Regulatory, Policy and Standards
Electric Vehicle & Grid Storage

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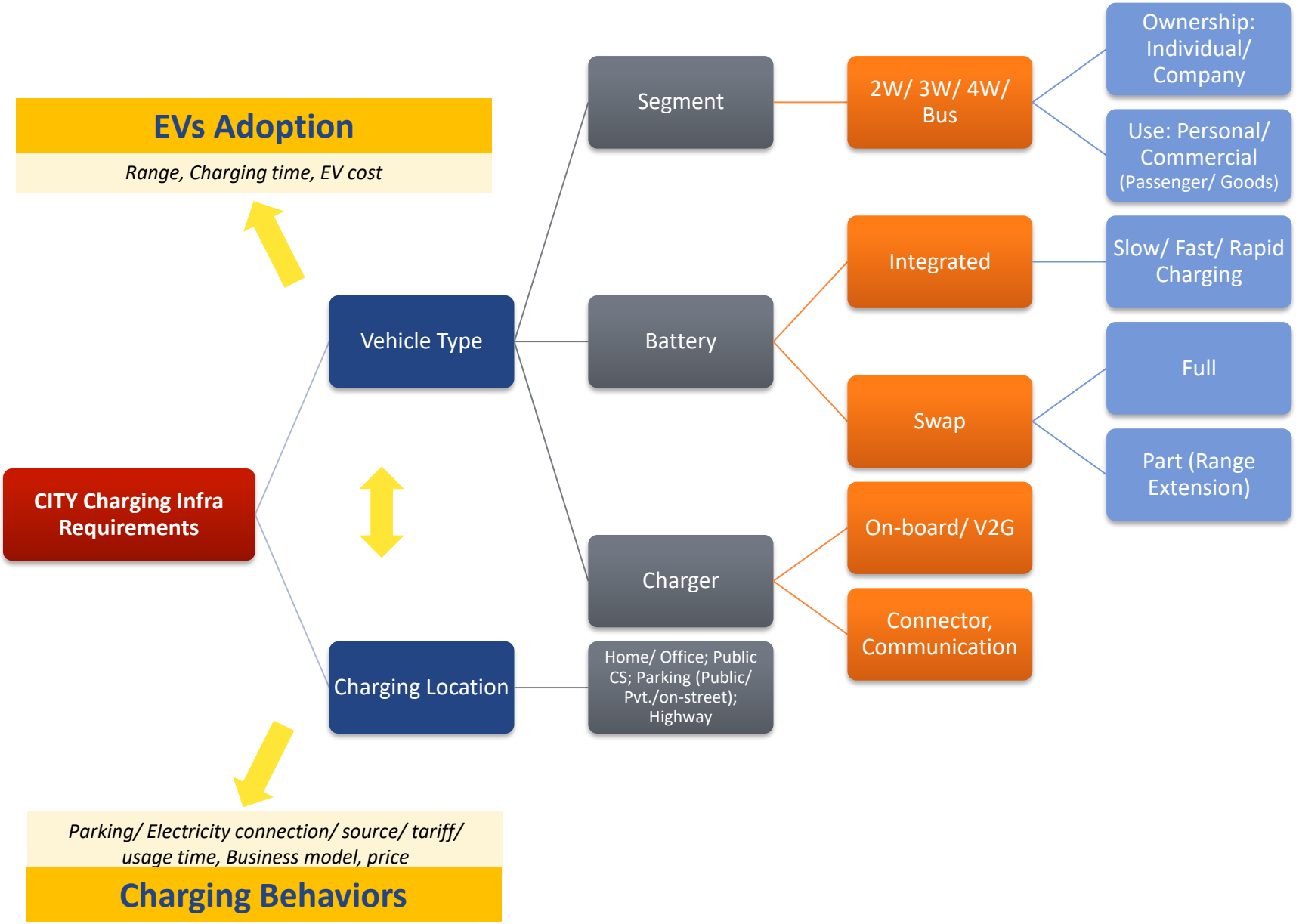
pMANIFOLD BUSINESS SOLUTIONS

Transforming Markets and Customer Experience

RESEARCH | CONSULTING | ENGAGEMENT | GLOBAL KPO

What drive selection and use of EVs?



