Strategy to Electrify Three-Wheeled Passenger and Goods Vehicles in Cities of Odisha

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Odisha State Road Transport Corporation

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Section 1: The mandate

Consistent with the national policy on electrification of the vehicle fleet and considering the crucial role that the transportation sector plays in reducing local air pollution and heat trapping carbon emissions, the Government of Odisha published its electric vehicle policy in 2021. The prime objective of the Odisha Electric Vehicle Policy 2021 is to accelerate the pace of electrification with the special focus on two-wheeler, three-wheeler and light motor vehicle (LMV) segments. In response, several department-wise initiatives are underway to detail the strategies related to different aspects of the policy.

Against this backdrop, the Odisha State Road Transport Corporation (OSRTC), a key member of the state-level steering committee responsible for coordinating multi-departmental action for implementation of the e-mobility programme in Odisha, and also implementing the electric bus programme, has taken the lead to assess the potential of electrification of the three-wheeler segment, an integral part of the intermediate public transport or para-transit systems as it provides last-mile connectivity and is a feeder to the other transportation systems. These vehicles meet substantial urban travel demand, especially in smaller cities, and are high-mileage vehicles.

For this purpose, Odisha State Road Transport Corporation (OSRTC) has collaborated with Centre for Science and Environment (CSE) to assess the ground reality of three-wheeler operations and identify the unique challenges associated with this segment to prepare actionable strategies for rapid electrification of this segment for implementation in the state. For this pilot assessment, three cities of capital region have been selected, including Bhubaneswar, Cuttack and Puri.

The detailed scope of this engagement includes a holistic assessment of different sub-segments of three-wheelers—both passenger and cargo—to understand the ownership pattern; operational characteristics and service conditions; available battery technologies and charging options; financing strategies; expectations of the three-wheeler operators; existing policies and procedures; city readiness for electrification; and need for capacity enhancement, among others, to provide a detailed step-by-step strategy for complete transformation.

For this purpose, a methodology has been developed for city-level assessment. It includes a comprehensive survey of auto fleet operators based on detailed indicators with the help of a professional survey agency, independent review of the operational characteristics, and stakeholder consultation. This rapid and diagnostic survey

has covered a sample size of 510 vehicles, including 400 passenger autos and 110 goods auto samples in three contiguous cities. Additionally, 40 e-rickshaw were surveyed in Puri, the only location where e-rickshaws currently ply, to understand the challenges of e-vehicle-based services. This is the sole electric vehicle service operating for the last two to three years in this region.

In addition, 500 user perception surveys were conducted in Bhubaneswar to understand the impact of Mo-bus services on the three-wheeler passenger services since its introduction in October 2019 as this has implication for the future demand for para-transit services in relation to the bus service augmentation. Depending upon the city sizes and number of vehicles in each category, the samples have been collected in a ratio of 0.5–0.7 per cent (see *Annexure 1: City-wise details of survey samples and their locations for passenger auto segment* and *Annexure 2: City-wise details of survey samples and their users for goods auto segment*).

This assessment is not only expected to provide guidelines for state-level implementation but also create the learning curve for other states of India that are currently embarking on implementation of the electric vehicle programme. Targeted electrification of the auto segment is expected to scale up soon as several policies, including national- and state-level electric vehicle policies, state clean air action plans and climate action plans, are providing for rapid electrification with a special focus on this segment. The implementation strategy will require vehicle segment-wise approaches.

Why auto-rickshaws need special attention

Three-wheelers with internal combustion engines (ICE) are widely used for point-to-point shuttle service and last-mile connectivity across India. Nationally, their market share is almost equally divided between diesel and petrol. These ICE vehicles are inherently designed to emit several times more toxic pollution compared to most other vehicles on the roads. What makes diesel autos especially worse is their highly toxic, cancer-causing fumes that are dangerous to human health. Already, as part of clean air action in several cities, these vehicles are being moved to cleaner fuels like CNG and LPG or their numbers are being capped as in Delhi under the directives of the Supreme Court during the late 1990s. A similar approach was adopted by several other cities subsequently.

Cities in Odisha face a special challenge as diesel three wheelers dominate the fleet.

There are special concerns around the diesel three-wheelers as these vehicles emit much higher particulate matter compared to their petrol and CNG counterparts. These autos have even higher emissions than diesel cars. Under the emissions standards of Bharat Stage IV (BSIV), a diesel auto is legally allowed to emit 1.7 times higher particulate matter and 1.3 times higher NOx + HC than a BSIV diesel car. This gap with diesel cars further widens under the more advanced BSVI regulations. Even after meeting BSVI emissions standards, a diesel three-wheeler emits close to six times higher particulate matter and two times more nitrogen oxide compared to a BSVI diesel car. Users of diesel three-wheelers suffer the consequence of high exposure and ill-health the most. School-going children also use these vehicles.

Moreover, the ICE three-wheeled vehicles face special technical challenges. They are powered by small, single-cylinder diesel engines of less than 500 cc displacement (if this engine size is exceeded, rules for four-wheelers will apply under the Central Motor Vehicle Rules). These small engines with unstable emissions and high exhaust temperatures limit the scope of application of advanced and effective after-treatment systems that are otherwise used in other diesel vehicles. These vehicles meet emission standards mostly through improved calibration and optimization. Most solutions used for larger engines are often not adaptable in these small engines. None of these diesel models use the systems that are widely applied in cars, namely, automatic fuel injection timing control, catalytic converters or exhaust gas recirculation. These will largely play around with the optimization of combustion, automatic ignition timing, friction reduction, improved air filters and lubricating oil. Also, given the price sensitivity of this market, expensive solutions are not possible.

Under the advanced BSVI regime, when all testing parameters for all other vehicle segments have improved significantly, three-wheelers are subjected to the same archaic testing systems and requirements that are much less exacting like being tested on the much less rigorous and older Indian Driving Cycle. Imagine how high the real-world emissions from these vehicles on the road therefore will be. Each of these diesel three-wheelers will be much worse than diesel cars.

The three-wheelers or the auto-rickshaw segment is the most amenable candidate for the leapfrog to zero-emissions electric mobility. In fact, the first phase of e-mobility in India started with the e-rickshaws in the informal market. In October 2017, the EREP Market Research Series had predicted that of the total estimated future electric fleet size, (if represented as total battery storage capacity), the

overall EV market for battery storage in India would be about 4.7 GW in 2022, and over 60 per cent of this capacity would be driven by E-rickshaws batteries.

The next challenge is not only to scale up the market to speed up transition e-vehicles, but also to upgrade the vehicle technology through certified product development to meet improved performance benchmark.

Why three wheelers are low-hanging fruit for electrification

NITI Aayog forecasts a potential for 80 per cent electrification of the two- and three-wheeler fleet by 2030. Such an ambition is possible as this segment is one of the smallest in Indian market in terms of total number of units sold in a year. In 2021, a total of 362,630 auto-rickshaws—including 132,443 e-rickshaws; 13,885 e-carts; 67,844 goods three-wheelers and 148,458 passenger three-wheelers—were registered in the country. With focused policy, 80 per cent of this segment can be fully electrified.

As these vehicles are the immediate target of clean air action in many cities, leading to the capping of numbers and replacement with cleaner fuels or phase-out of older vehicles, it is possible to set the mandate for targeted electrification of this segment that has low volume, high frequency and is a short-haul transport system. Further, with the scale of the market and incentive programmes of the Central and state governments, the cost curve of vehicles will decline further to bring greater price parity.

Therefore, there is benefit in shaping targeted policies to overcome some of the limitations of this electric vehicle segment in terms limited models in the market, need for upgradation of the technology and improvement in performance and safety through standards and certification. Currently, the top speeds of only 9 per cent of the models exceed the 25 kmph mark. Out of 23 of the most commonly sold electric three-wheeler (E3W) models, 17 have a range equal to or greater than 100 km and 30 per cent 120 km. Especially in the cargo category, vehicles with high-payload capacity require uninterrupted running times or longer range. Thus, limited public charging stations deter adoption. Proper public charging facilities, including night time and home charging, are needed to ensure minimal downtime. This segment also has a special challenge related to access to capital. Banks are reluctant to lend to start-ups. Also the operational model of autos that are largely based on daily rentals/lease for operations add to the complexity and make financing and monthly repayment a challenge. Product development, innovation and mandate for targeted electrification is important.

Opportunity for electrification of three-wheeler segment in Odisha

There is strong opportunity for electrification of this segment in the cities of Odisha, especially the capital region including Bhubaneswar, Cuttack and Puri. As per the Draft Integrated Comprehensive Mobility Plan 2010, the latest reported document available, approximately 0.2 million people travelled in autos in Bhubaneswar—i.e. almost 25 per cent of the total passenger mode share of the city—while buses carried around 0.05 million people, i.e. roughly 6 per cent.

It is true that after modernization of bus services since 2019–20, buses have gained in popularity, which has helped reach a ridership of around 0.15 million (i.e., increase of around 15 per cent*) in the end of 2021.[1] However, even if we consider the increment in bus ridership is inversely proportional to auto ridership, autos still play a vital role in the passenger transport. This is an opportunity to convert a sizeable part of urban commuting to zero emissions. Bhubaneswar, the capital and largest city in Odisha, along with Cuttack and Puri can help to create the framework for electrification of both passenger and cargo vehicles in other urban centres as well.

Another opportunity is the compact form of the cities, which keep the average trip length within 3–5 km and up to 10–12 km i. This is well within the average driving range per charge of these vehicles that can do without top-up charging.

Highlights of key findings

To understand the potential of transforming this segment to becoming zero emissions, it is necessary to understand the current imperatives of this segment with regard to parameters such as vehicle ownership pattern, usage by fuel types, operational characteristics, travel behaviour, financing systems, earnings, responses to incentives and charging requirements. This will have bearing on the decision making related to switching to electric vehicles.

Vehicle registration data available from the RTOs of Bhubaneswar, Cuttack and Puri show that approximately 45,500 new three-wheelers (3Ws), including 36,500 passenger and 9,000 goods vehicles were registered in these cities during 2012–21. Nearly half of these ply in Bhubaneswar. These vehicles provide livelihood to about 50,000 people and their families in the capital region. Almost 70–75 per cent of the goods auto-drivers and passenger auto-drivers are less than 45 years of age. Around 80 per cent of this age group have 5–20 years of driving experience.

* Assuming Bhubaneswar's current ridership is 1.22 million (estimated) and trip rate is 0.8 (assuming same trip rate as provided in draft ICMP report of 2010.

Individual driver-cum-owners dominate: Almost 94 of the passenger auto-drivers and 97 per cent of goods auto drivers are driver-cum-vehicle owners in this capital region of Odisha. Only 6 per cent of the passenger auto drivers operate on a rental basis. The majority of the drivers-cum-owners—95 per cent—are single vehicle owners. This minimizes the problems that are largely associated with daily rental of vehicles in the capital region of Odisha.

Multiple ownership of vehicles is very limited. Only 12 per cent of the passenger auto drivers-cum-owners have multiple vehicles for their business operations. Among the rental drivers, almost 77 per cent have shown preference for a new vehicles on rent instead of using second-hand vehicles. Among the goods auto drivers, around 89 per cent are single vehicle owners and 11 per cent have multiple vehicles. Only a few of these vehicles—8 per cent—are second-hand vehicles. Around 58 per cent diesel autos are less than five years old. Of the total of all fuel types, 94 per cent goods autos are less than 10 years old. This indicates that there is a greater preference for new vehicles and second-hand vehicle market is limited.

Diesel autos dominate the fleet adding to the toxic risk: The importance of electrification of the auto segment is underscored by the fact already noted that currently about 90 per cent of the auto drivers operate diesel autos and the rest are CNG autos. Almost all goods vehicles—99 per cent—operate on diesel fuel. About 84 per cent of diesel autos are less than 10 years old. CNG autos are much newer as the first CNG station had opened in Bhubaneswar in 2017. This is a matter of serious concern as diesel emissions are responsible for highly toxic and carcinogenic emissions and need to be phased out as part of the clean air action plan while accelerating the pathways to zero emissions.

Operational characteristics: About 69 per cent of the auto drivers are open to providing flexible services depending on demand for services. About 23 per cent of the passenger auto drivers operate their vehicles as point-to-point services. Around 25–75 per cent of the passenger auto-drivers operate their vehicles for 11–14 hours with two to three hours of resting period. Passenger three-wheeler (3W) services are available from early morning up to 10 p.m. The peak hours are usually 7–8 a.m. and 8–9 p.m. Such information can help inform the charging strategy for e-autos.

Daily average running km of goods 3Ws varies according to the size of the cities. In Bhubaneswar, the majority of these vehicles—around 50 per cent—operate within 120–150 km per day. In Cuttack, it is in the range of 100–120 km per day. Puri shows great variation in terms of daily operating km of 60–150 km per day. About

25 per cent of the drivers in Bhubaneswar and Puri operate up to 200 km to serve remote locations. Unlike passenger autos, goods auto services are demand based and largely tied up with different use cases such as carrying and transporting a variety of goods including gas, water bottles, furniture, electronic appliances etc. Goods 3Ws operate for 11–12 hours a day in all cities of the capital region.

Cost of operations: Barring a few exceptions, majority of the passenger auto drivers spend around Rs 300–400 per day to operate the vehicles and have a profit margin of Rs 400–600 per day. Goods auto drivers earn around Rs 800–900, with a profit margin close to Rs 500 per day. Every passenger 3W driver spends around Rs 15,000–20,000 per annum or Rs 1,250–Rs 1,650 per month for maintaining their vehicles. Each goods 3W driver spends around Rs 18,000 per annum or Rs 1,500 per month for maintaining their vehicles. This information is important for framing a fiscal strategy for this segment.

Heavily dependent on financing: Auto drivers have expressed their apprehension related to availability of finances for procuring new vehicles and high cost of vehicles. About 76 per cent of vehicle owners confirmed that they took assistance from financial institutions such as banks and non-banking financial institutions (NBFCs) to procure their vehicles. Almost 50 per cent (falling within the interquartile range of 25–75 per cent) of the vehicle owners took financial assistance in the range of Rs 2–2.75 lakh for procuring new vehicles. Around half the loan receivers got loans with payback period of three and a half to five years. While those repaying their loans for new vehicles pay a monthly installment of about Rs 4,300–6,200, those driving rented vehicles pay roughly around Rs 6,000–7,500 per month to the vehicle owners (at Rs 200–250 per day). Almost 40 per cent said they would require assistance of Rs 1–2 lakh or more.

Almost half of the goods auto-drivers took financial assistance in the range of Rs 2.1–2.55 lakh to procure new vehicles with payback period of four to five years and at monthly installment rate of Rs 5,100–6,800. Those driving the vehicles on rent are paying Rs 250–300 per day (which is roughly around Rs 7,500–9,000 per month) to the vehicle owner.

Willingness and awareness to shift to e-autos: The electric vehicle policy of the Odisha government provides for purchase incentive for three-wheeler vehicles, i.e. 15 per cent of the vehicle cost with maximum amount limited to Rs 12,000 per vehicle. Almost 91 per cent of passenger auto-drivers are unaware about the subsidy. This has negatively impacted their preferences to buy electric passenger three-wheelers. Among those who want to buy electric passenger autos in the

coming years, 62 per cent prefer to buy due to financial benefits such as availing government subsidy and lower cost operation and maintenance. Similarly, almost 98 per cent goods auto drivers are not aware of the provision of the purchase incentives in the Odisha state EV policy.

However, around 36 per cent of respondents have expressed the desire to buy an electric goods auto in the coming years. About 68 per cent of them have indicated lower cost of operation and maintenance of vehicles for their reasons to shift.

However, one-third of the auto drivers have highlighted immature technology, lack of availability of finances and charging facilities as their key constraints and barriers to purchase decisions.

Concerns around charging infrastructure: Auto drivers have highlighted the challenges related to charging infrastructure. Charging is a priority concern as almost 42 per cent of passenger auto drivers have expressed that they generally park their vehicles on the road due to lack of parking space. Also, 41 per cent of passenger auto drivers park their vehicles in front of their houses and need special provisions for installing charging systems with proper electricity connection. Similarly, almost 44 per cent of goods auto drivers park their vehicles on the road due to lack of parking space. About 41 per cent park in front of their own houses. These need special provisions for charging infrastructure with proper electricity connections.

Retrofitment of older vehicles: Increasingly, regulatory interest in retrofitting vehicles with electric motor and battery is growing for cost-effective transition to electric mobility. There are, however, several concerns around this option, including lack of enforcement of safety regulations, mass use of lead acid batteries and ensuring compliance with certification of kits by the Automotive Research Association of India.

About 97 per cent of passenger auto drivers and 88 per cent of goods auto drivers are unaware of such options and facilities. After they were made aware of this option with facts and figures, around 64 per cent of the passenger auto drivers and 38 per cent of goods auto drivers have shown interest in retro-fitment. Close to 70 per cent are ready to bear just 25–30 per cent of the total cost. Close to 70 per cent of goods auto drivers are ready to bear 20–25 per cent of the total cost.

The way forward

It is an opportunity that during the early stages of planning for e-bus deployment in the Capital Region, the potential and strategies for electrification of the auto segment is also being evaluated for an integrated approach to public transport system, with a zero emissions target. With strategic intervention and appropriate support under the new EV policy in Odisha, it is possible to catalyse the change. To accelerate this process, it is necessary to focus on the following steps.

Transformation requires a policy mandate for targeted development and electrification of the auto segment in the capital region. This pilot can help to calibrate the framework needed for further scaling up electrification of this segment across other cities of Odisha.

Given the unique challenges of this segment, the incentive programme will require further strengthening, including non-fiscal incentives that will provide preferential parking and zero or discounted parking charges, preferential entry into special mobility zones to create demand for e-autos, among others.

The programme has to encourage linking of incentive with good quality products that are tested and certified according to norms to build confidence in the market and of the financial institutions for lending to this segment. Like several other state governments have done, the Odisha state government also needs to empanel manufacturers after rigorous testing and trials of their product and allow only approved vehicles to avail of government subsidy. It is necessary to improve product quality, durability and provide warranty that are comparable to conventional diesel and CNG autos including extended warranty. This will also help to resolve vehicle related disputes.

Several steps are needed to address the uncertainty around financing. The state government may consider to be credit guarantor for providing easy loans with reasonable interest rates; provide purchase subsidies directly into the loan account of the loan recipient to reduce EMI burden; interest subvention or paying of a part of the interest to reduce EMI burden.

