# BEYOND NAGPUR: THE PROMISE OF ELECTRIC MOBILITY

## LESSONS FROM INDIA'S FIRST MULTIMODAL E-MOBILITY PROJECT

A STUDY BY

OLA MOBILITY INSTITUTE

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**Ola Mobility Institute (OMI)** is a policy research and social innovation think-tank of Ola that is focussed on developing knowledge frameworks at the intersection of mobility and public good. The Institute concerns itself with public research on the social and economic impact of mobility as a service, the climate footprint of mobility innovations, skill development and job creation, transportation-oriented urban planning, and the digitization of mobility. All research conducted at OMI is funded by ANI Technologies Pvt. Ltd. (the parent company of brand Ola).


**www.ola.institute**

**mobilityinstitute@olacabs.com**

**@olamobilityinst**

**AUTHORS:** Nitish Arora, Aishwarya Raman

**CONTRIBUTORS:** Ola Electric Team, Paroma Bhat, Carson Dalton, Anand Shah


**DISCLAIMER**

This report takes into account data points from all aspects of EV operations spread over 18 months since inception, data points from primary research as well as established sources of secondary data. Whilst every effort has been taken to validate and verify correctness and accuracy of all material in this document, neither Ola, Ola Mobility Institute nor any other party associated with this report will we liable for any loss or damage incurred by the use of this report.

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# EXECUTIVE SUMMARY

As one of the most populated countries in the world coming of age with one of the lowest vehicle penetration rates of a major economy, India has a unique opportunity to establish a sustainable transportation system. The Central Government flagged off radical policy changes since 2018 to encourage the Electric Vehicles (EV) ecosystem, helping India move closer to delivering on the promise of e-mobility. Ola Mobility Institute (OMI) believes e-mobility is the gateway to more affordable, reliable, cleaner, and efficient transportation – enabling India to become an example for other nations.

## THE STUDY

The Institute studied India's first multimodal[*1] electric mobility project in Nagpur.

The pilot, inaugurated by Hon'ble Chief Minister of Maharashtra, Shri Devendra Fadnavis, and Hon'ble Union Minister, Shri Nitin Gadkari in May 2017, excited industry and government stakeholders to execute and understand the potential for electrification of transport. The pilot built battery charging and swapping infrastructure and deployed a multimodal EV fleet in a brief span. At the time of conducting this study **the electric fleet by Ola in Nagpur - a combination of e-rickshaws and e-cabs - had served over 3,50,000 customers, clocked over 7.5 million clean km, saved over 5.7 lakh litres of import-dependent fossil fuel, and reduced CO2 emission by over 1,230 tons since its inception.**

With the key objective to determine how to proliferate EVs, this study attempts to gain an understanding of operational issues that include vehicle performance, customer charging behaviour, the impact of temperature on charging and battery life, and of integrating renewables at the charging station, etc.

The study found that the pilot required a broad set of actions. To start with, the Nagpur fleet comprised of electric cabs and electric rickshaws from the manufacturers, Mahindra and Kinetic. Ola's vehicle leasing arm, Ola Fleet Technologies, procured all EVs and offered them on daily lease to driver-partners, as a key component of Ola's e-mobility strategy. Ola designed lucrative value propositions for a seamless transition to e-mobility. For e-cabs, riders were offered Ola Play[*2] sedan services at fares equal to lower-cost conventional ICE hatchback services. Driver-partners were provided free-of cost-charging in the first month, followed by 50% rebate[*3] in subsequent months. To address concerns of driver-partners regarding their income, time taken for charging, and dry run, the initial lease for vehicles was just 10% of what was being charged on conventional ICE vehicles. To increase effective on-road hours, Ola deployed multiple fast charging stations in Nagpur. It also installed slow charging points at driver-partners' residences. This provided driver-partners the technical know-how of charging their EVs, and pioneered the home charging infrastructure for the ecosystem in Nagpur. Thus, the pilot focused primarily on **ensuring usage of EVs - or simply put, clean kilometres travelled – to test the viability of EVs on economic metrics.**

[*1] More than one mode of commute. The project in Nagpur, for instance, had e-cabs and e-rickshaws.
[*2] Ola Play, the world's first connected car platform, aims to transform the in-cab experience by bringing advance car controls, choice of personalised content and a fully connected interactive experience, to the backseat of the cab, creating a perfect ambience for oneself.
[*3] The driver partners were charged only for 50% of electricity units consumed.

# KEY LEARNINGS AND RECOMMENDATIONS

With evidence from the Nagpur pilot, OMI has the following key recommendations to accelerate EV adoption in India.

**The success of e-mobility is hinged on leveraging shared mobility.**

On the one hand, high upfront costs, lack of charging infrastructure and uncertain performance of a battery-powered vehicle may hold back rapid adoption of e-mobility for private users; on the other, fleet operators are potential early adopters due to business sensitivity to operating costs. Due to the low operating cost of an EV, commercial and public utility vehicles have more compelling economics when compared with private / passenger-owned vehicles. Ergo, shared mobility actors, such as fleet operators / app-based aggregators, can lead and accelerate the EV penetration because they generate more km on their vehicles. They can amortize the high upfront costs over more travel in a shorter payback time frame, despite a higher TCO*[1] (Total Cost of Ownership) per km (Arora. N and Raman. A, 2019). For instance at current crude prices and electricity tariffs, when an electric four-wheeler is compared to an ICE powered 4W - it provides operational savings of Rs 3.07/km and Rs 4.57/km to fleet operators and private owners respectively. The high upfront costs get recovered in five years for a fleet operator, which takes almost 11.5 years when driven for private use. Fleet operators provide the necessary scale and ability to manage with limited infrastructure: resolving the classic question of EV first or the charging infrastructure.

**Vehicle segment prioritisation, with an eye on TCO viability, is at the heart of the EV adoption drive across the country.**

Unlike Western models, India may not easily kick start its electric journey by deploying premium electric cars. Instead, it makes sense to focus on electrifying vehicles with the highest demand and utility in the Indian context: two-wheelers and three-wheelers. The rickshaw is already proliferating in electric variants, suggesting it is both viable and practical. Thus, appropriate prioritisation of vehicle segments for electrification may prove to be critical to the adoption of e-mobility.

This study carried out extensive TCO analyses - comparative analyses between EV and ICE (Internal Combustion Engine) categories of various segments of vehicles. *(Refer pages 34 to 40 for detailed TCO analysis for all vehicle segments.)* Public transit agencies, new age app aggregators of bikes, auto-rickshaws, and cabs, and fleets managed by government agencies put in more km on their vehicle each year compared to personal vehicles*[2]. Such high asset utilisation allows these fleet operators to spread the cost recovery of buying, maintaining and operating the vehicle, thereby making electric mobility service a more viable prospect. This consideration, referred to as Total Cost of Ownership (TCO), is critical to the financial viability of market-based e-mobility initiatives in India. In other words, fleet operators rationally consider the TCO profile of an EV and compare it with ICE vehicles, while making their purchase decisions. They weigh savings from EVs on account of lower operational and maintenance costs against high upfront purchase prices. TCO, therefore, is a useful calculation to assess the direct and indirect costs associated with a purchase.

The OMI study found that since TCO parity for four-wheelers (4W) will not be occurring before 2026, vehicle segments must be prioritised for electrification. This will help better expend resources on supporting segments where the TCO differential with ICE counterparts is minimal – as is the case of electric two-wheelers (2W) and three-wheelers (3W). This would also make fleet operators less dependent on the government for subsidising the upfront cost of the EV and battery. Third, given the price sensitivity of the Indian consumer market, leveraging fleet operators to drive down costs for the market may prove to be a significant catalyst.

Further, currently, over 80% of vehicles plying on Indian roads are 2W and 3W, contributing to 35% of pollution (NITI Aayog and World Energy Council, 2018). Any attempt at electrification of the country's vehicle fleet must include emphasis on these segments. In addition, the highest proportions of passenger-km traveled are by public and shared transport vehicles (bike-taxis, auto-rickshaws, taxi-cabs, and buses) (Roychowdhury. A and Dubey. G, 2018).

*[1] Total Cost of Ownership - TCO - uncovers hidden costs over the lifecycle of an asset, incorporating direct and indirect expenses.
*[2] On average, personal vehicles run only for 10,000-15,000 kms annually (adapted from UNEP, 2014 and Economic Times, 2017).

Additionally, the largest fleets in the country are maintained by government agencies and civic bodies. Decisions to electrify government-owned vehicles is a significant opportunity to address a large number of vehicles at once. Given that EVs have zero tail-pipe emissions, such electrification of public fleets could lead to a disproportionate reduction in air pollution. On the basis of such an analysis, it is recommended that commercial 2W and 3W be converted to electric first, followed by commercial / fleet 4W. Electrification of private vehicles should follow these early adopters as the costs of batteries and technologies reduce.

**TCO parity must be achieved for the viability and sustainability of e-mobility in India. Financial viability is the only way to have a Sunset Clause* in EV promotion policies.**

The Government may provide subsidies and concessions until a critical threshold limit for fleet electrification is achieved: thereby successfully introducing a Sunset Clause across all fiscal incentives. Policies that accelerate the path to a viability threshold will reduce the continuing burden on the exchequer, enabling national and subnational governments to implement initiatives for longer, and helping the e-mobility industry find a market-based path to scale.

**Incentives should be on USAGE rather than the purchase of EVs.**

The Prime Minister commented at the Move Summit in 2018 that India should focus on "clean km travelled." Indeed, a national framework on electrification should emphasise increasing clean km travelled using different modes of mobility. This would naturally promote the electrification of high utilisation vehicles, i.e. shared mobility solutions such as public transit, commercial vehicles, three-wheelers, delivery services, etc. (Arora. N and Raman. A, 2019).

One way to achieve this is to subsidise operational expenditures of managing EV fleets, which would link incentives to usage rather than moving vehicles off a sales lot. In addition, this could be seen as a "pay-for-success" arrangement, where public money is only spent when an electric vehicle is used. This could be done indirectly by maintaining the delivered cost of electricity for charging vehicles low at INR 5/unit for 4-5 years to make e-mobility projects financially viable, GST subvention for charging / swapping services, creating zero-emission zones in cities, allotting dedicated and sufficient parking spots for EVs, enabling the land lease rental to set up energy infrastructure, and other non-fiscal initiatives to incentivise demand for electric mobility in India. These incentives would only be delivered if demand for clean kilometers is generated and delivered by the recipient. It is commendable that the Department of Heavy Industries, the Ministry of Road Transport and Highways (MoRTH), and several state governments have signaled major steps at waiving permits and offering a combination of fiscal and non-fiscal incentives, with the intent to reduce the relative costs of ownership for EVs.

To ensure that EVs are being powered by clean energy, state governments should ease access to renewable energy by allowing aggregation of open access electricity wherein buyers (such as shared mobility providers) have access to the transmission and distribution (T&D) network to obtain electricity from suppliers other than the local distribution company (discom). State governments should offer an exemption to maintain contracted demand. Today, there is a requisite to maintain a minimum threshold of 1 megawatt of power on standby to contract open access electricity. This requirement of a minimum threshold on contract demand especially for EV charging should be removed. Further, the government rightly encourages the adoption of renewable energy sources to power electric vehicles. To strengthen this, the state electricity regulatory commission in collaboration with local discoms should create necessary infrastructure in the form of net metering and banking facilities, among others, to measure the energy derived from renewable sources. Experience from the country's first multimodal electric mobility project shows that solar net metering reduced electricity bill by 28% and contributed to improved economic viability.

* In public policy, a sunset provision or clause is a measure within a statute, regulation or other law that provides that the law shall cease to have effect after a specific date, unless further legislative action is taken to extend the law.

**Fiscal incentives should be designed to specifically subsidise the one cost that makes EVs expensive: batteries.**

The government should also recognise battery swapping as a viable alternative to direct charging of a vehicle. **Battery swapping, as piloted in Nagpur, offers significant advantages in the EV paradigm, with global implications.**

The Nagpur pilot has provided proof of battery swapping acting as a reliable charging mechanism for small vehicles (2W, 3W). Battery swapping is doable, efficient, and in the case of Nagpur, successful. Battery swapping helps in mitigating long waiting time of drivers at charging stations, for commercial and private users alike. *(Refer pages 28 and 29 for details.)*

Consider the case of e-rickshaw drivers in Nagpur. Their livelihood is dependent on driving throughout the day with minimal idle time, i.e. time not spent in ferrying a passenger around. For EVs without battery swapping mechanism, the time spent at charging stations - i.e. waiting time - is also considered as idle time. Slow and fast charging alike cause a driver to miss an earning opportunity. Conventional fast and slow charging could take anywhere from 2 to 6 hours respectively *(Refer pages 23 and 24 for details)* for a vehicle to be fully powered. This is precious time that a commercial vehicle driver cannot afford to lose. The OMI study of the country's first multimodal electric mobility project found that EVs usually have 20-25% less running time compared to conventional fuel vehicles, given the time spent in charging. *(Refer pages 23 and 24 for more details.)*

Battery swapping, therefore, offers the much-needed solution to reduce wait time / idle time, increase the running time of an electric vehicle, and improve the earnings of drivers. It is imperative that the government recognises the value of battery swapping especially in the shared mobility context of India, and designs ways of promoting the technology across the country. Fiscal incentives should, therefore, be designed to specifically subsidise the one cost that makes EVs expensive: batteries. Most other components are already produced at scale in India's thriving automotive sector, with the exception of advanced batteries. The high upfront cost of EVs is on account of the high cost of the battery pack, which constitutes 40-50% of the cost of an electric vehicle. It is this cost, i.e. the cost of the battery that needs to be subsidised to promote faster adoption of EVs in India.

By offering financial incentives for manufacturing of batteries as against the entire EV, the manufacturing of batteries too would get accelerated; technology and innovation would flourish; economies of scale would be achieved; and batteries would be both domestically produced and affordable.

