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Delhi: From pollution capital of the world to EV capital of India

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Abstract
Delhi, the capital city of India has very high level of air pollution which is a threat to health and life of the residents of the city. Delhi has been declared the most polluted capital city of the world by the Switzerland based agency IQ Air Visual. The massive and slow-moving traffic in the city is one of the major causes of air pollution. The dynamics of the mobility sector in Delhi are unique as well as challenging. The transportation sector is predominated by two wheelers (62.90%). Nearly 47.9% of the population does not own a vehicle and have dependence on public/shared mobility means of transportation. Daily there is a huge influx of traffic from its satellite towns, which has a tremendous contribution to polluting emissions. As the population of the city is increasing, the number of vehicles is also increasing. Adoption of clean energy transportation in the city will help in combating air pollution. In the past few years, the city is moving towards electric mobility, but the movement is rather slow and requires strong government push and support. The Delhi Electric Vehicle Policy 2020 has been recently notified and is a strong step towards achieving faster EV adoption in the city. The policy focuses on creating EV demand through incentives and concessions. Switch Delhi campaign has also been launched to increase consumer awareness towards benefits of EV adoption. The policy has certain gap areas in which targeted actions by the government can facilitate faster EV adoption in the city. Electric Vehicles present a significant opportunity for improving the air quality by shifting the emissions in the city from multiple moving sources to point sources.

Keywords: e-mobility, e-rickshaws, Delhi EV policy, shared mobility, last mile connectivity, feebate system, FAME II, lithium-ion batteries, battery swapping, scrappage

Introduction
Recently the world has seen a movement towards adoption of electric vehicles. As compared to the conventional fossil fuel vehicles, electric vehicles have an advantage of curtailing greenhouse gas (GHG) emissions, make lesser noise pollution and entailing lesser fuel costs. According to the World Air Quality Report, 2020, Delhi is the 10th most polluted city in the world and the most polluted capital city. The city has an average annual PM 2.5 concentration of 84.1 micrograms per cubic meter, which is 40 times more than the WHO standards. Air pollution is world's greatest environmental health threat and requires transition towards clean energy. Adoption of EV's at a large scale is one movement that will reduce emissions and save health care costs and oil import costs. The Delhi government recently notified its EV policy and the Switch Delhi campaign. Both these policies aim at making consistent efforts to reduce air pollution in Delhi. The Delhi EV Policy 2020 will work for three year to create demand for electric vehicles through incentives and schemes. Policy framework for developing a massive charging infrastructure in the city has also been laid out by the Delhi government. The Delhi EV Policy 2020 can be understood with a backdrop of insight on the pollution levels in the city and the massive vehicular load in the city. New and innovative methods need to be adopted to streamline the traffic congestion and the resulting emissions in the city. The EV policy is very ambitious and targets registering 5 lakh electric vehicles by 2024. To take lead by example the Delhi government has mandated conversion of its entire fleet of cars to electric in a span of one year from the announcement of the policy.

Air Pollution from Transportation Sector in Delhi
New Delhi is amongst the world's six most polluted urban agglomerations. The magnitude of pollution is massive in the city. The toxic air causes devastating effect on people's health and overall well- being. In India economic cost of fossil fuel air pollution alone is estimated to be around INR 10,700 billion, or 5.4% of the country's GDP. In Delhi Air pollutants including particulate matter (PM), sulfur dioxide, nitrogen oxides (NOx), carbon monoxide (CO), and ozone (O3) mostly are above the National Ambient Air Quality Standards(NAAQS). There is high degree of particulate material in the air which causes environmental degradation. The main sources of air pollution in Delhi are vehicle exhaust, heavy industries like power generation, small scale industries, suspended dust on the road due to vehicle movement and construction activities, open waste burning, combustion of fuels for various purposes, and power generation from diesel generator sets. Seasonal emissions from farm fires and dust storms compound the situation. Delhi experiences thick toxic smog for long periods of time during the winter months.