Lack of charging was perceived as one of the major obstacles for electrification of three wheelers by auto drivers. As these vehicles rely largely on night-time home charging supported by top-up charging in the public charging infrastructure, this requires public charging facilities at the community parking locations at subsidized fee. Odisha State EV policy has already provided for this. This will also require

building-level audits to assess adequacy of the connected load of households and ancillary requirements and provide incentives/grants to e-3W owners for setting up charging points at home.

While incentives can be a pull factor, it is also necessary to disincentivize the ICE-3Ws by limiting their number and restricting registration of new diesel 3Ws to push the demand towards e-autos and to create the critical mass needed for it become self-sustaining trend.

One of the barriers to scaling up of the e-auto segment is the lack of knowledge in the market about the product. This dampens demand. This requires targeted programme for sensitization and awareness to demystify the product, its technology, operational aspects, availability of incentives, charging needs and safety requirements.

Section 2: Imperatives of three-wheeler (auto-rickshaw) market and its challenges

In India, three wheelers—popularly called auto rickshaws—are part of the intermediate public transport or para-transit system and play a very important role in urban commuting, particularly in medium and smaller cities. In most cities, autos are the dominant mode of transfer, i.e. they account for 42–76 per cent of modes of public services (see *Graph 1: Share of three-wheeler mode in Indian cities*). In bigger cities these modes also provide substantial share of last mile connectivity and feeder services that integrate multiple modes of mass transportation including buses and metro.

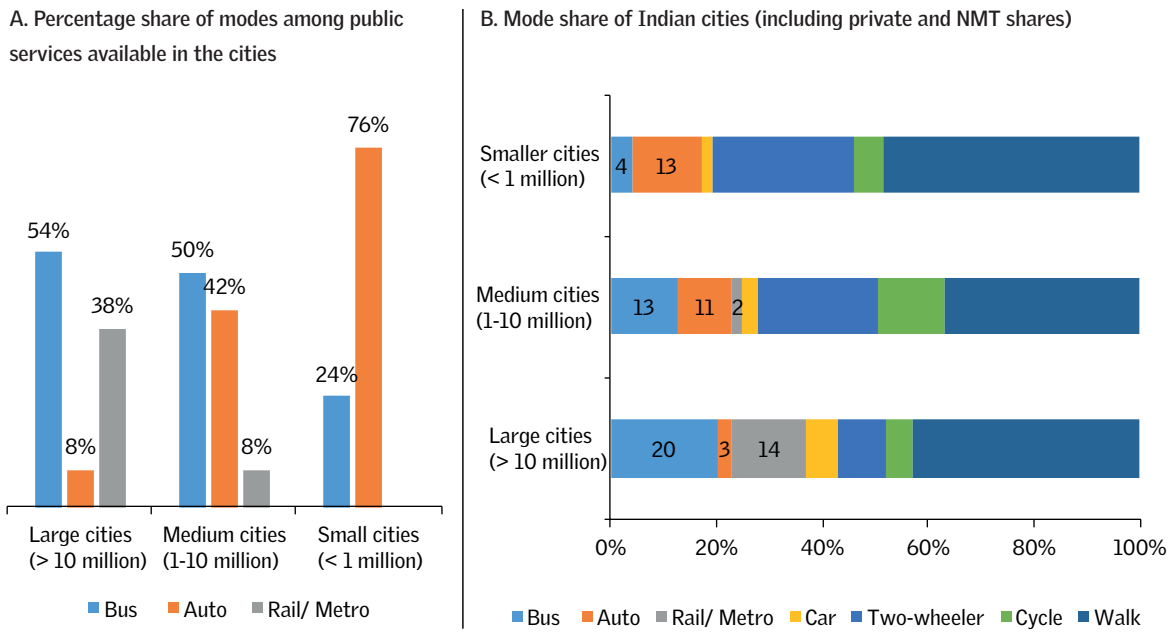
At the national level, annually, more autos are registered in cities than buses. But these are expected to play a complimentary role (see *Graph 2: Comparative assessment of number of stage carriage buses and 3Ws registered per lakh of population [as on March 31, 2018]*). Increasingly, now these vehicles are also being inducted into the shared mobility services and for last-mile delivery in addition to these being important part of local cargo services.

Preference of 3W services as a means of last-mile connectivity to mass modes (like metro, bus rapid transit-BRT, city bus services etc.) has been observed in various studies. An earlier study on last-mile connectivity of Delhi metro services, in 2010, conducted by a researcher of the School of Planning and Architecture, New Delhi, found that almost 31–45 per cent metro commuters had shown their preference to use 3W services, including cycle-rickshaws (available on certain locations of that time).[3] In 2021, a similar commuter study on Ahmedabad BRTS, identified autos as the most preferred last-mile mode for commuters to travel home or office from BRT stations.[4]

Nationally, till March 2019, India had 9.5 million registered 3Ws (i.e. 2.7 million 3W goods and 6.8 million 3W passenger vehicles); the number had almost doubled in the past decade, i.e. 4.8 million in 2010. The trend of new registration per annum shows that over the past six years (i.e. 2013–19), except for 2015–16, the number of newly registered 3Ws was continuously breaking its previous high with a new one.

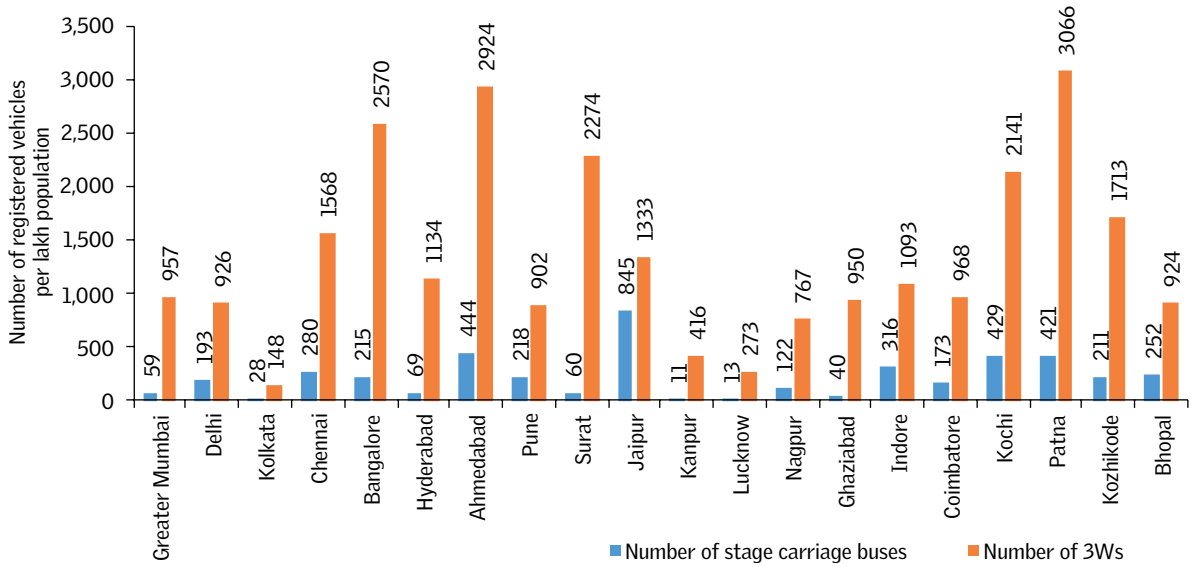
Similarly, if we look at the 3W production and domestic sale data of past five

Graph 1: Share of three-wheeler mode in Indian cities



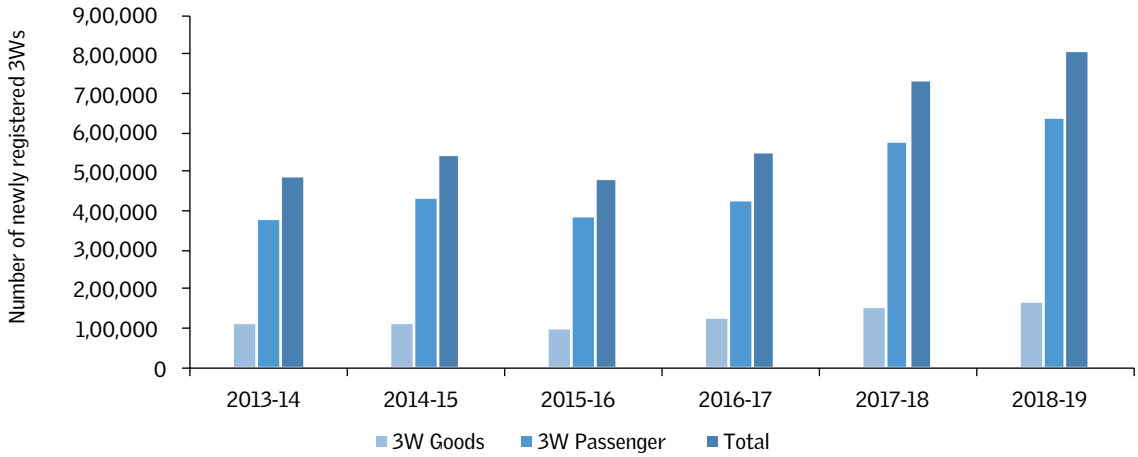
Source: Ravi Gadepalli 2016, Role of Intermediate Public Transport in Indian Cities, Vol. 9, *Economic and Political Weekly*.[2]

Graph 2: Comparative assessment of number of stage carriage buses and three-wheelers registered per lakh of population (as on March 31, 2018)



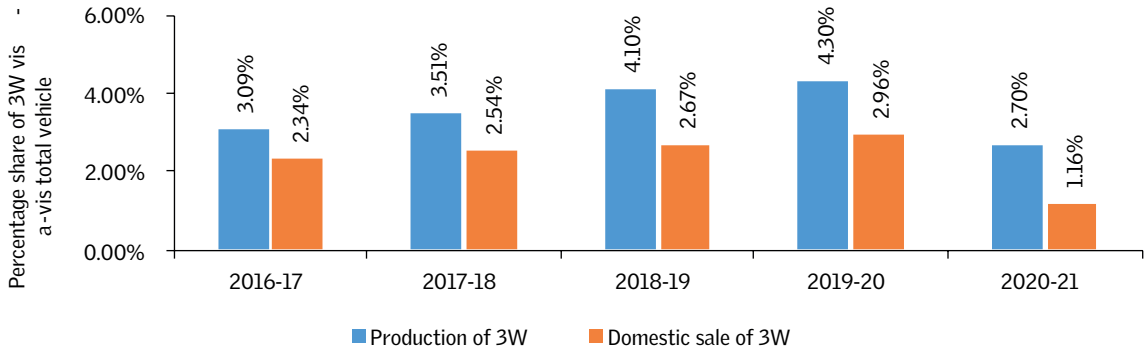
Source: Road Transport Year Book (2017–18 and 2018–19), Ministry of Road Transport and Highways, Government of India.

Graph 3: Trend of newly registered three-wheelers per annum in India



Source: Road Transport Year Books (2013–2019), Ministry of Road Transport and Highways, Government of India.

Graph 4: Trend of production of three-wheelers and domestic sale in India



Source: Society of Indian Automobile Manufacturers

years, both the data sets clearly show that the percentage share of 3W segment is continuously growing against the total vehicles, except in 2020–21, when both drastically declined due to the Covid pandemic. However, the 3W segment is also recovering from its pandemic disruption. In April–December 2021, 2.6 lakh of three-wheelers were sold, which is almost double the sale on a year-on-year basis (i.e. April–December 2020).[5]

State electric vehicle policies and e-three-wheelers

As many as 21 states in India have notified or drafted state electric vehicle policies to guide state-level implementation. Several states have specifically provided for targeted electrification of the three-wheeler segment and supportive incentives (see *Table 1: State electric vehicle policy and three-wheelers*).

Table 1: State electric vehicle policies and electric three-wheelers

State	Incentive
Andhra Pradesh	Electric autos to be given permits on a priority basis Low-powered auto rickshaws to be restricted in areas Model cities to phase out all fossil fuel-based three- and four-wheelers by 2024 and other cities by 2030
Assam	No targeted incentives for three-wheelers
Bihar	No targeted incentives for three-wheelers
Chandigarh	No targeted incentives for three-wheelers
Delhi	Purchase incentive of Rs 30,000 Interest subvention of 5 per cent As per the FAME II eligibility criteria Open permit system Scrapping incentive up to Rs 7,500 to be reimbursed Hire-purchase scheme for ARAI-certified autos and with advanced Li-ion batteries
Goa	Incentive for new autos and for retro-fitment (including both categories of batteries)
Gujarat	No targeted incentives for three-wheelers
Haryana	No targeted incentives for three-wheelers
Karnataka	Autos to be 100 per cent electric by 2030
Kerala	No targeted incentives for three-wheelers
Madhya Pradesh	Incentivize purchase of e-autos and promote conversion of CNG auto to EVs
Maharashtra	Demand incentives and scrappage incentives
Meghalaya	Purchase subsidy
Odisha	Purchase subsidy Open permits
Punjab	E-autos: 100 per cent waiver on permit fees and motor vehicle tax. If manufactured in Punjab waiver for 10 years E-rickshaws: 100 per cent waiver on permit fees and registration fee. If manufactured in Punjab waiver for 10 years Goods carrier three-wheelers: 100 per cent waiver on permit fees and motor vehicle tax. If manufactured in Punjab waiver for 10 years. 100 per cent transition aimed for.
Rajasthan	No targeted incentives for three-wheelers
Tamil Nadu	Permit fees to be waived off 100 per cent road tax exemption Waiver on registration charges/fees
Telangana	100 per cent waiver on road tax and registration fees for first 20,000 units Retrofitment incentives: 15 per cent of retrofitment costs or up to Rs 15,000, whichever is lower, for the first 5,000 retrofitted units Hire purchase scheme at discounted rates
Uttar Pradesh	No targeted incentives for three-wheelers
Uttarakhand	No targeted incentives for three-wheelers
West Bengal	No targeted incentives for three-wheelers

Source: Compiled from state electric vehicle policies

Collectively, the incentives include purchase subsidies, interest subvention, exemption from permit fees, scrapping incentives, waiver on registration fees. In some cases passenger and goods e-autos have been taken on board separately. However, the combination of incentives vary from state to state.

Imperatives of three-wheeler market in Odisha

In Odisha, 3Ws are considered to be the prime mode of transport for intra-city commuting, and sometimes inter-city services. They have gained such popularity due to following reasons:

- Smaller city sizes: Except Bhubaneswar and Cuttack all other cities and/or urban centres in Odisha have areas that is less than 100 sq. km in size and compact urban forms. As a result, the average trip length is small, and accessible through 3W services.

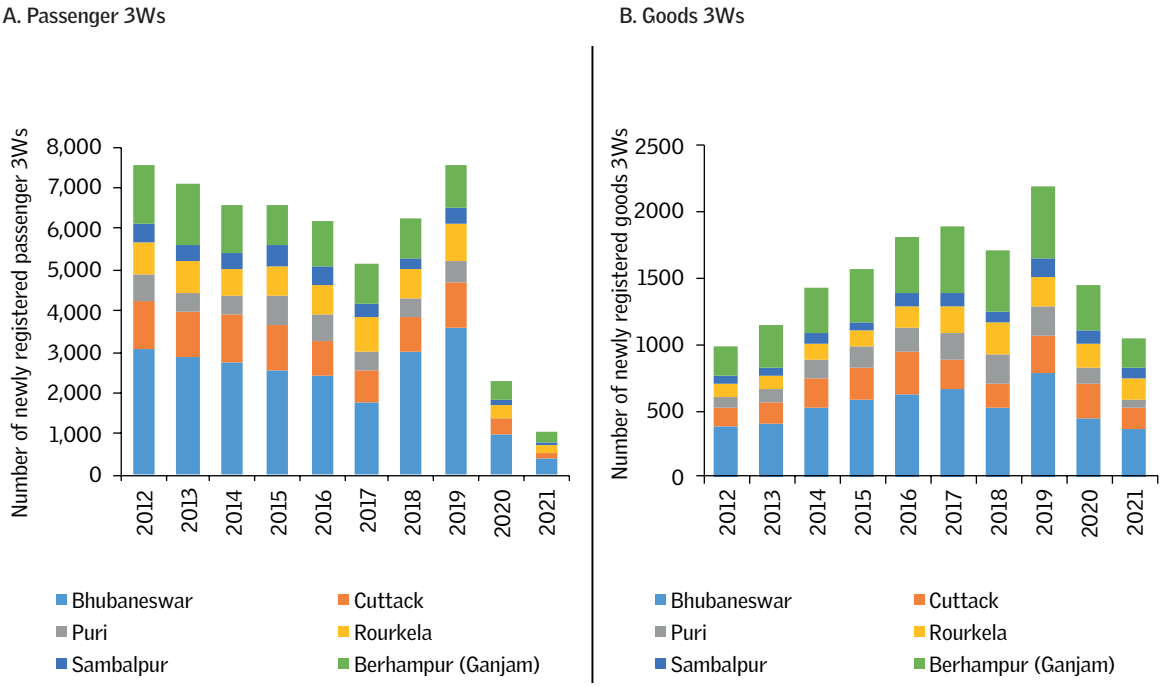
- Low population that does not support mass-transport requirements: All the nine cities and/or urban centres in Odisha have less than 1 million population. And, if we remove the top three cities, the rest have less than 0.4 million population as per Census 2011, in which large vehicles find it difficult to operate in higher frequencies, except in a few corridors.

- Absence of other competitive modes: Except Bhubaneswar, cities in Odisha do not have good intra-city connectivity through other modes like buses. Odisha has six city bus services, but except Mo-Bus services in Bhubaneswar, other city services are largely confined to main corridors of the city and organized as a network to for wider coverage of the city and population.

As a result of these factors, the 3W passenger population in Odisha has increased approximately three times; from 0.06 million in 2010 to 1.68 million in 2019.[6] Simultaneously, 3W goods numbers have also more than doubled to 0.09 million.[7]

A deeper analysis of newly registered 3Ws during 2012–21 of six major cities or urban centres in Odisha shows that due to the Covid-19 pandemic, both 3W passenger and goods vehicle registration declined to its lowest level in 2021, to approximately 1000 vehicles for each vehicle category. Before the pandemic, in 2012–19, the registration of 3W passenger vehicle was 5,000–7,500 per annum and during the same period 3W goods registration also increased from 1,000 vehicles to 2,000 vehicles per annum (see *Graph 5: Trend of newly registered three-wheelers in major cities/urban centres in Odisha*).

