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India's EV Transition

Catalysing Kochi's Electric 3-Wheeler Market Through Local Policy

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Image: Abhishek Chinnappa/Climate Visuals Countdown

Executive summary

While we aspire to own two wheelers and four wheelers, the humble 3 wheeled autorickshaw has provided affordable intracity and intercity commutes for a long time in India. It has remained an integral part of mobility in urban, suburban and rural areas in the country. Three-quarters of the total autorickshaws in the world ply in India (Harding et al. 2016). Although autorickshaws form only a small percentage of vehicle stock in various cities (2–11 per cent), they make up 10–20 per cent of the daily trips made using motorised transport (Mani, Pai, and Aggarwal 2012). **Autorickshaws, which ply as a for-hire vehicle, provides livelihood for an estimated 11 million people across the country** (using inputs from Chhabra, Chowdhury, and Chowdhury 2021).

Autorickshaws offer a comfortable and easy commute for the masses, but their use of petrol and diesel as fuel causes high emissions and noise. The electric autorickshaw bestows several benefits such as low cost of ownership, higher savings for its owners, zero tail pipe emissions and negligible noise. However, their uptake has been slow. **The share of electric autorickshaws in India in overall autorickshaw sales increased from just 0.1 per cent in 2013 to almost 6.2 per cent in 2022** (Ministry of Road Transport and Highways, August 2022).

ES Figure 1 A snapshot of how 3W fleet operates currently in Kochi

90%
Personally owned autorickshaws

16,449
Total number of autorickshaws in Kochi

CNG, petrol, diesel
Fuel used in all autorickshaws in Kochi

72%
Autorickshaws are parked at home during non-operational hours

4 years
Average age of an autorickshaw in Kochi

76%
Autorickshaws plying on a flexible route

100 km
Average distance traveled daily

Source: Authors' analysis

Electric transition in the three-wheeler (3W) segment still lags behind the desired pace. This could be attributed to low level of awareness, lack of clear perception about electric 3Ws (e-3Ws), limited financing and incentives, poor visibility, deficiency in supply, and absence of charging infrastructure. The 3W segment is probably the lowest hanging fruit for EV transition. It is the strongest example of inclusivity in India's green growth pathway. **e-3W is a clear solution for simultaneously reducing emissions and improving livelihoods and local policy action is needed to catalyse this market.** For charting the market for e-3W, we use data from a primary survey of 268 autorickshaw drivers, secondary data on 3W registration from road transport authority (RTO), group discussions with autorickshaw drivers, and extensive interviews with government officials, political leaders, and civil society stakeholders.

A. Key findings

- **Business as usual 3W market**
  - No new diesel autorickshaws are likely to be sold from 2023 in Kochi.
  - E-autorickshaws are expected to have a 34 per cent market share in 2030, composing 20 per cent of on road 3W fleet in Kochi.
  - CNG autorickshaws are expected to be the dominant market leader in near future. They will account for the entire market share left uncaptured by e-autorickshaws.
- **Livelihood improvement from e-3W**
  - Autorickshaw drivers in Kochi can increase their daily savings by almost 30 per cent by switching to e-autorickshaws. This increase in savings is enough to pay back Equated Monthly Installments (EMI) on e-autorickshaws in most cases.
  - Electric autorickshaw options considered are 13–46 per cent cheaper to own than autorickshaws currently plying on CNG, diesel, or petrol.
- **Emissions potential**
  - Current 3W fleet in Kochi is responsible for 0.16 million tonnes (MT) of nitrous oxides (NO_x), 0.04 MT of particulate matter (PM), and 0.9 MT of carbon monoxide (CO) emissions annually.
  - 3W segment in Kochi could potentially contribute to more than 66,000 tonnes of carbon dioxide equivalent emissions annually by 2030.
- **Potential for fleet renewal**
  - 36 per cent of Kochi's 3W fleet is aged 10 years or older.
  - 60 per cent of the vehicles in Kochi's stock are diesel-based Piaggio models. Piaggio is also e-3W manufacturer.
  - An estimated 5253 diesel and petrol autorickshaws are expected to phase out of Kochi's 3W fleet by 2023 due to age or lack of fitness.

Induced demand from phasing out of old petrol, diesel and CNG vehicles can generate a demand for more than 32,000 e-autorickshaws by 2030.

By catalysing the e-3W market, business-as-usual situation of 3W fleet in Kochi where EVs constitute to 20 per cent of the fleet in 2030 can be altered to a situation where 100 per cent of the fleet is electric.

B. Recommendations

Based on the case study of Kochi, we recommend 10 goals for a local policy action for any city to accelerate their 3W transition to electric, without requiring any sales or registration mandate.

All the 10 goals and suggested policy actions may not be applicable or necessary for all the cities. However, this may be used as a guide by the local government to develop a programme for 100 per cent transition of their respective 3W fleet into electric vehicles.

Chart targeted transition plan
Model 3W fleet, understand age and ownership patterns
Think tanks

Accelerate fleet renewal
Introduce scrapping incentives, progressive scrapping mandates, original equipment manufacturers (OEM) buy back scheme
OEMs and RTOs

Establish retrofit market
Approve retrofit kits, ease re-registration process, establish retrofit forum, ensure service and maintenance, iintroduce incentives for retrofit kits
Retrofit kit OEMs and RTO

Reduce upfront cost
Add EV incentives from the state government, urban local body (ULB), or Smart City Mission
State Government, Smart City Mission, and ULB

Recommended local policy actions for catalysing e-3W demand

Ensure demand and supply
Aggregate demand through co-operative society, streamline purchase through the government
Co-operative society and transport department

De-risk financiers
Credit guarantee by the government, co-operative ownership model, telematics
Co-operative society, ULB and OEMs

Improve awareness
Information campaigns with comparative cost information, daily savings tool, EV options
Think tanks, OEMs and ULB

Increase visibility
Standardise e-auto colour, conduct e-auto demonstration events
OEMs and co-operative society

Plan for charging
Plan for 3W-specific charging and swapping infrastructure, telematics, subsidised for on-street charging
Electricity regulator, discoms and co-operative society

De-risk drivers
Ensure telematics, promote rental business models, battery swapping, ensure service and maintenance guarantee, price regulation for charging
OEMs, RTO, battery-swapping providers and charging providers

Stakeholders

Source: Authors' analysis

1. Background

Autorickshaws have been an integral part of intra-city (and at times intercity) mobility since independence. Three-quarters of the total autorickshaws in the world ply in India (Harding et al. 2016). Although autorickshaws form only a small percentage of vehicle stock in various cities (2–11 per cent), they make up 10–20 per cent of the daily trips made using motorised transport (Mani, Pai, and Aggarwal 2012). We estimate that 11 million people in India rely on autorickshaws for their livelihood (using inputs from Chhabra, Chowdhury, and Chowdhury 2021). Owing to the high level of emissions from the current stock of autorickshaws and skyrocketing prices of diesel, petrol, and even compressed natural gas (CNG), there is a gradual shift towards a cleaner alternative, the electric autorickshaws (e-autorickshaws), across India. The share of e-autorickshaws in India in autorickshaw sales increased from just 0.1 per cent in 2013 to almost 6.2 per cent in 2022 (till 24 August) (Ministry of Road Transport and Highways 2022).

Autorickshaws come under the Intermediate Public Transport (IPT) category, which consists of shared tempos/vans, e-rickshaws, and micro buses. Autorickshaws are classified under the L5M homologation as passenger carrier, with gross vehicle weight (GVW) of such vehicles being 1,500 kg (MoRTH n.d.).

An autorickshaw is a versatile mobility vehicle, put to many commute usages ranging from work and education to recreation and even health-related journeys, and has been catering to the daily mobility needs of citizens across various types of cities. In places of low private vehicle ownership and in the absence of proper public transport infrastructure, autorickshaws have consistently acted as a backbone of mobility in the urban, suburban, and rural areas in India (Chhabra, Chowdhury, and Chowdhury 2021).

In cities, autorickshaws supplement the formal public transport infrastructure available in the form of buses and metro trains by acting as a last-mile provider (Chakravartty 2014). They also serve areas where public transport coverage is low or simply absent. The autorickshaw services are regulated through a contract carriage permit system (MoRTH 2022), which allows autorickshaws to move passengers from point to point or door to door, without any fixed route. Autorickshaws invariably serve the purpose of first- and last-mile connectivity as well as door-to-door transport. Autorickshaws are also an important mode of travel for late-night travellers when public transport options are scarce (*The Hindu* 2012).

E-autorickshaw options are 13-46% cheaper than CNG, petrol and diesel autorickshaws.

The number of autorickshaws varies depending upon the city size. Cities with a population greater than 4 million have autorickshaw fleets of more than 50,000 and cities with a population ranging between 1 and 4 million have autorickshaw fleet ranging between 15,000 and 30,000 (Mani, Pai, and Aggarwal 2012). For a majority of Indian cities, autorickshaws constitute a minor share in the vehicle population but account for a much higher share in the modal split.

The number of IPT vehicles in India has increased from less than 400,000 (4 lakh) in 2015–16 to close to 700,000 (7 lakh) in 2018–19. Of the IPT modes, autorickshaws comprise the larger share. In 2018–19, the number of autorickshaws crossed 500,000 (5 lakh) (Ministry of Road Transport and Highways 2019).