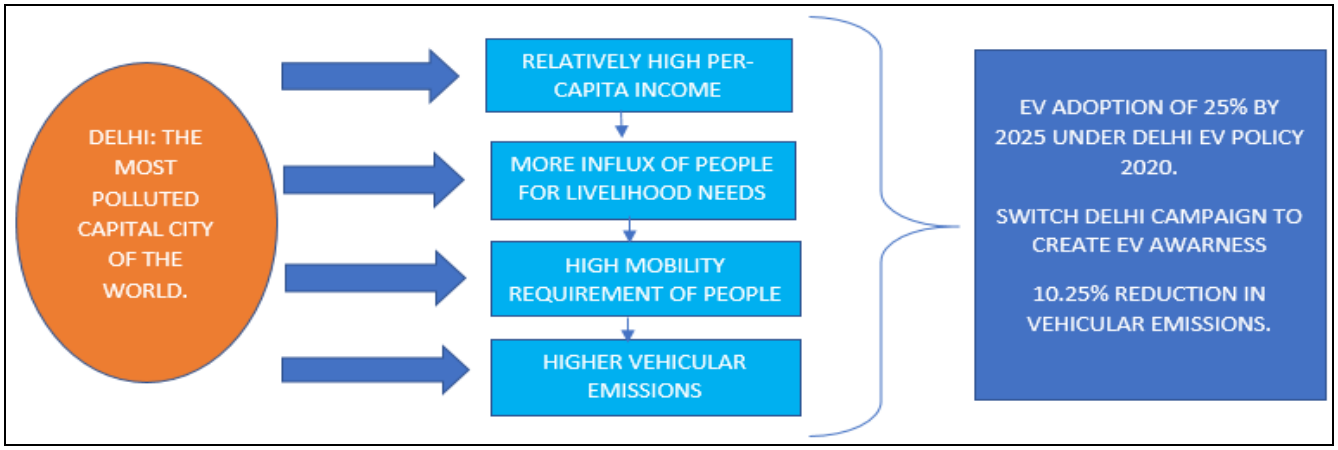

Fig 1: EV policy for air pollution reduction

According to estimates the current population of Delhi is around 2.05 crores (20,591,874 approximately) in 2021, and it is expected to rise by 10% by 2022. The city has a very high population density of 11,313 people per square kilometer. The economic development of Delhi has lured many people from outside to settle in the city. Due to the size of the city and linkages between various cities of NCR region, commuting and transportation are a challenge in the city. There has been a consistent increase in the number of registered automobiles in the city. Though the city has a good network of public transport and metro connectivity, the registrations of private non-commercial vehicles has increased in the past few years. This increase is driven by high population growth and high per capita income in the city. There is a high correlation between per capita income and per capita mobility, and high mobility implies more emissions from the vehicular traffic.

