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Updated analysis of incentives for electrifying India's four-wheeler ride-hailing fleet

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Introduction

During the last few years, the ride-hailing segment has grown faster than other transport modes across many metropolitan areas and cities in India.[1] The Indian ride-hailing market is estimated to have a compound annual growth rate of 19% and is forecasted to reach net sales of INR 3,806 billion (€46.8 billion, $52.5 billion) by 2024.[2] Although the COVID-19 pandemic has temporarily shrunk ride-hailing demand,[3] its future prospect in India in the mid and long term are unlikely to be significantly affected.

An earlier ICCT study (hereafter, "the 2019 ICCT study") about the electrification of India's ride-hailing fleet examined the total cost of ownership (TCO) for drivers.[4] The TCO includes the vehicle purchase cost and the costs of operation. The 2019 ICCT study showed that in 2019, battery electric vehicles (BEVs) were not yet cost competitive with comparable gasoline, diesel, or compressed natural gas (CNG) vehicles, considering an ownership period of 5 years. The main reasons were insufficient financial incentives for BEVs, the higher upfront price of BEVs, and the high opportunity cost of fast charging. This study updates the earlier study, as some state governments have announced new electric vehicle policies and several more electric vehicle models were launched in the Indian market in 2020.

Here we analyze the changes in terms of incentive policies and TCO since 2019. We first analyze the impacts of financial incentives under current policies in a *baseline scenario* for selected BEV, gasoline, diesel, and CNG car models. Following that, we analyze a *hypothetical additional policy scenario* where we introduce additional policies and observe the deviation from the baseline scenario. For the baseline scenario, we compare

1 Ride-hailing in India is similar to that in Europe wherein a car needs to be specifically registered for commercial passenger transport purposes to be eligible for ride-hailing use. A personal car cannot be used for ride-hailing in India.

2 WBCSD, "Advancing electrification in ride-hailing in India: A BluSmart case study," (2020), https://www.wbcsd.org/wubkz. Note that the currency conversion values are taken from google search made on March 17, 2021. The conversion values are US$ 1 equals INR 72.49 and EUR 1 equals INR 86.63.

3 "ETAuto Exclusive: Ride-sharing not gaining momentum like auto sales in the 'Covid-Era'," (2020), ETAuto, https://auto.economictimes.indiatimes.com/news/aftermarket/ride-sharing-not-gaining-momentum-like-auto-sales-in-the-covid-era/76763746

4 Shikha Rokadiya et al., *Near-term incentives for electrifying ride-hailing vehicles in India*, ICCT Working Paper 2019-21, (ICCT: Washington, DC, 2019). https://theicct.org/sites/default/files/publications/India%20Ridehailing%20Working%20Paper-21.FINAL__1.pdf

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2020 results with those of 2019 and consider the implications on the effectiveness of hypothetical additional policies in later years. Based on the results of this analysis, we provide recommendations on how the Central Government of India and state governments could further steer ride-hailing drivers toward electric cars.

Policy background

Environmental and economic goals have pushed Indian states and the Government of India to pursue electric vehicle policy at various levels, including for ride-hailing fleets. The Government of India introduced the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles, an incentive program referred to as the FAME India Scheme. The first phase was launched in April 2015 and ran through March 2019, when it was extended until 2022 as FAME India Scheme: Phase II (FAME II). Among its aims is to generate market penetration of 55,000 electric four-wheeler passenger cars. This scheme is meant to be implemented through various pathways, including purchase incentives for electric vehicles, incentives for electric vehicle parts manufacturers, the establishment of a network of public charging stations, and the administration of the scheme through numerous information, education, and communications activities.[5]

At the state level, the National Capital Territory (NCT) of Delhi seeks to drive the electric vehicle market with measures across vehicle segments and with ride-hailing as one of the main areas of focus.[6] The state of Telangana envisions establishing itself as the benchmark state for electric vehicle adoption across personal, shared, and commercial vehicle segments while also creating enabling infrastructure and a local manufacturing base for electric vehicles and related components.[7] The state of Karnataka similarly intends to promote a conducive ecosystem for manufacturing in collaboration with industries and to be the preferred destination for electric mobility; there is a focus on achieving 100% electric mobility in segments like intermediate public transport (i.e., demand-based and bus-like services), cab aggregators, corporate fleets, and school vans.[8]

The states of Delhi, Karnataka, and Telangana all have high penetration of electric cars compared to other Indian states. The shares of these states of the total number of four-wheeler electric vehicle sales in the country based on all electric passenger car sales under the national FAME II scheme as of October 2020 stood at 39% (Delhi), 28% (Karnataka), and 9% (Telangana).[9] Hence, in this paper, we examine the electric vehicle policies in these states and their capital cities: Delhi (NCT of Delhi), Hyderabad (state of Telangana), and Bangalore (state of Karnataka). This is illustrated in Figure 1.

5 Department of Heavy Industry, "Policy Document," (2020), https://fame2.heavyindustry.gov.in/content/english/11_1_PolicyDocument.aspx

6 Transport Department, Government of Delhi, "Delhi Electric Vehicles Policy 2020," (2020), https://transport.delhi.gov.in/sites/default/files/All-PDF/Delhi_Electric_Vehicles_Policy_2020.pdf

7 Government of Telangana, "Telangana Electric Vehicle and Storage Policy 2020–2030," (2020), https://invest.telangana.gov.in/wp-content/uploads/2020/10/TS-EV-ESS-Policy.pdf

8 Commerce and Industries Department, Government of Karnataka, "Karnataka Electric Vehicle and Energy Storage Policy–2017," (2020), https://kum.karnataka.gov.in/KUM/PDFS/KEVESPPolicyInsidepagesfinal.pdf

9 Department of Heavy Industry, Government of India, "Total No. of Vehicles Sold," (2020), https://fame2.heavyindustry.gov.in/

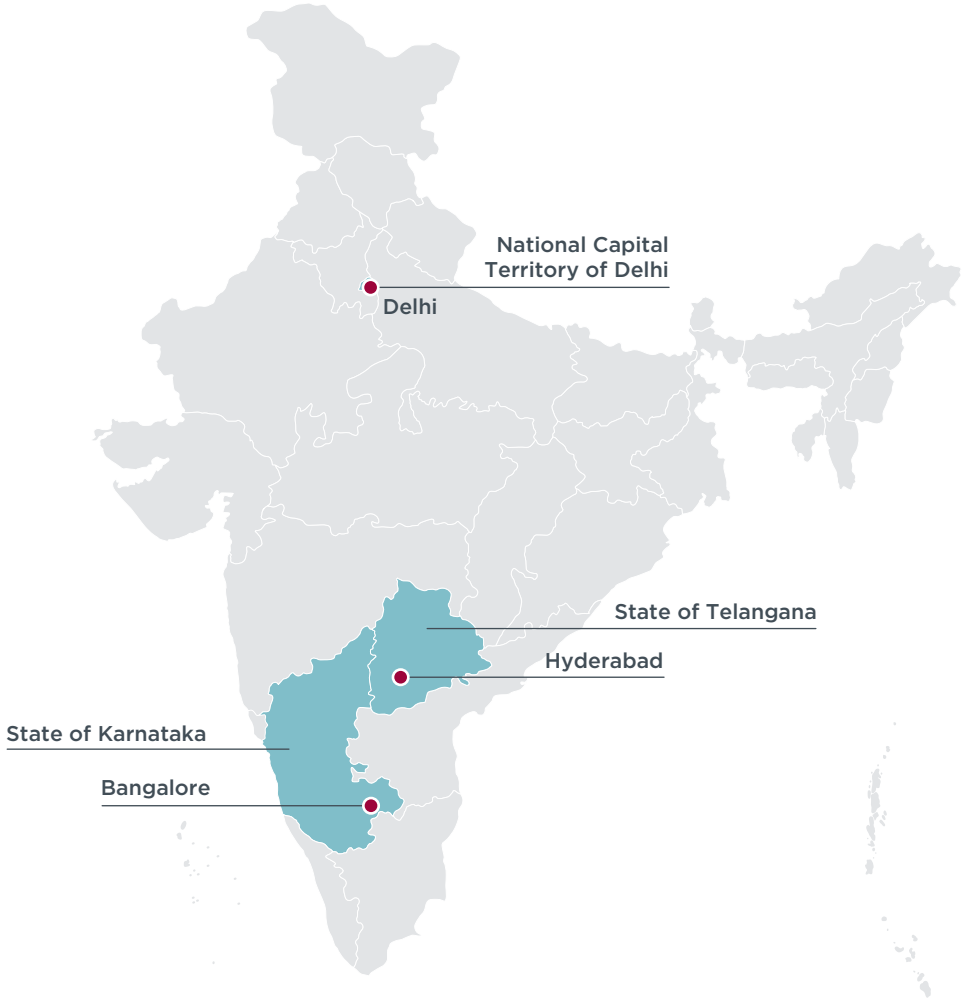

Figure 1. States and relevant capital cities selected for the analysis.

Delhi's Electric Vehicle Policy and Telangana's Electric Vehicle and Energy Storage Policy were approved in 2020, and for Bangalore, the policy was approved in 2017 and is valid until 2023 or until a new policy is approved. The NCT of Delhi seeks to have BEVs be 25% of all new vehicle registrations, including ride-hailing cars, by 2024. This push is supported by an upfront purchase incentive of INR 10,000 (€115, $138) per kilowatt hour (kWh) of battery capacity, eligible for the first 1,000 registered BEVs. Telangana aims to incentivize ride-hailing services for the first 5,000 four-wheeler commercial passenger vehicles registered through a 100% exemption from the road tax and registration fee, and is also incentivizing charging infrastructure. Although there are no near-term state targets in Karnataka, the state Electric Vehicle Policy seeks to convert all ride-hailing fleets to electric vehicles by 2030.

Additionally, to help make charging infrastructure more affordable across all vehicle segments, Delhi's Electric Vehicle Policy mandates a favorable electricity tariff for all public and captive charging stations[10] put to commercial use from 2020 until 2023. The state of Telangana plans to facilitate the setup of an initial batch of fast charging stations in Hyderabad and other towns, provide a special power tariff category for electric vehicle charging stations, and supply renewable energy for charging stations, including solar rooftop plants. Karnataka's policy proposes to provide renewable energy to charging stations with a low connection cost and a 25% capital subsidy on the

10 Captive charging stations are charging stations exclusively for electric vehicles owned or under the control of the owner of the charging station.

equipment; the limit is INR 10 lakh (€11,500, $13,800) per station for the first 100 fast charging stations in the state.

Cost analysis overview

Figure 2 gives an overview of the methodology followed in the research. First, we analyze the vehicle ownership cost under the baseline policy scenario for the selected electric vehicle models against the selected conventional vehicles (gasoline, diesel, and CNG) for the three cities in 2020. We then compared the vehicle ownership costs in 2020 with those from 2019 under their respective baseline policies in step two. To allow for a direct comparison, we re-evaluated the assumptions related to fueling cost in the 2019 study and considered two changes; based on those, we recalculated the TCO and cost per km values for the vehicle models. The first change is increasing the certified energy consumption per kilometer of use values by 25%. This adjustment is necessary to reflect the real world fuel efficiency of cars in India.[11] The other change is using of 6-month average fuel price for diesel, gasoline, and CNG fuels instead of using a day's price. Subsequently, in step three, we analyzed the implications of additional policies on vehicle ownership cost per kilometer (km) for the vehicle models under the hypothetical scenario for 2020.