This tipping point is crucial to make e-mobility dream a reality in the country, and to avoid replacing imports of fuels with imports of batteries. This type of battery subsidy should sunset as the viability gap of batteries closes with reducing costs over time.

**Nagpur pilot offers hope for powering India's EV dreams through renewable energy.**

Integration with renewable energy brings out the dual benefits of not only achieving financial viability but also greening the entire EV usage from cradle to grave. This serves as a promise towards a low carbon, resource-efficient future for India.

Nagpur pilot offers visibly tangible evidence of the financial and environmental benefits a city can witness at scale. Installing solar rooftop at charging stations in Nagpur reduced the average electricity expense by 28%. *(Refer page 31 for details.)*

On the same lines, batteries can also be treated as decentralised electricity storage solutions to further intertwine e-mobility with renewable energy. Discoms should be able to draw power from vehicle batteries to balance the grid. This will help meet the storage needs of renewable commitments and reduce the cost of maintaining grid loads while enabling a new revenue source for EV batteries (Arora. N and Raman. A, 2019).

**Build sustainable e-mobility ecosystem through *Make in India* solutions.**

It is commendable that the Central Government has recently approved a Phased Manufacturing Programme (PMP), valid for five years till 2024 to localise production with a focus on the upstream part of the EV value chain. The Union cabinet approved the setting up of a National Mission on Transformative Mobility and Battery Storage (PIB, 2019). Additionally,

- **Scrappage incentives should be offered on End-of-Life ICE vehicles (ELVs),** with a condition that such an incentive is redeemable only at the purchase of EVs. Such an approach helps manage the current fleet of ELVs besides accelerating EV penetration. State governments may incentivise setting up of recycling-businesses to focus on 'urban mining' of rare materials within the battery for feeding it back to the value chain.
- **Sustainable management of end-of-life EV batteries** is crucial to avoid pollution from toxic waste and secure a strong supply of raw materials at low environmental cost. Once batteries have reached 60-70% of their rated capacity and not fit for automotive uses, policy should incentivise its reuse as power banks for storing solar energy and for non-automotive applications. Reasons abound for why government funding should encourage the development and deployment of advanced battery technologies. The government may establish centres of innovation and excellence for various components of EVs and Autonomous vehicles industry including battery technologies, drivetrain technologies, software development and charging technologies, and thereby promote research, innovation, and *Make In India.*

Today, the nation has a real opportunity to change the EV landscape. With a vision for bringing 1 million EVs on the road by 2022, players like Ola can bolster the EV movement and help India lead EV adoption at scale. As a catalyst for the EV ecosystem of OEMs, policymakers, battery manufacturers and utilities, India could grab a significant opportunity for improving air quality, creating jobs, supporting domestic manufacturing, and boosting the Make in India initiative. India could lead this way by example.

# PROLOGUE

The electric vehicles (EVs) story in India has sparked a world of possibilities. The automobile industry is one of the key sectors driving the country's economic growth. But it is also one of its biggest pollutants – a glaring problem that India inherently understands. It is at this intersection of growth and sustainability that alternative mobility solutions, such as EVs, are brimming with potential to transform tomorrow.

EVs are steadily gaining traction. Not only are they relatively emission-free, thereby holding the key to India's burgeoning air pollution issue, they also have massive potential to reduce our oil import bills. As the next generation automotive technology, EVs offer a pathway towards low carbon, cost-effective and reliable mobility solutions. While the environmental impact of electric vehicles is obvious, there are other advantages to electric mobility solutions over conventional fossil fuel-powered vehicles. Apart from the high upfront costs, they are cheaper to maintain as they are powered by electricity and not fuel. The eco-friendly option means a lower carbon footprint for the country, while no combustion engine means a quieter, smoother ride, thereby offering a comfortable and sustainable way of moving around.In India, electric mobility presents a massive opportunity for improving air quality, creating jobs, supporting domestic manufacturing, and providing a boost to the Make in India initiative – pressing needs for a sustainable India. There are immediate positive impacts on strengthening national economic security through reduced oil import bills and self-reliance, and far-reaching benefits such as on health and productivity. Countries around the world are taking initiatives to replace gasoline taxis with plug-in EVs. These sustainable and sensitive business practices don't go unrecognised by the customers of these companies, but rather create brand loyalty and recall. Further, the social license protects the future interests of businesses and sets them apart from their competitors.

Ola Mobility Institute believes that the success of electric mobility is hinged on leveraging shared mobility. Given India's proliferating ride-sharing players; the nation has a real opportunity to change the EV landscape. It can bolster the EV movement and finally lead EV adoption at scale.

AN IDEA
IN MOTION

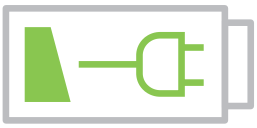
# THE E-MOBILITY CHALLENGE

With many environmental and socio-economic benefits, Electric Vehicles (EVs) can be the mobility game changer in more ways than one. But there are several perceived challenges on the road ahead.

**Climate challenge:** Within a single city, extreme temperatures within a day, variations across seasons, could affect the performance of EVs, which are essentially operated on batteries.

**Knowledge challenge:** Lack of awareness regarding how to operate EVs, and inadequate information on the functioning, care, repair and maintenance.

**Effectiveness challenge:** Lack of a network of charging and battery swapping stations for electric vehicles whether publicly or privately, uncertainty around performance and, most importantly, the high upfront cost of the vehicle, especially for individual owners.



**In Contrast**

**Fleet operators appreciate the low operational cost of EVs, and can recover high upfront costs through the vehicle lifespan.** Public transit agencies, new age app-aggregators of bikes, auto rickshaws, and cabs, and fleets of cars and buses managed by government agencies put in more km on their vehicles each year compared to personal vehicles. This high asset utilisation allows fleet operators to recover the cost of buying, maintaining and operating the vehicle, making electric mobility service a promising prospect. This makes fleet operators the ideal candidates for accelerating EV penetration, indicating a possible potential for shared mobility players such as public buses, taxis, rickshaws and shared cabs such as Ola, one of world's largest ridesharing platforms, to build an electric mobility ecosystem at scale.

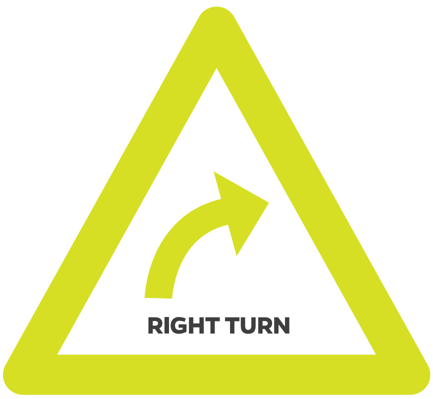
A 2017 NITI Aayog and RMI report on electric mobility emphasised that India could save 64% of anticipated passenger road-based mobility-related energy demand and 37% of carbon emissions in 2030 by pursuing a shared, electric, and connected pathway. Given the way technology alters business-as-usual scenarios, the report generated a larger debate around EV operations in Indian conditions.

# THE OLA PILOT

## INDIA'S FIRST MULTIMODAL* ELECTRIC MOBILITY PROJECT IN NAGPUR

In May 2017, Ola launched the country's first multi-modal EV project - inaugurated by Hon'ble Chief Minister of Maharashtra, Shri Devendra Fadnavis, and Hon'ble Union Minister, Shri Nitin Gadkari in Nagpur.






**Traditionally, EVs have been designed for personal use and to be operated in protected environments. In a first-of-its-kind bid to offer sustainable and comfortable rides to users and drivers on a shared mobility platform, Ola began testing e-cabs and e-rickshaws on Indian roads, thereby exposing them to extreme heat and cold. What unraveled was a turning point in the mobility journey of the company. Ola was able to discover a plethora of factors instrumental in operationalising EVs at scale in India.**



* More than one mode of commute. The project in Nagpur, for instance, had e-cabs and e-rickshaws.

At the time of conducting this study, Ola's electric fleet had:

- Served over 3,50,000 customers
- Clocked over 7.5 million clean km
- Saved over 5.7 lakh litres of import-dependent fossil fuel
- Reduced CO2 emission by over 1,230 tons

For the pilot, Ola worked with multiple industry partners including government authorities to understand how to execute electrification, and launch an industry-first e-mobility project from scratch. Key stakeholders came together to help build a robust battery charging and swapping infrastructure and a wide-ranging EV fleet in a brief span of time.

As a catalyst for the entire EV ecosystem of OEMs, policymakers, battery manufacturers and utilities, Ola committed to bring 1 million EVs for everyday mobility, on Indian roads by 2022 (Mission: Electric, 2018). The Nagpur electric mobility project was a stepping stone towards this.

## WHY NAGPUR

Nagpur became an early mover in e-mobility because of a variety of reasons:

- A pro-active state Government with favourable policies and regulations to increase the adoption of e-mobility in the state.
- A convenient size and controlled ecosystem and therefore, requirement of fewer charging stations than compared to large metropolitan cities.
- Smaller average trip lengths of 8 to 12 km allowing for a short and well-defined network of charging stations in the city, allaying range-anxiety in driver-partners.
- Extreme climate conditions ideal for battery and vehicle testing.

This confluence of factors provided the precise environment needed to understand and test e-mobility operations at scale.

*The Multimodal E-Mobility pilot in Nagpur was a first of its kind initiative to discover the various aspects of operationalising EVs at scale in India. We look forward to sharing our insights and learnings from here, with stakeholders in the mobility ecosystem to build the right sustainable mobility solutions at scale. This is a big step in the direction of achieving India's Nationally Determined Contributions (NDCs) for the success of the Paris Agreement.*

**Bhavish Aggarwal, Co-founder & CEO, Ola**

## THE STUDY

In 2018-19, Ola Mobility Institute (OMI) analysed Ola's Nagpur e-mobility project, in a study that dived deeper to extract crucial lessons that India could learn from its first multi-modal e-mobility project.

With the key objective to help understand how to proliferate EVs, the study attempted to gain an understanding of operational issues that include vehicle performance, customer charging behaviour, impact of temperature on charging and battery life, and impact on grid and of integrating renewables at the charging station, among others.

The study collated monthly data on required parameters and analysed it to arrive at evidence-based policy recommendations. It conducted a scenario building exercise to evaluate the economic viability of operations under regulatory provisions supporting EV penetration. Envisaging on-ground learning from the pilot, the study projected the tipping point where EVs achieve parity with ICE vehicles with appropriate assumptions on battery pack prices, crude prices, technological developments, BS VI* getting implemented in future, and more.

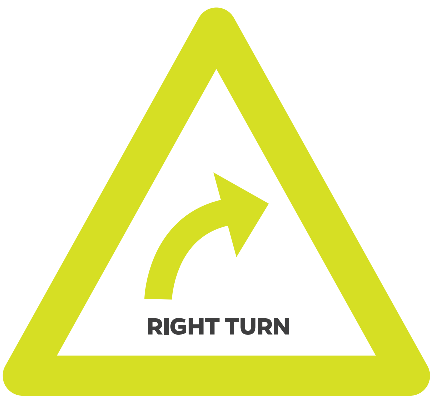
The study also examined the usability of EVs in a shared fleet, besides assessing the financial viability of the project. It delved into operational issues faced by Ola, and provided critical insights as lessons for all actors of the ecosystem. It also revealed insights on driver-partner and customer experiences, emphasising the need for incorporating value propositions for drivers and customers alike to keep demand alive. It stressed on expediting regulatory processes and building a robust policy framework for accelerating the transition to electric mobility in India.

Ola Mobility Institute sincerely intends that these findings would assist policymakers in making informed decisions regarding allocating public resources for EV deployment.

## LEADING THE CHANGE

With the goal of gauging the financial viability of e-mobility projects in cities, the EV pilot was launched on 26th May, 2017.

**The Fleet:** The pilot encouraged Ola to commit the deployment of over 10,000 electric three-wheelers across the country by 2019, and a million electric vehicles by 2022 (Mission: Electric, 2018).




**Ola's vehicle leasing arm, Ola Fleet Technologies, procured all the EVs and offered them on daily lease to driver-partners. This was a key component of Ola's e-mobility strategy, wherein the burden of ownership of a vehicle with high upfront cost is borne by Ola, clubbed with a financially viable and mutually beneficial engagement model with driver-partners.**

*Bharat Standard VI: Bharat stage emission standards {BSES} are emission standards instituted by the Indian Government regulate the output of air pollutants from ICE and Spark-ignition engine vehicles.

The Nagpur fleet comprised electric cars and electric rickshaws from the manufacturers, Mahindra and Kinetic.

Ola's EVs were fully operational in Nagpur for day-to-day commute, notwithstanding permit and RC issuance-based issues.

## ELECTRIC CABS IN THE OLA NAGPUR FLEET

Mahindra e2o Plus Hatchback

Battery capacity: 15 kWh Advanced Lithium ion battery

Practical Range ~100 km

Average Daily Run 142 km

Charging Time Slow: 7-8 hrs Fast: 1.5 - 2 hrs

In peak summer, the battery pack consumes 50% more units to reach full charge.

## ELECTRIC RICKSHAWS IN THE OLA NAGPUR FLEET

Kinetic Safar E-Rickshaw

Kerb Weight 295 kg

Battery Capacity 2.8 kWh

Top speed 25 kmph

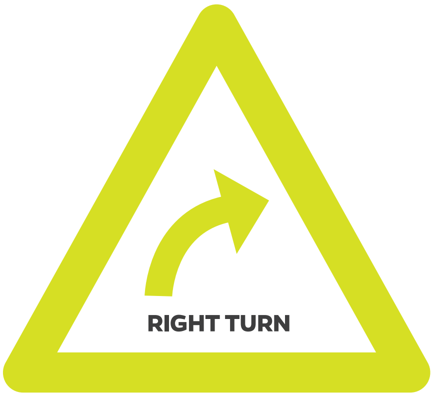
Passenger Capacity 4

Average Daily Run 66 km

Practical Range in full charge 35 km

# OPERATIONALISING THE INITIATIVE: MAKE CHANGE HAPPEN

Ola took several measures to create a smooth transition to e-mobility for its existing customers and driver-partners in Nagpur. For driver-partners, uncertainty over the performance and concerning operational costs of running the vehicle needed to be addressed immediately. Ola designed lucrative value propositions for a seamless transition to e-mobility.




