



SUPPORTING SUSTAINABLE MOBILITY  
UNDER SMART CITY MISSION

# HANDBOOK: E-RICKSHAW DEPLOYMENT IN INDIAN CITIES

**HANDBOOK:  
E-RICKSHAW  
DEPLOYMENT IN  
INDIAN CITIES**

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**About Shakti Sustainable Energy Foundation**

Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support renewable energy, energy efficiency and sustainable transport solutions.

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# MESSAGE

Greetings!

Urban areas in India act as catalysts of economic growth as they play a significant role in contributing towards national income, employment generation and productivity in their region of influence. Yet, city governments in urban areas continue to lag behind in capacity and have poor infrastructure, resulting in substandard quality of life for end users even today. Air pollution caused by transport sector in our cities has been reportedly adversely affecting the health of the citizens.

We are glad to provide our support to assess the status of deploying E Rickshaws in Indian cities. This has been a unique exercise which is also in line with the ongoing initiatives of Government of India such as Smart Cities Mission, FAME scheme etc. I would like to express our gratitude to Shakti Sustainable Energy Foundation for giving us an opportunity to work in this sector and would also wish to thank various stakeholders who include the manufacturers, government officials, traffic police for their assistance and inputs in the completion of this report.

(Emani Kumar)  
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# CONTENTS

	<b>Executive Summary</b>	<b>1</b>
<b>1</b>	<b>Background</b>	<b>4</b>
1.1.	Introduction - E-rickshaws and history	8
<b>2</b>	<b>Emerging Policy Landscape</b>	<b>10</b>
2.1.	National level initiatives	10
2.2.	State level initiatives	12
2.3.	Initiatives at local/city level	15
<b>3</b>	<b>Existing Scenario</b>	<b>16</b>
3.1.	E-rickshaw inclusion in a city	19
3.2.	E-rickshaw operation in Indian cities: Case study of Delhi	22
<b>4</b>	<b>Typical Barriers</b>	<b>33</b>
4.1.	Local authority level	33
4.2.	Operator level	35
4.3.	Commuter	35
<b>5</b>	<b>Frequently Asked Questions</b>	<b>36</b>
<b>6</b>	<b>Models for Regulations and Operation</b>	<b>45</b>
6.1.	Role of a city	45
<b>7</b>	<b>Actions Required</b>	<b>48</b>
<b>8</b>	<b>Way to Deploy E-Rickshaw</b>	<b>50</b>
8.1.	Big bang approach	51
8.2.	Phased transition approach	51
<b>9</b>	<b>Way Forward</b>	<b>52</b>
9.1.	Short term action plan (3 - 6 months)	52
9.2.	Medium term (6 months – 2 years)	53
9.3.	Long term (beyond 2 years)	53
<b>10</b>	<b>Roadmap for Cities</b>	<b>54</b>
10.1.	Category 1	55
10.2.	Category 2	56
<b>11</b>	<b>Afterword</b>	<b>57</b>
<b>12</b>	<b>E-Rickshaws in News</b>	<b>57</b>
<b>13</b>	<b>Recommended Readings</b>	<b>58</b>
<b>14</b>	<b>Appendix</b>	<b>58</b>
	<b>References</b>	<b>60</b>

LIST OF TABLE

Table 1:	The difference in extent of role of government of a city, its authorities, financial institutions, manufacturers and private operators	20
Table 2:	Annual emission reduction from single e-rickshaw in Udaipur	21
Table 3:	Detail of calculation of CO2 mitigation from e-rickshaw (considering example of Delhi)	21
Table 4:	The options of roles available to a city to incorporate e-rickshaws in its mobility landscape along with the details of roles and stakeholders	46
Table 5:	Various stakeholders and various actions required to be taken by them for supporting e-rickshaw deployment through planned inclusion in a city	48
Table 6	Difference in requirements, extent of control on system, investment and risk involved in big bang approach and phased approach	51

LIST OF FIGURES

Figure 1:	Map illustrating E-rickshaws deployed/proposed in Indian Smart cities	5
Figure 2:	Illustration of electric rickshaw market projection in India by motor power	6
Figure 3:	Interrelation between issues related to e-rickshaws, its smart feature and future development	9
Figure 4:	Map illustrating where e-rickshaws are operating	16
Figure 5:	Map illustrating the two categories of smart cities in India interested in e-rickshaw deployment or improvement of operation	54

EXECUTIVE SUMMARY

Urban development in India has resulted in a rise in number of cities from 5,161 (2001) to 7,935 (2011)<sup>1</sup>, along with indicative concentration of population in cities and existing urban agglomerations. As per 2011 data, 53 cities had population greater than a million and about 377 million people were residing in towns<sup>2</sup>. With this, a notable rise in demand for vehicles was also observed for inter-city or intra-city mobility of goods and passengers. A considerable rise in number of registered vehicles (25.3 times against the population growth of 1.77 times between 1981 and 2011) was also observed, further indicating need for viable passenger mobility solutions.

Million plus cities in India have observed a similar trend of increase in vehicular population (e.g. Delhi witnessed a growth from 3,635 vehicles in 2001 to 7,228 in 2011<sup>3</sup>) with a simultaneous rise in issues related to vehicular emissions. Conventional fuel powered vehicles, currently available as mobility modes largely contribute to pollution and emissions, leading to poor air quality, health problems and various other issues. The need to combat these issues has been realized by cities and alternative mobility options are being explored.

Electric vehicles (EVs) are increasingly being considered as the most logical option towards achieving this aim of combating local air pollution through alternative powered vehicles. In recent times EV technology has matured and is being promoted in line with zero tailpipe emissions. These are soon becoming a smart alternative for conventional fuel vehicles in India. The strongest push to shift towards electric modes comes from the national government, through promotion of various programs, schemes and policy support.

Since 2011, national government has been making efforts to introduce a transition from conventional vehicles to electric vehicles. Ministry of Heavy Industries (MoHI) launched National Electric Mobility Mission Plan (NEMMP) in 2013. Later in 2015, Department of Heavy Industry (DHI) introduced FAME I (Faster Adoption and Manufacturing of Hybrid & Electric Vehicles) scheme, followed by FAME II (in 2019). In addition, India’s vision of Intended Nationally Determined Contribution (INDC) specifies decarbonisation target of 33-35% with respect to GDP between 2005–2030,<sup>4</sup> supported by Draft National Energy Policy (June 2017). In 2018, GoI announced in MOVE global summit that discussions to introduce ‘E-Cess’ on fuel powered vehicles are ongoing.<sup>5</sup>

Recently in February 2019, Ministry of Power issued guidelines and standards for setting up charging infrastructure for electric vehicles as an amendment to the Model Building Byelaws 2016, supporting long term India’s vision of implementing electric mobility<sup>6</sup>. Along with these national government efforts, notable initiatives like Smart city mission (2015) and Atal Mission for Rejuvenation and Urban Transformation (AMRUT 2015) laid respective



emphasis on multi modal options for last mile connectivity along with development of supporting infrastructure, targeting mass scale EV integration in future.

Initiatives at national level further triggered states to initiate development of a prominent policy landscape around EV adoption. States including Telangana, Karnataka, Delhi, Kerala, Maharashtra, Uttar Pradesh and Uttarakhand have announced EV focused policies.

Though EV sector includes modes of public transport (PT), private transport (PV) and last mile connectivity with fast developing policies/ initiatives but still an example of often ignored mode for urban mobility is the modest e-rickshaw. A recent report published by Deloitte stated that e-rickshaws can be 'low hanging fruits' in EV adoption due to low life cycle cost,<sup>7</sup> thus a better understanding of this mode may result in effective deployment of modal combination.

E-rickshaws are zero tailpipe emission modal option used as first/last mile connectivity in cities. This 3 wheeled electric powered vehicle is usually expected to complete the value chain of public transport service gaps, for commuters. These have net power less than 4000 W, speed restriction of 25kmph and seating capacity for four passengers along with driver. E-rickshaws are welcomed by commuters and operators due to their characteristics of being demand responsive, comfortable, affordable, flexible and convenient. However, with uncontrolled rise in number of e-rickshaws, their regulation has become a challenge for authorities.

In 2010, e-rickshaws gained prominence in suburban and urban areas of Delhi NCR, towns of Uttar Pradesh, Bihar, West Bengal and some other areas. Majority of e-rickshaw operation in these areas are unplanned inclusion or a pilot planned inclusion later expanding in an unplanned way.

Around 2010, city governments noticed increasing number of e-rickshaws operating on city roads, realizing the need for a regulatory framework. Today, almost a decade since emergence of this EV mode, there is still a little evidence of guidance documents assisting optimal use of e-rickshaws promoting low carbon mobility in a city. National and state governments have initiated efforts by developing a regulatory framework to control operation and number of e-rickshaws, still there is a need of focused implication at local level to ensure fast learning, resulting in efficient e-rickshaw operation.

National government approved Central Motor Vehicle Rules (Amendment) 2015 and mandated safety standard compliance specified by Automotive Research Association of India (ARAI) / International Centre for Automotive Technology (ICAT) for regulating e-rickshaws. Some states also became active and attempted to consider e-rickshaws in their EV policy. At local level, though no focused regulation exists, cities are working towards integrating e-rickshaws as a part of other projects. Delhi is an illustrative example of a comparatively vibrant policy landscape, focused on e-rickshaw<sup>8</sup>.

From the case study of Delhi, it was understood that mere development of policies for a city may not be helpful while understanding of issues and resolution along with strict regulations may be helpful in improving operation of e-rickshaws in a city. Also as per the speculation, number of unregistered e-rickshaws is more than the registered ones. Major reasons for this may be attributed to unregulated manufacturing, purchase and operation of locally assembled e-rickshaws using low cost parts imported from China or other neighboring countries. Although these may not comply well with specified standards deeming them ineligible to be registered, still are very popular among operators due to their low price as compared to the standard compliant models.

In case of planned approach for e-rickshaw deployment in city, government has to face difficulty due to typical barriers including perception, standard compliance monitoring of e-rickshaws, unplanned inclusion/expansion in a city, unavailability/ lack of authorized

supporting infrastructure, inter vehicle conflict, safety issues for commuters and after life cycle use of e-rickshaws as major ones.

A city plays an important role in deployment/operation of e-rickshaws. A clear understanding and decision on role of a city may result in effective deployment and operation of e-rickshaws. A city may play the role of operator/regulator/ promoter and facilitator or a combination of these. A case in which a city is a promoter and facilitator is considered to be most efficient as the vehicles would be owned, operated and maintained by private individuals but are supported and monitored by the city. Also a phased approach may be preferred by a city in comparison to big bang approach of incorporation of e-rickshaws as it would be less risky and more feasible in terms of economic aspect and implementation.

An action plan is developed for two categories of cities. For a city which aims towards deployment of e-rickshaws requires background study, decision of approach and role of a city, policy landscape development, development of support infrastructure, training and awareness of operator and commuter and monitoring of operation.

Similarly for a city which already has e-rickshaw operational on ground and aims for improving its operation requires a detailed study of existing operation, user perception, infrastructure and regulations. Assessment of gaps in the above sectors should be analysed and improved through a policy landscape, support infrastructure and further monitoring operation.

It is evident from study of projects and schemes initiated by Government of India (GoI) that many cities in India already have e-rickshaws operational while many others are in process of including these in their transport system. Thus a basic understanding of e-rickshaw, its benefits and drawbacks is required before introducing e-rickshaws or further improving its operation.

This document has been developed by ICLEI South Asia with support from SG Architects and Shakti Foundation. The team has been working in three smart cities (Udaipur, Kakinada and Gwalior) on e-rickshaw deployment. Also 'CapaCITIES' project (supported by SDC) included pilot project of e-rickshaw deployment in Udaipur and observations from operations in Delhi and Siliguri. Developing on learning from these projects, ICLEI South Asia felt the need for developing a report to provide guidance and support to cities interested in deploying/ improving e-rickshaws.

# 1 BACKGROUND

In India, percentage of urbanised area along with its residing population is rising rapidly, leading to derived demand of travel for work, education, recreation, health or better quality of life. Increasing transport activities may lead to a rise in issues of congestion, pollution, accidents and health hazards. Solution to these issues are resulting in a major transformation of India's transport landscape, developed through various government initiatives at national and subnational levels. These schemes and initiatives include NEMMP 2020, NDCs, FAME India scheme, NULM, Smart city mission, etc.<sup>9</sup> These encourage alternative modal options, shift to electric vehicles, last mile connectivity improvement, improvement of public transport and road infrastructure are some of the projects.