Customer Preference for EV Purchase

20-30% awareness about some extent of EV economics and benefits over ICE. ***Range, Charging time and upfront Cost*** *form key purchase decision matrix.*

e-2W

	Units	60 kms per charge	90 kms per charge	120 kms per charge
Slow Charging	Rs. Lacs	A1-0.61 **1**	A2- 1.05	A3- 1.48 **3**
Fast Charging	Rs. Lacs	B1- 0.67 **2**	B2- 1.16 **2**	B3-1.62
Rapid Charging	Rs. Lacs	C1- 0.89 **3**	C2- 1.58	C3- 2.27 **1**

- *For potential e-2Wheeler buyers, if cost was not a barrier, buyers prefer the highest technology option i.e. 120 kms range and rapid charging. However, considering the cost, 60kms with slow charging is most preferred.*

e-4W

	Units	75 kms per charge	100 kms per charge	200 kms per charge	300 kms per charge
Slow Charging	Rs. Lacs	A1-7.2	A2-8.2	A3-12.1	A4-17
Fast Charging	Rs. Lacs	B1-7.5	B2-8.6 **1**	B3-12.6 **2**	B4-17.7 **2**
Rapid Charging	Rs. Lacs	C1-9.1	C2-11.1	C3-18.7 **3**	C4-28.3 **1**

- *For potential e-4Wheeler buyers, if cost was not a barrier, buyers prefer 300 kms and 200 kms range with fast/rapid charging. However, considering the cost, 100 km range with fast charging is most preferred.*

Source: pManifold, UMTC, UNEP Case study of City of Pune

Cost of EV Charging

EV Charging Cost differ across charging locations. Different electricity tariffs and operation cost components will drive differences in costing.

e-2W (60 kms range)

Electricity Tariff Rs./kWh	6.0	8.0	9.0	6.5	6.0	8.0

	Individual Home Charging	Building Common Charging	Work Charging	On-street charging	Public Charging Station	Mall Charging
Direct AC plug charger	9	-	-	-	-	-
AC charger (slow)	-	21	30	25	24	22
DC charger (fast)	-	32	47	37	39	35
DC charger (rapid)	-	-	-	43	53	48

All nos. in Rs./full-charge

e-4W (100 kms range)

	Individual Home Charging	Building Common Charging	Work Charging	On-street charging	Public Charging Station	Mall Charging
Direct AC plug charger	83	-	-	-	-	-
AC charger (slow)	-	144	206	158	174	189
DC charger (fast)	-	174	266	185	223	224
DC charger (rapid)	-	-	-	199	225	237

Battery Swapping Attractiveness

TCO for all segments of EVs comes lower than comparable ICE vehicles. Swap Battery system has further potential to optimise the TCO better.

TCO (Rs./km)			
Vehicle Segment	**ICE**	**EV (Fixed Battery)**	**EV (Swap Battery)**
2W	Rs. 3.5/km	Rs. 2.2/km (Range- 60km)	Rs. 2.1/km (Range- 60 km)
3W	NA	Lead- Rs. 3.1/km (Range- 60 km) LIB- Rs. 2.9/km (Range- 60km)	Rs. 2.2/km (Range- 60 km)
4W	Rs. 15.5/km (Petrol) Rs. 17.0/km (Diesel)	Rs. 13.20km (Range- 100km)	Rs. 11.4/km (Range- 75 km)
Buses	Rs. 57.4/km	Rs. 56.2/km (Range- 100km)	Rs. 51.5/km (Range- 46 km)

