Digital India
Power To Empower
स्वच्छ भारत
एक कदम स्वच्छता की ओर
GOVERNMENT OF INDIA
MINISTRY OF HOUSING AND URBAN AFFAIRS
11th Urban Mobility India Conference & Expo 2018

POTENTIAL OF ELECTRIC MOBILITY FOR GREEN MOBILITY ENVIRONMENT

Case Study Delhi

MADHUR KUKREJA, SPA DELHI

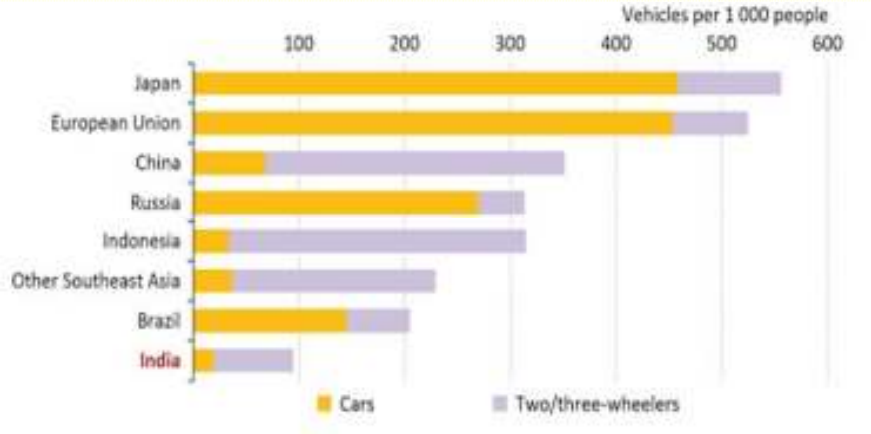
MOBILITY & ENVIRONMENT

INSTITUTE OF URBAN TRANSPORT (INDIA)

PRESENTATION STRUCTURE

- Need of Electric Mobility
- Aim & Objective
- Basic Terminologies and Concepts
- Global Policy Approach
- Indian Policy Scenario
- Data Collection
- Scenario for Delhi
- EV User & Usage Scenario
- OEM's & Charging Ecosystem Providers
- EV Non User Mode Choice Modelling
- Impact of Electric Vehicles on the City
- Conclusion and The Way Forward

NEED OF ELECTRIC MOBILITY



MOTORIZATION TRENDS

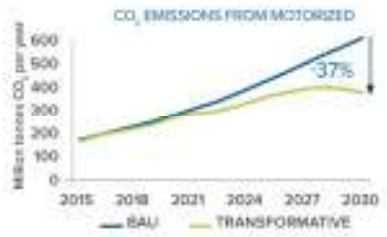
The total number of vehicles registered in India has been 5.4 million, 11 million, 33 million, 40 million and 210 million in the years 1981, 1986, 1996, 2000 and 2015.

This indicates a 3500+ % growth in the total number of vehicles between 1981 and 2015.

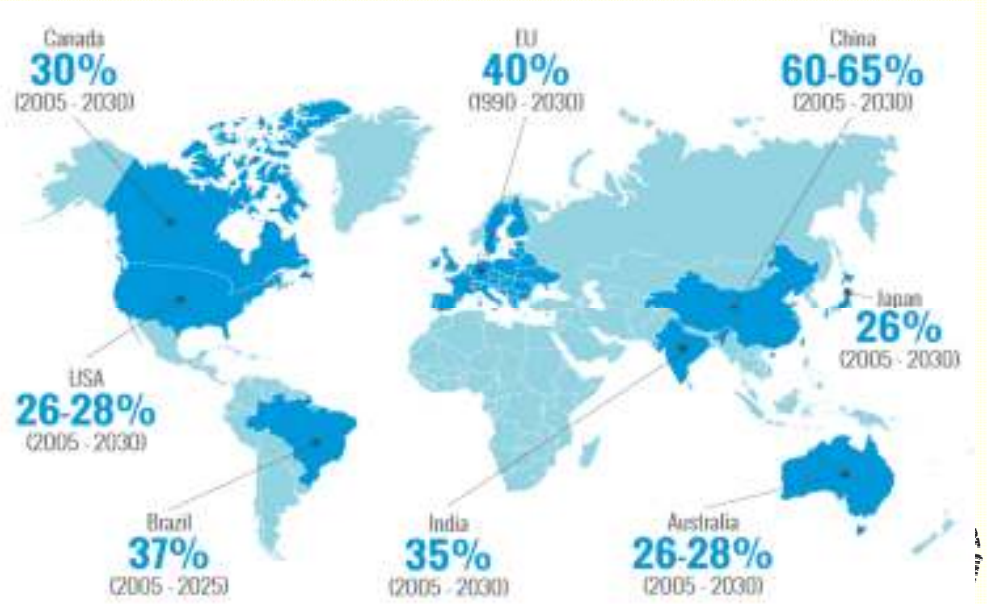
EMISSION TARGETS

From 2006 to 2030, the global energy consumption is likely to rise by 53% and about three quarters of the projected increase in oil demand will come from transportation.

EMMISSION CUTS PROMISED BY RESPECTIVE COUNTRIES IN THEIR NATIONALLY DETERMINED CONTRIBUTION PLANS in COP21 (PARIS AGREEMENT 2015)



EMMISSION CUTS PROMISED BY RESPECTIVE COUNTRIES IN THEIR NATIONALLY DETERMINED CONTRIBUTION PLANS in COP21 (PARIS AGREEMENT 2015)



AIM

To assess the Potential of electric mobility for green mobility environment in India in the case study area of Delhi

OBJECTIVE

To **appreciate the concepts, features and technology of electric mobility** and its potential role in Indian cities.

To **review global trends, policies and practices** for implementation of Electric Mobility.

