

In Motion Charging trolleybuses vs Depot charging Battery bus

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Background

A study done for the City of Gothenburg in 2023 the LCA (Life Cycle Assessment) and the LCC (Life Cycle Cost) has been calculated for three types of electric PT; In Motion Charging trolleybuses, Depot charging battery buses and trams. (Livscykelkostnader och klimatpåverkan för spårväg och buss, Trivektor Rapport 2023:74, 2024-06-13).

In this summary the results for Trolleybuses and battery buses is presented.

Calculations are done based on a fictive route that is 9 km long and have a round trip of 60 mins. The comfort capacity in buses is based on 65 passengers in a 18 meter single articulated bus and 90 passengers in a 24 meter double articulated bus. The number of Battery buses will be 10% more than the number of Trolleybuses as Battery buses need to charge standing still. Buses run on a segregated busway, 8 meter wide, and is the same for both trolley and Battery. Trolleybuses of course need overhead wires, and the cost is estimated to 10 MSEK per km including substations. Overhead wires is used over 50% of the route (4,5 km), the rest is operated in battery mode. Battery buses need charger, and the cost is estimated to 0,9 MSEK per bus. Both types of buses need to change the batteries once during the lifetime that is 20 years for trolley bus and 12 years for battery bus.

Result

The result show that In Motion Charging Trolleybus give better results both regarding LCA and LCC. Below a short summary of the results from the report.

Table 1 Climate impact and energy consumption Depot charging Battery Buses

Type (length)	Climate impact material and production 12 year life time (ton CO2e/ year)	Climate impact operation (g CO2e/km)	Climate impact WTW (g CO2e/km)	Energy consumption (kWh/km)
12 m	9,8	44	22	1,4
18 m	13,7	131	39	2,5
24 m	18,2	174	54	3,5

Table 2 Climate impact and energy consumption Trolleybuses

Type (length)	Climate impact material and production 20 year life time (ton CO2e/ year)	Climate impact operation (g CO2e/km)	Climate impact WTW (g CO2e/km)	Energy consumption (kWh/km)
18 m	5,7	122	30	2,0
18 m without battery	5,1	122	30	2,0
24 m	7,6	163	40	2,6
24 m without battery	6,8	163	40	2,6

Based on this data the cost (LCC) for transporting 2000 passengers in max direction in the max hour has been calculated for battery and trolley with length of 18 or 24 meter. The trolleybus comes out well based on the life time of 20 years for the vehicle.