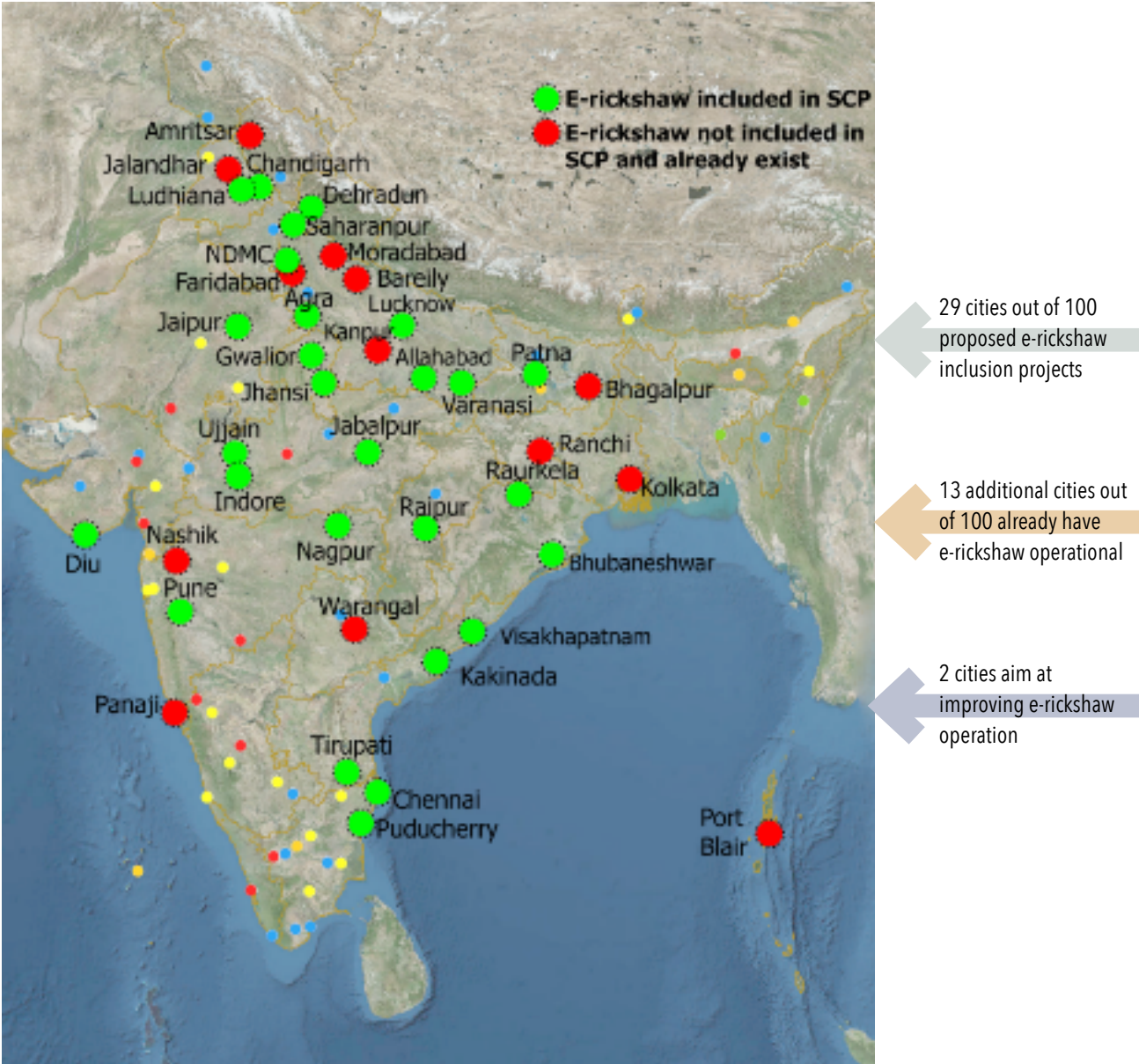
Public transport and road infrastructure is owned and maintained by the government, while last mile connectivity is usually owned, operated and maintained by government organisations while private individuals play more important role in case of last mile connectivity modes. E-rickshaw, rickshaw, autos, mini buses are categorised as last mile connectivity modes and are expected to complete the value chain of public transport service gaps for commuters. These are demand responsive vehicles, affordable and reliable for commuters, but are usually owned and operated by private individuals while their operation may/ may not be controlled by city/ state government.

Since there is deficiency of strict standards on maintenance of these last mile modes, these contribute to large percentage of pollution in cities.

As per the projection of International Energy Agency, electric vehicles are expected to have 35% to 45% lower emission in comparison with conventional IC engines.<sup>10</sup> Thus introducing electric vehicles as last mile connectivity option could result in effective reduction of pollution and health issues. Electric option for last mile connectivity mode may include e-rickshaws, e-autos, mini electric buses, etc. depending on city's requirement and feasibility. A recent report published by Deloitte stated that e-rickshaws can be 'low hanging fruits' in EV adoption, due to low life cycle cost,<sup>11</sup> and also due to the fact that e-rickshaws are zero tailpipe emission modal option used as first/last mile connectivity in cities. It is for the same reason that e-rickshaws have currently gained popularity among commuters and operators. These are demand responsive modes, affordable, comfortable and reliable for commuter but are usually not well maintained by the operator. Despite the fact that e-rickshaw popularity is prominently visible in cities, documented evidence and guidelines supporting effective deployment of this mode are still very deficient.

National government schemes/initiatives like AMRUT, Smart cities, NULM, FAME, etc. encourage e-rickshaws in cities by providing funding/subsidy for e-rickshaw procurement and development of supporting infrastructure. Following map<sup>12</sup> illustrates the 31 cities (out of 100 smart cities) who are interested in e-rickshaw deployment/ improvement in operation. 13 smart cities already have e-rickshaws integrated in their mobility system and have not included it in their Smart city proposal but may be working towards improving its operation improvement while 2 cities have proposed projects for its improvement.

Figure 1: Map illustrating E-rickshaws deployed/proposed in Indian Smart cities.



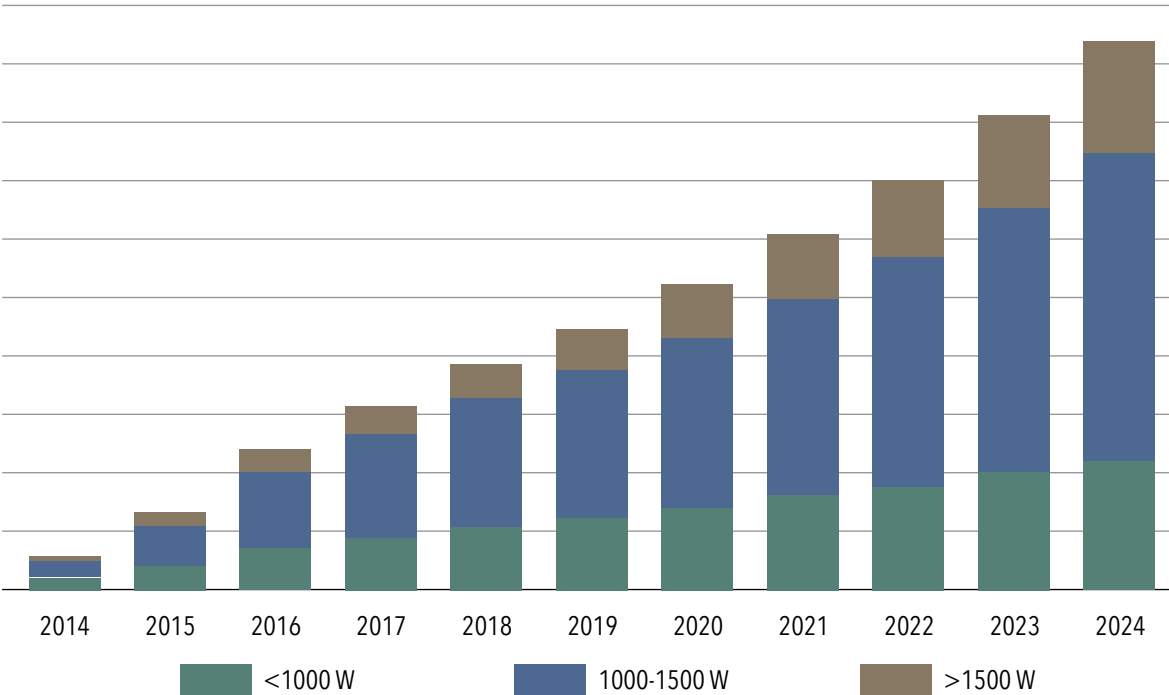
According to the projections by P&S Intelligence (2019), market of electric rickshaws in India is expected to reach 935.5 thousand units by 2024, with a CAGR (Compound annual growth rate) of 15.9%<sup>14</sup>. Figure 2 illustrates that an increased rise in demand of e-rickshaws may be expected with growing demand for models, which may cover larger range, require less charging and are more efficient.

It is evident that since e-rickshaw popularity is rapidly spreading across cities in India, a basic understanding of this mode including its benefits and drawbacks is required before introducing it. If a planned approach is followed to introduce e-rickshaws in mobility system of a city, it may result in effective inclusion and operation. This requires guiding documents related to e-rickshaw deployment and operation.



This report builds on ground experience in supporting e-rickshaws deployment in cities of Kakinada, Udaipur, Gwalior and documentation evidence in cities of Delhi and Siliguri. It is a part of output reports produced under the project 'Supporting Smart Urban Mobility and Built Environment in Indian Cities'. It may be helpful in providing guidance to the cities interested in deployment of e-rickshaws and catering to issues faced in operation/regulation of the same.

Figure 2: Illustration of electric rickshaw market projection in India by motor power<sup>13</sup>



With the growing demand for quality products and the entry of big, organised players in the market, the demand for vehicles equipped with higher-power motors is expected to increase during the forecast period

Objective of conducting this study of e-rickshaws was to analyse the current situation of e-rickshaws and create a better understanding of e-rickshaws. Since there is a deficiency of information related to e-rickshaws, perceptions of operator/commuter/authorities/dealers, issues, feasibility, performance, safety, comfort, maintenance, and various other related heads; a clear understanding of the scenario may be developed through this report.

ICLEI South Asia conducted secondary analysis of primary study of e-rickshaw deployment results (in Kakinada, Udaipur, Gwalior) and feasibility analysis of existing deployment (in Siliguri and Delhi) which were a part of previous project.<sup>15</sup> Development of the present report included:

- Review of existing secondary information- Secondary study of deployment projects related to e-rickshaws in cities of Gwalior, Udaipur, Siliguri, Delhi and Kakinada with support from ICLEI South Asia.
- Interviews of government officials, traffic police officials, manufacturers and other stakeholders involved in EV mobility sector of Delhi-NCR to understand the prevailing situation of the sector.

- Secondary study through newspaper articles, research papers and other available online secondary sources.
- Learnings from experiences in Delhi, Siliguri, Udaipur, Gwalior and Kakinada were summarised to develop a list of questions and suitable responses which could be useful for a city to understand and resolve doubts related to e-rickshaws.
- A roadmap for e-rickshaw deployment in city has been developed based on the understanding from analysis. It is developed for two categories of cities depending on their existing status.
- Comments and review by several smart cities were considered, aimed at content finalisation.

### 1.1. INTRODUCTION - E-RICKSHAWS AND HISTORY

E-rickshaw development started in the global market sometime during World War period, but faded away with time. These were later introduced in China by local and Japanese motor vehicle industries further spreading in areas of Asia<sup>16</sup>.

In India development of e-rickshaw started in late 1990s with the aim of improving manual rickshaws. E-rickshaw was developed with motor assisted pedal rickshaw (MAPRA) by Nimbkar Agricultural Research Institute (NARI). ELECSHA (electric rickshaw) 2000 was also developed later on, but there were issues with battery performance and quality, due to which these could not trend in market<sup>17</sup>. Illustration of these two models is as follows<sup>18</sup>:







ELECSHA (Top) and MAPRA (previous page) developed in late 1990s and 2000

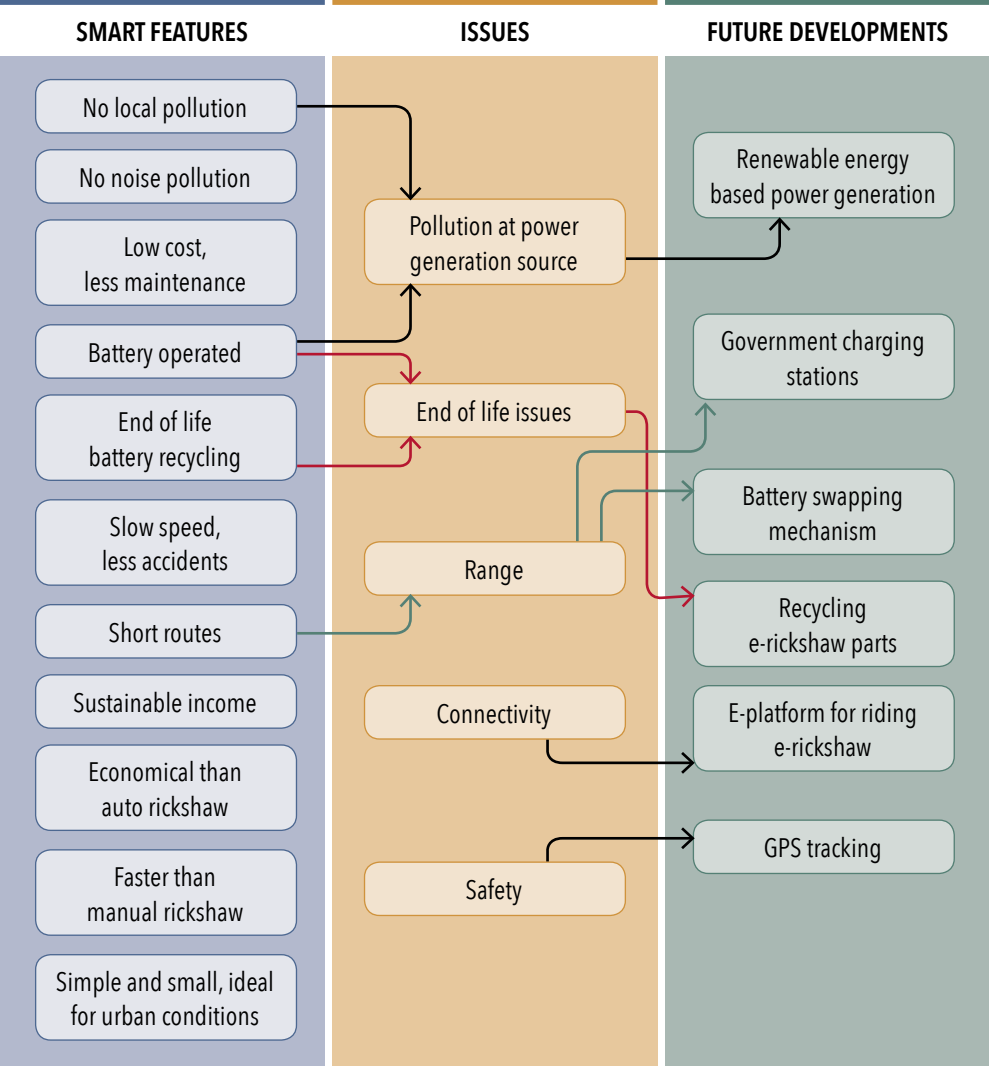
In 1999, Mahindra launched its first electric 3-wheeler.<sup>19</sup> Around 2010, E-rickshaws gained prominence in various urban and semi urban areas of UP, Bihar, West Bengal and cities of some other states. Delhi NCR also witnessed a rise in number of e-rickshaws during Commonwealth Games<sup>20</sup>. E-rickshaws were launched in Delhi with the objective to eventually phase out conventional cycle rickshaws; this objective was eventually altered when e-rickshaws were excluded from NMT category and included in Motor Vehicles Act (2014) as last mile connectivity modal option.