Source: pManifold Analysis

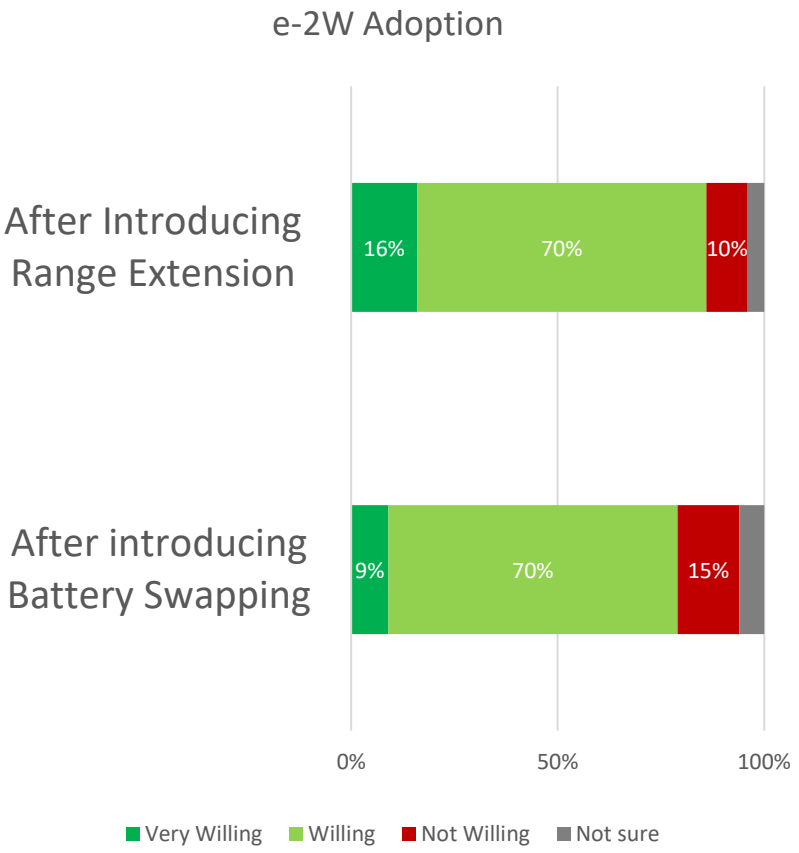
TCO Assumptions:

	2W	3W (Rickshaw)	4W	Buses
ICE Vehicle Cost	Rs. 0.55 lakhs	-	Rs. 8 lakhs (Petrol) Rs. 9.5 lakhs (Diesel)	Rs. 65 lakhs (12m Standard with AC)
Electric Vehicle Cost (without battery)	Rs. 0.35 lakhs	Rs. 0.75 lakhs	Rs. 6 lakhs	Rs. 80 lakhs
EV Base Range	60 kms	60 kms	100 kms	100 kms
EV Vehicle Efficiency (Wh/km)	20 Wh/km	Lead- 60 Wh/km LIB- 45 Wh/km	125 Wh/km	1,370 Wh/km
Vehicle Life	10 years	6 years	15 years (EV & Petrol) 12 years (Diesel)	10 years
Running (kms/year)	6,600	28,800	12,600	76,650
Charger Type	Slow AC	Slow AC	Fast DC	Fast DC

Common Parameters	Value
Interest Rate	10.5%
Diesel Cost (Rs./litre)	70
Petrol Cost (Rs./litre)	75
Battery Cost (Rs./kWh)	20,400
Grid Tariff (Rs./kWh)	
- Home	6.0
- Housing Society	8.0
- Office	9.0
- Commercial	6.5
- Public	6.5

