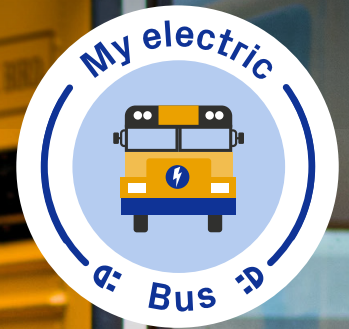


# Charging

Fact Sheet



This campaign is made possible thanks to support from:

## Basic concepts

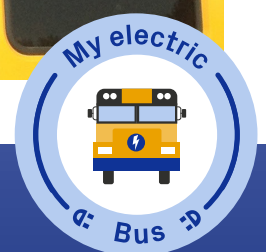
- A battery's capacity (the amount of energy that can be stored in it) is measured in kWh, and for an electric school bus this typically ranges between 84 and 220 kWh.
- Charging power (transmitted energy flow) is measured in kW and typically ranges between 8 and 20 kW, depending on the installation (for Level 2 charging stations), and up to 50 kW for DC fast charging. The maximum charging power is determined by the power of the charging point or the power accepted by the battery controller (whichever is less).
- The average consumption for a school bus is 1 kWh/km. This is the average under normal operating conditions. However, this figure can increase to 1.2 kWh/km in winter conditions, during a trip with a steep incline or against strong headwinds. This same consumption can also be affected if the driving is not energy efficient.
- Charging demands are defined by the energy consumed during travel. Vehicle range, the duration of charging periods, and charging power are all parameters to be considered in properly addressing charging needs.

## Charging options

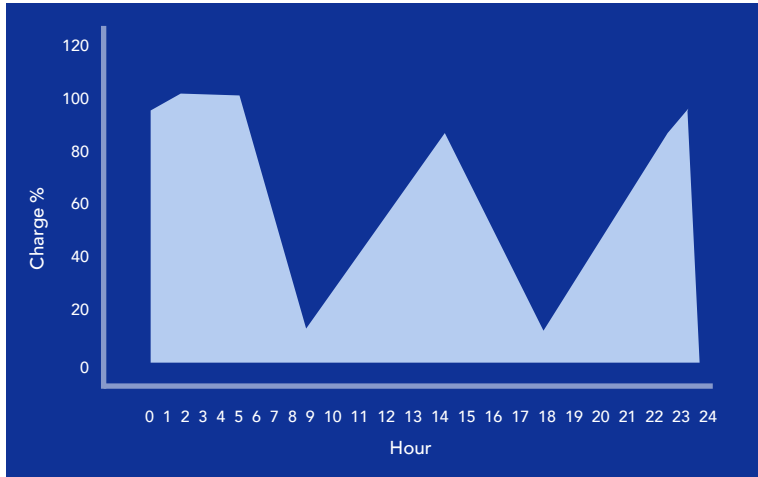
It is important to evaluate the charging infrastructure options available when it comes time to select vehicles, in order to determine the most appropriate choice based on various constraints (budget, range required for each vehicle, deployment schedule, available charging time, power requirements and electrical capacity of the facilities).

## Planning: For each trip, a charge

On some routes, it is necessary to schedule time during the day to charge the vehicle in order to replace the energy used in the morning so that the same trip can be made again in the afternoon (see Graph a). For other routes, it is possible that the distances to be covered in a day can be completed on a single charge, with charging done only during the night (see Graph b).

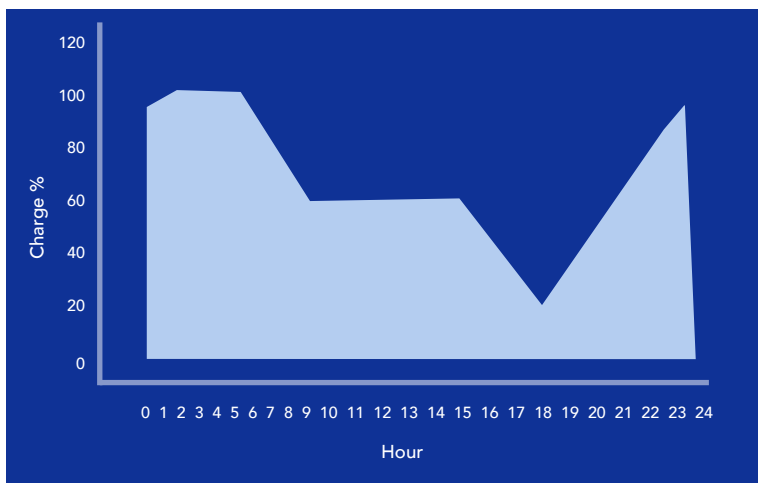


**A.** Distribution of charging over the course of a typical day for an electric school bus (with mid-day charging).



- Route that includes 5 hours of charging during the day
- Distance covered: 320 km
- Battery: range of 200 km

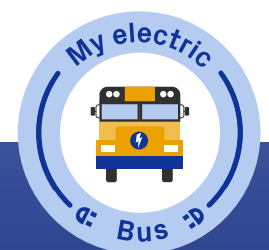
**B.** Distribution of charging over the course of a typical day for an electric school bus (without mid-day charging).



- Route with no mid-day charging
- Distance covered: 160 km
- Battery: range of 200 km

It may be worthwhile for buses to run different routes in the morning and afternoon in order to achieve kilometrage consistent with their ranges or available charge times. Below is an example where two buses share two routes of different lengths but will have covered the same number of kilometers by the end of the day (150 km).