As per Motor Vehicles Act 2014 and Motor Vehicles (amendment) Act, 2015<sup>21</sup> e-rickshaws are defined as “A special purpose battery operated vehicle having three wheels and intended to provide last mile connectivity for transport of passengers for hire or reward, provided, such vehicle is constructed or adapted to carry not more than four passengers, excluding the driver, and not more than 40kg luggage in total; net power of its motor is not more than 4000 W and maximum speed of the vehicle is not more than twenty-five kilometer per hour.”<sup>22</sup>

IS E-RICKSHAW A SMART CHOICE FOR URBAN MOBILITY?

It would be a smart choice to consider e-rickshaws as last mile connectivity mode in combination with other vehicles. E-rickshaws are considered smart in terms of no local pollution, low cost, slow speed, sustainable income, affordable and ideal for urban conditions. There are some issues associated with e-rickshaws which may be connected to some smart features but these may be improved through developments. Detail of interrelation of features, issues and development may be summerised as follows:

Figure 3: Interrelation between issues related to e-rickshaws, its smart feature and future development



## 2 EMERGING POLICY LANDSCAPE

**R**apid increase in number of e-rickshaw in cities are perceived and projected as a reason to rising congestion on roads and increased accidents. Considering rising issues related to e-rickshaws, in 2013, government has initiated efforts to develop a regulatory framework to control e-rickshaw operation. These emerging policy/initiatives at national, state and city levels are as follows:

### 2.1. NATIONAL LEVEL INITIATIVES

At national level, initiatives and policies related to e-rickshaws developed cover various aspects including safety standard adherence mandate for manufacturers, financial support through loans or subsidy, details of licensing and other supporting reforms. Brief explanation of these emerging initiatives is as follows:

#### National Electric Mobility Mission (NEMMP), 2020

This mission was launched in 2013 to promote manufacturing and use of electric vehicles in India. Its aim is to achieve national fuel security by promoting hybrid and electric vehicles. It focuses on 2, 3 and 4 wheeler vehicles but states nothing specifically about e-rickshaws. It has a set target of 5-6 million electric/hybrid vehicle sales in India by the year 2020.<sup>23</sup>

#### National Urban Livelihoods Mission (NULM), 2013

Deendayal Antyodaya Yojana-National Urban Livelihoods Mission (DAY-NULM) was introduced by MoHUA on 23 September 2013 by replacing Swarna Jayanti Shahri Rozgar Yojana (SJSRY). It focuses on reducing poverty and vulnerability of urban poor household by assisting them in self-employment.<sup>24</sup> It provides e-rickshaw procurement assistance through facilitation of loans for owner/operator in cities like Jamshedpur, Dhanbad<sup>25</sup>, Ranchi<sup>26</sup>, and some other cities.

#### Motor Vehicles (Amendment) Act, 2014

Motor Vehicles (Amendment) Act notification was issued on 8 October 2014 by Ministry of Road transport and highways, Government of India. This was further published to amend the 'Central Motor Vehicles (16th Amendment) Rules, 1989'<sup>27</sup>. In this notification, e-rickshaw and e-carts were categorised as a separate category of transport vehicles<sup>28</sup> and defined as 'three wheel vehicle used to carry passengers/goods and limited power up to 2000 watts<sup>29</sup>'. It also states about the driver's license.

Another notification from Ministry of Road transport and Highways on 8 October 2014 stated the safety standards for e-rickshaws and e-carts. The parts and respective standards were

mentioned, which would be verified by any test agency as specified by the rule 126 of CMVR rules 1989.<sup>30</sup>

#### Central Motor Vehicles (Amendment) Rules, 2015

CMVR (Amendment) 2015 were published on 13 January 2015 with intent to provide provisions for the amendment of the CMVR, 1989. This amendment clarifies the procedure for obtaining driving license, road worthiness certificate, and other formalities required for e-rickshaw operation.<sup>31</sup>

CMVR also mentions that e-rickshaw models have to be approved by International Center for Automotive (ICAT) at Manesar, Vehicle Research and Development Establishment (VRDE) Ahmednagar, Automotive Research Association of India (ARAI) in Pune or Indian Institute of Petroleum (IIP) in Dehradun.<sup>32</sup>

#### Motor Vehicles (Amendment) Act, 2015

This was an act to amend the Motor Vehicles Act 1988 which came into force on 7 January 2015.<sup>33</sup> It included improvement in definition of e-rickshaws as 'special 3 wheeled vehicle of power not exceeding 4000 Watts' instead of 2000 watts specified earlier.

#### Pradhan Mantri Mudra Yojana (PMMY) 2015

GoI launched PMMY on 8th April 2015 to 'fund the unfunded'. This enables small borrower to borrow money from PSUs (at low interest) as loans and return it within 5 years. There are three categories of PMMY loan as 'Shishu' (loan upto INR.50000), 'Kishor' (loan >INR 50000 and <INR5 lakh) and 'Tarun' (loan >INR5 lakh and <INR10 lakh)<sup>34</sup>. This has been helpful for the people who wanted to take a loan to purchase e-rickshaw.

Apart from this, Ministry of Social Justice and Empowerment and Ministry of Minority Affairs run various finance schemes for welfare of SC/ST/OBC and minorities under which loans are provided on concessional rate of interest.<sup>35</sup>

#### FAME India

Faster Adoption of Electric/Hybrid Vehicles (FAME) was announced on 8 April 2015 by the Government of India to be implemented in phases. It was introduced by Ministry of Heavy Industries and Public Enterprises under National Electric Mobility Mission Plan (NEMMP). Detail of FAME I and II is as follows:

**FAME I:** It aimed at market creation through incentives (subsidy outlay of Rs.795 crore) across segments of vehicles.<sup>36</sup> It provided subsidy on the purchase of e-rickshaws (INR 25,000 – INR 61,000 depending on the model)<sup>37</sup>. FAME scheme also included details of registration of Original Equipment Manufacturer (OEMs) and vehicle models.<sup>38</sup>

**FAME II** was also announced on 28 February 2019 by the Government of India, proposed to be implemented from 1 April 2019. It has total outlay of INR 10,000 crore for 3 years. About INR 1000 crore out of total are sanctioned for setting up charging stations. It aims to support vehicles of all categories, 5 lakhs are allocated for 3 wheelers to be used as public transport modes or registered as commercial vehicles.<sup>39</sup>

#### Smart Cities Mission 2015

SCM was launched by GoI in 2015. Financing for e-rickshaw purchase and deployment were included in Smart city proposal (SCPs) of 29 out of 100 cities. E-rickshaw support infrastructure development was proposed in 13 other cities out of remaining 71 (cities which did not include e-rickshaw related project in their SCP but already have e-rickshaws operational)<sup>40</sup>.

**Draft Taxi Policy, 2016**

The policy Ministry of Road Transport and Highways (MoRTH), GoI introduced this in December 2016. It provides provisions for e-rickshaws, to promote urban mobility. It mentions the e-rickshaws should be allowed to ply on city roads for last mile connectivity to major public transport sources as these offer low cost and zero-pollution transportation. Also states may restrict e-rickshaw movement in specific areas in view of traffic or differential speed of the vehicle.<sup>41</sup>

**Intended Nationally Determined Contribution (INDC)**

India's vision of Intended Nationally Determined Contribution (INDC) communicated to UNFCCC specifies decarbonisation target of 33-35% with respect to GDP between 2005 and 2030. INDC takes existing policies/programs related to transport sector into consideration which can be utilised to meet intensity reduction targets. Clean electricity is a part of vision which would help in developing favourable conditions for EVs.<sup>42</sup>

**Draft National Energy Policy 2017**

The policy aimed to meet Government of India's electricity sector announcements including NDC's target reduction of emissions intensity by 33-35% by 2030 over 2005. It includes development of charging stations as an integrated part of city planning and to develop an enabling environment for EV charging stations.<sup>43</sup>

**Model Building byelaws 2019**

In February 2019, Ministry of Power issued guidelines and standards for setting up charging infrastructure for electric vehicles as an amendment of the Model Building Byelaws 2016, supporting long term India's vision on implementing electric mobility<sup>44</sup>.

**2.2. STATE LEVEL INITIATIVES**

After national level efforts in EV sector, in 2014 states realised the need to develop a regulatory framework for e-rickshaws at state level. In recent time, state governments have become very active in developing policies depending on the conditions prevailing on ground. List of states which have attempted to develop EV related initiatives are as follows:

**Tripura**

"Tripura Battery Operated Rickshaws Rules. 2014" were published in 2014. This focuses on rules to regulate the movement of e-rickshaws in urban areas. This includes the details of licensing, registration, fitness certificate, permits, penalty, parking and halting areas, standards and fare structure.<sup>45</sup>

**Delhi**

Delhi is the capital city of India, state and a union territory. It has developed the most vibrant and mature reforms and regulations as compared to all the other states of India. Since 2014, Delhi has developed following initiatives/ policies:

- *E-Rickshaw Sewa Scheme: The scheme stated that vehicles bought before October 2014 can get a certificate of road worthiness from their manufacturer or registered e-rickshaw association. This scheme allows plying of e-rickshaws in NCT of Delhi after compiling with mentioned conditions the same. This scheme also includes permit conditions.*

- *Subsidy scheme: Government of NCT of Delhi launched subsidy scheme. It provides 15,000 subsidy to owners of e-rickshaw whose vehicle is registered INR15000 (for those purchased before 2016 and INR30000 (for e-rickshaws purchased after 2016). INR 6,000 subsidy is provided by the Delhi Pollution Control Committee; (an autonomous body under administrative control) and Department of Environment, GNCT Delhi. The Motor Licensing Officer (MLOs) inspects e-rickshaws and approves them if they are registered, then this report is sent to DPCC from where the subsidy amount is remitted.*
- *Domestic charging: On 31 August 2017, Delhi government stated that domestic charging of e-rickshaws is legal and the drivers can charge their rickshaws at home. A petition towards a request to monitor e-rickshaw charging and its tariff was filed by BSES Yamuna Power Limited (BYPL) in 2018 Separate tariff category has been created for charging station for e-rickshaws with a flat rate of INR 5.50/KWh.<sup>46</sup>*
- *Government of National Capital Territory of Delhi approved 'Delhi Electric Vehicles policy' on 27 November 2018. The primary objective of the policy was to reduce the emissions from transport sector through rapid adoption of battery vehicles (BEVs) and further contributing to 25% of new vehicle registrations by 2023. It also aims to support job creation in operations related to EVs (driving, selling, financing, charging, etc.)<sup>47</sup>*
- *Charging stations: Ministry of Power and Delhi Government approved the plan for setting up 131 new EV charging stations (33 EV chargers at metro stations, 34 at CNG filling stations, 24 at Indian Oil filling stations, 15 at Bharat petroleum and 9 at Hindustan Petroleum outlets).<sup>48</sup>*

**Karnataka**

Government order dated 25 September 2017, announced 'Karnataka Electric Vehicles and Energy Storage Policy 2017'. The policy aims to attract investment and jobs; it includes facilitating EVs and associated technologies to develop in state. It focuses on electric auto rickshaws and retrofitting towards EV segment, but mentioned nothing specifically about e-rickshaws.<sup>49</sup>

**Kerala**

Transport department of Kerala Government drafted a 'Policy on Electric Mobility' for the state of Kerala and issued the order on 29 September 2018. The policy focuses on EVs. Its vision is to promote shared mobility and clean transportation. It aims to ensure environmental sustainability, pollution reduction, energy efficiency and create an ecosystem for manufacturing EV components in Kerala. Electric auto rickshaws are specifically focused in 3 wheeler category while e-rickshaw are not considered.<sup>50</sup>

**Uttar Pradesh (UP)**

Draft 'Uttar Pradesh electric vehicles (EVs) Manufacturing Policy 2018' was released in 2018 for a period of 5 years. Its objective is to establish UP as preferred area for investments of EVs, create job opportunities, encourage shift from conventional vehicles to EVs and develop human capital to meet industry needs.<sup>51</sup> Proposal for tax exemption, interest free loans and subsidy as incentives to the buyers is also included. It further states that 'e-rickshaws are already booming in the state and further development of EV sector is focused'.<sup>52</sup>

**Andhra Pradesh (AP)**

'AP Government Electric Mobility Policy 2018-2023' was introduced in June 2018 for 5 years. It states that low powered e-rickshaws will be allowed in some areas outside the major cities to avoid pollution. The policy highlights that the state will invest INR 30,000 crore by 2030 in



EVs along with the setting up battery manufacturing units.<sup>53</sup>

**Telangana**

‘Telangana electric vehicle policy’ was introduced on 27 September 2018. Its objective is to achieve 100% shift to EVs by 2030 in their state, and is supported by infrastructure and local manufacturing base for EVs and its components. This includes permission of e-rickshaws to operate in fringe areas, retrofitting rule for existing vehicles and permission for corporate ownership of manufacturing industries.<sup>54</sup>

**Uttarakhand**

Uttarakhand introduced its ‘Electric vehicle manufacturing, EV usage, promotion and related services, Infrastructure policy’ in October 2018.<sup>55</sup> It aims at creating suitable ecosystem for EV manufacturers and tackling vehicular pollution. It includes incentives for early adopters including tax exemption and land provision for EV manufacturing for 15 years. The incentives for entrepreneurs includes 100% electricity duty exemption, term loans to micro, small and medium enterprises (MSMEs) to manufacture EVs and contribution to GST from government.<sup>56</sup> This does not mention e-rickshaws but focuses on EV in general.

