





GOVERNMENT OF INDIA MINISTRY OF HOUSING AND URBAN AFFAIRS

SYSTEMATIC PLANNING AND CHARGING STRATEGIES FOR ELECTRIC BUSES



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ON-GROUND CHALLENGES WITH E-BUSES

Missing systematic planning of e-Bus, infra, systems and operations





SYSTEMATIC PLANNING FOR E-BUSES

✓ Data log & plan for Routes		✓ Plan for realities✓ Plan for	or aging effects
	e-Bus spec inputs	 length, width, floor height seating capacity, battery location AC 	
Q	Route selection, duty cycle profiling	 depots, routes route duty cycle (distance, speed, slope) 	Validating to desired SLAs & GCC bid
kWh	Route energy consumption modeling	 duty cycle, passenger load AC load, battery aging, driver skill 	
·····	Charging strategy, Battery sizing	battery reserve (DOD), agingroute level energy requirement	Financial
P	Chargers & Grid sizing	 charger peak power, no. of chargers charger location, arrival/departure SOC charging schedule utilization 	TCO assessment
	i Scheduling & Operations planning	 bus schedules operational SLAs 	
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ROUTE ENERGY CONSUMPTION & VARIATIONS High Range variations with Passenger + AC loading and Ageing on single route

Year-1 Year-10 **Operations Operations** 9-10% battery degradation 250 350 **Minimum Daily** (in kWh) 300 322 200 Min. SOC 20% operational km 199 21% 40% 46% 250 Range (in km) 257 150 158 **Battery Capacity** 200 119 kWh/km 150 100 kWh/km 1.6 kWh/km 1.3 kWh/km 107 100 50 50 2.2 2.2 0 0 AC Off Half AC On Half AC On AC On **Operational** Battery Overloading Overloading, Occupancy Ocupancy capacity energy Year 10

Source: pManifold's EVSYS© Analysis



RANGE SHORTFALL ON EXPECTED DAILY KMS. UTILIZATION High range variations along different Routes due to different duty cycles



How to then meet expected daily utilization? What battery size to standardize across routes?

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CHARGERS SELECTION AND LOCATION

AC vs. DC Chargers; Depot/ Opportunity/ Battery swapping types





STRATEGIES FOR NIGHT DEPOT CHARGING

Shared vs. Dedicated chargers, interchange time & resource, accounting for battery degradation

Scenario	S1: Charger sharing (Year 1)	S2: Charger sharing (Year 10)	S3: Dedicated chargers (Year 1)
Risk buffer/Route changes	Limited	Limited	Medium
Interchange time - minutes	20	20	NA
Interchange resources	2	2	NA
Number of e-Buses	55	55	55
Mean battery capacity (kWh)	330	263	330
Mean arriving SOC (%)	23.2	17.0	23.2
Mean target dep SOC (%)	80	90	80
Number of chargers	15	18	53
Chargers rating (kW)	125	125	30
Chargers working time (%)	22.7	23.7	34.3
Maximum power demand, 15 minute intervals (kW)	1,875	2,250	1,500
Total energy consumption (kWh)	10,327	10,327	10,327

55 e-Buses (no AC; 330 kWh; night depot charging); Avg. daily distance 144 kms (min. 110 kms and max 160 kms per day)

Source: MGL's EVOPT Analysis

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TOTAL COST OF CHARGING (TCC)





E-BUS SYSTEMATIC PLANNING IS ESSENTIAL Multiple parameters and interdependencies



THANK YOU !

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