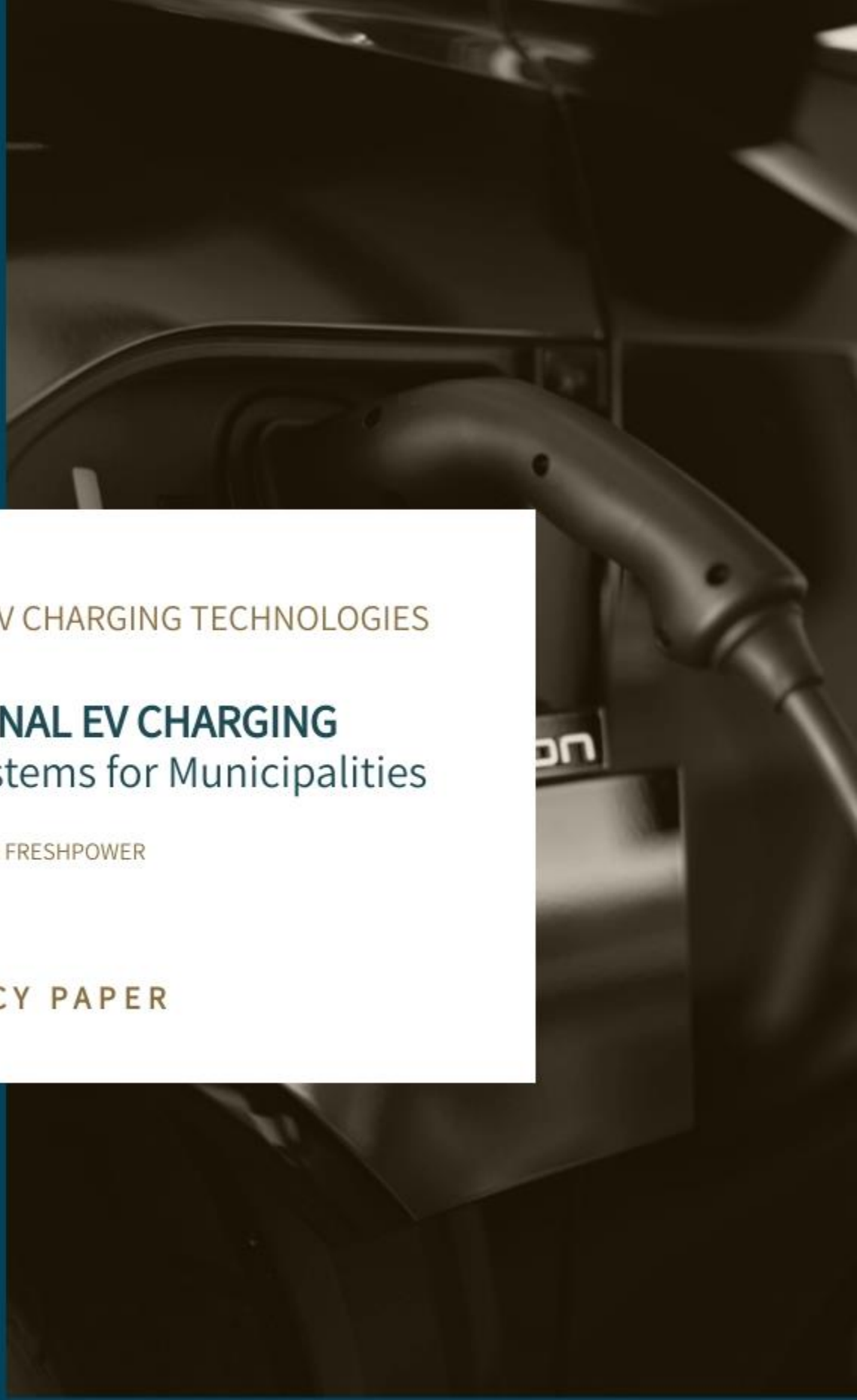
TEXZON UTILITIES



V2B AND V2X EV CHARGING TECHNOLOGIES

BIDIRECTIONAL EV CHARGING
Security Systems for Municipalities

IN ASSOCIATION WITH FRESHPOWER

COMPETENCY PAPER

TABLE OF CONTENTS

ABSTRACT

Texzon Utilities and BorgWarner delivers the only UL-Certified bi-directional V2G / V2X / V2B capable chargers in the U.S. marketplace.

Vehicle-to-grid (V2G) technology adds resiliency to the power grid and provides revenue-making opportunities for electric school bus and commercial fleet operators. The technology allows electric vehicles to store energy from the grid and return it to the grid when it is needed, allowing for a more reliable and efficient power grid. Additionally, V2G technology helps reduce carbon emissions and enables school buses and commercial fleet operators to monetize their electric vehicles. By connecting their vehicles to the grid, fleet operators can earn money from energy providers for providing energy back to the grid during peak times. This helps reduce the strain on the grid and enables energy providers to meet demand more efficiently.