Other than the policies, some states have taken following steps to encourage EVs:

**Maharashtra**

Maharashtra provides tax exemption and subsidy as incentives to buyers and EV manufacturers. Incentives to buyers include exemption of GST, registration tax, road tax, and 15% subsidy. EV manufacturer incentives include permission to install EV chargers at petrol/gas stations and subsidy to first 250 stations which install EV chargers along with other incentives. Charging stations are proposed to receive electricity at a tariff cheaper than the commercial rates. In June 2018, Maharashtra State Electricity Distribution Corporation (MSEDCL) proposed charge of INR6/unit from EV charging stations.<sup>57</sup> The incentive focuses on all the EVs in general but not specifically on e-rickshaw.

**Goa**

Road tax is not levied on electric vehicles.

**Gujarat:**

The state has been providing subsidies of about INR 10,000 to 2000 students who purchase 2 wheeler EVs under GEDA BOV subsidy scheme 2018-19<sup>58</sup>. Gujarat plans on having 600 3 Wheeler BOV (e-rickshaws) in 2019 under the same scheme<sup>59</sup>. State’s focus is on developing infrastructure for battery swapping, charging facilities and other supporting infrastructure required for operation<sup>60</sup>. The state may further develop its EV policy for the same.

**Delhi** being a city-state, has the most **evolved policy framework** and **regulation support at present**. Delhi allows domestic charging of e-rickshaws, identification of routes and banning e-rickshaws on some routes. It also launched an e-rickshaw sewa scheme which provides assistance to e-rickshaw owner in licensing process along with the subsidy scheme to help the operators economically. Delhi Electric Vehicles policy launched in November 2018 also supports e-rickshaw deployment.

**2.3. INITIATIVES AT LOCAL/CITY LEVEL**

Specific city/local level policy framework does not exist for e-rickshaws at present. Policy and reforms at state level are applicable at city level, supporting the operation of e-rickshaws at local level. Currently, city authorities may have the role of route optimisation, taxation, licensing and registration of e-rickshaws, but policy landscape of transport sector is controlled majorly by the state.

No clear regulation document exists, but cities are working towards integrating e-rickshaws as a part of other projects like developing low carbon action plans and defining low carbon areas in the city, where NMT/ e-rickshaws are planned to ply. Examples of such areas include e-rickshaw deployment in Maharaj Bada area in Gwalior, beach road in Visakhapatnam, roads in Udaipur, etc. Usually a municipal order specifies and mandates these low carbon areas or routes in a city.

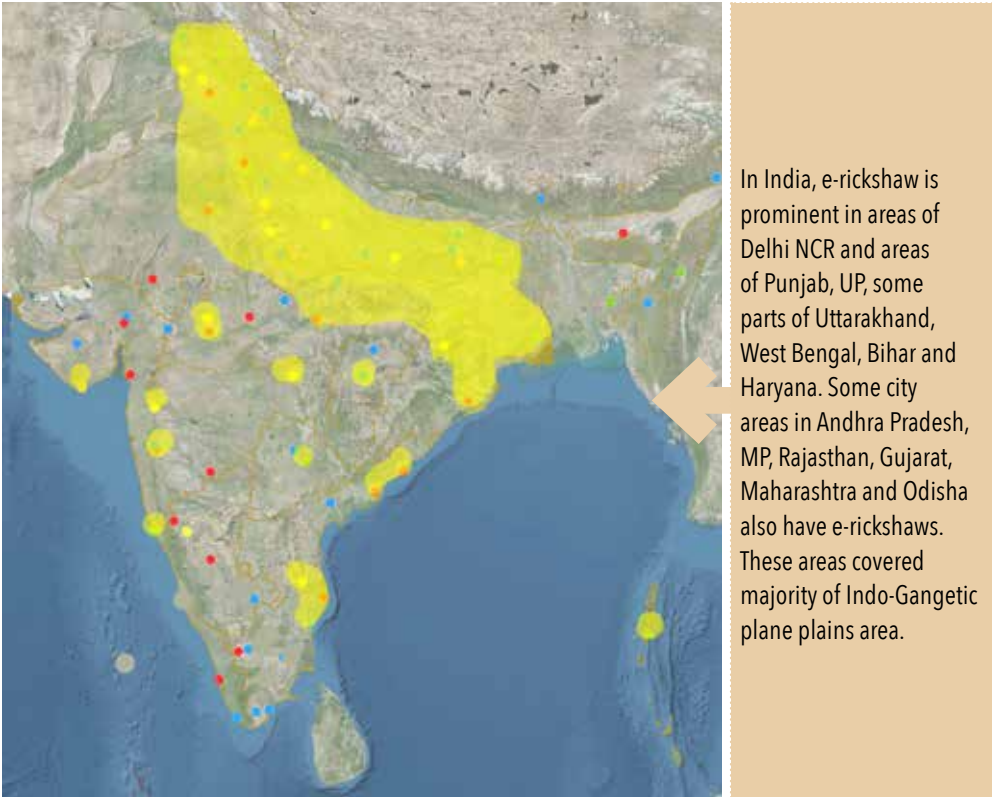
Though there is lack of specific policies at city level, some national level projects are being implemented at the city level. NULM and FAME are examples of such projects/scheme which assist by providing loan and subsidy for e-rickshaw procurement. Cities initiative related to e-rickshaws are majorly ‘project focused’ and include deployment or improvement of e-rickshaws through a project, these lack focused policy initiatives. Examples of project based deployment of e-rickshaws includes examples from Ludhiana, Karnal, Noida and Delhi where e-rickshaws were initially deployed in a planned manner, under a specific project but due to lack of monitoring, the number of e-rickshaws increased in unplanned manner in other areas of the city.



### 3 EXISTING SCENARIO

India has about 1.5 million e-rickshaws and about 11,000 new e-rickshaws enter the mobility setup every month. Further, an annual increase of about 9% is expected by 2021 in the sales of e-rickshaws.<sup>61</sup> In 2015-16, more than 4,00,000 e-rickshaws were sold in India and the market was expected to grow at over 30-35% in 2016-2020.<sup>62</sup>

Figure 4: Map illustrating where e-rickshaws are operating\*



Map (Figure 4) illustrates the areas where e-rickshaws operate in present scenario. As per an article published in 2017, only 1 lakh out of 10 lakh e-rickshaws were registered in India and about 70% of these total registered e-rickshaw numbers were operating in areas of UP and

National Capital Region (NCR).<sup>63</sup> Although number of registered e-rickshaws is very less as compared to unregistered e-rickshaws still their operation is quite common in Indo Gangetic area. According to estimates, about 4000 rickshaws (in 2010) increased to more than 1,00,000 in 2016 in Delhi but only 29,123 i.e. only 29% were registered from April 2013 to March 2017).<sup>64</sup>

Recently e-rickshaws have become visible in areas of Maharashtra, Hyderabad, MP and some cities of Rajasthan also, with the advent of electric vehicle incentives at state and national level. Cities are promoting e-rickshaws as zero emission last mile connectivity modes.

At present, manufactured models are tested for compliance with safety standards (specified by ARAI/ICAT)<sup>65</sup> and approved only if they perform satisfactorily in compliance tests. Approved models are registered by RTO and their operation is legal, while exceptions are e-rickshaws which are not registered deeming their operation illegal.

Despite of prevailing rules and safety standards, large number of manufacturers still assemble parts imported from neighboring countries (majorly China) or utilise low quality parts manufactured locally<sup>66</sup>. Parts like batteries, chargers and tyre-tubes are available in locally, while the body, tyre controllers, motors and engines are imported from China<sup>67</sup>. These spare parts are assembled in Delhi or Rajasthan and supplied to other parts of the country. Sometimes entire models are imported from China.<sup>68</sup> Locally assembled e-rickshaws may not comply with safety standards but are purchased by the operators due to their low cost. These are sold/ bought without any official evidence and are ineligible to be registered for operation leading to illegal operation.

In the existing situation, it is difficult to differentiate between an e-rickshaw which is manufactured by a licensed manufacturer and illegal e-rickshaw because of large market of illegal local assembling by non licensed manufacturers. A study conducted by TERI (2018) stated that there are about 340 e-rickshaw manufacturers in Delhi alone<sup>69</sup> but those manufacturing ARAI/ICAT standard compliant models may be very less in numbers. Also in a recent interaction with Society of Indian Automobile Manufacturers (SIAM) official, it was stated that about 477 e-rickshaw manufacturers exist in India but no clear evidence is available to support<sup>70</sup>.

#### E-rickshaw manufacturers

E-rickshaw manufacturers in India may be categorised as under:

1. Licensed manufacturers: These manufacturers are licensed to manufacture e-rickshaws in India. These usually manufacture all e-rickshaw parts (except controller which is imported from neighboring countries) and comply with safety standards. Egs. Include Hero, OK Play, Goenka, etc.
2. Licensed assemblers: These include manufacturers which import parts from other countries or from other companies but the models are usually standard compliant. Vehicle body, controller, motor and engine are imported while tyre, batteries and chargers may be available locally.
3. Local assemblers/garages: These are local assemblers operating in garages /local markets with no license to manufacture e-rickshaws. These e-rickshaws models may utilise low quality parts or retrofit models. These usually are unable to comply with safety standards. Low cost of these models as compared to compliant model (cost difference of about INR 60,000- INR 80,000 i.e. almost 70% - 90%) attracts the operators.

In metropolitan and tier 1 cities (e.g. Delhi) e-rickshaws operate as last mile connectivity modes while in tier 2 cities (e.g. Allahabad, Kanpur) its operation fills the gaps of public transport and even serves as an alternative of public transport in some areas while in tier 3 cities (e.g. Gaya and Jamshedpur) these help in connecting the nearby villages to towns. The demand and area of operation of e-rickshaws in the types of cities can be summerised as:

	Tier 1 city (eg. Delhi)	Tier 2 city (eg. Allahabad, Kanpur, Agra, Lucknow)	Tier 3 city (eg. Gaya, Jamshedpur)
Connectivity	First/last mile mode	First/last mile mode independent/main mile	Main mile transport
Coverage	Peri urban. Urban-rural and core city	Urban areas as well as a connection to adjoining areas.	Peri urban and urban areas



Toto in Kolkata operating as last mile connectivity mode <sup>71</sup>



E-rickshaw operating as last mile connectivity and domestic charging of vehicle



3.1. E-RICKSHAW INCLUSION IN A CITY

E-rickshaws are usually demand responsive last mile connectivity mode and operate on routes depending on commuter’s demand and comfort. E-rickshaw presence in a city may result from a planned initiative from the government or an unplanned inclusion on adhoc basis by the operators in haphazard manner. These can be explained as follows:

1. **Planned inclusion-** This initiative is usually made by the government through support from various schemes/ programs. Local government follows an action plan including background study, feasibility study, route rationalisation, financial incentives, along with simultaneous development of supporting infrastructure for charging and parking of vehicles. Regulation and operation is controlled and managed by the government. This system is better than the adhoc inclusion system as there is a record of all the vehicles and supporting services. At present typical example of this type of inclusion is not available. Close initiative examples include Kochi metro introduced e-rickshaw as last mile connectivity mode to metro stations, Smart E in NCR (developed an almost similar landscape of planned e-rickshaw deployment in areas of Gurgaon and Faridabad), pilot project of e-rickshaw deployment in Udaipur (where the city procured the vehicles and deployed it on routes decided after analysis) and Gwalior city proposal to deploy e-rickshaw and e-loaders in the city as a pilot project. Also other smart cities which have included e-rickshaw deployment as a part of SCP may initiate a planned attempt.
2. **Unplanned ad-hoc inclusion-** This inclusion system is prevalent in majority of Indian cities at present. It includes a system in which e-rickshaws are owned and operated by private individuals on routes decided by the associations/operators. There is a lack of supporting infrastructure, operation and maintenance system. Though e-rickshaws are operated in large numbers in these area, authorities face difficulty in managing and regulating these due to glitch in policy implementation. Provision of supporting infrastructure and other service provision also becomes very difficult because of deficiency of data to validate e-rickshaws as there are large number of unregulated e-rickshaws which are not reported anywhere.
3. **Planned inclusion to unplanned expansion-** This is the system in which the city introduces e-rickshaw in a planned way but with time, it expands in an unplanned way. Example of this exists in various cities of India including Ludhiana, Karnal, Noida, Delhi, etc. where e-rickshaws were introduced by the government or in partnership with a private organisation through an initiative under a project. With time, these e-rickshaws spread in areas of the city in an unplanned manner due to absence/lack of regulations and monitoring structure.

Preferably, a city may opt for a planned inclusion and expansion for effective deployment results and regulated operational model. Planned inclusion of e-rickshaws help in efficient deployment results including provision of supporting infrastructure according to the number of e-rickshaws, estimate of projected future growth in demand and numbers may also be estimated in this case reducing the issues of unregulated operation. It should include future expansion plans including strict implementation of regulations for effective deployment results. (Table 1)

■ 3.1.1.Emission savings

E-rickshaws can be attributed to a reduction in local air pollution compared with conventional diesel and petrol rickshaws. E-rickshaws contribute to zero emissions (local) which are a major source of air pollution in urban areas.<sup>72</sup>

Considering total number of e-rickshaws in India to be 1.5 million approximately<sup>73</sup> annual emission reduction is of 3.801 x 10<sup>6</sup>t of CO<sub>2</sub> (approximately) (Table 2).