1.1 What is the problem with the current autorickshaw fleet?

Pollution and health risks

Diesel autorickshaws are highly polluting, emitting much higher particulate matter than petrol and CNG autorickshaws as well as diesel cars (Roychowdhury 2018). Diesel engines are very noisy and can make the occupants of the vehicle uncomfortable (Sen et al. 2011) evaluate and study the noise exposure from autorickshaws in running condition in Kolkata city of India. Statistical Regression analysis is done among the different parameters like LAeq, L90, and calculated parameters like TNI and Lnp. TWA (Time Weighted Average. These factors affect the health of the drivers and increase their fatigue (Weitekamp et al. 2020).

The emissions from the autorickshaws in their working condition are 49 per cent higher than their declared emission (Harding et al. 2016). As the autorickshaws age, their emissions tend to go up. The type of fuel also plays a decisive role in the emissions, with fossil fuel-powered (petrol and diesel) autorickshaws causing higher emissions. Autorickshaws powered by liquefied natural gas (LNG), CNG, liquefied petroleum gas (LPG), or battery power (electric) have lower emissions. Maintenance costs also increase with the autorickshaw's age (Harding et al. 2016). Initially, two-stroke autorickshaws were in a majority on the roads. Owing to their high emission rates, most state

governments decided to phase them out, ushering in four-stroke autorickshaws (Thakur 2019).

Low earnings affecting drivers' livelihood

The COVID-19 pandemic greatly affected the livelihoods of the autorickshaw drivers. Their incomes declined drastically from nearly INR 1,000 per day to less than INR 300 per day during the pandemic (Khan 2020). Lower incomes, combined with the increase in fuel prices, pushed the drivers to suffer huge losses and many are still struggling to make their ends meet (Prabhakaran 2021).

1.2 Why shift to e-autorickshaws?

Better health for drivers and users

Electric vehicles have zero tailpipe emissions and negligible noise and vibrations (Hua, Thomas, and Shultis 2021). This can largely reduce driver and commuter fatigue in internal combustion engine (ICE) autorickshaws. These vehicles are also environment-friendly as they make zero tail pipe emissions.

Increased profits leading to better livelihood

The total cost of ownership (TCO) of e-autorickshaws in India is already lower than other autorickshaws powered by CNG, diesel, petrol, and LPG (see P. Kumar and Chakrabarty 2020; P. Kumar and Kanuri 2020). By bringing down the costs, e-autorickshaws can improve the profits for drivers, leading to an improvement in their livelihood. We present a detailed analysis of the costs and expected increase in savings later in this brief.

1.3 Why do we need local policy action for e-3W transition?

Even though the economic and environmental benefits of e-autorickshaws are theoretically clear, the transition in this segment is still riddled with many hurdles (Goel, Sharma, and Rathore 2021). Autorickshaw drivers have limited awareness about the availability of e-autorickshaws, and their potential to improve their livelihood (Zee News 2022). Drivers perceive risks regarding the reliability of batteries and availability of service and maintenance.

Limited visibility of e-autorickshaws in the market also increases the drivers' perceived risk (Jain, Bhaskar, and Jain 2022) in transitioning to an e-autorickshaw. The limited visibility also deters financiers from financing the purchase of these vehicles. Uncertainty regarding the ability of the e-autorickshaw driver to pay back the loan and the perceived low potential of e-autorickshaw resale market, push up the interest rates on loans (Gupta 2022). Moreover, for a fast transition, many autorickshaws must be scrapped or converted to an electric version before their mandated retirement age (15 years in most cities). Retrofitting of ICE autorickshaws with batteries to convert them into an e-autorickshaw is much discussed in the literature but not implemented at scale in any Indian city (Sai 2021). There are also e-autorickshaw supply constraints, as waiting periods to procure the vehicles are long. Even though electric vehicle (EV) transition is led by the 3W segment, charging infrastructure development in most cities is not 3W-focused (Das, Sasidharan, and Ray 2020). The low availability and accessibility of charging points for e-autorickshaws remains a major impediment.

> **E-3W is a clear solution for simultaneously reducing emissions and improving livelihoods.**

The 3W segment is probably the lowest hanging fruit for EV transition. It is the strongest example of India's inclusive EV transition. However, e-autorickshaws are yet to capture the imagination and aspirations of the autorickshaw drivers, resulting in its mass uptake. So, the transition calls for local policy action to catalyse e-3W market. By taking up the case of 3W segment in Kochi, we show how the potential e-3W market can be tapped for 100 per cent electrification of the autorickshaw fleet in the city by 2030. Based on our analysis, we recommend 10 goals and associated local policy action for catalysing the e-3W market in the country.

Image: iStock

2. Autorickshaws in Kochi: A case study

The city of Kochi is part of the Greater Kochi Region, which consists of other municipalities and various gram panchayats as well. The city has a population of 0.6 million spread over an area of 94 km² and the Greater Kochi Region has a population of 2.1 million spread over an area of 440 km² (Kuriakose and Philip 2021). This study is limited to the area falling under the jurisdiction of the Kochi Metropolitan Transport Authority (KMTA). This covers areas that fall under the Greater Cochin Development Authority (GCDA) and Goshree Island Development Authority (GIDA). We refer to our study area as the Kochi region in this study.

In 2020, the Government of Kerala established the Kochi Metropolitan Transport Authority (KMTA), a first of its kind in India with the aim to facilitate the coordinated planning and implementation of urban transport programmes and projects and for an integrated management of urban transport systems in the Greater Kochi Region (GCDA + GIDA Area). The authority brings several bodies such as the Motor Vehicles Department, Kochi Corporation, and town and urban planners under a single umbrella (*The Hindu* 2020).

Kochi's transport was historically water based, but over time, the advent of land transportation relegated water transport to the margins. The city still has a few national and inland waterways along with passenger ferry services. Currently, almost half of the city's population is dependent on public transport and 32 per cent of people in Kochi depend on autorickshaws for their commute (Tiwari and Raman 2018). In the following sections, we discuss the data collected and approach we followed for charting out the strategy for 100 per cent electrification of Kochi's 3W fleet. We also show the results of how the 3W fleet in in Kochi will evolve in a business-as-usual scenario.

2.1 Approach

For charting the path for 100 per cent 3W fleet electrification, we use data from the primary survey of 268 autorickshaw drivers and secondary data on 3W registration from road transport authority (RTO) apart from engaging in group discussions with autorickshaw drivers and conducting extensive interviews with government officials, political leaders, and civil society stakeholders (Table 1). The EV potential is analysed with regard to the political, environmental, social, technical, economic, and legal scenario in Kochi. We employ the political, economic, social, technological, legal, and environmental (PESTEL) framework for our analysis (Perera 2017).

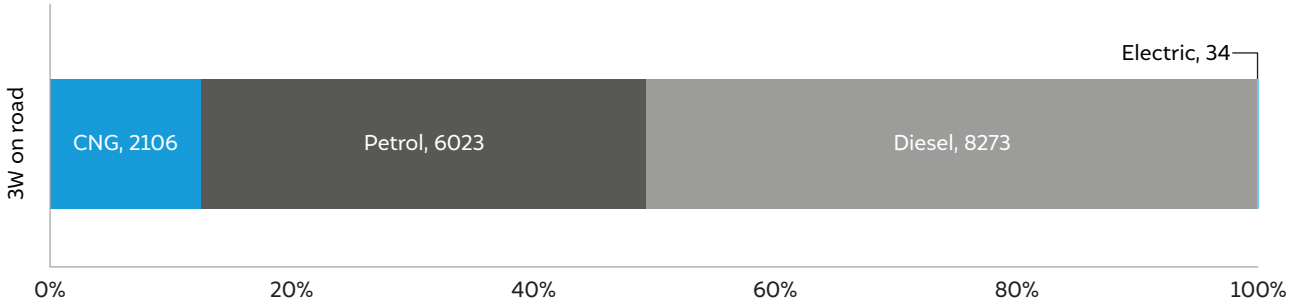
In the quantitative survey, we collected vehicle, operational, and economic characteristics from 268 autorickshaw drivers across the Kochi KMTA area. The survey covered the main autorickshaw stands of seven RTOs the in the KMTA area. The survey sample size was determined using the Cochran formula (Robert 1986) considering the total 3W registrations from Vaahan dashboard (Ministry of Road Transport and Highways 2022). With a confidence level of 90 per cent, we consider 268 samples for the analysis.

Table 1 Stakeholders engaged for 3W transition in Kochi

Government	Political	Private
Kochi Metropolitan Transport Authority (KMTA)	Ernakulam Jilla Autorickshaw Drivers' Cooperative Society (EJADCS)	Piaggio Vehicles Pvt Ltd
Cochin Smart Mission Limited (CSML)	Indian National Trade Union Congress (Autorickshaw union)	Sun Mobility Pvt Limited
Road Transport Office, Ernakulam	Centre of Indian Trade Union (Autorickshaw union)	RACE energy
District Collector, Ernakulam	NA	Mahindra and Mahindra Ltd
Kochi Municipal Corporation (KMC)		Kinetic Green
Centre for Heritage, Environment, and Development (C-HED)	NA	Voltas, MEdrive

Source: Authors' compilation

Figure 1 Half of Kochi's autorickshaws run on diesel



Source: RTO, Ernakulam (October 2021)

As a baseline for charting the transition, we model the stock of 3W fleet in Kochi using data from our survey along with secondary data from RTO. This is presented towards the end of this chapter.