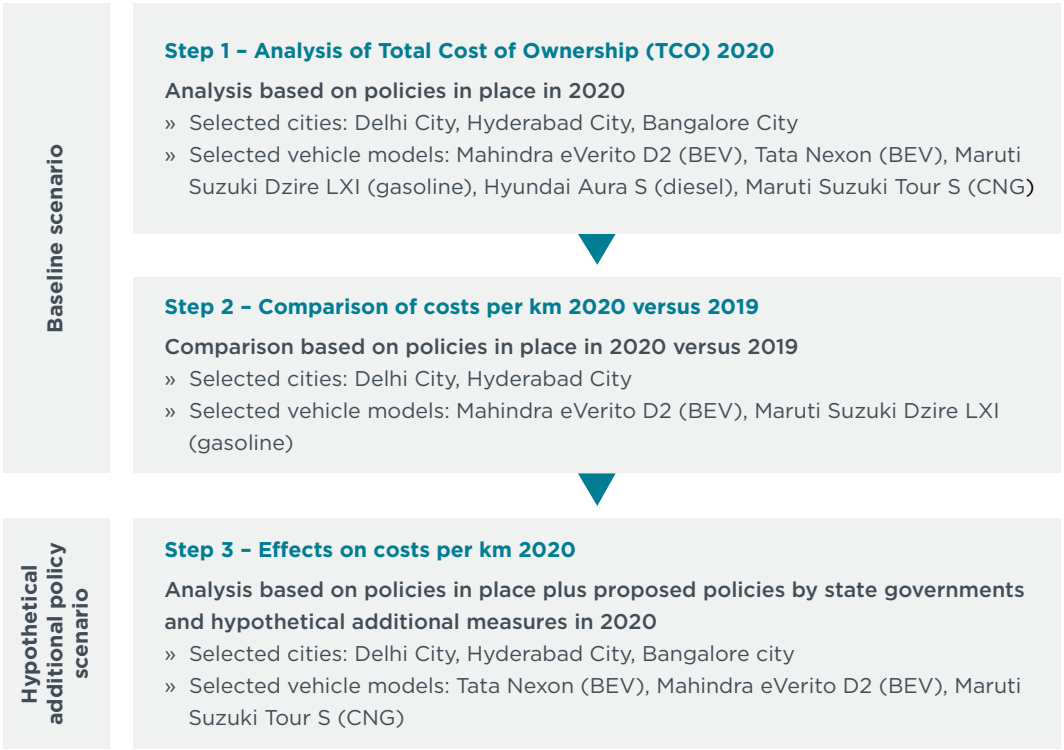

Figure 2. Cost analysis approach.

Cost analysis for ride-hailing fleet vehicles – Baseline scenario

Delhi, Hyderabad, and Bangalore are metropolitan in nature and are among the top cities for ride-hailing markets in India.[12] All three local governments are actively involved in and have pursued electric vehicle policies to support the electrification of transport fleets. All three states—Delhi, Telangana, and Karnataka—have special tariff pricing schemes to

11 "What Is Fuel Economy Or Car Mileage Or Bike Average?," CarBikeTech.com, July 27, 2020, https://carbiketech.com/fuel-economy-car-mileage-bike-average/

12 "Delhi-NCR Tops List of Indian Cities for Most Uber Rides: Report", News18, last modified January 3, 2020, https://www.news18.com/news/auto/delhi-ncr-tops-list-of-indian-cities-for-most-uber-rides-report-2443995.html

promote electric vehicle adoption. In India, the electricity costs and hence energy prices differ by state and are mandated by state electricity authorities that periodically review and decide electricity pricing.

For BEVs, we chose the Tata Nexon and Mahindra eVerito D2 and compared the costs with the gasoline Maruti Suzuki Tour Dzire LXI, the diesel Hyundai Aura S, and the CNG-powered Maruti Suzuki Tour S. The vehicles selected are used or have the potential to be used in fleet operations with comparable costs and performance criteria. The selected vehicle models and their key specifications, all obtained from manufacturer websites,[13] are detailed in Table 1. Carbon dioxide (CO_2) emission values for conventional vehicles are obtained from the Society of Indian Automobile Manufacturers (SIAM) website.[14] The BEV energy consumption values from manufacturers were obtained from the Department of Heavy Industry of the Indian Government, and the fuel consumption figures for conventional vehicles were obtained from manufacturer's websites. The fuel consumption test values are certified by the Automotive Research Association of India. These certified values are further adjusted by increasing energy consumption by 25% to reflect real-world performance.

Table 1. Selected vehicle models for analysis.

Manufacturer	Model	Fuel type	Ex-show-room price with tax (INR)	Peak power (kW)	Tailpipe CO_2 emission (g/km)	Length (mm)	Battery capacity (kWh)	Certified fuel consumption (per 100 km)	Adjusted fuel consumption (per 100 km)
Mahindra	eVerito D2	BEV	912,515	31	0	4,247	21.2	14.6 kWh	18.3 kWh
Tata	Nexon	BEV	1,399,000	95	0	3,993	30.2	10.6 kWh	13.3 kWh
Maruti Suzuki	Dzire LXI	Gasoline	445,000	66	111.8	3,995	N/A	4.3 liters	5.4 liters
Hyundai	Aura S	Diesel	773,800	55	104.5	3,995	N/A	3.9 liters	4.9 liters
Maruti Suzuki	Tour S	CNG	599,000	61	103.0	3,995	N/A	3.7 kg	4.7 kg

To compare the costs for the selected vehicle models, we analyzed the impact of vehicle purchase and financing costs, national and state taxes and fees, vehicle insurance cost, fueling costs, vehicle maintenance cost, the opportunity cost of fueling, and incentives for BEVs available from the national government of India and, if available, from the respective state or local governments. For the TCO analysis, we also made some standard assumptions primarily based on the 2019 ICCT study. Tables with the key variables, input data, and assumptions are summarized in the appendix.

We assumed that the vehicles are purchased and owned by the ride-hailing drivers and are subject to an amortization period of 5 years. We based our calculations on vehicle procurement in 2021 and ownership through 2025, and applied a discount rate of 5% to obtain the present value of 5-year costs, in line with previous studies.[15] For the reference BEVs, test-consumption values are not disclosed by the manufacturer. Instead, we estimated the consumption based on efficiency projections for battery technologies in 2020, also based on earlier studies.[16] We estimated a daily 12 hours of logged-in time, of which 67% is spent on trips that earn revenue. Furthermore, we considered an average

13 "Maruti Suzuki Dzire LXI Fuel Consumption," Maruti Suzuki, (2020), https://www.marutisuzuki.com/dzire; "Hyundai Aura S Performance," Hyundai, (2020), https://www.hyundai.com/in/en/find-a-car/aura/performance; "Maruti Suzuki Tour S Fuel Consumption," Maruti Suzuki, (2020), http://www.marutisuzukicommercial.com/tour/tour-s.aspx#mileage; "Specs & Features," Tata Nexon, (2020), https://nexonev.tatamotors.com/features/; "eVerito features & specifications," Mahindra Electric, (2020), https://www.mahindraelectric.com/vehicles/everito/

14 SIAM, "SIAM BS VI Fuel Efficiency (FE) Data as on 1st April 2020 – Passenger Vehicles," (2020), http://www.siam.in/uploads/filemanager/2154W-FE-Data-Ason1stApril2020upload.pdf

15 Nikita Pavlenko, Peter Slowik, and Nic Lutsey, *When does electrifying shared mobility make economic sense?*, ICCT Working Paper 2019-01, (ICCT: Washington DC, 2019). https://theicct.org/sites/default/files/publications/Electric_shared_mobility_20190114.pdf

16 Peter Slowik, and Nic Lutsey, *Evolution of incentives to sustain the transition to a global electric vehicle fleet*. (ICCT: Washington DC, 2016). https://theicct.org/sites/default/files/publications/EV%20Evolving%20Incentives_white-paper_ICCT_nov2016.pdf

daily travel distance of 200 km traveled for 317 working days a year, from the 2019 ICCT study and corroborated by other sources.[17] It is estimated that BEV drivers will meet their daily charging needs through one overnight charge and an average of 0.27 and 1.11 fast-charging cycles per day for the BEV Tata Nexon and BEV Mahindra eVerito D2, respectively, on public chargers.

Vehicle purchase costs are based on ex-showroom prices. Interest rates for conventional cars are estimated at 9.5% and that rate is estimated to be 0.2% lower for the BEVs, based on India's green loans for electric vehicles.[18] Electric vehicles are exempted from the car loan processing fee of 0.5% of the financed amount for the first 6 months of its launch, and are thereafter subjected to the same processing fee as conventional vehicles.[19] Further, the vehicle price assumptions for 2020 also account for the latest prices of conventional vehicles, notably diesel-powered vehicles that are compliant with the Bharat Stage VI emission standards in effect from April 2020 onward. *Vehicle finance costs* are estimated based on a 5-year loan with 15% down payment.

Taxes and fees considered include the national one-time goods and service tax (GST), the compensation cess, and the tax collected at source (TCS) for vehicles costing more than INR 10 lakh (€11,500, $13,800); these are added to the vehicle's base price. BEVs benefit from lower rates by 23 percentage points on the GST compared to conventional cars and are exempt from the compensation cess, which is 1% of the vehicle's base price for gasoline and CNG vehicles and 3% for diesel cars.[20] There are no preferential rates or exemptions from the TCS, which is 0.75% for all vehicle types. BEVs are also exempt from the INR 1,000 (€12, $14) registration fee under current policy. Proposed increases in registration and renewal fees for commercial conventional vehicle taxis from INR 1,000 to INR 10,000 (€11.5 to €115, $13.8 to $138) and from INR 1,000 to INR 20,000 (€11.5 to €230, $13.8 to $276), respectively, have not yet been adopted.[21] State taxes and fees analyzed include regularly payable road tax, permit fees, parking charges, and per-trip congestion fees. All three states exempt a certain number of BEVs from the road tax.