Graph 5: Trend of newly registered three-wheelers in major cities and/or urban centres in Odisha



Source: Vahan database, Ministry of Road Transport and Highways

Now as the state and cities are normalizing from the pandemic phase and gearing up for rapid economic transformation, due to small city sizes, the 3W segment in Odisha is poised to grow drastically compared to other public transport services in the coming days. And, this expected growth of 3Ws poses a special challenge for the state's green mobility future.

Autos by type of fuel in capital region of Odisha: Registration data available from the Vahan database of the Ministry of Road Transport and Highways shows that the numbers of diesel autos overwhelm the fleet in several key cities of Odisha, especially Bhubaneswar.

If only the capital region is considered, then according to the Vahan database of the Ministry of Road Transport and Highways, during 2012–21, around 45,000 3Ws were registered, among which almost 41,000 are diesel and rest 4,000 are CNG, including both passenger and goods.[8] If we assume all 3Ws are in operation, the vehicle segment alone contributes to 0.19 million tonnes of CO_2 emissions

per annum** in the capital region. Besides, these vehicles consume 16 million gallons of DGE (diesel gallon equivalent) of energy per annum, costing up to Rs 500 crore per annum to public exchequers. Converting these vehicles, specifically the old diesel ones into electric, will provide direct benefits in terms of pollution reduction, cost saving and emissions.

Primary surveys conducted within the capital region area, covering the local administrative jurisdiction of Bhubaneswar, Cuttack and Puri, reveals that 90 per cent of the passenger 3Ws services are being operated using diesel fuel and rest with CNG (compressed natural gas). Use of diesel 3Ws for goods services is even more—almost 99 per cent.

Similarly, if we assess the emission profile, then roughly 66 per cent or two-thirds of the 3W passenger vehicles and almost 50 per cent of 3W goods vehicles surveyed are under BS-3, or the older category including both diesel and CNG fuel vehicles (see *Graph 6: Fuel and emission profile of three-wheeler services in capital region of Odisha, for details*)

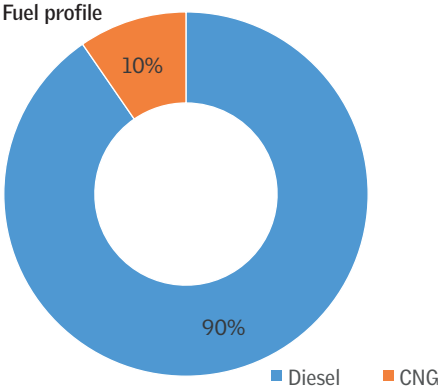
Electrification of the 3W segment will also help states to achieve its objective of rapid adoption of the small vehicle segment, as it constitutes almost 3 per cent of the total registered vehicles in the state.[9] Besides, as 3Ws are being used as one of the major modes of the city mobility, a substantial portion of city trips will directly be converted into zero emission trips.

** Considering 3Ws operate for 120 km per day, as observed from primary survey and emission factor for BS-3 diesel 3W—102.183 g/km and BS-3 CNG 3W—52.1653 g/km.

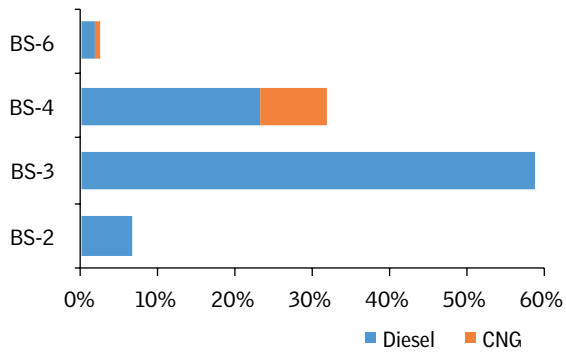
Graph 6: Fuel and emission profile of three-wheeler services in capital region of Odisha

Three-wheeler passenger vehicles

Fuel profile

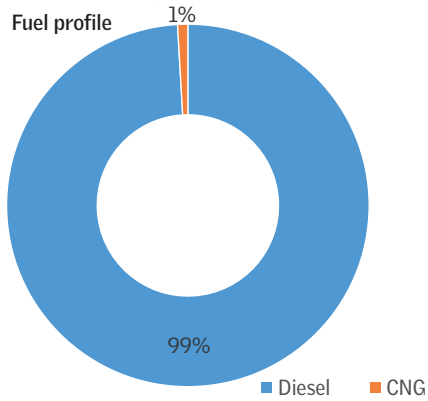


Emission profile

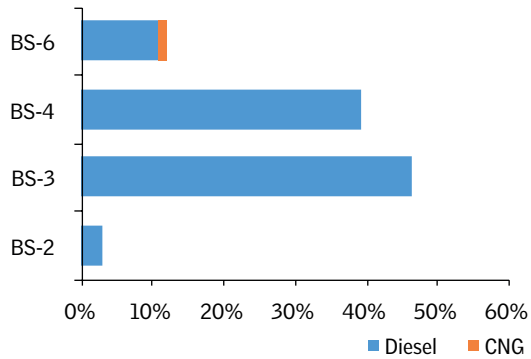


Three-wheeler goods vehicles

Fuel profile



Emission profile



Source: Primary survey conducted by CSE, December 2021

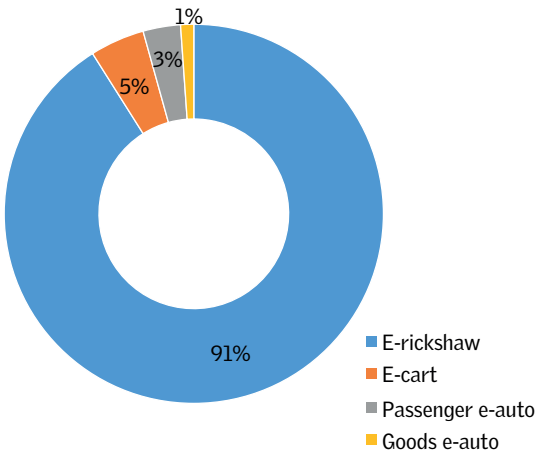
Section 3: Electric three-wheeler technology

As the cities embark on electrification of the e-auto segment, it is necessary to understand the available technologies in the market. India currently has almost 6.75 lakh registered electric three-wheelers,[10] of which almost 91 per cent are e-rickshaws. The percentage share of e-auto, including both the passenger and goods segment, is only 4. Since 2015, the overall electric 3W segment (including e-rickshaws, e-carts, passenger e-autos and goods e-autos) have increased at an astonishing rate of 69 per cent (compound annual growth rate) per annum (see *Graph 7: Trend of electric three-wheelers in India for details*).

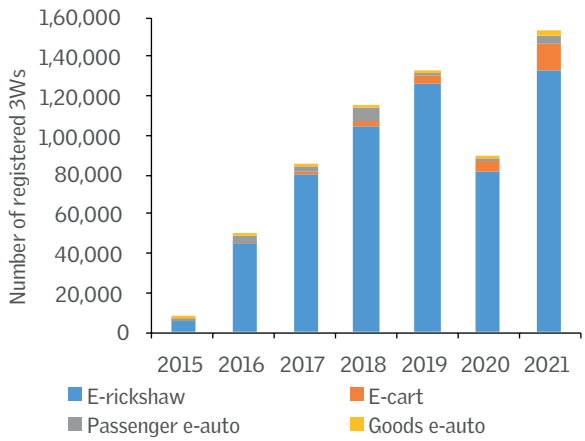
In the past two years (2019–21, particularly after introduction of FAME 2 funding scheme, the rate of growth per annum in passenger and goods e-auto segment has increased by almost three and a half times and five times, respectively.

Graph 7: Trend of electric three-wheelers in India

A. Percentage share of different electric three-wheeler segments in India



B. Growth trend of different electric three-wheeler segments in India



Source: Vahan database, Ministry of Road Transport and Highways

Electric three-wheeler market in India

Passenger segment

E-rickshaws: As per the technical definition, these vehicles are designed to carry not more than four passengers, excluding drivers, and not more than 40 kg of luggage in total. The net power of the motor is not more than 2,000 KW, and maximum speed of the vehicle is not more than 25 km per hour.

There are currently more than 600 e-rickshaw makers in India. Till February 2022, however, only 14 makers, with a combined market share of 42 per cent, have been able to sell more than 10,000 e-rickshaws each.

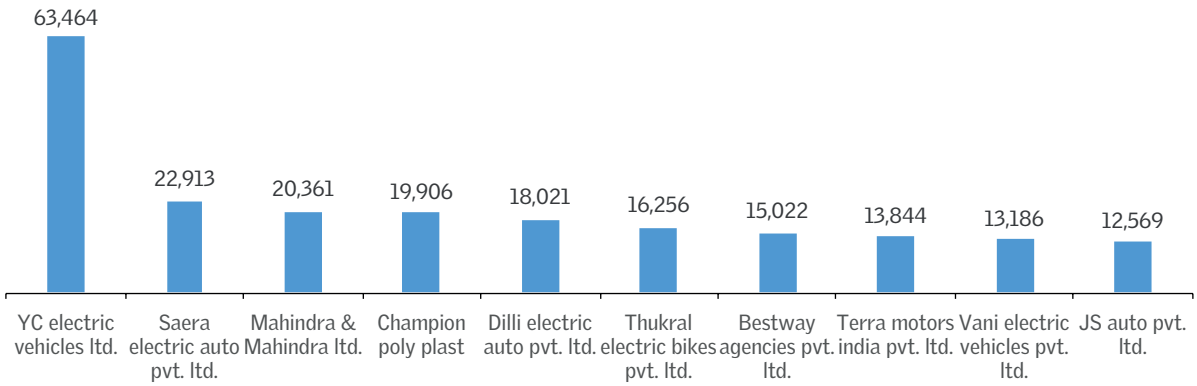
Among the top 10 makers, except Mahindra and JS Auto, all others are new to the three-wheeler business. YC Electric Vehicles Ltd tops the chart, with 10 per cent market share, which is almost 7 per cent higher than the second contender, i.e. Saera Electric Auto Pvt. Ltd (see *Graph 8: Top 10 e-rickshaw makers in India*).

Among the top 10 e-rickshaw makers, except two makers, all others have e-rickshaw models based on lithium-ion (Li-ion) batteries. The Li-Ion battery vehicles are different from lead-acid battery models in range of the vehicle, price of the vehicle and availability of FAME 2 funding. The range of Li-ion battery is higher (i.e. 85–129 km) than of lead-acid battery (i.e. 75–110 km) per single charge. Accordingly, the cost of Li-ion e-rickshaw is also higher (i.e. Rs 1.1–1.7 lakh) than lead-acid models (i.e. 0.95–1.3 lakh). Li-ion models of all the eight makers are eligible to avail of the FAME 2 subsidy at a range of Rs 30,000–36,000, depending upon their battery size. All the models currently use conductive charging (plug-in) facilities, which take three to four hours and seven to eight hours for full charging in the case of Li-ion and lead-acid based battery models, respectively.

Currently, e-rickshaws are operating in almost 21 Indian states. However, almost 84 per cent of the total e-rickshaws are concentrated in just five states; namely Uttar Pradesh, Delhi, Bihar, Assam and West Bengal (see *Graph 9: Top 10 states with e-rickshaws in India for details*).

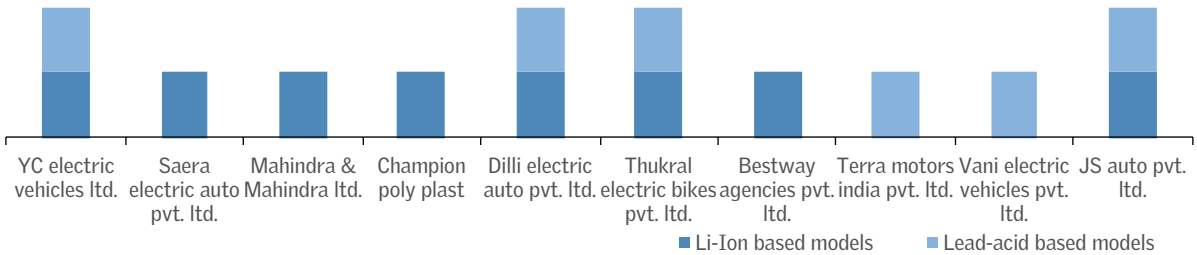
A detailed analysis of e-rickshaw deployment in India revealed two major reasons for such massive concentration in few states. First, states with large numbers of traditional cycle-rickshaws like Delhi (Old Delhi area), Uttar Pradesh (Mathura, Vrindavan, Lucknow, Varanasi etc.) and West Bengal (Kolkata and interior parts of Bengal) have been able to transition to e-rickshaws, as they later provide better

Graph 8: Top 10 e-rickshaw makers in India (till February 2022)



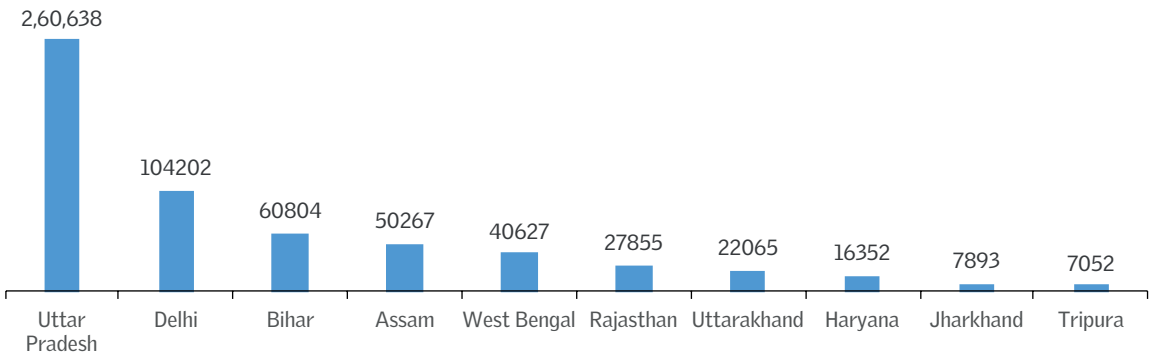
Source: Vahan database, Ministry of Road Transport and Highways

Graph 9: E-rickshaw models with battery composition (among top 10 makers) in 2021



Source: Data collected by CSE

Graph 10: Top 10 states with e-rickshaws in India (till February 2022)



Source: Vahan database, Ministry of Road Transport and Highways

BOX 1: STATE INITIATIVE IN DEPLOYING E-RICKSHAWS:

UTTAR PRADESH

- In 2015, the state cabinet approved the tender for free distribution of 27,000 e-rickshaws in first phase.
- In 2017, the state introduced the Samajwadi e-rickshaw Scheme—almost 2.48 lakh rickshaw pullers have registered with the scheme.
- In 2019, under the state EV policy, the state set a target of rolling out 10 lakh EVs, including all segments of vehicles by 2024. No doubt, e-rickshaw will play a greater role in achieving this target.

DELHI

- In 2015, the state government-approved one-time fixed subsidy of Rs 15,000 to battery-operated rickshaw owners under the Air Ambience Fund.
- In 2016, the state increased the one-time fixed subsidy on battery-operated rickshaw from Rs 15,000 to Rs 30,000.
- In 2020, under the state EV policy, the state continued their support for e-rickshaws by providing a purchase incentive of Rs 30,000 per vehicle. Additionally, the state has also committed to provide interest subvention of 5 per cent on loans and/or hire-purchase scheme on some specific advanced battery models approved by ARAI. Additionally, policy document sets a target of 25 per cent of all new vehicle registrations as battery electric by 2024.
- Interestingly, a ban on new auto registration within Delhi also pushed for rapid increase of e-rickshaw population.

BIHAR

- In 2018, the state transport department introduced the Mukhyamantri Gram Parivahan Yojana, under which the almost 42,000 beneficiaries will get grants up to 1 lakh or 50 per cent subsidy for purchasing vehicles for public transportation. The vehicles include four-seater auto or e-rickshaws and 10-seater van.
- In 2020, under the state EV policy, a special grant of Rs. 10,000 per kWh has been allocated for manual rickshaw puller for conversion to electric mobility.

WEST BENGAL

- In 2015, the state transport department introduced the Gatidhara Scheme to generate self-employment in urban and rural areas. Under this scheme the state provides financial assistance of a maximum of Rs 1 lakh or 30 per cent of the vehicle cost.
- In 2021, under the state EV policy, the state has set a target of rolling out 10 lakh EVs, including all segments of vehicles by 2026.

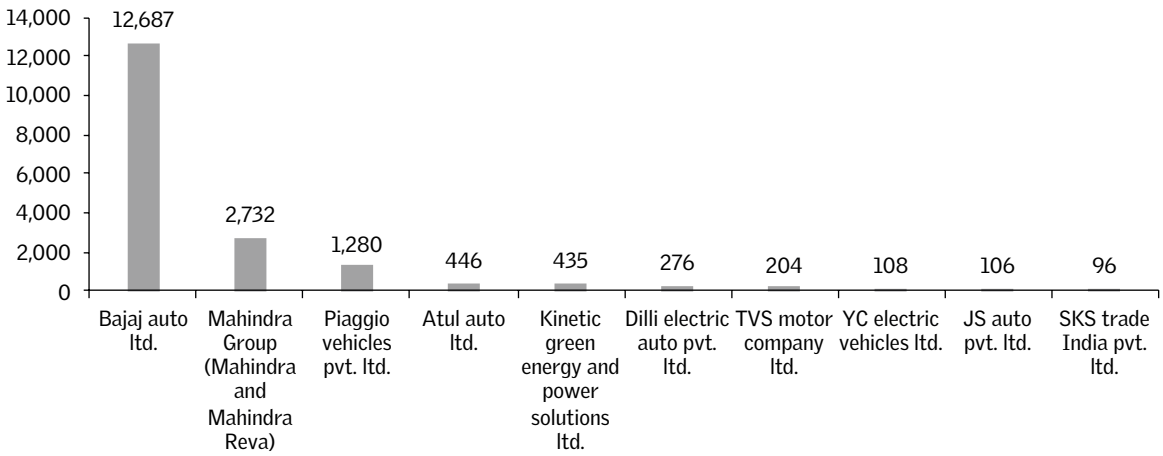
service delivery with better profit margins (as passenger occupancy has doubled with e-rickshaws). Second, all of these state governments have provided considerable initial support in terms of providing subsidy in e-rickshaw deployment.