2.2 How many autorickshaws are there in Kochi?

We collected data from the Ernakulam RTO regarding the number of on-road vehicles in the study area. As per this data, 50 per cent of the autorickshaws currently on Kochi roads run on diesel (Figure 1). The rest use petrol (37 per cent) and compressed natural gas (CNG) (13 per cent). The number of e-3W currently plying in Kochi is rather miniscule (34). In total, there are **16,449 autorickshaws** on-road as on October 2021 in the Kochi region.

2.3 How is 3W demand expected to grow in the Kochi region?

There were 3,312 new autorickshaws registered in the Kochi region in 2019 alone. This growing trend of autorickshaw sales in Kochi was disrupted by COVID-19. There were only 1,267 autorickshaws registered in 2020 and 2021 combined. We linearly forecasted the growth of 3W based on observed registrations from the years 2013 to 2019. The 3W registrations in the pandemic years 2020 and 2021 were omitted while estimating the future trend of total 3W registrations in the Kochi region.

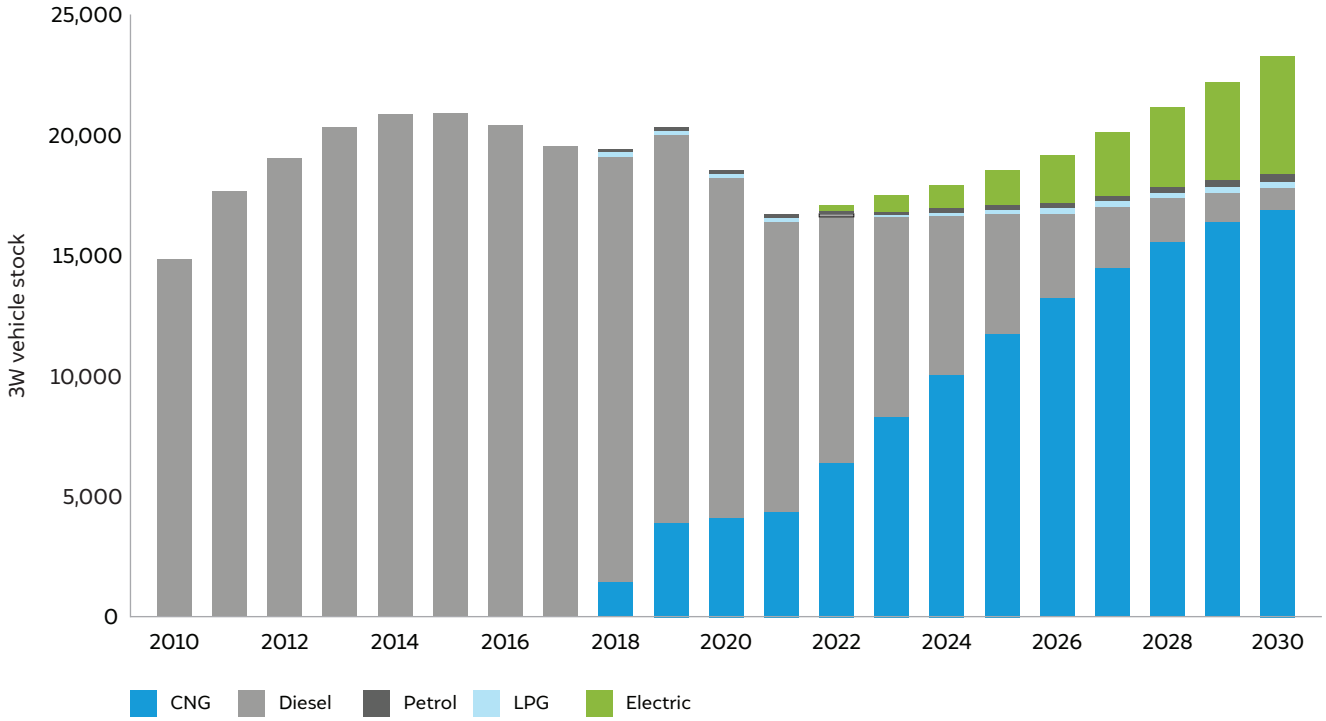
Diesel autorickshaws have drastically lost their market share in the total 3W new sales in the Kochi region, declining from 99 per cent in 2013 to just 5 per cent in 2021 (Figure 2). Although the pandemic disrupted 3W sales in 2020 and 2021, the declining trend in the sale of diesel autorickshaws was clear from the pre-pandemic years. Qualitative interviews with drivers revealed that diesel autorickshaws are not preferred against the cheaper and less noisy CNG autorickshaws. Linear forecast trend suggests that new diesel autorickshaws are not likely to be sold from 2023.

Liquefied petroleum gas (LPG) run autorickshaws were first introduced into the fleet in 2013. However, registration data suggests that their uptake has never been significant in any year. Similarly, there were only 123 **petrol autorickshaws** registered in the entire period from 2013 to 2021. Linear forecast for LPG and petrol autorickshaws (from 2013 to 2021) suggests a share of less than 2 per cent registration in this decade.

E-autorickshaws in the Kochi region had a 6 per cent share of registrations in 2021 (in 2020 and 2021, mobility was restricted on account of the pandemic). E-autorickshaws are being adopted in scale in other regions in Kerala. Significantly lower operational costs and government subsidies ensure that e-autorickshaws have the lowest total cost of ownership (TCO) than autorickshaws run on any other technology. The growth of electric 3W market share in the Kochi region since the inception of *Faster Adoption of Electric vehicles* (*FAME-II*) is used to project its development till 2030. By that projection, **e-autorickshaws are expected to have a 34 per cent market share in 2030.**

CNG autorickshaws grew from 0.1 per cent market share in 2016 to 81 per cent in 2019. Their sudden popularity over diesel is attributed to favourable fuel costs as discussed later. Since diesel autorickshaws are expected to lose their entire market share, CNG autorickshaws are expected to be the dominant market leader. However, as we will be demonstrating in the next section, e-autorickshaws are far cheaper than CNG counterparts and could penetrate the market if there is a matching supply of vehicles. Hence, it is projected that CNG autorickshaws will account for the entire market share left uncaptured by e-autorickshaws.

Figure 2 Kochi's 3W fleet is transitioning from diesel autorickshaws to CNG and e-autorickshaws



Source: Authors' analysis

3. What is the EV potential in Kochi's 3W segment?

In this chapter, we discuss the political, economic, sociological, technological, legal, and environmental (PESTEL) potential of EVs in Kochi's 3W segment. Each aspect of PESTEL is discussed below in the light of sample survey analysis and interviews. The objective of the analysis is to describe the potential of Kochi's autorickshaw segment to transition into e-autorickshaws and determine factors that either support or do not support the transition.

3.1 Political potential

Unlike other cities in Kerala, Kochi region's political map is complex, consisting of a corporation, multiple municipalities, and a few panchayats (Kuriakose and Philip 2021). During the survey, multiple stakeholders were interviewed out of which KMTA and Ernakulum Jilla Autorickshaw Drivers' Cooperative Society (EJADCS) were determined as the primary agencies that could lead the the transition to e-autorickshaws in Kochi. EJADCS, formed by all the active political trade unions of autorickshaw drivers in Kochi and inaugurated by the Kerala Chief Minister in February 2019, has 3,000 members as of 2021. EJACDS launched autorickshaw ambulances to help the COVID patients, ably supported by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), during the pandemic lockdown period, which received wider press coverage (*New Indian Express* 2021). The board members of EJADCS are aware of the benefits of e-autorickshaws and are willing to make the transition as early as possible.

The Kochi Metro launched 18 e-rickshaws as feeder services from certain metro stations with the help of EJACDS. However, the e-rickshaw pilot failed due to technical issues during the Kerala floods in 2019 and

> **Even though economic and environmental benefits of e-autorickshaws are theoretically clear, the transition is not happening at the desired pace.**

then COVID-19 lockdown in 2020. Despite this glitch, the interviewed members expressed keenness towards transitioning Kochi's 3W fleet to electric vehicles. This gives the EJACDS the first-hand experience and understanding of the challenges and advantages of e-3Ws.

Positives

- Potential stakeholders are well aware of the benefits and needs of e-autorickshaws.
- EJADCS is keen to make the transition to electric vehicles so as to improve the livelihood of autorickshaw drivers.

Negatives

- There is no stakeholder who is currently taking leadership for a scaled 3W transition in Kochi.

3.2 Economic potential

According to autorickshaw union members interviewed, the average profit made by an autorickshaw driver per day at Kochi is INR 584, which is lower than the minimum average daily wages set by the Kerala government (INR 600). The union representatives interviewed noted that the average daily wage in Kochi is INR 1,000 and an autorickshaw driver who works about 12 hours a day does not earn what he deserves when compared to labourers who work in other unorganised sectors.

In our sample survey, most of the drivers said that they work 12 hours a day. The union leaders felt that autorickshaw drivers' poor earning affects their spending capacities and they are unable to bear the expenditure for basic needs like education of children and health of dependent family members. Another respondent stated that one-third of the revenue earned daily is spent on fuel expenses and maintenance costs. From the daily profits, the autorickshaw driver has to spend on food and other miscellaneous expenses, which are not captured in the survey but mentioned in the group interviews. In the group interviews, autorickshaw drivers expressed their concern about the fuel price hike and how it affects their daily life. They have a positive dispensation towards the e-autorickshaws, hoping that it will reduce their fuel bill.