To **analyze the efforts (policies and ecosystem) for promoting EM** in Indian cities so far and identify the constraints for its targeted implementation

To **assess the existing demand (user behavior), supply ecosystem and policy features** of electric mobility in case study of Delhi

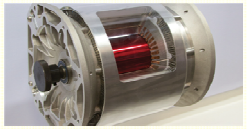
To **assess and estimate the infrastructure, economics and ecosystem requirements** for meeting potential and projected demand

To **propose guidelines for accomplishing electric mobility in Delhi** and suggest appropriate bye - laws for its implementation

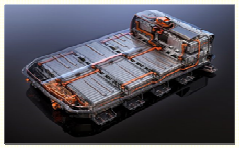
KEY CONCEPTS OF ELECTRIC MOBILITY

MAIN COMPONENTS

CHARGING INFRA



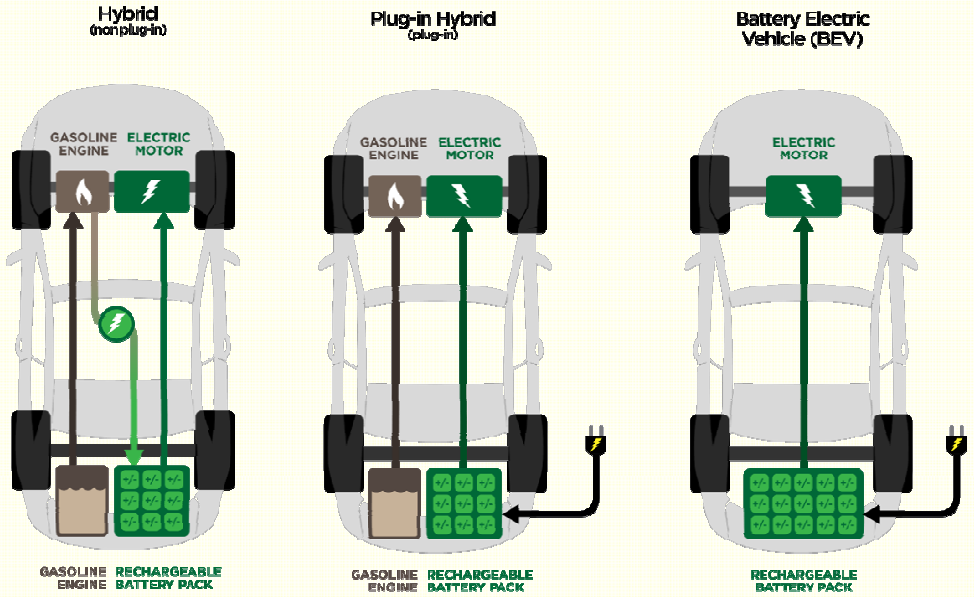
MOTORS



BATTERIES

An Electric Vehicle has a relatively simple component architecture with the number of moving parts in the vehicle being less than 50 compared to over 500 parts in an IC engine powered vehicle

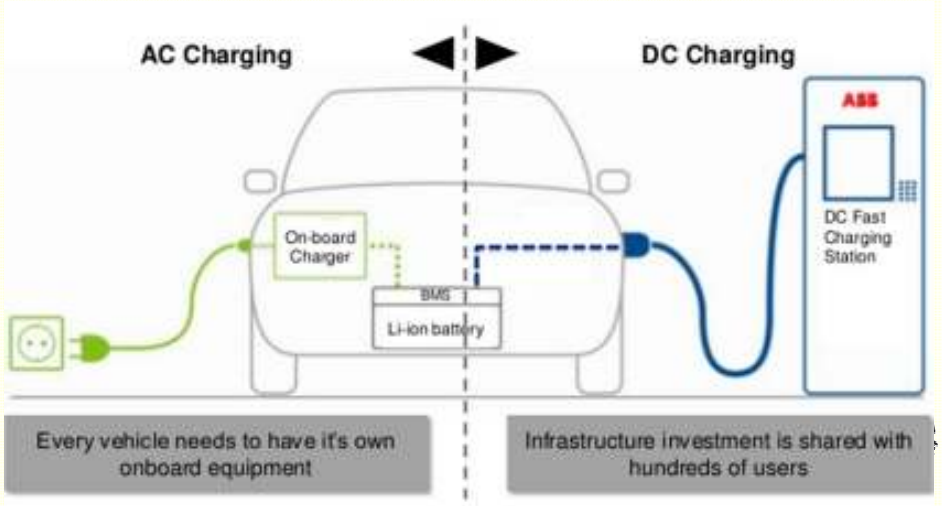
VEHICLE TECHNOLOGY



CHARGING TECHNOLOGY

CHARGER TYPE	LEVEL 1	LEVEL 2	LEVEL 1	LEVEL 2
CURRENT TYPE	AC	AC	DC	DC
RANGE/ CHARGING TIME	8 Km/ 60 min.	22 Km/ 60 min.	100 Km/ 20 min	180 Km/20 min

The charging technology is changing very rapidly. The current specialized public charging stations run on DC charging.

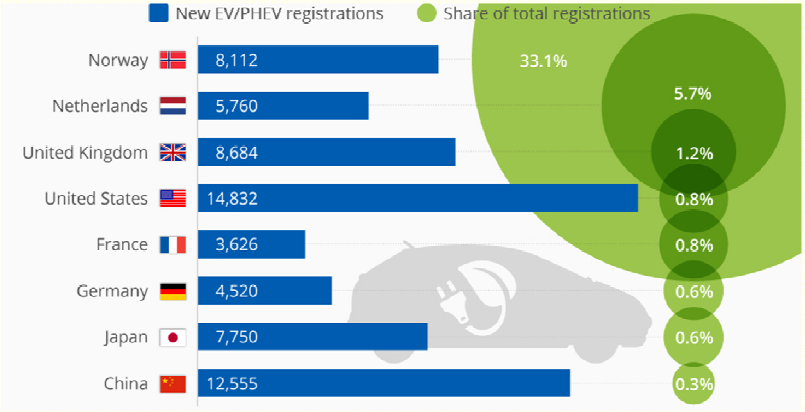


GLOBAL POLICY APPROACH

Electric Vehicles Initiative

EV30@30 campaign

The EV30@30 campaign, launched at the Eighth Clean Energy Ministerial in 2017, redefined the EVI ambition by setting the collective aspirational goal for all EVI members of a 30% market share for electric vehicles in the total of all passenger cars, light commercial vehicles, buses and trucks by 2030.