**Just as with all vehicles under Ola Fleet Technologies, Ola handles repair and maintenance of EVs too. In partnership with manufacturers, vehicles are serviced after every 10,000 km of run / vehicle. This helps maintain optimal performance levels for the entire fleet.**

**For e-cabs, riders were offered Ola Play*[1] sedan services at fares commensurating conventional ICE hatchback services. This encouraged riders to prefer e-cabs over conventional choices of commute. Driver-partners were provided free-of cost-charging in the first month, followed by 50% rebate*[2] in subsequent months. The feebate is phased out now, and the driver-partners pay a charging fee depending on the number of electricity units consumed.**

*We were not sure of swapping the horsepower of a combustion engine for a battery. But driving an EV for longer hours effortlessly with relatively less fatigue changed our perception. For us as the driver community to make a mass adoption, the charging infrastructure and time taken to charge under different temperature conditions are important. Only this can inspire true confidence in using electricity as a transport fuel.*
**Roshan Paunekar, Driver Partner**

*Air pollution is an imminent danger for my loved ones and also a public health emergency. Cleaning the air is solely not the Government's responsibility – but must be shared by all citizens. Ola's EVs empower us to contribute by cleaning our ride and offering a more sustainable way to move.*
**Swapnali Jagdale, Passenger**

To address concerns of driver-partners regarding their income and concerns of time taken for charging and dry run*[3], the initial lease rent for vehicles was just 10% of what was being charged on conventional ICE vehicles. Partners were also compensated for time spent on charging. Today, incomes and earnings parity has been achieved between drivers of ICE vehicles and electric vehicles, thereby allowing the fleet operator to charge the same lease rental from the two categories of driver-partners

*[1] Ola Play is a connected car platform, that aims to transform the in-cab experience by bringing advance car controls, choice of personalized content and a fully connected interactive experience, to the backseat of the cab.
*[2] The driver partners were charged only for 50% of electricity units consumed.
*[3] Idle run or distance traveled by drivers to pick up a passenger.

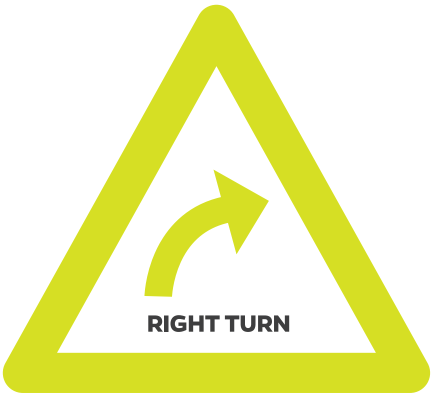
# ELECTRIFYING FUEL PUMPS TO CHARGE BATTERIES

Ola helped build a network of charging stations - based on its offering of a demand-responsive mobility solution, historical trends on rides, expanse and coverage of a service within a city, increased adoption of and demand for e-mobility services, and so on.

To start with, a charging station was set up during launch at the premises of Dr. Babasaheb Ambedkar International Airport at Nagpur. Independently built by Ola, the station was equipped with four fast and four slow chargers.

Simultaneously, other charging stations were constructed as per the size and spread of Nagpur. As the company ramped up its vehicle deployment to 100, the construction of other charging stations was expedited with the support of the Municipal Corporation of Nagpur and other partners in the ecosystem.

This paved the road for a second charging station in Nagpur. This station, equipped with two fast and two slow chargers, met with limited success at continuing operations. Subsequently, two more charging stations were set up - one in partnership with Indian Oil Corporation Limited (IOCL) at their fuel station with two fast and two slow chargers, and an Ola-owned charging station at Nandanvan, with five fast and five slow chargers. Overall, Ola-owned stations can charge 22 vehicles at a single point in time. This is the combined capacity of all Ola-owned stations in Nagpur. Ola also partnered with Hindustan Petroleum Corporation Limited (HPCL), allowing driver-partners to access HPCL charging facilities.




**Notwithstanding the charging stations set up in public places by Ola and its partner organisations, Ola also installed slow charging points at driver-partners' residences. This provided driver-partners the technical know-how of charging their EVs, and pioneered the home charging infrastructure for the ecosystem in Nagpur.**


Ola partnered with the Indian Oil Corporation Limited (IOCL) to establish and operate India's first ever fast-charging station for EVs at a fuel station in Nagpur.

# EXPANDING THE CHARGING INFRASTRUCTURE

To increase effective on-road hours of the EV fleet, Ola deployed multiple charging stations in Nagpur (as detailed in the previous section). The following table outlines the availability of fast and slow chargers along with the connected load at various charging locations.

Table 1: Average Location and Capacity of Charging Stations

| Charging Station Location | Connected load (in KW) | Number of chargers |
|---|---|---|
| Airport | 150 | 4 fast and 4 slow |
| IOCL fuel station | 30 | 2 fast and 2 slow |
| Nandanvan | 150 | 5 fast and 5 slow |

Professionals operating the charging infrastructure were trained and the highest level of safety measures was ensured. The safety training and measures are from the government-prescribed Automotive Industry Standard (AIS) 138 - part 1. This training covers safety precautions to be followed throughout the charging cycle from start to end, including measures to be taken in case of power failure and charging interruptions (DHI, 2017).

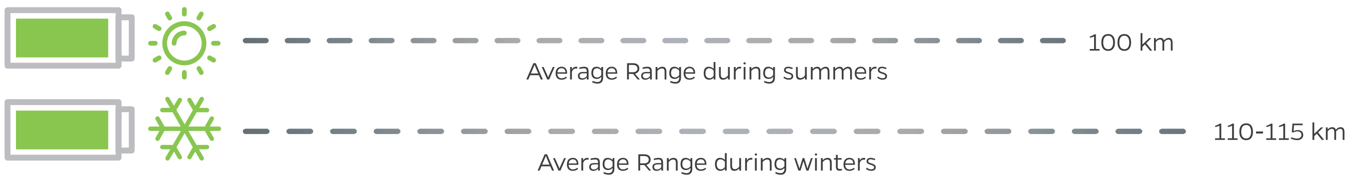
*As India's leading oil refiner and marketer, IOCL promotes ecological sustainability as part of its core business. A robust network of charging stations can address range anxiety for EVs, by establishing nationwide charging infrastructure. Nagpur added one more feather to our cap by installing the first electric charging station at Indian Oil's COCO (company-owned, company-operated) fuel station in the city – it brings us closer to how we re-imagine India will commute in coming years.*
**Indian Oil Corporation Limited (IOCL)**

# HOW 4W ELECTRIC BATTERIES WORK

The vehicle battery functions optimally within certain operating windows of temperature, voltage, structural changes (during charge–discharge), and other parameters. These operating windows are specific to each battery management system.

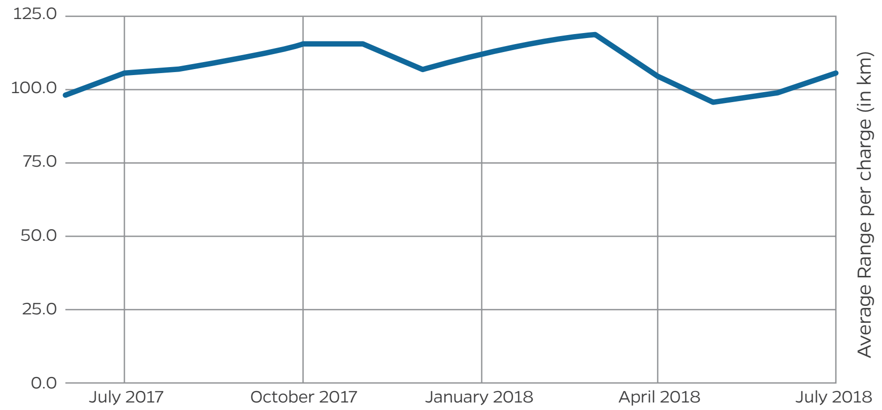
**Specific to Indian conditions, the temperature was expected to have a significant impact on the performance, safety, average range and cycle-lifetime of lithium ion batteries.**

For instance, at higher temperatures, the battery ran the risk of decomposition of electrolyte and electrode materials which could lead to thermal runaway of the battery. If temperatures fell below the operating window, the diffusivity of Li-Ion decreased and resulted in an under-performing battery. However discharge rate of batteries was relatively less at lower temperatures compared to higher temperature. **Thus, it is seen that the average range per full charge is influenced by ambient temperature (Fig. 1). For instance, the average range / charge is 100 km in summers and increases to 110-115 km in winters.**




## Fig 1: Average Range per charge (in km)

Range is influenced by ambient temperature. This figure shows the seasonal variations in average range per charge experienced in Nagpur.



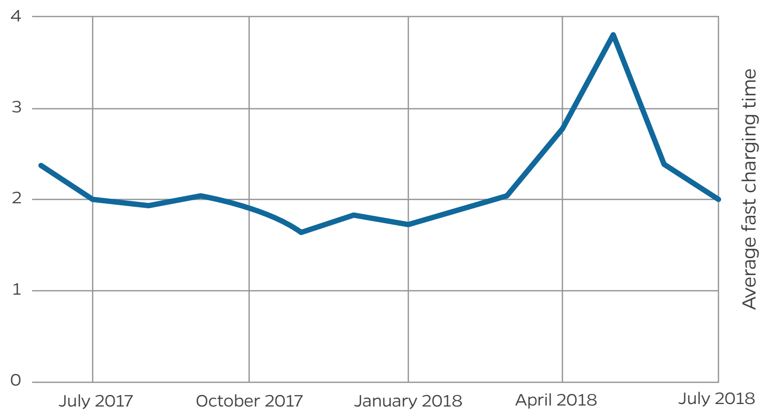

EVs usually have 20-25% less running time compared to conventional fuel vehicles, given the time spent in charging. This would imply that for earning a similar level of income as operating ICE vehicles, driver-partners needed to increase their login hours which dis-incentivised them to transition to e-vehicles. To eliminate this pressure and for smoother transition to e-vehicles, Ola fleet technologies compensated its driver partners as mentioned earlier.

## TALKING NUMBERS

Average fast charging takes 90-110 mins of plug-in time for a full charge. **But the time for fast charging was affected severely by weather conditions, as against slow chargers**. In summers, when temperatures rose to over 45°C, the charging time increased from 90 mins to 200+ mins for a full charge. It also increased electricity units consumed for a full charge by up to 50%.

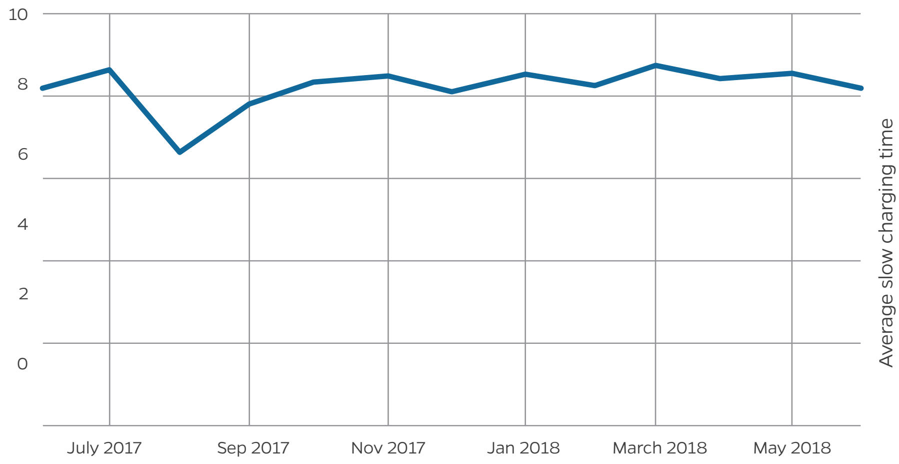
## Fig 2: Average fast charging time (in hours)

Compared to slow charging, fast charging is severely affected by weather conditions. This figure shows seasonal variations in charging time for fast charging.



## Fig 3: Average slow charging time (in hours)

Time for slow charging is not affected by weather conditions. This figure shows seasonal variations in time taken for slow charging.




However, there were no reported instances of battery life getting affected on account of increased ambient temperatures during charging. The air conditioner prevented overheating. However, one fast and one slow charge a day was desired for optimal vehicle performance and extended battery life. On the other hand, average slow charging took over 7-8 hrs of plug-in time for a full charge. **But the time taken for slow charging did not seem to get affected by external conditions such as temperature and weather.**

# CHARGING E-RICKSHAWS

Ola's e-rickshaw provided a convenient and eco-friendly mode for going short distances. These e-rickshaws had advance li-ion battery packs of 2.8 kWh, and clocked an average daily run of 66 km. An e-rickshaw would get charged in 2 hrs flat using fast rack chargers whereas charging through slow portable chargers took up to 6 hrs. As with four-wheeler charging, high electricity tariffs coupled with limited fleet size, restricted fast charger utilisation to 25% of its installed capacity.