	Route 1 Distance of 200 km	Route 2 Distance of 100 km
AM	Bus # 1: 100 km travelled	Bus # 2: 50 km travelled
PM	Bus # 2: 100 km travelled	Bus # 1: 50 km travelled



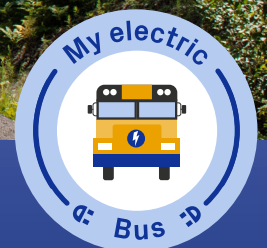
- On average, the equivalent of 15 to 20 km per hour of charging is possible with a Level 2 charging station. Over a 24-hour cycle, if a bus is idle for 12 hours (consecutive or non-consecutive), it is possible for it to travel up to 240 km per day. If it is idle for 16 non-consecutive hours (e.g., a bus travels from 6:00 a.m. to 10:00 a.m., is recharged between 10:00 a.m. and 2:00 p.m., travels from 2:00 p.m. to 6:00 p.m., and is recharged from 6:00 p.m. to 6:00 a.m.), it could travel up to 320 km..

## Energy consumption and pricing

- There are 2 factors associated with the pricing of charging: energy (kWh) and power (kW).
- The amount of energy used depends on distance traveled, the type of driving and weather conditions (traction, wind and temperature.) Nevertheless, it is still possible to reduce energy consumption by:
  - Training the drivers to adopt an eco-friendly driving style;
  - Reducing the speed of the bus;
  - Reducing the load carried by each bus.

Refer to the data sheet entitled [Range and Route Planning](#) for electric school buses.

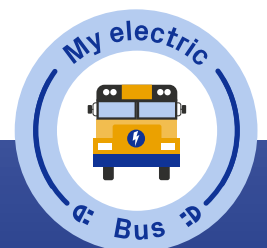
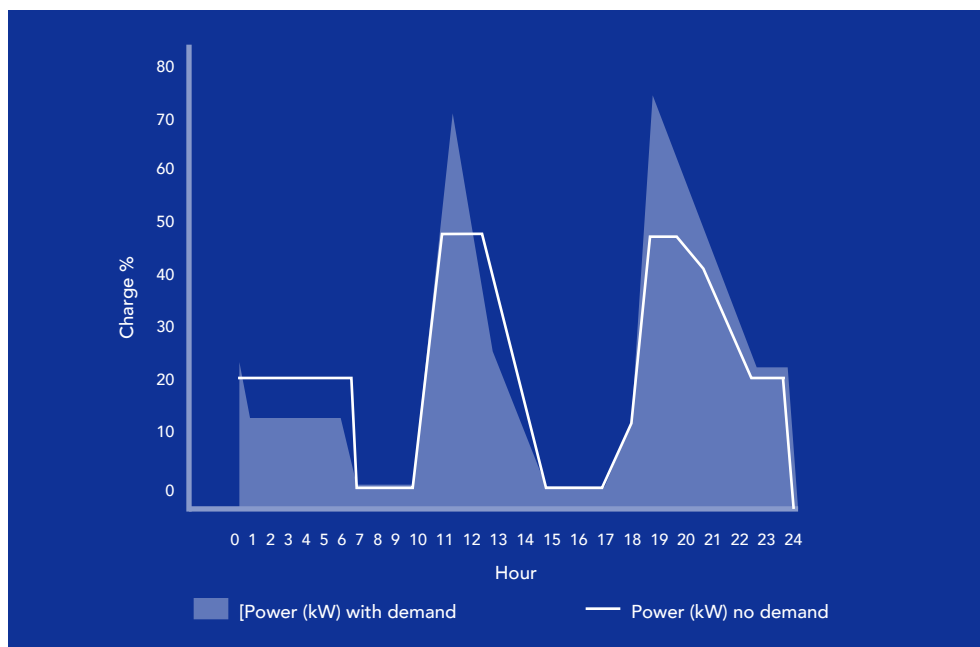
- The power level can also be a factor that has a very significant impact on Hydro-Quebec pricing and therefore on your overall energy costs. The power level depends on the number of buses being charged at the same time, their charging power and that of the charging stations.
- When buses are connected to a building's meter, the impact on power demand will also depend on other energy uses in the building (for example, power demand may be limited if charging is done at night when the building is using less electricity.) Three or more buses charging at the same time (excluding any other type of electrical installation or appliance) can be considered to increase the power demand.
- Under the current rate structure there is a threshold of 50 kW, beyond which the power is billed (power demand). It is therefore important to properly manage and distribute your energy consumption in order to avoid additional charges on your energy bill. For more information on power and its pricing, refer to the [Hydro-Québec website](#).



## Power management tools and support services

- It is important to spread the need for power as much as possible over a 24-hour cycle to ensure that there is sufficient energy to fully charge all vehicles, while minimizing the maximum power used and the potentially associated costs. There are various tools and systems available to balance this consumption and avoid power demands, all while ensuring that vehicles are available to make their assigned trips. These tools can also help reduce or eliminate the need for costly electrical system investments that may be required to incorporate electric vehicles into an existing building.
- In the near future, Hydro-Québec may be introducing a turnkey service that will ensure optimal management of vehicle charging based on the daily needs of each bus. With this type of service, bus fleet operators will no longer have to worry about power demands, as this will be managed by Hydro-Québec. Hydro-Québec will also acquire and own the required charging infrastructure. The service will be billed monthly.

### Power management



## Read relevant resources

- For a better understanding of the concepts related to power demand, visit <https://www.hydroquebec.com/business/customer-space/rates/understanding-power-demand.html>
- To assist you in the decision-making process or to answer any questions you may have regarding charging and types of installations, Hydro-Québec has an information phone line for carriers regarding school transportation electrification. This line is open from 8:30 a.m. to 4:30 p.m., Monday to Friday, and can be reached at 1 877 512-1981. Information on the services offered through this hotline can also be found on the Hydro-Québec Web website at <https://www.hydroquebec.com/transportation-electrification/electric-bus/school-transportation.html>



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