

WHITE PAPER

eBus Charging: a (very brief) primer



Understanding the many tradeoffs in charging system design is essential for any transit operator contemplating a shift to electric drive.

It's an exciting time to be in the transport business. With battery costs coming down and energy densities going up, Bloomberg New Energy Finance predicts electric vehicles will reach cost parity with conventional cars within the next five years. Amid all the hype around EVs and driverless cars, though, it's easy to overlook the impact that electrification can have on public transit.

Buses are just another type of EV, but with battery packs ten times the size of a typical passenger car (or more), and as part of a larger transit system, they have unique requirements. Understanding the many tradeoffs in charging system design is essential for any transit operator contemplating a shift to electric drive.

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First, let's define the three types of charging for buses:

- **Depot** charging happens... well, at the depot, usually overnight. Chargers in these applications can be either AC or DC and they run at relatively low power levels (10kW– 150kW) because they have 5-8 hours to fully charge the bus's battery.
- **Terminal** charging happens during the day at a depot or remote terminal location, and is typically defined as taking no more than two hours.
- En-route charging, as the name implies, occurs when the bus stops momentarily to pick up and drop off passengers. These applications require higher power to deliver a useful charge in such a short time, so to date all en-route chargers use DC and operate between 150KW and 600KW.

We should note here that while several en-route charging designs use overhead connections, retrofitting overhead charging on a bus that was manufactured without it, is complex and adds cost. This is one of a number of challenges—standards for charging connections is another—that suppliers of eBus rolling stock and charging infrastructure alike are working to overcome.



Transit operators are similarly in an early stage of adoption with regard to electric bus fleets. Choosing the right mix of charging schemes, buses, maintenance schedules and support systems is a daunting task, especially during the transitional phase when you might be running diesel, hybrid and all-electric vehicles simultaneously. In planning a charging approach, though, there are some important things to consider.

The system itself should have as small a footprint as possible, with extra points awarded for modular units that can scale easily by simply adding cabinets. An automated connection system, remote management capability and built-in redundancy are all highly recommended.

Something else to consider is energy storage. The batteries in the buses aren't the only ones benefitting from the rapid advancement of technology, and strategic use of wayside energy storage systems can help address peak demand and ease integration with the surrounding grid. Ultimately, though, having the right charging technology (or technologies) in place is something that transit operators will likely revisit often as they navigate the transition from fossil fueled vehicles to electric ones. Service needs will change, and technologies will continue to advance. And there's always regulation....

The best advice for transit operators is to take a holistic approach and account for the full range of forces that impact system performance and cost. Pulling together engineering assessments, utility rate structures and even the topography of the service territory won't be easy, but this too should get easier as the sector advances.

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