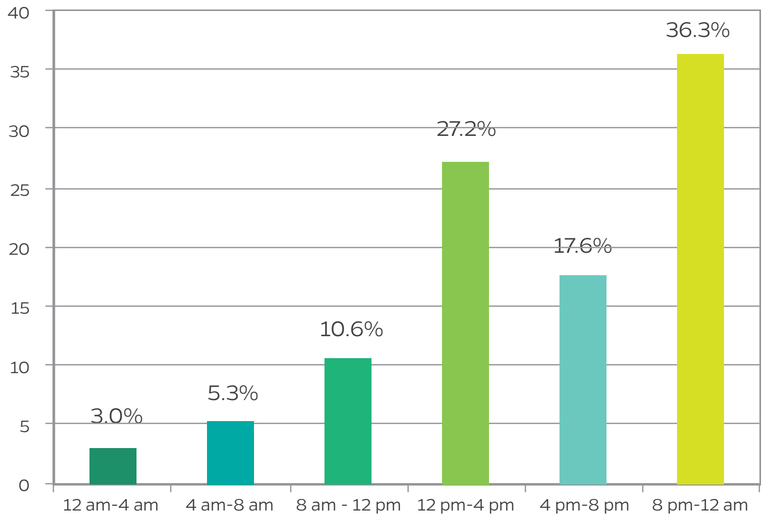
Fast-Rack Charger

Slow Portable Charger

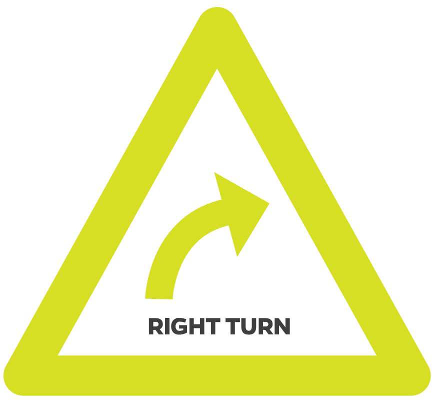
## CHARGING BEHAVIOUR

Analysing the charging behaviour of driver-partners showed that power demand at charging stations peaked during noon time (12pm-4pm) and at night (8pm- 12am) - with 63.5% of charging happening at this time.

Fig 4: Percentage of Cars Charging




## CHARGING INFRASTRUCTURE AND COSTS INVOLVED




**To keep up the on-road hours of the EVs i.e. comparable to ICE vehicles, Ola created a robust network of charging infrastructure with numerous stations spread across the city, all with different capacities. This accessible network of charging infrastructure was critical for smoother operations. It would meet on-demand charging needs of driver-partners and cut wait time at charging stations.**

The high electricity tariffs coupled with limited fleet size led to under-utilised charging infrastructure. The average utilisation rated 40% and 5% for fast and slow chargers respectively. Fig. 5 shows the operating costs of charging stations. The land lease rental alone at INR 23-28 per sq. feet made it the largest component accounting for over 31% of overall opex. The commercial electricity tariff of INR 17.7 per kWh made electricity expenses the second biggest contributor at over 30% of the total opex. However, the share of electricity expenses shrunk significantly post the implementation of special EV tariff proposed in the state EV policy, starting October 2018. This was followed by manpower expenses and depreciation. Land lease rental coupled with electricity expenses constituted over 62% of total operation costs, adversely affecting the economic viability of the project and discouraging scaling up of operations.

*SI Unit - International System of Units: The kilowatt hour (symbol kWh, kW-h or kW h) is a unit of energy equal to 3.6 megajoules. If energy is transmitted or used at a constant rate (power) over a period of time, the total energy in kilowatt hours is equal to the power in kilowatts multiplied by the time in hours.

Fig 5: Operating costs of charging infrastructure (May 2017 - Sep. 2018)

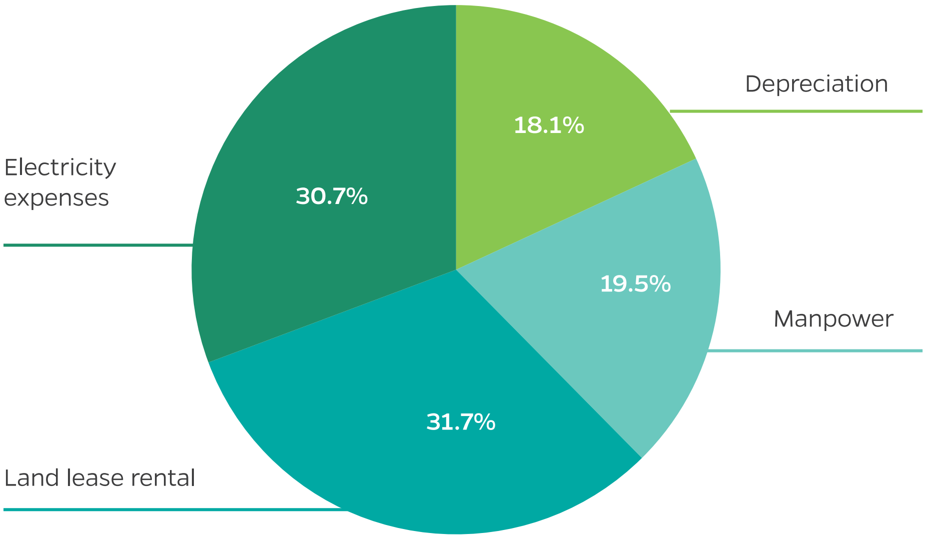
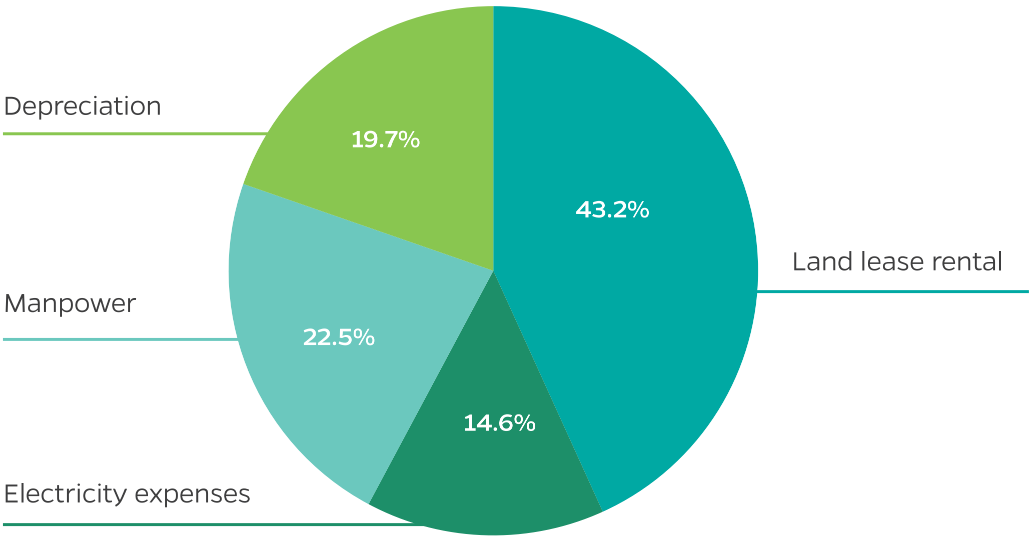



Fig 6: Operating costs of charging infrastructure at current electricity tariff (Oct. 2018 onwards)



## BREAKUP OF ELECTRICITY TARIFF (INR/KWH)

The tables below provide breakup / unit of delivered cost of electricity.

- Energy charge reflects the per unit electricity costs.
- Wheeling charges shows transmission cost - transfer of electrical power through transmission and distribution lines from one utility's service area to another.
- Fuel adjustment costs reflects the amount which utilities apply based on varying price of fuel or coal. This value differs every month and is based on current cost of coal.
- Fixed charges depend on the connected or sanctioned load.

Table 2: Breakup of the Electricity Tariff applicable from May 2017 to Sep. 2018 (INR/KWH)

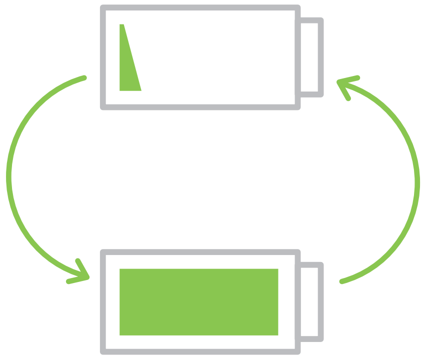
| | | |
|---|---|---|
| Energy Charges (INR /kWh) | Energy Cost | 12.55 |
| Wheeling Charges (INR /kWh) | Transmission Cost | 1.21 |
| Fuel Adjustment Charges | Due to varying price of Coal | [-1,1] |
| Electricity Duty | Tax on electricity consumption @ 21% on above items | [2.8,3.3] |
| Tax on sale (INR /kWh) | 9 Ps/kWh | 0.09 |
| **Sub Total** | | **16.7** |
| Fixed Charges | | 1 |
| **Net Payable Per kWh** | | **17.7** |

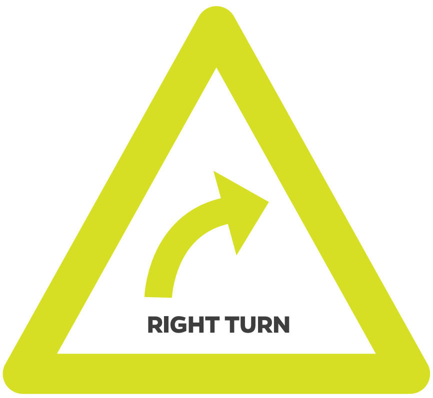
Table 3: Breakup of the Current Electricity Tariff from Oct. 2018 onwards (INR/KWH)

| | | |
|---|---|---|
| Energy Charges (INR /kWh) | Energy Cost | 4.63 |
| Wheeling Charges (INR /kWh) | Transmission Cost | 1.3 |
| Fuel Adjustment Charges | Due to varying price of Coal | 0 |
| Electricity Duty | Tax on electricity consumption | 1.38 |
| Tax on sale | 9 Ps/kWh | 0.09 |
| **Sub Total** | | **7.4** |
| Fixed Charges | | 0.61 |
| **Net Payable (INR /kWh)** | | **8.01** |

# BATTERY SWAPPING

Battery charging time plays a pivotal role in the adaptability of EVs– hence as a critical cog in the wheel, the Nagpur pilot experimented e-rickshaws with battery swapping for over a year from May 2017 to July 2018. The EV ecosystem has been evincing interest in battery swapping because of speed and ability to downsize battery capacity. Swapping may successfully eliminate wait time of drivers at charging stations and reduce total capex per vehicle. Consider the case of e-rickshaw drivers in Nagpur. Their livelihood is dependent on driving throughout the day with minimal idle time, i.e. time not spent in ferrying a passenger around. For EVs without battery swapping mechanism, the time spent at charging stations - i.e. waiting time - is also considered as idle time. Slow and fast charging alike cause a driver to miss an earning opportunity. Conventional fast and slow charging could take anywhere from 2 to 6 hours respectively *(Refer pages 23 and 24 for details)* for a vehicle to be fully powered. This is precious time that a commercial vehicle driver cannot afford to lose. The OMI study of the country's first multimodal electric mobility project found that EVs usually have 20-25% less running time compared to conventional fuel vehicles, given the time spent in charging. *(Refer pages 23 and 24 for more details.)* Battery swapping, therefore, offers the much-needed solution to reduce wait time / idle time, increase the running time of an electric vehicle, and improve the earnings of drivers. In Nagpur, battery swapping boosted driver-partner earnings as they were able to operate the vehicle for 25% longer range compared to conventional Li-Ion battery-based vehicles and 50% more compared to conventional Lead-Acid battery-based vehicles. The Nagpur pilot provided sufficient evidence against the apprehension over the success of swapping in Indian conditions.






**With the aim to assess the viability of battery swapping solutions for Indian use conditions, Ola piloted e-rickshaws with swappable batteries.**

Unlike dedicated charging, battery swapping could offer fast "recharge" (5 minutes for swapping vs. 1.5-2 hrs for dedicated fast charge solution). Battery swapping stations require a fraction of the real estate per vehicle compared to park-and-charge solution. This approach would reduce the cost of building charging infrastructure, as land lease rental forms one of its biggest cost components .

Battery swapping technology using Li-ion batteries offered another advantage over the current set up of e-rickshaws prevalent across Indian cities, where lead-acid batteries are predominantly used. A conventional e-rickshaw with lead-acid battery was around INR 80,000 - 1.2 lakhs - the battery alone accounting for one-third to one-fourth of the total vehicle cost.

On the other hand, the cost significantly changed with a Li-ion battery which costs around INR 60,000. This was the cost of the battery alone. Although lead-acid batteries would cost much less at INR 20,000, its life was one-fourth that of Li-ion, and usually needed to be replaced every 8 months, besides requiring more frequent charging compared to Li-ion batteries.

A key pain point being experienced by e-rickshaw drivers in the country is a need for sustainable energy solutions for e-rickshaws to revolutionise first and last mile connectivity across cities. Li-ion battery-operated e-rickshaws offer the most pragmatic solution.

Such focus on battery swapping creates a huge opportunity for the manufacture of lithium batteries in the country with more battery swap stations dotting the landscape. Just as mobile telephony infrastructure created huge employment (Telecom Sector Skill Council, 2018), battery swap stations too could have tremendous potential for job creation.

* Land lease rental for the battery swapping station in Nagpur, for instance, stood at INR 40 per sq. feet.

# DRIVE LEARNINGS HOME

A learning curve marks the road to growth.

# PAIN POINTS & RESOLUTIONS

There were several challenges around operating and charging the vehicles at the on-ground level. But a series of quick resolutions helped address the situations in an agile manner.

**High electricity tariffs:** The electricity tariff of INR 17.7 per kWh was adversely affecting the economic viability of the operations and constituted more than 30% of total operating costs. Although the cost of electricity shrunk significantly post the implementation of special EV tariff in October 2018, the tariff continues to be unfavorable for TCO economics to work.

**High waiting time:** The limited availability of charging infrastructure increased driver partner's waiting time* to around 3-4 hours implying that they spent considerable time (login hours) off-road while charging.

**Voltage fluctuations at charging stations:** There had been instances of fast chargers becoming non-functional due to voltage fluctuations once every 40 days. These would tend to increase as more EVs hit the city roads, emphasising the need to improve transmission and distribution networks and integrate energy storage systems at charging infrastructure facilities.

**Limiting design and systems:** Interactions with riders highlighted the need for a better e-vehicle design to accommodate more luggage volume. There had been concerns about the effectiveness of air-conditioning systems as well.