Yearly cost at 2000 passengers in the max hour

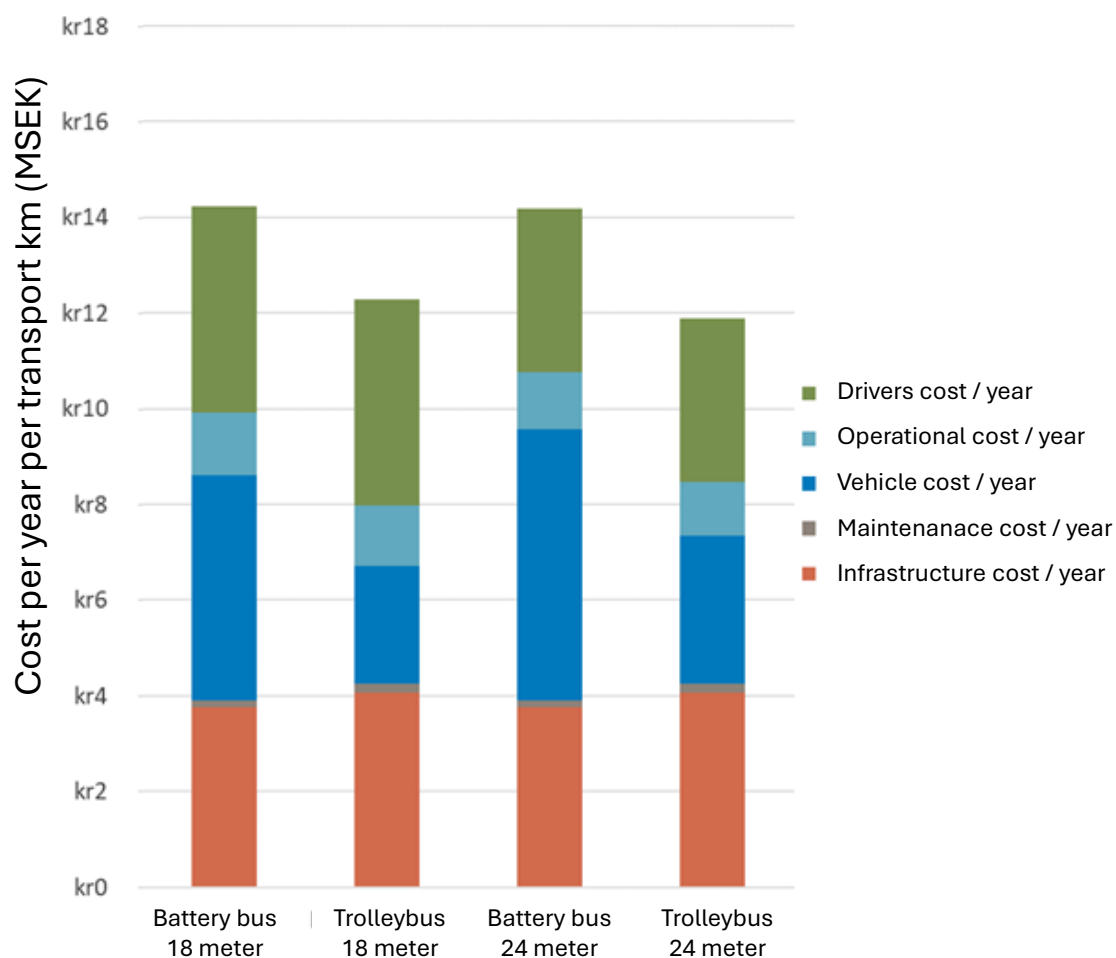


Figure 1 Cost per route km at 2000 passengers an hour and direction. Depot charging battery bus and trolleybus.

The climate footprint based on LCA indicate that the trolleybus has a lower foot print the battery bus with depot charging. The big difference is the production of the vehicles including the batteries which is much higher than the impact of the trolleybus infrastructure.

Yearly climate impact at 2000 passengers per hour and direction

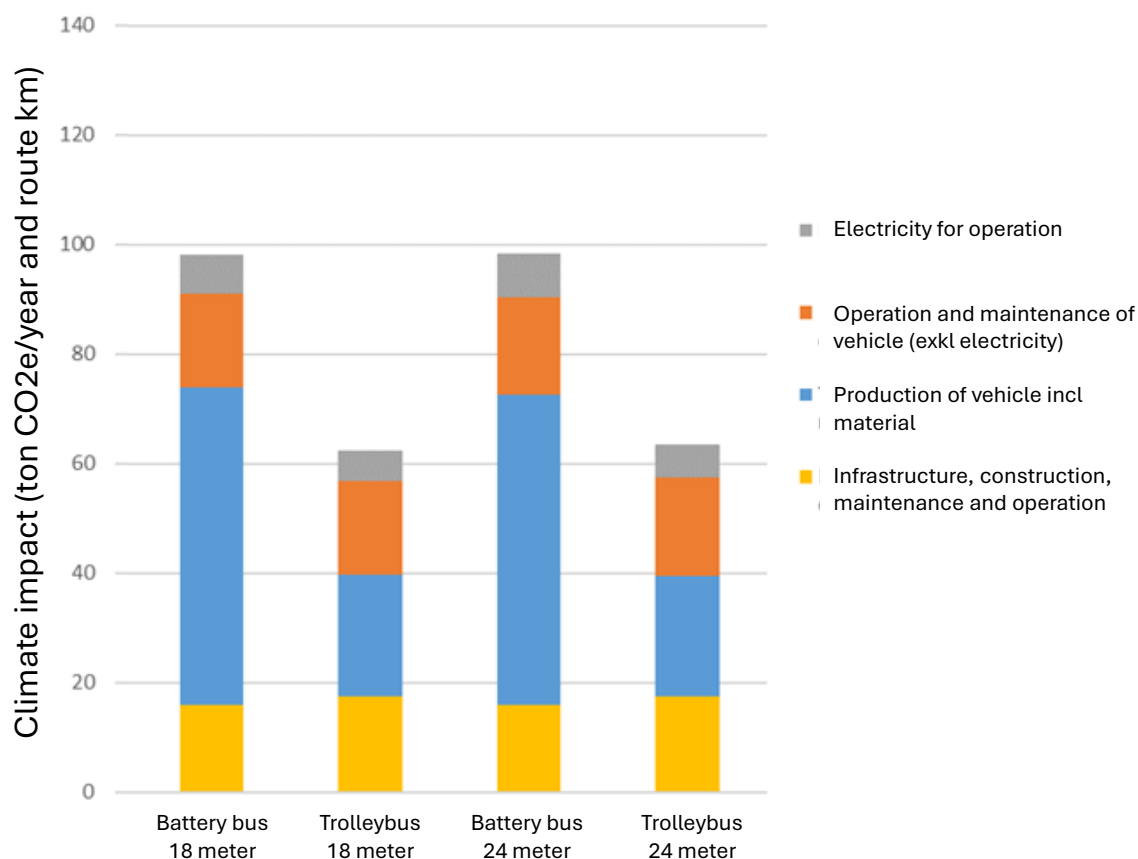


Figure 2 Climate impact (CO2e/year) per route km at 2000 passengers an hour and direction. Depot charging battery bus and trolleybus.

The result is indications of the LCC and LCA as all input of course has a low and a high value. The calculations are made on the best figures available and regarding vehicle climate impact the base data is from several different vehicles EPD (Environmental Product Declaration).