Passenger e-auto: Passenger e-auto are battery-operated L5-category three-wheeler vehicles with maximum speed exceeding 25 km per hour and gross vehicle weight limited to 1,500 kg. There are currently close to 200 passenger e-auto (L5M category) makers in India. There are only three manufacturers, however (as of February 2022), namely Bajaj, Mahindra (combined Mahindra Reva and Mahindra) and Piaggio, who have sold more than 1,000 e-autos each. Their combined market share is 78 per cent. Unlike the e-rickshaw segment, which is largely dominated by new entrants, the passenger e-auto (L5M category) segment is largely dominated by conventional ICE auto makers. Among 9 passenger e-auto makers, who have sold more than 100 e-autos each, only two makers, namely, YC Electric Vehicles Ltd and Dilli Electric Auto Pvt. Ltd, do not have models in the ICE auto segment (see *Graph 11: Top 10 passenger e-auto (L5M category)* makers in India).

Among the top 10 passenger e-auto makers, Bajaj, Mahindra, Piaggio, Kinetic and TVS provides models that look similar to conventional ICE auto models. The rest are like e-rickshaws with upgraded features that are to be considered under the L5M category.

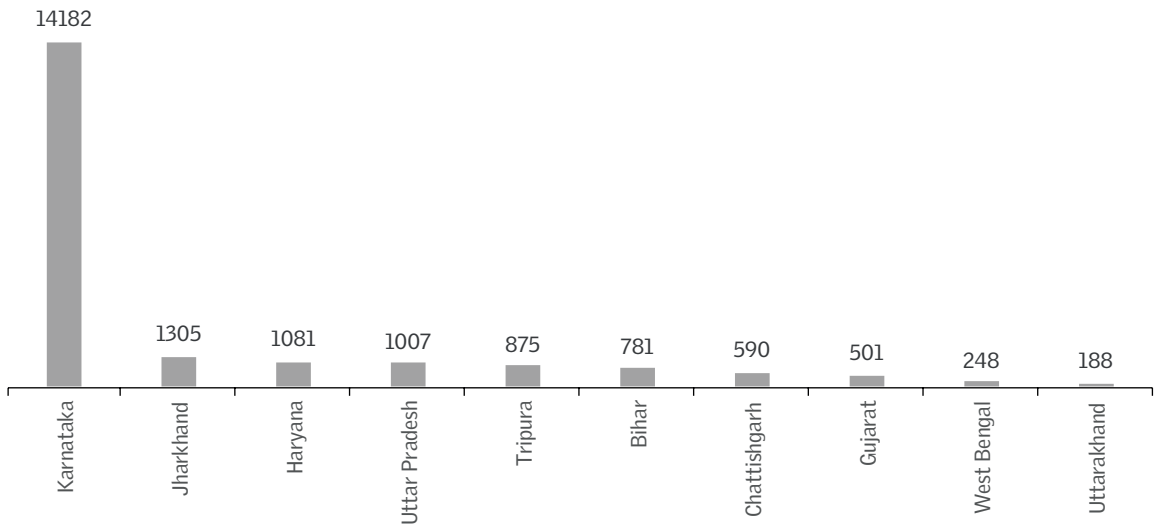
These e-autos (especially the top three brands) can operate for a range of 120–

Graph 11: Top 10 passenger e-auto (L5M category) maker in India (till Feb 2022)



Source: Vahan database, Ministry of Road Transport and Highways

Graph 12: Top 10 states with passenger e-autos in India (till February 2022)



Source: Vahan Database, Ministry of Road Transport and Highways

170 km in a single charge, with a maximum speed up to 40–45 kmph. In terms of battery technology, all the above makers use Li-ion batteries, with conduction charging (plug-in) facilities with a charging time three to four hours. The cost of these passenger e-autos generally is Rs 1.8–2.9 lakh.

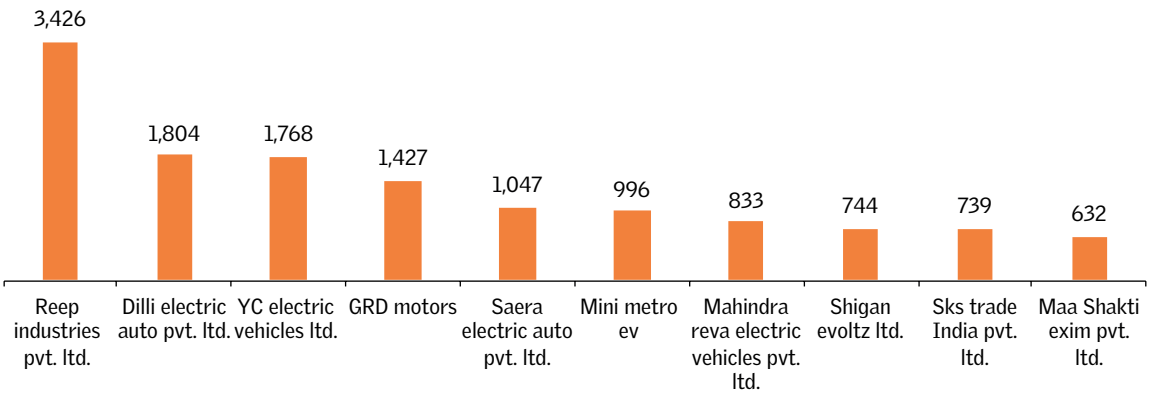
Passenger e-autos currently operate in 26 Indian states. However, 66 per cent of these e-autos are concentrated in only a single state, i.e. Karnataka. There are only eight Indian states that have more than 500 passenger e-autos which together cover 89 per cent of the total passenger e-autos in India.

One of the pioneering states in implementing EV policy in 2017, Karnataka has set the target of achieving 100 per cent e-mobility in the auto-rickshaw segment by 2030. The state has also taken various initiatives to expand charging infrastructures. Also, e-rickshaws are not allowed to operate within Bangalore, but e-autos are. This has led to significant increase in the passenger e-auto population

Goods segment

E-cart: E-cart is a battery-operated three-wheeled vehicle that provides last-mile connectivity to transport goods. These vehicles are constructed to carry goods by providing a separate load body or compartment with maximum weight of 310 kg aside from the driver. Net power of the motor is not more than 2,000 W; and maximum speed of the vehicle is not more than 25 km per hour.

Graph 13: Top 10 states with e-cart maker in India (till February 2022)



Source: Vahan database, Ministry of Road Transport and Highways

There are currently around 300 e-cart makers in India. Until February 2022, however, only five e-cart makers pan India have been able to sell more than 1,000 e-carts. The combined market share of the top 10 e-cart makers is almost 43 per cent. Similar to the e-rickshaw segment, the e-cart market is also largely dominated by new players.

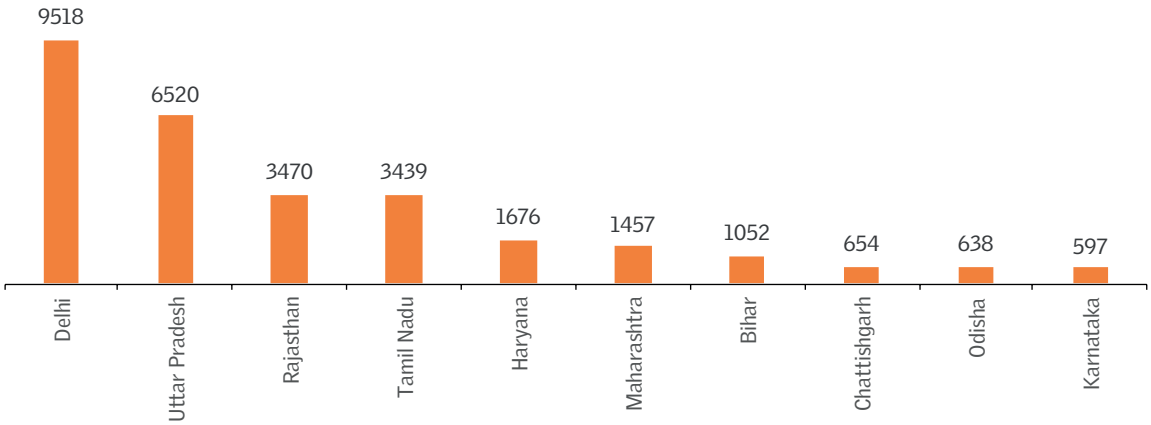
Major brands, including Reep Industries, GRD Motors, Saera Electric, Mini Metro, Mahindra and Shigan, use Li-ion batteries. The rests have lead-acid models. All these e-carts can operate at a maximum speed of 25 kmph and provide a range of 80–120 km per single charge. Brands such as Reep Industries, Mahindra and Shigan provide models with battery capacity of 4.4–5.1 kWh which takes six to eight hours to get fully charged. All the top brands use conductive charging (plug-in) facilities. In terms of cost, these e-carts are available for Rs 95,000–1.95 lakh, depending upon battery type and capacity.

Currently, e-carts operate in 24 states, of which one-third are there in Delhi alone. Almost 85 per cent of total e-carts are registered within five states (see *Graph 14: Top 10 states with e-carts in India*).

A deeper analysis of both Delhi and Uttar Pradesh e-cart data (which together cover 55 per cent of the total) reveals that inclusion of clear targets in the respective state EV policies have impacted e-cart sales. Over the last two years, almost 65 per cent and 71 per cent of the total e-carts are being registered in Delhi and Uttar Pradesh, respectively.

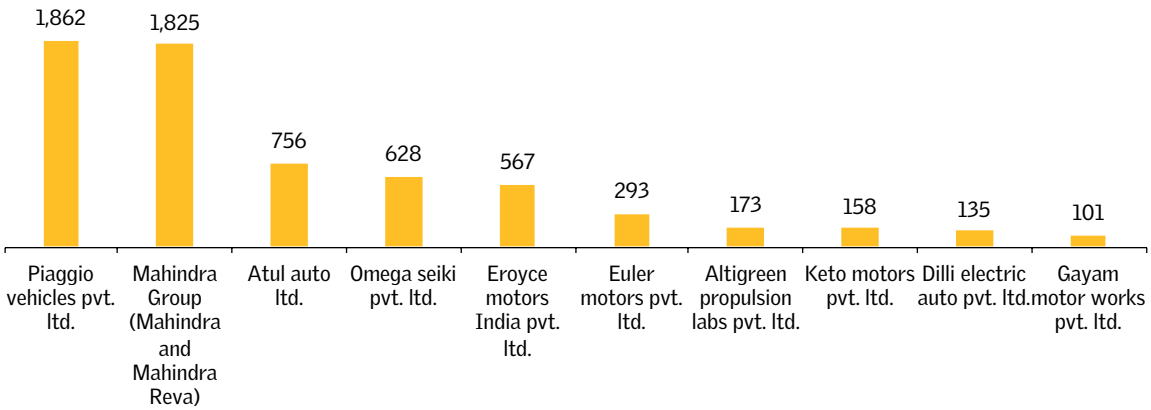
Goods e-auto: Like passenger e-autos, goods e-autos are also a battery-operated L5 category three-wheeler vehicle specifically designed to carry goods.

Graph 14: Top 10 states with e-carts in India (till February 2022)



Source: Vahan database, Ministry of Road Transport and Highways

Graph 15: Top 10 goods e-auto makers in India (till February 2022)

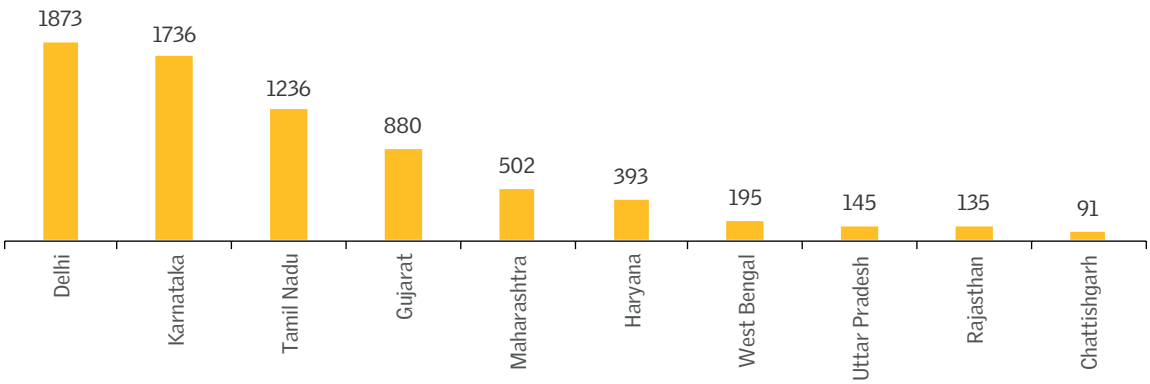


Source: Vahan database, Ministry of Road Transport and Highways

There are close to 100 goods e-auto (L5N category) makers in India, but only five makers have been able to sell more than 500 goods e-autos each (as of February 2022). The big conventional auto players like Piaggio, Mahindra and Atul have dominated the market, with around 60 per cent market share. However, new players like Omega Seiki and Eroyce Motors have also made their strong presence felt in the market.

Except for Gayam Motor Works, all the other top brands have Li-ion models with a battery range of 120–190 km per single charge. The speed of the vehicles is fairly decent, in the range of 40–55 kmph. Except lead-acid model which is

Graph 16: Top 10 states with goods e-auto in India (till February 2022)



Source: Vahan database, Ministry of Road Transport and Highways

little cheaper, the Li-ion models are available in the range of Rs 2.4–3.8 lakh per vehicle, depending upon battery capacity. Generally, goods e-autos use conductive charging (plug-in) facilities and charging generally takes seven to eight hours.

Presently, goods e-autos are there in 23 Indian states. However, 83 per cent of total goods e-autos are concentrated in five states of which almost 57 per cent is there in Delhi and Karnataka.

The combined effect of FAME 2 scheme along with the state EV policies has drastically increased the goods e-auto stock. In Delhi, out of the total registered goods e-autos almost 69 per cent were registered in 2021. Similarly, 67 per cent and 70 per cent of total goods e-auto in both Karnataka and Tamil Nadu, respectively, were added in 2021.

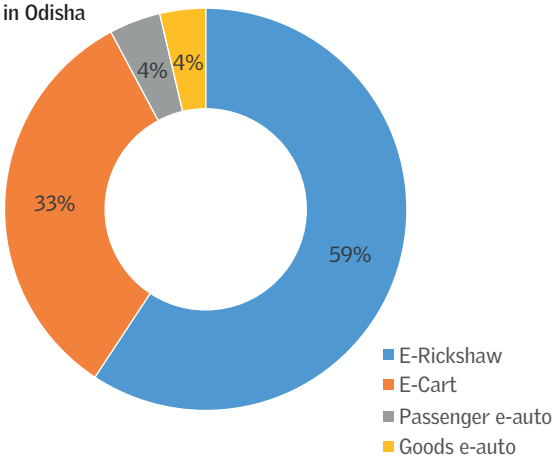
Electric three-wheeler market in Odisha

The electric three-wheeler market in Odisha is still at a nascent stage. Until February 2022, Odisha had little less than 2,000 registered electric three-wheelers, including both passenger and freight vehicles (combining all the four segments, i.e. e-rickshaw, e-cart, passenger e-auto and goods e-auto), which is merely 0.3 per cent of the total registered three-wheelers in the country.

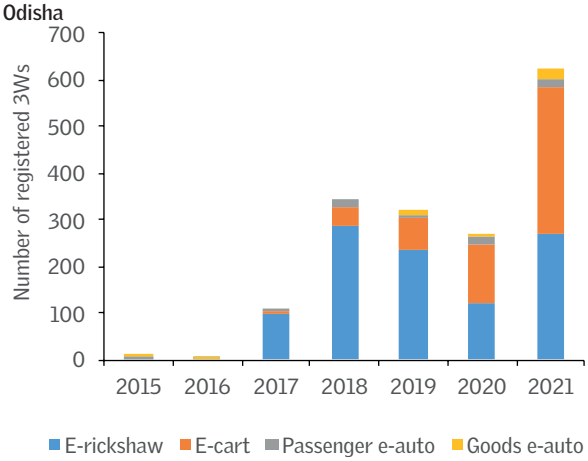
Among the various segments, the smaller ones (i.e. e-rickshaws and e-carts) in both passenger and goods categories contribute 92 per cent of the total market. An analysis of the growth trend of different electric 3W segments reveals that since their introduction, the annual registration of e-carts is continually increasing and surpassing its previous high.

Graph 17: Growth of electric three-wheeler in Odisha

A. Percentage share of different electric 3W segments in Odisha



B. Growth trend of different electric 3W segments in Odisha



Source: Vahan Database, Ministry of Road Transport and Highways

Passenger segment

E-rickshaw: Currently, approximately 1,200 e-rickshaws are in Odisha. E-rickshaws of more than 35 brands are currently available in the state, of which Pubang Etron Electric Motor Pvt. Ltd has the largest market share of 25 per cent, followed by Mahindra Reva (11 per cent) and Kinetic Green Energy (8 per cent). Other than the above three brands, e-rickshaws of other big names such as YC Electric, GK Rickshaw, Goenka Electric, Saera Electric, Terra Motors, Atul Auto, Piaggio etc. are also available in Odisha.