When CNG autorickshaws were introduced in Kochi, many drivers turned to the new option. Our stock model shows how CNG is evolving to be the dominant fuel technology for autorickshaws in Kochi. The fuel price provides an advantage for the CNG autorickshaw drivers, but the price hike is worrying them. The combined expenses of fuel and maintenance give the CNG autorickshaw drivers just 5 per cent more profit than the average profit.

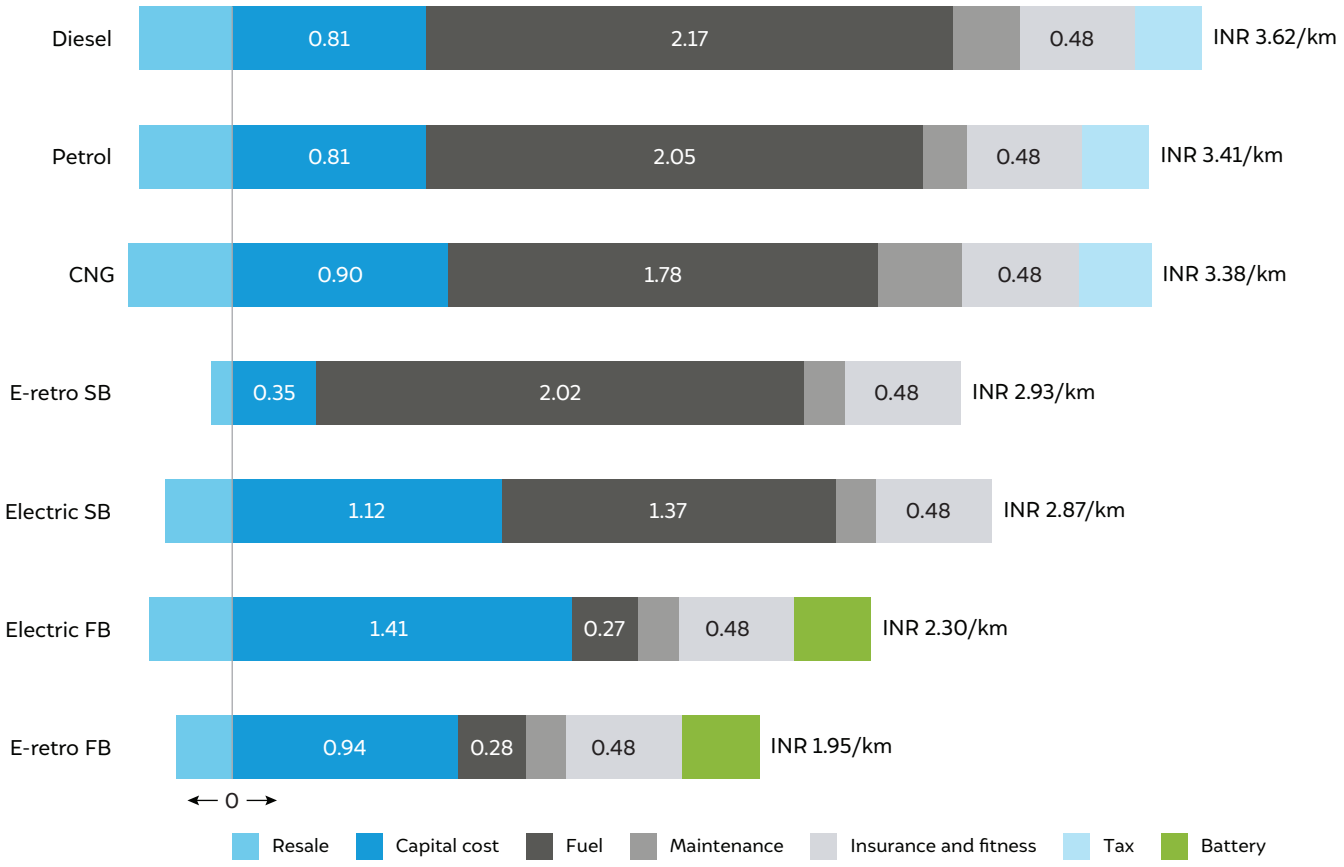
KMTA officials pointed out in the interview that financing e-autorickshaws is a major challenge. They stated that the estimation of depreciation value of the electric autorickshaw is going to be a challenge for the banks, especially for the point-charging autorickshaws with fixed batteries. As the battery has a higher depreciation factor, banks will be either forced to increase the interest rate or increase the down payment, which can potentially affect the owners' decision to transition to e-autorickshaws. The bankers interviewed highlighted two uncertainties that increase their lending risk for e-autorickshaws. One being ability of autorickshaw drivers to pay back the loan and the other being availability of a resale market.

Table 1 Electric autorickshaw options available for drivers in Kochi

Electric 3-wheeler options available		OEMs (not exhaustive)
Electric FB	New 3W with fixed battery	Piaggio, Mahindra Electric
Electric SB	New 3W with Swappable battery	Piaggio
E-Retro FB	Retrofit old autorickshaw with fixed battery	Voltas EV, ME Drive
E-Retro SB	Retrofit with swappable battery	RAC Energy

Source: Stakeholder consultation by authors

Figure 3 Cost of owning e-3W can be 46% lower than owning diesel 3W



Source: Authors' analysis

Our survey found that 97 per cent of the autorickshaw drivers in the Kochi region are also owners of their autorickshaws. Hence, the autorickshaw drivers themselves will be making the purchase decision to transition to electric 3W.

The autorickshaw drivers have the option to buy a new electric three-wheeler or retrofit their existing autorickshaws in Kochi. Additionally, the owners can choose whether to have a fixed or swappable battery system. Hence, we find four types of potential electric autorickshaw options for drivers in the Kochi region (Table 1).

We calculated the net present value (NPV) of the total cost of ownership (TCO) of the four electric options mentioned in Table 1. We also calculated the TCO for the current diesel, petrol, and CNG autorickshaws using the Kochi-specific data collected in our prior survey.

Electric autorickshaw options considered here are 13–46 per cent cheaper to own than autorickshaws currently plying on CNG, diesel, or petrol (Figure 3).

- Owning a CNG autorickshaw is 7 per cent and 1 per cent cheaper than diesel and petrol autorickshaws, respectively. Although the fuel cost of CNG is lower than petrol and diesel, CNG autorickshaws entail higher maintenance costs.

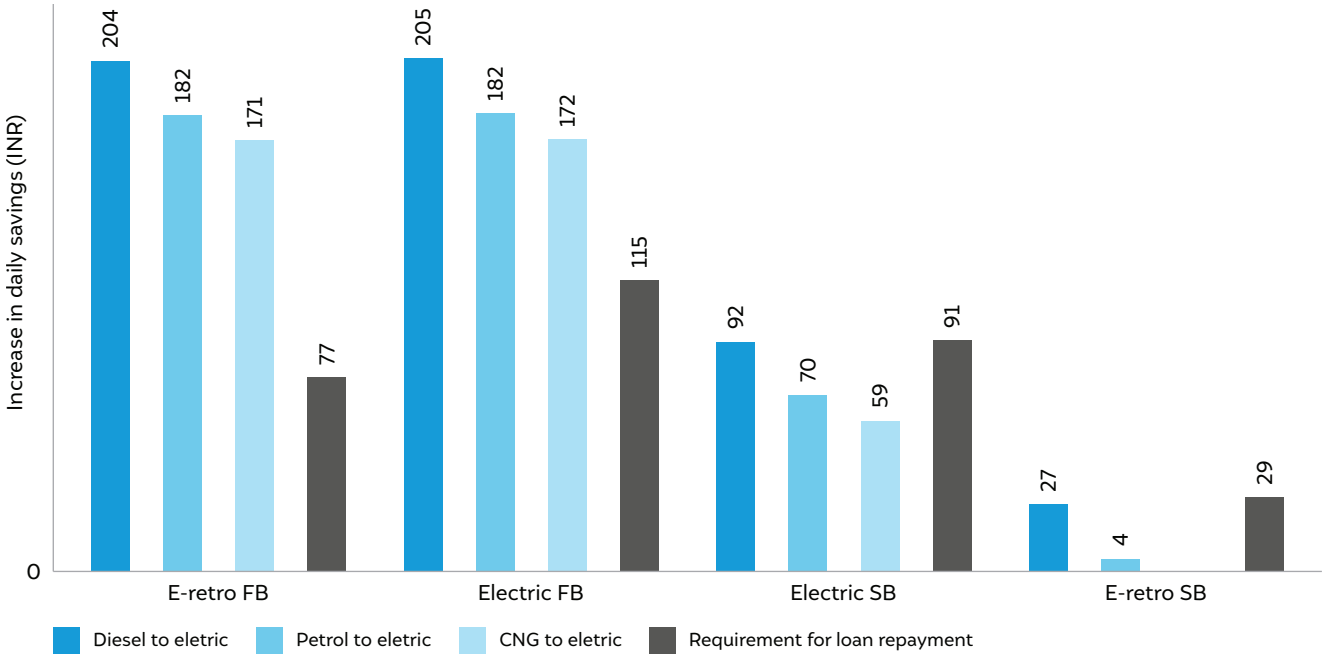
- In the current scenario, fixed battery (FB) e-rickshaws have the cheapest ownership costs, primarily due to low-energy costs. The opportunity cost of charging time is not accounted for in a TCO model as only real monetary expenses are included in this analysis.
- Swappable e-autorickshaw models do not incur battery replacement expenditure in the future, but their energy costs are presently higher than fixed battery models. This is because swapping rates per unit of energy is higher than home-charging rates. Swappable batteries cannot be charged at home and can only be swapped at swapping stations.
- Fitness and insurance costs for e-autorickshaws could be reduced through policy interventions.
- Apart from reducing economic costs, e-autorickshaws can reduce driver and passenger fatigue due to reduced noise and vibrations compared to current diesel autorickshaws.

