City Campus EV Transition Plan (Intro to EVs)

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1. Scenario:

Your university wants to convert its on-campus fleet (shuttle buses, maintenance vans, security bikes) to EVs within 3 years.

2. Current Fleet Assessment

To design a feasible transition plan, the first step is to evaluate the current Internal Combustion Engine (ICE) fleet in terms of count, usage, fuel consumption, and maintenance.

2.1 Fleet Overview:

Vehicle Type	Quantity	Average Daily Distance (km)	Fuel Type	Mileage (km/litre)	Avg. Fuel Cost (Rs./litre)	Annual Maintenance (Rs./year)
Shuttle Buses	5	120	Diesel	4	95	2,00,000
Maintenance Vans	6	60	Diesel	10	95	80,000
Security Bikes	15	40	Petrol	45	105	20,000

2.2 Operational Cost (Current ICE Fleet)

Using the above data, annual fuel and maintenance costs can be estimated.

Example (Shuttle Buses):

120 km/day × 365 days = 43,800 km/year

Fuel = 43,800 / 4 = 10,950 litres/year × Rs.95 = Rs.10,40,250 per bus

For 5 buses = Rs.52,01,250 per year in fuel.

Total Estimated Annual Costs (All Vehicles):

Category	Fuel Cost (Rs./year)	Maintenance (Rs./year)	Total (Rs./year)
Shuttle Buses	52,01,250	10,00,000	62,01,250
Maintenance Vans	12,41,400	4,80,000	17,21,400
Security Bikes	5,10,000	3,00,000	8,10,000
Total	**Rs. 69,52,650**	**Rs. 17,80,000**	**Rs.87,32,650/year**

3. Proposed EV Replacement Plan

3.1 Recommended Electric Models

Vehicle Type	Charger Type	Power Rating	Charge Time	Charging Locations
Buses	DC Fast Charger	60 kW	2 hours	Transport Yard
Vans	AC Type-2	15 kW	4 hours	Maintenance Garage
Bikes	Standard 3-pin	3 kW	2.5 hours	Security Posts

3.2 Motor & Battery Overview

- Motor Type: Most EVs use Permanent Magnet Synchronous Motors (PMSM) for high torque and efficiency.
- Battery: Lithium-ion or LFP (Lithium Iron Phosphate) batteries — chosen for long life, low maintenance, and safety.
- Battery Management System (BMS): Monitors voltage, temperature, and charging cycles to prevent degradation.

3.3 Power Electronics & Control (Simplified Overview)

- Inverter: Converts DC battery power to AC for the motor.
- DC-DC Converter: Steps down voltage for auxiliary systems (lights, fans, dashboard).
- Motor Controller: Regulates torque and speed based on accelerator input.
- Regenerative Braking: Converts kinetic energy during braking into stored electrical energy, improving efficiency.

3.4 Charging Infrastructure Plan

Vehicle Type	Charger Type	Power Rating	Charge Time	Charging Locations
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4. Total Cost of Ownership (TCO) Comparison

TCO considers purchase cost, fuel/electricity, maintenance, and battery replacement over the vehicle's life (8 years assumed).

4.1 Assumptions:

- Electricity rate: Rs.8/kWh
- Average running: 43,800 km/year (buses), 21,900 km/year (vans), 14,600 km/year (bikes)
- Battery replacement after 7 years (~Rs.6 lakh for bus, Rs.1 lakh for van, Rs.35k for bike)

4.2 Annual Operating Cost (EV)

Vehicle	Electricity Use (kWh/km)	Cost/km (₹)	Annual Electricity Cost (₹)	Maintenance (₹/year)
Bus	1.2	9.6	4,20,480	50,000
Van	0.25	2	43,800	20,000
Bike	0.05	0.4	5,840	5,000

4.3 Comparison (ICE vs EV)

Category	ICE Annual Cost (₹)	EV Annual Cost (₹)	Savings (₹/year)
Bus	12,40,250	4,70,480	7,69,770
Van	2,87,000	63,800	2,23,200
Bike	54,000	10,840	43,160

5. Policies and Incentives

5.1 National-Level Support

- FAME II (Faster Adoption and Manufacturing of Electric Vehicles):
  - Up to ₹50,000 subsidy per e-2W, and ₹20 lakh per e-bus.
  - Charging station support: 70% subsidy for institutional campuses.
- GST Reduction: 12% → 5% on EVs, 18% → 5% on chargers.

5.2 State-Level Incentives (Tamil Nadu EV Policy 2023)

- 100% road tax and registration fee waiver for EVs until 2025.
- Capital subsidy for charging infrastructure.
- Interest-free loans for institutions adopting EV fleets.

5.3 Impact on Payback

- Payback period: ~3.2 years for buses, 2.5 years for vans, 1.5 years for bikes.
- After payback, operational savings add directly to the sustainability fund.

6. Risks and Mitigation

Risk	Description	Mitigation Strategy
Battery Degradation	Loss of range after 6–8 years	Use BMS; replace under warranty (8 years typical); second-life storage use
Training Needs	Technicians and drivers need EV familiarity	Conduct campus EV training workshops with OEMs
Charging Downtime	Limited chargers may cause queues	Implement smart scheduling and solar-assisted chargers
Resale Value	EV resale market immature	Use vehicles till full depreciation; consider battery recycling
Initial CapEx	High upfront cost	Finance via green campus fund + CSR partnerships

7. Implementation Roadmap (3-Year Plan)

Phase	Duration	Key Activities
Phase 1 – Pilot (Year 1)	Q1–Q4	Procure 1 EV bus, 2 vans, 5 bikes; install 3 chargers; collect performance data
Phase 2 – Expansion (Year 2)	Q1–Q4	Replace 50% of fleet; set up solar-assisted charging; conduct training sessions
Phase 3 – Full Transition (Year 3)	Q1–Q4	Replace remaining ICE vehicles; complete policy compliance and reporting

Post-Year 3	—	Monitor KPIs (costs, CO_2, uptime); plan EV lifecycle replacements