ENERGY MANAGEMENT CENTRE KERALA

CSTEP

Electrifying School Buses in Kerala

Empowering schools to transition to electric buses

Why electric school buses?

Diesel Bus		Electric Bus
		
• Air pollution causes respiratory diseases • Fumes are carcinogenic and harmful	**Children's health**	No health hazards
• High carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter (PM) emissions • Potential source of black carbon, especially if bus is old • High noise pollution	**Environmental**	• Zero tailpipe emissions • No black carbon emissions • Silent operations
• High running cost (INR 12–20/km) • Cost of diesel = INR 98/litre*	**Economical**	• Low running cost (INR 5–10/km) • Cost of electricity = INR 6–15/unit*

Electric bus (e-bus) manufacturing in India is rapidly growing, and more than 10 e-bus original equipment manufacturers (OEMs) are operational in the country. The following OEMs* offer electric school buses:

VE Commercial Vehicles Ltd

PMI Electro Mobility Solutions Pvt Ltd

Pinnacle Mobility Solutions Pvt Ltd (EKA Mobility)

* Based on CSTEP's market review conducted in December 2024

Is your school ready for e-bus transportation?

Check the suitability of e-bus adoption based on your school metrics:

School characteristics and requirements						Suitable e-bus procurement model based on TCO parity with similar diesel buses	Cost per kilometre (INR/km)	
Administration type	Student strength	Bus fleet size	Existing bus financing	Preferred bus size	Minimum daily kilometres travelled		Diesel bus	Electric bus*
Private	3,000+	50+	Self-finance / school corpus	7 m	100 km	Outright purchase	41	41–59
				12 m	240 km		39	39–55
Government-aided or private	1,500–3,000	10–50	Bank loan	7 m	80 km	Battery leasing	47	39–58
				12 m			84	77–111
Government	Up to 2,000	1–10	Governm ent funds	7 m	100 km	Contract basis	54	54–73
				12 m	240 km		51	51–68
		NA			90 km	Retrofitting#	77	62–87

TCO: Total cost of ownership

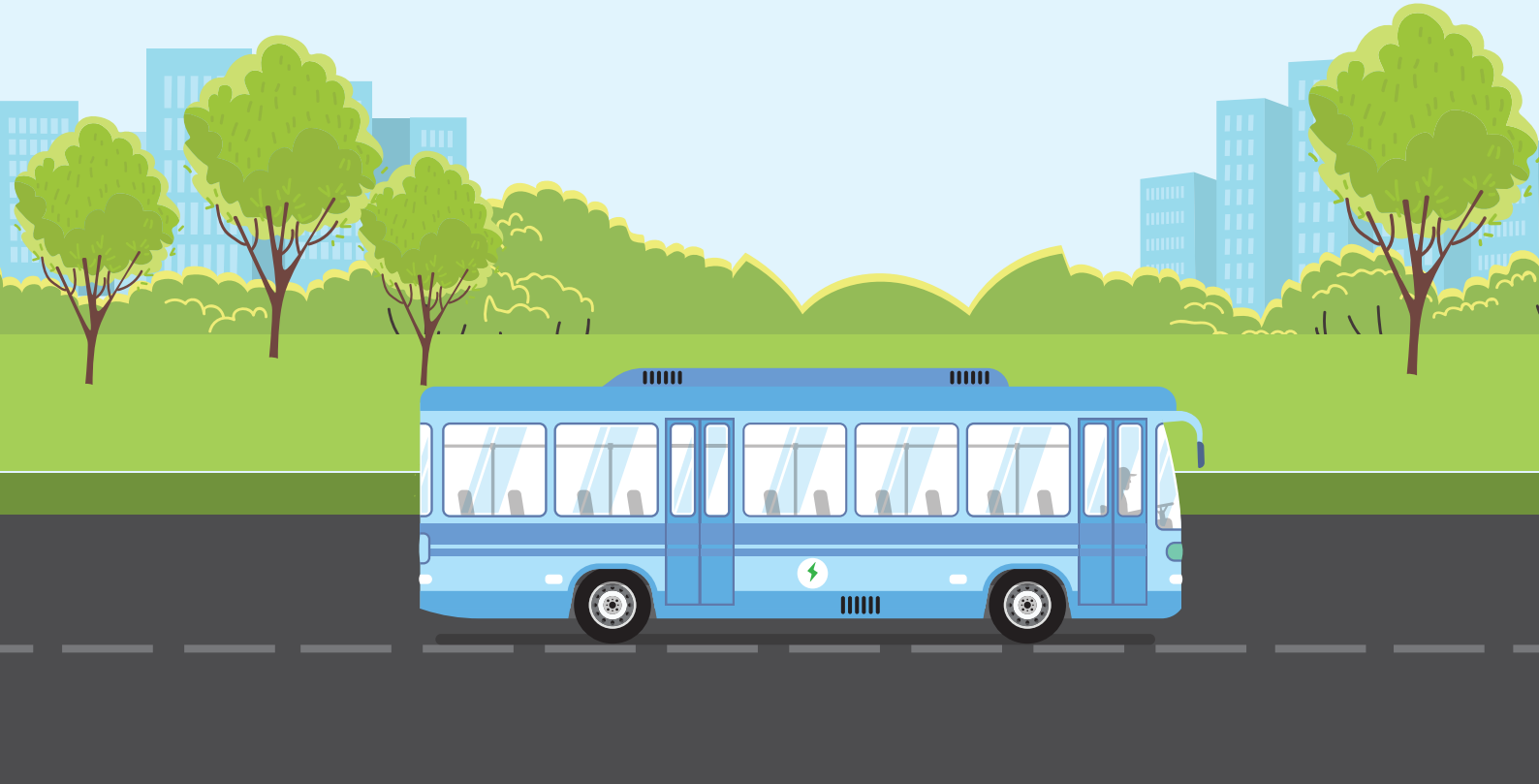
**These values are considered without any government subsidy, as the current electric bus schemes do not include buses for school transportation.*