VALUE CHAIN EV — UP STREAM R&D and production: R & D → Production → Services → Customers

VALUE CHAIN GRID — Customers → Services → Production → R & D — DOWNSTREAM Consumers

GLOBAL EFFORTS TO PROMOTE ELECTRIC MOBILITY

Most countries focus on vehicles rather than charging

Countries	EV VALUE CHAIN				INFRASTRUCTURE VALUE CHAIN			
	R&D	Production	Services	Customer	R&D	Production	Services	Customer
Belgium	+	+	+	++		+	++	++
Denmark	+++		+	++	++	+	+	++
Germany	+++	++	+	+++	++	++	+	+
Netherlands	+	++	+	+++	+	+++	+	+
Norway	++	+	+	+++	+	++	+	++
Sweden	++	+	+	++	++	+	+	++
UK	++	+	+	++	+	++	++	++
US	+++	++	+	++	+	++	+	+++

INDIAN POLICY SCENARIO

India has had the following development in the Electric Vehicle Policy Scenario. The pace of reforms have expanded quickly in the past few years with government's increasing emphasis on sustainability and efficiency

2010 — ALTERNATE FUELS FOR SURFACE TRANSPORTATION PROGRAM (AFSTP) SCHEME

OBJECTIVE Incentivize the purchase of electric vehicles

KEY ASPECTS

GOVERNMENT OF INDIA MINISTRY OF NEW AND RENEWABLE ENERGY

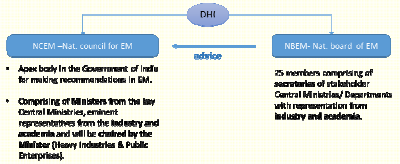
- It had an outlay of Rs 95 crores.
- The incentive was provided to OEMs that gave at least one year warranty and were setting up at least 15 service stations across India.

2011 — NATIONAL MISSION FOR ELECTRIC MOBILITY (NMEM)

OBJECTIVE Promote electric mobility and manufacturing of electric vehicles in India

KEY ASPECTS

Department of Heavy Industry



2013 — NATIONAL ELECTRIC MOBILITY MISSION PLAN (NEMMP) 2020

OBJECTIVE Promote electric mobility and manufacturing of electric vehicles in India

KEY ASPECTS

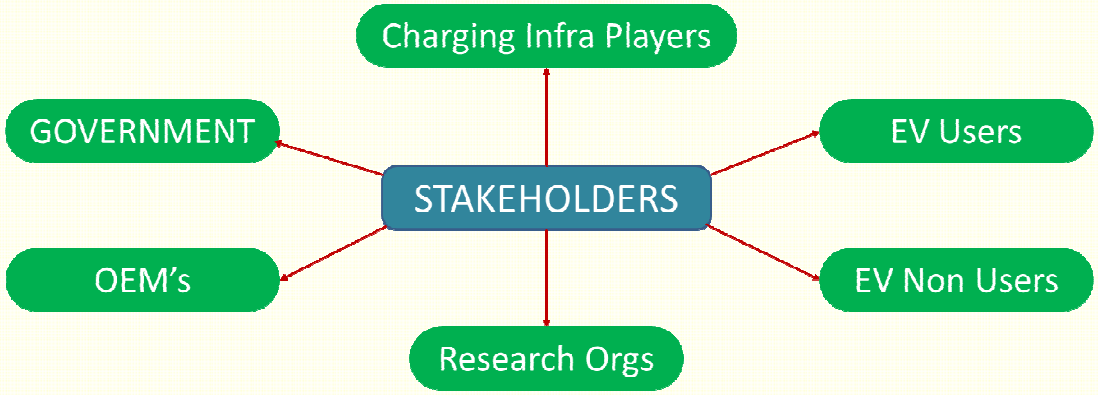
Department of Heavy Industry

- Gradually ensuring a vehicle population of about 6-7 million electric/hybrid vehicles in India by the year 2020
- 20% penetration of electric/hybrid (eco-friendly) vehicles by 2020

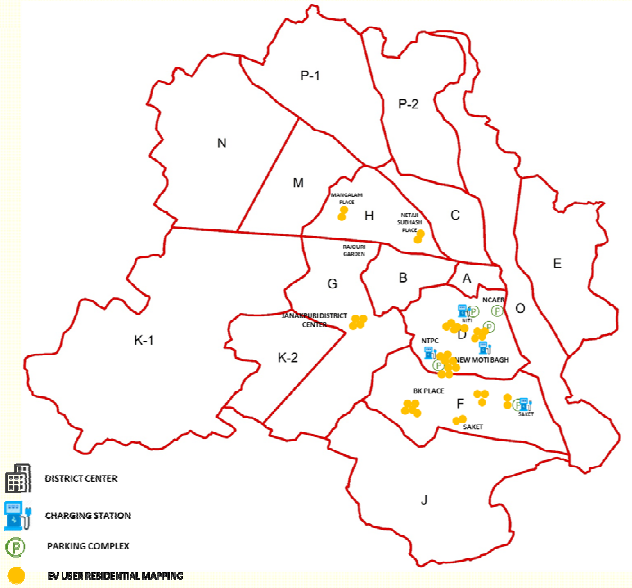
KEY FOCUS

- Demand side incentives to facilitate acquisition of hybrid/electric vehicles
- Promoting charging infrastructure
- Supply side incentives
- Encouraging retro-fitment of on-road vehicles with hybrid kit

