Bi-Directional Charging for EV Fleets

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Who is Rhombus Energy Solutions?

• Rhombus is an industry leader in advanced power conversion, providing made-in-the USA solutions for:
  • AC-DC Systems for Transportation Electrification
  • Energy Storage Systems For Charging Support / Power Load Leveling
  • Microgrids, w/ Integrated Command / Control energy management

• Rhombus is headquartered in San Diego with a high-power testing lab and manufacturing in Dearborn as well as an India design center.

• Our expertise is developing bidirectional high-power inverters for renewables, energy storage and microgrids… enabling V2G charging

• Our products are easily customized for specific EV OEMs and fleet requirements

• Rhombus has deployed over 820 systems worldwide

Rhombus is the expert in V2G charging systems for EV fleets
Why is V2G Compelling for EV Fleets?

- An 85kWh EV auto can store 3 days of power consumed by a US home

- A 155kWh EV school bus can store 5 days of power consumed by a US home

- A 600kWh EV transit bus can store 23 days of power consumed by a US home

This battery capacity represents “money in the bank” for school bus operators
Requirements for V2G Charging Infrastructure

“Smart” bidirectional charger provides the gateway to the utility grid connection
  • It controls power flow/direction, and communicates to the aggregator, the utility grid, and the vehicle.
  
  • V2G chargers must have multiple communication paths
    • Measuring, Monitoring, and Metering requirements for demand energy or behind the meter factory demands
    • Advanced electric vehicle communication link (ISO15118)
    • Aggregator platform and back-end service provider connections

  • V2G chargers must meet a significant number of certification standards
    • Eg: UL 1741-SA, IEEE1547, UL 2202, UL 2231, UL 9741…

Other Requirements:
  • Enough capacity to charge the vehicle in a reasonably short window
  • Industrial rated design to reliably operate at full power continuously day and night
  • Easily maintained and serviced if problems occur.
  • Remote diagnostics/prognostics to reduce downtime and prevent issues before they happen.
Deploying V2G for School Buses

- Equipment installation guidelines:
  - Install PCSs (refrigerator-size unit) out-of-the-way near incoming grid feeds
  - Install dispensers near bus charging ports
  - Dispensers can be up to 600 ft away from PCSs
  - Install one dispenser for each bus
  - Optimal - 1:1 ratio of PCSs to dispensers
    - If not 1:1, multiple buses will charge “round-robin” from a PCS
    - BUT this impacts V2G operation
  - PCS should be sized to fully charge bus(es) in no less than 6 hours
    - Rhombus recommends 60kW chargers – can charge a single bus in 2-1/2 hours (150kWh bus battery)