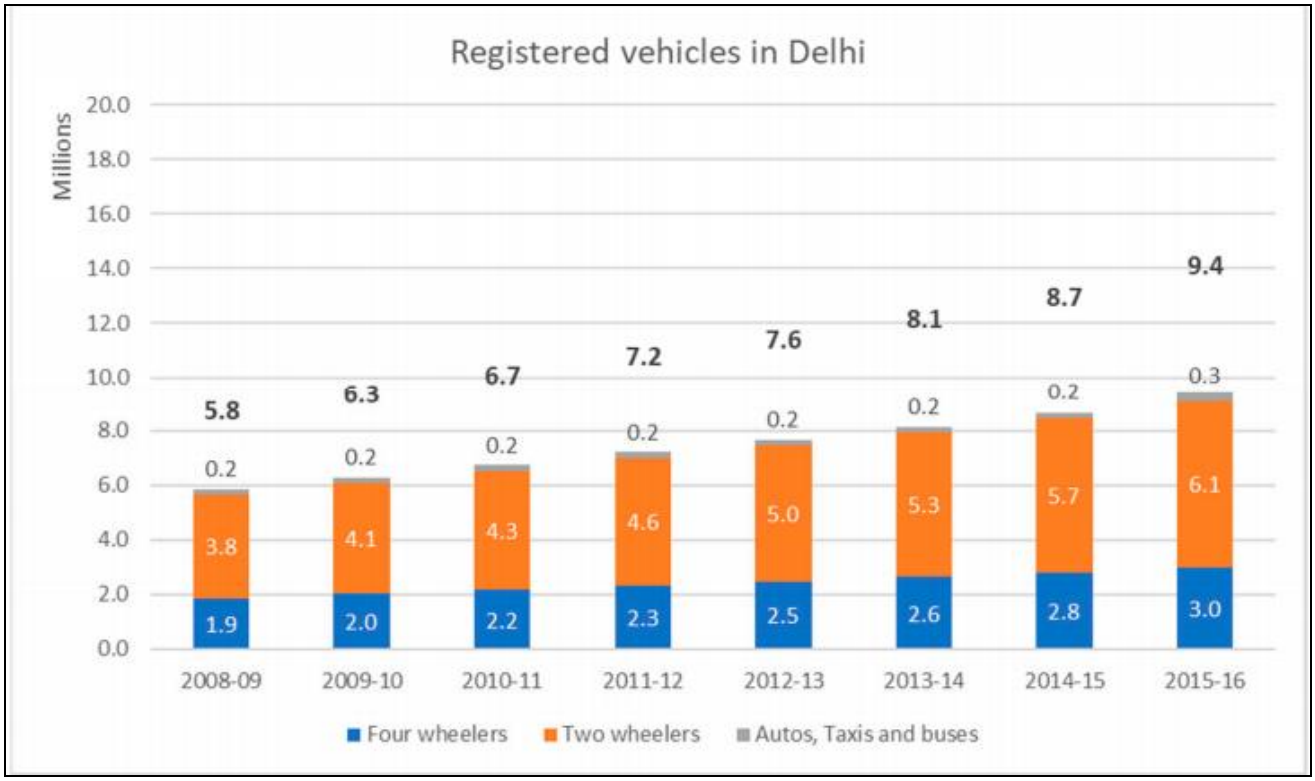

Fig 2: Increase in vehicle registrations in Delhi.

Transport sector is one of the main contributors of Delhi's pollution, accounting for 28% of the PM2.5 emissions and it contributes to about 41% of total pollution load in Delhi. Vehicular contribution also makes up around 80% of nitrogen oxides and carbon monoxide in Delhi's air. Data on vehicular pollution in Delhi reveals contribution of each of the vehicle segments towards PM2.5 emissions; trucks and tractors 9%, two wheelers 7%, Three wheelers 5%, cars 3%, buses 3%, Light commercial vehicles 1%.

The number of vehicles was 10.9 million in 2018, out of which 7 million were two wheelers. The annual growth rate of vehicles dropped from 8.13 percent in 2005-06 to 5.81 percent in 2017-18. But the number of vehicles per thousand population increased from 317 to 598 during the same period. According to a CSE survey conducted in 2019 the daily influx of vehicles from 124 entry points, is equal to the number of vehicles registered in Delhi in a particular year. This influx of vehicles aggravates pollution, congestion, and energy guzzling mobility. Cars from outside Delhi contributed to nearly 25-45 percent of overall emissions

from four wheelers.

Four-wheeler taxies have a high contribution to Delhi's air pollution. Taxies like Ola, Uber travel around 400 km per day and in comparison, personal cars travel on an average 55 kms per day. Even if these taxies are on CNG their contribution to pollution is high. Electrification of the taxi fleets will reduce the pollution levels.