Increase in daily savings

The ability of autorickshaw drivers to pay back the loan was highlighted by financiers interviewed in the study. Our survey found that on average, an autorickshaw driver in the Kochi region earns **INR 950 daily**. With e-autorickshaw meters having the same fare structure, we assume that e-autorickshaws will also generate the same income.

Our qualitative interviews with autorickshaw drivers suggest that drivers typically evaluate their daily business by mainly deducting fuel and maintenance costs from their income. Using inputs from our survey and TCO analysis above, we have estimated an increase in daily savings for currently diesel, petrol, and CNG autorickshaw drivers on switching to the e-autorickshaw options. Figure 4 compares the increase in savings with the amount required to pay back principal and interest for the respective e-autorickshaw purchase.

Figure 4 Autorickshaw drivers will generate enough additional savings by switching to electric vehicles to pay back their loan



Source: Authors' analysis

Current **diesel** autorickshaw drivers can increase their daily savings by switching to any of the four e-autorickshaw options considered here. They will save an additional **INR 205 daily** if they operate a new electric autorickshaw with a fixed battery. From these extra savings, they could easily put aside INR 77 daily towards paying back the loan obtained to purchase the e-autorickshaw.

- Extra daily savings are expected for current petrol autorickshaw drivers by switching to all four options considered here. However, the increase in daily savings is more than the requirement for loan repayment only in the fixed battery options.
- For current **CNG** autorickshaw drivers, fixed battery options are more attractive than swappable battery vehicles in terms of impact on daily savings. CNG drivers earn no extra daily savings by retrofitting their autorickshaws with swappable batteries.
- For both **fixed battery options** of buying a new vehicle or retrofitting the old vehicle, all ICE autorickshaw drivers will have enough savings to pay back the loan and save more.
- New autorickshaws with **swappable battery** is an attractive option for **only diesel autorickshaw drivers** who can pay back their loans with an increase in savings.

> **CNG autorickshaws are expected to be the dominant market leader accounting for the entire market share left uncaptured by e-autorickshaws.**

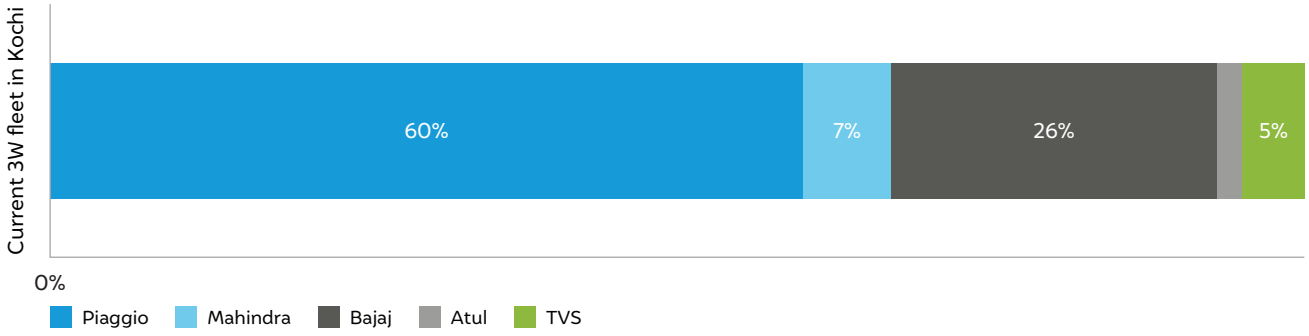
- **Costs per swap** for retrofit autorickshaws have to be reduced for this option to be attractive for all autorickshaw drivers.

3.3 Social potential

Due to lower vibrations and noise, e-autorickshaws will lessen driver and passenger fatigue. This was highlighted by many drivers in group interviews. A complete EV transition of 3W segment can also potentially reduce transport costs for autorickshaw users. Even though EJADCS had a negative experience with e-rickshaw pilot in 2019–20, they are still assured about the possibility of e-autorickshaws improving their livelihood. The adoption of e-autorickshaws in Thiruvananthapuram and Kozhikode in Kerala is also a driving factor for their adoption in Kochi.

Not having adequate parking space for the e-rickshaw and charging location at home is a potential social barrier for electric autorickshaw adoption in Kochi. We find that 30 per cent of drivers in Kochi do not have a parking space for their autorickshaws at home.

Figure 5 Kochi's 60% 3W fleet comprises of Piaggio models



Source: Authors' analysis

3.4 Technology potential

The survey results show that in Kochi, on average, an autorickshaw makes trips covering 100 kilometres daily. Of these, 92 per cent of the trips are within the city and 70 per cent of the drivers have the provision of charging at home. We find that 80 per cent of the stated daily distances are within the range 130 kilometres, which is highest range for the e-autorickshaw available in the Kochi market. Although this range increases the potential of home charging for most autorickshaw owners, it also indicates the need for public charging as well as battery swapping. As many as 20 per cent of the 3Ws in Kochi cannot be cover their daily distance under one full charge. This raises the need for battery swapping as well as public point charging solutions.

Out of the average of 10.7 hours of operation, most autorickshaw drivers responded that they get 3 hours of idle time. So there exists a potential for top-up charging during the running time of e-autorickshaws.

As discussed in the social context, there are autorickshaw drivers who do not have the advantage of home charging and they should have the option to go for either point-charging or battery swapping. Considering range anxiety and charging infrastructure outside the city, electric autorickshaw drivers might have to compromise on the 8 per cent of the intercity trips depending on the distance and state of charge of the battery.

We find that 60 per cent of the vehicles in Kochi's stock are diesel-based Piaggio models (Figure 5). It is interesting that Piaggio is also one of the leading OEMs offering e-autorickshaws. This makes it viable for the same OEM to exchange their old autorickshaws for a new electric autorickshaw. This is attractive for both the OEM and the user.

Positives

- E-autorickshaws in the market at present can cover the average distance that an autorickshaw plies in a day in Kochi city.
- Well-deployed point charging infrastructure can help the drivers to fully charge or partially charge their autorickshaws during the idle time in between their operational hours without compromising on potential rides.
- Battery swapping has a potential market and will be helpful for those who do not have home charging option as well as those with high opportunity costs of charging.

Negatives

- 30 per cent of drivers do not have home-charging facility.
- 20 per cent of the stated daily distances is beyond maximum range of e-autorickshaws available in the market.
- 8 per cent of 3W trips on average are intercity trips, which may not be catered by e-autorickshaws.

Image: CEEW

3.5 Environmental potential

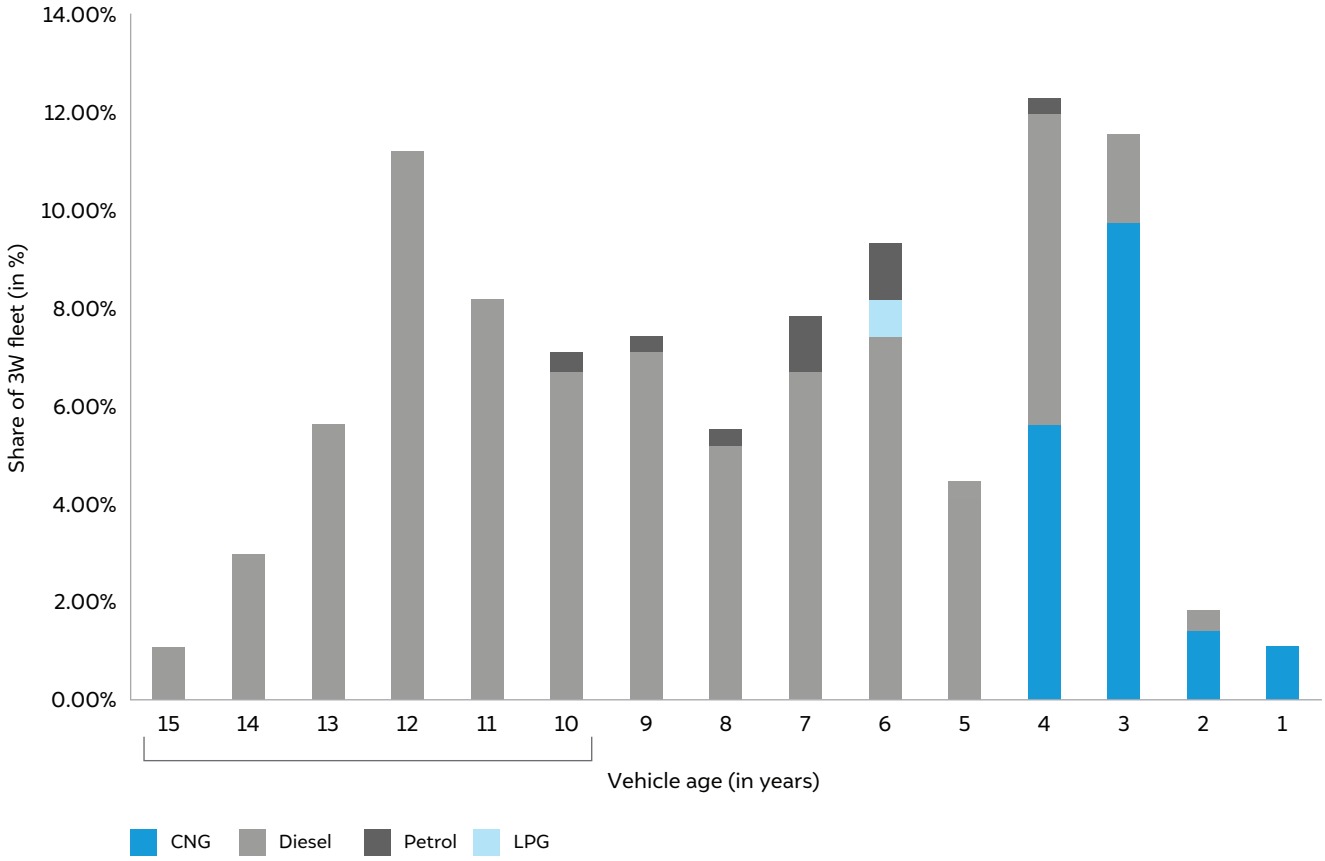
As shown in section 2.2, 76 per cent of Kochi's 3W fleet consists of diesel autorickshaws. With high greenhouse gas (GHG) and pollutant emissions, diesel is the most environmentally unfriendly technology that could be used for autorickshaws. Our analysis shows that about 36 per cent of Kochi's 3W fleet is aged 10 years or older (Figure 6). Older fleet would mean even higher emissions from each of those vehicles.