STUDY DATA COLLECTION



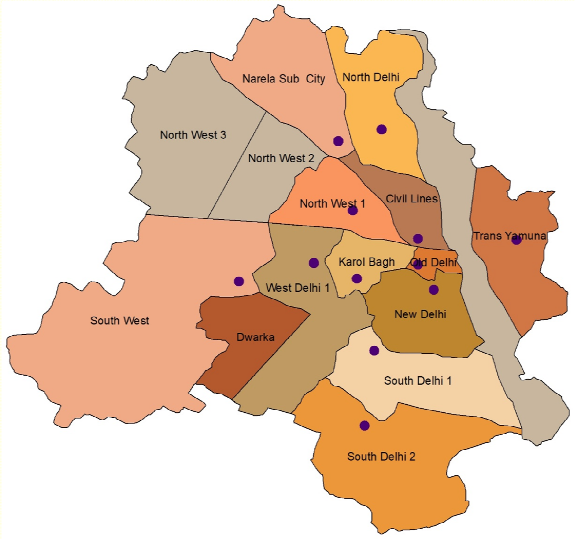
EV USER SURVEY STRATEGY



TOTAL SAMPLES COLLECTED : 35

CHARGING STATIONS IN DELHI : 7

EV NON USER SURVEY STRATEGY



NUMBER OF DISTRICT CENTERS SURVEYED : 13

TOTAL SAMPLES COLLECTED : 424

ZONE	SAMPLE SIZE
North West 1	35
Narela Sub City	36
North Delhi	30
Civil Lines	31
Old Delhi	40
Karol Bagh	30
New Delhi	25
South Delhi 1	35
South Delhi 2	22
West Delhi 1	21
South West	32
Dwarka	23
Trans Yamuna	64
North West 2	21
North West 2	24
TOTAL	**469**

DELHI EV SCENARIO

DELHI REIGSTERED VEHICLE CATEGORIES

VEHICLE CATEGORIES 2014
Agricultural Tractor
Ambulance
Bus
Cash Van
Crane Mounted Vehicle
E- Rickshaw
E- Rickshaw with Cart
Fire Fighting Vehicle
Goods Carrier
Invalid Carriage
Luxury Cab
Maxi Cab
M- cycle/ Scooter
Mobile Workshop
Moped
Motor Cab
Motor Car
Motorized Cycle
Private Service Vehicle
Omni Bus
Recovery Vehicle
Three Wheeler (Goods)
Three Wheeler (Passenger)
Three Wheeler (Personal)
Tractor (Commercial)

VEHICLE CATEGORIES POST 2014
Agricultural Tractor
Ambulance
Bus
Electric Bus
Cash Van
Crane Mounted Vehicle
E- Rickshaw
E- Rickshaw with Cart
Fire Fighting Vehicle
Goods Carrier
Invalid Carriage
Luxury Cab
Maxi Cab
M- cycle/ Scooter
Electric M-cycle/ Scooter
Mobile Workshop
Moped
Motor Cab
Motor Car
Electric Car
Motorized Cycle
Private Service Vehicle
Omni Bus
Recovery Vehicle
Three Wheeler (Goods)
Three Wheeler (Passenger)
Three Wheeler (Personal)
Tractor (Commercial)

E VEHICLE REGISTRATION IN DELHI

STATE	2016-17	RANK	2015-16	RANK
Gujarat	4200	1	1600	1
Maharashtra	2650	2	1085	4
Rajasthan	2250	3	980	5
Uttar Pradesh	2100	4	1108	3
West Bengal	2045	5	850	6
Andhra Pradesh	1820	6	554	7
Delhi	1072	7	1124	2
Haryana	580	8	220	8
Others	1050		620	
TOTAL	17,767		8141	

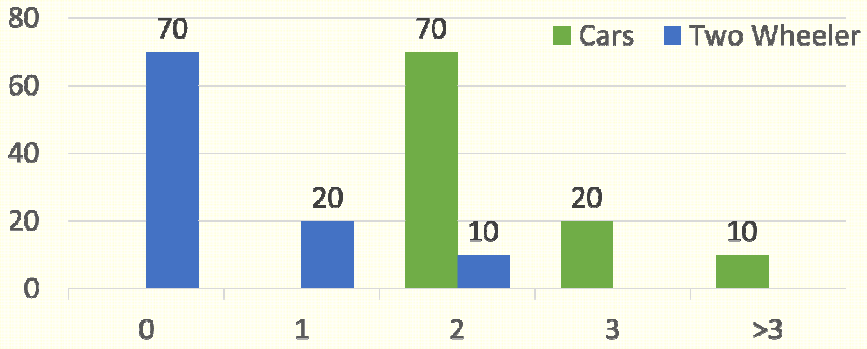
EESL VEHICLES DEPLOYED IN DELHI

Source	2018-19	2017-18	2016-17
Vehicles for Tender Issued	NA	15,000	250
Vehicles for Tender Accepted		10,000	200
Vehicles delivered by cos.		480	200
Vehicles Deployed in Delhi		115	200
Vehicles Left To be deployed		365	0
Planned procurement	20,000		NA

It can be observed that the main drivers of the electric vehicles in Delhi are the retail and institutional customers

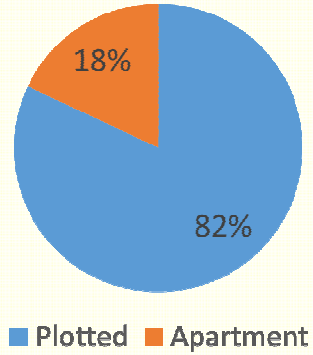
EV USER USAGE SCENARIO

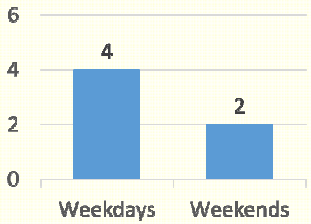
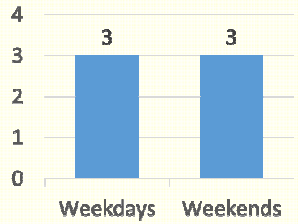
VEHICLE OWNERSHIP



Most EV users own more than 1 vehicle and live in plotted localities with a dedicated charging facility

TYPE OF HOUSING



	ELECTRIC VEHICLE	NON ELECTRIC VEHICLE	REMARKS
NO. OF TRIPS MADE Trips made on a daily basis on the vehicles per household	**Average Trips/ Day : 3.4**  Trips made on EV are more on Weekdays	**Average Trips/ Day : 3**  Trips made on IC Vehicle are constant throughout the week	People prefer to use their electric vehicles on Weekdays and IC Vehicles on weekends

