City EV Readiness

Bottom-up approach to scale EVs

A Knowledge Paper by

MANIFOLD
BUSINESS SOLUTIONS

MAY 2019

A Knowledge Paper by
pManifold Business Solutions Pvt. Ltd.

Published and released during
EV & Battery Tech India Summit
At 5th Smart Cities India 2019 Expo
Organised by Exhibitions India Group

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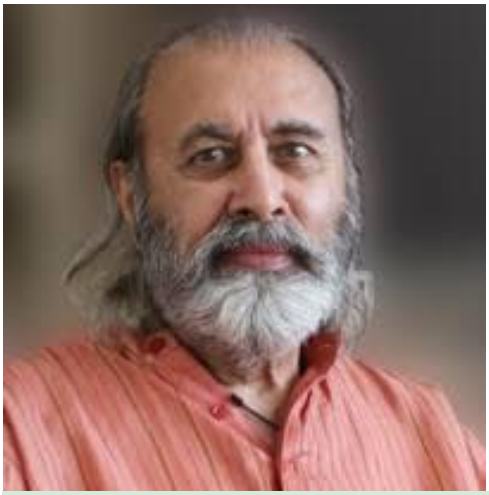


Prem Behl
Chairman & Managing Director
Exhibitions India Group

"Electric Vehicles is a definite reality for India and lot progress has been made in last 3 years. There are good many EV models across vehicle segments that are in market and on roads; multiple EV aggregators across 2wheelers, 3 wheelers, 4 wheelers and also buses; Slow and steady progress on standards, policies and deployment on public charging infrastructure and a lot more happening at central, state and city levels. India has a long way to go to meet its EV commitments and there are many learnings from earlier similar initiative in Solar, Smart cities and others.

There is increasing and growing conversions of different technologies at city levels including smart grid, solar rooftops, home automations, electric vehicles, grid energy storage, shared mobility, intelligent transportation system etc. At exhibitions India we are keen to host a dedicated EV and Battery Tech India Summit 2019 recognizing the importance of broader e-mobility sector in building smart cities.

I am very excited with the industry growth possibilities and belief that cities will stand up to the challenge of scaling EVs through a balance of Top-Down and Bottom-Up approach. pManifold launched City EV readiness score card is in right direction and I encourage industries to use benefit from it."

"EVs need very few parts compared to very complex supply chain of ICEs. This has resulted into breaking the earlier oligopoly of ICE OEMs, and many new players are entering into the value chain. This increased many players, new technology and early product development cycle has led to many new brands interacting with the customers and many ground pilots. There is strong need to build periodic intelligence on ground EV deployments at city level, and use generated insights to continuously improve product, supply chain, charging experience, financing, and policies bottom-up.

pManifold has built strong city learning for EV deployment and scale-up, and continue to work with industry players for collecting most relevant city intelligence across its stakeholders to build viable business proposition and detailed models. I am pleased to launch pManifold's "City EV Readiness Scorecard", which is based on in-depth secondary and primary research undertaken at city level. This with its evolution and periodic update will become good industry tool to benchmark city's EV evolution and share best practices."

Rahul Bagdia
Director, pManifold
Partner, Energy & Utilities

Executive Summary

India downsize its 100% new sales target to become Electric Vehicles (EVs) by 2030 to 30%. Achieving this revised target will not be easy journey, and specially so with big democracy and diverse country it is. The diversity at city level is huge, and this provides both challenges and opportunities. It was industry participation and city level entrepreneurship traction that resulted into early pilots in e-Mobility in India, despite Centre delays in announcement of dedicated National e-Mobility Mission. Government has important role in setting targets, streamlining actions between different stakeholders and guiding early investments. But ultimately, it will be market forces that has to sustain e-Mobility development and its scale-up in India.

A big question comes as how these market forces can be developed speedily and coordinated for more and more well integrated EVs deployment in cities. This missing link as studied in this whitepaper is City level intelligence around EV deployment and bottom-up strengthening of 1) product development 2) production supply chain strengthening 3) charging infrastructure and services 4) financing 5) institutional structure for policies execution across different departments. The city ground intelligence is based on primary research with EV users (both individual and commercial), non-users (high buy intent exemplified with visit to the EV dealers), EV dealers, charging station operators, urban local body, local Discom, RTO and others. Some key insights gained from multi-city interaction with these stakeholders revealed following:

- **EV Users:** Current market available EV models are more or less meeting user's basic performance expectations including range and speed. Attention is required on product quality and robustness, bringing prices down, improving post sales services, creating resale value, making easy finance, and improving subsidy and incentives disbursement process. Home charging is acceptable solution for its ease and cost, and meeting needs of individual users. Easy access public charging infra would bring higher confidence, and important to commercial EV fleet operators.

- **EV Non-users**: Price is acting as one strong deterrent to switch to EVs. There is inclination to go for Lithium Ion Battery model over lead acid variant, but with willing price point of lower than INR 50K for e-2W, INR 1.25L for e-3W and 6.25L for e-car. Also as more new players are entering into the EV market, customers are taking some time to understand feedback on their products and be able to put confidence. New EV OEMs need to work on building strong brand to win customer trust.

- **EV Dealers:** Foot fall to conversion rate is good, and it will take improved marketing and mass awareness to impress right EV value proposition in the masses. Easy financing and subsidy are perceived as important drivers for improving sales. Key asks of dealers from their OEMs is to support them with improved marketing, post sales services and flexible ordering and payment to better control their working capital, especially in mid of slow demand generation.