Made in the USA

Applicable for securing government funding.

Charging for All Vehicles

DC fast chargers designed for convenient charging of electric vehicle models from passenger vehicles to heavy-duty equipment with high-voltage battery systems.

Scalable Design

Individual modules for the PCS and dispenser facilitates future expansion and easy site layout planning.

Flexible Mounting

Floor/pedestal or wall-mounted dispenser options.

Certified Bidirectional

BorgWarner chargers are UL-certified bi-directional chargers for V2G applications.

Wide Range

A wide output voltage range of 270 – 920 makes our chargers ready to handle batteries of all sizes.

Exploring the Use Cases for Vehicle-to-Grid (V2B/G)

The concept of V2B (Vehicle to Building) is straightforward – it allows energy to be taken from vehicles and put back onto a municipal or first responder building or the grid. There are two main scenarios of interest for V2:
•Using vehicle power to establish a grid (typically for a critical building or first responder vertical) during power outages; this is known as vehicle-to-building (V2B). Looking primarily at V2G (Vehicle to Grid) for municipal fleets, since V2B is generally an "emergency" and egress conditions. While any EV could theoretically be utilized for V2B (or V2G), the vehicles that are of most interest are medium- and heavy-duty (M/HD) EVs such as busses. Thus, busses deploy as rolling "power" and provide a dual purpose of municipal value and on-call 24/7.
•Using vehicle power to mitigate the impact of peak usage on both the grid (reduced generation needs) and on energy prices (lower municipal bills because of peak demand usage)

M/HD EVs have significant battery capacity (150kWh to well over 600kWh), the fleets have robust DC fast charging infrastructure (with charging capacities of 60kW up to 500kW), and fleet operating hours that are generally complimentary to peak hours. A recent study by the US Public Interest Group (US PIRG) has predicted that V2B and V2G can reduce the lifecycle costs of an electric school bus by up to $130,000; with a 12-year lifespan, that is about $11,000/year.

The two primary impacts that V2B/G has on M/HD EV use cases are: i) it *potentially* shortens the window for charging; and ii) during this shorter window, the vehicles of interest may need to be fully charged. We say "potentially shorter window" because in most cases, fleets avoid charging during
peak usage hours because of the increased energy costs. The impact of having to fully recharge a vehicle is easier to quantify. With a charging window of 9pm-5am (8 hours), a 675kW public transit bus would need a charger that can put nearly 85 kW of power into the bus per hour. Since these vehicles are generally run to 80%-90% of their battery capacity (68kWh-100kWh of remaining charge), V2B/G requires an increase in charging capacity of roughly 10 kW (i.e., a non-V2G bus could utilize a 75kW charger vs the 85kW charger needed for V2B/G). For an electric school bus, V2B/G would increase the charging required from 125kWh in non-V2G mode to 150kWh in V2G mode – an increase of 25kWh, or 3kW per hour over an 8-hour charging window. In both the public transit bus and school bus use cases, the impact of V2B/G is relatively small – an increase in charger capacity of only 10%- 17%. Of course,
the main requirement is that the charger can operate in **bidirectional** mode.

Texzon Utilities' bi-directional EV charging systems (which are designed from the start for the needs of fleet operators) are **designed and built in the USA**. BorgWarner also excels in the design of high-power smart inverters for next-generation renewable energy and energy storage deployments. Our expertise in energy management system (EMS) software is also embedded in our VectorStat EMS controller and software which is embedded in our EV charging systems and smart inverters. We have built over a thousand V2G-capable high-power, high-reliability chargers and bi-directional smart inverters for a variety of different sizes and classes of EVs.

V2B/G Improves Total Cost of Fleet Ownership and Grid Resilience

The future of EV infrastructures will include Vehicle-to-Grid (V2B and V2G) capabilities using bi-directional chargers to reduce the cost of fleet ownership while providing a viable safety and security system for your constituents in the case of grid failure or natural disaster. Fleet vehicles are uniquely suited to V2G applications due mainly to predictable usage patterns and the fact that they often return to base at the end of the working day, where they sit idle overnight. Regular charging patterns provide the perfect condition for V2B/G applications by allowing the use of stored energy during specific periods while planning enough time to charge vehicles again for the next day. This will be a crucial feature for reducing the cost of fleet ownership by enabling fleets to sell energy, safety, first responder resiliency, including from renewable sources to meet sustainability goals.