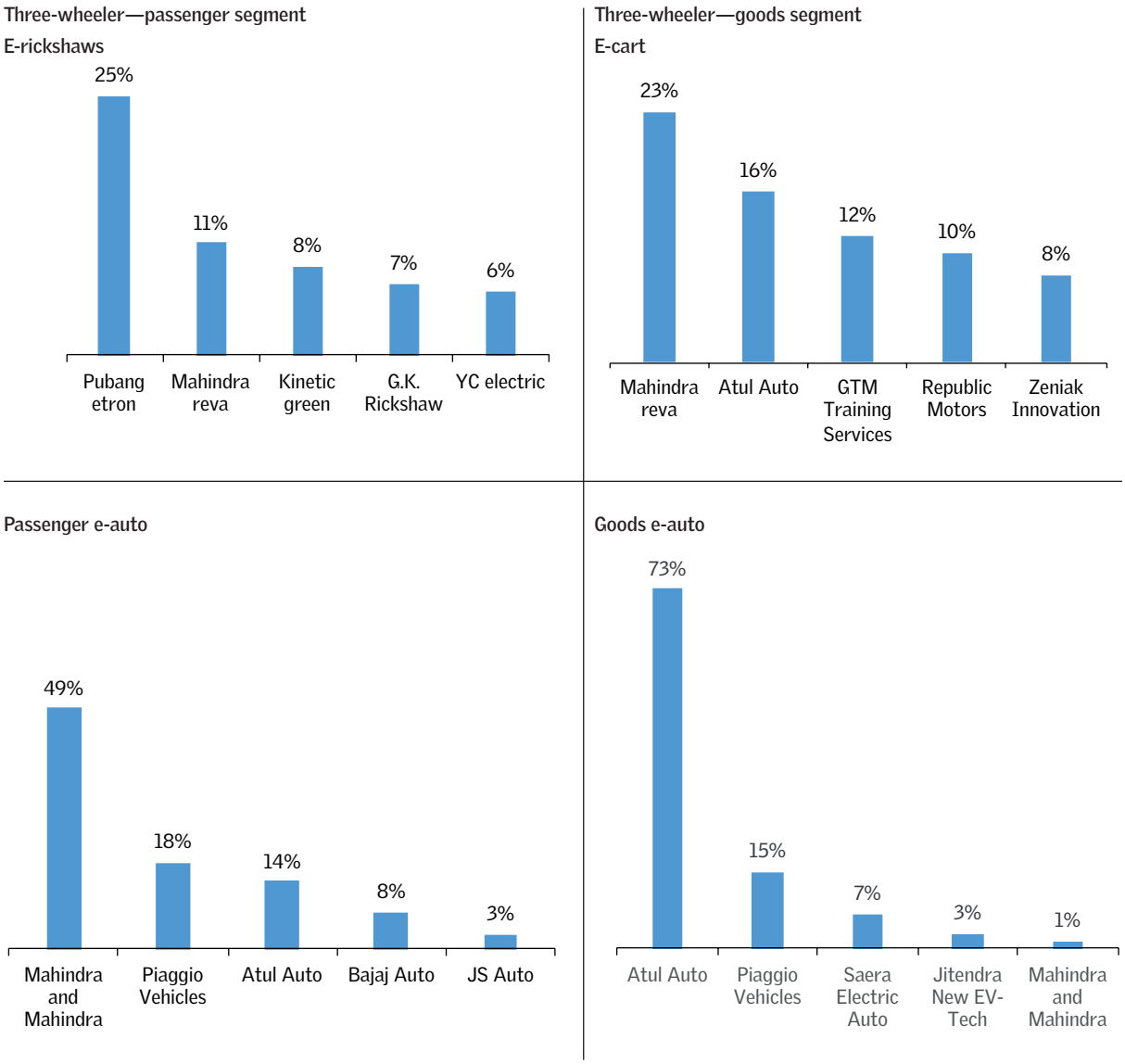
Passenger e-auto: This vehicle segment is still uncertain, there are only 80 vehicles in the state. This segment consist of e-auto models of big brands like Mahindra (including Mahindra Reva), Piaggio, Atul Auto, Bajaj etc. are available.

Goods segment

E-cart: Currently, there are only 636 e-carts in Odisha (as of February 2022). However, this segment is increasing rapidly. Almost 50 per cent of the total registration was in last year (2021). Big brands such as Mahindra, Atul Auto, Saera Electric, Piaggio and Terra Motors have their presence in Odisha. Altogether a total of more than 30 brands are in existence in the state.

Goods e-auto: Like passenger e-autos, goods e-autos are also new to the market. There are only 71 registered goods e-autos in the state. Brands such as Atul Auto, Piaggio, Saera Electric and Mahindra are available.

Graph 18: Top five three-wheeler makers in Odisha



Source: Vahan database, Ministry of Road Transport and Highways

In the case of smaller three-wheeler categories like e-rickshaws and e-carts, there are a few new players in the market. But for large auto segments, including passenger and goods e-autos, the market is still dominated by conventional auto makers such as Mahindra, Piaggio, Atul and Bajaj among others.

Performance of e-autos in comparison to ICE autos

As already mentioned, due to ease of service delivery and maintenance, e-rickshaw and e-carts have replaced manual rickshaws and carts nationally. However, the e-autos segment (L5M/L5N categories) remains a challenge. Vehicle technology and performance differentiate the models and also enable comparison with ICE counterparts. It is necessary to understand the key performance parameters of the available models of major brands in Odisha.

E-autos versus diesel autos: From the perspective of auto operators, it is inevitable that conventional ICE engines will become the reference point for comparing

Table 2: Comparative matrix between electric and conventional diesel and CNG autos

Key parameters	Diesel auto	CNG auto	E-auto
A. Passenger auto segment (L5M category)			
1. Range (in km)	160–250/500 km (Fuel tank: 8–10/20 L)	120–170 km (Fuel tank: 4–5.6 kg)	120–170 km in single charge
2. Speed (in kmph)	65–70	65–70	40–45
3. Seating capacity	D + 3	D + 3	D + 3
4. Fuel consumption per unit	25–30 km/l.	30–35 km/kg.	4.6–5.8 kWh/100 km
5. Refuelling time/Charging time	5 minutes (maximum)	5 minutes (maximum)	4–5 hrs.
6. Gradeability (in percentage)	18–26	18–22	18–26
7. Capital cost (in Rs lakh)	2.4–2.8/3.5	2.2–2.6	1.8–2.9
8. Operating cost (in Rs)	3–3.5/km	2–3/km	0.2–0.3/km
9. Availability of finance	Easy finance— almost all banks and NBFCs provide easy loans	Easy finance—almost all banks and NBFCs provide easy loans	Finance difficult—very few financial institutes provide loans like IndusInd, Mannapuram, Revfin etc. but with stricter conditions.
B. Goods auto segment (L5N category)			
1. Range (in km)	160–250 km (Fuel tank: 8–10 L)	120–170 km (Fuel tank: 4 kg)	80–150 km in single charge
2. Speed (in kmph)	50–60	50–60	45–55
3. Payload capacity (in kg)	500–510	500–600	480–500
4. Fuel consumption per unit	25–33 km/l	30–35 km/kg.	6.4–8.6 kWh/100 km
5. Refuelling time/charging time	5 minutes (maximum)	5 minutes (maximum)	4–5 hours
6. Gradeability (in percentage)	17–18	18–22	16–20
6. Capital cost (in Rs)	2.6–3	2.4–2.8	2.4–3.8
7. Operating cost (in Rs)	3–3.5/km	2–3/km	0.4–0.6/km
8. Availability of finance	Easy finance—almost all banks and NBFCs provide easy loans	Easy finance–almost all banks and NBFCs provide easy loans	Finance difficult—very few banks or NBFCs provide loans. IndusInd, Mannapuram and Revfin etc. provide loans but with much stricter conditions.

Source: CSE analysis

BOX 2: BATTERY SWAPPING CAN BE A GAME CHANGER FOR E-AUTO SEGMENT

Electric vehicle makers need to balance high cost of vehicles and low range of vehicles compare to make them competitive vis-à-vis conventional vehicles. Increasing the vehicle range by increasing the battery size increases the cost as well. About 40–50 per cent of the overall cost is actually battery cost. Also larger batteries increase the vehicle weight and substantially reduces the loading/ payload capacity of the vehicle. It also affects the energy consumption of the vehicle and increases the charging time. Fast charging (high c-rate) also deteriorates the batteries more quickly unless battery composition allows it and batteries with such composition costs even more.

Currently, the majority of electric vehicle makers are offering plug-in charging models with comfortable travel range for personal usage, where one can travel a maximum 50–70 km but for commercial usage it becomes a challenge. Average commercial vehicles (including 3W, cars and buses) travel at 120–240 km per day depending upon the type of vehicle and city size. For additional km of travel they either have to go for larger batteries or have to compromise their operational efficiency by charging the batteries during the operational hours—in both their earnings are impacted. Cities also need to develop entire ecosystems with dense public charging network to support it. This requires huge investment.

In this situation, battery swapping can emerge as a viable alternative solution which can take care of concerns related to cost and range. In swapping technology, vehicles don't have to have large batteries to begin with. This substantially reduces the upfront cost. Additionally, innovative business models can be developed to completely disconnect battery cost from vehicle cost itself. Swapping takes very little time and thus range will not be an issue anymore. Furthermore, batteries can be charged in controlled environment with required charging rate which will help in increasing battery life.

In the beginning of government policies and incentive structures based on battery sizes have indirectly favoured plug-in technology over swapping. To make swapping successful some short of standardization in terms of battery casing, common communication gateway is required.

Although battery swapping in the case of large vehicles like cars and buses is technically possible, it is still challenging given the heavy weight of the batteries, need for robotic arms for battery replacement etc. But in small commercial vehicles such as commercial 2Ws and 3Ws this is more feasible. However, for this initiative to take off it is necessary to create a committed demand for this business to become viable and attract investments.

performance and service levels of e-autos. Both opportunities and limitations are associated with e-autos in comparison to its diesel or CNG counterparts.

Operating cost of e-autos is much less than of diesel or CNG autos, especially after the rapid increase in fossil fuel prices over the past few years. This has already begun to attract more rickshaw drivers to the e-auto segment.

However, range is still a challenge with regard to e-autos. Though some makers claimed range up to 170 km, in reality it is far less. Additionally, the certified range is bound to reduce over time due to battery degradation.

Smaller range affects service delivery and income of the auto-driver and/or owner. Either they have to curtail their operation periods or accommodate top-up charging time of one to two hours within their current operational schedule. In both the cases, they will lose some earning. Arranging finances for e-autos are also difficult compared to that for diesel and/or CNG autos. Financing and cost aspects will be discussed later.

Section 4: Three-wheeler operations in Bhubaneswar, Cuttack and Puri: Key findings

To understand the detailed vehicular and operational characteristics of existing three-wheeler services and key challenges in the sector, it has become necessary to carry out a detailed assessment of the sector to identify the pathways. CSE has carried out primary surveys with the auto drivers of each city. It has, additionally, assessed the level of awareness and perception of auto drivers.

Sample collection methodology: This study has mapped all major passenger auto service locations in each urban cluster within the capital region area. Assuming a ratio of 0.5–0.7 per cent of the total autos available in each location, the actual survey samples were collected using random sampling techniques (see *Annexure 1: City-wise details of survey samples and their locations for passenger auto segment*).

Similarly, for goods autos, this study has subdivided the major users of goods autos into different groups or strata depending on the type of cargo moved (which may include gas suppliers, water bottle suppliers, large furniture shops and/or areas, large suppliers of electrical appliances, and major wholesale and retail market areas in the city).

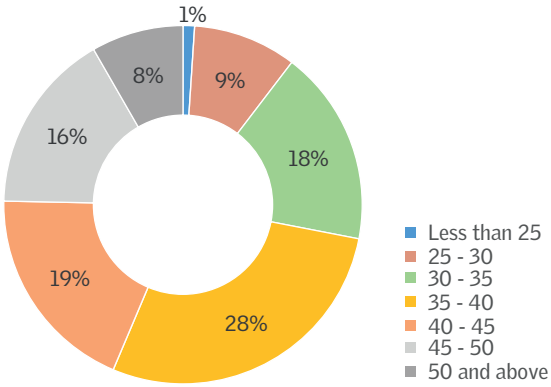
They cater to business areas such as Units 1 and 2 market area in Bhubaneswar and Malgodown in Cuttack, etc. Survey samples were collected from each urban cluster, covering each user type, using random sampling techniques. Survey samples covered the entire jurisdiction of all the urban clusters (see *Annexure 2: City-wise details of survey samples and their users for goods auto segment*).

Passenger autos in three urban clusters of capital region area

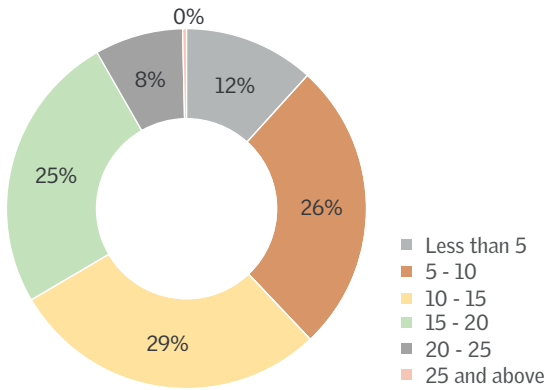
A total of 400 passenger auto samples (including 250 samples from Bhubaneswar, 100 samples from Cuttack and 50 samples from Puri administrative jurisdiction) were collected from individual auto drivers. After screening the data, 15 samples (including ten from Bhubaneswar, four from Cuttack and one from the Puri list) were rejected due to inadequate information of the majority of the parameters.

Graph 19: Age profile and driving experience of passenger auto-drivers

A. Age profile of the passenger auto-driver



B. Driving experience of auto-drivers (drivers ess than 45 years of age)



Source: Primary surveys conducted by CSE

Profile of surveyed auto drivers: Almost 75 per cent of the auto drivers are of less than 45 years of age. Furthermore, around 80 per cent of these drivers have five to 20 years of driving experience (see *Graph 19: Age profile and driving experience of passenger auto-drivers*). Thus, there is a sizeable number of skillful and competent workforce already there who can serve for a minimum of another 15–20 years.

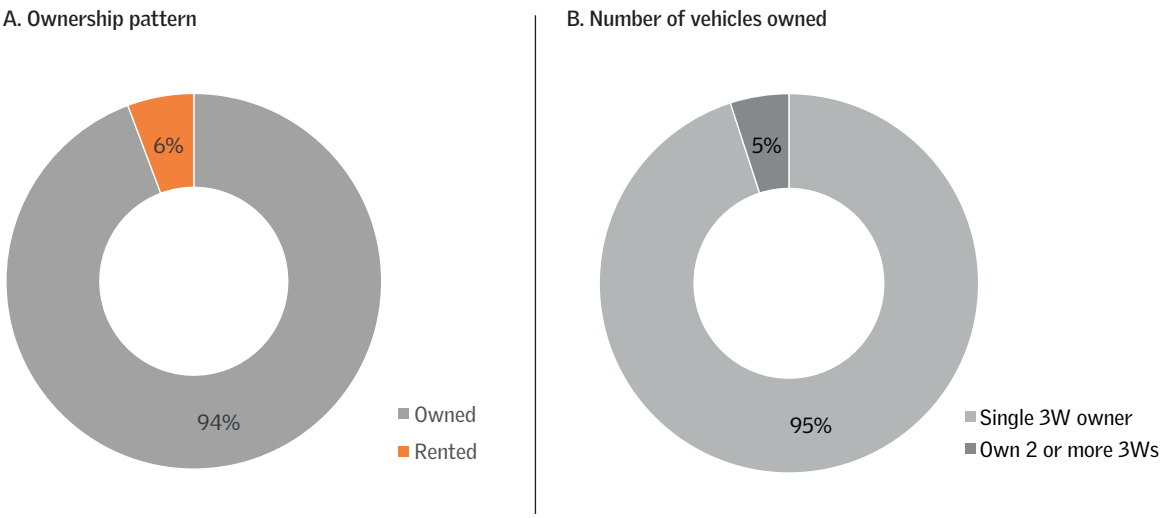
Individual driver-cum-owners dominate: Almost 94 of the auto-drivers are mainly driver-cum-owners. Only 6 per cent take vehicles on a rental basis. Among the drivers-cum-owners, the majority—around 95 per cent—are single vehicle owners and only 5 per cent of them have two or more vehicles. The majority of passenger auto drivers are individual driver-cum-owners.

Only 12 per cent of drivers-cum-owners procured second or older vehicles for their business operations. Even among rental drivers, almost 77 per cent showed preference for a new vehicles on rent over purchase of second-hand vehicles.

Of the vehicle owners, 76 per cent confirmed that they took assistance from financial institutions such as banks and NBFCs to procure their vehicles. In almost 95 per cent cases, assistance was taken to finance new vehicles.

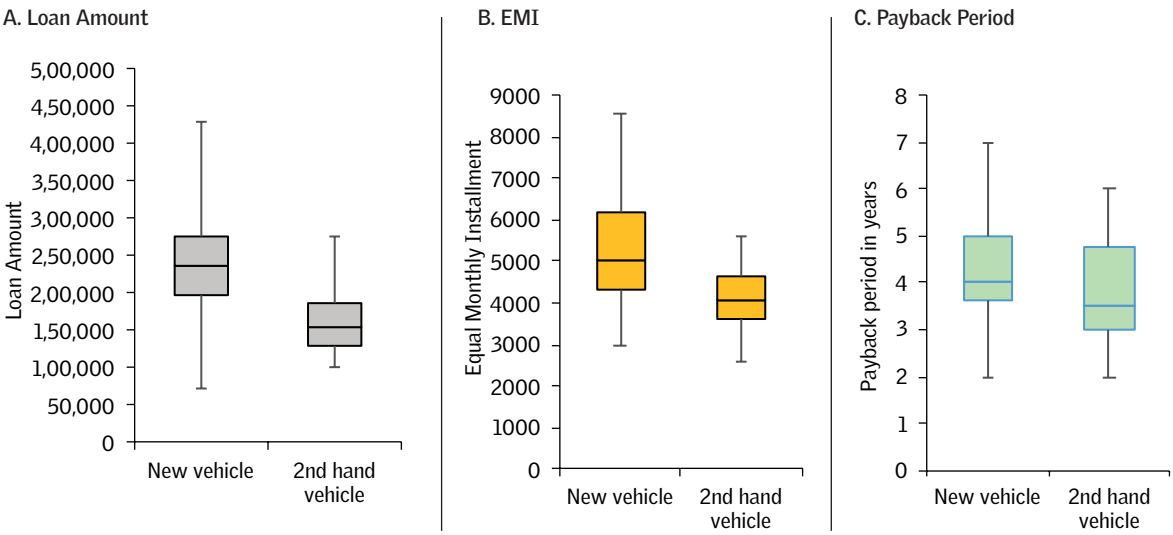
Almost 50 per cent (falling within interquartile range of 25–75 per cent) of vehicle owners took financial assistance in the range of Rs 2–2.75 lakh for procuring new vehicles (see *Graph 21: Details of financial assistance—loans, EMIs and payback*

Graph 20: Vehicle ownership pattern of passenger auto-drivers



Source: Primary surveys conducted by CSE

Graph 21: Details of financial assistance—loans, EMIs and payback periods



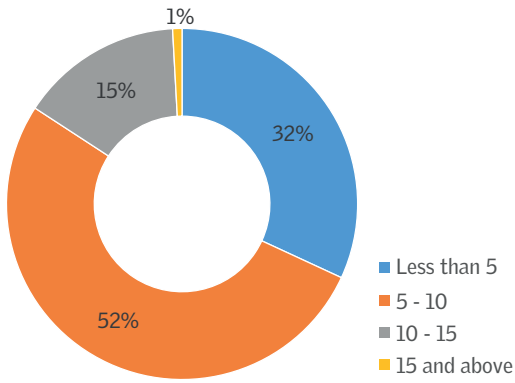
Source: Primary surveys conducted by CSE

periods). The lower base of the box shows the first quartile value (25 per cent) and upper base reflects the third quartile value (75 per cent).