**Limited exposure to operating EVs:** Driver partners, due to lack of familiarity of the mechanics of an EV, required more hands-on support. In the initial days of the pilot, the EVs were taken for frequent repair and maintenance due to the unfamiliarity of the driver-partners. This resulted in the vehicles spending more time in the workshop and less time on-road, thereby affecting the earnings of the driver-partners.

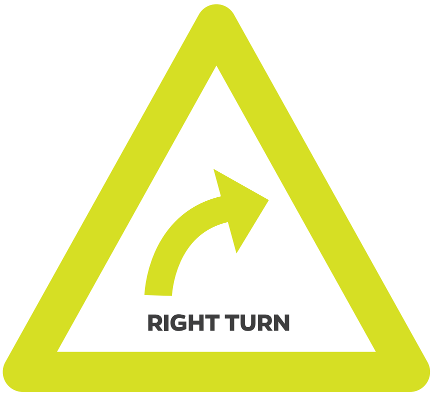
**The following measures were taken to resolve the most critical challenges:**

**Cut electricity bills:** To improve the financial viability of the project, Ola installed solar rooftops at two charging stations – Nagpur Airport and Nandanvan with a capacity of 16 kWh and 15.12 kWh respectively. This helped in reducing the overall electricity bill, thanks to solar net-metering which fed the power generated back to the grid. **As a result of this corrective measure, the average monthly electricity bill reduced by 28%.**

**More charging stations:** Setting up more stations reduced the waiting time from 3-4 hrs to 15-20 mins. But this has significantly increased the land lease rent and affected the overall economic viability of the project.

**Periodic vehicle service camps at charging stations:** To take care of repair and maintenance needs of EVs, periodic service camps provided driver-partners with requisite information and advice on the 'dos and don'ts', suggestions on upgrades and repairs, and tips on improving performance and overall experience. Service camps followed a 'preventive maintenance approach': a systematic process of inspection, detection, and correction to ensure that incipient failures are identified much before they develop into major faults. Such workshops led to a reduction in actual repair and maintenance frequency and increased driver-partner earnings.

* Waiting time refers to the time period that the vehicle waits at a queue for a charging outlet to become available (called queuing time). It doesn't include the time period during which the vehicle is being charged (called charging time).




**To safeguard driver-partner earnings against high commercial electricity tariffs, Ola installed slow charging points at driver-partners' residences, so they could charge at home at a relatively low cost.**

# IMPROVEMENT MEASURES

The Nagpur pilot shed light on several learnings to follow through on.

## ENHANCE THE CHARGING FACILITY

- The electricity tariff of INR 17.7 per kWh proved unfavourable for the economic viability of the project. Here the states' decision to design a special EV tariff provided some relief. However, despite the implementation of a new tariff, the delivered cost of electricity continues to remain at INR 8.01 per kWh. For scaling up e-mobility initiatives in a successful fashion, there is a need for placing the **delivered cost of electricity at INR 5 per kWh along with a lock-in period of 4-5 years to align with life of assets.**

- **Installing rooftop solar at charging stations would have a significant value proposition financially and environmentally.** It was observed that to improve the financial viability of the project, Ola installed solar rooftops at two charging stations – airport and Nandanvan with a capacity of 16 kWh and 15.12 kWh respectively.

  This helped in reducing the overall electricity bill, thanks to solar metering which fed the power generated back to the grid. As a result of this corrective measure, the average monthly electricity bill reduced by 28%. The overall electricity expense could also be reduced by open-access regulations and reduction in wheeling charges.

- **Innovative business models for setting up charging infrastructure customised towards both franchising and company-owned stations would be required.** With over 60,000 fuel stations in the country, these spaces could be utilised for setting up charging infrastructure.

- **A strategic location for setting up charging infrastructure is essential for economic viability would be needed.** Apart from considering the geographical spread and demand pattern in the city, multiple parameters from construction feasibility would determine site selection:
  - Location of the nearest electricity transformer
  - Site depth below road level
  - Future development plan of surrounding area
  - Legal cases/inheritance disputes

- **User interface and display requirement for chargers would be needed.** Unlike chargers for four-wheelers which had robust technical specifications, chargers used at battery swapping facility, such as for three-wheelers, did not display critical input and output parameters.

- **A lock-in period for land leased for charging infrastructure would be desirable.** In the current setup in Nagpur, for instance, the lease agreement for the charging station at the airport needs to be renewed regularly. This makes operationalising the charging station a time-consuming and cumbersome process.
- The Nagpur experience showed that demand for slow charging would remain limited on account of time taken to charge. Thus, **there is an impending need to build demand-responsive charging stations given the paucity of land.** Public charging stations could limit the space designated for slow chargers to a third of the total space required for charging infrastructure.

## SHIFT THE MOBILITY MINDSET

- **Demand aggregation would be the key to gain from economies of scale, and ensure optimum utilisation of charging infrastructure.** By aggregating demand at charging stations, the stations would be utilised to optimal capacities. Maximising the utilisation of the charging infrastructure would, thus, allow the charging station operator to benefit from higher returns on investment.
- **Building customer value proposition and design vehicles for shared mobility ethos would be important.** It was seen that low-speed e-rickshaws made for shared rides were not preferred by drivers and customers. There is an urgent need for accelerating R&D on battery chemistries and develop battery packs for shared mobility uses to address the range anxiety. Having an intelligent battery management system (BMS) was vital to learn about vehicle performance and support operations real-time.
- **There would be a need to expedite regulatory processes and facilitate faster diffusion of information through a regulatory setup.** Although the state EV policy provisioned for a special EV tariff in February 2018, implementation of it was only seen in October 2018. Till then, local utilities continued to charge a tariff rate of INR 17.7 per unit. Standard guidelines on construction and operation of Charging Stations and Swapping Stations could be provided by Municipal departments, City Planning Offices, and other statutory bodies. Such a regulatory clarity would significantly reduce the time spent on sanctioning the site for construction of charging infrastructure.

# DESTINATION EV

Sometimes it’s the journey that teaches a lot about the destination.

# TCO ECONOMICS

Public transit agencies, new age app aggregators of bikes, auto-rickshaws, and cabs, and fleets managed by government agencies put in more km on their vehicle each year compared to personal vehicles. Such high asset utilisation allows these fleet operators to recover the cost of buying, maintaining and operating the vehicle, thereby making electric mobility service a profitable prospect. This consideration, referred to as Total Cost of Ownership (TCO), forms the basis for the financial viability of e-mobility initiatives in India. In other words, fleet operators consider the TCO profile of an EV and compare it with ICE vehicles, while making their purchase decisions. They weigh savings from EVs on account of lower operational and maintenance costs against high upfront purchase prices. TCO, therefore, is a useful calculation to assess the direct and indirect cost associated with a purchase.

To evaluate the economic viability of operations under different regulatory provisions supporting EV penetration, we built different scenarios. These scenarios assume that the service provider owns both the fleet of vehicles and the charging infrastructure and have disaggregated cost of fuel, i.e. electricity and cost of charging infra.

In the most generic case, for either fleet operator or individual drivers, the overall cost could be bundled as one that includes both the cost of electricity and cost of operating the charging infrastructure.

**TCO is defined as the total cost of purchasing, running, and maintaining a vehicle over its lifetime (1,80,000 km, or 4 years in the case of a car operating in a fleet). It also takes into account the losses incurred due to depreciation of the vehicle over its lifetime.**

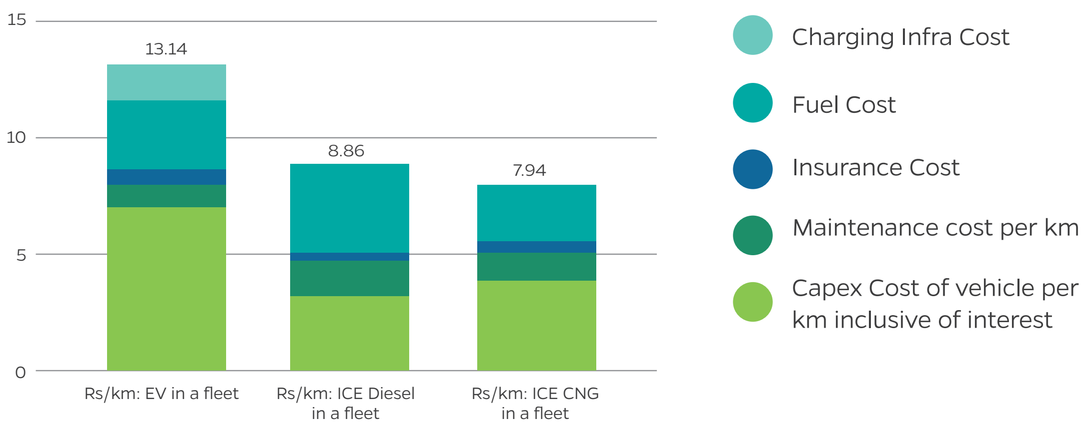
## FOR A FLEET OF CABS (ELECTRIC 4 WHEELERS)*

The TCO breakup in terms of capex (acquisition cost), and fuel, maintenance, insurance, and charging infrastructure costs have been adapted from analyses carried out by SIAM, IESA, EY, ICCT, Mahindra Electric, and Ola EV operations.

### SCENARIO 1:

Baseline Scenario: TCO Comparison EV vis-a-vis ICE - at commercial electricity tariffs implemented till September 2018.

Fig 7: Baseline Scenario: TCO Comparison EV vis-a-vis ICE - at commercial electricity tariffs implemented till September 2018



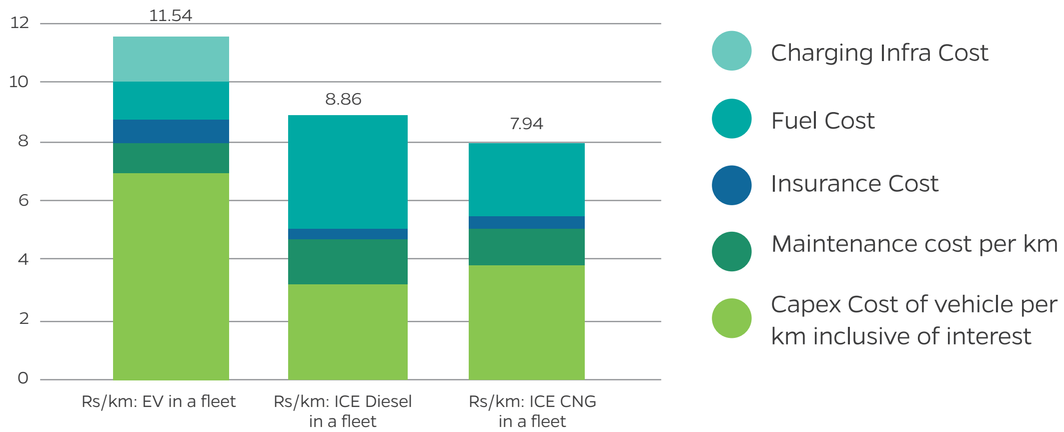

*While modeling the TCO scenarios for 4Ws, the authors have assumed the following.
1. Fuel price: Diesel price at INR 70-75 / litre; CNG price at INR 41 / kg.
2. The modeling incorporates incentive structure of FAME I.
3. The modeling doesn't take into account the impact of BS VI norms due for effective implementation from April 1, 2020.

Baseline scenario shows an exorbitant TCO differential of operating an Electric Taxi in a fleet vis-a-vis an ICE taxi. Apart from high capex costs of an EV, surprisingly the fuel cost contributes significantly - to an extent that at commercial electricity tariffs, the operating costs are greater than that of a diesel vehicle. While limited short-term measures can be taken to reduce the capex cost of an EV, technology is at its nascent stage and is still evolving. To address the TCO differential, the state government created a special EV tariff which got implemented in October 2018.

## SCENARIO 2:

### Current Scenario: TCO Comparison: At special EV tariff* proposed in the State policy and implemented w.e.f. October 2018

Fig 8: Current Scenario: TCO Comparison: At special EV tariff* proposed in the State policy and implemented w.e.f. October 2018




The scenario reveals that after the implementation of special EV tariff proposed in the state EV policy, TCO for operating an EV has reduced by INR 1.60 per km - but TCO differential continues to remain significant. High upfront costs, lack of charging infrastructure and uncertainty regarding performance are bottlenecks. Given the low operational costs, it implies that fleet providers would be the ideal candidates for accelerating EV penetration as they put in more km on their vehicle each year compared to personal vehicles. This solves the deadlock of high upfront costs by providing a shorter payback time period.

Benefits of electrifying shared mobility will outweigh any benefits whatsoever of electrifying personal mobility. Private users have to battle with high discounted future savings, uncertainty associated over newer technological developments making choice obsolete, lack of awareness, and access to capital and inability to assess lifetime benefits and costs. Slow adoption could mean a disproportionate rise in air pollution. Fleet operators would also provide the necessary scale effect, resolving the classic question of what should come first - EV or the charging infrastructure. This would also maximise a Make in India opportunity missed in the case of promotion of solar energy.



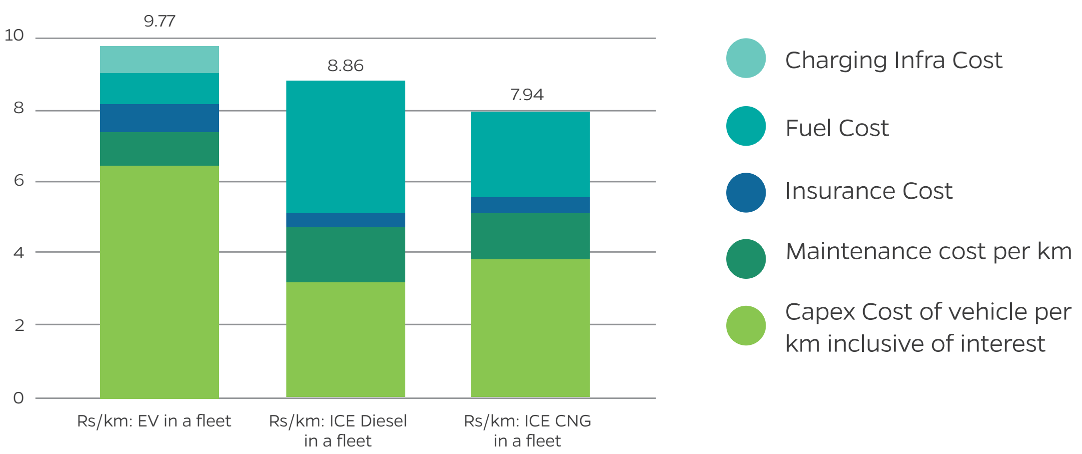
*Electricity Tariff w.e.f. 1 st September 2018 and Implementation thereof. Maharashtra State Electricity Distribution Co. Ltd. https://www.mahadiscom.in/consumer/wp-content/uploads/2018/10/Comm_Cir_311.pdf

## SCENARIO 3:

### TCO comparison: When the delivered cost of electricity at INR 5/unit is augmented with reduced land lease rental for charging infra, and zero registration and permit charges.