Table 1: The difference in extent of role of government of a city, its authorities, financial institutions, manufacturers and private operators<sup>74</sup>

	Roles	Planned inclusion	Unplanned inclusion	Planned inclusion to unplanned expansion
1	Planning: Background study, feasibility study	City authorities	Not carried out	City authorities
2	Acquisition: Rolling stock procurement	City authorities	Individual operators	City authorities
	Financial assistance	Government/ city authorities supported by financial institutions	Private loans/ financial institutions/ supported by government	Government/ city authorities supported by financial
	Provision of supporting infrastructure	Government/ city authorities supported by private	City authorities/ private organisation/ individuals	Government in collaboration with other private organisations.
3	Deployment: Regulatory roles (routes,fare,etc.)	Government/ city authorities	Individual operators	Government initially and individual operators later on
4	Operation Operation on ground	Government/ city authorities/ private individuals tendered by govt.	Individual operators	Individual operators/ government
	Maintenance	Private individuals	Individual operators	Individual operators/ government
5	Organisation Associations	Government/ city authorities	Individual operators	Individual operators/ Government
	Social benefits	Government/ city authorities	Not available	Government/ city authorities/ not available
6	Monitoring	Government/ city authorities	Government/city/no monitoring	Government/ city authorities
	After life (reuse/ recycling)	Government/ city authorities	Private shops.	Private shops/ Government

Table 2: Annual emission reduction from single e-rickshaw in Udaipur (based on analysis and calculations performed by ICLEI SA)<sup>75</sup>:

	Single e-rickshaw	Total number of e-rickshaws in India (approximately 15,00,000)
CO <sub>2</sub>	2.534 tonnes	3801833.4 tonnes

In cities like Bangalore, Delhi, Mumbai, etc. fossil fuel based autorickshaws are being phased out with CNG autorickshaws (completely replaced by CNG autorickshaws in Delhi). Thus comparing e-rickshaw CO2 emission with CNG auto rickshaws in Delhi it was observed that 1036.595 tonne CO2 can be mitigated per day (378357.3 tonne CO2 annually) if CNG auto is replaced by e-rickshaws.

Table 3: Detail of calculation of CO2 mitigation from e-rickshaw (considering example of Delhi<sup>76</sup>)

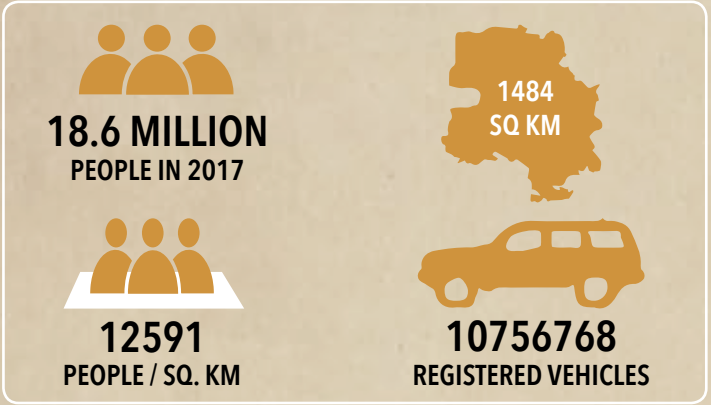
Emissions mitigation from E-rickshaw		
Average trip length of E-rickshaw	4.04	Km per trip
Average occupancy of E-rickshaw	4.45	passengers
Average number of daily trips by E-rickshaw	14.27	
Average distance travelled by E-rickshaw	57.6508	
Total passengers ferried by E-rickshaw in single day	63.5015	km per day
Average daily passenger Km covered by E-rickshaw	256.5461	
Total number of E-rickshaw	100000	passenger Km
Total passenger Km covered by all E-rickshaw in Delhi	25654606	Nos
Average Power consumed by E-rickshaw	6.5	Kwh per vehicle per day
Total power consumed	650000	
Emission factor for Grid electricity	0.82	Kg of CO2 per unit <sup>77</sup>
<b>Total emission due to electricity consumed by E-rickshaw</b>	<b>533000</b>	<b>Kg of Co2 per day</b>
Average occupancy by CNG Autorickshaw	1.76	
Emission factor for CNG Auto rickshaw	0.10768	Kg CO2 /km <sup>78</sup>
Total emission to cater demand of E-rickshaws	1569595	Kg of CO2 per day
Total Emission mitigated per day	1036595	Kg of CO2
Total emission mitigated per day (in tonnes)	1036.595	t CO2 per day
<b>Total Emission mitigated per annum</b>	<b>378357.3</b>	<b>t CO2 per annum</b>

Thus e-rickshaw inclusion in a city replacing/in combination with fossil fuel based/CNG auto-rickshaw would enable in mitigation of emission.

# E-RICKSHAW OPERATION IN INDIAN CITIES

## Case study of Delhi

In an attempt to understand the deployment scenario in cities of India, the team conducted a short term sample study of existing e-rickshaw operation in Delhi. The on-ground observations related to the role of e-rickshaws in city, quick facts related to operation, specifications of e-rickshaw, life cycle and daily operation description and issues related to operation was covered. The analysis is briefly illustrated in the following section on ‘Operation of e-rickshaws in Delhi’.



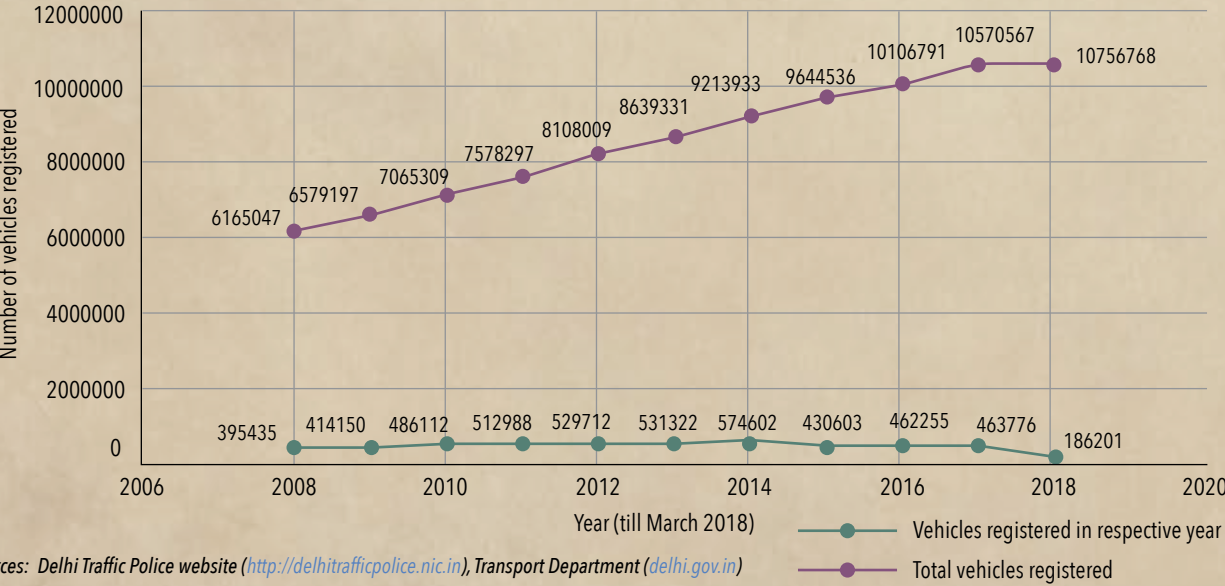
E-rickshaws offer sustainable mode of first/ last mile connectivity to/ fro origin and destination to the commuters.

E-rickshaws presence and operation in Delhi was initially a planned introduction by the government in 2010 to provide last mile connectivity during commonwealth game, later number of e-rickshaws spread in an unplanned ad-hoc basis in the city with time due to deficiency of regulation and strict implementation.

E-rickshaws in Delhi, helps in commuting approximately 63,44,378\* passengers per day i.e. more than 2.5 times more than the number of passengers moved by metro per day.

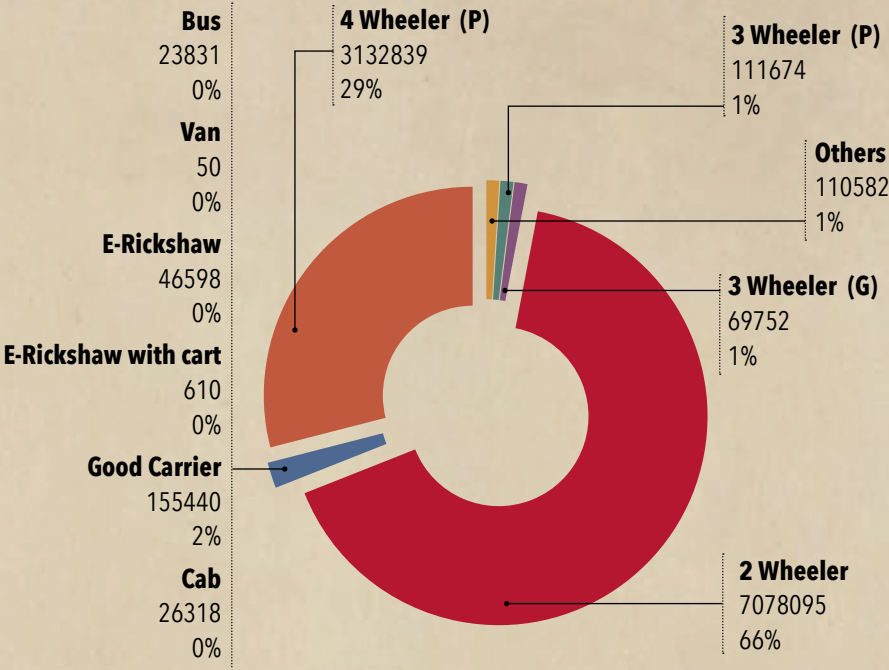
\*Data from sample survey conducted by ICLEI SA. Total no of e-rickshaw considered as 100000, av. occupancy as 4.45 and av. trip per day as 14.27. Metro ridership in October 2017 was 24.2 lakhs per day. (Source: Sample survey, NDTV news and periodical articles)

Registered Vehicles in Delhi



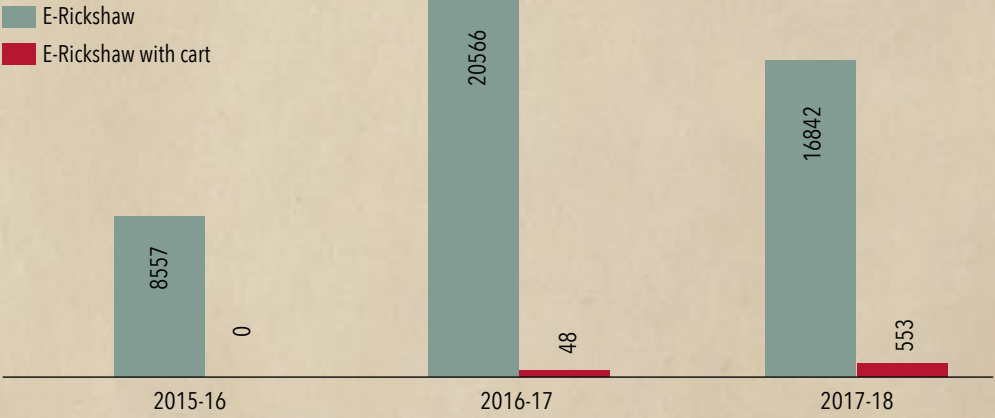
Sources: Delhi Traffic Police website (<http://delhitrafficpolice.nic.in>), Transport Department ([delhi.gov.in](http://delhi.gov.in))

Vehicle Share



Sources: Delhi Traffic Police website (<http://delhitrafficpolice.nic.in>), Transport Department ([delhi.gov.in](http://delhi.gov.in))

Registered E-Rickshaws



Sources: Delhi Traffic Police website (<http://delhitrafficpolice.nic.in>), Transport Department ([delhi.gov.in](http://delhi.gov.in))

## QUICK FACTS

>100000

e-rickshaws (registered & unregistered) operating in Delhi (data as per 2017). Exact estimate of e-rickshaws is not available due to large number of unreported illegal e-rickshaws (not approved by ARAI/ICAT).

935%

increase in registered e-rickshaws (from August 2016 to March 2018). Number of unregistered e-rickshaw is not available.

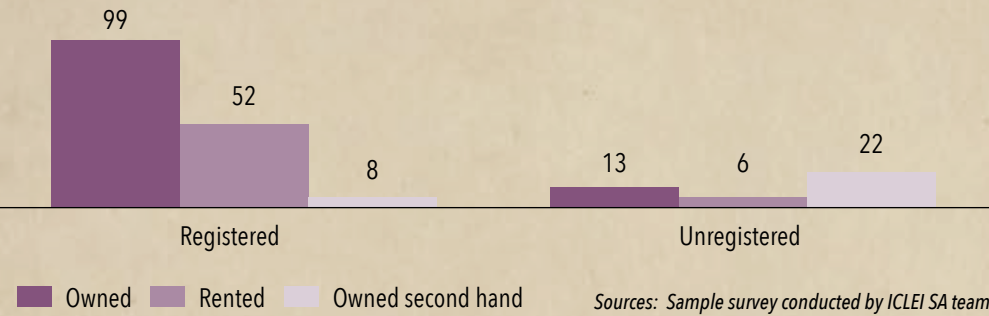
236

number of roads operation of e-rickshaw is banned on, including 77 roads in New Delhi, 38 in South Delhi, Ring road, Vikas marg and some others as specified by Traffic Department.



E-RICKSHAW OWNERSHIP AND REGISTRATION

- A sample survey (sample size 200) was conducted in Delhi and following results were obtained:
- 71% owned the e-rickshaws (21% of these were second hand), while the rest of 29% drivers operated e-rickshaws on rent.
  - About 89% e-rickshaws are registered which are owned/rented/owned second hand, 21% unregistered e-rickshaws are still operating on roads of Delhi.