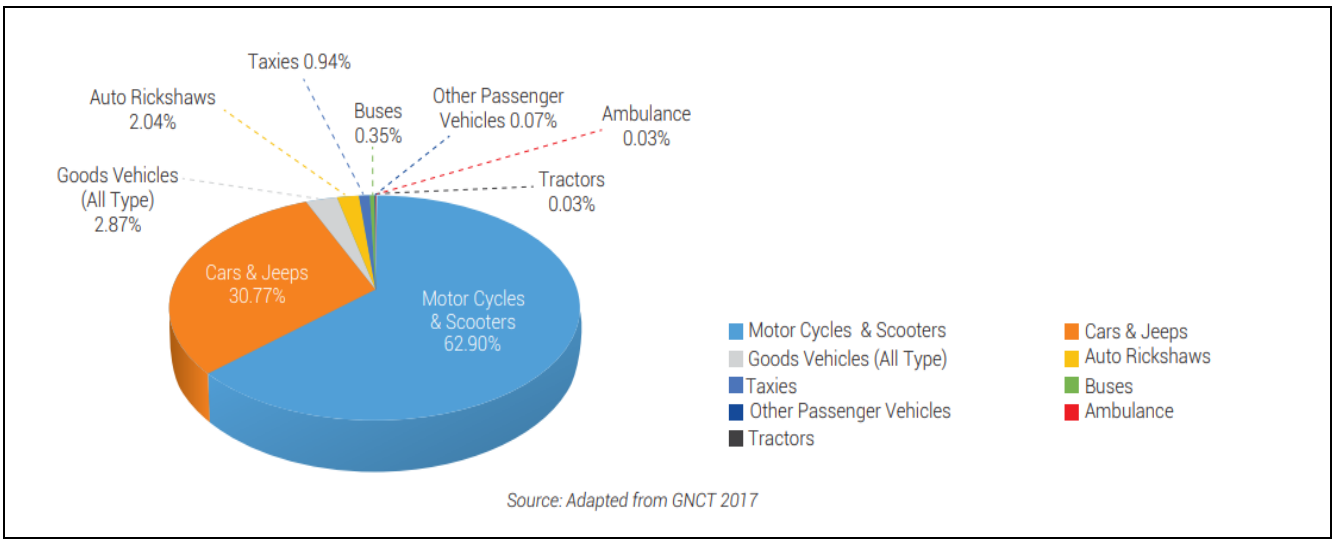

Fig 3: The Share of Different Types of Vehicles in Road Transport in Delhi

There has been a tremendous growth of private vehicles in Delhi at the expense of public and shared modes of transport. There is a need to scale up and improve the shared and public modes of transportation to reduce vehicular emissions. These modes help in decongesting roads by occupying lesser space for same number of passengers. The ownership data of different segments of vehicles in Delhi shows that there is tremendous potential for developing public and shared transportation system. Around 53% of the population has some mode of private transport and a reliable, comfortable, and affordable public transport will help to battle air pollution and reduce the vehicle density in the city. Electrification of the public transportation in Delhi is an effective way to bring down the pollution levels. Electric buses are one of the most potent solution to transition to green and sustainable at scale mobility. The capital cost of an electric bus is 2-3 times higher than the conventional buses, but operating costs of electric buses is 65% lower(Electric Mobility Alliance 2017). Currently Delhi has set a target of procuring 300 low floor electric buses in 2012-22, after it got an approval for subsidies under central government's FAME II scheme. These buses will be procured under built-own-operate-transfer (BOOT) model. Another 1000 electric buses which were committed by the state government over a period of two years are under different stages of delivery.

A distinguishing feature of Delhi transportation system is that 2.5% of the vehicles are medium and heavy commercial vehicles (MHCVs), which release very high levels of carbon monoxide and nitrogen oxide. These vehicles are responsible for around 60% of vehicular pollution and fuel consumption. These vehicles are using old BS norms.

Shift Towards Electric Vehicles in Delhi

In a city like Delhi electric transition toward electric mobility is a definitive solution to attain cleaner air, without compromising on functionality. There is a persisting need to change the strategies of the transportation sector and have a rapid transition towards clean energy.