The previous scenario reveals that even at the special EV tariff implemented by the state government, the TCO for an Electric 4W in a fleet continues to remain high when compared to ICE counterparts. Further as seen above, the high land lease rental makes it the largest component accounting for over 31% of overall opex of charging infrastructure. On the positive side, a few state governments have waived off registration tax, road tax and permit charges for improving the economics of EVs.

Fig 9: TCO comparison: When the delivered cost of electricity at INR 5/unit is augmented with reduced land lease rental for charging infra, and zero registration and permit charges




Overall, the scenario building exercise for four-wheelers (4W) reveals that the incentives modeled above, along with the delivered cost of electricity at INR 5 per kWh, could reduce the TCO for Electric 4W in a fleet by INR 1.77 / km.

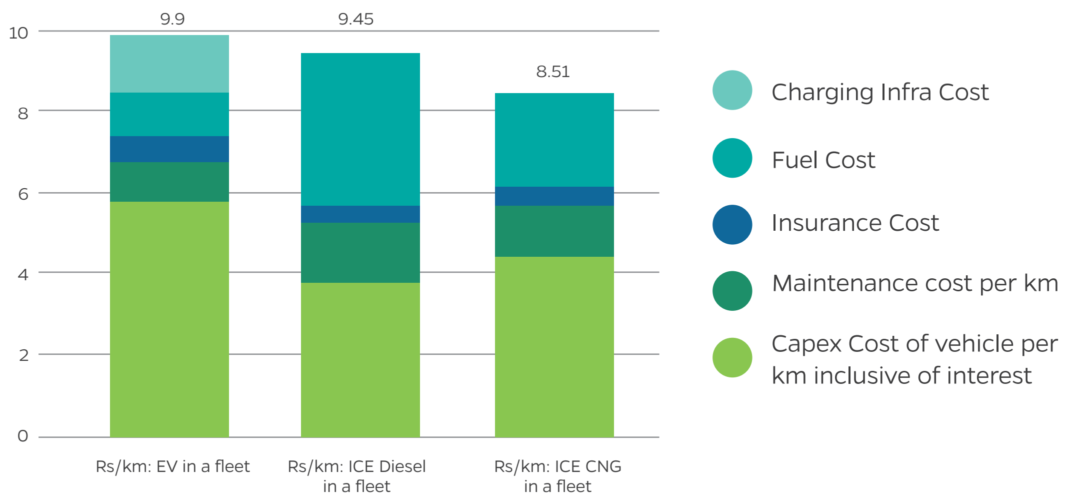
# TIPPING POINT FOR ELECTRIC 4-WHEELERS: LEARNING FROM THE SCENARIOS

Having captured massive learnings from the Nagpur pilot, this section aims at utilising the on-ground learnings to project the tipping point, where EVs achieve parity with ICE vehicles. The tipping point has been estimated a few times in the recent past using assumptions on parameters such as battery pack prices, crude prices, technological developments etc. With BS VI norms (MoRTH, 2016) going into effect from April 2020, it is expected that prices of ICE vehicles would rise. The analysis shows that battery costs will come down due to better technology and manufacturing processes. Battery pack prices are expected to drop from around \$203/kWh in 2017 to \$110/kWh in 2025 and further to \$86/kWh (Adapted from Mosqouet. X et. al. 2018).

With battery costs expected to come down and the cost for meeting CO2 compliance on ICE vehicles going up, the question arises - are we approaching TCO parity? To arrive at TCO values, the following assumptions have been considered:

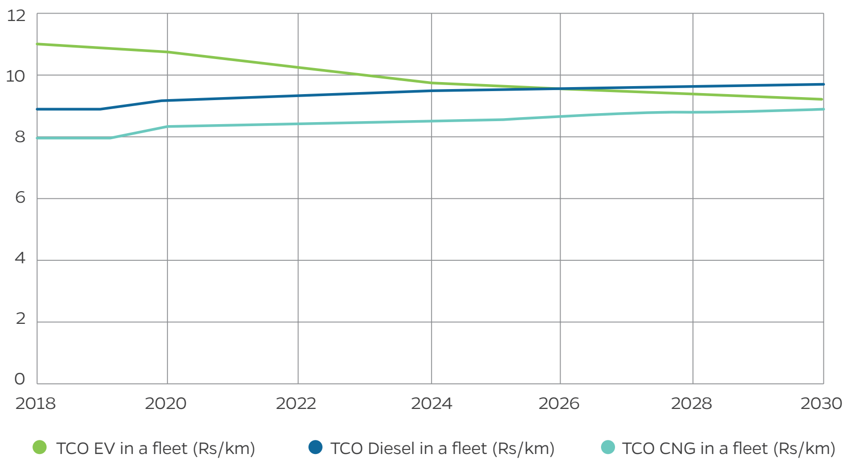
( i ) Battery prices expected to decrease by 40% in 2025 and by 55% in 2030 from current levels;
(ii) The delivered cost of electricity remains at INR 5 per kWh;
(iii) Prices of ICE vehicles increase from April 2020 with BS VI coming into effect;
(iv) Minimum incentives to the level of FAME I continues (DHI, 2015).

Fig 10: TCO Parity: 2026 Tipping Point for Electric 4-wheelers

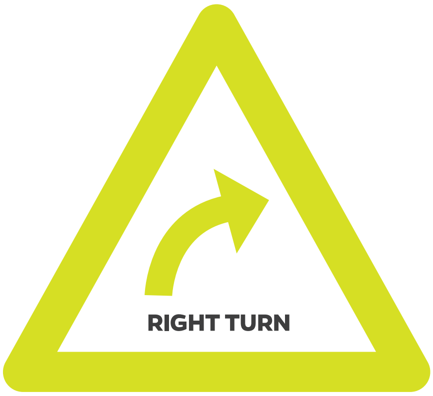



TCO analysis to determine the Tipping Point reveals that in 2026, the total cost of owning an EV (in terms of INR/km) over its lifetime will be lower than that for a conventional combustion engine car in small and medium car segment, which constitutes majority of car sales in the country.

Fig 11: TCO Parity: 2026 Tipping Point




**Having seen that TCO parity for four-wheelers is not occurring before 2026, fleet electrification may be considered. Additionally, the ecosystem may prioritise vehicle segments for electrification by identifying modes where TCO differential with ICE counterparts is minimal.**




# VEHICLE SEGMENT PRIORITISATION

From the TCO analysis for 4W, it is evident that India is in a unique position - the country cannot aspire to kick start its electric mobility journey with e-cars. The country should explore if TCO viability can be achieved in other vehicular segments such as 2W and 3W. The next couple of figures show at the delivered cost of electricity of INR 5 per kWh, the TCO is most attractive for 3W and 2W, compared to 4W. This is primarily because TCO differential is minimal in the case of electric 2w and electric 3w. This would also make fleet operators less dependent on the government for subsidising the upfront cost of the EV and battery.

While the benefits to a fleet operator are clear, electrification of 2W and 3W is beneficial to the country as well. Currently, over 80% of vehicles plying on Indian roads are two-wheelers and three-wheelers, contributing to 35% of pollution (NITI Aayog and World Energy Council, 2018). Therefore, any attempt at electrification of the country's fleet must address these segments on priority. Further, the highest proportions of passenger km traveled are by public and shared mobility vehicles (buses, bike taxis, auto-rickshaws, taxi-cabs, private and public sector employee transportation, etc.). Their electrification will generate a disproportionate reduction in air pollution.

In short, India should prioritise its vehicle segments for electrification to achieve e-mobility success. Vehicle segment prioritisation based on TCO calculation for all segments is presented in the sections below. On the basis of such an analysis, it is recommended that 2w and 3w be converted to electric fleets first.

## FOR FLEETS OF ELECTRIC THREE-WHEELERS AND TWO-WHEELERS*

Fig 12: TCO Comparison for 3-wheelers

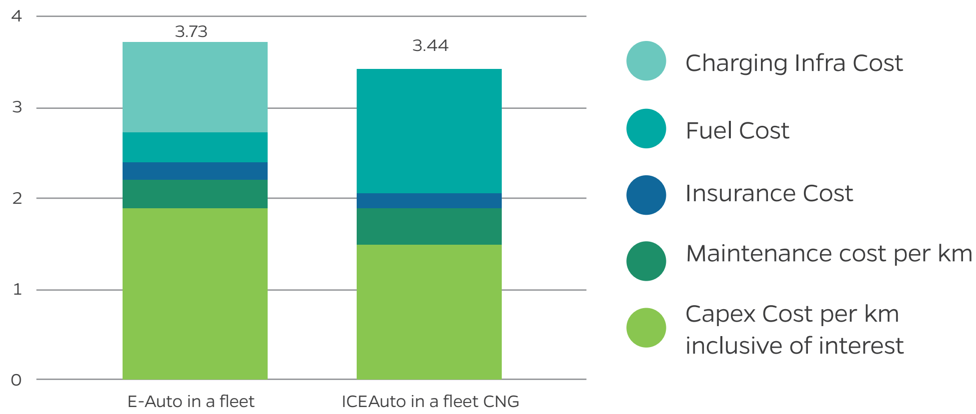
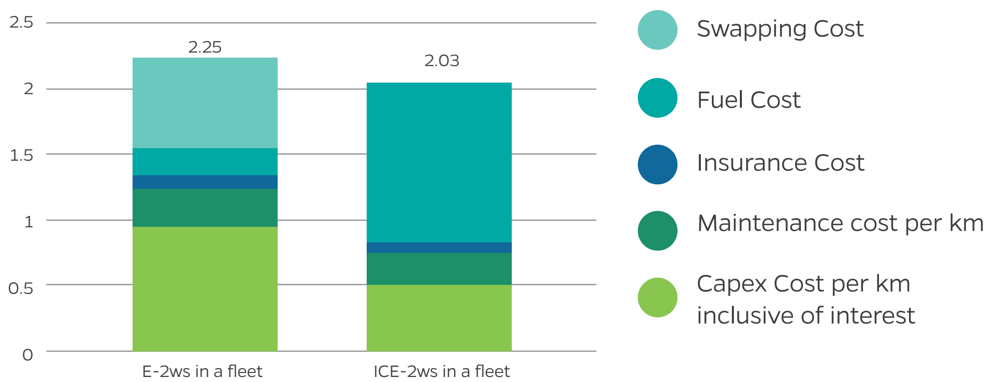



Fig 13: TCO Comparison for 2-wheelers




## ADOPTION SEQUENCE

The above TCO modeling has been carried out using ideal factors, i.e. conditions most favourable to achieve TCO parity: a) FAME I incentives, which were relatively higher for 2Ws and 3Ws compared to the recently announced FAME II structure, have been incorporated for the calculation; b) an ideal electricity tariff at INR 5/kWh as the delivered cost of electricity has been factored in. Only at such ideal conditions, TCO differential between an EV and its ICE counterpart is minimal for 2W and 3W, as can be seen above. This indicates that for mass adoption of EVs, substantive impetus needs to be offered by central and state governments to address the viability gap between EV and ICE, including offering delivered cost of electricity at INR 5/kWh making the opex attractive and thereby encouraging usage. Overall, the modelling exercise concludes that the TCO differential is the least for 2W followed by 3W, and 4W. Accordingly, it is recommended that India adopt the following sequence for electrification of its fleet.

### Sequence of adoption of EVs

*While modeling the TCO scenarios for 3Ws and 2w, the authors have assumed the following.
1.Fuel price: Electricity at INR 5 per kWh; CNG price at INR 41/kg; Petrol price at INR 75 per litre.
2. The modeling incorporates incentive structure of FAME I.
3. The modeling does not take into account the impact of BS VI norms due for effective implementation from April 1, 2020.

# RECOMMENDATIONS FOR TOMORROW

As part of its Nationally Determined Contributions (NDCs) to the Paris Agreement, India has pledged to improve the emissions intensity of its GDP by 33 to 35 percent below the 2005 levels by 2030. In India, the transport sector contributes close to 10% of the total national GHG emissions, with road transport contributing about 87% (MoEFCC, 2015). Electrifying the road transport sector has the highest energy savings potential of around 40% in 2030, which is largely driven by ambitious adoption of electric vehicles and a shift from private to shared modes (CSTEP, 2018). Hence, only a leapfrog opportunity through EVs will bring India closer to its mission. The following strategies, initiatives and programmes would translate EV dialogue into action, accelerating the adoption of electric vehicles in India and taking India closer to its 2030 EV targets.

# AT A GLANCE

| Suggested Schemes | Suggested Initiatives |
|---|---|
| A. For Augmenting Early Adoption of Electric Mobility<br>B. To make E-Mobility Operations financially Viable and Sustainable<br>C. To Setup and Strengthen Charging Infrastructure<br>D. To Promote Sustainable Manufacturing of EVs<br>E. Schemes For Higher Education, Research, Capacity Building, and Re-skilling | F. Promoting use of Shared Mobility Services like app-based e-bikes/e-autos/e-rickshaws/e-cabs<br>G. Decentralised Feebate policy and ZEV mandate<br>H. Non-fiscal incentives |

# SUGGESTED SCHEMES

## A. FOR AUGMENTING EARLY ADOPTION OF ELECTRIC MOBILITY

### A.1 Incentives should be on USAGE rather than purchase of EVs:

To unlock the existing economic benefits of EVs, the policy should specifically encourage high utilisation rates of EVs. This will help owners realise advantages of TCO, while maximising electric km traveled in aggregate.