We estimate that the current 3W fleet in Kochi is responsible for 0.16 million tonnes (MT) of nitrous oxides (NO_x) emission annually. Similarly, we find annual emissions of 0.04 MT of particulate matter (PM) and 0.9 MT of carbon monoxide (CO) emissions from 3W fleet in Kochi alone. The role of 3W segment in Kochi's air pollution is discussed in the literature as well. We also find that if the 3W segment could potentially contribute to more than 66,000 tonnes of carbon dioxide equivalent emissions annually by 2030. So transitioning the entire fleet into a e-3W fleet would bestow environmental benefits for Kochi in terms of reduced GHG emissions and emission of pollutants like NO_x, PM, and CO.

3.6 Legal potential

The permit regulation for autorickshaws exists only in the KMC area. Other areas of the KMTA do not have any permit system that restricts the number of e-autorickshaws. As per the gazette order 48/2018 of the Government of Kerala, the Municipal Corporation of Kochi can allow 2,000 extra e-autorickshaws. However, the RTO officials state that the gazette order is not applicable to e-autorickshaws and they are exempted from permits as per Section 66 of the *Motor Vehicles Act*. Hence there is a legal framework that supports the transition to e-autorickshaws (Figure 7).

Figure 6 Kochi's 36% 3W fleet is 10 years or older



Source: Authors' analysis

Figure 7 Legal regulation of autorickshaws in Kochi is conducive for e-3W transition

14 Dec 1995 S.R.O no. 1502/95	State governments direct Road Transport Authorities (RTAs) to limit number of autorickshaws in the cities of Kochi, Kozhikode & Trivandrum
27 January 2011 S.R.O no. 76/2011	State government direct RTAs to increase the limit of autorickshaw permits in Kozhikode to 4337
20 February 2016 S.R.O no. 158/2016	State government direct RTAs to increase the limit for autorickshaw permits in Trivandrum from 4550 to 30,000 Fix the limit exclusively for LPG/LNG/CNG/electric autorickshaws as 3000, apart from the already fixed autorickshaw permits
2018 G.O.(P)No. 41/2018	Amendment to previous order: fix the limit of permits as 2000 for e-autorickshaws in each of the cities 1000 permits for CNG/LNG/LPG part from the autorickshaw permits already fixed
22 April 2020 S. R.O. No. 284/2020	E-autorickshaw to be exempted from paying tax for a period of 5 years from date of registration
22 April 2020 S. R.O. No. 284/2020	Autorickshaw older than 15 years and running on diesel not to be allowed to operate after 01.01.21 unless retrofitted with LPG/LNG/CNG/electric

Permits on operation are issued for the autorickshaws as prepaid city permits. The RTA charges Rs 300 for a new permit and renewal

Source: Authors' compilation from literature (Government of Kerala orders, 1995 to 2020)

When it comes to the deployment of charging infrastructure, there are certain legal issues. The KMTA officials note that most autorickshaw stands are not legally designated for the purpose by the RTO. In such conditions, the utility would be reluctant to issue connections for the charging infrastructure.

Positives

- Supportive EV policy.
- No restrictions on the permits of e-autorickshaws.

Negatives

- Land ownership and charging infrastructure deployment would be a challenge.

4. What is the potential e-3W market in Kochi?

As discussed earlier, in a business-as-usual scenario, e-autorickshaws are expected to have a 34 per cent market share in the new autorickshaw registrations by 2030. However, this does not factor in the demand for retrofitting the current autorickshaws with batteries to convert them to electric vehicles. The demand for e-autorickshaws could further increase if the purchases induced by the scrapping mandate in Kochi (to scrap vehicles older than 15 years) get converted into e-autorickshaw purchases. Using RTO data of current stock vehicles and yearly registration, we

modelled Kochi's on-road 3W stock till 2030. Excluding vehicles older than 15 years, the vehicles in the current stock are likely to go out of fitness for various reasons such as crash and theft for vehicle components. The survival curve of the autorickshaw fleet in Kochi was derived from our prior survey. We recommend that for faster fleet renewal from old ICE autorickshaws to new e-autorickshaws, progressive scrapping mandates may be enforced. In this section, we estimate all such potential demand for e-autorickshaws.

Market for new e-autorickshaws from old diesel autorickshaws

In the current fleet in Kochi, **169 diesel autorickshaws** in will be older than 15 years by the end of 2022. These will have to be mandatorily scrapped. Another estimated **2,163 diesel autorickshaws** will be phased out due to lack of fitness by the end of 2022. Using the stock model, we have estimated such demand for new e-autorickshaws from phasing out of old diesel autorickshaws till 2030.

Market for new e-autorickshaws from old petrol autorickshaws

The RTO data shows that there are **6,023 petrol autorickshaws** in the Kochi region. It is observed from vehicle registration data that only 123 petrol autorickshaws have been registered since 2013. This would mean that at least 98 per cent of the fleet is older than 8 years as of 2022. According to RTO data, 36 per cent of the on-road autorickshaws are petrol autorickshaws, but our survey did not show a similar trend. According to our survey, only 5 per cent of the autorickshaws in the Kochi region are running on petrol. Our team did discuss the phasing out of petrol autorickshaws in the qualitative interviews we had with the autorickshaw drivers. It was suggested that many petrol autorickshaws have been phased out due to low post-pandemic demand, high fuel costs, and unavailability of vehicle parts for repair and maintenance. Based on the CEEW survey and qualitative interviews, we assume that 5 per cent of the petrol autorickshaws are still on the road as per RTO data. About 860 petrol autorickshaws in the current fleet can be targeted to be phased out by 2023. It is assumed in consequent demand projections that there is an equal likelihood of retro-fitment and electric variant replacement (i.e. 50 per cent of these petrol autorickshaws will demand electric retrofit and 50 per cent will demand new e-autorickshaws).

Local policy action can catalyse e-3W demand to accelerate India's inclusive EV transition.

Market for the retrofit kit from diesel autorickshaws

The diesel, petrol, or CNG autorickshaw drivers would incur minimal costs and realise higher savings by retrofitting current autorickshaws with a fixed electric battery. A retrofit is an especially attractive option for autorickshaw drivers who own ageing vehicles. However, too old vehicles may be unfit for retrofitment as some of the essential parts may have been worn out. Based on our discussions with retrofit kit manufacturers, and on account of benefits like effective utilisation of the kit life and extended vehicle life for the driver, it is assumed that retrofitting vehicles aged 10–12 years in the fleet will yield the most benefits.

In Kochi's current on-road fleet, most vehicles aged 10–12 years are diesel autorickshaws. It is assumed that **30 per cent of the autorickshaws that are aged between 10 and 12 years** can be targeted for electric retrofit kits. We estimate demand for 1,458 electric retrofit autorickshaws by 2023 from the current fleet of diesel autorickshaws aged 10–12 years. Similarly, we estimate demand for retrofit kits from diesel autorickshaws till 2030.

Market for retrofit kit from CNG autorickshaws

For CNG autorickshaws, it is assumed that 30 per cent of the autorickshaws aged 10–12 years each year would potentially need electric retrofit kits. CNG autorickshaws will fall in this category only from 2028 onwards. We estimate that 810 CNG autorickshaws can potentially need retrofit kits but only from 2028 to 2030. There is expected to be a negligible demand for retrofitting CNG autorickshaws till 2027.