#Retrofit kit price assumed as INR 25–40 lakh

School buses running for 50 km or less per day are unsuitable for electrification as per the TCO analysis.

Lower than a diesel bus

Price parity achieved



How can schools procure e-buses?

Different ways for schools to procure e-buses

Outright purchase	Battery leasing	Mobility-as-a-Service (Gross Cost Contract)	Retrofitting
The school purchases an e-bus and operates and maintains it.	The school purchases an e-bus without its battery and operates and maintains it. The school rents/leases the battery from a Battery-as-a-Service (BaaS) provider and pays at INR/km.	The school hires bus operators to run on pre-fixed routes and frequencies and pays the operator per km.	A school with old diesel buses salvages them by retrofitting with a battery-powered electric powertrain and operates and maintains it.
High capex required Assets on school books Risk and responsibility with the school	30%–40% lower capex required Fewer assets on school books Operational responsibility with the school	No capex required Asset free Risk averse Least responsibility on the school	Lower capex than new electric bus Salvages old diesel bus Certification and homologation more challenging than new electric bus purchase Asset on school books

Demand Aggregation

As the demand from schools is low (<10 buses) and disaggregated, in the early stages of e-bus adoption, schools in a neighbourhood can aggregate their e-bus demand to benefit from economies of scale and shared charging infrastructure. For the 'grand challenge' to promote the nationwide adoption of e-buses undertaken by the Convergence Energy Services Limited (CESL), demand from several state transport undertakings (STUs) were aggregated, and the bid prices turned out to be 14%–21% lower than individual STU tenders without any subsidy.

Financing options for schools to adopt e-buses

Self corpus

Schools with good financial health can utilise their own corpus for e-bus(es). This way of financing ensures minimal or zero financing cost (i.e. interest rate).

Bank loans

Schools lacking high capital expenditure ability but having good credit-seeking ability can opt for bank loans. Some banks also offer attractive interest rates and concessions for 'green vehicles'. For example, the State Bank of India (SBI) offers up to 0.5% concession on electric vehicle loans.

