

SYSTEMATIC PLANNING AND CHARGING STRATEGIES FOR ELECTRIC BUSES



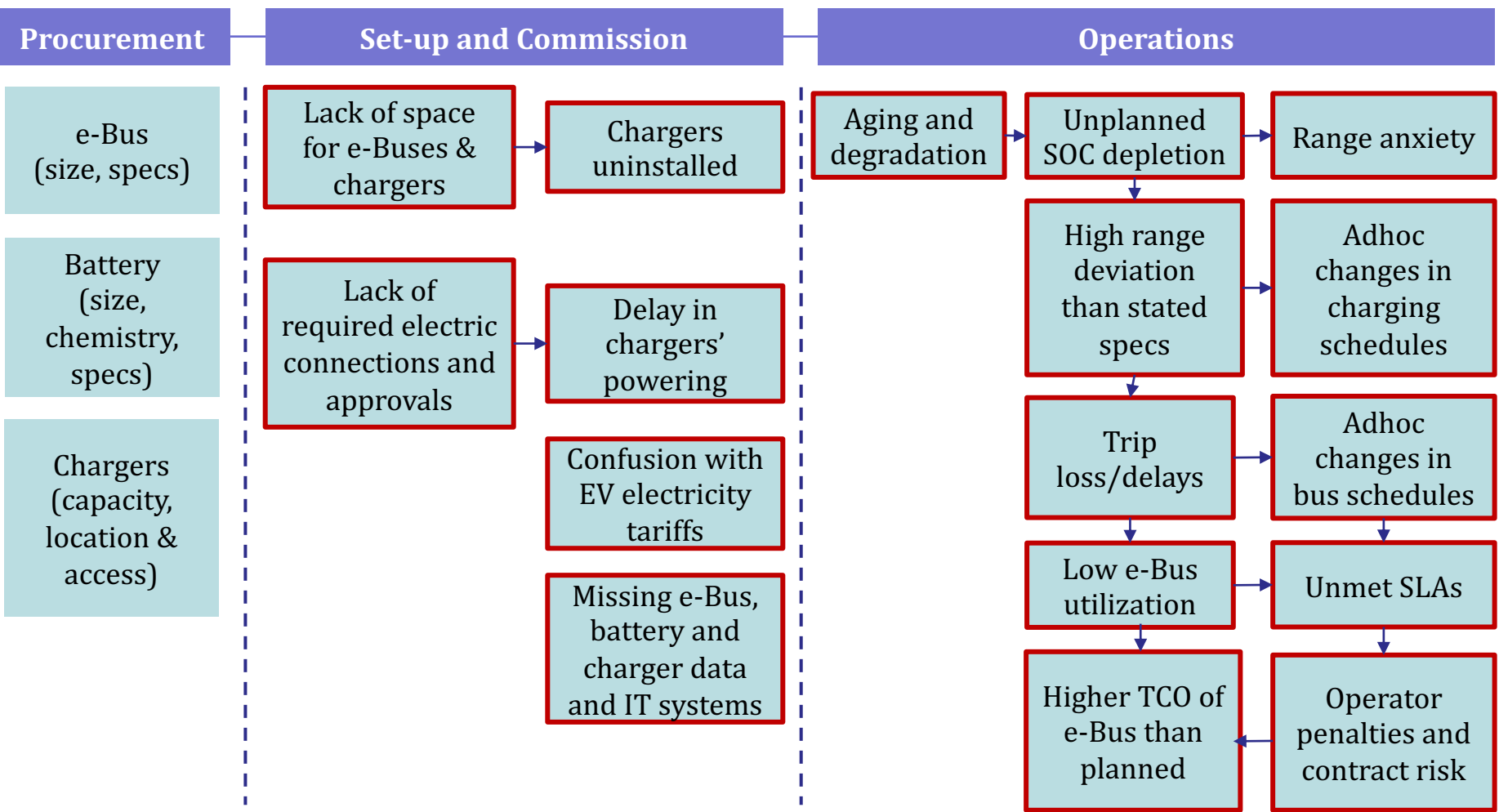
PRESENTED BY:

RAHUL BAGDIA

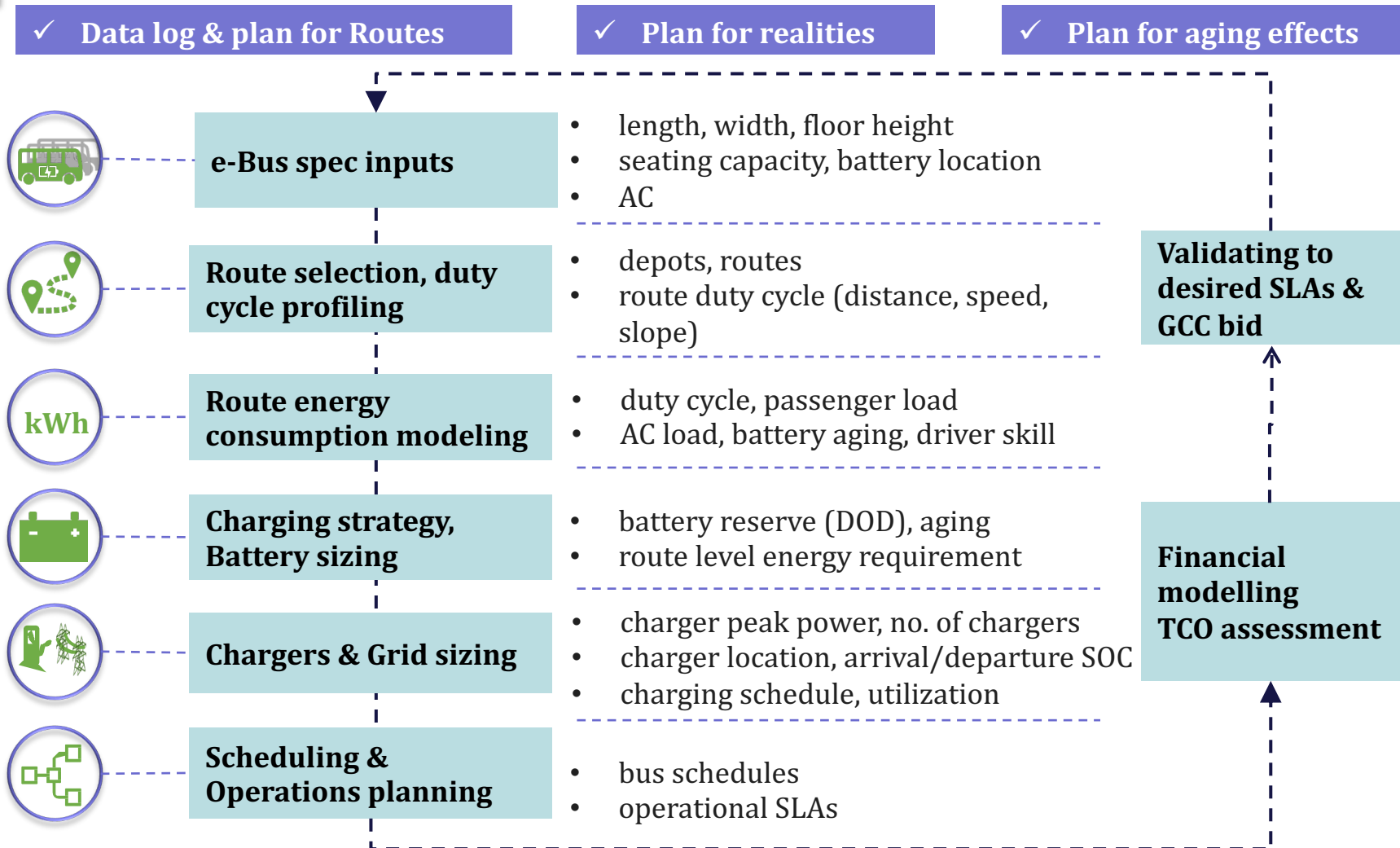
MANAGING DIRECTOR, PMANIFOLD

ON-GROUND CHALLENGES WITH E-BUSES

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



SYSTEMATIC PLANNING FOR E-BUSES