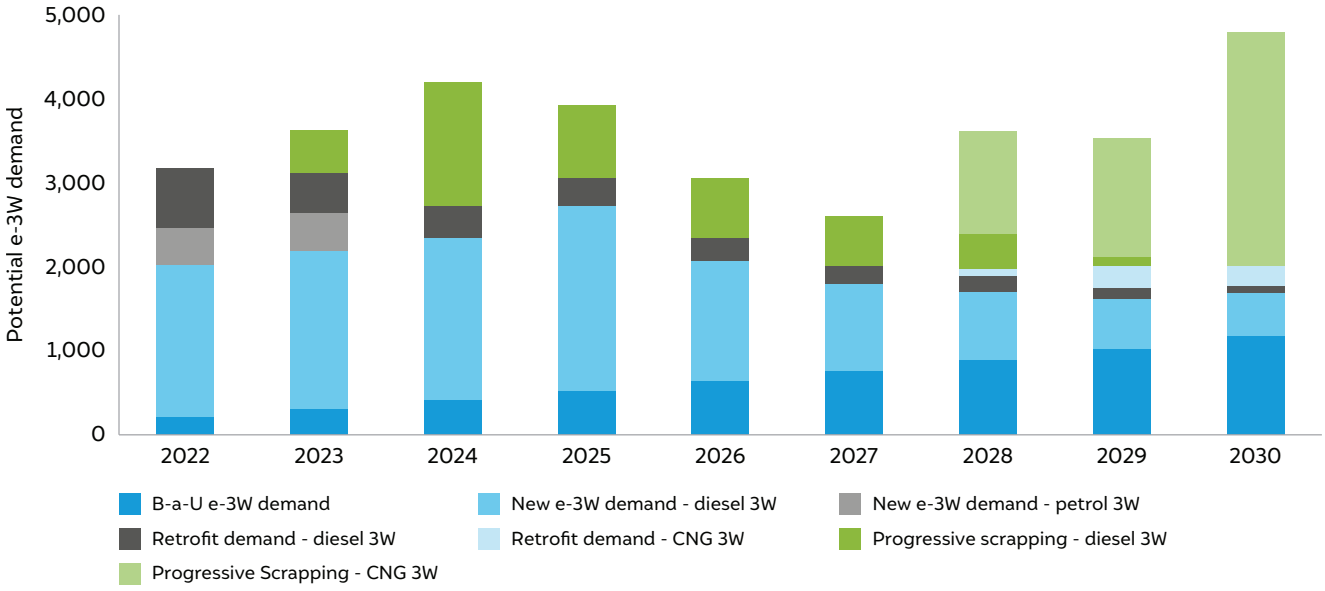
Market for new autorickshaws from progressive scrapping mandates

We suggest that the Government of Kerala may enact a progressive scrapping mandate to accelerate phasing out of diesel autorickshaws. The age for mandatory scrapping (15 years) may be reduced by one year, every subsequent year after 2022. It means that in

2023, vehicles older than 14 years will also have to be scrapped. In 2024, vehicles older than 13 years will be scrapped, and so on till 2027. Post 2027, ICE vehicles older than 10 years will be phased out till 2030. Diesel vehicles can be phased out in an accelerated manner with progressive scrapping. Even with progressive scrapping mandate, CNG autorickshaws will have to be mandatorily scrapped only from 2028. We estimated potential demand for e-autorickshaws that may be induced by progressive scrapping mandates (Figure 9).

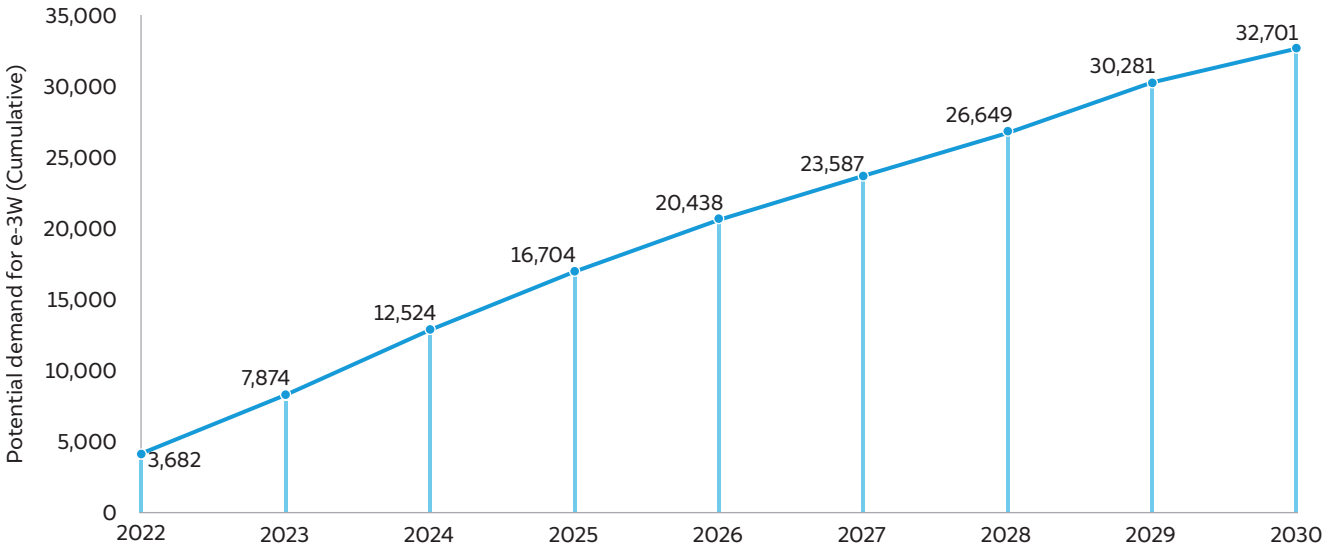
In a business-as-usual scenario, a maximum of 554 e-autorickshaws are estimated to be sold in the Kochi region. However, we estimate a maximum potential demand for 7,874 e-autorickshaws can be generated in the Kochi region by the end of 2023.

Figure 8 Potential e-3W demand can be generated through scrapping and retrofit interventions



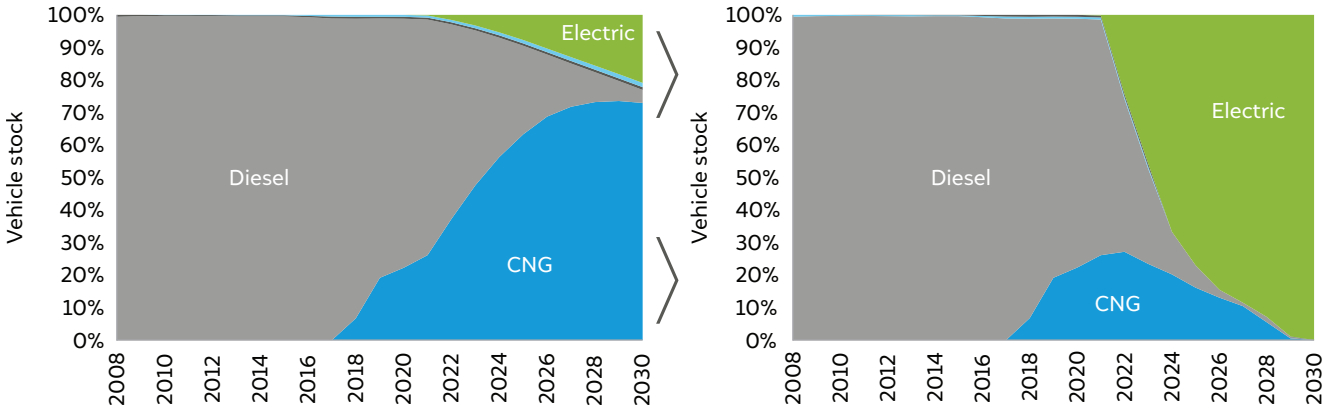
Source: Authors' analysis

Figure 9 A cumulative demand for 32,701 e-autorickshaws can be generated in Kochi by 2030



Source: Authors' analysis

Figure 10 Kochi can convert 100% of its 3W stock by realising the potential market for e-3W



Source: Authors' analysis

If the e-autorickshaw demand projected in Figure 10 is realised, Kochi will be able to transition the entire fleet into electric vehicles by 2030. It can alter the business-as-usual situation of 3W fleet in Kochi (discussed in 2.3) where EVs constitute 20 per cent of the fleet to a situation where 100 per cent of the fleet is electric (Figure 10).

In order to generate this demand for e-3W, the barriers discussed in section 1.3 and chapter 3 must be addressed through local policy. In the next section, we list 10 goals and associated local policy actions for addressing the roadblocks and catalysing e-3W demand in any Indian city. This can be considered a generalised guide for any local government to achieve the transition to e-3W.

5. How can potential e-3W market be catalysed?

Using the case of Kochi, we recommend policy action encompassing 10 goals for catalysing the e-3W market. These 10 goals are broad buckets informing policy actions by addressing barriers and tapping the e-3W market potential. These goals are not necessarily sequential. Although they are relevant in the case of Kochi, all of them may not be relevant to all the cities. However, as observed in the literature and validated through primary data and discussions, these goals are somewhat exhaustive in catalysing the e-3W market. Hence, other than informing policy action in Kochi, these 10 goals can act as a guide for the electrification strategies of 3W fleet for most cities in India. We do not recommend all the suggested policy actions for all the cities but present them as a guide to chart out a detailed 3W electrification policy/programme unique to each city.

Market-based principles form the basis of most of the suggested policy actions. Command and control policy actions mentioned include progressive scrapping mandates and telematics mandates. The rest of the policy actions are informational, organisational, and infrastructural in nature or suggest the use of economic instruments.