For car *insurance premiums* we assume that all vehicles are covered by a mandatory third-party damage policy, a mandatory personal-accident policy, and an own-damage cover policy for every driver. For the third-party damage coverage, we assume the premiums specified under the latest order by the Insurance Regulatory and Development Authority (IRDAI) in 2020 for fiscal year (FY) 2020–21.[22] The order defines discounted rates for private electric cars but not for electric cars in commercial use. In the absence of a tariff for commercial four-wheeled BEVs, assumptions for the BEVs Mahindra eVerito D2 and the Tata Nexon are based on the conventional vehicle equivalent and for vehicles between 1,000 cm^3 and 1,500 cm^3. The personal accident policy coverage for an owner-driver of a conventional vehicle is also mandated by IRDAI and we use the current premium rate of INR 750 (€9, $10) per year for all

17 Shailesh Menon, "For Uber, Ola drivers, big dreams come to a screeching halt," *The Economic Times*, November 27, 2016, https://economictimes.indiatimes.com/small-biz/startups/for-uber-ola-drivers-big-dreams-come-to-a-screeching-halt/articleshow/55465119.cms?from=mdr; Duckju Kang, "Driving for Ola or Uber in India: How Much Do You Need to Work to be Profitable?" Valuechampion, September 27, 2019, https://www.valuechampion.in/credit-cards/driving-ola-or-uber-india-how-much-do-you-need-work-be-profitable; SIAM, *Adopting pure electric vehicles : Key policy enablers*, (SIAM: New Delhi, India, 2017), https://www.siam.in/uploads/filemanager/114SIAMWhitePaperonElectricVehicles.pdf

18 "SBI Green Car Loan," State Bank of India (2020), https://www.sbi.co.in/web/personal-banking/loans/auto-loans/green-car-loan

19 Prashant Singh, "SBI Launches India's First Green Car Loan," Zeebiz, February 2, 2020, https://www.zeebiz.com/personal-finance/news-sbi-auto-loan-india-s-first-green-car-loan-lower-interest-rate-longest-term-processing-fee-waived-check-details-119152

20 "GST on Cars in India," Paisabazaar, April 19, 2020, https://www.paisabazaar.com/tax/gst-on-cars/#Compensation_Cess_in_GST_Act

21 Subham Parashar, "Motor vehicles in India to get more expensive as government proposes hike in registration charges," Carandbike, July 27, 2019, https://www.carandbike.com/news/motor-vehicles-in-india-to-get-more-expensive-as-government-proposes-hike-in-registration-charges-2076226

22 "Premium Rates for Motor Third Party Liability Insurance Cover," IRDAI, March 27, 2020, https://www.irdai.gov.in/ADMINCMS/cms/frmGeneral_Layout.aspx?page=PageNo4077&flag=1

vehicles. The own-damage cover value varies across different insurance providers. We use the lowest cost option among the commercial car own-damage cover rates listed on the insurance comparison website Coverfox.[23]

Fueling costs differ between electric and conventional cars. The fueling cost for conventional cars is based on gasoline, diesel, and CNG average rates prevalent over 6 months from October 2020 to March 2021.[24] In estimating the energy cost associated with electric vehicle charging, we drew upon the residential and public charging electricity rates and on assumptions based on the electricity tariff orders approved by Delhi,[25] Telangana,[26] and Karnataka[27] for FY 2020–21. Residential electricity rates considered correspond to the 400 kWh to 800 kWh consumption bracket. To estimate the cost of public fast charging for electric vehicles, we used the power tariffs offered by power suppliers to charging service providers in respective cities. For this, we assume the latest preferential tariffs specified by Delhi for FY 2018–19 and Telangana for FY 2018–19 for supply to charging stations will prevail in 2021, and by Karnataka for FY 2020–21 with special tariff rates included for high tension (HT) and low tension (LT) electric charging stations. We further add INR 3 (€0.03, $0.04) per kWh to the preferential tariffs as an estimate of the retail rate paid by vehicle drivers.[28]

Maintenance costs for BEVs are less than that for conventional vehicles. These per-kilometer costs are estimated from the routine service costs of the vehicle over 5 years, based on the annual distance traveled. Maintenance costs are estimated at INR 0.35 per km for the BEV Tata Nexon and INR 0.13 per km for the BEV Mahindra eVerito D2; these costs are estimated at INR 0.46 per km for gasoline vehicles, INR 0.44 per km for diesel vehicles, and INR 0.29 per km for CNG vehicles. The routine service costs of conventional vehicles for a period of 5 years were obtained from websites like Mycarhelpline[29] and Zigwheels.[30] The maintenance cost for the BEV Mahindra eVerito D2 and BEV Tata Nexon were obtained from a service center based in Bangalore and corroborated with values published on the websites Bookyourcar and The Quint.[31]

The opportunity cost of fueling is an important cost factor because revenue is not earned during the time spent recharging or refueling. The costs are based on the refueling/recharging time, the driver's daily wage, and the daily vehicle utilization. Refueling time to full capacity for conventional vehicles is estimated at 5 minutes for gasoline and diesel vehicles and 30 minutes for the CNG model; this is from the mileage values and fuel-tank capacities from the 2019 ICCT study and verified by other sources.[32]

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23 Coverfox, "Own-Damage Premium for Commercial Cars," (2020), https://www.coverfox.com/commercial-car-insurance/?flow=fb&hp=1&hp=1

24 "Petrol price in India," Mypetrolprice, (n.d.), https://www.mypetrolprice.com/petrol-price-in-india.aspx?stateId=; "Diesel price in India," Mypetrolprice, (n.d.), https://www.mypetrolprice.com/diesel-price-in-india.aspx?stateId=; "CNG price in India," Mypetrolprice, (n.d.), https://www.mypetrolprice.com/cng-price-in-india.aspx

25 Delhi Electricity Regulatory Commission, "Delhi Power Tariff rate," (n.d.), http://www.derc.gov.in/tarriff-orders

26 Telangana state electricity regulatory commission, "Telangana Power Tariff rate," (n.d.), http://www.tserc.gov.in/currentyearorders.php

27 Karnataka Electricity Regulatory Commission, "Determination of tariff for FY-21," (n.d.), https://karunadu.karnataka.gov.in/kerc/Tariff%20Order%202020/Tariff%20Filing/BESCOM/Chapter-7_Determination-of-tariff.pdf

28 Reji Kumar Pillai et al., "Electric Vehicle Charging Stations Business Models for India." (India Smart Grid Forum: New Delhi, India, 2018). https://indiasmartgrid.org/reports/ISGF%20White%20Paper%20-%20EVSE%20Business%20Models%20for%20India.pdf

29 "Maruti Swift, Dzire Service Cost Detailed with PMS Schedule and Spare Part Prices," Mycarhelpline, April 30, 2020, https://www.mycarhelpline.com/index.php?option=com_easyblog&view=entry&id=515&Itemid=91

30 "Maruti Dzire Service Cost," Zigwheels, (n.d.), https://www.zigwheels.com/newcars/Maruti-Suzuki/dzire/service-cost

31 "Tata Nexon EV Service Cost," Bookyourcar, (n.d.), https://www.bookyourcar.co.in/tata/nexon-ev/service-cost; "Mahindra eVerito EV Service cost", The Quint, (n.d.), https://www.thequint.com/tech-and-auto/car-and-bike/electric-car-cost-comparison-with-petrol-diesel#read-more

32 Sanjay Dutta, "Why queues at CNG stations in Delhi are long and unending," November 13, 2017, *The Times of India*, https://timesofindia.indiatimes.com/city/delhi/why-queues-at-cng-stations-in-delhi-are-long-and-unending/articleshow/61620273.cms

For BEVs, recharging time estimates are based on the number of recharging events per day, which is different for the two models. We also take into account seasonal variations and assume that both fast-charging cycle time and electricity consumed to reach full charge increase by an average factor of 1.5 during the three summer months (April, May, June). For example, the full fast-charge cycle time for the BEV Tata Nexon and BEV Mahinda eVerito D2 is 60 minutes and 90 minutes, respectively, during non-summer months but 90 minutes and 135 minutes, respectively, in the summer months. For the daily wage, we assume the selected BEV, gasoline, and diesel models, as sedans, are earning a higher fare of INR 10 (€0.12, $0.14) per km, and the CNG model, as a compact car, is earning INR 8 (€0.09, $0.11) per km.[33] As previously stated, vehicle utilization rates are based on 200 km driven per day, of which 67% is spent on trips, and a 12-hour workday. We considered an opportunity cost of INR 112 (€1.3, $1.5) per hour for sedan drivers and INR 89 (€1.0, $1.2) per hour for compact car drivers, as per the 2019 ICCT study and corroborated by other sources.[34]

The Government of India offers *purchase incentives* under FAME II. For purchasers of commercial battery operated four-wheelers, there is a one-time purchase incentive of INR 10,000 (€115, $138) per kWh of battery capacity with an upper limit of 20% of the base price of the vehicle. Apart from the central incentive, the Delhi government offers an additional upfront purchase incentive of INR 10,000 per kWh with a maximum limit of INR 1.5 lakh (€1,700, $2,100). There are no similar additional incentives in place in the states of Telangana and Karnataka.

Baseline scenario analysis in 2020

Using all of the assumptions regarding costs of vehicle purchase and ownership, and all of the available incentives, we evaluated the TCO for the chosen vehicles over a 5-year use period to create a baseline scenario. The results, normalized to the distance traveled over 5 years, are presented by city. The colors in Figure 3, Figure 4, and Figure 5 represent the various costs, as indicated, and the arrows reflect the cost reduction as a result of the incentives available from the central FAME II and the state schemes.

Figure 3 shows the 5-year TCO for our selected ride-hailing vehicles driven in Delhi City. Overall, both BEV models are reasonably cost-competitive with comparable gasoline and diesel models. Other than the CNG model, the BEV Mahindra eVerito D2 is the least costly option over 5 years..

33 The classifications of sedan and compact in our study are based on how cab aggregators in India categorize the models and do not reflect any official classification by the auto industry in India.

34 "Average Taxi Driver Salary in India", Payscale, (n.d.), https://www.payscale.com/research/IN/Job=Taxi_Driver/Salary; Nafisa Khatoon et al., "A Case study on Ola and Uber from the driver partners' perspective," (Tata Institute of Social Sciences: Hyderabad, India, n.d.). https://tiss.edu/uploads/files/Cab_Aggregator_Services.pdf

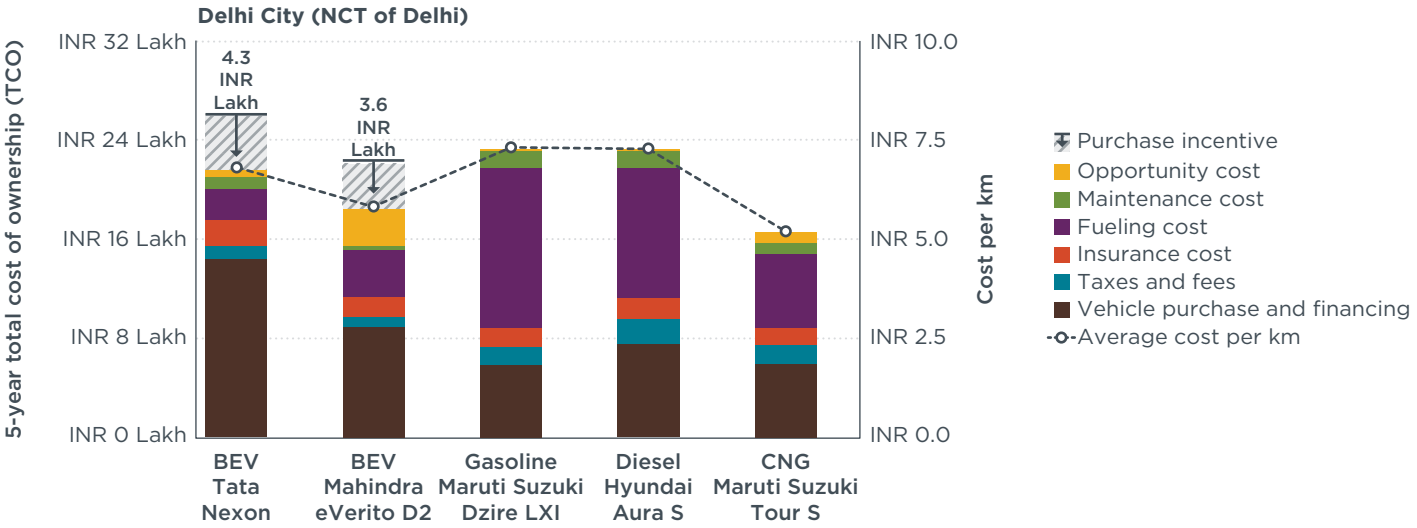


Figure 3. Comparison of 5-year TCO for selected vehicles for full-time ride-hailing drivers in Delhi City (NCT of Delhi).

