
- State of Kentucky, *Sample Mutual Aid Agreement* (download)

## Appendix E: List of Potential Federal Funding Sources for Procurement and Resilience Improvement

Funding at the federal, state, or local levels can be used for procuring an electric school bus and for bidirectional charging infrastructure. Depending on the funding source, it is likely that various sources could be "layered" on top of one another,

[45] To serve as a mobile backup power source in such situations, the ESB likely would require an onboard power outlet sufficient to match the power needs and/or some type of adapter. Or, a bidirectional charger could be situated on the same circuit as the traffic signal, etc. The U.S. Department of Energy defines a microgrid as a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously; information available at: https://www.energy.gov/articles/how-microgrids-work.

[46] Interviewees referenced this potential use case. Examples of transit buses being used as shelters for cooling and heating in Philadelphia and Washington, DC, respectively, can be found here: https://whyy.org/articles/philadelphia-four-cooling-bus-locations-heat-health-emergency/ and https://afro.com/gray-brings-out-warming-buses-to-protect-homeless-during-cold-weather/.

or used in conjunction with one another, to maximize the leverage of all resources. Sources of funding include programs at the Environmental Protection Agency (EPA), Department of Energy (DOE), Department of Homeland Security (DHS) (under which the Federal Emergency Management Agency [FEMA] is located), though programs under the Department of Defense (DOD) may be applicable as well. One or more of these programs also might help serve as the required source of matching funds for another program.

The EPA's Clean School Bus Program is an obvious, excellent source of funding for ESBs. The IIJA authorized $2.5 billion explicitly for ESB deployment, with another $2.5 billion allocated for clean school buses, with ESBs being eligible for this funding, too.

The IRA also included a new clean commercial vehicle tax credit, referred to as the Section 45W credit, that can apply to the purchase of ESBs. This credit is available for tax-exempt entities, such as schools, states, cities, or local governments, via a direct pay option that the credit offers. The credit amount is 30 percent of the "incremental" cost of a new ESB, up to a maximum of $40,000 for ESBs that weigh more than 14,000 pounds. IRS guidance for this credit is forthcoming.

Section 22004 of the IRA provides $9.7 billion through September 30, 2031 for the long-term resiliency, reliability, and affordability of rural electric systems. This funding is to provide financial assistance, including loans, for rural electric cooperatives to purchase renewable energy, zero-emission systems, and more to achieve greenhouse gas emissions (GHG) reductions. There could be opportunities for school districts to partner with their rural electric cooperatives to deploy V2X infrastructure, to the extent it would enhance grid resiliency.

Section 40107 of the IIJA modifies and extends a multi-billion dollar Smart Grid Investment Grant Program that originally was created a number of years ago, such that it now explicitly makes bidirectional charging technology eligible for these grants.

Sections 40101 and 40103 of the IIJA contain additional grid resilience grant programs directed at the public and private sectors.  Depending on how stakeholders structure their program applications, it is conceivable that bidirectional charging infrastructure could be part of these applications to help enhance critical infrastructure resilience.

The U.S. DoD has program funding designated to increase the resilience of the communities that surround and support its military facilities, such as through the Office of Local Defense Community Cooperation's (OLDCC) Defense Community Infrastructure Pilot (DCIP) and Installation Resilience programs.

Finally, FEMA has several programs under which bidirectional charging infrastructure, and, possibly, ESBs, could be eligible. Hazard Mitigation Assistance Program Grants provide funding for eligible mitigation measures that reduce disaster losses. Building Resilient Infrastructure and Communities (BRIC) grants also support states, local communities, and more to implement hazard mitigation projects, such as improving grid resilience.

These examples illustrate some of the many funding opportunities that exist for local governments, including school districts, cities, states, and, in some cases, private sector stakeholders or partners for those stakeholders that are involved or interested in pursuing V2X-enabled ESB projects for resilience purposes. Such stakeholders are encouraged to coordinate or collaborate to identify funding resources for which to apply separately or jointly, including evaluating those programs that could involve public-private partnership opportunities. In addition, stakeholders are encouraged to "layer," and other wise leverage, programs and funding resources to the greatest extent possible, as described earlier in this guide.

## Appendix F: Bidirectionally-Enabled ESBs Electric Vehicle Supply Equipment (EVSE) Procurement Procedures

There are a number of helpful tools to assist school districts with procuring ESBs.

First, the Electrification Coalition (EC) has a number of resources for adding electric school buses to a school or district's fleet. The EC's free, publicly-available "Dashboard for Rapid Vehicle Electrification" (DRVE) tool shows the total cost of ownership for incorporating electric school buses into the school fleet.

WRI's *Electric School Bus Initiative* has multiple resources that range from a technical assistance menu, sample slide decks to pitch the procurement of electric school buses, an ESB buyer's guide, and much more.

Current ESB manufacturers also have helpful resources on their websites, including those of:

1. Blue Bird;
2. BYD;
3. Lion Electric;
4. New Flyer;
5. Proterra; and,
6. Thomas Built.

In addition, a number of vendors supply V2X technology and aggregation services. Some examples include:

1. Ampcontrol;
2. Bp Pulse Fleet;
3. Fermata Energy;
4. Highland Electric Fleets;
5. Nuvve Holding Corp.;
6. Rhombus Energy Solutions; and,
7. Synop.

Electrification Coalition

*The Electrification Coalition is a nonpartisan, nonprofit organization that advances policies and actions to facilitate the widespread adoption of plug-in electric vehicles to overcome the economic, public health, and national security challenges that stem from U.S. oil dependence.*

SAFE

*SAFE is a nonpartisan, nonprofit organization committed to strengthening U.S. energy, economic, and national security by advancing transformative transportation and mobility technologies and ensuring that the United States secures key aspects of the technology supply chain to achieve and maintain its global strategic advantage. The transition to a more electrified transportation future calls for a more resilient, reliable, and secure electric grid, which is the focus of SAFE's Grid Security Project. SAFE is aided in its work by an advisory group called the Energy Security Leadership Council, which consists of retired four-star military leaders and senior business executives.*