

Appendix M
**Battery Electric Truck and Bus Charging Cost
Calculator**

This rate calculator estimates annual electricity costs for battery electric truck and bus deployments at a given utility meter. For ease of use, the calculator is pre-populated with several utility rate schedules, charging strategies, and charging time periods. The user can select from these or add additional, rate schedules, charging strategies, and charging periods as needed.

The cost estimates are for the entire electrical load at each meter using weekday utility rates and includes the monthly meter fee, but does not include lower weekend rates nor local taxes and fees that are unique to a given customer. The pre-populated electricity rates are for “secondary voltage” which is the most common rate category. We recommend that users read a summary of electricity rates to understand basic rate structures and terminology before using this tool. The tool addresses time-of-use rates or tiered electricity rates and will be updated periodically with new rate structures or schedules. Blue shaded cells are user input fields and are modifiable.

The "**Rate Calculator**" sheet can be used to estimate monthly charging cost for a wide range of daily mileage, fleet size, chargers, and utility rate schedules where the charging period and daily usage is constant each month.

The "**Monthly Rate Calculator**" sheet allows for estimating monthly variations throughout the year including changes in daily miles, charging periods, and vehicle energy usage. This allows the user to account for seasonal variation in vehicle usage, heating and AC loads, or other scenarios. The results for each month can be expanded to see a detailed breakdown of the components of the monthly cost.

The "**Data**" sheet includes all pre-populated input values and allows for additional user inputs of utility rates, charging strategies, and charger ratings.

Input Selection Options

This section describes key input selection used in the electricity cost calculations.

Utility Rate Schedule

The utility rate schedule for your facility depends on the facility’s utility provider and maximum demand throughout the year. Generally, there are multiple rate schedules per utility and the one that applies to the facility will depend on the highest demand drawn throughout the year.

Charging Strategy

Charging all vehicles simultaneously reduces the total charging time necessary, but also results in the highest demand charges for a given charger rating. Demand charges are

based on the highest kW demand during any 15 minute interval in the monthly billing period. Demand charges can be reduced by limiting how many buses are charged at the same time (if in the depot for 8 to 10 hours) which is modeled in the “Depot Managed” option or by selecting the lowest kW charger needed to charge buses overnight in the time available.

“Unmanaged Charging” assumes that during the month, all vehicles will be charged simultaneously in the depot and results in the highest demand for the charging period selected. Demand charges can potentially be lowered by downsizing chargers in an unmanaged strategy.

“Managed Charging” automatically determines if vehicles can be charged in sequence in the depot during the selected charging period which can result in lower demand (and lower demand charges) than charging all vehicles at the same time. If the time available to charge is not long enough to stagger charging, then the maximum demand is used.

“On-Route X of 15 Min” allows multiple buses on one route or on intersecting routes to use the same on-route charger where the buses commonly charge for about 5 to 10 minutes at a time rather than charging solely overnight in the depot. On-route chargers generally deliver far more power than depot chargers, up to or above 500 kW. Due to charging time and logistics, 8 buses per charger is assumed to be the upper limit.¹

For on-route charging, charging time refers to the total amount of time in a 15-minute demand-metering period that the charger is drawing electricity. Monthly demand is determined based on the maximum average demand in any 15-minute period during the month. On-route-charging buses will typically charge for about five minutes, according to NREL data from Foothill Transit. It is possible, however, for two buses to connect to the charger in one 15-minute demand-metering window. This could yield up to a 12-minute charging time. Charging at full power for a full 15 minutes and realizing demand equal to charger power is very unlikely for 500 kW charging.

Charging Period

For depot charging, some charging will likely occur during mid- and possibly during on-peak hours, especially if extending range between trips by charging midday, but charging during the night during off-peak periods is expected to be common. The user can select from several predetermined charging time windows (e.g. “Evening”, “Late Night”, “Day Time”, “Tripper”) that best represent when the vehicles at the location

¹ Federal Transit Administration (FTA) (2014). Peak Demand Charges and Electric Transit Buses. White Paper. October 1, 2014. Available: http://www.calstart.org/Libraries/Publications/Peak_Demand_Charges_and_Electric_Transit_Buses_White_Paper.sflb.ashx.

would be available to charge. For depot charging, the percent of the fleet that is available to charge can be input for each hour of the day (0% means no charging occurs during that hour). Charging strategies can be modified in the “User Defined” rows to more accurately represent an operator’s expected usage. If only a portion of the fleet is expected to be available to charge, a percentage less than 100% can be entered into the “Charging Period” table.

Reference List M

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code section 11346.2, subdivision (b)(3). Additionally, each appendix references the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

Note: Each “Explanatory Footnote” is a footnote containing explanatory discussion rather than referencing specific documents relied upon.

1. Federal Transit Administration (FTA) (2014). Peak Demand Charges and Electric Transit Buses. White Paper. October 1, 2014. Available: http://www.calstart.org/Libraries/Publications/Peak_Demand_Charges_and_Electric_Transit_Buses_White_Paper.sflb.ashx.