The gasoline Maruti Suzuki Dzire LXI has the highest 5-year TCO if used for ride-hailing in Delhi and adds up to INR 23.2 lakh (€26,800, $32,000) or INR 7.3 per km. It is closely followed by the diesel Hyundai Aura S at INR 23.1 lakh (€26,700, $31,900) and cost per km of INR 7.3. The BEV Tata Nexon has the third highest 5-year TCO of INR 21.6 lakh (€24,900, $29,800), or per km cost of INR 6.8. The comparative lower ownership cost of the Tata Nexon results from Delhi state and the central FAME II incentives assumed, which add up to INR 4.3 lakh (€5,000, $6,000).[35] The BEV Mahindra eVerito D2 generates the second lowest 5-year TCO of INR 18.5 lakh (€21,400, $25,500), including an upfront incentive of INR 3.6 lakh (€4,200, $5,000) and per-kilometer costs of INR 5.8. The CNG Maruti Suzuki Tour S is the vehicle that has by far the lowest TCO, INR 16.5 lakh (€19,100, $22,800) or INR 5.2 per km.

Yet, the upfront purchase and financing costs for the BEV models are higher compared to the three conventional cars. Despite the state and central government incentives, the purchase and financing costs add up to INR 14.5 lakh (€16,700, $20,000) for the BEV Tata Nexon and INR 8.9 lakh (€10,300, $12,300) for the BEV Mahindra eVerito D2. For the other three models, these costs range between about INR 5.8 lakh (€6,700, $8,000) and INR 7.6 lakh (€8,700, $10,400). The differential between the BEV with the lowest cost, the BEV Mahindra eVerito D2, and the highest priced conventional car, the diesel Hyundai Aura S, is still INR 1.3 lakh (€1,500, $1,800).

In Hyderabad city, the BEV Tata Nexon and diesel Hyundai Aura S generate the highest 5-year TCO in ride-hailing operations as shown in Figure 4. The CNG model is the most cost attractive option, followed by BEV Mahindra eVerito D2 and the gasoline car.

35 While the Delhi Government recently excluded the Nexon BEV from eligibility for subsidies, the Delhi High Court subsequently stayed the order and incentives are still valid. "HC stays Delhi govt's order suspending subsidy on Tata Nexon EV," *Hindustan Times*, March 11, 2021, https://auto.hindustantimes.com/auto/news/hc-stays-delhi-govt-s-order-suspending-subsidy-on-tata-nexon-ev-41615430687427.html

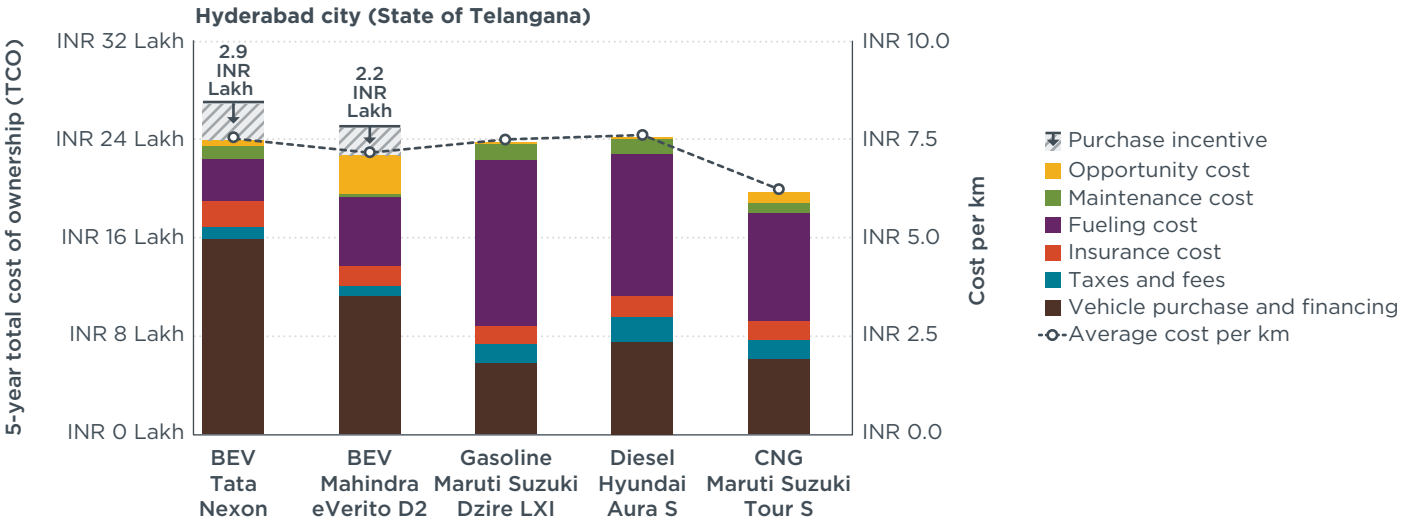


Figure 4. Comparison of 5-year TCO for selected vehicles for full-time ride-hailing drivers in Hyderabad City (state of Telangana).

The 5-year TCO for the BEV Tata Nexon adds up to INR 24 lakh (€27,600, $33,000), including a one-time incentive on car purchase, and corresponds to a TCO per km of INR 7.6. Among conventional cars, the diesel Hyundai Aura S has a TCO of INR 24.1 lakh (€27,800, $33,200) over 5 years and an INR 7.6 cost per km. It is also more expensive than the gasoline Maruti Suzuki Dzire LXI, which has an INR 23.7 lakh (€27,300, $32,700) TCO over 5 years and a cost of INR 7.5 per km. Mahindra's eVerito D2 costs notably less than the gasoline and diesel cars and more than CNG car, bearing a TCO of INR 22.7 lakh (€26,200, $31,300) and a per-km cost of INR 7.2. The CNG Maruti Suzuki Tour S is the least expensive, with an INR 19.7 lakh (€22,700, $27,200) 5-year TCO and a cost of INR 6.2 per km. Despite the FAME II incentive, the upfront purchase and finance costs of the BEV Tata Nexon are INR 15.9 lakh (€18,300, $21,900) and for the BEV Mahindra eVerito D2, it is INR 11.3 lakh (€13,000, $15,500); this contrasts with just INR 7.6 lakh (€8,700, $10,400) for the diesel model, INR 6.1 lakh (€7,100, $8,400) for the CNG vehicle, and INR 5.8 lakh (€6,700, $8,000) for the gasoline model.

In the absence of state purchase incentives, the central government's FAME II incentive and state road tax waiver of INR 2.9 lakh (€3,200, $3,900) for the BEV Tata Nexon cannot balance out the higher purchase cost despite its lower fueling cost compared to the gasoline, diesel, and CNG models. Similarly, even with central government's FAME II incentive and state road tax waiver amounting to INR 2.2 lakh (€2,400, $2,900), the BEV Mahindra eVerito D2 cannot balance out the higher purchase and opportunity costs over a 5-year operation period, despite lower fueling costs compared to the gasoline, diesel, and CNG models.

In the city of Bangalore, the BEV Tata Nexon is the costliest vehicle. Similar to the cities of Delhi and Hyderabad, the CNG model is the most attractive based on 5-year TCO and also in terms of cost per kilometer (Figure 5).

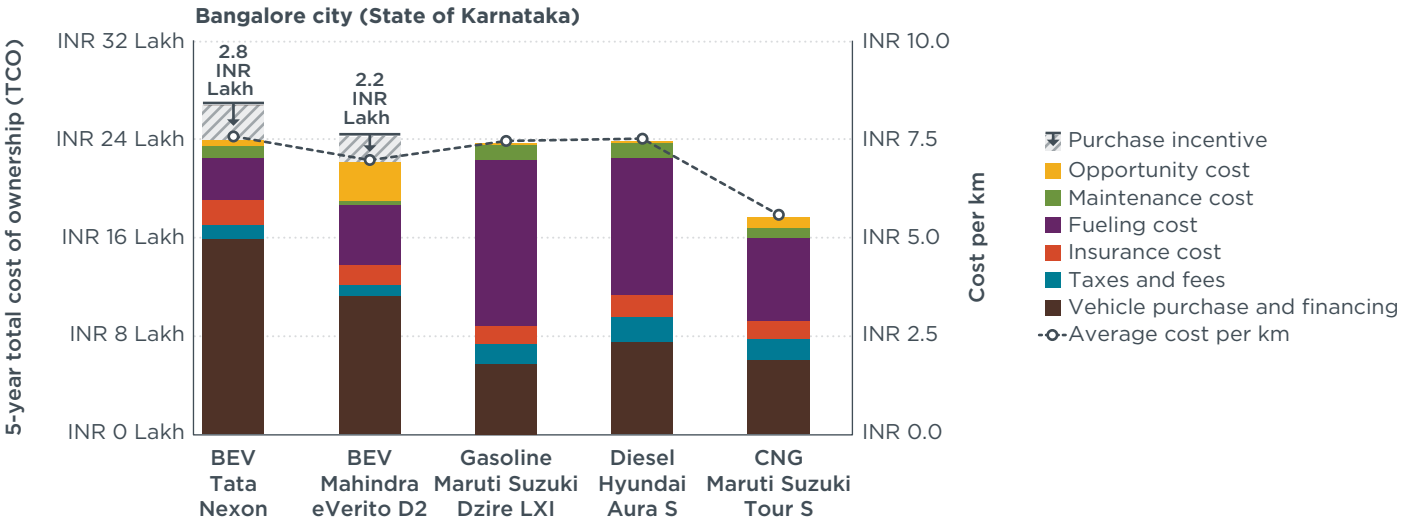


Figure 5. Comparison of 5-year TCO for selected vehicles for full-time ride-hailing drivers in Bangalore City (state of Karnataka).