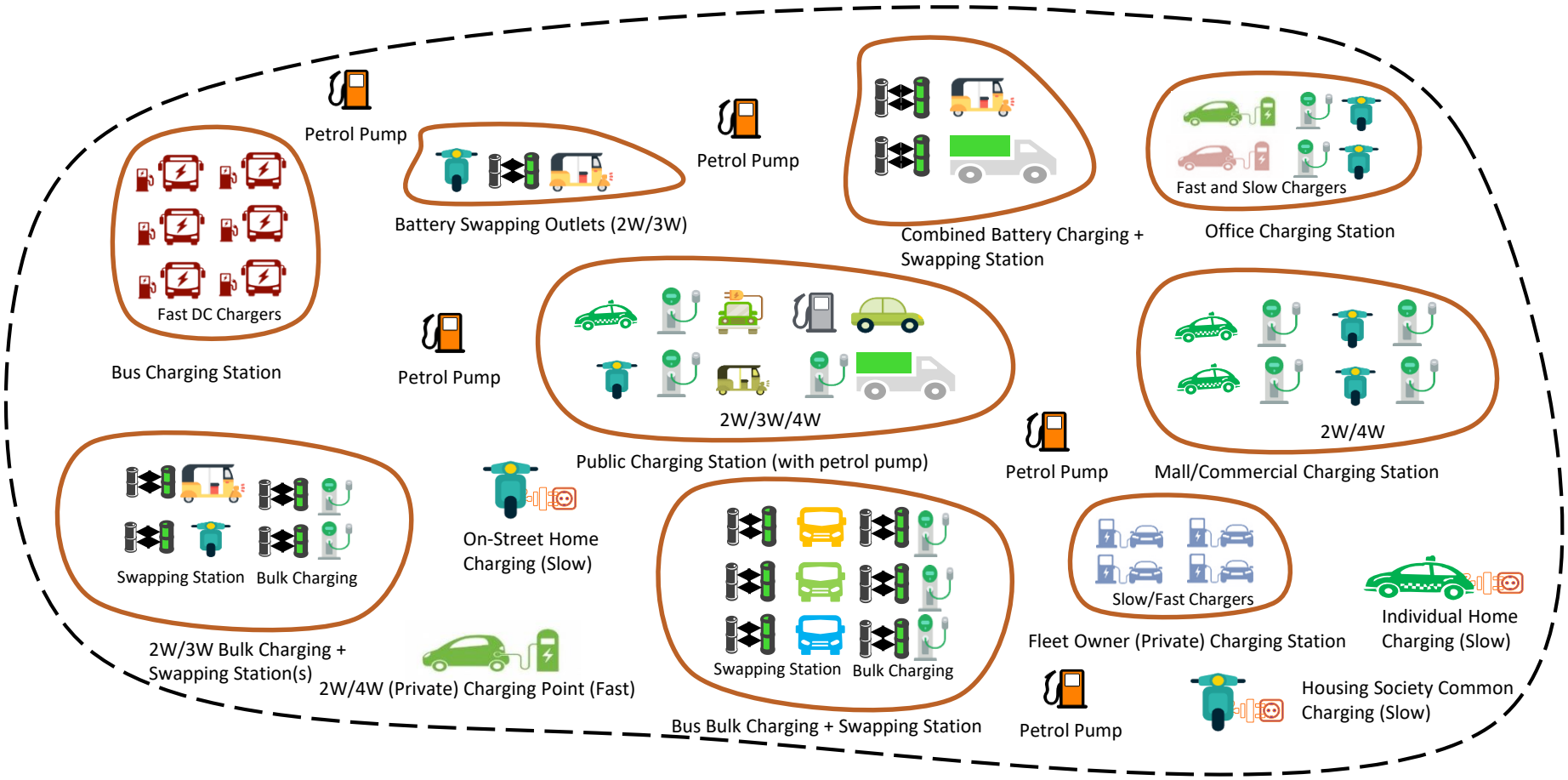
End-Customer Preference for Battery Swapping

*e-2W may see higher adoption of full battery swapping model over e-4W. **Range Extension** is better preferred over **full battery swapping** for flexibility to use personal charging at home/work.*



Source: pManifold, UMTC, UNEP Case study of City of Pune

Mix of EV Charging Options at City Level

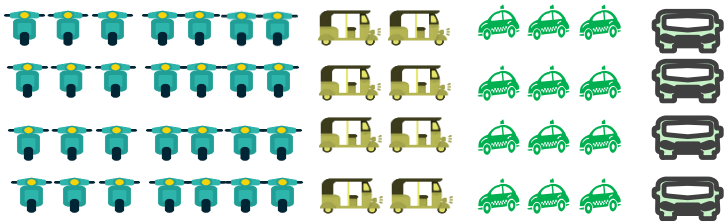


Source: pManifold

India EV & Charging Trends

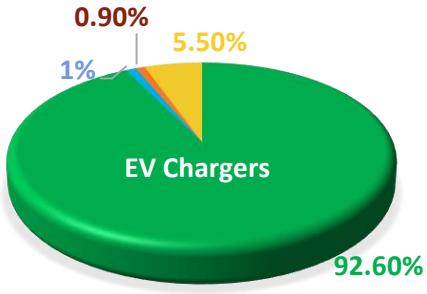
2W to form major share of EVs. Swapping Batteries has potential to capture >10% market share. Home charging will form major load share. Peak load and electricity consumption from EVs shall be sizeable and shall need sizeable grid augmentation and smart management solutions.