AVERAGE TRIP LENGTH

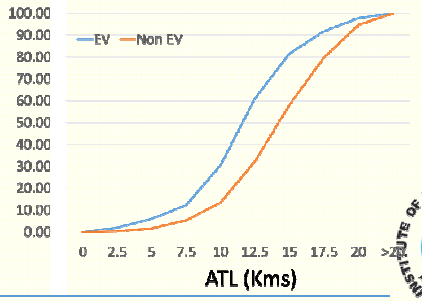
Purpose wise average trip length of the household

PURPOSE	EV ATL	NON EV ATL
To/ From Work	14	18
Shopping	10	9
Education	8	8
Medical	6	6
Social	2	3
Other	5	5

ATL CUMULATIVE FREQUENCY DISTRIBUTION

People use their electric vehicles for trips nearby their home and workplace. For all other uses, they prefer IC vehicles

EV ATL: 12 Km **NON EV**: 15 Km

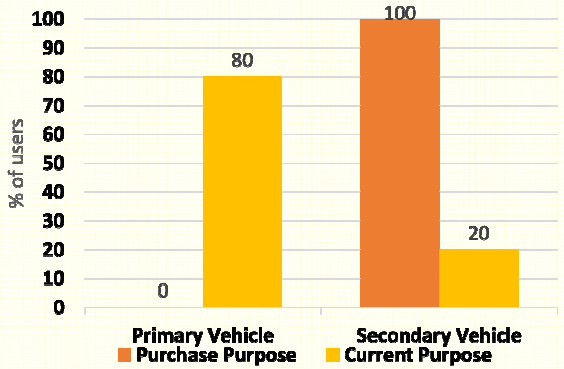


11th Urban Mobility India Conference & Expo 2018

INSTITUTE OF URBAN TRANSPORT (INDIA)