5.1 Chart targeted transition plan

For any city, its **3W vehicle stock has to be modelled** to understand the age distribution across fuel segments. This is essential to chart out retrofit, scrapping, and demand aggregation strategies for the transition into e-3W. We model the 3W stock of Kochi to show how scrapping interventions and retrofit of existing autorickshaws can fast track EV adoption. 3W vehicle stock can be modelled using the current stock of 3W from RTO, Vaahan registration data, and survival curve of the autorickshaw fleet in the city. It is also important to **understand ownership patterns** so as to identify decision makers for the e-3W purchase. As 97 per cent of autorickshaw drivers are owners of the vehicles in Kochi, in this case, e-3W purchase decision is taken by the driver themselves.

5.2 Accelerate fleet renewal

Fleet renewal can be accelerated by scrapping interventions at the city level. Many cities, including Kochi, have mandatory scrapping of autorickshaws that are 15 years old. These policies anyway induce the purchase of new autorickshaws. A policy nudge can easily alter this induced demand for new autorickshaws into demand for e-autorickshaws. **Scrapping incentives** linked with e-autorickshaw purchase can generate demand. In the case of Kochi, we find that most diesel autorickshaws in the current fleet are from Piaggio, which also offers e-autorickshaws in the market. We find that an incentive of INR 5,000 to INR 50,000 is offered by Piaggio to new e-autorickshaw buyers in exchange of their old ICE autorickshaws. This can be formalised as an **OEM buy back scheme.** Offering **scrapping incentives** in the form of purchase incentives through the e-OEM can nudge OEMs to initiate scaled buy back schemes, accelerating fleet renewal.

Further, we also show how **progressive scrapping mandates** can further accelerate fleet renewal. This intervention will have to be notified and enforced by the transport department in the respective city.

5.3 Establish retrofit market

We find that retrofit is an attractive option for many autorickshaw drivers who have vehicles aged 10–12 years. The transport department has a crucial role to play in approving retrofit kits and eligibility of vehicles to ensure technical reliability of retrofit e-autorickshaws. Governing bodies like the urban local bodies (ULB) or Unified Metropolitan Transport Authority (UMTA) in the city must bring together retrofit manufacturers and interested autorickshaw drivers to generate demand for retrofit kits. This, coupled with **stringent monitoring of vehicle fitness for retrofitting** by the RTO, can drive successful retrofit markets. Local governments must establish **retrofit forums** to monitor and address the needs of service and maintenance markets for such kits.

> **Induced demand from phasing out of old petrol, diesel and CNG vehicles can generate a demand for more than 32,000 e-autorickshaws by 2030.**

5.4 Reduce upfront cost

Even though the Government of India offers incentives under the *Faster Adoption of Electric vehicles* (*FAME*) programme, high upfront cost continues to remain a barrier for e-3W adoption. State governments like the Government of the National Capital Territory of Delhi (GNCTD) have further reduced these costs by offering state-level incentives. In the 80 e-autorickshaws being procured by EJADCS in Kochi, GIZ is providing support with a subsidy of INR 42,000 per e-3W and Cochin Smart Mission Limited (CSML) is adding on with further incentive per e-autorickshaw. This has made e-autorickshaws far more attractive for autorickshaw drivers in Kochi. **Local governments can explore e-autorickshaw incentives from the state government as well as special purpose vehicles (SPVs) established under the *Smart City Mission*.** If the e-autorickshaws are planned as feeders for public transport, incentives may be sought from mass transit companies like metro rail corporations in respective cities.

5.5 Ensure demand and supply

An assured demand for e-autorickshaws is necessary for consistent supply by OEMs. Autorickshaw driver cooperative societies like EJADCS have a proven role in aggregating demand for vehicles from their members. Establishing **driver cooperative societies** will be a vital catalyst for 3W transition in any city. The demand can be aggregated through these cooperative societies. Streamlining this aggregated demand through a government body for the purchase of e-3W from an OEM can put the city's e-3W supply on priority. This has been observed in the case of e-3W procurement by GNCTD. Aggregating demand through cooperative societies and **streamlining purchase through government** can ensure

steady demand and supply for the e-autorickshaw market to grow. Local transport authorities can take the initiative to establish driver cooperative societies. Streamlining purchase through the government can be done through a **notified scheme for e-autorickshaws** at the local level.

5.6 De-risk financiers

There are two uncertainties highlighted by financiers for their low interest in financing of e-autorickshaws. First, the ability of autorickshaw drivers to pay back the loan and, second, the resale potential of the e-3W. Most autorickshaw drivers do not have their Credit Information Bureau of India Limited (CIBIL) scores. In the case of Kochi, ownership of vehicles by the cooperative society helped financing of e-autorickshaws at an interest rate of 9 per cent. The **formation of autorickshaw driver cooperatives can play significant role in de-risking the financiers.** Otherwise, local governments can step in to provide credit guarantee for the e-autorickshaws. Schemes like ***Credit Guarantee Fund Trust of India*** **(CGFTI) scheme** can be used by local governments to support new e-autorickshaw purchase (D. Kumar 2013). **Mandating telematics** on e-autorickshaws can help the government, financiers, or cooperative societies to remotely monitor and manage them, further reducing the risk.

5.7 Improve awareness

We find that many autorickshaw drivers are not aware of the e-3W options available and its potential to improve their livelihood. Many have not stayed informed about any incentives provided by the state government and the Centre for e-autorickshaws. We also find that metrics like TCO are not relatable for autorickshaw drivers. Expressing the costs in terms of daily savings will have higher impact on preferences of the drivers for EVs. Local governments must chart a **communication strategy** aimed at improving awareness of autorickshaw drivers regarding favourable TCO, improved daily savings, e-autorickshaw options available, and the ways to purchase one. Information can be disseminated through e-autorickshaw scheme website, advertisements at auto-stands, and peer-to-peer communication through driver cooperative societies.

5.8 Increase visibility

Ensuring visibility of EVs is a strong catalyst for further EV adoption. E-autorickshaws must be clearly classifiable to nudge EV adoption by their peers as well in other vehicle segments. Although EVs are identifiable from green number plates, it is not completely effective. E-3W factory colours vary across OEMs. Branding all e-autorickshaws in the city by the **same colour paint** can boost the visibility, which will further accelerate adoption by other autorickshaw drivers. This can be easily mandated to the OEM if the procurement is streamlined through the local government. E-autorickshaw **demonstration events** can be organised to simultaneously improve awareness and visibility.

5.9 De-risk drivers

As the technology is nascent with higher upfront costs and limited visibility, the perceived risk by autorickshaw drivers to adopt e-autorickshaws is still high. Limited availability of service and maintenance options for e-autorickshaws also keeps the driver's perceived risk high. Local governments can de-risk the drivers by facilitating e-autorickshaw **rental business models**, where ownership is with the cooperative society or a private business. Battery swapping ecosystem shifts the battery failure risk from driver to swapping provider. However, we observed that the drivers perceived risk in being reliant on the same swapping provider over the entire life of the vehicle. Local governments can facilitate **long-term price lock for battery swapping** or introduce **distance-based pricing** mandate for swap providers. Distance-based pricing by battery service providers will de-risk drivers from deterioration in battery performance. Subsidised on-street charging can further reduce the perceived risk of autorickshaw drivers. **Telematics** in e-autorickshaws by local government can facilitate locally driven ride-hailing apps, improving driver earnings.

5.10 Plan for charging

E-autorickshaw-focussed charging infrastructure is essential for this transition. Many drivers do not have the parking space for autorickshaws at home.

This makes public charging essential. Total distances covered by autorickshaws in a day are beyond the e-autorickshaw range on full charge. This makes battery swapping also essential. We show that a combination of point charging and battery swapping is essential for establishing a vibrant e-3W ecosystem. The local government, in collaboration with electricity distribution companies, must chart out charging infrastructure plan focussed on 3W segment to improve availability, accessibility for e-autorickshaws, and utilisation of the infrastructure. Mandated telematics by the local government can facilitate e-3W ride hailing business to optimise ride allocation in tune with the charging points. 3W-specific charging infrastructure plan should be initiated by the electricity regulator, supported by the local development authority and coordinated by the transport authority or ULB. In the case of Kochi, the Kerala State Electricity Board (KSEB) must include 3W-focused charging stations in its larger charging infrastructure plan, GCDA/KMC must offer support in identifying the charging point locations, and KMTA must coordinate between these agencies.

6. Conclusion

E-autorickshaws are leading India's EV transition. The transition offers clear economic and environmental benefits for both users and drivers. However, e-3W transition is riddled with several hurdles such as lack of awareness among autorickshaw drivers regarding e-autorickshaws, perception of various risks, financing and incentives options available, lack of visibility of e-autorickshaws, low supply, and absence of affordable and accessible charging infrastructure. We emphasise that a fast and effective transition to e-autorickshaws can easily be achieved through local policy action. By studying the case of Kochi, we show how the entire 3W fleet in Kochi could be turn into an electric fleet by 2030. Based on our understanding from the case of 3W segment in Kochi and inferences from other cities in India, we recommend a 10-point local policy action plan for transitioning any 3W fleet into an electric fleet. This action plan can be used by any local government to prepare an effective 3W transition scheme. This issue brief thus informs policy action for a locally driven inclusive EV transition in India.

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