Corporate Social Responsibility (CSR) funds

Schools (government or government-aided) can explore and seek CSR funds from industry to support their climate- and environment-friendly initiatives of e-bus deployment. Some case studies are listed below:

- CSR funds used for the renovation of Devaki Memorial Senior Basic School, Kakkayur, Palakkad
- CSR funds used for the purchase of a school van for transporting differently abled children of Deenadaya Seva Trust, Thodupuzha

Member of Parliament (MP)/Member of Legislative Assembly (MLA) funds

Constituency-wise MP/MLA funds can be sought by schools (especially government-run schools) to support e-bus operations under the Gross Cost Contract (GCC) model.

Soft loan

Schools can avail low-interest (soft), long-term loans from the Energy Management Centre Kerala for energy-efficient programmes, including e-school bus deployment.
Interest rates applicable: 2% p.a. for government schools and 4% p.a. for non-government schools.

How can schools prepare for e-bus operations?

1. Planning

Phase-wise adoption:
Phase-wise adoption: Schools can plan for phase-wise adoption (i.e. starting with a pilot run and moving to full-fledged adoption) of e-buses subject to their fleet size requirements and financing capabilities.

- Outright purchase: minimum of five e-buses and one charging station on the school premises
- GCC: minimum demand of five e-buses across neighbouring schools can be aggregated to use one shared charging station set up by the operator at a suitable location

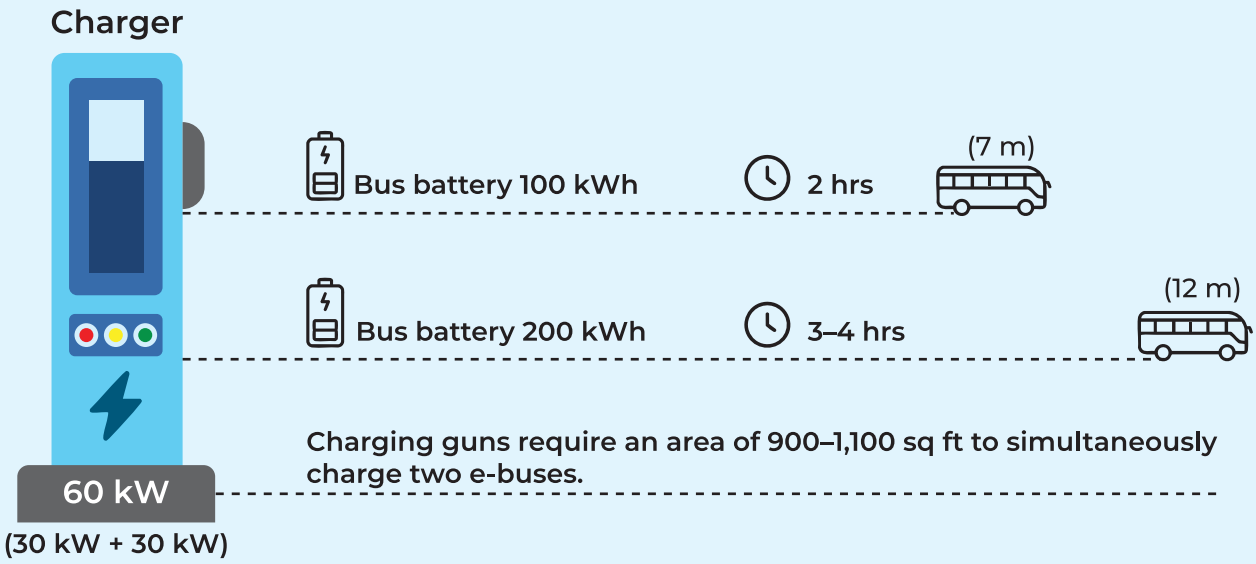
Route identification:
Among the existing bus routes, schools can identify those feasible for e-bus operations based on the range of e-buses (80–120 km; round trip distances ≤ 80%–90% claimed range of e-bus). This can be done in consultation with e-bus OEMs using available tools.

Charging schedules:
Given that e-buses need 2–4 hours for charging, schools need to account for the charging durations and prepare accordingly to ensure that the buses do not run out of charge during the trips. Schools can prefer to charge during the daytime (9 am–4 pm) to take advantage of solar energy and reduced tariffs[1] .

[1] Kerala State Electricity Board (KSEB) has differential tariffs for electric vehicle charging during solar (9 am–4 pm) and non-solar hours at INR 5/kWh and INR 9.3/kWh, respectively.