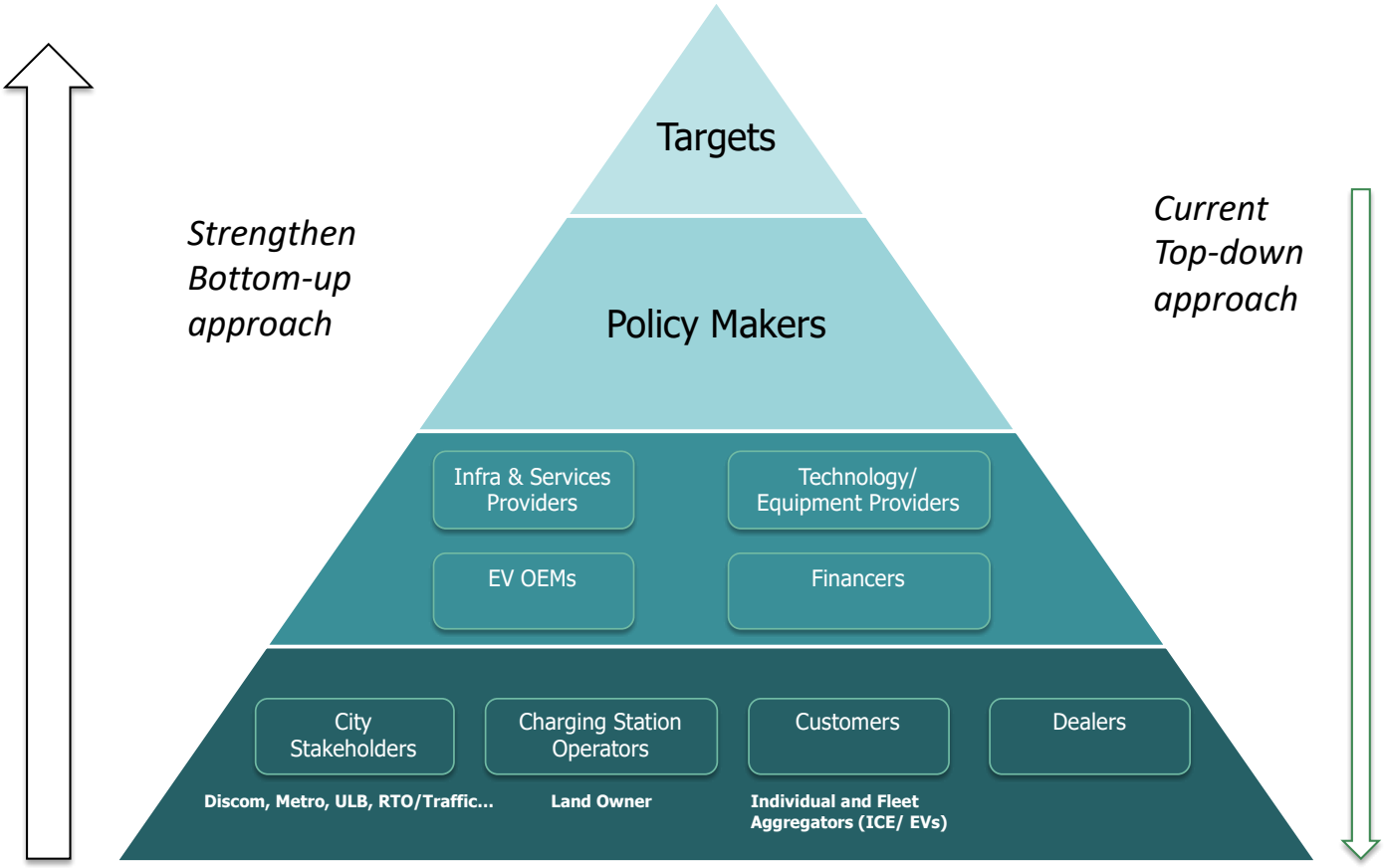
- **Charging Station Operators:** Operators continue to hassle with obtaining different approvals/ permits, capital subsidy, and finding low rental cost land to set up public charging infrastructure. Utilization of charging stations is very low given small number of EVs, and mostly doing home charging. Private EV fleet owner dedicated station has better utilization and business certainty. EV Tariffs charged by public charging stations accounting for low utilization, high land lease cost, and high supplied electricity cost comes high.

It will be important to track such regular intelligence from cities various EV deployment across different stakeholders and draw insights and best practices and put into next improvement and expansion plans. In this regard, pManifold has developed **'City EV Readiness Scorecard'** which has 3 dimensions:

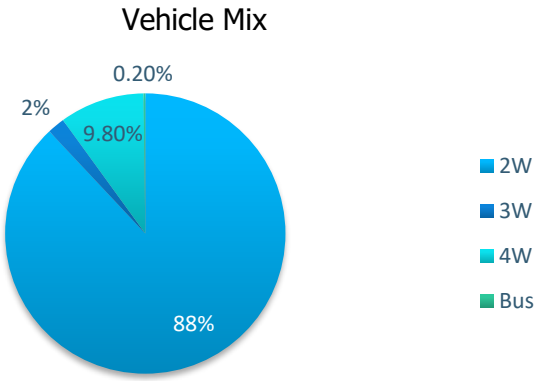
- **City EV Players Readiness:** This capture current EV deployment across vehicle segments, including players
- **City EV Potential:** This capture city's dynamics which provide impetus to apply EVs
- **City EV Institutional Readiness:** This capture State and City Govt alignment, capacity and EV related policies and execution

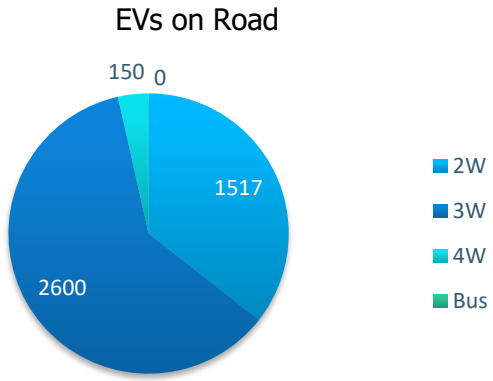
This scorecard shall allow benchmarking city's EV progress and share best practices. pManifold shall continue building city level EV research and keep it updated periodically.
While Government is doing its job and it shall flow top-down, cities shall act as zero ground for all EVs deployment. And industry and local stakeholders at city level need to come together to strengthen the overall ecosystem, supply chain and experience of the end-users to drive big wave of e-Mobility in India.

