TLA – CTCE – V2G Power

Buses are Lining Up to Sell Power to the Grid Using V2G

The need for energy is both the culprit and the solution for combating climate change. Reducing our energy needs is a non-starter - managing what we have is the key. And it seems appropriate that ground transportation, which has been a primary source of carbon emissions, may soon become one of the biggest contributors of reliable energy to the grid.

Vehicle-to-grid (V2G) technology will be needed as more buses, trucks, and cars go electric. With V2G, electric vehicles (EVs) share energy with the power grid while plugged in, offsetting local energy production and balancing peak electricity consumption.

A study predicted that by 2050, 25 gigawatts more energy will be needed in the UK. With smart charging, only 10 gigawatts more will be needed. However, with smart charging and V2G deployed, 5 gigawatts less than what is being produced today will be required.

Canada is responsible for less than 2% of greenhouse gases but is still one of the highest per capita emitters in the world. According to the Canadian Climate Institute, emissions have been declining in buildings, electricity, and agriculture, but emissions from transportation have been climbing, up 7 metric tonnes of carbon dioxide equivalent in 2021, an increase of 4.9%. Using mass transit helps reduce emissions, but buses and trains are still big polluters. Independent research shows that trains have the lowest carbon emissions at 177 grams of CO2 per passenger mile, while buses produce 299 grams per passenger mile and cars 371 grams.

The more EVs replace diesel- and gas-powered vehicles, the fewer carbon emissions and the more opportunity to optimize energy use with V2G technology.

What is V2G/B2G? History

In 1997, Willett Kempton, a professor at the University of Delaware, and Steve Letendre, a professor at Green Mountain College in Vermont, published a series of journal articles imagining the bidirectional EV as a resource for electricity utilities. The researchers estimated that, if applied to the task of generating electricity, all of the engines in the U.S. light-duty vehicle fleet would produce around 16 times the output of stationary power plants. Kempton and Letendre also noted that the average light vehicle was used only around 4 percent of the time. Therefore, they reasoned, a fleet of bidirectional EVs could be immensely useful to utilities, even if it was only a fraction of the size of the conventional vehicle fleet.

Vehicle-to-grid (V2G) and vehicle-to-building (V2B) technology was eventually developed so electric vehicles could exchange power with the grid. The bi-directional system enables two-way charging, so in addition to recharging the electric vehicle, the system also allows energy stored in the vehicle battery to flow back to the grid to offset demand. In the wake of the Fukushima

nuclear disaster in 2011, for instance, Nissan developed and marketed a vehicle-to-building (V2B) charging system that enabled its Leaf EV to provide backup power.

V2G systems can also help address the problem of storing renewable energy. Unlike fossil fuels that release energy as they burn, renewable energy sources such as solar and wind power must consume the energy as it's produced or store it for later. As renewable energy production increases, the need for reliable energy storage increases to offset times when renewable energy is unavailable, e.g., at night for solar or on a calm day for wind power. V2G converts EVs to an extension of renewable energy storage.

V2G or B2G (bus-to-grid) technology is ideal for fleets of buses and trucks, and these are finally being produced at scale. Electric bus power systems generally fall into one of two categories: long-range or fast charge. Long-range buses have bigger batteries (250-660 kWh) and are designed to be charged once a day. Fast-charge batteries (50-250 kWh) are better suited for EVs like electric school buses with shorter routes that can be recharged between shifts. Canada has more than 600 zero-emission buses in service at the start of 2022 (not including school buses), with plans to have 5,000 zero-emission buses in service nationwide by 2025. E-bus sales are growing faster than any other segment and will make up 67% of the global bus fleet by 2040.

As more electric buses enter service, more transportation companies will adopt V2G technology for its revenue and environmental benefits.

The Move Toward V2X

V2G requires EV owners to replace conventional charging stations with more sophisticated charging systems. The EV industry currently offers different charging solutions:

- **V1G Smart Charging** – V1G is often called unidirectional smart charging, i.e., recharging batteries from the grid. These chargers are "smart" since they can dynamically charge EVs based on electricity rates and times to take advantage of lower energy costs. With V1G, the EV communicates with the charging station for safer charging and to optimize recharge times.

- **V2G Vehicle-to-Grid** – V2G evolved from V1G and adds the bidirectional feature. Communications systems balance the power exchange with the grid, throttling power to recharge EVs at optimal rates or selling excess EV battery power back to the grid.

- **V2B/V2H** – Vehicle-to-Building or Vehicle-to-Home (V2B/V2H) supports an energy exchange between EVs and a specific building or location. V2B technology can supplement sustainable power sources, such as solar power. It can extend a building's power storage to provide power when needed, such as during a blackout. For example, Tepco, a Japanese electricity utility, has a bidirectional charger capable of using 10 Nissan Leafs to power 1,000 homes for one hour. In Oakland, the California Energy

Commission is using V2B technology at the West Oakland Public Library to power filters in unhealthy air conditions and provide backup power during rolling blackouts.

As EV technology gains momentum, so will V2G technology. Electric car sales are expected to break new records, with sales of 14 million EVs expected in 2023, representing 35% year-on-year growth.

And to meet this demand, CTCE is about to embark on a proof-of-concept project, to create one of the first bi-directional hubs, a true V2G endeavor, with the hopes of expanding capacity to locations across Vancouver and beyond.

So, the next time you take a municipal electric bus, consider that your bus fare may support sustainable energy. Recharging that bus may help offset electrical fees or keep the lights on during the next blackout.