TRIP CHARACTERISTICS

About 88% of the trips were short trips, which formed the general routes of the rickshaws. The mode generates medium trips at considerable percentage and only about 2% e-rickshaw go for longer routes during their normal operational hours. However the average trip length covered by e-rickshaws is 4.04 km and average distance covered is 77km.

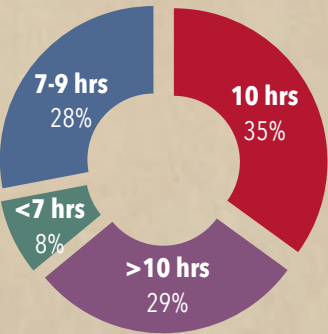
Type of trip	Frequency of trips	
	≤ 15 trips per day	>15 trips per day
Short trips (<5km or 5km)	74	56
Medium trip (>5 km <10 km)	15	2
Long trip (>10 km)	3	0

Source: Sample survey conducted by ICLEI SA team

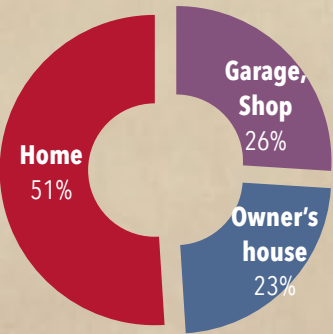
TRIP CHARACTERISTICS

About 63% of e-rickshaws are charged overnight and operated all day. Charging time increases with the age of battery and usually requires a replacement at every 9-11 months. 51% e-rickshaws are charged domestically at operator's home. About 26% of these are charged and parked at the private garages/shops (daily charges of 100-150) and 23% e-rickshaw are charged by owners at their home.

Battery charging hours



Battery charging location

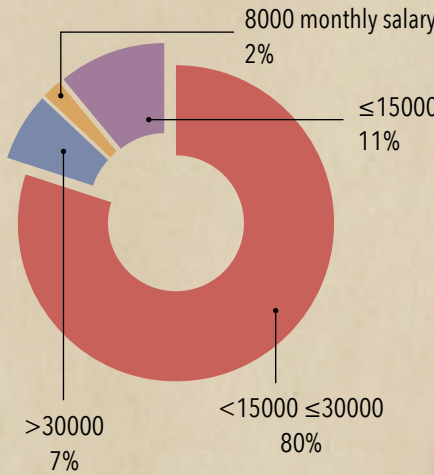


Sources: Sample survey conducted by ICLEI SA team

INCOME AND MAINTENANCE

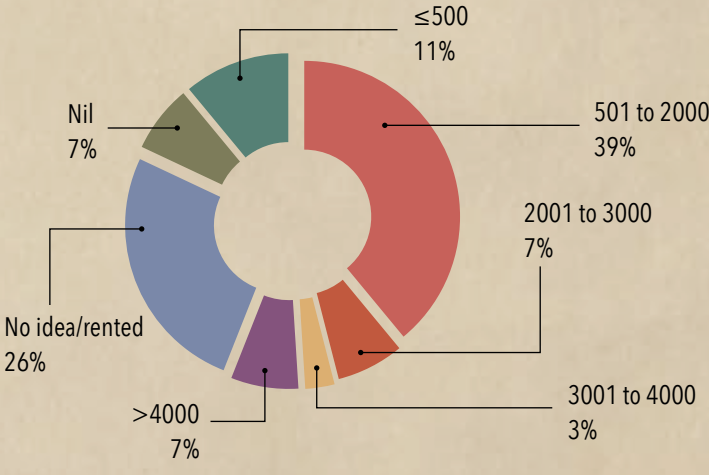
- 80% operators have a monthly income ranging from INR.15000 to 30000.
- Vehicle maintenance cost (including daily maintenance of greasing and other parts maintenance excluding battery and tyre replacement) vary from INR 500 to 2000 depending on operation and age of vehicle.
- Considering the average income of driver as INR 900 per day, maintenance cost of 2000 per month, battery cost INR 25000 (after exchanging, at every 9 months) and tyre cost of INR 900 (changed at every 12 months) monthly income of operators may be calculated as follows:
- In case of domestic charging and parking : {electricity rate of INR4/unit(7 units per day)}, income is INR 22,290 per month (INR 267480/annum)
  - In case of charging and parking in shops/garages (considering average cost of 120/day), income is INR 19,491 per month (INR 2,33,900/annum)

Income (per month)



Sources: Sample survey conducted by ICLEI SA team

Vehicle maintenance cost (per month)



OPERATION RELATED FACTS

Emission reduction  
Annual emission mitigation from single e-rickshaw is about 378357.3 tonne CO2 if CNG auto is replaced by e-rickshaws.  
(Source- Detailed calculation in section of Emission reduction in this report)

Battery swapping model for e-rickshaws

- Time taken for swapping is 5-7 min (approximately).
  - At present there are 5 swapping stations in Delhi offering services to 25 vehicles on a commercial trial basis. (February 2018)
- (Sources- Articles from periodicals and interview of battery swapping organisation-Lithion official)



Market aggregators

**Smart-E (Smart electronic transport system)** is closely working on deploying e-rickshaws in areas of Delhi since 2015. It is an initiative of Treasure Vase Venture (TVV). SmartE provides paid infrastructure facilities (charging and parking) and training for drivers in partnership with other organisation. It has served over **15 million riders** in 30 months of its operation. Currently there are about **800 SmartE** deployed on routes of **Faridabad and Gurgaon** for last/first mile connectivity to metro/public transport system, residential areas and commercial areas depending on demand coving short loops under 5km. The vehicle is equipped with GPS and CCTVs addressing the issue of commuter safety.



**OLA** is also planning to deploy **10,000 e-rickshaws** in 2019.

Sources- Website of SmartE, article from Livemint, ELE times, Times of India, Down to earth



SPECIFICATIONS & OPERATION DETAILS

E-rickshaw models have to comply with safety standards specified by ICAT/ARAI.

Table below illustrates the variation and similarities in standards and existing e-rickshaws

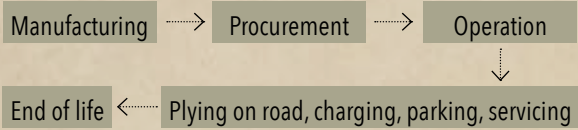
	Standards	E-rickshaws existing in Delhi
1	<b>Vehicle dimensions</b> 2700 x 1000x 1750 mm (Max width 1000mm and max length of 2800mm)	2700 x (900 to 1000) x 1750 (varying sizes available in this size range)
2	<b>Capacity</b> 4 passengers + 1 driver and load capacity of 450kg	4 or 5 passengers + 1 driver and additional luggage (average occupancy is more than 4 passengers in Delhi which is due to lack of enforcement. Carrying >4 passengers is overloading and violation of rules)
3	<b>Battery specifications</b> 4 batteries   100 Ah or more battery capacity  Lead acid	4 batteries of 100/120/140 Ah Lead acid
4	<b>Charging time and range</b> Charging for 7 to 8 hours   Range of 80km to 100km	Charging for 8-10 hours depending on battery life   Average range of 77 km.
5	<b>Speed</b> Speed restriction of maximum 25kmph	Speed ranging from 20kmph to 40kmph
6	<b>Electricity consumption</b> 6-7 units per day	6-7 units per day.
7	<b>Routes</b> Not allowed on some roads specified by the traffic department of Delhi.	E-rickshaw ply on almost all the roads on which they can operate. Operators pay penalty (challan) from traffic officials in case these ply on restricted roads.
8	<b>Life of e-rickshaw</b> 2-3 years	Life of e-rickshaw depends on the operation. It may range from 2 years to upto 8 years for some e-rickshaws if maintained from time to time. Parts of e-rickshaws have to be replaced from time to time (batteries in every 9-11 months, tyres in 12-15 months, etc.)

Sources- ICAT, ARAI website, article in periodicals and sample survey conducted by ICLEI SA



E-RICKSHAW LIFE CYCLE

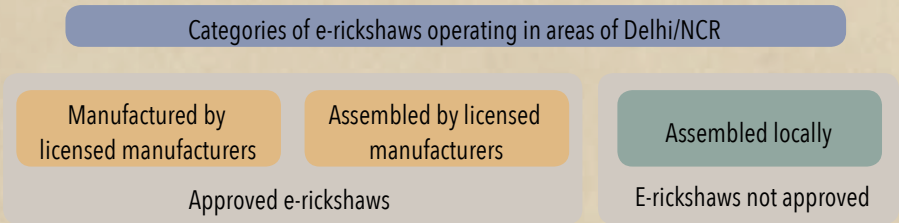
E-rickshaw life cycles includes the following steps:



Manufacturing

E-rickshaws are manufactured/ assembled in India after the models are approved by ARAI/ ICAT. There are both categories of approved and unapproved e-rickshaws. Unregistered e-rickshaws are vehicles which are locally assembled using local parts, usually not complying with the safety standards specified by ARAI/ICAT.

There is no exact estimate of the total number of e-rickshaw manufacturers in India A study conducted by TERI (2018) stated that there are about 340 e-rickshaw manufacturers in Delhi but those manufacturing ARAI/ICAT standard compliant models may be very less.



Information source: TERI (2018), sample survey, traffic police interview

E-RICKSHAW PROCUREMENT

Variety of e-rickshaw includes goods e-rickshaws (with cart) and passenger e-rickshaws. Following are some examples of e-rickshaws in Delhi.

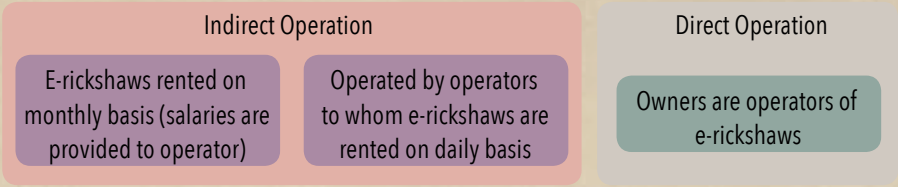
E-rickshaws are purchased by the owner/operator through loan (annual or monthly EMI) or though cash payment of amount of e-rickshaw. Loan assistance is also provided by the dealers of e-rickshaws in some cases.



Information and photograph sources: Primary sample survey by ICLEI SA and online sources (jagdambey, indiamart)

E-RICKSHAW OPERATION

E-rickshaw may be owned and operated by the operator or the owner may rent it out to other operator. This may be summerised as under:



Further operation on ground includes charging, parking and servicing for vehicle maintenance as under:

- **Charging:** Required for 8hrs to 10 hrs for 80-100km operation. Charging time depends on battery life and is done domestically or at shops on daily charges.
- **Parking:** E-rickshaws have to be parked during non -operational hours/ during night. These may be parked at home or shops/ charging stations on chargeable basis. Some of these are also parked illegally on road side.
- **Maintenance/ servicing:** E-rickshaws require maintenance from time to time depending on its age and operation. Servicing is free for 6 months/1 year at authorized service centre, but operators prefer local shops due to distance and time taken.



E-RICKSHAW END LIFE

Evidence of after-life process of e-rickshaw does not have evidence. However it is clear that at present, no manufacturer provides ‘return service’ for e-rickshaw. According to the interaction with operators and shopkeepers during sample survey, it was found that e-rickshaws are either resold (used again after servicing), or scrapped after selling its parts at the end of their operational life. If e-rickshaw is well maintained, it may be operational for 5-8.

Source: Interaction with e-rickshaw dealers, operators and scrap dealers.

Source: Sample survey conducted by ICLEI SA, <https://www.rushlane.com/delhi-metro-electric-rickshaw-12275579.html>, [plauderickshaw.com](http://plauderickshaw.com)



ISSUES

Lack of enforcement of regulatory measures

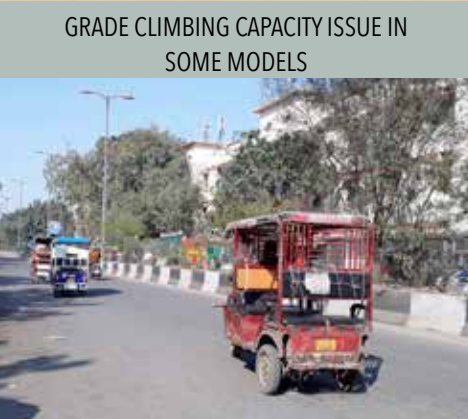
Safety standards provided by ARAI/ICAT have to be complied for manufacturing approved models of e-rickshaws wwhich operate on roads after registration. All the regulations and laws exist, but strict implementation of these regulation is a major issue leading to issues related to e-rickshaw operation on roads. Examples of issues related to lack of strict implementation are as follows:



Information source: Sample survey and online article in periodicals. Photograph source: Primary sample survey.

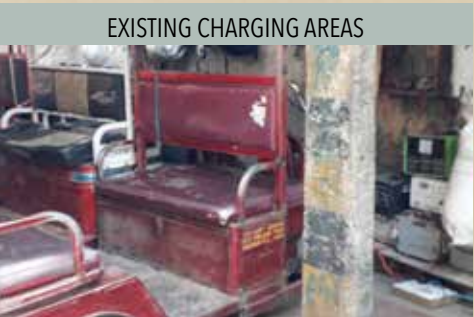
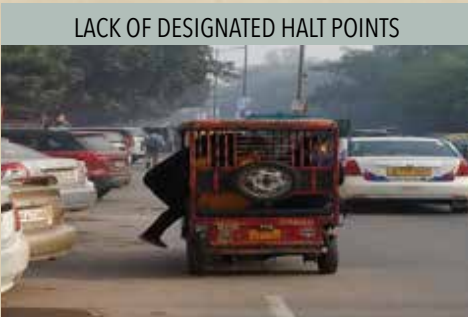
Technological/mechanical issues

With the development and advancement in technology, issues related to grade climbing capacity, water resistant design have been overcome but the models plying on roads still face these issues.