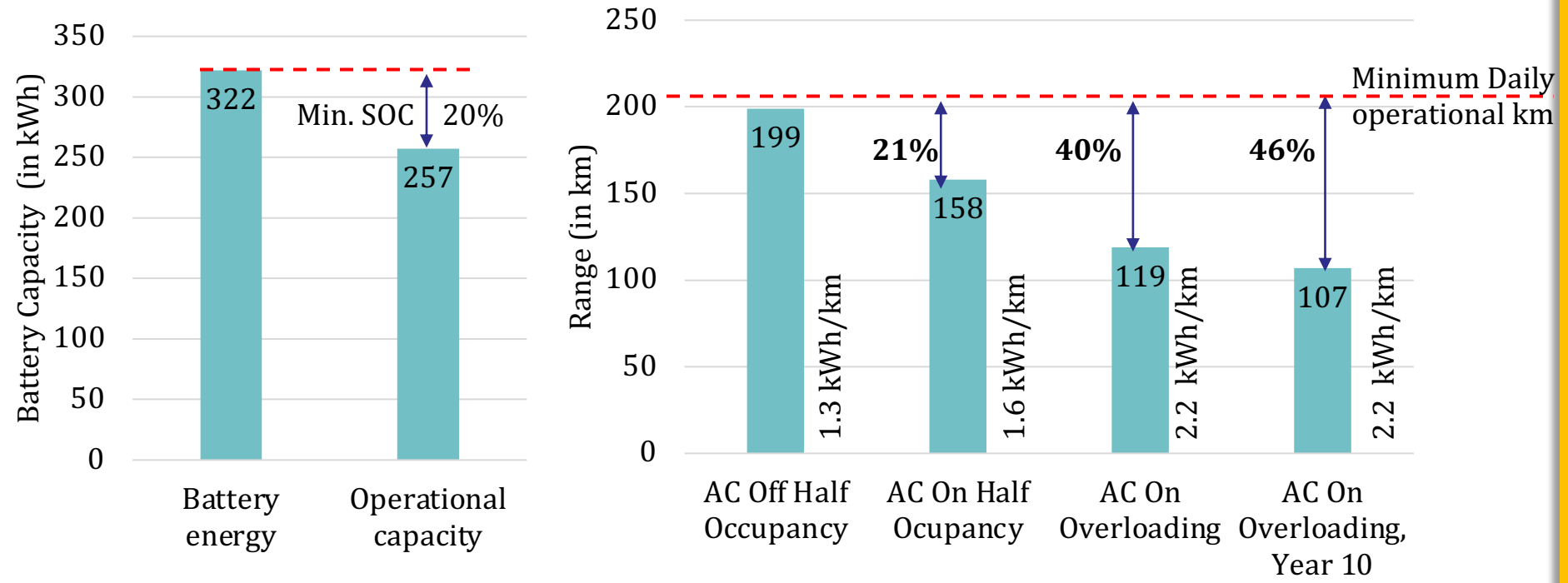


ROUTE ENERGY CONSUMPTION & VARIATIONS

High Range variations with Passenger + AC loading and Ageing on single route

Year-1 Operations Year-10 Operations

9-10% battery degradation

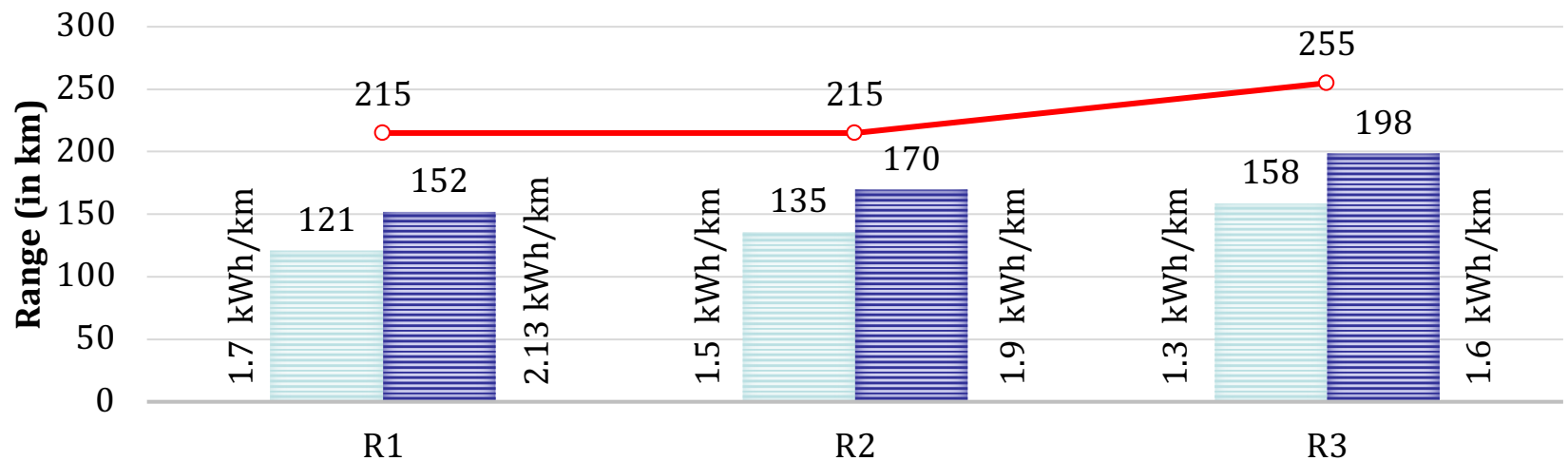


Source: pManifold's EVSYS© Analysis

RANGE SHORTFALL ON EXPECTED DAILY KMS. UTILIZATION

High range variations along different Routes due to different duty cycles

Year-1 Operations (Full Passenger Loading)