EV USER USAGE SCENARIO

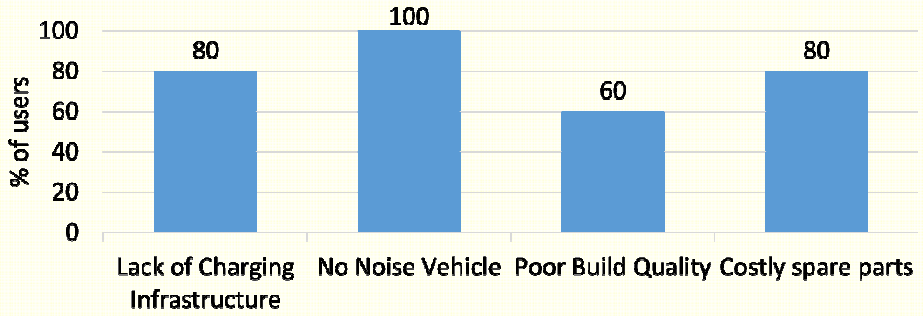
TYPE OF EV OWNERSHIP



EV's tend to become the primary vehicle over time

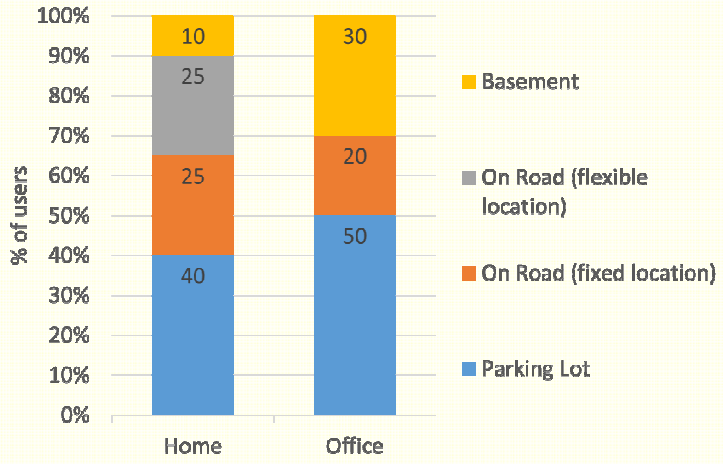
MAJOR ISSUES

% OF EV USERS CONCERNED ABOUT THE ISSUE

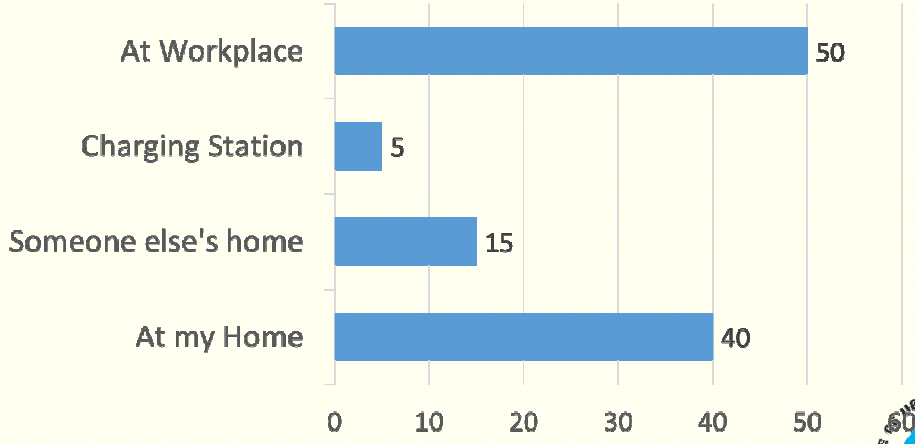


The most concerning issue for people is the fear of accidents from an EV

LOCATION OF PARKING

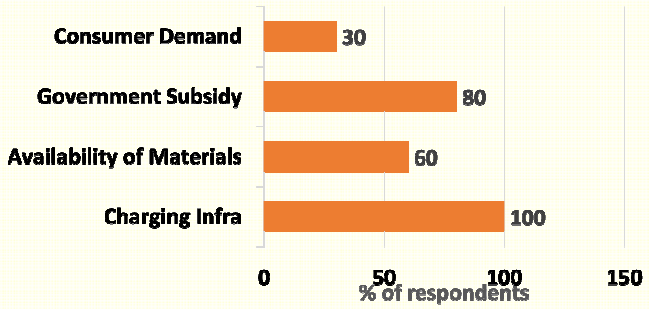


EV CHARGING SCENARIO



OEM's & CHARGING ECOSYSTEM PROVIDERS

CURRENT BOTTLENECKS FOR EV OEM'S

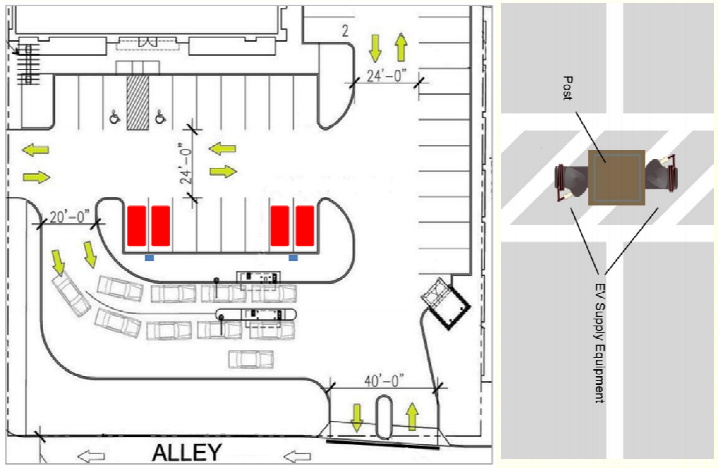


CURRENT BOTTLENECKS FOR CHARGING INFRA PROVIDERS

The current industry bottlenecks for expanding charging infrastructure is as under

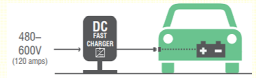
1. **Lack of viable policy for revenue model for charging user fee**
2. **Lack of availability of Land at the required places**
3. **Little clarity on standardization of electric vehicles**

LAND REQUIREMENT



As per Code of Practice, 500 sq. m (about 600 sq. yards) of site with 20 meters frontage/width is required for **only Filling Stations** without other Services like Lubrications, etc. **and 1000 sq. m (1200 sq. yards)** with minimum frontage/width of 35 meters is required for **Filling-cum-Service Stations.**

CHARGING TECHNOLOGIES

	LEVEL 1	LEVEL 2	LEVEL 3
			
CHARGING TIME	8 – 15 Hours	4- 8 Hours	15 Minutes
SERVING THROUGHPUT	6 vehicles/ Day	10 vehicles/ Day	25 vehicles/ Day
USE CASE			

Source: NTPC Report on the Charging Technology for Electric Vehicles '16

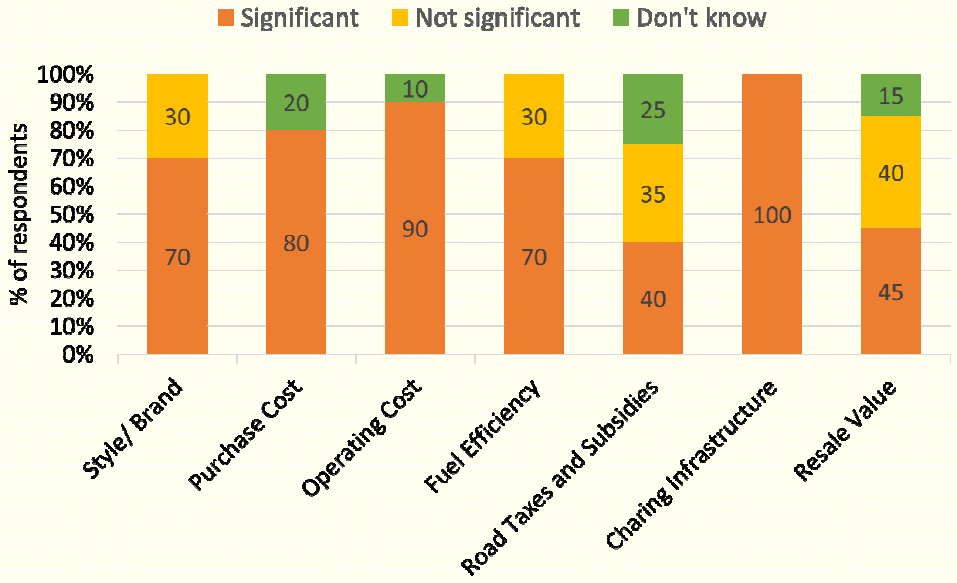
COSTING

Cost of setting up a Level 1 charging point (2 plugs): INR 4 Lakh
Cost of setting up a Level 2 Charging Point (2 Plugs) : INR 8 Lakh
Cost of setting up a Level 3 Charging Point (1 Plug) : INR 12 Lakh

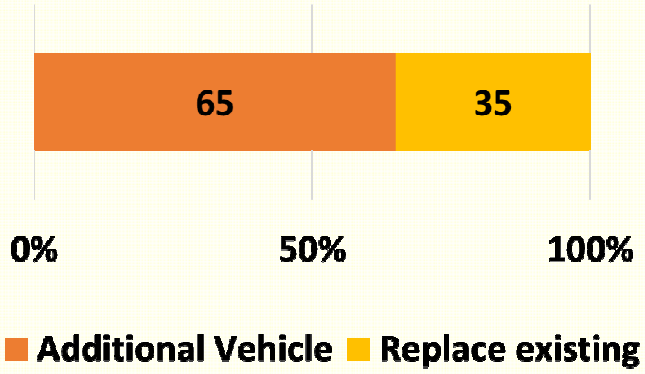
Operation and Maintenance Cost : INR 10,000/ point/ month

EV NON USER MODE CHOICE MODELLING

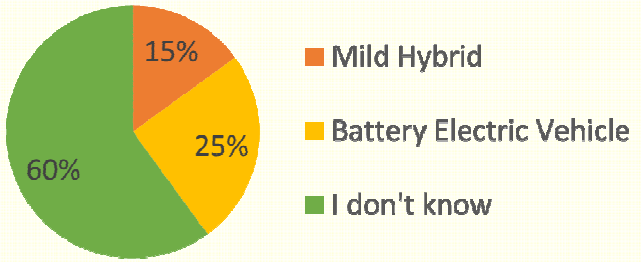
FACTORS INFLUENTIAL FOR PURCHASING A VEHICLE