Bottom-up Approach to engage cities better to scale-up EVs in India



Nagpur City EV Readiness Case Study

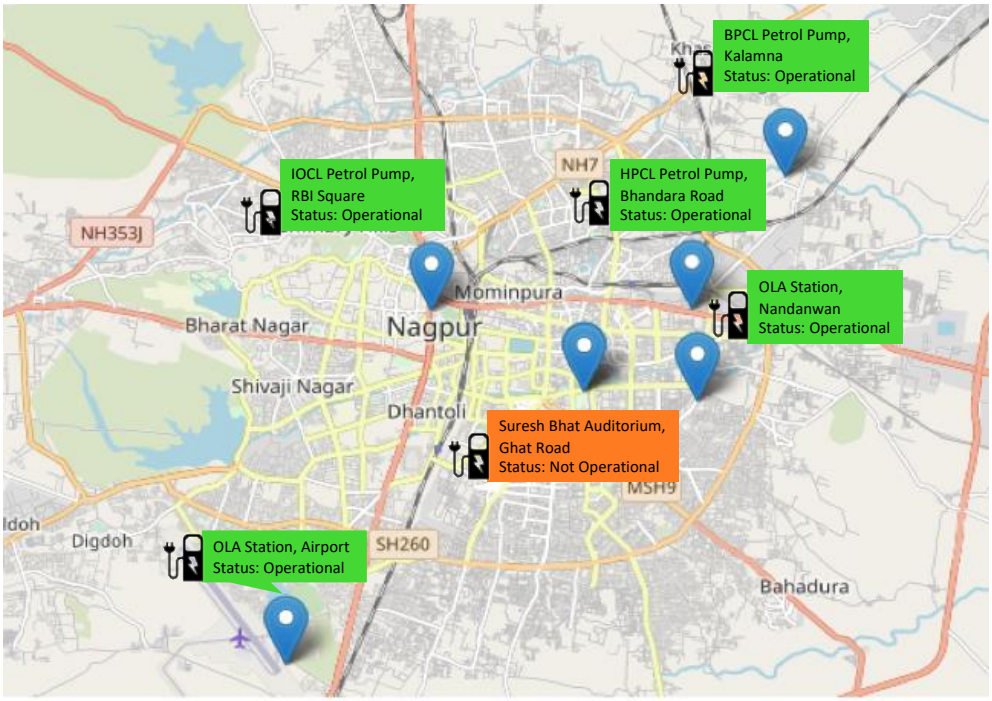




City population	28 lakhs (2019); 19% decadal growth rate (2011)	**EV Fleet Operators**	Ola (4W – 100; e-Rickshaw – 16)
Vehicle population	16.4 lakhs (2019); 0.59 vehicles per person	**Number of Public Charging Stations**	3 Total Charging Points: 19 Slow Charging Points: 2 Fast Charging Points: 17
Annual EV Sales (2018-19)	Total - 2811 2W - 1284 3W - 1512 4W - 15 Bus - 0	**Number of Private Charging Stations**	3 (by OLA) Total Charging Points: 22 Slow Charging Points: 11 Fast Charging Points: 11
No. of EV Dealers	Total: 23+ 2W: 12 3W: 10+ 4W: 1	**EV Deployment in Pipeline**	6 e-Buses under procurement by Nagpur Municipal Corporation

Nagpur, a zero-mile city of India has been amongst the first to adopt and successfully implement and scale-up various utilities and infrastructure business models, including in EVs. The city has seen successful deployment of PPP models in electricity distribution, 24x7 water supply, public bus transport, treated sewage water supply to thermal power plant and others

Existing Public and Private Charging Stations



Charging Stations Profile

Location	Owner	Type of Charger	Charging Standard	No. of Charging Points	kW (per gun)	Status	Charging Tariff*
IOCL, RBI Square	IOCL	Slow	AC001	2	3KW	Operational	50 Rs./hr
		Fast	DC001	2	10KW	Operational	350 Rs./full charge
HPCL, Bhandara Road	HPCL	Slow	AC001	1	3KW	Operational	45 Rs./hr
		Fast	DC001	1	10KW	Operational	170 Rs./hr
OLA, Nandanwan	OLA	Slow	AC001	5	3KW	Operational	50 Rs./hr
		Fast	DC001	5	10KW	Operational	350 Rs./full charge
OLA, Airport	OLA	Slow	AC001	4	3KW	Operational	50 Rs./hr
		Fast	DC001	4	10KW	Operational	350 Rs./full charge
BPCL, Kalamna	BPCL	Slow	AC001	1	3KW	Operational	-
		Fast	DC001	1	10KW	Operational	-
Suresh Bhat Audi, Ghat Road	Suresh Bhat Audi	Fast	AC	5	43KW	Not Operational	-
		Fast	DC (CHAdeMO)	5	50KW	Not Operational	-
		Fast	AC-DC (CCS)	5	50KW	Not Operational	

**Actual charging tariffs closely match pManifold estimation*

Utilization of charging stations is very low given small number of EVs, and mostly doing home charging

Insights from EV Dealers

	e-2W	e-3W	e-4W
Key OEMs/Brands present	Hero, Okinawa, Raptor, Yo bikes, Electrowheelz, Ampere, others	Lohia, Mayuri, Yatri, Simba, Basantee, Ashv, Kinetic Green, Mahindra, others	Mahindra
Footfall to sales conversion	15%	21%	3%
LIB model unit sales mix	6%	5%	100%
Dealers view on Customer seen top purchase criterion (in priority order)	• Range • Charging Time • Top Speed • Brand • Price	• Range • Look and Feel • Maintenance • Price • Brand	• Price • Range • Charging Time • Choice of Models
Dealers view on top interventions that can drive increased sales (in priority order)	• Subsidy • Financing • Soft incentives (road tax exemption, parking, etc.)	• Financing • Subsidy • Public Charging Infra	• Financing • Public Charging Infra • Subsidy
Dealers view on top asks from EV OEMs (in priority order)	• Post-sales support (like spare parts availability) • Increased Marketing support • Higher margins • Increased flexibility on ordering and payments • Easy Access to Finance	• Easy Access to Finance • Increased Marketing support • Increased flexibility on ordering and payments • Post-sales support (like spare parts availability)	• Post-sales support (like spare parts availability) • Increased Marketing support • Increased flexibility on ordering and payments • Easy Access to Finance

More number of new EV players in the market and product design and supply chain is not still matured, leading to low post-sales support