Financial Impact

V2B/G takes the unused energy in an EV's battery, puts it back onto the grid during peak demand hours, and then recharges the vehicle during off-peak hours (typically 9pm-9am). The energy put back onto the grid during on-peak time of use (TOU) hours allows the vehicle operator to get a premium for that energy and recharge at cheaper rates. As an example of potential cost savings, San Diego Gas & Electric (SDG&E) charges less than $0.24 per kWh during super off-peak TOU and almost $0.60 per kWh during on-peak TOU, double the price (prices from June 1, 2022, Time-of-Use Plans). The impact of V2B/G on electric vehicle fleet energy costs can be substantial, but the impact on the choice of EV charging infrastructure is also noteworthy. This is because both the energy used by the vehicle and the energy put back onto the building or grid during peak hours must be recovered to charge the vehicle fully. Maximizing infrastructure uptime is critical for a successful implementation. Considerations for selecting capable electric vehicle supply equipment (EVSE) for a V2B/G infrastructure are listed further in this paper.

Grid Resilience

Both extreme weather and peak loads constantly challenge the utility grid's resilience. Recent events underline the need for backup power storage, such as Hurricane Katrina, Hurricane Ida, Hurricane Sandy, Hurricane Sally, the Texas cold snap of 2021, and the extreme heatwave of 2022. Power outages during these events reveal vulnerabilities of our emergency power systems which can be critical hospitals, nursing homes, and other healthcare facilities. The potential power available from EV fleets can help manage disruptions as they unfold and mitigate the impact of power outages on communities. Utilities realize V2G potential for adding grid stability and are implementing incentives for fleets. For example, Pacific Gas & Electric (PG&E) is planning to pay up to $2 per kWh for emergency use.

V2G Infrastructure Considerations

Fleet operators must consider several factors when planning a V2G-capable charging infrastructure. Equipment is the first consideration. Fleets must be equipped with vehicles and Electric Vehicle Supply Equipment (EVSE) that support bidirectional charging. Operators will need UL 1741-SA certified Level 3 DC fast chargers (DCFC), such as displayed here, which run on 480 3-phase power. Fleet operators should also reach out to a utility rep to find out about any potential upgrades that may be required because of the new loads from EVSE, such as a new service line or an upgraded distribution transformer. Your local utility may offer EVSE rebates to reduce the capital cost, so it's important to contact a rep early in the V2G infrastructure planning process. Other considerations include determining site layout, future planning, and steps to mitigate installation costs.

V2G Infrastructure Planning – Top 3 Considerations

Using Vehicle-to-Building / Grid (V2B/G) technology, commercial EV fleet operators can support grid resiliency and maximize renewable energy sources while adding monetization opportunities by selling energy back to utilities. However, the greater value is providing power to first responder verticals and city hall during natural disasters and/or grid failures. V2B/G essentially allows fleets to store energy in EV batteries and discharge it back into the building or grid. Using the additional energy source from fleet EVs can help stabilize energy conditions, provide power in emergencies, and alleviate the need to start up additional energy and power sources. The energy fleet operators can provide to the grid, or buildings could offer revenue. Texzon partner, BorgWarner chargers are successfully supporting several V2B/G programs, and each commercial EV has the potential to make thousands of dollars per commercial EV. Through successful testing and V2B/G pilot programs, we uncovered three implementation considerations when creating a full-scale V2B/G fleet infrastructure.

Site Layout and Future Planning

Our DC Fast Chargers are designed for fleets of all types and leverages installed V2B/G charger to provide energy and power when needed – no new infrastructure. Fleet operators should consider site layout for future planning when developing a V2B/G charging depo. Taking steps during the initial layout phase to accommodate future fleet growth will substantially mitigate installation costs for the additional units. Texzon engineering with BorgWarner chargers can be installed in a daisy-chain wiring architecture so that a single charger can accommodate up to five power dispensers or in a 1:1 Power converter: dispenser ratio to maximize power/energy delivery back to the grid or critical load. Even if you only need two charging spots now, you can plan and layout your depot floorplan to provide enough space to add three chargers when your fleet grows incrementally.

Commercial EV and EVSE

Equipment is the crucial consideration to make V2G work. Fleets must be equipped with Electric Vehicles (EVs) and Electric Vehicle Supply Equipment (EVSE) that support bidirectional charging. Operators will need UL 1741-SA certified Level 3 DC fast chargers (DCFC), such as RES-DCVC125-480 chargers and RES-D3-CS20 dispensers, which run on 480 3-phase power. Both vehicles and charger will need to support a compatible discharge protocol. Emerging into the market is the ISO15118-20, the follow-on to ISO15118-2 edition 2.-20 enables a standard method for V2G. Both vehicle and charger must support this standard. Contact a Texzon advisor at 912-256-8077 for additional information.