R1: short length route

R2: average length route

R3: long length route

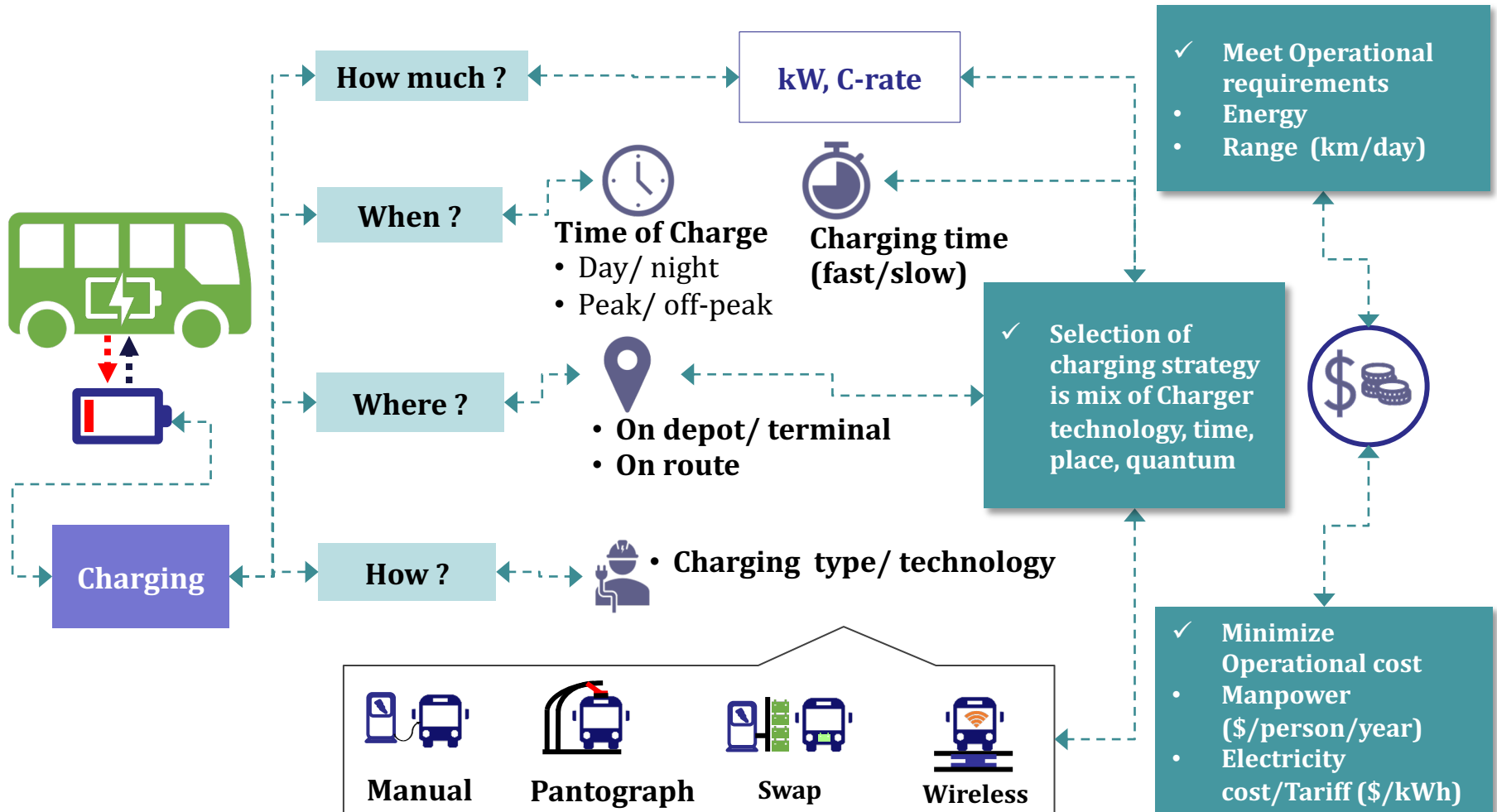
AC ON AC OFF Expected Daily utilisation (in km)