A study by NITI Aayog, RMI, and ORF (2018) estimates that shared vehicles could reduce annual mobility demand by nearly 1,800 billion vehicle km in 2035, by improving asset utilisation with high adoption of ride-sharing and public transit. To embrace shared mobility and discourage vehicle ownership, financial incentives should be provided on usage and not the purchase of vehicles.
Since one of the primary goals for introducing EVs is to fight vehicular pollution and improve air quality, the focus should be on increasing usage of EVs.

Reduced vehicular emissions due to the use of EVs would depend upon (i) the distance or journeys completed through EVs and (ii) source or fuel used for electricity generation.
Any financial incentive should be designed to encourage usage of EVs rather than vehicle purchase.

*In public policy, a sunset provision or clause is a measure within a statute, regulation or other law that provides that the law shall cease to have effect after a specific date, unless further legislative action is taken to extend the law..

## A.2 Incentives should be targeted towards BATTERIES:

Fiscal incentives should be designed to specifically subsidise the one cost that makes EVs expensive: batteries. The cost of EV batteries constitutes almost half the overall costs – posing a great challenge to the adoption and acceleration of e-mobility in India. Incentivisation of batteries necessitates the acceptance of the larger paradigm of treating the battery and vehicle as separate entities. When batteries and vehicles are treated separately, a battery swapping system can operate seamlessly.

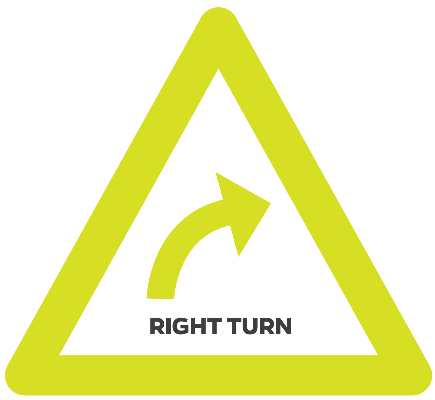
The Nagpur pilot has provided proof of battery swapping acting as a reliable charging mechanism. Battery swapping is doable, efficient, and in the case of Nagpur, successful. Battery swapping helps in mitigating long waiting time of drivers at charging stations, for commercial and private users alike. It further increases the running time of an electric vehicle, and improves the earnings of drivers. It is imperative that the government recognises the value of battery swapping especially in the shared mobility context of India, and designs ways of promoting the technology across the country.

Ergo, incentives should be targeted towards batteries to promote faster adoption of EVs in India. Most other components are already produced at scale in India's thriving automotive sector, with the exception of advanced batteries. A potential subsidy per kWh should be provided along with quality criteria that encourage advanced technologies, such as batteries with a higher number of certified recharge cycles compared to others. Although FAME II provides an incentive of INR 10,000 per kWh on vehicles fitted with lithium-ion batteries, the incentive here needs to be extended to batteries without the vehicles for reasons discussed above (PIB, 2019). This subsidy can progressively phase out, i.e. have a sunset clause, as the viability gap of batteries closes with reducing costs over the next few years.

By offering financial incentives for manufacturing of batteries as against the entire EV, the manufacturing of batteries too would get accelerated; technology and innovation would flourish; economies of scale would be achieved; and batteries would be both domestically produced and affordable. This tipping point is crucial to make e-mobility dream a reality in the country, and to avoid replacing imports of fuels with imports of batteries.

Further, batteries made in India - transferring technologies to India - may be considered for higher subsidies over batteries imported from outside. This would allow the entire ecosystem to embrace the Make in India opportunity concurrent with market development (India missed this opportunity in the case of solar energy push in the country - an industry which continues to rely heavily on imports). Towards this, the Central Government has recently tightened the localisation criteria for availing benefits under FAME II. OEMs now need to ensure minimum localisation content of 40% on ex-factory price of the vehicle in case of buses and 50% for all other categories of vehicles (electric two-wheelers, electric three-wheelers, electric four-wheelers, and e-rickshaws). To encourage component makers to localise, electric powertrains will attract an import duty of 15% in a year's time. Import duty of batteries will be raised to 15% in two years from the current 5% (Mukherjee and Chaliawala, 2019).

**Fiscal incentives should be designed to specifically subsidise the one cost that makes EVs expensive: batteries. Reducing the cost of the battery through subsidies initially makes the capex of an EV comparable to ICE vehicles. This type of battery subsidy should sunset as the viability gap of batteries closes with reducing costs over time. Overall, providing a subsidy on the battery and electricity can address the viability gap vs ICE counterparts.**

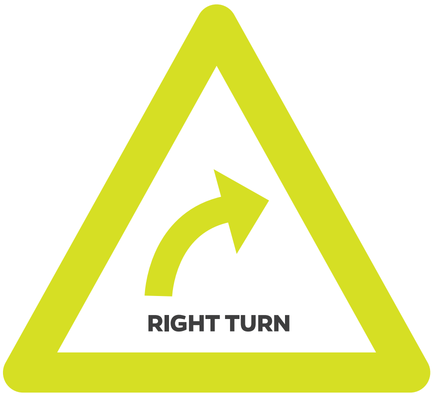


## A.3 Incentives on scrappage of ICE fleet needs to be linked with EV adoption:

For easier and timely transition to e-mobility, scrappage*[1] incentives should be offered on End-of-Life ICE vehicles (ELVs), with a condition that such an incentive is redeemable only at the purchase of EVs. Such an approach serves the dual purpose of managing current fleet of ELVs besides accelerating EV penetration. It is estimated that as many as 21 million vehicles would reach end-of-life by 2025. Over 3.2 million tonnes of steel scrap, 0.3 million tonnes of aluminium scrap, 0.05 million tonnes of copper and 0.075 million tonnes each of plastic and rubber could be recovered from the current fleet of end-of-life vehicles (Arora.N et.al 2017).

Given that fleet operators are (i) major buyers of vehicles and (ii) their fleet would be reaching End of Life (EOL) earlier compared to others, on account of higher utilisation rates, extending such incentive to fleet operators ensures a more aggressive transition to e-mobility.

**Low operational cost implies that fleet providers would be the ideal candidates for accelerating EV penetration. They put in more km on their vehicle each year compared to personal vehicle, which solves the deadlock of high upfront costs by providing a shorter payback time period. The benefits of electrifying fleets and shared mobility are more effective than encouraging electric personal mobility. Fleet operators would provide the necessary scale and ability to manage with limited infrastructure: resolving the classic question of what should come first - EV or the charging infrastructure.**




## A.4 Retrofitment across vehicular segments:

Given the high upfront costs of EVs, state governments should promote retrofitment*[2] for timely transition to e-mobility. Towards this, the central government has recently amended Central Motor Vehicle Rules for retrofitment of motor vehicles with Hybrid or Pure electric systems (MoRTH, 2019). Retrofitment is relatively simpler. For instance, an existing 3W post retrofitment is cheaper to run and maintain, but the high cost of conversion inhibits auto drivers in adopting these systems en-masse, although the investment could be recovered in a short span of time. The Central Government should subsidise retrofitment with electric drive trains as part of FAME 2; this would yield benefits for the millions of drivers who rely on autos for their sustenance.

## A.5 Corporate ownership of three wheelers:

The cost of ownership of electric three-wheelers is closest to their conventional counterparts but the initial investment is high. This implies that this segment of vehicles would lead the transition towards electrifying the fleet. However, drivers put a high discount rate on future returns. They are only concerned with high upfront costs, with no understanding of the TCO concept. To encourage the push towards fleet electrification, the state governments should allow for commercial ownership of 3W fleets.

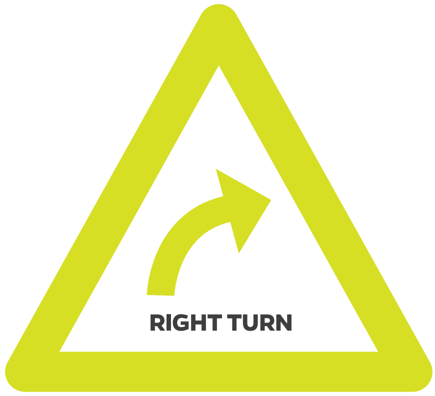
*[1] A scrappage program is a government budget programme to promote the replacement of old vehicles with modern vehicles. These programmes generally have the dual aim of stimulating the automobile industry and removing inefficient, more polluting vehicles from the road.

*[2] Addition of new technology to an existing model of vehicle. For example, as three-wheelers in Delhi transitioned from petrol / diesel to CNG powered-engines, they were retrofitted with a CNG kit. Similarly, as threewheelers transition to e-mobility, the ICE 3Ws may be retrofitted with EV kits allowing for time- and cost-efficient transition to e-mobility.

### A.6 Reduced and consistent GST on EVs, Batteries, and Charging-Swapping Station Services:

The current costs of EVs are almost twice compared to their conventional ICE versions. Taxes and registration charges further elevate on-road prices of vehicles by approximately 10-15%.

**The GST on EVs, batteries, chargers, and related components should all belong to the same GST slab as that of the EVs. Reducing GST rates on EVs and batteries from 12% and 18% respectively to 5% and relaxation of road tax would provide the necessary boost in the short term. Further, GST waiver on charging and swapping services would offer the much-needed fillip to the electric mobility ecosystem of the country without creating a burden on the exchequer.**




### A.7 Exemption from Permits:

Commercial EVs for city transportation should be exempted from all the necessary permits otherwise needed to run commercial vehicles, including taxis, auto-rickshaws, and 2W used for commerce in the country. This has proven to be a strong barrier to EV deployment, given the lack of awareness in regulatory bodies. Commercial vehicles would therefore be incentivised to go electric, and have a tendency to run disproportionately more km than personal vehicles.

### A.8 Bridging the Gap with a Predefined Sunset Clause:

The Government should provide subsidies and concessions until a critical threshold limit for fleet electrification is achieved.

## B. TO MAKE E-MOBILITY OPERATIONS FINANCIALLY VIABLE AND SUSTAINABLE

### B.1 Cost of Electricity including wheeling charges to be reasonable:

**Delivered Cost of Electricity at INR 5/unit, for a period aligned with viability of business models:** To have viable vehicle economics from Total Cost of Ownership (TCO) perspective, electricity rates have to be at INR 5/unit for next 4-5 years. This will make large-scale deployment of EVs financially viable. This rate can rise as costs of batteries and EV components drop.

**Time of Day, Net Metering, and Battery-to-Grid:** Electricity rates are the single most important factor in the economics of operating an EV. Time of Day (ToD) charges and timings, energy banking, load balancing, should be considered while extracting value from available batteries to reduced pressure on electricity price alone.

Time of day (TOD)*[1] tariff structures that give cheap electricity rates during off-peak periods (eg. late at night) and higher rates for using electricity during high-demand times would help in peak load shaving*[2]. Because most EVs are parked at home overnight, TOD rates appeal to the EV drivers.

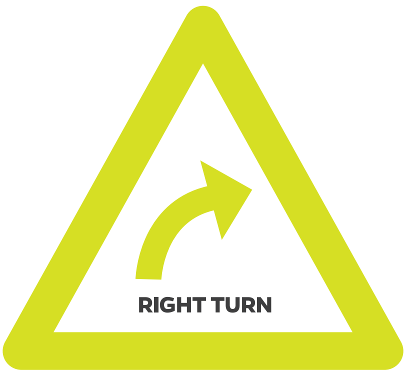
**Allow the Aggregation of Open Access to Electricity, and greater Integration of Renewable Energy:**

a) The State Electricity Regulatory Commission should allow aggregation of open access electricity wherein buyers (such as shared mobility providers) have access to the transmission and distribution (T&D) network to obtain electricity from suppliers other than the local distribution company (discom).

b) The State Electricity Regulatory Commission should offer an exemption to maintain contracted demand. Today, there is a requisite to maintain a minimum threshold of 1 megawatt of power on standby to contract open access electricity. This requirement of a minimum threshold on contract demand especially for EV charging should be removed.

c) Further, the government rightly encourages the adoption of renewable energy sources to power electric vehicles. To strengthen this, the State Electricity Regulatory Commission in collaboration with local discoms may also create necessary infrastructure in the form of net metering and banking facilities, among others, to measure the energy derived from renewable sources. Experience from the country's first multimodal electric mobility project shows that solar net metering reduced electricity bill by 28% and contributed to improved economic viability.d) For fleet operators, it is recommended that transmission and distribution costs of electricity flowing from a central node to multiple centres across the country should be kept low.

e) In short, wheeling charges, as well as other charges and surcharges for accessing electricity, must be reasonable.




**Continuous Supply of Required Electricity Load at Demand Locations**

**The right location for charging and swapping stations is important for a better experience for driver-partners, optimisation of daily runs, and battery performance. These are also required to be deployed at prominent demand locations (metro stations, malls, office complexes) which are easily accessible. Hence, ease of installation and availability of continuous electricity supply at these locations for the desired load is vital for smooth operations.**

## B.2 Ensuring optimum utilisation of charging infrastructure:

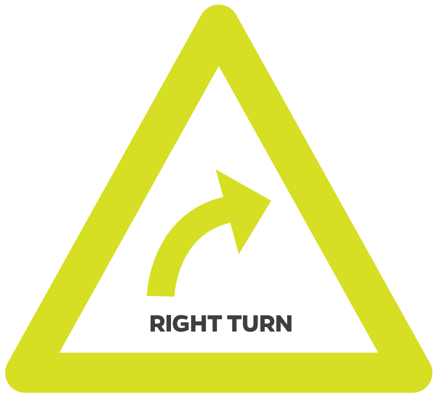
To ensure optimum utilisation apart from ride-hailing platforms, corporate adoption must be incentivised along with a mandate for government agencies and local civic bodies to convert their fleet to electric.