In Bangalore, the 5-year TCO for the BEV Tata Nexon is INR 24 lakh (€27,700, $33,100) and the vehicle has a per km cost of INR 7.6. Mahindra's eVerito D2 is the second lowest cost option after the CNG; it incurs a 5-year TCO of INR 22.1 lakh (€25,500, $30,500) and a cost per km of INR 7.0. The selected diesel and gasoline cars bear similar costs over a 5-year holding period of INR 23.8 lakh (€27,500, $32,900) TCO and per-kilometer cost of INR 7.5, and INR 23.7 lakh (€27,300, $32,700) TCO and INR 7.5 per km, respectively. In Bangalore, as in the other cities, the costs over 5 years are the lowest for the CNG-powered car, INR 17.7 lakh (€20,500, $24,500) TCO and INR 5.6 per km. Similarly, the purchase and financing costs are the highest for the BEV models, followed by the diesel, CNG, and gasoline-powered cars. In the absence of an upfront state purchase incentive, the national FAME II incentive cannot balance out the higher purchase prices, nor the higher TCO of BEV Tata Nexon specifically over a 5-year holding period compared to the selected conventional cars.

Recently, some commercial charging service providers have begun offering public charging services at a higher retail rate of INR 13 (€0.15, $0.18) per kWh.[36] We evaluated the magnitude of this effect on the TCO and per-kilometer costs of the BEV Tata Nexon and BEV Mahindra eVerito D2 across the three cities and found that the per-kilometer cost of the BEV Tata Nexon remains the same and for BEV Mahindra eVerito D2, the per-kilometer cost increases by INR 0.5 in Delhi, INR 0.1 in Hyderabad, and INR 0.3 in Bangalore. However, the higher retail rate for charging does not change the relative sequence of the vehicle models in terms of TCO or per-kilometer cost values.

Baseline scenario analysis in 2020 compared to 2019

The 2019 ICCT study analyzed the 5-year TCO and per-kilometer cost for selected BEV, gasoline, diesel, and CNG vehicles in Delhi and Hyderabad. Only the BEV Mahindra eVerito D2 and the gasoline Maruti Suzuki Dzire LXI are analyzed in both the 2019 study and here. Hence, we highlight changes between the 2019 and 2020 baseline scenarios for only those models.[37]

36 "Pricing list and Terms & Conditions", Fortum, accessed March 17, 2021, https://www.fortum.in/products-services/vehicle-charging/pricing-list-and-terms-conditions.

37 As related earlier, we recalculated the TCO and cost per km values for the vehicle models in the 2019 study after considering 25% increase in the energy consumption per-kilometer of use and a 6-month average fuel price for diesel, gasoline, and CNG fuels.

In Delhi, the cost for the BEV Mahindra eVerito D2 dropped from INR 8.8 per km in 2019 to INR 5.8 per km in 2020, a 34% decrease (Figure 6, left). This decrease is attributable to a 21% reduction in the base price of the vehicle and the approval of the Delhi Electric Vehicle Policy 2020, which includes a purchase incentive of INR 10,000 per kWh (€115 per kWh, $138 per kWh) of battery capacity per electric four-wheeler, subject to a maximum incentive of INR 1.5 lakh (€1,700, $2,100) per vehicle to the purchasers of the first 1,000 electric cars registered. Also, vehicle road tax, congestion fees, and registration fees are waived for all BEVs registered in Delhi from 2020 to 2023, further decreasing the cost.

At the same time, the cost in Delhi has increased slightly for the gasoline Maruti Suzuki Dzire LXI, from INR 7.0 per km in 2019 to INR 7.3 per km in 2020. This is primarily because of a 15% increase in the fuel cost. As a result, compared to the gasoline model in 2020, the BEV Mahindra eVerito D2 generates a cost advantage of INR 1.5 per km. This is a significant improvement compared to 2019, when the per-kilometer cost for the same BEV in Delhi was higher than gasoline car by INR 1.8.

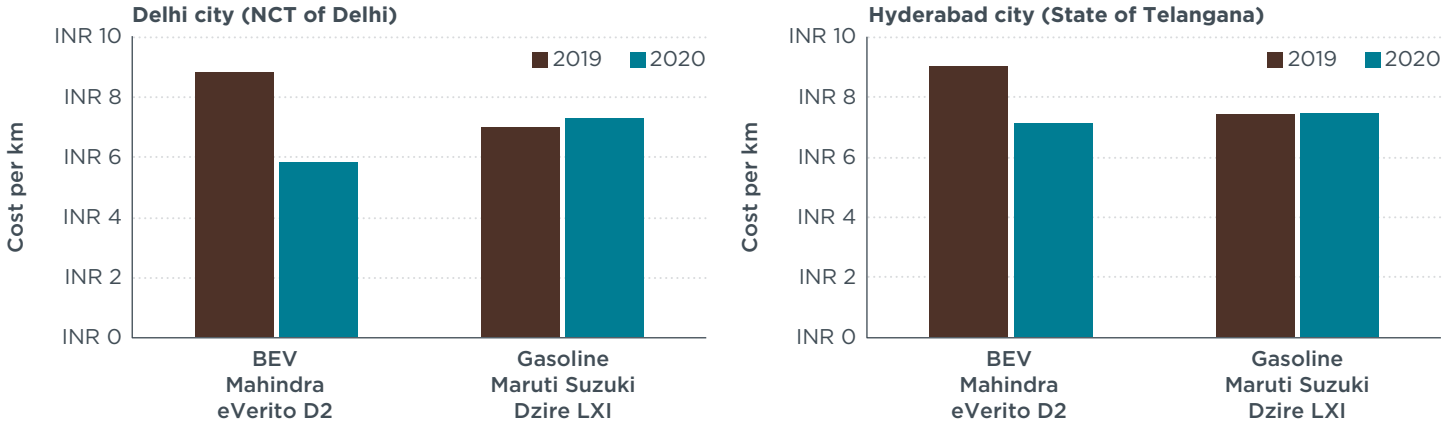


Figure 6. Changes in cost per kilometer for selected BEV and gasoline model for full-time ride-hailing drivers in Delhi (left) and Hyderabad (right) between 2019 and 2020.

In Hyderabad, the per-kilometer cost for the BEV Mahindra eVerito D2 dropped in 2020 to INR 7.2 per km from INR 9.0 per km in 2019, a 20% decrease (Figure 6, right). The reduction is primarily attributable to the 11% decrease in the vehicle base price from INR 12.95 lakh (€14,900, $17,900) in 2019 to INR 11.61 lakh (€13,400, $16,000) in 2020, and the improved battery capacity from 18.5 kWh in 2019 to 21.2 kWh in 2020, which resulted in a 14.6% higher FAME II incentive. In Hyderabad, the BEV Mahindra eVerito D2 had a cost disadvantage in 2019 compared to the gasoline Maruti Suzuki Dzire LXI. The driver of the BEV Mahindra eVerito D2 had to pay INR 1.6 more per kilometer than the gasoline Maruti Suzuki Dzire LXI. In 2020, the situation has changed where the driver of the BEV Mahindra eVerito D2 has to pay INR 0.3 less per kilometer than the driver of the gasoline Maruti Suzuki Dzire LXI.

Cost analysis for hypothetical additional policy scenario

This section introduces several polices and actions, some of which are already proposed by state and central governments and others are not yet proposed but which could help to enhance the cost-competitiveness of electric vehicles used for ride-hailing. The following adaptations are analyzed as opportunities to bridge the price differential and strengthen the case for BEVs in Indian four-wheeler ride-hailing fleets. The policies focus on incentivizing electric vehicle purchase and operation. Although not treated here, the

adoption of polluter-pay policies that impose high taxes on high-polluting vehicles could help to durably fund the transition to zero-emission vehicles in the long-term.[38]

Methodology

We estimate the incremental cost reduction potential of the hypothetical additional incentives and actions over the course of a 5-year TCO for the two selected BEVs. As a first step, results are presented to show the difference in the 5-year TCO between the BEV Tata Nexon and the CNG Maruti Suzuki Tour S vehicle in 2020 under the hypothetical policy scenario. Next, we show the difference in the 5-year TCO between the BEV Mahindra eVerito D2 and the CNG Maruti Suzuki Tour S vehicle in 2020. The comparison helps demonstrate the potential impact of incentives on any significant change in the respective costs of BEVs and the impact on the cost difference between BEVs and the CNG car. It is observed in the 2020 baseline scenario that the CNG vehicle has the least TCO and cost per kilometer among both BEVs and ICE vehicles. Therefore, if BEVs become cost competitive compared to the CNG vehicle, it would also make these BEVs cost competitive against the diesel and gasoline cars.

Table 2 gives an overview of the hypothetical additional interventions. These have been classified as either *proposed* or *additional measure*. Proposed interventions are those that are mentioned in the central and state electric vehicle policy documents but not in effect. Additional measures are the hypothetical interventions for fast uptake of electric vehicle adoption.

Table 2. Key assumptions under the hypothetical additional policy scenario.

Actor	Suggested interventions for hypothetical additional policy scenario		Status	Assumptions	
				BEV Tata Nexon	BEV Mahindra eVerito D2
Central and state government	Deployment of DC fast charging infrastructure		Additional measure	50 kW	50 kW
State government	States matching FAME II incentive for Hyderabad and Bangalore		Additional measure	INR 10,000/kWh	INR 10,000/kWh
Central government	TCS waiver in electric vehicle purchase		Additional measure	0%	0%
Central government	Discount on IRDAI insurance rates for commercial BEVs		Proposed	15%	15%
State and local government	Fee waivers like parking charges from state and local authorities for electric vehicles	Delhi (NCT of Delhi)	Proposed	INR 2,500	INR 4,000
		Bangalore (state of Karnataka)	Proposed	INR 3,744	INR 3,744
Central government	Interest rate subvention on electric vehicle loan financed amount		Additional measure	5%	5%
Central and state government, cab aggregator	Rebates on trip taken to electric vehicle ride-hailing cab drivers		Additional measure	INR 5/trip	INR 5/trip
Cab aggregator	Bulk purchase discount for electric ride-hailing vehicles		Additional measure	INR 60,000	INR 60,000
Cab aggregator	Opportunity cost rebate to electric ride-hailing vehicle drivers		Additional measure	INR 50/hour	INR 50/hour

38 Peter Slowik et al., *Funding the transition to all zero-emission vehicles.* (ICCT: Washington, DC, 2019). https://theicct.org/sites/default/files/publications/Funding_transition_ZEV_20191014.pdf

Similar to the 2019 ICCT study, we draw upon the following assumptions:

» For the baseline scenario, the average full charging time assumption is 68 minutes for the BEV Tata Nexon and 101 minutes for the BEV Mahindra eVerito D2, considering seasonal variations. India's present electric vehicle DC charging ecosystem is standardized at 15 kW supply by Bharat-001, substantially lower than the fast charging standards of the United States and Europe, and this has the potential to increase the opportunity cost of charging in ride-hailing fleets. We consider that fast charging could potentially reduce the opportunity cost and hence model the effect of *50 kW DC fast charging infrastructure deployment* over and above all the incentives in the baseline scenario.

» The *state match of FAME II incentive* for electric cars provided by the Government of India (INR 10,000/kWh) is applied only for Hyderabad and Bangalore because a state incentive is already in effect for the city of Delhi.