Insights from EV Users

e-3W Users placed Importance and Expectations achievement

Source: pManifold Analysis

- Initial purchase cost, look and feel, post-sales support, range and brand are important to 3W users, and their expectations are reasonably met. Charging infra availability, resale value, subsidy process and detachable battery are some important areas where expectations are not met.
- Prevalent **Lead Acid battery** EV models in 2Ws (60%) and 3Ws (100%). LIB models are getting induced slowly.
- **Direct Home Charging** is used by 100% of individual 2W and 4W users. 3W drivers doing 1-2 times home charging because of lack of convenient public charging infra. 4W Ola drivers doing one night home charging and another as required in Ola fast charging stations.
- Prime time for home charging is night 10 pm-6 am. Ola drivers peak time for charging at Ola station is 8 pm-12 am and 12 pm-4 pm.
- 20% 2W and 30% 3W users availed Finance. Established banks like SBI, HDFC, BOI, local co-operatives and NBFCs doing finance at average 11% interest. Easy and lower interest finance shall improve penetration.

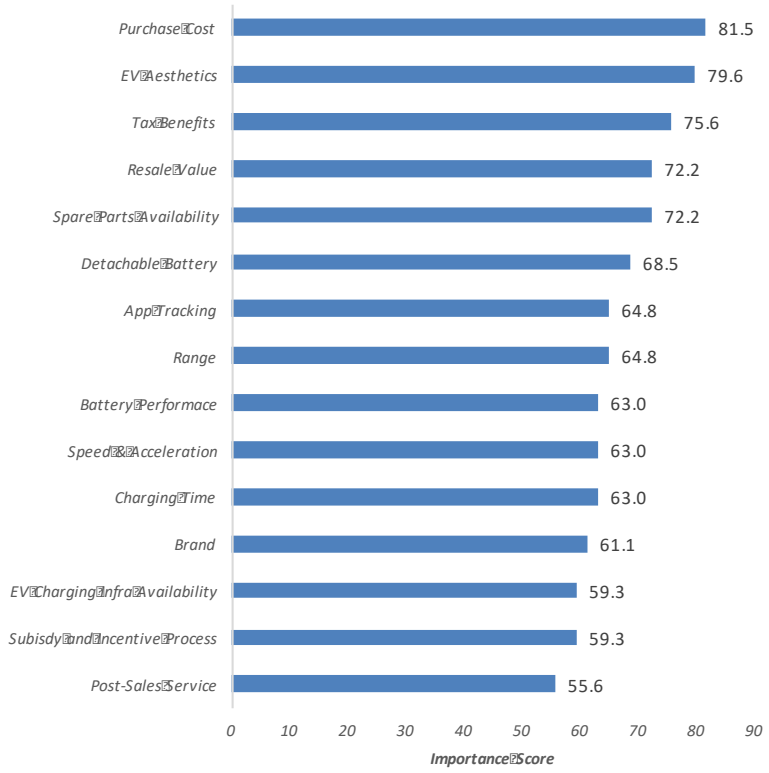
100%

users believe on EVs viability to them, and >80% 2W and 100% 3W recommending EVs to peers.

Insights from Non-Users*

**Non-users are customers who have intention to buy EV and have visited Dealers, but haven't yet purchased*

e-2W prospect Buyers placed Importance on EV attributes and features



Source: pManifold Analysis

- Initial purchase cost, look and feel, tax benefits, resale value, spare parts availability and detachable battery are rated high features over and above range and speed for e-2W buyers. This highlight the importance of **value for money** for this class of buyer. e-3W prospect buyers has more focus on battery performance, speed and post-sales services.
- Expected range and speed from EVs mostly matching with current market model's availability
- Price inflection point for willing mass market purchase of LIB model of EVs stand lower than INR 50K, INR 1.25L and 6.25L for e-2W, e-3W and e-car respectively
- Existing ICE 3W auto drivers have started feeling the pinch with strong competition coming from shared mobility and e-3W options, which is hurting their revenues and savings. Given strong TCO of e-3W, this market segment is poised to grow very fast.

>33%

customers found their Dealership visits just ok, indicating improved sales training for rightly showcasing LIB models and impressing EV's custom proposition to the customers

Insights from EV fleet Aggregator deployment

Ola deployed India's first EV multimodal operations at Nagpur in 2017, and with strong learning is now ready to deploy 10K e-3Ws across India in 2019, and 1 million EVs by 2022.

EV Operations:

	e-cab	e-3W
No. of EVs deployed	100 e20 plus (15 kWh)	16 Kinetic Safar (2.8 kWh)
Range	~100 kms (10% higher in winter)	>35 kms
Avg. Daily run	142 kms	66 kms
Charging Time	Fast* – 1.5 to 2 hours Slow – 7 to 8 hours * In summer, fast charging time rise to >3.3 hours	Fast – 2 hours Slow – 6 hours

Charging Station Operations:

	Fast Charger	Slow Charger
Number of Charging Points	11	11
Charger Utilization	40%	5%
Charging Tariff for e-cab	INR 350 per full charge	INR 50 per hour

	Key Challenges	Corrective Measures
1	*High supplied electricity tariff*	Installed solar rooftop at Charging station
2	Long waiting time for charging	Allowed home charging. Increased number of private charging stations.
3	Initial high Repair & Maintenance *(limited understanding to operate EVs)*	Organized periodic service camps and training at charging stations

Source: 'Beyond Nagpur: The promise of Electric Mobility By OLA Mobility Institute

Ola pilot helped learn useful do's and don'ts for city stakeholders and EV Aggregators to setup and scale EV fleet operations at city level. Commercial EV fleet business (2W, 3W, 4W and buses) offer higher advantageous TCO as compared to individual use applications, and hence their speed enablement at city level will be good start for all cities. The higher visibility of this EV fleet will also attract individual users to switch to EVs.

Nagpur EV Market Size

	2019	2025	2030
Two Wheeler	0%	5%	11%
	~ 2,217	~ 87,451	~ 0.26 million
Three Wheeler (PV+CV)	5%	12%	24%
	~ 1,701	~ 4,974	~ 13,621
Four Wheeler (PV+CV)	0%	6%	15%
	~ 118	~ 12,280	~ 41,417
Buses	0%	9%	25%
	~ 0	~ 261	~ 970

How to Read?