There are 76000 e-vehicles in Delhi, most of them are e-rickshaws and e-carts, which received legal status in 2015 after a law was passed to recognize them as motor vehicles. Since then, e-rickshaw sales have been growing at 20% annually replacing cycle rickshaws. However, the actual number of e- vehicles in the city could be much more as most of the e- rickshaws operate without any registration. The unorganized sector got a head start due to lower cost advantage before the e-rickshaw regulations were notified in 2018. The un-organized market e-rickshaw costs around Rs40, 000/- as compared to over one lakh mark cost of e-rickshaw from organized players. E-rickshaws are the most effective last mile connectivity solution in Delhi.

Delhi Electric Vehicle Policy 2020

The Delhi Vehicle Policy 2020 was adopted on 7th August 2020. Delhi is the first Indian state to notify an EV policy. The policy aims to make EV capital of India and to speed up the adoption of electric vehicles of all categories. The focus of EV adoption would be in the segments of two wheelers, public/shared transport vehicles and goods carrier. The policy aims at speedy adoption of Battery Electric Vehicles [BEVs] so that they constitute 25% of all new registrations by the year 2024. This will help to bring down emissions from transportation in Delhi. According to India's Ministry of Earth report published in 2018 vehicular emissions contribution is 41% of the total emissions in Delhi, and the city has recently been announced as the most polluted capital city of the world. The new EV policy aims to kickstart the EV adoption process to combat air pollution. The process of EV adoption had been very slow in the past few years and will get an impetus from the policy. The policy also aims to create jobs in driving, selling, servicing, financing, and charging of electric vehicles. This policy will work in a three years' time framework.

The policy will provide waiver of road tax and registration fee, purchase subsidies, interest subvention on loans, and scrappage incentives. A wide network of charging and swapping centers will be established in the city. A state

electric vehicle board will be constituted, and an extensive public outreach and awareness programmes will be undertaken. Battery recycling ecosystem will also be set up. Funding of all programmes will be done through a non-lapsable State EV fund.

- Electrification of two wheelers is the main target of the policy, as two wheelers are the major component of the total vehicles plying on Delhi roads. Demand incentives based on battery capacity will be provided to two wheelers. Demand incentives of Rs.5000 per kWh will be available to two wheelers with advanced batteries and maximum incentive will be Rs.30,000 per vehicle. The eligibility criteria of the vehicles will be in alignment with the central government's FAME II norms. Scrapping incentive of Rs 5000/- will be available for scrapping and deregistering of old two wheelers.
- The policy aims to incentivize e-vehicle adoption by delivery service providers (i.e., e-commerce logistic providers, food delivery, couriers) in time bound manner. Delhi Finance corporation will give financial support to all delivery service providers who are willing to convert 50% of their fleet operating in Delhi to electric by 31st March 2023 and 100% by 31st March 2025.
- The government will incentivize purchase of e-auto rickshaws to support self-employment. A purchase incentive of Rs 30,000/- will be provided to registered owners of e-autos. An interest subvention of Rs 5000/- will be given on loans for purchase of e-autos. A scrappage incentive of Rs 7500/- will be given for scrapping and deregistering old ICE autos. Autos in Delhi are the lifeline for inter-city movement and to provide last mile connectivity. Electrification of autorickshaws in the city will reduce the emissions load considerably.
- A purchase incentive of Rs 30,000/- will be given to individuals for purchase of e-rickshaws and e-carts. This incentive will cover all models of e-rickshaws and e-carts including lead acid battery and swappable battery models where battery is not sold with the vehicle. There is a huge unorganized market of e-rickshaws in Delhi, and which poses a great challenge for the policy makers.
- For buses, the Delhi government had set a target of procuring 1000 e-buses by 2020, which is under different stages of delivery currently. A target that electric buses constitute at least 50% of all new state carriage buses has been set for 2022.
- Light commercial Vehicles (LCV) or goods carriers ply on the city roads in large number and are very useful for deliveries in the congested areas of the city. Individual fleet owners will be incentivized to adopt e-goods carriers by providing an incentive of Rs 30000/- to first 10,000 e-goods carriers purchased after announcement of the policy. Interest subvention of 5% on loans for purchase of e-LCVs and scrappage incentive of Rs 7500/- will also be given under the New Delhi government policy. These e-goods carriers shall also be exempted from various prohibitions of Delhi transport department regarding plying and idle parking on certain roads, during specific timings.
- The four wheelers segment has least electric penetration in India as well as in Delhi, which can be attributed to high cost of e-cars in comparison to fossil fuel counterparts. The registered owners of first 1000 e-cars, after the announcement of the policy, will be getting a purchase incentive of Rs 10,000/- per kWh of battery capacity (subject to maximum incentive of Rs 1,50,000/- per vehicle). These incentives will be applicable to electric four wheelers with advanced batteries and eligible under FAME II. Swappable models which are sold without batteries will also be eligible for these incentives.