Infrastructure related issues

The number of e-rickshaw is increasing rapidly in an unplanned manner in Delhi with lack of required infrastructure leading to various issues. These infrastructure gaps include lack of authorised charging and parking areas due to which domestic charging of bulk e-rickshaws is observed in many areas. Development of authorised parking and charging spaces may curb these unregulated charging areas.



Information source: Sample survey and online article in periodicals. Photograph source: Primary sample survey.



PERCEPTION RELATED TO E-RICKSHAWS

E-rickshaws related perception were mapped based on sample survey conducted in areas of Delhi. The perception of owners/operators, commuters, dealers/manufacturers and authorities differ to a large extent and has been summerised as under.

	Owner/operator	Commuter	Dealers/ manufacturers	Authorities
Manufact- uring related	Design of some model of e-rickshaw are not water resilience and face difficulty in operating during rainy season and some models does not work efficiently on sloped terrain.	Not applicable.	Safety compliance is mandatory for e-rickshaw models to be approved and getting registered for plying on roads.	Many illegal manufacturers exist in market which manufactures e-rickshaws not complying to safety standards leading to accidents.
Safety related	94% operators feel that e-rickshaws are safe for drivers and commuters	63% commuters feel that e-rickshaws are safe, rest 37% feel it is unsafe.	70% dealers consider e-rickshaws safe if manufactured with safety compliance.	Unregulated operation is considered unsafe and may lead to accidents.
Operation related	Difficulty in operating in rainy season (in some models).	-	-	Challenge to manage unregistered e-rickshaws
Fares	Fare price depends on demand and time.	Unregulated fare and should be regulated.	Should be regulated.	
Charging	High cost of commercial charging if the operator charges their vehicles in private charging stations.	No applicable	Charging domestically is promoted by sellers.	Unauthorised charging stations are a menace.

Information source: Sample survey, interview of officials, commuters, owners/operators and dealers, online article in periodicals.

4  
TYPICAL BARRIERS

Depending on engagement of ICLEI South Asia in cities of Gwalior, Udaipur and Kakinada and analysis of operation in Siliguri and Delhi, typical barriers were identified. This section focuses on typical barriers in planned inclusion of e-rickshaws. The details of barriers related to category of regulator, operator and commuter are as follows:

4.1. LOCAL AUTHORITY LEVEL

Regulators include all government officials at all levels, power energy providers, policy makers, local traffic police, and other organisations involved in regulating e-rickshaws at local level. The barriers from the point of view of regulators are as follows:

1. Perception related: Article in periodicals promote e-rickshaws as low emission mode of last mile connectivity. Few press articles have also created a perception that e-rickshaws are unsafe, technologically downgraded and also lead to congestion issues, this in turn may influence a city’s e-rickshaw deployment decision.  
Majority of unsafe and downgraded e-rickshaws are those which are assembled locally with low quality parts contributing to various issues including accidents. Also a rise in number of unregulated e-rickshaws in an area may contribute to congestion due to clustering. Thus clear understanding and addressing of issues may overcome this barrier.
2. Effective compliance monitoring of E-rickshaw standards: Safety standard by ARAI/ICAT have to be complied by e-rickshaws, but effective enforcement is still lacking i.e. effective compliance check and monitoring of e-rickshaw is still deficient due to which there are a large number of illegal assembled e-rickshaws operating in the cities, making regulation a challenge for authorities as they do not exist in any records.
3. Uncontrolled growth of e-rickshaw fleet: In case of unplanned inclusion in a city and operation of unregistered/unapproved e-rickshaws results in a challenge to estimate the number of e-rickshaws. This unpredictable number leads to difficulty in developing

supporting infrastructure, financial incentives and other services. It may also add up to regulatory challenge for traffic officials as controlling and regulating these vehicles. Also the environmental hazards due to battery mishandling after its usable life is also considered a great issue and needs to be addressed.

4. Lack of policy clarity: Lack of clarity in policies at local level is a major barrier in operations. Existing policy landscape mentions details of manufacturing, operation and maintenance of e-rickshaws directly or indirectly, but a clear understanding, application and effective implementation is a factor of concern. Emerging policies are trying to include e-rickshaws but effective deployment requires further analysis and impact evaluation.

#### 4.2. OPERATOR LEVEL

Operators may/may not own the e-rickshaws but operate these on roads. These face different barriers due to the regulatory authorities and lack of support. These are as follows:

1. Finance related: According to the on-ground observations and articles from periodicals, it was realized that majority of e-rickshaw operators were low income workers and required financial assistance in form of government loan/private loan to purchase e-rickshaws. Thus easing financing system for purchase of e-rickshaw is required.
2. Infrastructure related: Lack of infrastructure facilities is one of the major challenge for operators. At present, operators approach private charging stations in case they are unable to charge their vehicles at their home. Parking areas, resting areas and waiting areas are not defined for e-rickshaws due to which operators end up paying local associations to operate. Option of O&M ecosystem to operate and maintain supporting infrastructure for e-rickshaws may be helpful in solving this issue.
3. Inter-vehicle conflict: 'Love of status quo' is observed to be one of the biggest barriers in implementation of planned method of e-rickshaw deployment in a city. Dominant unions like those of auto-rickshaws strongly oppose introduction of e-rickshaws and do not allow its proper operation in case these are introduced, as they feel that e-rickshaws may hamper the usage of auto-rickshaws by commuters. However e-rickshaws cater to niche areas different from those of auto rickshaws and are not alternative mode of auto-rickshaws (due to speed restriction), yet their operation is opposed due to lack of understanding.
4. Technical: E-rickshaws operators feel that currently the range of operation is limited to due to unavailability of supporting infrastructure at specific distances. Also e-rickshaw's grade climbing capacity is affected as they are unable to drive on slopes when its battery is low. Technical upgrade of e-rickshaw may improve this issue.
5. Social benefits: Currently social benefits are not provided to the operators of e-rickshaws.
6. Awareness of national schemes: National schemes like NULM, PMMY, FAME, etc. provide financial incentives/loans at reduced rates for procuring e-rickshaws but operators are not aware about the same due to which they are unable to take their benefit. Additionally lack of awareness related to policy amendments (at operator's level) also acts as one of the barrier for example domestic charging is allowed in Delhi, but operators are not yet aware of this and have to pay money to charge their vehicles at shops.

#### 4.3. COMMUTER

Affordability, reliability, flexibility and comfort are the major positive factors which encourage commuters to use e-rickshaws. Barriers from commuter's point of view are as follows:

1. Accessibility related: Commuters feel that accessibility to e-rickshaws in some areas is very limited as they have to wait for it with no surety of probable time. Integration of mobile application to ride an e-rickshaw may be helpful in improving their access in unserved areas. Aggregators like OLA/UBER/Smart E may are already working towards this issue.
2. Safety related: Overloading is very common in case of e-rickshaws. E-rickshaws are permitted to carry maximum of 4 passengers but usually carry 5-6 passengers which lead to discomfort and may lead to accidents. Few articles in periodicals have also raised the issue of safety by creating a perception that these are unsafe. Few commuters may not prefer e-rickshaws due to this concern.

#### Battery menace: Lack of organised system for battery recycling

At present majority of e-rickshaws use lead acid batteries as these are the cheapest way to store energy. After end of usable life, handling of these batteries is a concern due to presence of lead which may cause health and environmental hazards. There is a lack of organised system for recycling. **Batteries (Management and Handling) Rules, 2001** was notified by Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India on May 16, 2001. It stated that it is the responsibility of manufacturer/ importer/ assembler to ensure that the batteries are collected and sent to registered recycling units. Later on April 4, 2016, **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2015** were published by Gol and applied on management of hazardous and other waste including lead.

Despite of presence of recycling rules, still this sector is not yet developed. Even though these rules are valid and provide required guidance but does not acknowledge EV push and batteries being used in transport industry.

Some organisations in India recycle lead batteries. An example includes Gravita, which is involved in recycling of lead acid batteries and offers turnkey plants for recycling batteries. Batteries should be collected locally and sent to official recyclers but in as per the article in periodicals, these are broken in road side shops.

# 5

## FREQUENTLY ASKED QUESTIONS

In case the city plans to introduce e-rickshaws in its mobility system, there are some typical questions related to the deployment process and outcome to be considered. The following is the list of some typical questions describing the pros and cons of the same and few additional comments supporting the question:

### 1. DOES E-RICKSHAW SOLVE THE LAST MILE CONNECTIVITY ISSUE?

#### Response

In case e-rickshaw deployment is a feasible option for a city, providing demand intensive, flexible, affordable, robust and comfortable modal option of last mile connectivity for commuters. It can operate on non arterial roads, including collector roads which are not approachable by public transport to complete the first mile/last mile connectivity.

#### Pros

- It is an option of first/ last mile connectivity mode for the commuters.

#### Cons

- Due to slow speed, it may interfere with other modes on high speed corridors.
- Low cost of acquiring may lead to uncontrollable rise in number of e-rickshaws.
- Unplanned operations may interfere with the existing traffic and add to congestion and chaos on busy routes.

#### Comments

- E-rickshaw deployment should preferably integrate background study of geography and topography of city. If the city has sloped terrain, has sufficient last mile connectivity modes or receives heavy rainfall, it may not be feasible to incorporate e-rickshaws as a mobility option.
- Deployment requires clear policy, guidelines and supporting infrastructure for efficient

implementation on ground (halt points, tariff, route rationalisation, charging infrastructure, parking areas, etc.)

- Presence of main mile PT mode is necessary for e-rickshaws to exist as last mile mobility mode.

### 2. SHOULD A CITY GOVERNMENT/ULB OPT FOR E-RICKSHAW OR E-AUTO DEPLOYMENT?

#### Response

As per the definition, e-rickshaws have speed limitation of 25 kmph while e-auto has higher speed of about 45 kmph, thus deployment of e-rickshaws can be considered for last mile connectivity on low speed corridors, while e-autos can be considered for all urban corridors. A city government/ULB may use a combination of e-rickshaw and e-auto deployment for urban commute as per its requirement.

#### Pros

- Deployment with consideration of city background assessment and needs may help in efficient incorporation required EV in an area.

#### Cons

- If e-rickshaws are deployed on routes with large distances, neither the financial model nor the operational model may work.

#### Comment

Decision of type of electric vehicle to be deployed involves in-depth background study to analyse the demand in an area. Typically an e-rickshaw can cover 3-5 km distance with ease as first/last mile connectivity so for trip length more than this, e-autos may be preferred.

### 3. DOES E-RICKSHAW SOLVE THE CITY'S PROBLEM OF POLLUTION?

#### Response

E-rickshaws have zero tailpipe emission so direct contribution to pollution is nil but indirectly these vehicles contribute to emissions based on the source power generation for charging.

#### Pros

- Local pollution is nil as there is no direct emission by vehicle.

#### Cons

- Electricity source required for charging may also contribute to emissions at the power generation source.
- Lead acid batteries may contribute to emissions after completion of their life cycle, if they are not recycled properly.

#### Comments

- Renewable source of energy may be employed for electricity generation.
- Alternatives of reusing lead acid batteries can be explored for e.g. Li-ion batteries and other battery types.
- Swappable batteries may be a very environment friendly option.

4. IS E-RICKSHAW A REPLACEMENT MODE FOR MANUAL RICKSHAWS?

Response

No, manual rickshaws and e-rickshaws have different operational spaces and demand. Manual rickshaws can operate on narrow roads which is difficult for e-rickshaws but not an option for high speed corridor or urban roads. Also manual rickshaws are zero emission while e-rickshaws may contribute to emissions at electricity generation source.

Pros

- Manual rickshaws are zero emission.

Cons

- • Manual rickshaw requires more substantial hardships from operator than e-rickshaw.
- • Manual rickshaws may not be able to cover large distance as in case of e-rickshaw (average trip length of about 4km)

Comment

Decision for deployment of e-rickshaw and manual rickshaw may be made by a city depending on its requirements and exiting scenario. Combination of modes should preferably be deployed as manual rickshaw may not be a choice for urban roads. Introducing e-rickshaws may allow restricting or reallocating routes for manual rickshaw enabling safer operation.

5. SHOULD A CITY GOVERNMENT/ULB OPERATE E-RICKSHAW INSTEAD OF PRIVATE INDIVIDUALS?

Response

The city government/ULB is best positioned to support and facilitate e-rickshaw deployment. Private individuals may own and operate e-rickshaws.

Pros

- Sustainable and low cost employment option.

Cons

- Maintenance of standards may be an issue which may be addressed through strict implication of rules and regulations.

Comment

City government may facilitate e-rickshaw deployment and operation by providing financial support to the operators (subsidy/ eased loan process), social support (insurance, unions/ associations, etc.) and developing supporting infrastructure (charging, parking areas, etc.)

6. SHOULD ROUTE RATIONALIZATION AND DESIGNATED HALT POINTS BE PLANNED BY CITY AUTHORITIES AS A PRE-REQUISITE FOR E-RICKSHAW DEPLOYMENT?

Response

E-rickshaws have a speed limit of 25kmph and may not be allowed to ply on high speed corridors as decided by city authorities. Currently, drivers decide the routes on which they

operate their vehicles according to the commuter's demand. The routes and halt points should be decided and monitored by city authorities to reduce the possibility of clustered and unregulated operation in an area.

Pros

- Route rationalization helps in understanding the demand of mode keeping in mind the ROW and speed limit. This could help in promoting E-rickshaws in desired areas.

Cons

- Some drivers may not pile on recommended routes due to low income in those areas.

Comment

Route rationalization and halt points may be planned by cities for e-rickshaws as a part of planning phase after consultation with users, operators, transport officials, traffic police and various other stakeholders.