PURCHASE TYPE OF EV

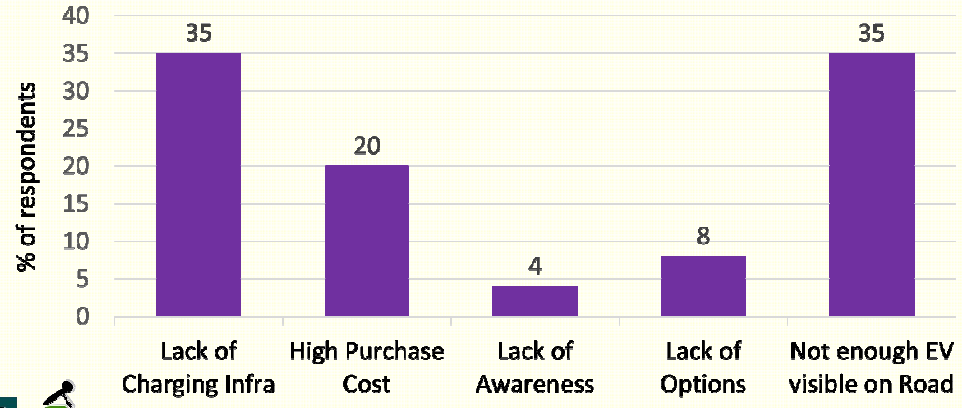


TECHNOLOGY PREFFERED FOR EV



People need more education in order to get convinced and compelled to use and purchase EV

REASONS FOR NOT PREFFERING EV CURRENTLY



11th Urban Mobility India Conference & Expo 2018

INSTITUTE OF URBAN TRANSPORT (INDIA)

EV NON USER BEHAVIOUR

MODELLING USER BEHAVIOUR

VEHICLE PURCHASE COST

VEHICLE OPERATING COST

AVERAGE CHARGING DISTANCE

PROBABILITY TO SHIFT

	TARGET YEAR	PROBABILITY TO SHIFT
Scenario1	2020	15.5 %
Scenario2	2025	43.9 %
Scenario3	Existing	5.2 %
Scenario4	2022	20.5 %
Scenario5	2023	28.2 %
Scenario6	2024	37 %

11th Urban Mobility India Conference & Expo 2018

INFRASTRUCTURE REQUIREMENT

CHARGING STATION REQUIREMENT

YEAR	EV SALES (Lakh)	TOTAL CHARGING STATIONS REQUIRED	ADDITIONAL CHARGING STATIONS REQUIRED
2018	4.1	573	
2019	12.8	1866	1292
2020	8.2	2694	828
2021	9.0	2941	247
2022	13.5	4417	1476
2023	13.5	5796	1378
2024	19.3	6327	532
2025	25.0	8196	1869

Assuming 1 Charging Station/ 305 vehicles (Fortum India)

COSTING

COST OF SETTING UP 1 CHARGING STATION (EXCLUDING LAND COST)

ASSUMING LEVEL 2 CHARGERS

Number of units in each charging station : 4

Cost of setting up each unit : Rs. 8 Lakh

Total Cost of a Charging Station : 32 Lakh

Number of Charging Stations proposed by 2025: 8196

Cost of setting up charging stations : Rs. 2600 Crore

LAND REQUIREMENT

ASSUMING LEVEL 2 CHARGING STATION

Land Required for 1 charging station : 1500 Sq. m

Estimated Land Required for 8196 stations : 12.2 Sq. Km.

Assuming 50 %the requirement is met at existing fuel stations

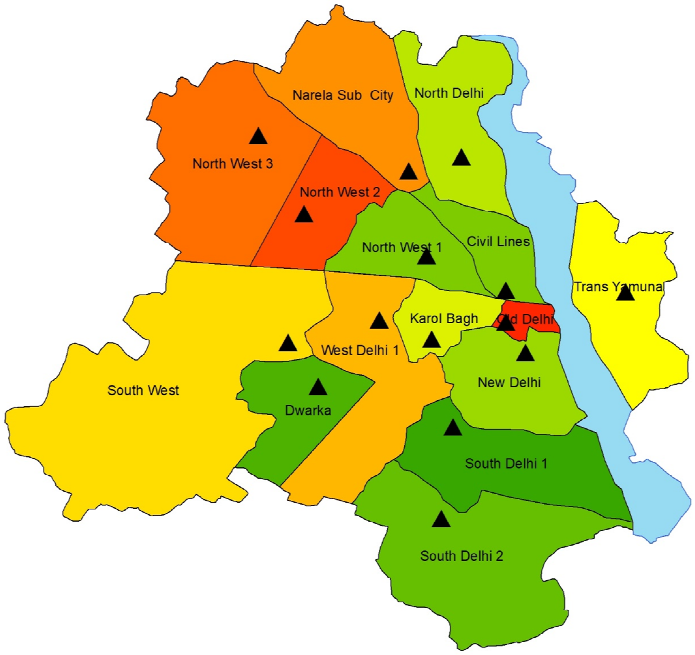
At existing fuel stations, if 1 unit is installed;
Total Fuel Stations in Delhi (projected '25) : 3674
Number of units to be installed : 3674
Equivalent Charging Station : 920
New Charging Stations to be set up : 7276
ADDITIONAL LAND REQUIRED : 10.2 SQ. KM