» Tax and fee waiver interventions considered include a complete *TCS waiver on electric vehicles*, which is presently applied at 0.75% across all vehicle segments, and a *15% discount on third-party insurance premiums* for electric cabs. As per the 2020–21 IRDAI notification, a 15% discount on the premium rates charged for privately owned conventional cars is also available to electric cars. However, at present, commercial cabs are deprived of such incentive. Through our hypothetical policy scenario analysis, we determine the impact of this discount on the cost per kilometer of commercial electric cabs. Delhi and Karnataka have additional fee waivers in effect for all electric four-wheel vehicles and Telangana has an additional fee waiver specifically for ride-hailing electric commercial vehicles. Key state and local fees applicable to vehicles operating on ride-hailing platforms include registration fees, permit fees, road taxes, and annual parking charges. The Telangana Electric Vehicle Policy has provision for 100% exemption of road tax and vehicle registration fee for ride-hailing commercial vehicles. The Delhi and Karnataka Electric Vehicle Policies exempt BEVs from vehicle registration fee and road taxes.

  We additionally model the cost advantage presented to BEVs through *fee waivers for parking charges* and include a *5% reduction on the vehicle loan interest rate* through interest subvention to be provided by respective state governments through financial establishments.[39]

» *Rebates on trips taken in electric cabs* are projected at INR 10 per trip for passengers for rides in electric vehicles through ride-hailing platforms, with the objective of making such rides 10% to 20% cheaper than rides in conventionally powered cabs. We model the impact of states providing a rebate of INR 10 per trip, but with passengers and cab drivers each receiving 50% of the rebate amount.

» *A bulk purchase discount of INR 60,000 per new electric ride-hailing cab* purchase is assumed. This is similar to the discounts received by drivers who adopted CNG vehicles on the Ola platform following the Supreme Court's directive in Delhi for commercial vehicles to transition to CNG as an air pollution control measure.[40]

39 This waiver is proposed in the Delhi Electric Vehicles Policy, 2020 (https://transport.delhi.gov.in/sites/default/files/All-PDF/Delhi_Electric_Vehicles_Policy_2020.pdf) for the purchase of eAuto, eRickshaw, eCart and Goods carriers. We envisioned here its impact on the TCO of ride-hailing four-wheeler electric vehicles in all cities.

40 Pearl Daniels,"Ola drivers to get Maruti, Hyundai and Tata cars at discounted prices," *Rushlane*, August 27, 2015, https://www.rushlane.com/ola-drivers-to-get-maruti-hyundai-discount-12159547.html

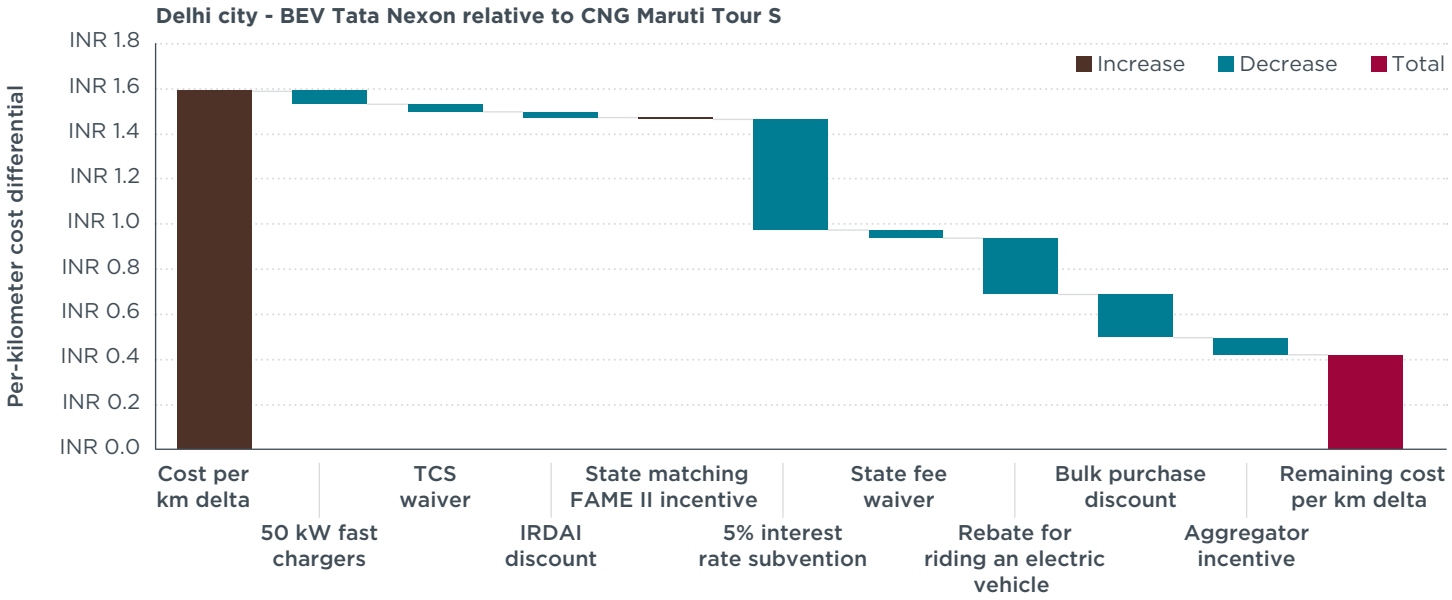
» We also consider the case of *ride-hailing aggregators compensating electric vehicle drivers on their platforms* at INR 50 per every hour spent on vehicle charging during business hours**.** Ola Mobility Institute's pilot study in Nagpur also indicates that drivers were compensated for opportunity costs as an incentive to adopt BEVs on their platform.[41]

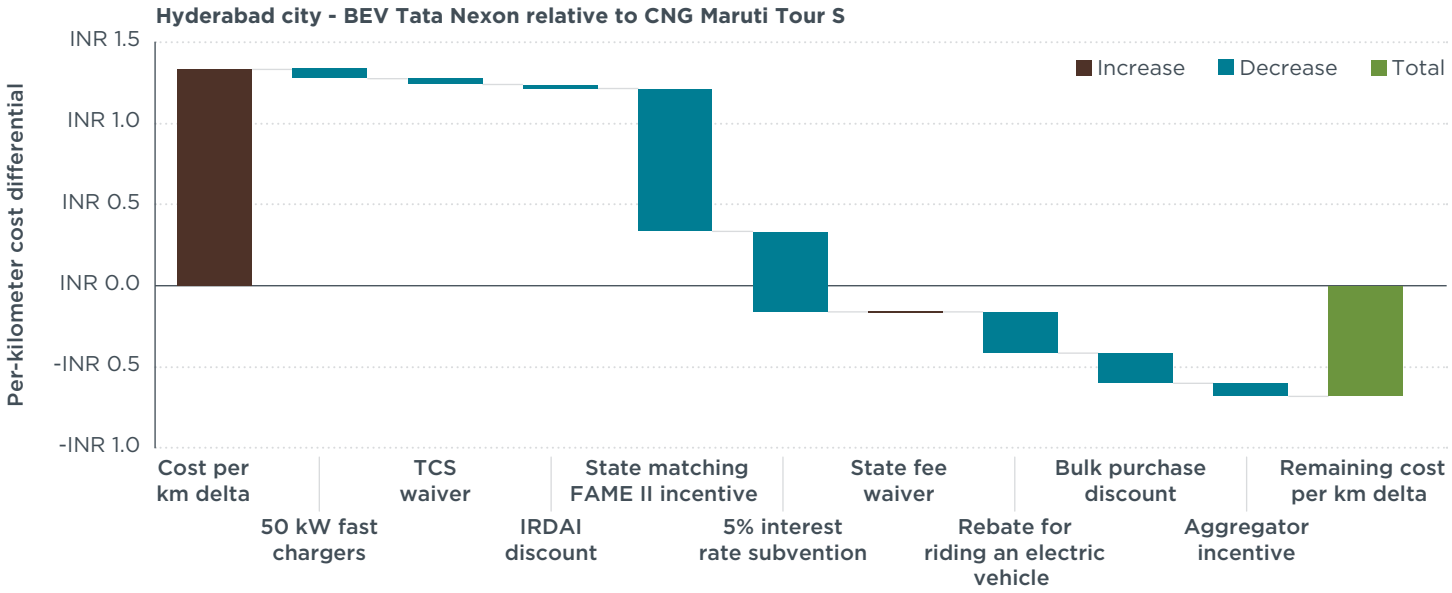
Hypothetical additional policy scenario results for 2020

Figure 7 illustrates the per-kilometer TCO of the BEV Tata Nexon relative to the selected CNG vehicle, shown as brown bars on the left end of the figures, in Delhi, Hyderabad, and Bangalore in 2020. Figure 8 illustrates the cost differential of the BEV Mahindra eVerito D2 relative to the CNG Maruti Suzuki Tour S (also the brown bar) in Delhi, Hyderabad, and Bangalore in 2020. We illustrate the incremental effect of hypothetical additional policy measures on the per-kilometer cost of the BEVs by estimating the net impact of each additional policy on the relative costs, shown using the blue bars. A red bar indicates the remaining gap in per-kilometer cost to be covered by the BEV model in one case; green bars indicate the net improvement in the per-kilometer cost of the respective BEV model compared to the CNG car model after factoring in all proposed additional measures.

Recall that, in the baseline scenario, the BEV Tata Nexon costs more than the CNG in Delhi, Hyderabad, and Bangalore by INR 1.62 per km, INR 1.42 per km, and INR 2.00 per km, respectively. Similarly, under the baseline scenario, the BEV Mahindra eVerito D2 costs more than the CNG vehicle by INR 0.63 per km, INR 0.97 per km and INR 1.39 per km in Delhi, Hyderabad, and Bangalore respectively.

41 Ola Mobility Institute. (2019). *Beyond Nagpur: The promise of electric mobility*. https://olawebcdn.com/ola-institute/nagpur-report.pdf





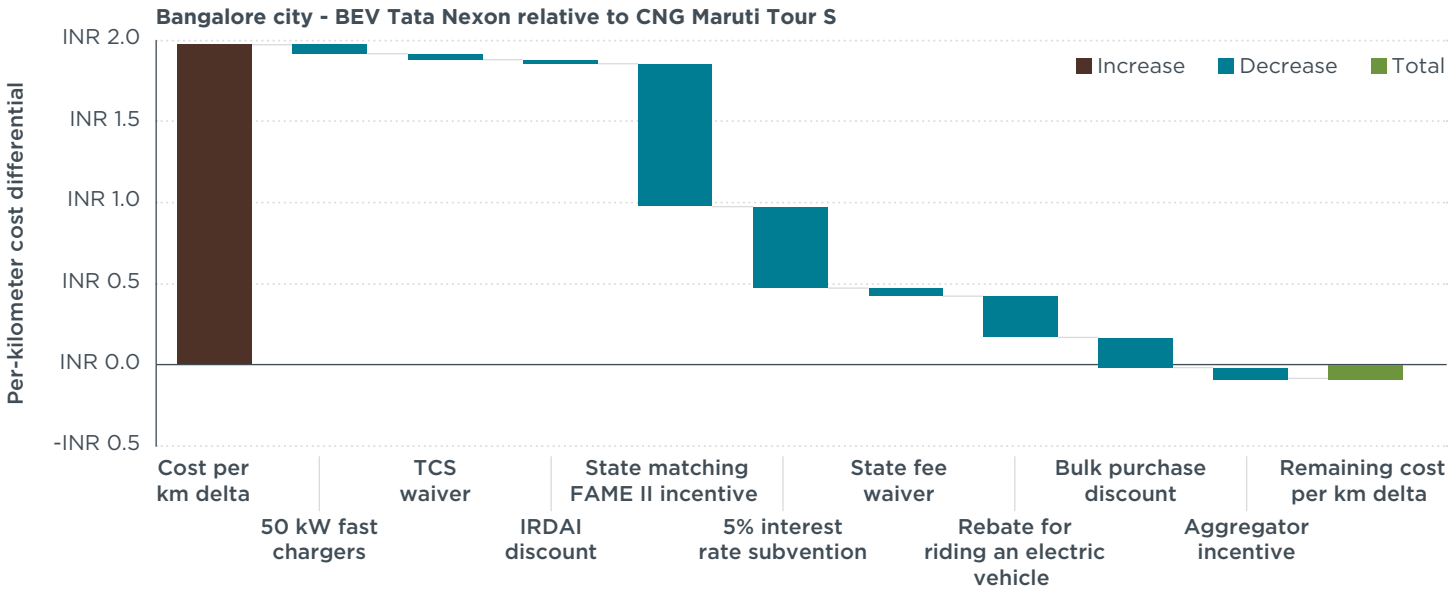


Figure 7. Impact of hypothetical additional policies in bridging the 5-year per-kilometer cost differential between the BEV Tata Nexon and the CNG Maruti Suzuki Tour S in Delhi, Hyderabad, and Bangalore in 2020.