Similarly, around 50 per cent of loan receivers received the loan with payback period of three and a half to five years and equal monthly installment amount of Rs 4,300–6,200. And, 38 per cent of loan receivers are still paying their EMIs.

On the other hand, 82 per cent of those who are driving the vehicles on rent pay Rs 200–250 per day (roughly around Rs 6,000–7,500 per month) to their vehicle owners.

Graph 22: Age profile of diesel autos



Source: Primary surveys conducted by CSE

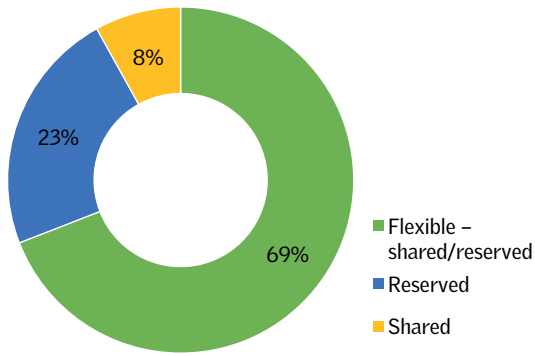
Vehicle profile: 90 per cent of the respondents/auto drivers operate diesel autos and the remaining CNG autos. Both Bajaj and Piaggio are the desired auto brands among auto drivers, and designed to carry four people (D+3) with a speed range between 40–60 kmph. About 84 per cent of diesel autos are less than 10 years old. In 2017, the first CNG station was opened in Bhubaneswar. Naturally all the CNG autos are comparatively much younger (i.e. less than five years old) than their diesel counterparts.

Operational characteristics of the existing services

The majority of the passenger auto drivers, i.e. 69 per cent, are open to providing flexible services, depending upon the situation. Only 23 per cent of the auto drivers operate their vehicles as reserve or point-to-point services.

In terms of operating hours, around 25–75 per cent of the passenger auto drivers operate their vehicles for 11–14 hours, including two to three hours of resting period.

Graph 23: Passenger 3W service pattern

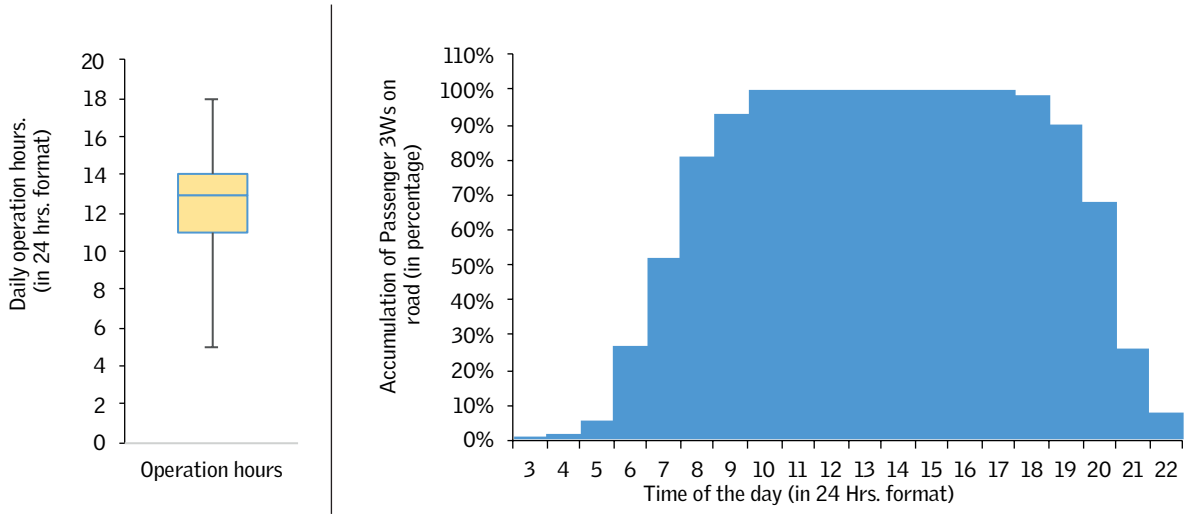


Source: Primary surveys conducted by CSE

In general, passenger 3W services are available from 3–4 a.m. (early morning) to 10 p.m. However, the majority of these vehicles ply at 7–8 a.m. and 8–9 p.m. This holds for all geographies (i.e. Bhubaneswar, Cuttack and Puri), with very small differences.

However, average daily running km varies depending upon city size. In Bhubaneswar, the majority of these vehicles,

Graph 24: Operation hours of passenger three-wheeler services

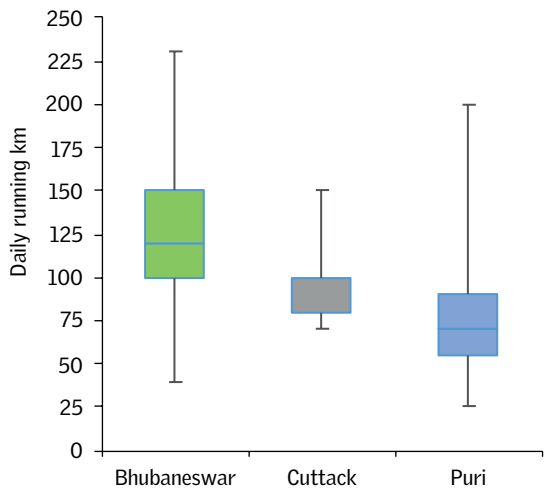


Source: Primary surveys conducted by CSE

around 75 per cent of them, operate for less than 150 km per day. In Cuttack and Puri this number is 100 or even less (see *Graph 25: Daily running km across geographies*). However, there are 25 per cent odd drivers, particularly in case of Bhubaneswar and Puri who operate up to 200 km or more to remote locations.

With regard to the average cost of operations, barring a few exceptions, majority of the vehicle drivers spend around Rs 200–400 per day to operate the vehicle and earn Rs 700–900 with a profit margin of Rs 400–600 per day.

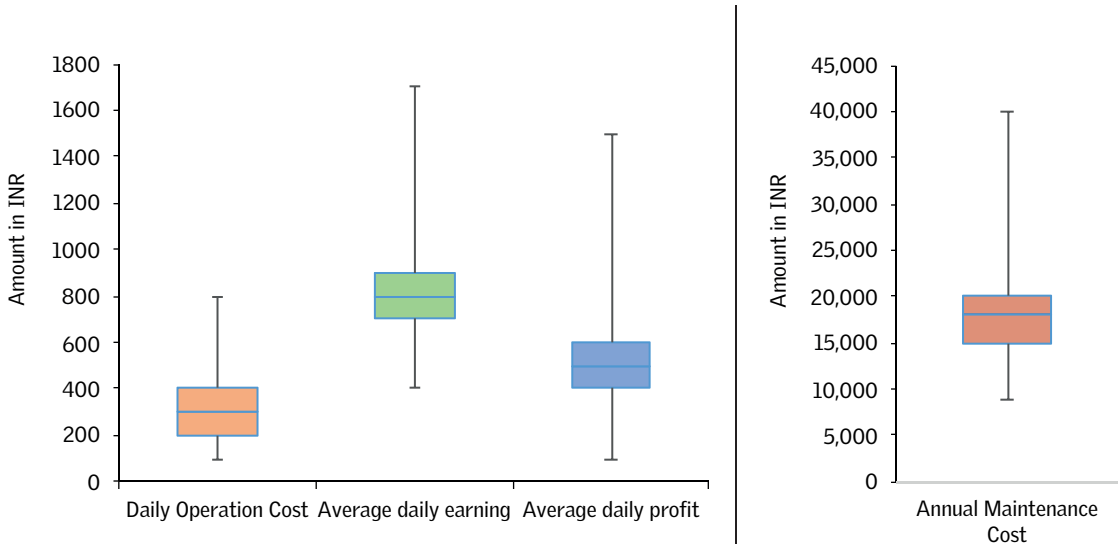
Graph 25: Daily running km across geographies



Source: Primary surveys conducted by CSE

Similarly, every passenger 3W driver spends around Rs 15,000–20,000 per annum or Rs 1,250–1,650 per month for maintaining their vehicles.

Graph 26: Average earning and expenditure for operating passenger three-wheeler services



Source: Primary surveys conducted by CSE

Awareness about passenger 3W electrification and willingness to shift: It has been a year since Odisha has introduced its state EV policy, which has provided for purchase incentive of 15 per cent of the price of the vehicle or a maximum amount of Rs 12,000 per vehicle.

Surprisingly, almost 91 per cent auto drivers expressed that they were unaware of the availability of subsidy. While asking about their awareness about low operating cost of electric 3Ws compared to diesel or CNG counterparts, around 42 per cent expressed that they were completely unaware of such facts. This has negatively impacted their preferences to buy electric passenger 3Ws.

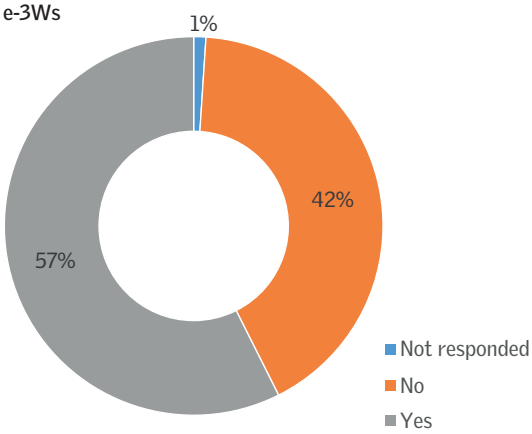
Of those who wanted to buy electric passenger autos, 62 per cent preferred to buy due to financial benefits such as availing government subsidy, lower cost of operation and maintenance.

In response to the questions regarding the major concern areas that may obstruct 3W electrification, the majority highlighted the challenge regarding charging infrastructure and finances, including availability of finances for procuring a new vehicle and high cost of vehicles.

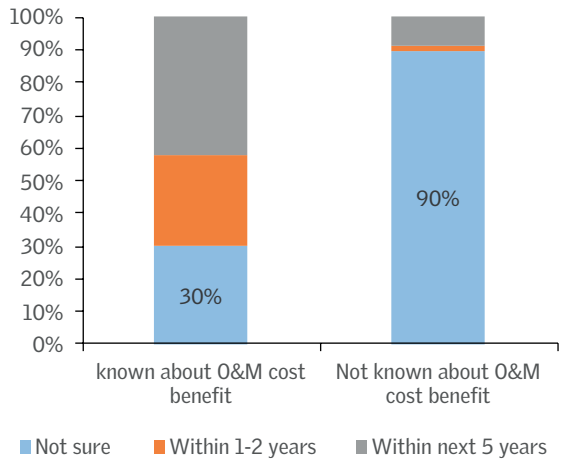
Charging is a priority concern as almost 42 per cent respondents expressed that

Graph 27: Awareness of passenger e-three-wheelers and preference to buy

A. Awareness about low operating and maintenance cost of e-3Ws

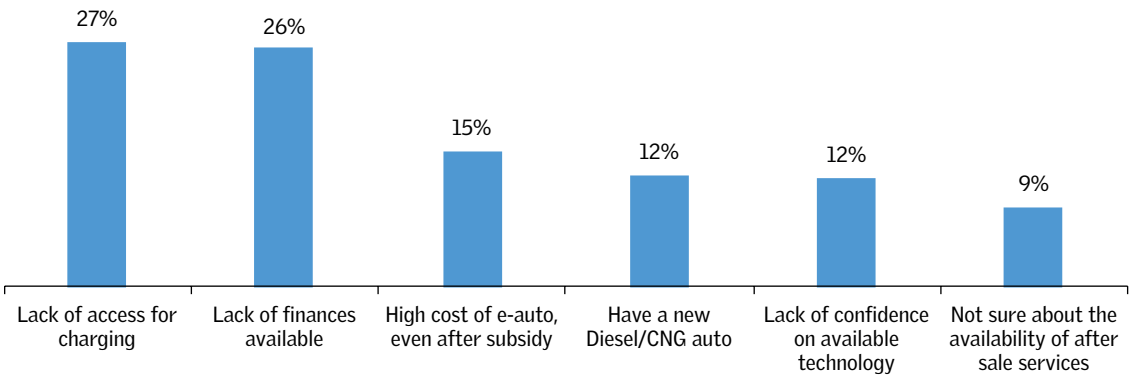


B. Preference to buy a passenger e-3W



Source: Primary surveys conducted by CSE

Graph 28: Major area of concern in passenger 3W electrification

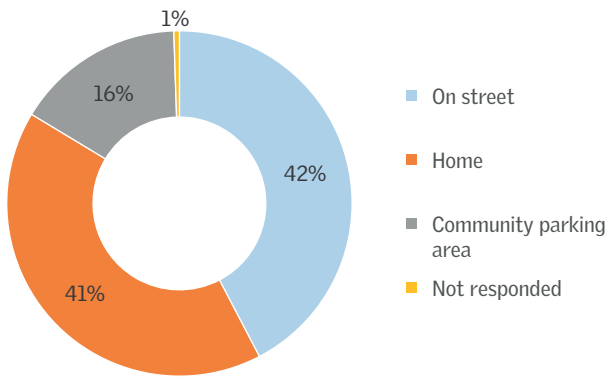


Source: Primary surveys conducted by CSE

they generally park their vehicles on the road due to lack of parking space. Also, 41 per cent who park their vehicles in front of their houses need special provisions for installation of charging systems with proper electricity connection.

In the case of procuring new e-3Ws, almost 40 per cent expressed that they would require assistance to the tune of more than Rs 1–2 lakh.

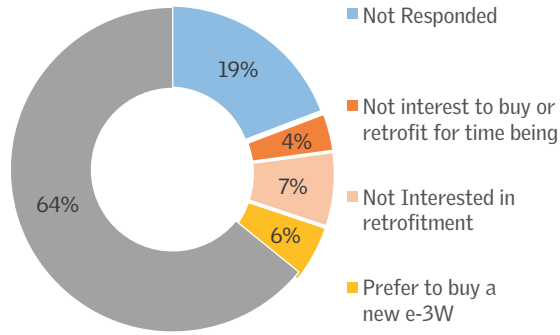
Graph 29: Parking issues



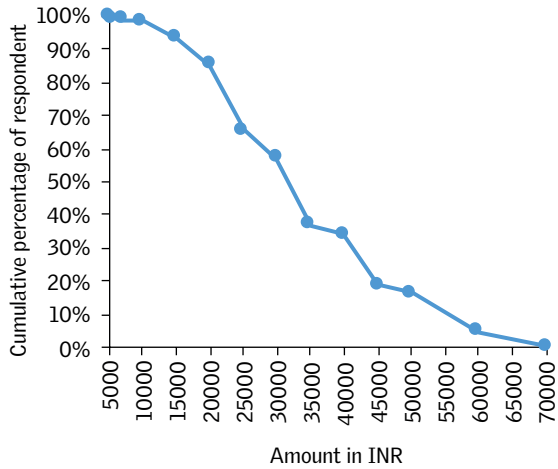
Source: Primary surveys conducted by CSE

Graph 30: Choice regarding retrofitment of vehicle

A. Preference for retrofitment



B. Ready to incur maximum amount for retrofitment



Source: Primary surveys conducted by CSE

Regarding retrofitment kit, 97 per cent auto drivers said that they were unaware of such facilities. After learning about the retrofitment procedures and cost of retrofitment, around 64 per cent showed interest in retrofitment although close to 70 per cent were ready to bear just about 25–30 per cent of the total cost.

Goods autos in three urban clusters of capital region area

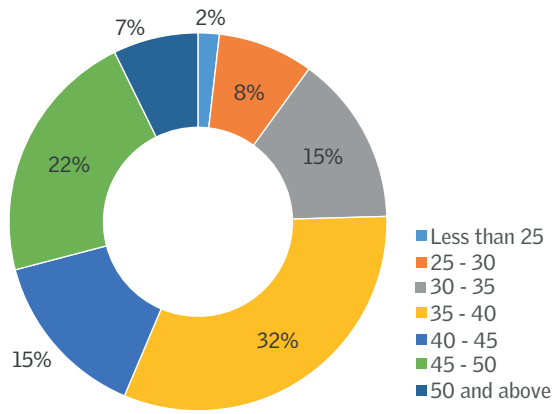
The ground-level survey for this the study covered a sample size of 110 goods autos (50 samples from Bhubaneswar, 35 samples from Cuttack and 25 samples from Puri).

The majority of goods auto drivers—as much as 71 per cent—are less than 45 years old. Around 79 per cent of drivers who are less than 45 years old have five to 20 years of driving experience (see *Graph 19: Age profile and driving experience of passenger auto drivers*).Thus, a sizeable number of skillful and competent workforce is already employed in the goods auto segment and can serve for another 15–20 years in this sector.

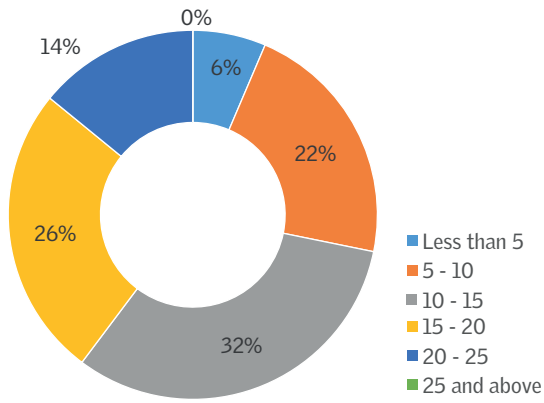
Goods auto-drivers are mainly driver-cum-owners—97 per cent drive their own vehicles. Among the drivers-cum-owners, around 89 per cent are single vehicle owners and only 11 per cent have two or more vehicles. Like the passenger auto segment, the goods segment is also dominated by individual driver-cum-owners. Only a few handful of these vehicles (i.e. 8 per cent) are second-hand vehicles.