Chart subtitles: EV Stock as % of Total Vehicle Stock in a given vehicle segment
Example: 25% of total 2W on road will be a electric 2W

Source: pManifold Analysis

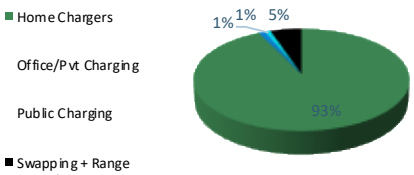
EV Lithium Ion Batteries (LIBs)

	Scenario 1
Total Capacity Connected (MWH)	1370
Integrated LIBs	70%
Swapping + Range Extender LIBs	30%

Impact on Grid

	Scenario 1
Total Peak Load (including EVs)	840 MVA (16% EV contribution)
Total Electricity Consumption (including EVs)	3491 Mus/year (9% EV contribution)

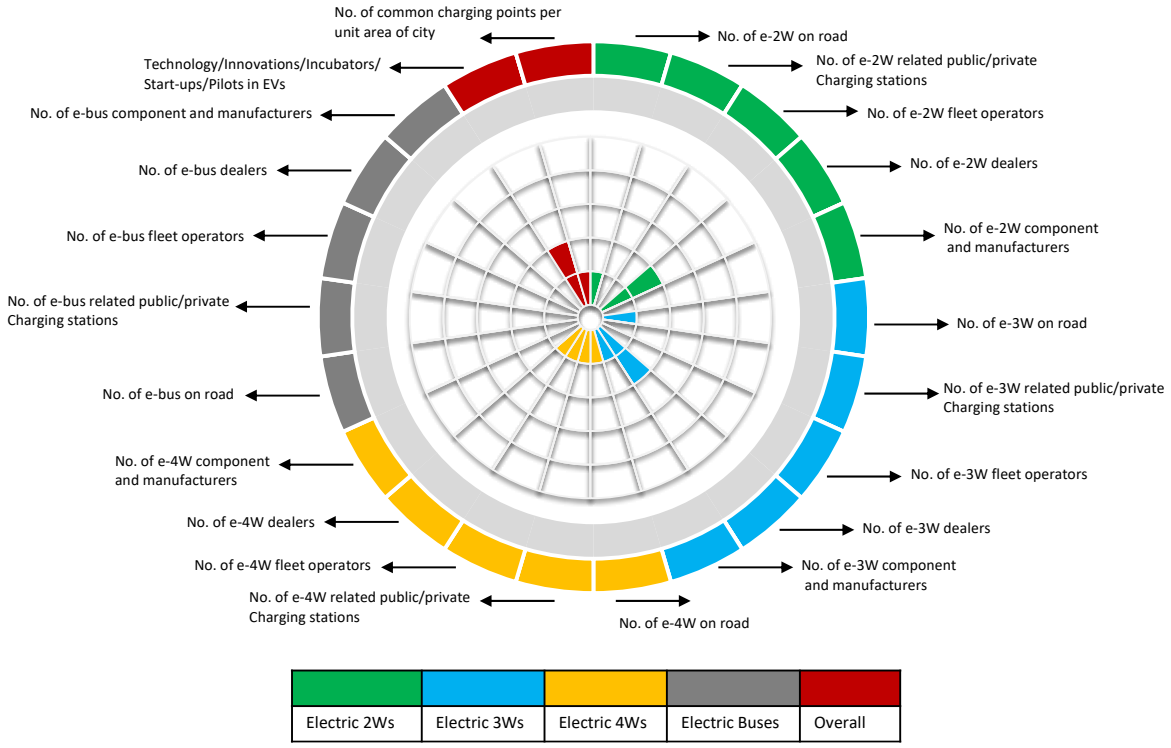
EV Chargers



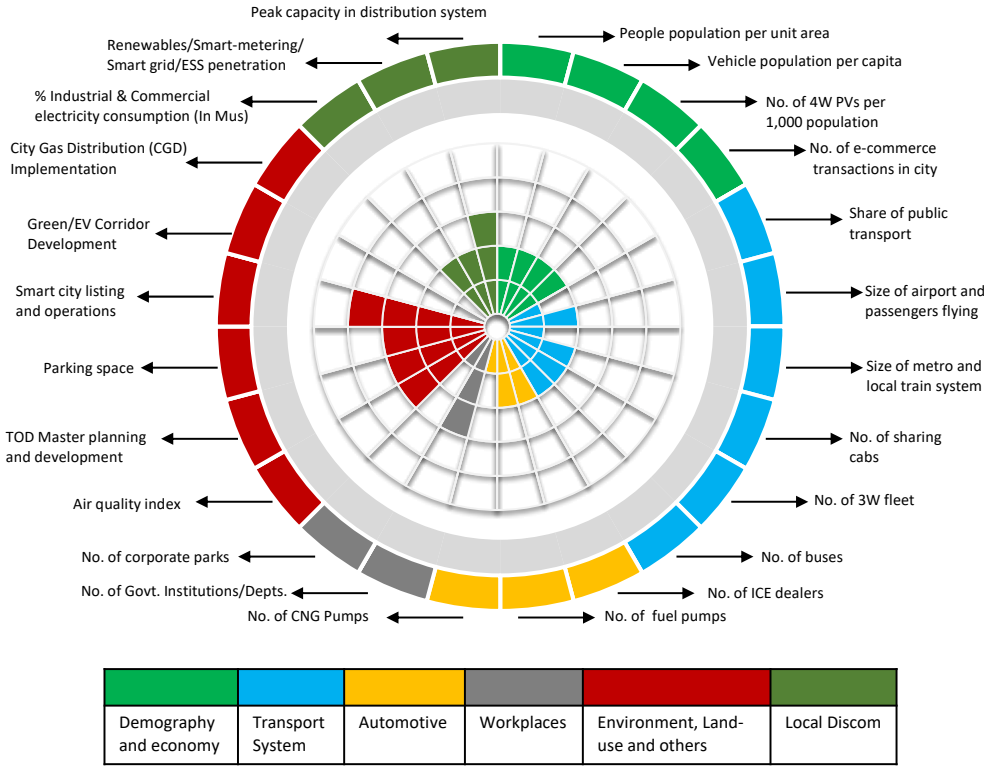
By 2030, it is estimated there will be ~2.8 million total vehicle stock on road. With aligned EV policy and aggressive Govt. support, if 30% new sales shall become EV by 2030 across vehicle segments, then it is estimated there will be approx. 0.32 million total EV stock on road, taking 12% share.