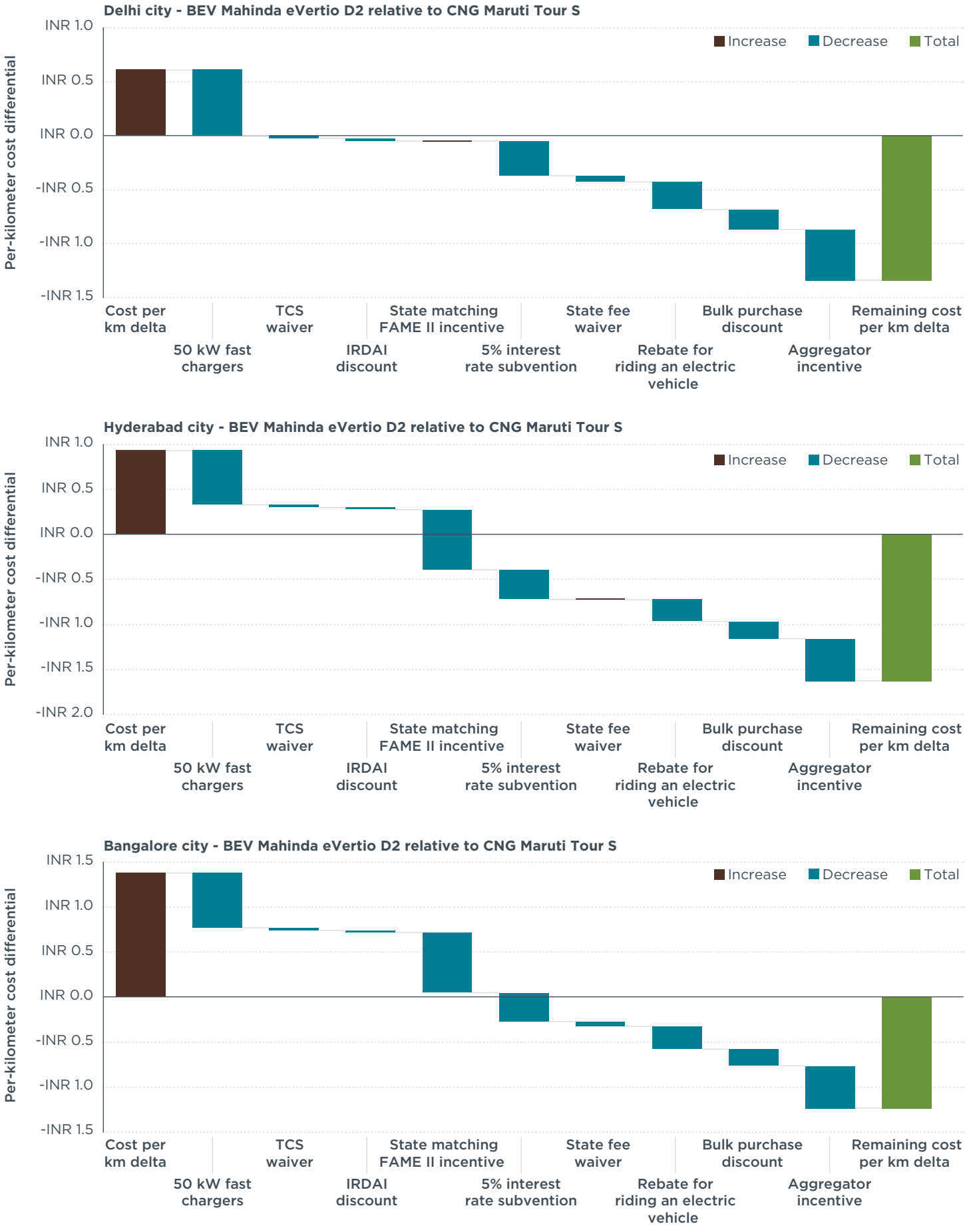


Figure 8. Impact of hypothetical additional policies in bridging the 5-year per-kilometer cost differential between the BEV Mahindra eVerito D2 and the CNG Maruti Suzuki Tour S in Delhi, Hyderabad, and Bangalore in 2020.

Several of these actions and incentives can bridge much of the gap between the TCO of the BEVs and the conventional CNG vehicle model. Because the upfront costs associated with vehicle acquisition comprise more than half of the TCO for the BEVs, purchase incentives and discounts from states and aggregators can have a substantial impact on improving their cost competitiveness. Under the baseline scenario, the lack of state-level upfront purchase incentive for BEVs in Hyderabad and Bangalore contributes to making the BEV Tata Nexon and the BEV Mahindra eVerito D2 more expensive than the CNG vehicle in these cities compared to Delhi. However, under the hypothetical additional policy scenario for Hyderabad and Bangalore, including state incentives of the same value as FAME II (INR 0.88 per km) can substantially bridge the gap between the BEV and the conventional vehicles. Also, in Delhi, the existing state incentive value is less than the central FAME II value. If the state incentive were to be increased to the level of the FAME II incentive in Delhi, there will be a further drop of INR 0.41 and INR 0.20 in the per-kilometer cost of BEV Tata Nexon and BEV Mahindra eVerito D2, respectively.

Among all the incentives applicable to the BEVs, the 5% interest rate subvention produces the second largest cost reduction for the BEV Tata Nexon and the third largest cost reduction for the BEV Mahindra eVerito D2 across Delhi, Hyderabad, and Bangalore. For the BEV Tata Nexon, the per-kilometer cost gap relative to the CNG vehicle is reduced by 31%, 35%, and 25% in Delhi, Hyderabad, and Bangalore, respectively. For the BEV Mahindra eVerito D2, the per-kilometer cost gap relative to the CNG vehicle is reduced by 52%, 33%, and 23% in Delhi, Hyderabad, and Bangalore, respectively. Thus, a discount on the interest rate could bring down the vehicle finance cost, which is the second highest cost component in the 5-year TCO after procurement cost. Making this additional intervention available as a government incentive could add to the cost reduction and supplement existing incentive mechanisms; this would push potential BEV penetration in ride-hailing fleets.

Fast charger technology deployment together with ride-hailing aggregator compensation for the opportunity cost incurred is the third largest component of TCO reduction for BEV Tata Nexon and the second largest component of TCO reduction for BEV Mahindra eVerito D2 under the hypothetical additional policy scenario. After procurement, finance, insurance and fueling costs, the opportunity cost is the next largest cost to BEV drivers. At the existing level of public charging deployment in India, our estimates indicate that ride-hailing drivers incur average opportunity costs of approximately INR 0.15 per km for the BEV Tata Nexon and INR 0.95 per km for the BEV Mahindra eVerito D2, which is equivalent to about INR 112 per hour. This is considering that it takes an average of 68 minutes and 101 minutes to charge a BEV Tata Nexon and BEV Mahindra eVerito D2 respectively, a time that takes into account seasonal variations in the rate of DC fast charging. Fast charger technology deployment could further reduce the cost per kilometer difference because it would mean less charging time and thus less opportunity cost. For example, the per-kilometer cost difference between the BEV Mahindra eVerito D2 and the CNG vehicle is reduced from INR 0.63 (baseline) to INR 0.01 in Delhi; from INR 0.97 (baseline) to INR 0.36 in Hyderabad; and from INR 1.39 (baseline) to INR 0.78 in Bangalore. We estimate that 50 kW fast chargers would reduce the average charging time from 68 minutes in the baseline scenario to 41 minutes for the BEV Tata Nexon and from 101 minutes in the baseline scenario to 36 minutes for the BEV Mahindra eVerito D2.

This is a long-term, sustainable solution and can lower the opportunity costs to BEV drivers. Deployment of 50 kW fast chargers reduces the average opportunity costs of ride-hailing drivers in the three cities from INR 0.15 per km to INR 0.09 per km for the BEV Tata Nexon and from INR 0.95 per km to INR 0.34 per km for the BEV Mahindra eVerito D2. Opportunity cost rebates provided by aggregators at 50% of the current costs, which is INR 50 per hour of time spent charging, can help drivers transition toward electric vehicles until investments in high-speed chargers are made.

Among other additional incentives, aggregators can pass on the benefits of bulk procurement deals to drivers on their platforms who adopt BEVs. A bulk purchase discount of INR 60,000 per vehicle can bridge the per-kilometer cost gap between the BEVs and the selected CNG vehicle by INR 0.19 in all three cities.

To further improve the competitiveness of BEV models compared to CNG models, more incentives are required. Such incentives could be in the form of trip-based rebates to cab drivers. We have considered a scenario of a rebate of INR 10 per trip to passengers on app-based cab rides on electric vehicles wherein 50% of this rebate is transferred to the passenger and 50% is transferred to the driver. With a rebate of INR 5 per trip, such an incentive can be significant in reducing the per-kilometer cost difference between the BEV Tata Nexon and the selected CNG vehicle by approximately 15% across the three cities. Similarly, this incentive can reduce the per-kilometer cost difference between the BEV Mahindra eVerito D2 and the CNG Maruti Tour S vehicle model by approximately 21%. Such incentives can also be paid by passengers of ride-hailing fleets, as has been the case with Uber passengers in London.

Apart from the incentives mentioned above, waivers in state and local taxes and fees, third-party insurance premiums set by the IRDAI, and the TCS levied on vehicles costing more than INR 10 lakh can bridge the TCO gap between BEV Tata Nexon and the CNG vehicle model by around 5% and between BEV Mahindra eVerito D2 and the CNG vehicle model by around 10%.