Graph 31: Age profile and driving experience of goods auto-drivers

A. Age profile of the goods auto driver



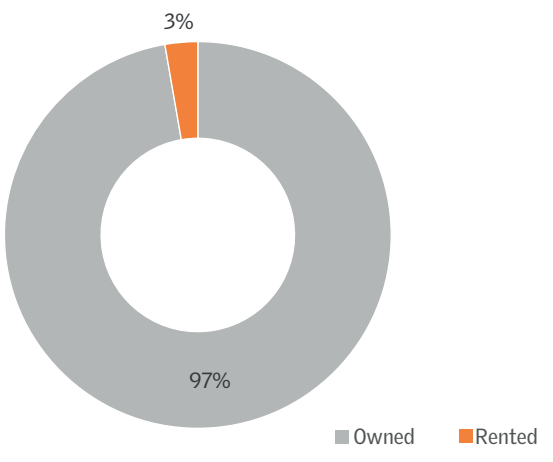
B. Driving experience of auto drivers
(Drivers with less than 45 years of age)



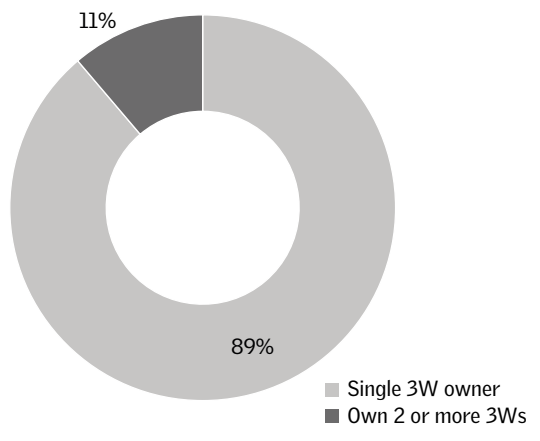
Source: Primary surveys conducted by CSE

Graph 32: Vehicle ownership pattern of goods auto drivers

A. Ownership pattern



B. Number of vehicles owned

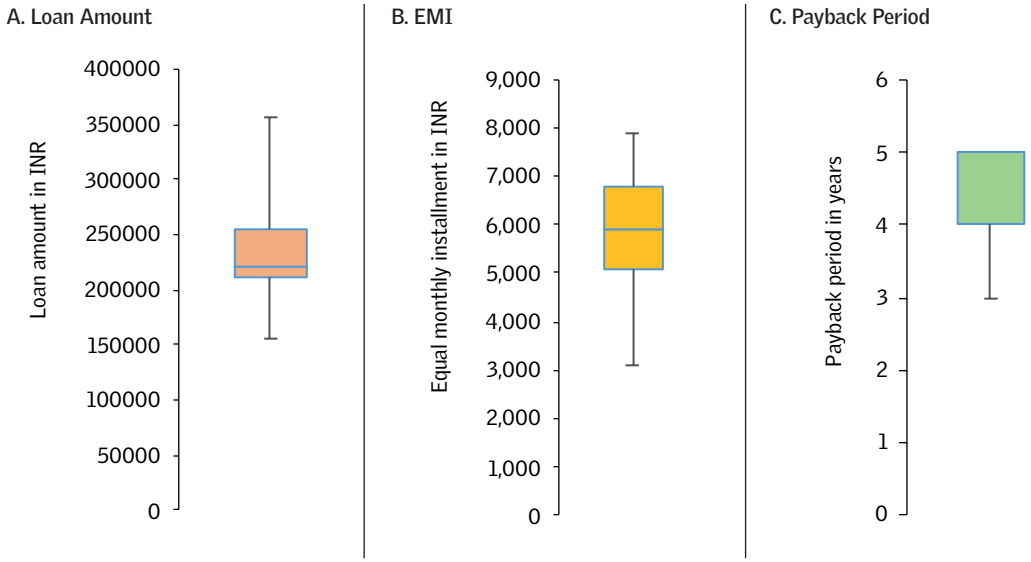


Source: Primary surveys conducted by CSE

Around 71 per cent of the vehicle owners revealed that they took assistance from financial institutions such as banks or NBFCs for procuring their vehicles.

Almost 50 per cent (falling within the interquartile range of 25–75 per cent) of the goods vehicle owners took financial assistance in the range of Rs 2.1–2.55 lakhs for

Graph 33: Details of financial assistance—loans, EMIs and payback periods

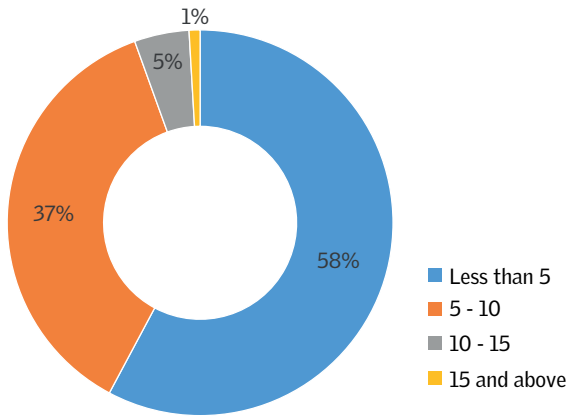


Source: Primary surveys conducted by CSE

procuring new vehicles (see *Graph 33: Details of financial assistance—loans, EMIs and payback periods*). Similarly, around 50 per cent of loan receivers received the loan with payback period of four to five years and equal monthly installment amount of Rs 5,100–6,800. Around 38 per cent of loan receivers will pay their EMIs in the coming years.

Those who are driving the vehicles on rent pay Rs 250–300 per day (which is roughly around Rs 7,500–9,000 per month) to the vehicle owner.

Graph 34: Age profile of diesel autos

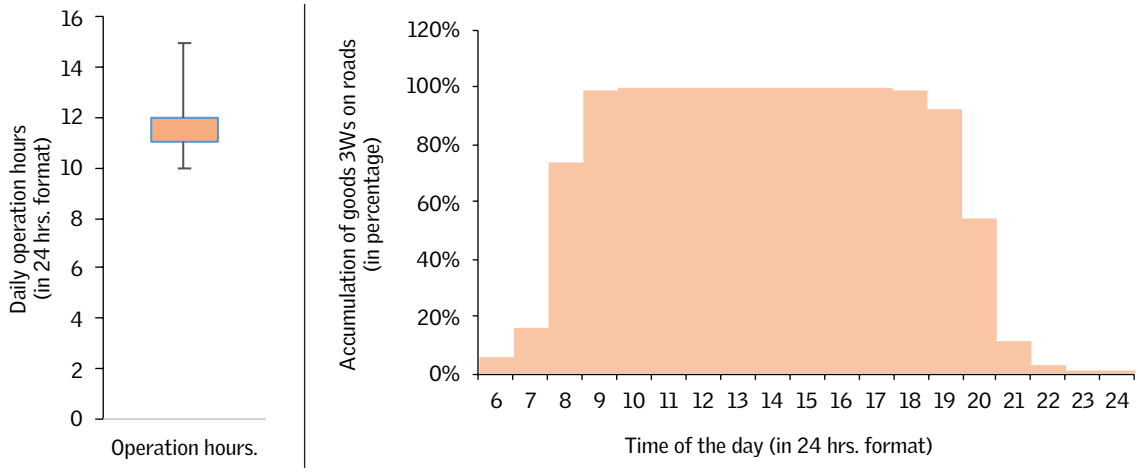


Source: Primary surveys conducted by CSE

Vehicle profile: Almost all goods vehicles—99 per cent—operate on diesel fuel. Among the brands, Piaggio dominates the market with 55 per cent market share, followed by Bajaj with 20 per cent market share. These are designed to carry two people (D+1), with 450–500 kg payload capacity.

Around 58 per cent of diesel autos are less than five years old. In the total fleet, 94 per cent of goods autos are less than 10 years old.

Graph 35: Operation hours of passenger three-wheeler services

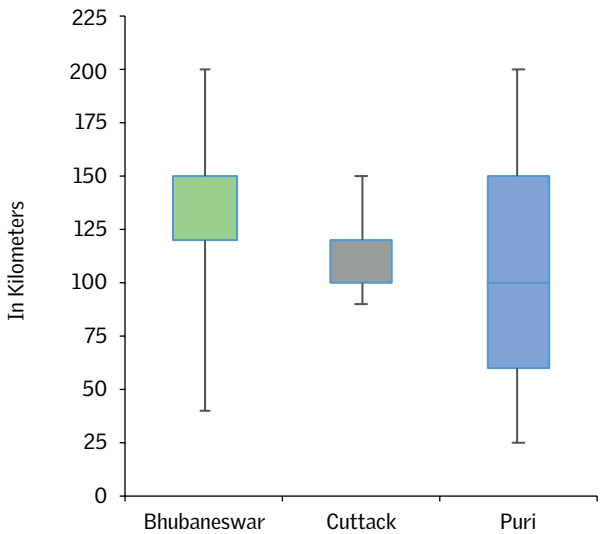


Source: Primary surveys conducted by CSE

Operational characteristics: Unlike passenger autos, goods auto services are demand-based largely and tied-up with different use cases, like carrying and transporting gas, water bottles, furniture, electronic appliances etc.

In general goods, 3Ws operate for 11–12 hours from 8 a.m. to 7–8 p.m. This is similar in all geographies (i.e. Bhubaneswar, Cuttack and Puri), with very small variation.

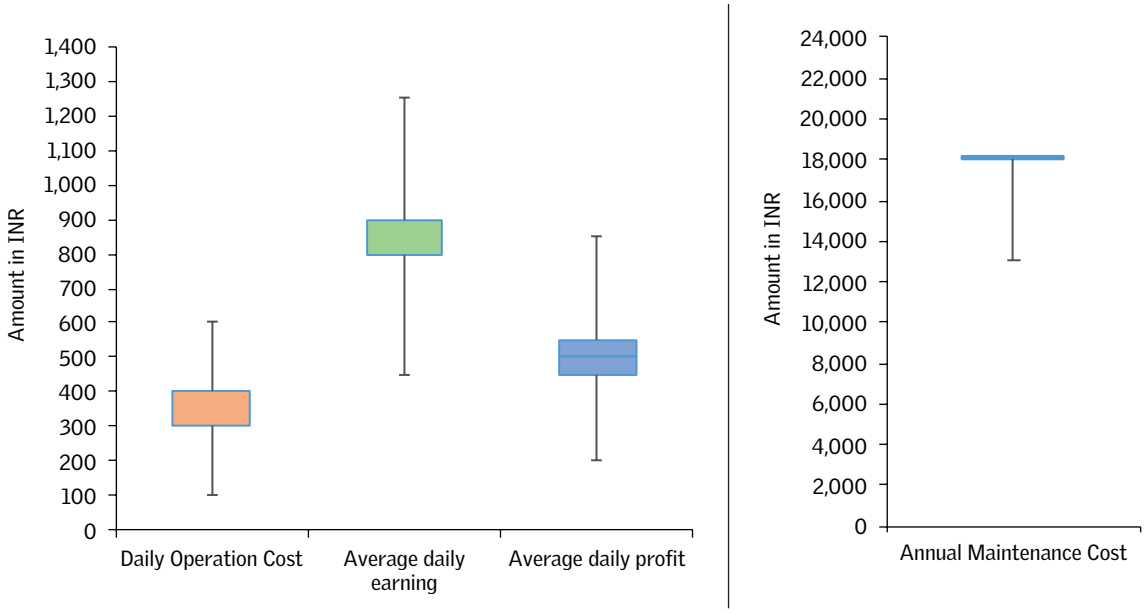
Graph 36: Daily running km of goods three-wheelers across geographies



Source: Primary surveys conducted by CSE

Daily average running km of goods 3Ws varies according to the size of the cities. In Bhubaneswar, the majority of these vehicles—around 50 per cent—operate within 120–150 km per day. In Cuttack, this range is 100–120 km per day. Puri shows great variation in terms of daily operating km from 60 to 150 km per day (see *Graph 36: Daily running km of goods three-wheelers across geographies*).

Graph 37: Average earning and expenditure for operating goods 3W services



Source: Primary surveys conducted by CSE

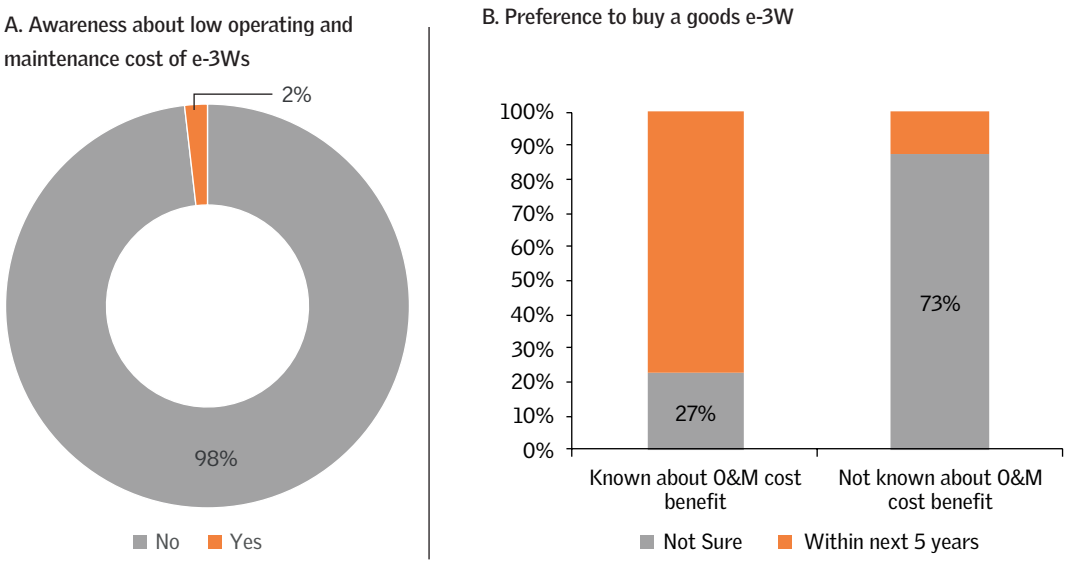
However, about 25 per cent of drivers in Bhubaneswar and Puri operate up to 200 km to serve remote locations as well.

As per the average cost of operations, barring a few exceptions, the majority of the vehicle drivers spend around Rs 300–400 per day and earn around Rs 800 to 900 with a profit margin close to Rs 500 per day (see *Graph 37: Average earning and expenditure for operating goods 3W services*).

Similarly, each goods 3W driver spends around Rs. 18,000 per annum or Rs. 1500 per month for maintaining their vehicles.

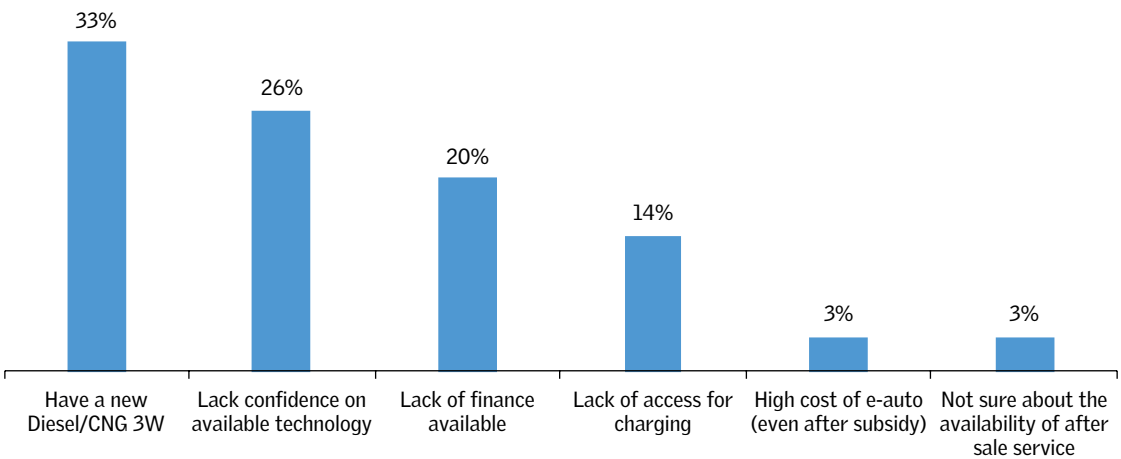
Awareness about goods three-wheelers electrification and willingness to shift: Even though Odisha state EV policy specifically mentions providing purchase incentive for three-wheeler vehicles, including goods 3Ws, almost 98 per cent auto drivers are not aware of this provision. Regarding their awareness about comparatively lower operating cost of electric 3Ws vis-à-vis diesel or CNG counterparts, around 49 percent expressed that they were completely unaware of such facts. This has negatively impacted their preferences and the purchase decision related to electric 3Ws goods vehicles (see *Graph 38: Awareness on goods e-three-wheelers and preference to buy*).

Graph 38: Awareness of goods e-three-wheelers and preference to buy



Source: Primary surveys conducted by CSE

Graph 39: Major area of concern in goods three-wheelers electrification



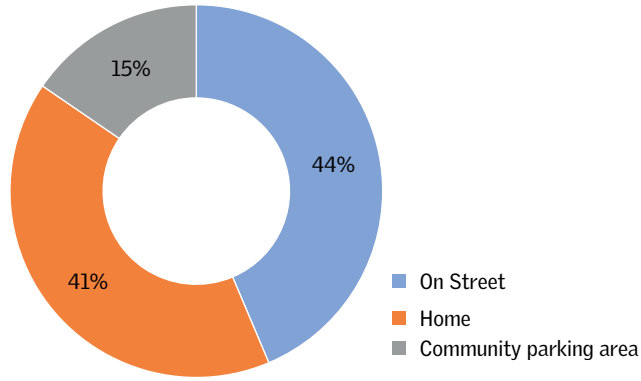
Source: Primary surveys conducted by CSE

Around 36 per cent of respondents wanted to buy an electric goods auto in the next few years. However, 68 per cent showed preference for lower cost of operation and maintenance of vehicles (see *Graph 39: Major area of concern in goods three-wheelers electrification*).