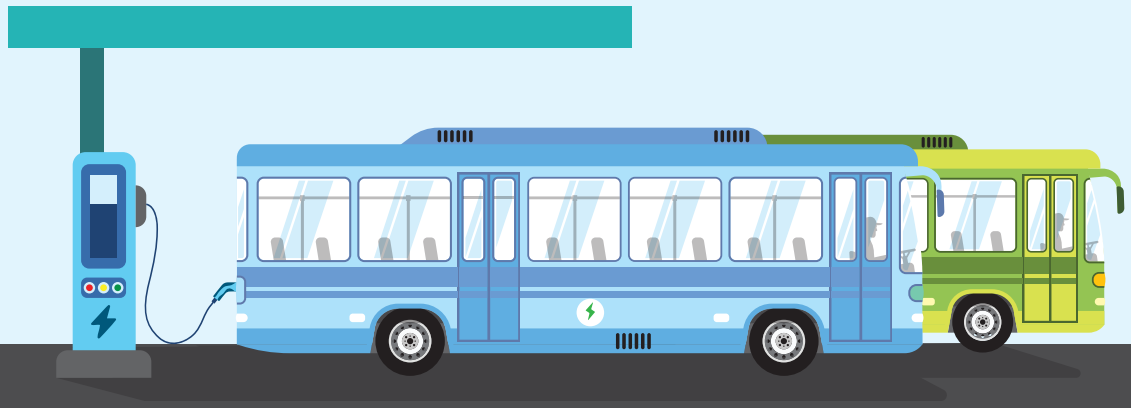
2. Infrastructure establishment

Schools can set up requisite e-bus chargers on their campus with the necessary approval from the distribution company (DISCOM) / Kerala State Electricity Board (KSEB) Limited. If schools are opting for a lease/GCC model, chargers will be set up by the operator and the schools are only required to obtain the necessary approval from the DISCOM/KSEB.



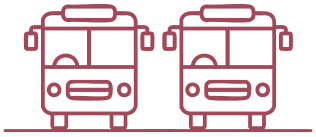
Procurement model	Land allotment	Permissions from KSEB	Acquire and install chargers	Operate and maintain chargers
Outright purchase	✓	✓	✓	✓
Battery leasing	✓	✓	✓	✓
GCC	✓	✓	✗	✗

School's responsibility: ✓ Yes, ✗ No



Clean school bus concept

Electric School Buses (total of 5)
100 kWh battery capacity

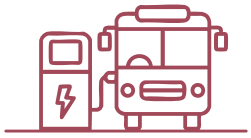


INR 1,00,00,000
(additional capital than diesel buses)

INR 17,90,000/year
(savings compared with diesel buses)

+

Vehicle-to-Grid (V2G) Charging System
50 kW charger rating



INR 10,00,000

INR 21,900/year

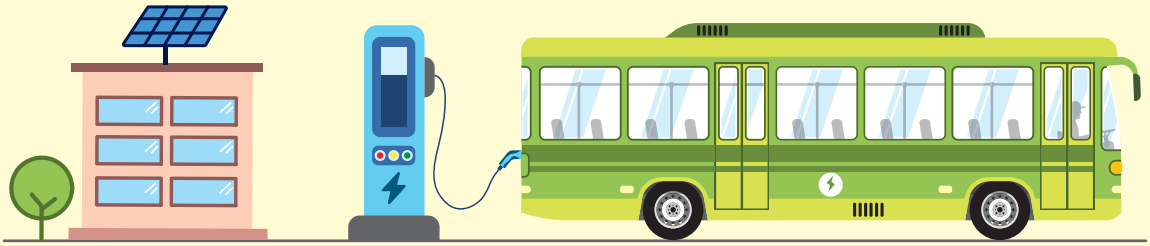
+

Rooftop Photovoltaic (RTPV) System
50 kWp solar panel system

INR 25,00,000

INR 13,333/year

Electric school buses charged with solar energy while giving energy to the grid via V2G



Incremental capital cost
INR 1,35,00,000

Annual savings
INR 18,22,700/year

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