These potential cost reductions from all the hypothetical interventions mentioned above can reduce the per-kilometer cost difference for the BEV Tata Nexon relative to the CNG model in Delhi from INR 1.59 to INR 0.42, in Hyderabad from INR 1.38 to INR -0.68, and in Bangalore from INR 1.98 to INR -0.1. Similarly, the per-kilometer cost difference between the BEV Mahindra eVerito D2 and the CNG model can be reduced from INR 0.62 to INR -1.34 in Delhi, from INR 0.94 to INR -1.63 in Hyderabad, and from INR 1.39 to INR -1.24 in Bangalore.

Conclusion

As a follow-up to the 2019 ICCT study, we re-evaluated the 5-year TCO of four-wheeler BEVs for ride-hailing purposes and compared the results with the TCO of comparable conventional gasoline, diesel, and CNG vehicle models in 2020. In this estimation, we selected the latest variant of the same make and model of BEV (i.e., Mahindra eVerito D2) that was included in the 2019 study and another BEV, the Tata Nexon, which is currently among the most popular four-wheeler BEVs in India.[42] We also included Bangalore city in this analysis, in addition to Delhi and Hyderabad; these three cities are among the top markets for ride-hailing four-wheelers in India and they have the highest shares of BEV four-wheelers when compared to other cities the country.

Results show some positive trends. First, across Delhi, Hyderabad, and Bangalore cities, with the current cost and incentive structures and without considering any additional incentives, the **BEV Mahindra eVerito D2 is cheaper than the comparable diesel and gasoline cars in terms of 5-year TCO and consequently the cost per kilometer. Similarly, the BEV Tata Nexon's per-kilometer cost is only marginally higher than the comparable diesel and gasoline cars in Hyderabad and Bangalore, and it is lower in Delhi**. Second, when considering the effects of some additional incentives on top of the existing cost structures, the cost differentials between the BEVs and conventional fuel vehicles decrease further from the baseline case across Delhi, Hyderabad, and Bangalore. As a result, apart from the BEV Tata Nexon–CNG cost differential in Delhi, all other cost differentials show that BEVs can be cheaper than conventional fuel alternatives in these

42 Dwaipayan Roy, "This is the best-selling electric car in India," *NewsBytes*, August 21, 2020, https://www.newsbytesapp.com/timeline/auto/64924/305901/tata-nexon-ev-sales-price-specifications-features

three cities over a five year holding period if additional policies are implemented. Third, the average base price of the latest variant of Mahindra eVerito D2 has dropped by 16% year-on-year, whereas the range of this vehicle has increased by 29% year-on-year; this indicates an improvement in the attractiveness of electric cars. With the existing electric vehicle ecosystem[43] and currently available incentives, the per-kilometer cost differences between the BEV Mahindra eVerito D2 and CNG, gasoline, and diesel alternatives are smaller in 2020 than they were in 2019.

Based on the study results, key policy actions for the central and state governments that could help reduce the cost of electric vehicles to the level of conventional vehicles are summarized below.

» **A state-level electric vehicle purchase incentive that matches the central purchase incentives is key to driving electric vehicle adoption in India's ride-hailing fleet.** Our analysis of the city of Delhi illustrates that incentives from the state government that partially match the central government's Fame II incentive can reduce the upfront purchase cost gap between the BEV Tata Nexon and conventional cars by more than 20% and between the BEV Mahindra eVerito D2 and conventional cars by more than 60%. Our analysis further shows that the procurement cost component is 59% to 87% of the TCO for the BEV Tata Nexon and Mahindra eVerito D2 in Delhi, Hyderabad, and Bangalore. The government of Delhi has made the purchase incentive available for a limited number of vehicles, as per the Delhi Electric Vehicles Policy, 2020.

  However, no such benefits are yet offered by other state governments. As a result, there is a distinct difference in the 5-year TCO and per-kilometer cost of the BEVs between Delhi and other cities. Also, the cost difference between BEV–CNG, BEV–gasoline, and BEV–diesel vehicles is less in Delhi than it is in Hyderabad and Bangalore, and this is mainly as a result of the state incentive.

» **A waiver on annual interest payments for loans taken for electric vehicle purchase could help to attract electric vehicles in ride-hailing operation**. The analysis illustrates that a 5% waiver on annual interest payments could reduce the cost differential between BEVs and conventional vehicles. This intervention could be put forth as an incentive for BEVs in ride-hailing through financial providers empaneled by government. In Delhi, an interest subvention of 5% is proposed for electric autos (three-wheelers), e-rickshaws, e-carts, and goods carriers—last mile mobility options for passenger and logistics movement. Extending this incentive to ride-hailing fleets would reduce the financing cost, which is the second highest cost component in the TCO of BEVs in this study. We estimate that the 5% interest subvention on electric vehicle purchase loans would have substantial impact: an average 34% reduction in the per-kilometer cost differential between BEV–CNG vehicles, across the three cities analyzed.

» **Fast charging infrastructure investment policy is an important step to transition toward BEVs in the four-wheeler vehicle segment.** As inferred from the 2019 ICCT study, availability of 50 kW fast charging facilities would reduce the time it takes to charge the BEV. This, in turn, would reduce the loss of business hours and consequently opportunity costs for ride-hailing drivers. For BEVs which have comparatively short range and long charging duration when using a slow charging method, the availability of fast charging would have significant positive impact. For example, the average charging time would decrease by 40% for the BEV Tata Nexon and by 65% for the BEV Mahindra eVerito D2 from the baseline scenario by using 50 kW fast charging. This intervention, in turn, would reduce the opportunity cost of

43 Ecosystem refers to all aspects on an electric vehicle including public charging infrastructure, power tariff, financing cost, insurance cost, tax and other fees, maintenance cost, opportunity cost, etc.

fueling from INR 0.15 per km to INR 0.09 per km for the BEV Tata Nexon and from INR 0.95 per km to INR 0.34 per km for the BEV Mahindra eVerito D2 across the three cities.

For BEVs costing less than INR 14 lakh (€16,200, $19,300) and of comparable range and charging durations as the BEV Tata Nexon and Mahindra eVerito D2, the three suggested measures of state incentives matching central incentive, annual vehicle loan interest waiver, and fast charging investment policy are sufficient to bring TCO parity with CNG cars within reach. For BEVs costing more than INR 14 lakh, a few more policy interventions, including a per ride-km financial incentive to drivers or a waiver on TCS, can further strengthen the cases for the BEVs in ride-hailing.

The future of four-wheeler BEVs in the Indian ride-hailing market looks promising. Although additional fiscal incentives and infrastructure investments are necessary, state governments appear to be in a position to require ride-hailing companies to electrify their vehicle fleets over the next several years.

Appendix

Table A1. Vehicle financing costs and relevant assumptions for vehicles selected for this analysis.

		BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Vehicle financing	Annual interest rate	9.32%	9.32%	9.52%	9.52%	9.52%
	Repayment period	5 years	5 years	5 years	5 years	5 years
	Financed amount	85%	85%	85%	85%	85%
	Processing fee	INR 6,065	INR 3,956	INR 1,929	INR 3,354	INR 2,597
	Equated monthly installment (EMI)	INR 24,870	INR 16,222	INR 7,948	INR 13,820	INR 10,698

Table A2. National and state taxes and fees and relevant assumptions for vehicles selected for this analysis.

			BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Taxes and fees (central)		Goods and service tax (GST)	5%	5%	28%	28%	28%
		Central compensation cess	0%	0%	1%	3%	1%
		Central tax collected at source – TCS applies if base price greater than > INR 1,000,000	0.75%	0.75%	0.75%	0.75%	0.75%
		Registration fees for commercial light-duty vehicles	INR 0	INR 0	INR 1,000	INR 1,000	INR 1,000
Taxes and fees (state)	Delhi	Road tax (annual	INR 0	INR 0	INR 605	INR 605	INR 605
		Parking charges (annual	INR 0	INR 0	INR 2,500	INR 2,500	INR 2,500
		Permit fee (annual)	INR 0	INR 0	INR 500	INR 500	INR 500
		Proposed congestion fee for trips through ride-hailing apps (per trip)	INR 0	INR 0	INR 0	INR 0	INR 0
	Telangana	Road tax (annual)	INR 0	INR 0	INR 2,608	INR 2,608	INR 2,608
		Parking charges	INR 0	INR 0	INR 0	INR 0	INR 0
		Permit fee (annual)	INR 0	INR 0	INR 1,000	INR 1,000	INR1,000
		Proposed congestion fee for trips through ride-hailing apps	INR 0	INR 0	N/A	N/A	N/A
	Karnataka	Road tax (annual)	INR 0	INR 0	INR 1,000	INR 1,000	INR 1,000
		Parking charges (annual)	INR 0	INR 0	INR 3,744	INR 3,744	INR 3,744
		Permit fee (annual)	INR 0	INR 0	INR 500	INR 500	INR 500
		Proposed congestion fee for trips through ride-hailing apps	INR 0	INR 0	N/A	N/A	N/A

Table A3. Insurance costs and relevant assumptions for vehicles selected for this analysis.

		BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Insurance Costs	Third party premium (annual)	INR 11,320	INR 11,320	INR 11,320	INR 11,320	INR 11,320
	Personal accident cover (annual)	INR 750	INR 750	INR 750	INR 750	INR 750
	Own-damage insurance (annual)	INR 27,429	INR 19,613	INR 15,685	INR 20,607	INR 16,636

* IRDAI rate category: Four-wheeled vehicles used for carrying passengers for hire or reward with carrying capacity not exceeding six passengers.

Table A4. Fueling costs and relevant assumptions for vehicles selected for this analysis.

				BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Fueling	Delhi	Refueling		N/A		INR 84 per liter	INR 74 per liter	INR 43 per kg
		Residential overnight charging		INR 6.5 per kWh		N/A		
		Public fast-charging		INR 4.0 per kWh				
	Telangana	Refueling		N/A		INR 87 per liter	INR 81 per liter	INR 65 per kg
		Residential overnight charging		INR 9.0 per kWh		N/A		
		Public fast-charging	6am to 10am, 6pm to 10pm	INR 8.8 per kWh				
			10pm to 6am	INR 6.8 per kWh				
			10am to 6pm	INR 7.8 per kWh				
	Karnataka	Refueling		N/A		INR 87 per liter	INR 78 per liter	INR 50 per kg
		Residential overnight charging		INR 8.8 per kWh		N/A		
		Public fast-charging		INR 5.75 per kWh				

Table A5. Maintenance costs for vehicles selected for this analysis.

		BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Maintenance	Maintenance costs	INR 0.35 per km	INR 0.13 per km	INR 0.46 per km	INR 0.44 per km	INR 0.29 per km

Table A6. Opportunity costs and relevant assumptions for vehicles selected for this analysis.

		BEV Tata Nexon	BEV Mahindra eVerito D2	Gasoline Maruti Suzuki Dzire LXI	Diesel Hyundai Aura S	CNG Maruti Suzuki Tour S
Opportunity costs of fueling	Refueling	N/A		5 minutes	5 minutes	30 minutes
	Recharging events	0.27 per day	1.11 per day	N/A		
	Full fast-charge cycle time (summer)	90 minutes	135 minutes			
	Full fast-charge cycle time (rest of year)	60 minutes	90 minutes			
	Full fast-charge cycle time (weighted average)	68 minutes	101 minutes			
	Overnight slow-charge events	1 per day	1 per day			