One-third of the auto drivers highlighted immature technology, lack of availability of finances and inadequate charging facilities as their key constraints. Charging

is a concern as almost 44 per cent respondents park their vehicles on the road due to lack of parking space. About 41 per cent park in front of their own houses. These need special provisions for charging infrastructure with proper electricity connections.

Graph 40: Parking issues



Source: Primary surveys conducted by CSE

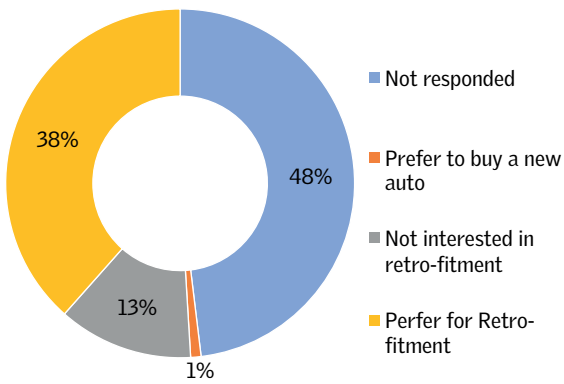
Regarding conversion of existing goods auto using a retrofitment kit, 88 per cent auto drivers said that they were unaware of such facilities. After learning about retrofitment procedures along with the cost of retrofitment, about 38 per cent showed interest in retrofitment although close to 70 per cent were ready to bear just 20–25 per cent of the total cost.

Key takeaways

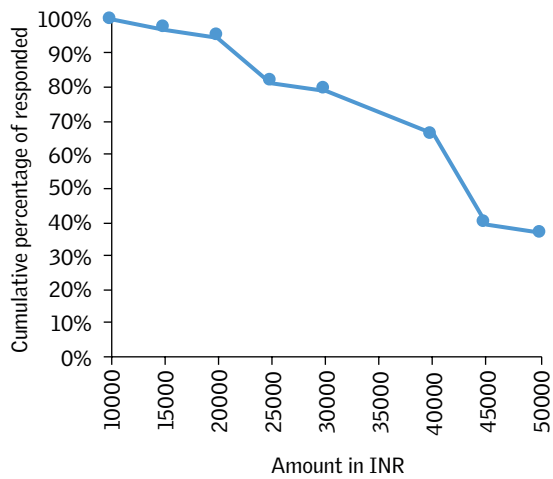
Detailed ground-level analysis of both passenger and goods 3W segment revealed several issues that need attention while developing a roadmap for 3W services in Odisha.

Graph 41: Choice regarding retro-fitment of vehicle

A. Preference for retrofitment



B. Ready to incur maximum amount for retrofitment



Source: Primary surveys conducted by CSE

The majority of 3W drivers, including both passenger and goods segment, are individual driver-cum-owner and more than two-thirds of them have taken financial assistance for procuring their current vehicles and close to 40 per cent of them are still paying EMIs.

In Bhubaneswar, where both passenger and goods 3Ws ply for slightly longer distances (i.e. 120–150 km per day), more customized charging mechanisms such as battery swapping for smoother operation of e-3Ws are probably needed.
In Cuttack and Puri, 3Ws ply within the maximum distance range of 100 km per day, which can be easily covered with the current conductive charging technology approaches.

It is necessary to carry out educational and awareness campaigns to make auto drivers more aware of the electric vehicle technology, its pro and cons, and government programmes and incentives.

Innovative mechanisms to overcome some of the key challenges such as issues regarding financing and creation of proper ecosystem for vehicle charging among others are needed.

Even though retrofitment may seem like a cost-effective option, it requires regulatory framework to ensure that only those vehicle models and retrofitment kits are deployed that are certified by the Automotive Research Association of India and are governed by the appropriate Automotive Indian Standards. This needs to meet the safety requirements and maintain optimal performance parameters.

Section 5: EV policy and city-readiness for electrification

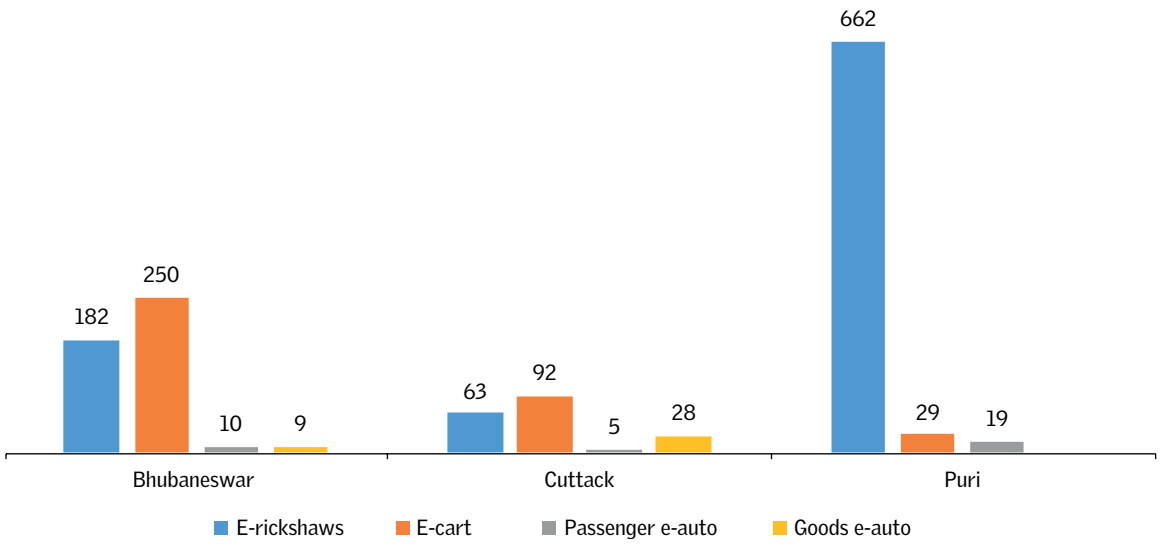
Currently, the entire state of Odisha has only 2,000 electric 3Ws of around 1,300 electric 3Ws of all categories (i.e., e-rickshaw, e-cart, passenger e-auto and goods e-auto) are in Bhubaneswar, Cuttack and Puri in the capital region.

The e-rickshaws in Puri cover 50 per cent of the overall e-3W penetration in the capital region. E-rickshaws have replaced manual rickshaws to improve service delivery and comfort level for the passengers. Operating e-rickshaws is also financially viable.

The state government has reduced the one-time tax by 50 per cent from 6 per cent to 3 per cent for e-rickshaws and e-carts. Subsequently, in October 2021, the state government has extended the benefits to all battery-operated electric vehicles (BEV) and has allowed 100 per cent exemption from motor vehicle tax and registration fees for all BEV.

The Odisha state EV policy has identified three-wheeler vehicles as one of prime vehicle segments for quick adoption. This has been further supported by an open

Graph 42: E-three-wheeler penetration in three urban clusters of capital region area (till February 2022)



Source: Vahan database, Ministry of Road Transport and Highways

permit system and purchase subsidy of 15 per cent of the total cost of the vehicle with a maximum cap of up to Rs 12,000 per three-wheeler.

It has also been decided that cities will prepare city parking plan to encourage on-street parking places for EVs with subsidized fees and EV charging. Recently, seven public charging stations were set up in Bhubaneswar, including in KIIT area (one fast charger and one slow charger), SUM Hospital (one slow charger), near Esplanade Mall, Rasulgarh (one fast charger and one slow charger), DN Regalia (one slow charger) and Krishna Plaza, CRP Square [one slow charger]).

Odisha Development Authorities (Planning and Building Standards) Rules 2020, has also made provisions for a minimum of 30 per cent parking spaces of all new developments (including project areas of more than 1 acre, high-rise buildings and multi-level car parking), to have EV charging points.

Capital Region Urban Transport (CRUT) is planning to operate 50 e-rickshaws as a feeder system for their main bus services which will also operate 50 e-buses in Bhubaneswar.

This interest in transforming to e-autos in the capital region requires support from the private partners to help develop and scale up charging network.

Section 6: E-autos (L5M/L5N category) and financing

In contrast to the ICE three-wheelers (diesel or CNG autos) that are eligible for financial lending by conventional banks and major NBFCs, e-autos have limited options. There are very few financial institutes—IndusInd Bank and Manappuram Finance are among the few that provide finances for both ICE and electric autos.

However, several new NBFCs and fintech companies have come forward to fill the gap of EV financing but their charges are much higher than that of conventional banks, with the interest rate around 20–25 per cent.

Similarly, the loan payback period for e-autos is much shorter than the ICE autos. The payback period for ICE autos can be four to five 5 years for banks and up to three years for NBFCs. But for e-autos it is shorter—usually two years. This low payback period discourages passenger e-autos as the EMI amount increases from Rs 8,000–8,500 (purchased with subsidy) to Rs 11,000–12,000 (purchased without subsidy). This is an almost 40–100 per cent increase in EMIs compared to Rs 4,300–6,200 that diesel and/or CNG autos are required to pay. As a result, a major share of the monthly profit (i.e. around Rs 15,000) is utilized for loan repayment for e-autos.

Similarly, for goods e-autos EMI increases from Rs 9,000–12,000 (purchased with subsidy) to Rs 12,000–16,000 (purchased without subsidy).

This review has brought out several challenges that impact e-auto financing.

Uncertainty around the vehicle technology: The e-auto technology is new and there are several new market players in this segment without proven track records. The financial institutes are unsure about the quality of the product. It has been observed that small start-ups/dealers are customizing the product according to the requirements stated by the customers (largely related to battery type and size etc.) which have bearing on the performance of the product.

Underdeveloped market for second hand e-autos: Given the uncertainty around the technology, the resale value of e-autos have not been established yet. There is no second-hand market for e-autos. Thus, financial institutes are unsure about the cost of recovery and payback in case there is default payment.

Differences in warranty period: In the case of diesel or CNG autos, the original equipment manufacturers (OEMs) generally provide a minimum of three years or 100,000 km warranty (whichever is earlier) on the whole vehicle. Extension of warranty period is also possible.

In the case of e-autos, differentiated warranty is offered for different e-auto components. Battery warranty is for three to five years, motor and controller for one year and charging system for six months. Extended warranty scheme is not available for e-autos. This creates uncertainty in the market.

Difficulty in ascertaining the value of the vehicle: As often some models of e-autos are customized according to the needs of the customers (particularly battery) and are not tested, it becomes difficult for financial institutions to decide and ascertain the right value of the product.

Difficulty in dispute resolution: E-battery performance and warranty depends on the usage pattern of the vehicle. For example, if a certain goods e-auto battery is designed to operate for five years with a 500 kg load, then it has to be used in the same way to sustain it for five years. Overloading can affect the battery durability. In such situation it becomes difficult to resolve the dispute between manufacturers and vehicle owners/operators.

Lack of credit worthiness: Majority of the e-auto owners/operators customers are new and there are concerns around their credit worthiness. Often they do not have experience in banking transactions. The creditors are apprehensive of providing credit.

Fragmented and small markets reduce access to financial services: As the market is new and demand is low, fragmented and dispersed, financial institutions or lenders find it difficult to widen the scope of services and serve across geographies.

Section 7: Three-wheeler electrification—the way forward

It is an opportunity that during the early stages of planning for e-bus deployment in the capital region, the potential and strategies for electrification of the auto segment is also being evaluated for an integrated approach to public transport system with a zero emissions target.

With strategic intervention and appropriate support under the new EV policy in Odisha, it is possible to catalyse the change. To accelerate this process, it is necessary to focus on the following steps.

Need policy mandate targeted development: It is possible to mandate time-bound electrification of the auto-segment in the capital region. The learning from this pilot can be replicated in other cities subsequently. This will require an ecosystem approach, including charging infrastructure for rapid transformation.

Strengthen incentive programme to including non-fiscal incentives: Odisha has already exempted the e-autos from MV tax and registration fees for e-3Ws, and announced purchase incentives. This may be further strengthened by adding scrapping incentives based on de-registration of old ICE vehicles. In addition, the state/city authority may also think of providing additional non-fiscal benefits to e-3W owners, such as discounted parking facilities, creating special zones for electric or zero emission vehicles etc.

Product development: Similar to the steps taken by the other state governments, manufacturers may be empanelled after rigorous testing and trials of their product, and allow only those vehicles to avail of government subsidy. The state government can create strong regulatory and monitoring framework to improve product quality.

All new manufacturers/start-ups need to take more responsibility for product development and testing and certification. This also requires product rebranding for the second-hand market or resale market. Product quality and durability need to be increased and warranty comparable to conventional diesel and CNG autos including extended warranty need to be provided. Advanced technology to track

and monitor vehicle performance will help to increase the life of vehicles and resolve vehicle-related disputes.

Resolve financing issues: Several steps are needed to address the uncertainty around financing. During the early stages of the programme, the governments may act as a credit guarantor for providing easy loans, with decent interest rates to individual auto drivers or owners. The governments may consider providing purchase subsidies directly into the loan account of the loan recipient to reduce EMI burden.

Also consider interest subvention or paying of a part of the interest to reduce EMI burden. State/city authority may think of creating green, low- or zero-emission zones within the city scape for increasing the demand for e-autos.

Support to create e-three-wheeler ecosystem: Lack of charging was perceived by auto drivers as one of the major obstacles for 3W electrification. As these vehicles rely largely on night-time home charging supported by top-up charging in public charging infrastructure, this requires public charging facilities at the community parking locations at subsidized fees. The Odisha Electric Vehicle Policy has already provided for this. It also requires building audits to assess adequacy of the connected load of households and ancillary requirements and incentives/grants to e-3W owner for setting up charging point at home.

Disincentivize ICE 3Ws: To promote e-autos, it is also necessary to disincentivize ICE 3Ws. A strategy to limit the number and operations of diesel 3Ws, banning registration of new diesel 3W and phasing them out in the city is needed.

Create awareness to build public support for e-three-wheeler services: The auto operators were observed to have limited knowledge about e-3W vehicle technology and its pros and cons etc. It is necessary to design an outreach programme to sensitize them about the technology, its operational aspects, availability of incentives, charging needs and safety requirements.

Annexures

Annexure 1: City-wise details of survey samples and their locations for passenger auto segment

Table 2: Primary survey locations along with sample size in Bhubaneswar

S. no.	Location	No. of samples
1	AG Square	6
2	Rajmahal Stand	8
3	Kalpana Stand	7
4	Badagada BRIT chaka	3
5	Ravi Takies Stand	3
6	Utara stand	4
7	Samantarapur Stand	1
8	Lingeraj mandir	7
9	Capital Hospital	4
10	Palashpalli	1
11	Sundarpada auto stand	1
12	Lingeraj Station	3
13	Pokhariput stand	1
14	ITER College stand (in front of gate)	3
15	Khadagiri	12
16	Dumduma Stand	2
17	AIIMS	2
18	Sum Hospital	6
19	Baramunda Bus Stand	27
20	Fire Station	9
21	CRP	12
22	Crown Hotel (in front of hotel)	1
23	Jaydev Vihar	14
24	Kalinga Hospital	2
25	Care Hospital	4
26	Chandrashekhar Petrol Pump	2
27	Damana Square	2
28	Patia Square	2
29	MP Prasad Eye Hospital	3
30	Nandankanan	6
31	KIMS Hospital	5
32	Info-city Square	5
33	Shikarchandipur	4
34	Apollo Hospital	3

S. no.	Location	No. of samples
35	Vani Vihar	14
36	VSS Nagar	4
37	Rasulgarh	15
38	Mancheswar Junction	2
39.1	Master Canteen (Janpath road)	20
39.2	Master Canteen (Old station road)	6
40	Acharya Vihar	14
	Total	250

Table 3: Primary survey locations along with sample size in Cuttack

S. no.	Location	No. of samples
1.1	Badambadi stand—towards Medical Chaka	14
1.2	Badambadi stand—towards Buxibazar	4
1.3	Badambadi stand—towards CDA	4
1.4	Badambadi stand—towards Stadium	4
2	Badambadi Traffic Chaka	9
3	Sishuvabhan	4
4	CSA Sec 7	2
5	CDA Sec 9	1
6	Deula Sahi	1
7	Shelter Chaka	1
8	Cantonment road (Chandi Mandir)	1
9	Kanika Chakka	1
10	Chandi Mandir	2
11	Buxibazar Samaj Office Chakka	4
12	SCB Medical Chakka	9
13	Kathagola Chakka	6
14	OMP Chakka	3
15	Ravenshaw University	1
16	Cuttack Railway Station	14
17	Sikharpur	9
18	OMP	4
19	Link Road—Madhupatna	2
	Total	100

Table 4: Primary survey locations along with sample size in Puri

S. no.	Location	No. of samples
1	Puri Bus Stand to Jaganath Mandir Road (Medical Chakka)	10
2	Jaganath Mandir Area (Car Parking, Uttar Dwar)	5
3	Swarga-Dwar (Beach Road)	4
4	Lighthouse	6
5	Harihara Chakka	3
6	Swarga-Dwar to Golden Beach (in front of Puri Hotel, Birla Guest House)	2
7	Blue Flag Beach	1
8	City road (Penthakata)	4
9	Puri Railway Station	15
	Total	50

Annexure 2: City-wise details of survey samples and their users for goods auto segment

Table 5: Primary survey samples along with user types

S. no.	User type	Bhubaneswar	Cuttack	Puri
1	Gas suppliers	10	10	8
2	Furniture shops/areas	5	5	3
3	Electric shops/areas	5	5	3
4	Wholesale market area (mandi)	15	5	3
5	Water bottle supplier	5	5	3
6	Others (retail markets)	10	5	5
		50	35	25

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Three-wheelers provide a substantial share of intermediate public transport services for last-mile connectivity and multi-modal integration in cities of Odisha and other states. Raising the level of ambition for its fleet electrification can help to eliminate toxic exposures and associated health risks from these vehicles and reduce carbon intensity of commuting in cities. The Odisha State Electric Vehicle Policy has already provided for purchase subsidy and open permits for electric three-wheelers.

This ground-level assessment in the capital region of Odisha bears out the opportunities for accelerated electrification of this segment and the challenges associated with implementation that need to be addressed for rapid transformation.

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