The Delhi government is taking lead in converting all the government four wheelers to electric. All leased/hired four wheelers used by Delhi government will be transitioned to electric vehicles in twelve months from the issuance of this policy.

Table 1: Incentives for different vehicle categories under Delhi government EV policy.

Demand side incentives available under the Delhi government EV policy[29] and the FAME-II scheme for various vehicle types:

Vehicle Type	Purchase Incentive (A)	No of units	Scrappage incentive
2W	**INR5000/kWh** Cap - Up to INR30,000/ vehicle	No limit	Up to INR5,000/ICE vehicle
3W (E-autos)	**INR30,000/vehicle** (L5M)	No limit	Up to INR7,500/ICE vehicle
3W (E-carts, E-ricks)	**INR30,000/vehicle** (including lead acid)	No limit	NA
LCV	**INR30,000/vehicle** (L5N/N1)	First 10,000 e-LCVs	Up to INR 7.5k/ICE vehicle
Cars	**INR10,000/kWh** Cap - Up to INR 150,000/ vehicle	First 1,000 cars	NA
Buses	**NA**	NA	NA

• *Interest subvention only if loan availed from Delhi finance corporation (DFC) or other finance providers empaneled with DFC

- Charging infrastructure is one of the main constraints in adoption of EVs in Delhi. The electric vehicle policy provides for creation of a robust charging infrastructure for a smooth transition of mobility sector towards EV adoption. The government under this policy plans to develop both private as well as public charging infrastructure. Building by-laws will be amended to make provision of private charging points, all new homes and workplace will be made 'EV ready' with power supply and charging points for up to 20% of the total vehicle capacity. The existing residential and non-residential building owners will be encouraged to install charging points in their premises. The government will provide a grant of 100% for purchase of charging equipment up to Rs 6000/- per charging point for first 30,000 charging points installed after the announcement of the EV policy.

The public charging infrastructure development is the key focus in this policy. The government has set a target of providing charging points at every 3 Kms in the city. 'Charging Infrastructure Working Group' has been constituted by the government with members from all relevant government agencies, local bodies, and DISCOMS. Energy Operators (EOs) shall be invited to set up charging stations at concessional locations across the city.

Development of a battery re-cycling ecosystem is also envisaged in the Delhi EV policy. The EV batteries need to be replaced once they have degraded to operating at 70-80% of their capacities. EV have a longer life span than the batteries, typically an EV requires two batteries in a 10-year life span. At the end of their life cycle the batteries must be either reused or recycled. These batteries have a risk of giving out toxic gases if they are damaged, also the lithium and cobalt in the batteries are finite resources and are expensive to extract. Recycling business will be developed under the policy to reduce the environmental costs accruing under the EV battery ecosystem.