EV Stock

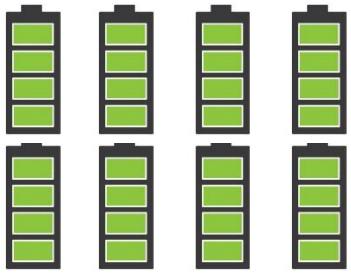


	Scenario 1	Scenario 2
% EV Sales in 2030	100%	30%
Total EVs on road	~ 256 million	~ 84 million
% EV Share of Total Vehicle Stock	41%	14%

Note: 2W to form 80% of the EV stock on road



	Scenario 1	Scenario 2
EV/EVSE ratio (without home chargers)	~ 19	~ 15



EV Lithium Ion Batteries (LIBs)

	Scenario 1	Scenario 2
Total Capacity Connected	~ 1045 GWh	~ 338 GWh
- Integrated LIBs	88%	88%
- Swapping + Range Extender LIBs	12%	12%

Impact on Grid

	Scenario 1	Scenario 2
Total Peak Load (including EVs)	464 GVA (27% EV contribution)	428 GVA (21% EV contribution)
Total Electricity Consumption (including EVs)	2,900 TWh (7% EV contribution)	2,820 TWh (4% EV contribution)

Source: pManifold Analysis

Pan city slow AC Smart Charging Network

Direct 15A charger with meter and communication put at key locations 1) Paid Public Parking 2) Malls 3) On-street Paid Parking 4) Housing Societies 5) Work/ Offices 6) Govt. offices and others.

- Adoption of AC-001 with one gun
- Portable charger provided with EV can be directly plugged in 15A socket on the charger (same as done in home charging socket). This allows to cope with different vehicle inlet connectors in next few years, until full standardization is enforced.
- Communication with CMS (over ethernet or sim)
- No communication required between AC Charger and EV
- Authentication, Payment gateway and Display on each unit
- Interlock of charging cable when plugged in and authenticate (to avoid theft)
- If multiple chargers in one location, they can be relayed via Master controller (with single connection meter) to CMS
  - CMS can control charging rate to meet sanction load of the load of the EV site. In future, when utility is ready, it can communicate with chargers via CMS.
- Need not be manned

Big Policy Changes

1. **Clear Target(s):** Define clear EV targets with timelines (vehicle segment wise, years, technology)

2. **ZEV Mandate on OEMs:** Notify and enforce % ZEV nos. over years, credit system, and penalties

3. **Tighten CAFÉ norm on OEMs:** to favor EVs, and enforce penalties (Possibly simplify norms in terms of km/litre and km/kWh instead gCO2/km)

Big Policy Changes

4. **Battery Swapping:** Allow level playing field to LIB swapping
    - Allow similar subsidies

5. **LIB Recycling:**
    - Tighten EPR regulation on EV Producers to collect 100% LIBs at defined EOL, and process with certified providers for reuse/ recycling
    - Allow import of LIB battery waste for reuse and recycling
    - Mandate min. one LIB recycling plant in each state

6. **EV Financing:** Encourage and incentivise lower financing rates for EV purchase (personal and commercial use) and related manufacturing

Big Policy Changes

7. **Pan city AC slow Charging Network:** Allow Discom (or cities) to invest in setting up pan city AC slow charging network. Allow Discom to capitalize in ARR.

8. **Public Charging Station:** Allow open market to decide upon number and type of chargers in public charging stations. The chargers should comply National standards. Support land lease and electricity connection.

9. **Time-of-Use (TOU) Tariff**

Charging EVs, Utilities and CX Journeys

Strategy	Reports	Business Plans
Feasibility	City EV Charging Infra	Workshops
Industry Outlook	Pilots Management	Policy

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