Utility Relationship/Interconnect Agreement

Reach out to the utility early with plans and power requirements. Note that a utility interconnect agreement must be in place. Fleet operators should also reach out to a utility rep to establish an interconnect agreement that ensures they will buy power back if seeking a V2G (vehicle to grid) program. Utility reps will provide information about potential upgrades that may be required because of the new loads from EVSE, such as a new service line or an upgraded distribution transformer. Your local utility and state may also offer EVSE rebates along with federal incentives to reduce the capital cost, so it's recommended that you contact a rep early in the V2B/G infrastructure planning process.

What Is V2B (Vehicle to Building) and V2G (Vehicle to Grid)?

Vehicle-to-grid (V2G) technology allows an EV to both draw energy from the grid (typically during periods of low cost and low demand) and discharge energy back to the grid (during periods of higher cost and high demand). Highland Electric Fleets (Highland) -- in partnership with BorgWarner, Thomas Built Buses, Proterra, and Synop -- is pioneering commercial V2G technology for electric school buses (ESBs), which supports community safety, first responders, grid stability, and reduces the cost of fleet electrification for school districts & fleet operators.

Bidirectional V2B/G Charger

Available for either 60kW or 125kWPower with Uni-Directional Only Operation.

- 60kW or 125kW Power with Uni-Directional Only Operation
- 270Vdc to 870Vdc Output Range
- Continuous Operation at Rated Load
- Remote Operation (up to 600 ft) (applies to 60kW variant)
- UL2202 & UL 2231

Downloads

RES-DCVC125-480 EV DC Fast Charging Power Conversion System (PCS) Product Sheet

RES-DCVC60-480 EV DC Fast Charging Power Conversion System (PCS) Product Sheet

Bidirectional Dispenser

- Up to five (5) dispensers per PCS
- 200A maximum rated current with bi-directional operation (V2G capable)
- 270V to 920V output range
- Continuous operation at rated load
- Remote operation (up to 600 ft)
- Floor-or Wall-Mountable

Downloads

RES-D3-CS20 Electric Vehicle DC Fast Charger Dispenser Product Sheet

EV Chargers

Texzon network partner, BorgWarner-Rhombus is a leading supplier of EV chargers for Electric and Hybrid battery power applications.

Our portfolio includes a full range of DC Fast chargers, DC stations, hybrid chargers, high-frequency chargers, battery recovery and multi-voltage chargers that provide customers with full-function solutions.

Automotive applications

- DC Fast Charger IPERION-120
- DC Fast Charger Dual-Port 120 kW
- Bidirectional V2G charger
- Bidirectional dispenser

Industrial applications

- DC station
- Hybrid charger
- High frequency
- Battery discharger
- Multi-voltage charger
- Ferro Resonant charger

DC Fast Charger Solution: Dual-Port 120 kW

Features / Benefits

- Charge Two EVs Simultaneously
- Power Two 60kW Channels or One 120kW Channel with Uni-Directional Only Operation
- 250Vdc to 920Vdc Output Range
- Continuous Operation at Rated Load
- Remote Operation (up to 500 ft)

Downloads

120 Modular DC Fast Charging System Product Sheet

DC Fast Charger IPERION-120

At 120kW power size, IPERION-120, the fast-charging station for automotive applications by BorgWarner, can charge one vehicle at full power, or two vehicles simultaneously at a maximum power of 60kW each.
With an output voltage range from 200Vdc to up to 900Vdc, the DC fast charger enables the charge of any vehicle size and of future generation batteries.

Features / Benefits

- Two completely isolated and independent 60 kW rated (200 A continuous) chargers, that, if needed, can be combined, and parallelized to deliver 120 kW on a single plug (200 A max)
- 94% efficiency, power factor > 0.97
- Compatible with standard charging protocols in Europe and North America (CCS, Chademo and GB/T)
- Output voltage up to 900Vdc
- Operates up to an altitude of 4.000m and between -30°C and +50°C
- Flexibility of configuration
- Long life span (>10 years)
- OCPP 2.0.1
- Ethernet, Wi-Fi, and Bluetooth communications support
- Credit card reader with several payment model options

Downloads

DC Fast Charging Station IPERION-120 Product Sheet
DC Fast Charging Station IPERION-120 Brochure

CONCLUSION

Vehicle to Building (V2B) and Vehicle to Grid (V2G) provide municipalities, fleet owners, and industrial campuses the ability to provide power through Medium and Heavy Duty EVs to identified verticals such as first responders, municipal buildings, healthcare facilities, cold storage, and critical manufacturing environments.

Utilizing electric school busses as "rolling power sources" to maintain operations when grid failures occur provides your constituents and stakeholders safety, security, and operational resiliency. The Texzon team can walk you and your team through the incentives, grants, and rebate programs which are currently available to offset system and bus capital expenses.

Commercial Energy | Texzon Utilities | United States