Besides the segment specific incentives there are certain provisions in the policy which will be common for all segments. During the policy period road tax and registration fee will be waived off for all electric vehicles. If the vehicles are sold without battery, then 50% of the incentive will go to the owner and remaining 50% to the energy operator. All electric vehicles will have a green number plate and electric vehicles availing government incentives will have stickers displaying the same.

Funding of the Delhi EV policy will be done through the 'Feebate' system, charging fee from the inefficient vehicles, and giving concessions to the energy efficient ones, various sources like road tax, congestion fee, Pollution cess will be levied to fund the policy. An environment compensation charge will also be levied in Delhi to provide funds for the policy. The transport department of Government of National Capital Territory of Delhi will be the nodal agency in implementing the EV policy.

Gaps in the Delhi EV policy and Recommendations

The Delhi EV policy 2020 is a progressive policy framework which will accelerate the pace of adoption of electrical vehicles across vehicle segments, especially in the mass category of two wheelers, public shared transport, and goods carrier. However, there are certain gaps in the policy framework which need to be addressed.

- The policy is relying heavily on subsidies on the demand side to push the EV adoption. Supply side incentives to create an ecosystem for manufacturing of electric vehicles and the drivetrain components is missing in the policy.
- There is no mandate for delivery service providers and corporate fleets to adopt electric vehicles in a time bound manner. A clear mandate should be provided on the lines of the EV adoption framework which the Delhi government has adopted to convert all government cars to electric cars within twelve months of the EV policy announcement.
- There should be a battery standardization in terms of kWh ratings, form factors and voltages to enable the EV owners to have flexibility in choosing a nearest battery swapping/ charging station.
- The unorganized e-rickshaws market is a challenge in the city. The un-organized market is thriving due to the cost differentials in comparison to the organized market. Stricter government laws and enforcement is required in this segment. Encouraging local manufacturing with technology incentives will bring down costs. The unorganized e-rickshaws manufacturing is currently relying on cheap imported kits from China.
- Also, there is no incentive for traditional e-rickshaws (that run on lead-acid batteries) to retrofit their vehicles with long life lithium-ion batteries. Providing incentives will help to convert the existing e-rickshaws to much reliable lithium -ion batteries and enable them to use public swapping stations.
- The policy lacks incentives for the manufacturers of critical EV equipment like DC fast chargers and lithium-ion batteries. Providing subsidized land to manufacturers and providing subsidies for import of cells used in battery packs will create a supply push for EVs.
- Delhi has a large young population of office/college commuters who are reluctant to own a vehicle and want to use public/shared transportation mode. Bike rental model like Bounce in Bangalore should be adopted in Delhi with government support through provision of subsidized land and hubs in metro stations.
- Public and private banks should be providing concessional loans for EV adoption. So far, all incentives and interest waivers are on loans from NBFCs (non-banking financial corporations), primarily DFC (Delhi Financial Corporation) and other finance corporations empaneled with DFC.
- Though lot of demand side incentives have been provided in the Delhi Electric Vehicle Policy 2020, there is lack of awareness and willingness amongst consumers to buy EVs. Switch Delhi Campaign launched in February 2021 by the Delhi government is a good initiative to mobilize demand for EVs. This campaign will make people aware how adoption of EVs will contribute towards fight against pollution in Delhi. Continuity in such initiatives is required to attain the ambitious target of 25% EV adoption in Delhi by 2024.

The Delhi Electric Vehicle Policy 2020 aims to make Delhi the electric vehicle capital of India by 2024. The fiscal incentives given in the policy will be in addition to the

FAME II incentives. The customers who were unable to get subsidy under central government's FAME II due to certain restrictive norms will now be able to avail subsidies under this scheme. The policy extensively covers key measures required by EV industry to move in the right direction. This will be a benchmark policy for other states to focus on catalyzing demand along with incentivizing the manufacturers. The policy will help Delhiites breath cleaner air in the coming years.

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