City EV Readiness Scorecard

EV Player Readiness

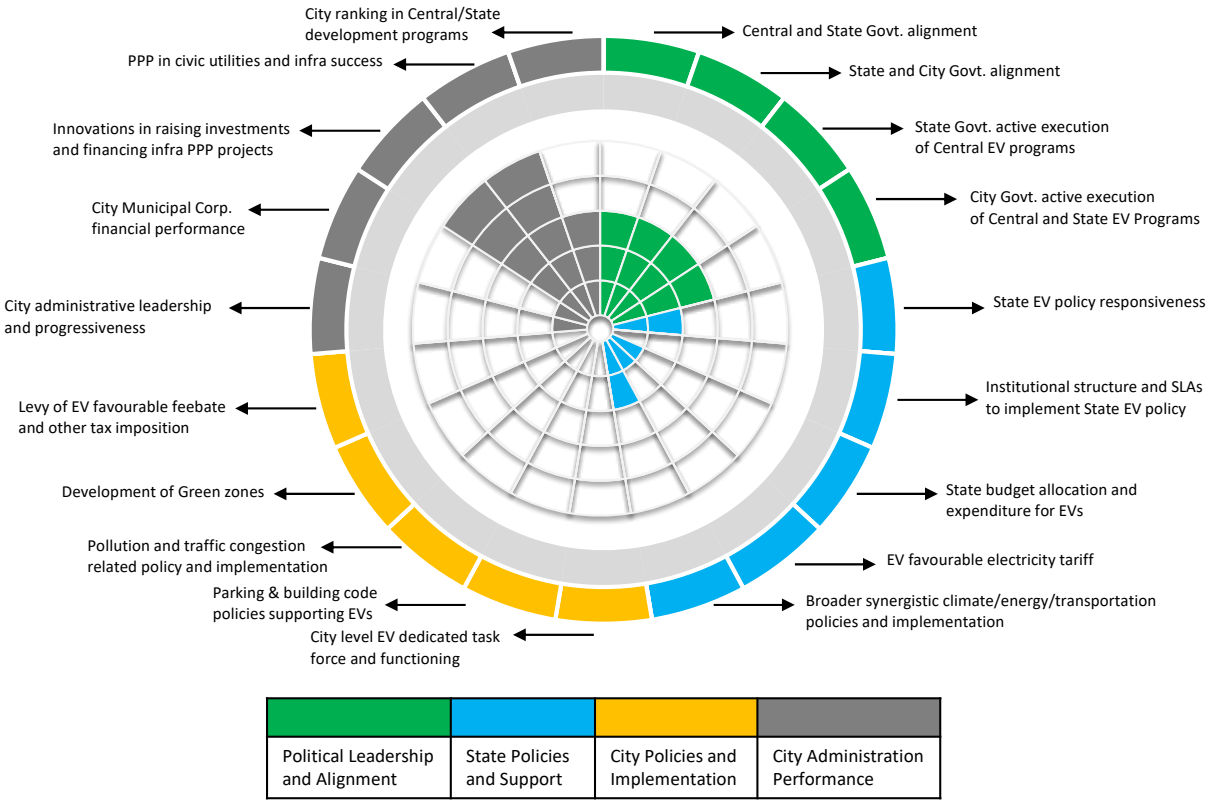


EV Potential



Source: pManifold Analysis

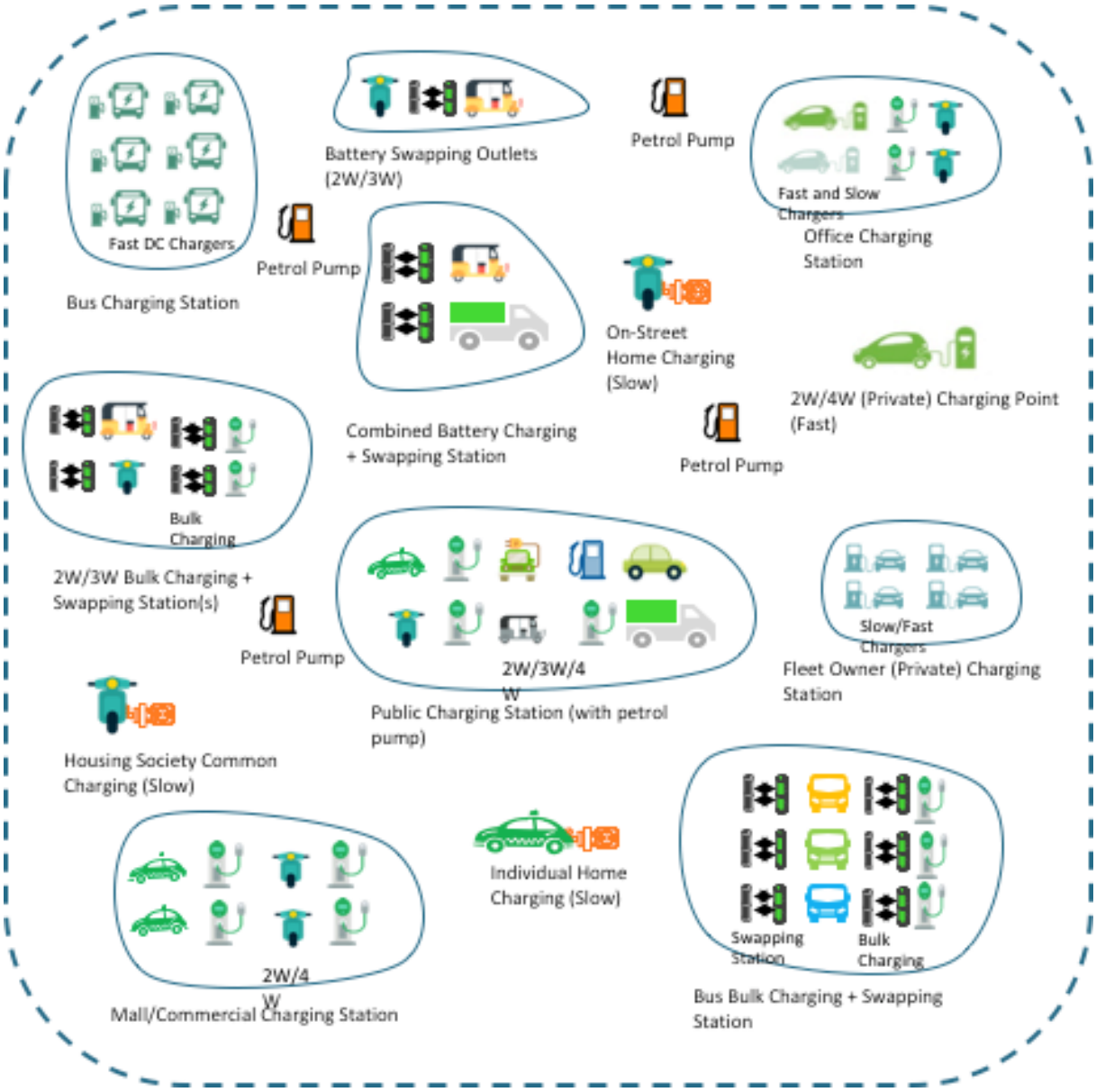
EV Institutional Readiness



Source: pManifold Analysis

Nagpur shows high EV potential. It's EV Players Readiness stands prepared to support future EV growth. The city's Institutional Readiness fairs good to support and build further EV momentum.

Mix of EV Charging Options and Infra

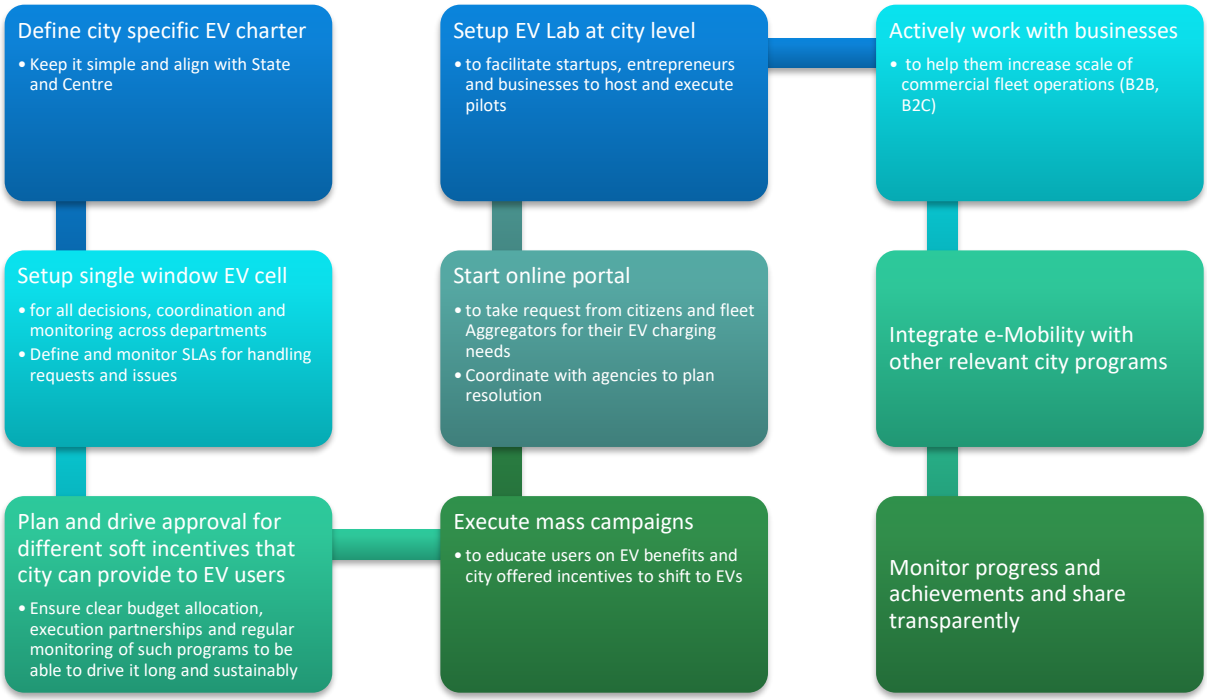


Note: *The above pManifold infographic is for representation and understanding only. The actual scenario may differ on a case to case basis.*

There will be a mix of different charging options and infra requirements depending upon 1) Vehicle segment 2) Charging Location (home, office, public charging, commercial place) 3) Integrated or Swapping battery model and 4) Ownership (public/private)

What cities can do?

EVs in time to come because of its economics will storm out ICEs, and this is huge disruption in the energy, transport and climate value chain. Multiple literatures have made suggestions on different aspects to be resolved for mass adoption of EVs. Cities should start looking at e-Mobility not in isolation but as means to build smart, sustainable and friendly cities.



Define EV vision, plan activities, allocate resources, drive execution, monitor progress and integrate with other city programs

Thought Leadership

"…MoHUA guidelines for 20% reservation for EV in all parking lots is an excellent opportunity. So where-ever you go, if there is an EV Parking, that is also where you Top-up charge the EV. Lithium ion Battery is excellent for partial charging. The charging needs to be tied to the parking.

All parking lots need to get equipped with some basic charging outlet with authentication, metering and safety features. If planned for bulk installation, the costs can be brought down drastically. In this way, the DISCOMs will be able to manage the grid load and utilize the distributed charging as a means of managing the grid fluctuations/ power quality. The car parking cum charging will be called an EV Bay…"

- **Mr. Sajid Mubashir, Member R&D at National Automotive Board, Department of Heavy Industries, GOI**

"…The key challenges for EVs rollout in a city are availability of (Public) Charging infrastructure, awareness generation among buyers and to bring disparate city functions to come together to support EV adoption.