Source: pManifold's EVSYS© Analysis

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

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

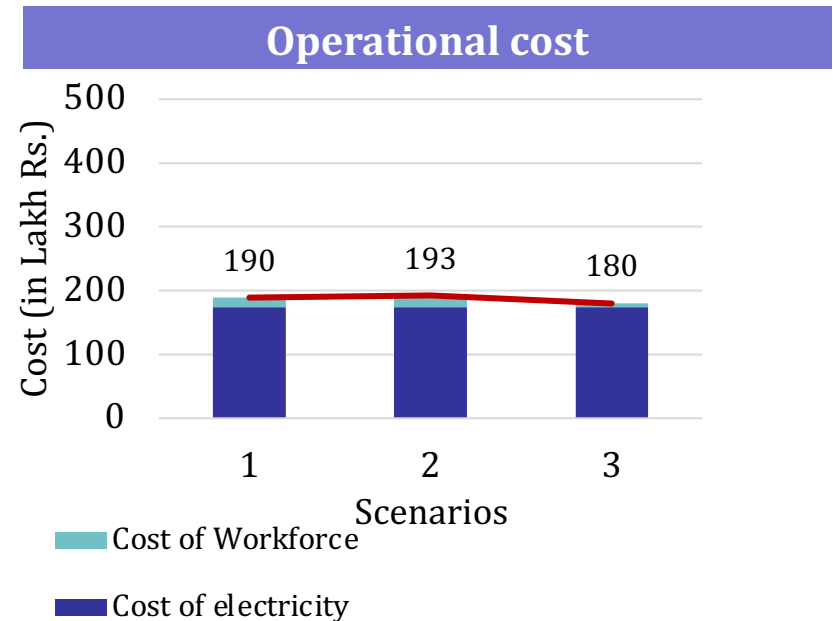
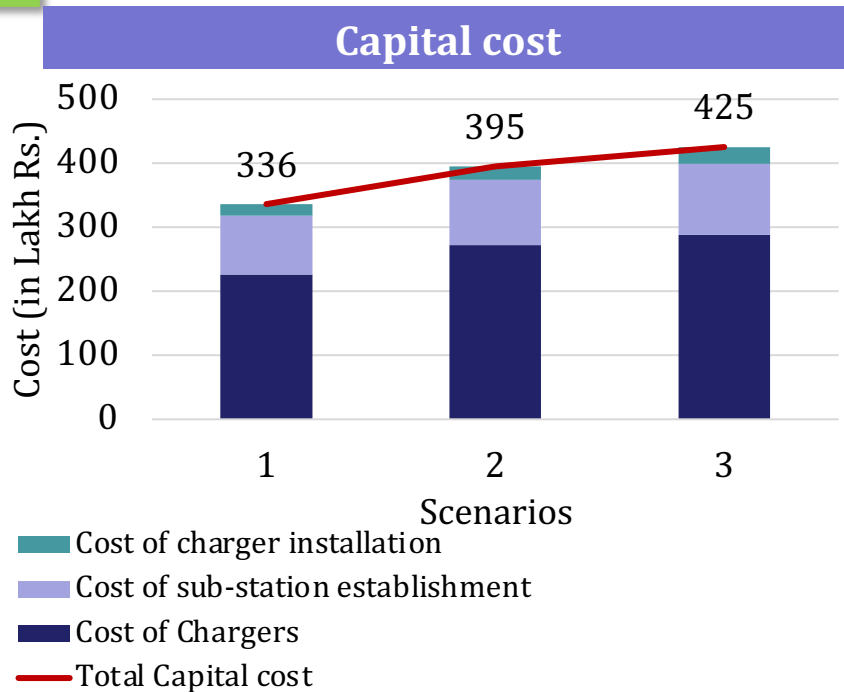


Scenario	S1: Charger sharing (Year 1)	S2: Charger sharing (Year 10)	S3: Dedicated chargers (Year 1)
Risk buffer/Route changes	Limited	Limited	Medium
Interchange time - minutes	20	20	NA
Interchange resources	2	2	NA
Number of e-Buses	55	55	55
Mean battery capacity (kWh)	330	263	330
Mean arriving SOC (%)	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)

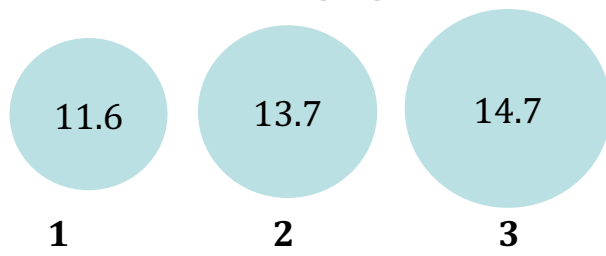
Source: MGL's EVOPT Analysis

TOTAL COST OF CHARGING (TCC)