LAND

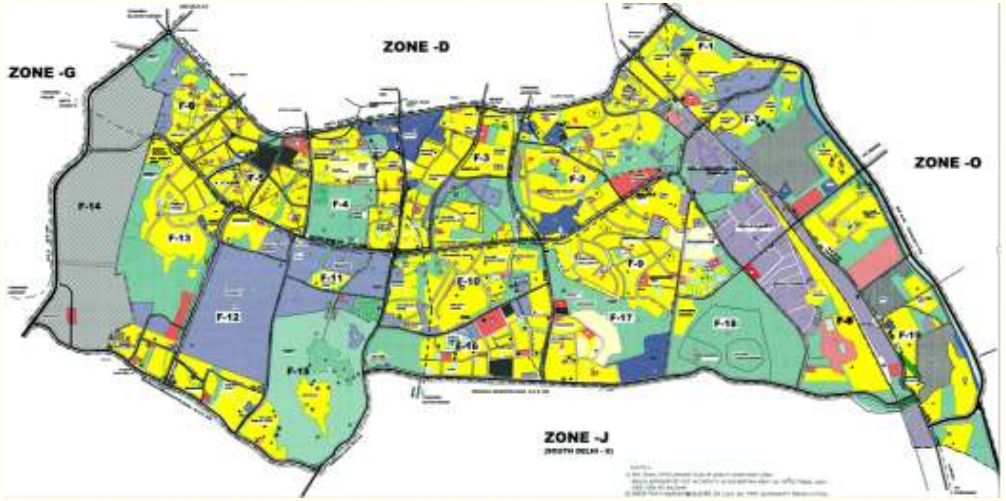
INSTITUTE OF URBAN TRANSPORT (INDIA)

EV NON USER MODE CHOICE MODELLING

DISAGGREGATE LEVEL ASSESSMENT



Zone	U_{switch}	Probability of Switch	RTO SERVICED	PROJECTED 2025 DEMAND	PROJECTED ELECTRIC FLEET
South Delhi 1	-1.12	62 %	Vasant Vihar, Sheikh Sarai	399	247
Dwarka	-2.33	55 %	Dwarka	230	126
South Delhi 2	-1.05	49 %	Sheikh Sarai	968	474
North West 1	-2.53	45 %	Wazirpur	232	105
Civil Lines	-2.53	45 %	Mall Road	134	61
New Delhi	-2.35	42 %	IP Estate	360	151
North Delhi	-2.51	39 %	Mall Road	134	52
Karol Bagh	-2.14	38 %	Raja Garden	639	243
Trans Yamuna	-2.24	33 %	Shahadra, Mayur Vihar	549	181
South West	-3.05	28 %	Dwarka	230	64
West Delhi 1	-3.05	23 %	Janakpuri	529	121
Narela Sub City	-3.45	22 %	Rohini	232	51
North West 3	-2.87	20 %	Rohini	39	8
North West 2	-2.98	17 %	Rohini	38	7
Old Delhi	-5.20	13 %	Ip Estate	360	47



CHARGING STATION REQUIREMENT

Projected 2025 Vehicle Fleet : 11.4 Lakh
Projected 2025 EV Fleet : 4.7 Lakh

1 Charging Station needed for 305 vehicles
Total Charging Stations Required : 1540

Total Fuel Stations (Existing) : 220
Fuel Stations (2025) : 280

Net Charging Stations Required : 1380

COST IMPLICATIONS

Cost for setting up 1 Charging Station : Rs. 32 Lakh (excluding land cost)

Cost for setting up 1540 stations : Rs. 492 crore

LAND REQUIREMENT

Land Required for 1 Charging Station : 1500 sq m.
Land Required for 1380 Charging Stations : 2 Sq. Km.

CHANGE IN BYE LAWS PROPOSED

- ***For Home,*** the charging should be planned as part of the neighbourhood site plans prepared by the DDA/ approved by DDA
- ***For offices,*** at places like Okhla Industrial Area, SISI Complex, Delhi University South Campus, District Centres, there should be charging facility available within their complex in order to encourage people to switch to electric mobility

IMPACT OF ELECTRIC VEHICLES ON THE CITY

CURRENT IMPACT ON THE CITY

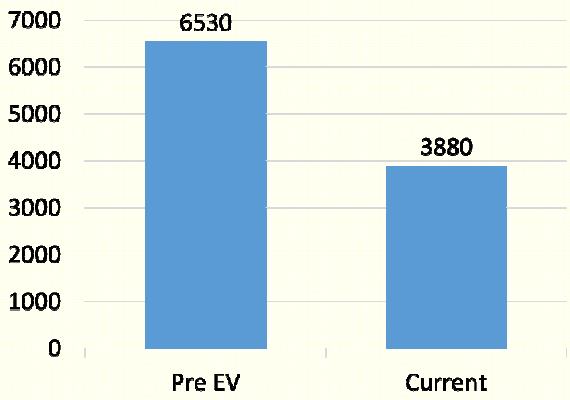
The environmental impact upon conversion from IC engine vehicle to Electric vehicle has been very positive on the environment.

ENVIRONMENTAL IMPACT

TECH	Previous Share	Earlier Fuel Consumption (Lit./ month)	Current Fuel Consumption (Lit./ month)	CO_2 Emission (Previous)	CO_2 Emission (Current)	CO_2 Reduction (per month)	% Change
PETROL	70	90	40	207.9 Kg	92.4 Kg	115.5 Kg	55.5 % reduction
DIESEL	30	120	30	321.6 Kg	80.4 Kg	241.2 Kg	75 % reduction

Assuming CO2 emissions of petrol : 2.31 Kg of CO2 per litre ,CO2 emissions of diesel : 2.68 Kg per CO2 per litre
(Source: Exeter UK https://people.exeter.ac.uk/TWDavies/energy_conversion/Calculation%20of%20CO2%20emissions%20from%20fuels.htm

ECONOMIC IMPACT : FUEL COST/ MONTH



Type	Previous Technology	Savings (Lit/ month)	Cost Savings (per month)
PETROL	70	50	3600
DIESEL	30	90	5670

MODELLED IMPACT ON THE CITY

ENVIRONMENTAL IMPACT

Type	Previous Technology	Current Fuel Consumption (Lit./ month)	Proposed Electricity Consumption (kWh/ month)	CO2 Emission Reduction (Kg)	Vehicles Projected for conversion (2025)	Total CO2 reduction (Tonne/ Year)
PETROL	75	90	40	207 Kg.	20 Lakh	41×10^4
DIESEL	25	120	30	322 Kg.	5 Lakh	16×10^4

CONCLUSION AND THE WAY FORWARD

The study's contribution is limited to assessing the potential of electric cars. The same can be extended in the following ways:

- **Assessment of Demand for Electric Two Wheelers**
- **Assessment of Demand from Public Transport**
- **Analysis of integrated charging stations for all modes of electric mobility**

Going electric with renewables is the future!

THANK YOU