# C. TO SETUP AND STRENGTHEN CHARGING INFRASTRUCTURE

With land lease rentals forming a major portion of the opex of charging / swapping stations, it is recommended that viability gap support in the form of land at low rentals with a predetermined initial lock-in period be provided. As the market matures and stabilises, market rent could be levied. This viability support in the form of reduced lease rental may be provided for setting up charging and swapping stations at strategic locations in areas of high demand zones within cities. By minimising the dry run for drivers of EV fleets, this proposition would solve the dual problems of range anxiety and low utilization of charging and swapping stations.

*[1]Time of Day (or TOD) tariff is a tariff structure in which different rates are applicable for use of electricity at different time of the day. It means that cost of using 1 unit of electricity will be different in mornings, noon, evenings and nights.
*[2] Peak shaving is the process of reducing the amount of energy purchased from the utility company during peak demand hours.

**Concessional locations for swapping stations should be made available by the State Govts to Battery Swapping Operators (BSOs) in every district along with bare minimum lease rentals. These Concessional locations should be carved out from existing public parking zones, bus depots and terminals, metro stations and other identified locations such that they offer easy entry and exit. Further reimbursement of 100% of net SGST, accrued to the State, should be provided to BSOs for purchase of Advanced Batteries to be used at swapping stations.**




## D. TO PROMOTE SUSTAINABLE MANUFACTURING OF EVS

The Central Government has recently approved a Phased Manufacturing Programme (PMP), valid for five years till 2024 to localise production with a focus on upstream part of the EV value chain. The Union cabinet approved the setting up of a National Mission on Transformative Mobility and Battery Storage (PIB, 2019). Further, state governments should incentivise setting up of recycling-businesses to focus on 'urban mining' of rare materials within the battery for feeding it back to the value chain. Sustainable management of end-of-life EV batteries is crucial to avoid pollution from toxic waste and secure a strong supply of raw materials at low environmental cost.

Once batteries have reached 60-70% of its rated capacity and not fit for automotive uses, policy should incentivise its reuse as power banks for storing solar energy. Further, batteries need to be designed for easier repair and repurposing with the objective of prolonging its in-use life. The design needs to be receptive to use secondary resources and enable greater recovery when recycled at its end-of-life (Bhattacharjya. S et.al 2018).

## E. SCHEMES FOR HIGHER EDUCATION, RESEARCH, CAPACITY BUILDING, AND RE-SKILLING

Many new jobs would be created due to increasing EV adoption, with some jobs requiring re-skilling and some requiring newer skill set. There is a need to set-up Centre of Excellence (CoEs) to train in EV mechanics and charging station staff. Vocational courses should be developed in association with OEMs, EOs and BSOs. Here the Govt should focus on apprenticeship programmes in collaboration with players across the value chain. Apprenticeship would make the manufacturing and service base of the country even more robust that it is today. For such apprenticeship programmes to be successful, incentives coupled with regulations are needed.

Additionally, the Government may consider establishing centres of innovation and excellence for various components of EVs and Autonomous vehicles industry including battery technologies, drivetrain technologies, software development, and charging technologies. The curriculum of IITs and other colleges and universities should be customized to incorporate and adhere to the industry requirements. For instance, some of the EU member states have been using policy instruments/schemes to facilitate newer developments across the value chain of the EV sector. These include support for developing new vehicle concepts and technologies for reducing energy consumption and pollution from road transport, project for increasing the energy and performance density of lithium-ion batteries, research in newer battery chemistries, support for developing advance cells and design technology for electric vehicle batteries with the aim to reduce battery costs and improve its use-life, and for developing advanced energy storage technologies and to enhance value through secondary use of EV batteries. It is commendable that the Indian Government will provide a policy framework as part of the recently launched National Mission on Transformative Mobility and Battery Storage, to promote effective use of applied research and analysis to support innovation.

# SUGGESTED INITIATIVES

## F. PROMOTING THE USE OF SHARED MOBILITY SERVICES SUCH AS APP-BASED E-BIKES/E-AUTO/E-RICKSHAW/E-CAB

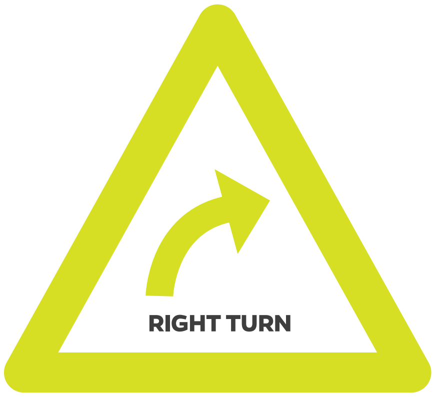
**User incentive scheme:** For all above rides taken through an app-based EV aggregator, the state should offer 'cash back' rebates for short first and last mile connectivity trips. Such a rebate can make rides on EVs at least 10-20% cheaper than an equivalent ride in an ICE vehicle.

## G. DECENTRALISED FEEBATE POLICY AND ZEV MANDATE

States should resort to the 'feebate' concept i.e. adopting measures by which inefficient or polluting vehicles incur a surcharge while efficient ones receive a rebate to provide for the viability gap funding needed to accelerate EV adoption. For instance, the Delhi Government in its draft EV policy (2018) proposes to create a State fund by levying instruments such as Pollution Cess Air Quality Parking Surcharge, additional Road Tax, Congestion Fee and ECC to support EV targets.

### Playing out the Decentralised Feebate Policy

**One of the prime reasons for the delays in the announcement of fiscal and non-fiscal incentives to accelerate EV adoption by both the central and state governments is because of its burden on the exchequer. Towards this, a state level fee-bate policy along with other fiscal and non-fiscal incentives would provide the right framework for accelerating EV adoption in the state. For instance, about 35 lakh vehicles are sold annually in Maharashtra. A feebate policy that imposes a tax of mere INR 1,000 on conventional ICE vehicles can yield INR 350 crores. This can then be used to cross-subsidise EVs.**




Further, to fastrack feebate, it could be coupled with a zero-emission vehicle (ZEV) mandate. The ZEV mandate requires automakers to sell a government-stipulated number of electric vehicles. The exact number of vehicles is linked to the automaker's overall sales within a specified geography.

ZEV regulation aims at increasing the share of EVs sold annually, something which has worked in US markets. EV sales grew faster, as the availability of new EV models increased. The ZEV regulation and rebates have expanded the market, for instance, the auto industry has over-complied with the ZEV regulation requirements, with several times more ZEV credits than required. As of mid-2017 leading companies such as BMW, General Motors, and Volvo have already transitioned their fleets to greater EV shares (9 to 11%) than what is required for the fleet to meet California's 2025 regulation (8%) (Lutsey.N, 2018).

Therefore, the government may consider a combination of two mechanisms to promote faster adoption of EVs in the country. One is a funding mechanism that looks at feebate-style fiscal instruments that levy penalties on inefficient or polluting vehicles, and creates sufficient funds for subsidising EV adoption. This also acts as a disincentive scheme discouraging the use of polluting vehicles. The other mechanism is a regulation imposed by the government on automobile manufacturers mandating the substantial production and sale of electric vehicles. While the Feebate mechanism may be considered as a demand-side impetus, the ZEV mandate / regulation may be treated as a mechanism providing supply-side impetus.

# H. NON-FISCAL INCENTIVES

Some of the most valuable incentives that the Govt. can provide are non-fiscal and should be considered at par with any fiscal considerations. A range of non-fiscal incentives could be offered that provide a boost to revenue streams thereby minimising the need for subsidising the cost.

### (i) Fast track approval and Single window clearance:

For effective and timely implementation of state's EV policy a dedicated EV cell should be established. It is further submitted that state governments should consider the following recommendations for faster implementation of EV projects in the state.

**Fast Track Approval -**

- Standard guidelines and single-window clearance for approvals from Municipal departments, City Planning Offices and other Statutory bodies for the construction and operation of Charging Stations and Swapping Stations. This needs to be augmented with fast track approvals for sanctioning of electricity load, design and building plan, fire and safety approval. Currently, this process takes around 90-120 days, which should be done within 7-14 days for faster operationalisation and mass adoption of EVs.
- Priority approvals from ARAI / ICAT for certification of EVs

**Single Window Clearance for Registration and Vehicle Transfer process /issuance of permits, and from Electricity Department -**

- There should be a defined checklist of documents to be uploaded online with self-declaration along with timeline of 48 hrs to execute the transfer and registration of cars, for issuance of permits and fitness certificate etc. While this would speed up the process of registering or transfer of vehicles, it would also curb irregularities at the RTOs' end. A dedicated EV cell shall be established within the Transport Department for effective day-to-day implementation of State EV Policy.
- Similarly, such a single window clearance system is required for approvals from the electricity department as well.

### (ii) Dedicated zones:

Zones should be defined where only EVs will operate, or will provide preferred access to EV. For instance, Airports / Train Stations / Tech Parks / Hotels / Markets could be zones where price sensitivity is lower. Waiver of parking charges and priority pickup zones could be created near Metro stations, markets and other high demand areas. We have seen from our experience that such zones can increase vehicle earnings by over 10%, thereby reducing the need to subsidise costs.

### (iii) Preferential Parking and Charging:

City wide parking locations should be retrofitted to maximise EV access to charging. Further, there should be free parking for EVs at coveted public and commercial spaces.

### (iv) Faster Homologation process for EVs:

Homologation process includes performance-oriented test requirements as well as administrative procedures. The administrative procedures address the type-approval of vehicle systems, parts and equipment, the conformity of production to prove manufacturer ability to produce a series of products exactly matching type-approval specifications. Further for EVs regulation also defines safety requirements with respect to the Rechargeable Energy Storage System (REESS), of road vehicles equipped with one or more traction motors operated by electric power and not permanently connected to the grid. The whole process takes around 3-4 weeks which if reduced to 7 days could help operationalise projects relatively faster.

# NON-FISCAL INCENTIVES FOR ADOPTION OF EVs ACROSS COUNTRIES

## DENMARK

- Reduced or exemption from parking fee.
- Free use of toll roads for EVs.

## GERMANY

- Preferential parking.

## NORWAY

- EVs have free access to public areas.
- Free parking in public places since 1990s.
- EVs can use the toll roads for free; EVs are permitted in bus and taxi lanes (since 2003).
- Free use of charging infrastructure. EV users can use the public charging infrastructure for free.

## SWEDEN

- Reduced Parking fee: In about 50 % of the 70 cities in Sweden where you have to pay to park.
- Exemption from Toll Tax: EVs bought before 1 January 2009 were exempted from paying toll tax in Stockholm until 2012.
- No congestion charge on EVs: A congestion charging scheme was implemented on a permanent basis in August 2007 in central Stockholm. A fee is charged during times of traffic congestion. However, plug-in hybrids and pure electric vehicles were exempted.

## UNITED KINGDOM

- Zero or reduced parking charges: Some local authorities in London provide exemptions or a reduced parking charge for electric cars.
- Zero Congestion charge: EVs are exempted from congestion charge with drivers saving up to £2,000 per annum in London.

## UNITED STATES

- High Occupancy Vehicle (HOV) Lane exemption: More than 10 American states have allowed EVs to use HOV lanes, including California, Colorado, Florida, and New York. A special sticker must be obtained from the Department of Transportation displaying an HOV lane exemption decal.
- Alternative fuel vehicle emission test exemption.
- Alternative fuel vehicle conversion tax credit.
- Zero Parking fee: Hawaii provides free parking for EVs at public places.
- Discount on toll roads: EV drivers in New Jersey enjoy a 10 percent discount on off-peak New Jersey Turnpike and toll road rates.

## CHINA

- EVs are not restricted by traffic control measures (policies to limit the number of cars on the road during a prescribed period).
- EVs are allowed to use bus lanes.
- Free parking for EVs.
- EV drivers in some Chinese provinces and cities can get their license plates without paying the typical fees and faster than conventional vehicle drivers. For example, Shanghai has waived EV drivers' license plate fee, which is about RMB 100 thousand ($15,900).



Source: Adapted from Steen. M et.al, 2015, Lu. J (2018), TERI (2018) and the US Department of Energy

# CONCLUSION

India has kicked off its EV journey with confident strokes. Lessons from Nagpur pilot come at an opportune time when the central and state governments alike are mulling over their EV policies. The pilot has offered in-depth learning in understanding the operating issues. Unlocking the 2030 agenda calls for the right kind of business models to help in introducing sustainable mobility solutions at scale.

Just like any other technological innovation, EVs are going through their technological adoption lifecycle and diffusion will take time. Ola's Nagpur initiative reflects the efforts to remain ahead of the curve and lead the e-mobility transition in the country. To accelerate these initiatives, there is a need to incentivise clean kilometres traveled. It is critical that EVs incorporate value propositions that are significantly better than existing choices. It also fits with consumers' perceptions about the projected cost of switching such as TCO viability.

A collaborative approach from players across the value chain can help achieve the EV dream faster. For instance, OEMs need to adopt mobility-as-a-service ethos and the need to redesign their components that meets the operating needs of fleet operators. Similarly charging infrastructure providers need to partner with smart city planners, fleet providers to plan, finance and implement the right infrastructure which minimises operating complexity. Support from the government in terms of allowing corporate ownership of vehicles, ease of permit license, dedicated points for pick-up and drop for shared mobility and viability gap funding for land needed to set up the required infrastructure, can further accelerate EV penetration for shared-use mobility programs. This, in turn, will amplify environmental benefits besides yielding significant monetary savings. The shift to electric vehicles could potentially help India save up to $300 Bn (INR 20 Lakh Cr) in oil imports and nearly 1 gigatonne of carbon dioxide emissions by 2030 (FICCI and RMI, 2017).

It is often said that tomorrow lies in the hands of today. EVs can finally be a stepping stone towards designing an intelligent, futuristic transport infrastructure in India that is capable of catering to the mobility needs of the country's huge population.

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