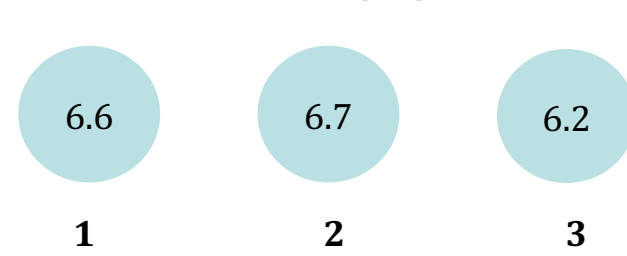


Source: pManifold, MGL

Capital cost of charging in Rs. per km

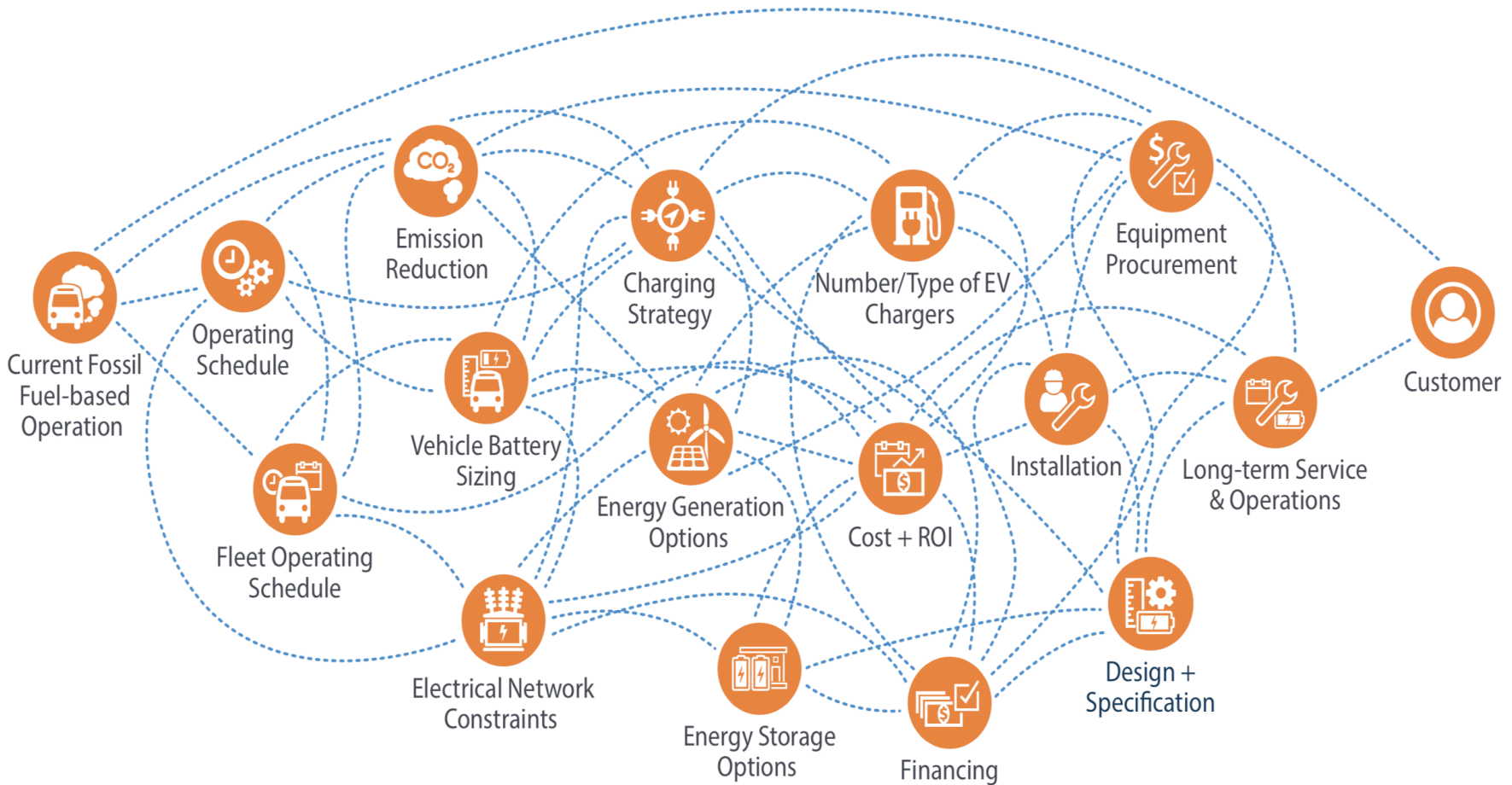


Operational cost of charging in Rs. per km



E-BUS SYSTEMATIC PLANNING IS ESSENTIAL

Multiple parameters and interdependencies



THANK YOU !

Rahul Bagdia

rahul.bagdia@pManifold.com



Enabling Smart & Clean Tech Markets



Energy



E-Mobility



LVDC



Enviro



Urban