Cities should start the online processes for registration of interest and approvals of charging infra based on consumer interest in EV, aggregation and procurement support to be provided to consumers.

Cities would need to integrate EV plans with Distribution System Plans, Building Codes, Transportation Plans (Integrated Transportation Services), RE Plans (e.g. Roof Top Plans) etc..."

- Mr. Vinod Kala, Founder, Emergent Ventures India

"…The bulk of charging for cars and two-wheelers is going to happen at the home or office end and therefore policies and regulations need simplification for this to happen. Changes are required in building bye laws, tariff policies for electricity and parking regulations.."

- **Mr. Subhash Dhar, Senior Economist at UNEP DTU Partnership, Copenhagen, Capital Region, Denmark**

"….As electric mobility is a multi-department and multi-sectoral issue, constituting a task force with relevant departments is an important first step.
Another important aspect is the battery waste management and disposal aspect of electric mobility. A city-specific plan to assess needs is required and to dovetail these plans with relevant departments (e.g. urban planning, DISCOMs, transport, energy, waste management, pollution control board etc.).
The task force can form an institutional structure to assess and monitor electric mobility. At city level, the implementation should also connect to the larger central programmers of FAME-II, NCAP, Smart Cities Mission and Urban Mobility Scheme and state-specific EV Policies"

- Shri Atul Bagai, Country Head, UN Environment – India

"….As EVs are expected to be adopted first in major cities of India, space constraint poses a major challenge. To overcome this, the government must support willing charging infrastructure companies with providing required space at public locations like municipal parking, metro stations, airports etc.

As India would be requiring a large number of public charging, private investment would be needed to scale up the infrastructure. To attract private investment, a fair competitive market environment has to be facilitated. FAME-2 has provided for about 150 million USD for creating Charging Infra in next 3 years, though the guidelines of using this fund has not been made public, it is hoped that private charging point operations shall also be given the opportunity to avail this fund for developing charging infrastructure"

- Mr. Sanjay Aggarwal, Managing Director, Fortum

"….The larger the adoption of EVs & greater would be the impact on DISCOM network, and to have reliable & uninterrupted supply DISCOMs need to carry out preventive planning to cater to EV charging needs as well. We believe it is true that robust, easily accessible & ubiquitous charging infrastructure is largest driver for adoption of EVs. Availability of such charging network will eliminate range anxiety & encourage in quick adoption of EVs. All stakeholder like Land Owning Agencies, Charger Developers, OEMs & Fleet Owners/ Prospective Customers need to plan together for development of EV charging infrastructure ecosystem.."

- Jitendra Nalwaya, BSES Yamuna Power Limited

"…Macro level city challenges are lack of ecosystem- consumer awareness, availability of key raw materials, supply chain, clarity in regulatory framework, integration with multi-modal transport systems.

Challenges for EV charging infrastructure players – lack of – required electricity infrastructure (power line, meter, connections, transformers, etc.), real estate, clarity in regulatory processes (permits, PESO, Open Access, implementation of state-level financial incentives, etc.)

Encourage mechanisms to retrofit fossil-fuelled vehicles such as autorickshaws, buses, taxis, etc. with electric powertrain to convert the existing base of vehicles to non-polluting ones…."

- **Mr. Chetan Maini, Vice-Chairman, Sun Mobility**

pManifold's EVIS©

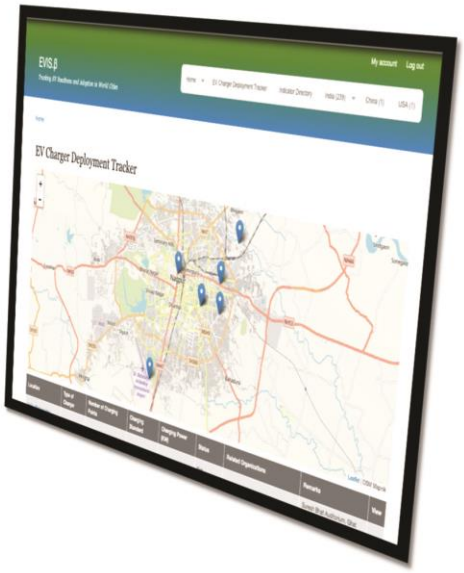
EVIS© (Electric Vehicle Information System) - One place for EV Intelligence at city level

The Government of India (GoI) launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013. Of late this plan has gained momentum.

The EV Eco-System has been growing, however city level information on EV adoption scenario, EV development strategies, EV landscape is not easily available and accessible that would be beneficial for different EV stakeholders to scale.

The portal provides a detailed solution on city level EV developments and propositions for top cities in India and globally as it expands.

The digital solution will act as a detailed repository available to professionals on a subscription basis enabling players in the EV Ecosystem to learn and design better solutions.



* Nagpur, Mumbai, Pune, Chennai, Bangalore, Hyderabad, Delhi, Kolkata, Ahmedabad, Surat

City Specific Coverage

- ☑ City EV attractiveness index
- ☑ Charger Deployment Tracker
- ☑ EV User reviews and perception
- ☑ EV Dealer and OEM reviews
- ☑ EV and Charger City level Forecast
- ☑ EV and Charger City level Impact on Grid
- ☑ EV related Projects Tracker
- ☑ EV Innovations & Org Tracker
- ☑ EV Model Specs & Performance Tracker

You can record your interest in the portal to be amongst first to subscribe. Also, you can share list of cities of your interest. Please send email with your enquiry at contact@pManifold.com.

About pManifold

pManifold is an **Energy & Utilities** focused Research and Consulting company working across – **power, electric vehicles, solar, LVDC, smart cities, water, waste** and others. Its focus on utilities comes from its vision - to create better everyday life and experience for the masses. Towards this, it engages and work with players across the utility value chain and help them improve their viability, reach, service quality and positive impact. It does this through:

- undertaking useful research (be it around technology, market, customer, business, and/or policy) to discover relevant 'small-data' and support strategic decisions
- benchmarking best practices to help improve services delivery and experience
- organizing technology and business pilots to innovate new, scalable and sustainable business models
- designing point of view and engage stakeholders for collaboration, policy advocacy and speeding industry reforms
- program managing strategic growth initiatives

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