Delhi has taken positive steps towards route rationalisation, e-rickshaw operation is banned on highways and other high speed corridors decided in consultation with traffic police. When the operators apply for registration in areas where e-rickshaws exist in high numbers, other routes are suggested by the authorities. These steps may be helpful in reducing possibility of clustering in an area and ensure effective coverage of operation in city areas.

7. DOES E-RICKSHAW CONTRIBUTE TO CONGESTION?

Response

Typically e-rickshaws are not a planned inclusion in cities and operate in an unplanned landscape. In absence of guidelines on route rationalisation or designated halt point, e-rickshaws compete with other IPT modes for space and commuters therefore resulting in clustered operation in areas and halting anywhere when the passenger wants to board/ deboard. This interference with other modes may contribute to congestion.

Comments

- Designated halt points and route rationalisation may reduce the issue of congestion as the ROW would be considered in that case.

8. DOES CITY GOVERNMENT NEED TO CONTROL VEHICLE DESIGN AND STANDARDS?

Response

There is a need to control vehicle design and standards to ensure safety of drivers, users and better operation, but this control is not required at city level. Currently this is already controlled at national level by ARAI and ICAT through mandate of safety standard compliance for approval of models to be operated.

E-rickshaw operators have to register their vehicles at respective RTO of the area (which is possible only for ARAI/ICAT approved models). This ensures that standard compliant models operate on city roads.

Pros

- Safety of users can be ensured through safety standards.
- The process of regulation and monitoring is eased by standard compliance and registration.



**Comments**

- The vehicles from manufacturers have to comply with safety standards. A city may provide fixed specifications related to dimensions, battery, power consumption, etc. which have to be considered by the manufacturers.
- City government can also facilitate the safety insurance for riders to improve health benefits.

**9. WHO SHOULD REGISTER E-RICKSHAW FOR OPERATION?**

**Response**

E-rickshaw operators have to register their vehicle with RTO for operation. Registration is a check ensuring that only ARAI/ICAT approved e-rickshaw models are allowed to ply on city roads.

**Pros**

Registration eases the regulation of e-rickshaws by traffic authorities.

**Comments**

- Strict implication of registration mandate is required to curb illegal e-rickshaw numbers operating in a city. Though Delhi illustrates an optimistic example of levying fines on unregistered e-rickshaws or confiscating illegal e-rickshaws still it has a long way to go to curb these vehicles.

**10. SHOULD CITY GOVERNMENT/ULB DEVELOP CHARGING STATIONS AND PARKING AREAS FOR E-RICKSHAWS?**

**Response**

Authorised charging stations developed by a city may help in encouraging efficient e-rickshaw operation. Currently e-rickshaws have a constraint of distance due to unavailability of charging stations which can be improved by setting up stations depending on the routes on which e-rickshaws are allowed.

**Pros**

- Public charging station developed by cities, would be useful for operators who do not have accessibility to authorised charging stations or are unable to charge e-rickshaws domestically with only unauthorized charging stations left as an option.
- Charging stations can also function as parking areas during non-operational hours and solve the issue of parking to some extent.

**Comments**

- Background study including planning of routes for e-rickshaws is necessary for developing the areas for parking and charging of e-rickshaws. This would be helpful in targeting the most demanded areas.

**11. SHOULD CITY GOVERNMENT ALLOW DOMESTIC CHARGING FOR E-RICKSHAWS?**

**Response**

Legalising domestic charging is a positive step which eases the challenges for the drivers/

owners of the rickshaws. It is a more affordable and convenient option for the drivers.

**Pros**

- It is easier for the drivers to charge their vehicles if domestic charging is allowed.

**Cons**

In case the operator does not have legal electricity connection, domestic charging may exert extra load on overtaxed electricity grid.

**Comments**

- E-rickshaw requires upto 6 to 7 units of electricity per day for charging.
- Earlier it was highlighted that electricity department has to bear losses due to utilization of domestic electricity for commercial use but now some states are planning to legalise domestic charging of e-rickshaws and Delhi has already allowed domestic charging.

**12. WHAT IS A BETTER OPTION, BATTERY SWAPPING OR BATTERY CHARGING?**

**Response**

Battery charging more prominent currently as compared to battery swapping. Battery swapping may be more user friendly and better option if is a planned intervention. A phased planning is required in case of shift from charging batteries to swapping so that these batteries cause minimum environmental impact.

**Pros**

- Battery swapping stations may require less time (3-5 minutes maximum)
- Battery swapping may require less area as compared to charging stations as these would require storage and charging areas for batteries and for swapping but charging station requires area for charging vehicles which may be more.

**Cons**

- It is perceived that battery swapping may require larger area for storage, advanced machinery/ equipment/ skilled labor for swapping the battery while monitoring of battery standards before swapping is also an issue due to presence of unauthorized manufacturers.

**Comments**

- As per an organisation working towards developing battery swapping stations, these may become a better option for operators as well as regulators but the eligibility criteria for setting up and operation of battery swapping stations have to be defined by the government to ensure quality standard and regulated landscape<sup>80</sup>.

**13. WHAT TYPE OF BATTERY IS GOOD FOR E-RICKSHAWS, LEAD ACID BATTERIES OR LI-ION BATTERIES OR ANY OTHER?**

**Response**

Lead acid batteries are prevalent in Indian market due to its low cost but a Li-Ion battery is perceived to be more efficient, it takes less time for charging, covers larger distance and has better life as compared to lead acid batteries. Lead acid may also cause environmental hazards

in case these are not recycled properly after end of their life cycle.

**Comments**

Cost of Li-ion battery is more as compared to lead acid so the city government may decide the battery type depending on its economic conditions or explore funding options for the same.

**14. SOLAR POWERED E-RICKSHAW ARE BETTER FOR A CITY OR A BATTERY POWERED E-RICKSHAW?**

**Response**

Exploring for renewable sources for electricity to power batteries of e-rickshaw is a good option to meet the electricity demand for increased number of electric rickshaws. The batteries can be charged by power generation through solar energy or include a solar panel for charging the batteries of rickshaws directly. The decision of reliability on solar power as electricity source depends on the city.

**Pros**

- Renewable source of electricity would help in saving fuel based electricity and also help in reducing the emissions due to electricity generation for charging batteries of e-rickshaws.

**Cons**

- Solar powered e-rickshaws may be more expensive.
- Operation of Solar powered e-rickshaws may be restricted due to weather conditions as it won't be relevant in areas with less sunshine hours. In such areas other renewable electricity generation source can be explored.

**Comment**

Solar e-rickshaws already exist in the market as 'Solecshaws'. These have solar panels attached on the roofs of e-rickshaws and run on batteries charged by these panels directly.

**15. HOW CAN THE CITY GOVERNMENT/ULB SUPPORT IN E-RICKSHAWS BE FINANCING/ SUBSIDISING?**

**Response**

City government/ULB may act as a facilitator/guarantee provider for financing e-rickshaw procurement. Financing/ subsidising options for e-rickshaws at the time of purchasing may ease the economic issues of the owners/operators/drivers and also be helpful in encouraging the owners to purchase the registered e-rickshaws with standard parts instead of non ARAI/ ICAT approved e-rickshaws due to low cost.

**Pros**

- • Financing/subsidising option may help in curbing and rolling out the unauthorized e-rickshaw manufacturers by encouraging the buyers to buy safety standard compliant models.

**Comment**

City government/ULB plays an important role in encouraging e-rickshaws and regulating these through provision of financial incentives. Thus these should be specifically promoted for

standard compliant models to make them affordable for the operators.

**16. HOW CAN THE CITY GOVERNMENT ENSURE E-RICKSHAW'S QUALITY AND SAFETY STANDARDS?**

**Response**

At present, e-rickshaw models are tested on various parameters and approved if they comply with the standards specified by ARAI/ICAT. After this the operators have to register their vehicle in RTO after which the RC of vehicle is granted to operate for 2 years, it is required to renew RC after completion of 2 years with a renewal requirement at every 3 years. The operator has to apply for RC renewal before its validity expires. Renewal is granted only after inspection of e-rickshaw, if the vehicle is unfit or does not comply with safety standards, RC is not renewed. This is an effective way to ensure compliance of e-rickshaw's to standards.

**Comment**

The standard compliance requirements and mechanism already exists but strict implementation and monitoring is required assuring the standards are complied.

**17. ARE E-RICKSHAWS FINANCIALLY VIABLE?**

**Response**

The cost of e-rickshaw is low as compared to ICE vehicles like auto rickshaws and offers employment to the unskilled drivers making them economically viable for the operators/drivers.

**Pros**

- Income of drivers from e-rickshaw operation is usually more than conventional rickshaws.
- From the perspective of users, these are affordable considering the time taken in comparison to conventional rickshaws.

**Cons**

- E-rickshaw cost is higher as compared to manually powered rickshaws but have a short payback time (7-8 months in Delhi and about 12-15 months in cities like Udaipur)
- Due to lack of fare regulation, e-rickshaw drivers may sometime charge higher fare from the users.

**Comments**

- E-rickshaws owners usually have to opt for a financial aid/loan to purchase e-rickshaw. Thus city's assistance as facilitator/ guarantee to financial institutions aid or subsidy may be helpful.
- The payback time of E-rickshaws usually varies from 6 months upto an year approximately, depending on the operation, income, expenses of operator and various other factors.
- Fare regulation policies are necessary for efficient and unbiased operation of e-rickshaws.

**18. DOES E-RICKSHAWS OFFER SUSTAINABLE LIVELIHOOD TO THE DRIVERS?**

**Response**

It offers sustainable livelihood to drivers. These require provide daily earnings of INR 600-1,000 depending on the areas where these are operated.

**Pros**

- E-rickshaw drivers manage to earn more as compared to conventional rickshaws.
- This does not require manual labor for operation so it may offer better sustainable livelihood to the drivers.

**Cons**

- Initial investment of INR 1,20,000 to 1,50,000 required to purchase the vehicle(ARAI/ICAT approved) is large and owner may have to take a loan which reduces his/her profitable income and may not be a sustainable livelihood.

**Comments**

- Availability of financial incentives for purchasing e-rickshaw may improve the sustainable livelihood factor.

# 6 MODELS FOR REGULATION AND OPERATION

**A**long with the policy setup, e-rickshaw system requires an institutional enabling framework for efficient operation and improved governance. The current system requires the operator of traditional three wheelers to apply for a stage or contract carriage permit to the authority (Municipal Corporation) and the authority has the power to grant/reject the operating permit. This process is often not transparent. The age of vehicle, driver and characteristics are the conditions considered for the permit. This existing scenario has resulted in attracting the operators to high demand routes leaving some areas of the city as underserved. E-rickshaws do not require such permits however due to their operating speed, city governments often restrict operations to certain routes, corridors and areas. There is still need for a model, where the city government/municipal corporation takes the approach of route rationalization and ensures that the e-rickshaw mobility services are provided to areas according to the demand of passengers.<sup>81</sup>

Alternative models for regulating e-rickshaw deployment and operation are as follows<sup>82</sup>:

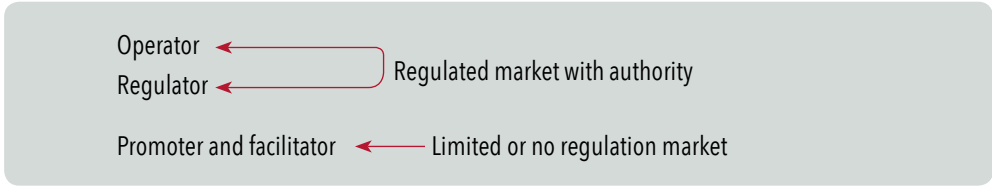
1. Regulated market with Authority Initiative: In this model, the city government/ regional transport authority (RTA) takes the initiatives of regulating and organising e-rickshaw services finalizing the areas and route rationalisation in the city. The authority has to plan, organize, supervise, bear the losses (in low demand route areas) and finance/ find a funding option for e-rickshaws. This would be helpful in reducing the concentration of e-rickshaw operators on high demand routes and improve the extent of areas being served.
2. Limited or no regulation market: In this model, the government/RTA has a passive role. The parameters for decision making of authority, if any should be defined for transparent grant of permissions. The role of authority in organising the market is limited in comparison to the operators themselves.

## 6.1. ROLE OF A CITY

E-rickshaws are usually owned and operated by private individuals and city administration is not involved in operation directly. A city may play an important role in promoting e-rickshaws



as last mile connectivity mode depending on the class of city. In case of tier 1 cities, city may play the role to regulate the operation to avoid hampering of other existing modes and in case of tier 2 or tier cities, these may support the system as per requirement. City administration plays an important role in IPT operation and regulations along with other agencies including traffic police, RTO, district administrators, etc. In order to promote e-rickshaws as IPT city needs to understand and perform the following roles or combination of these:



**City government as operator** - In case a city plans to play the role of owner and operator of e-rickshaws, then the rolling stock (e-rickshaws) is procured and operated by the city with no role of private individuals. In such a system, planned inclusion of e-rickshaws is proposed by the city. Government may give the e-rickshaws on lease to private operators/individuals but maintenance and regulation is controlled by the city. An example of such a system is pilot project of e-rickshaw deployment by Udaipur Municipal Corporation.

**City government as regulator** - In such a system, E-rickshaws are owned and operated by the private individuals but the city controls regulation and ensures efficient operation. City government plays the role of route identification, policy control, taxation, incentives, registration and licensing, standard maintenance and other regulatory factors related to e-rickshaws.

**City government as promoter and facilitator** - When a city government plays the role of promoter and facilitator for e-rickshaws, rolling stock are owned and operated by private individuals. Also the city government promotes e-rickshaw operation by developing supporting infrastructure including charging stations, parking areas, service stations, etc. Assistance is provided to the operators/owners of e-rickshaws procurement by ensuring easy access to finance from association/ bank/ other incentive, providing subsidy and other financial assistance.

City government also provides assistance in formation of association/union for e-rickshaws, provide social benefits (like accident cover, health insurance, education loan, house loan, etc.) for improving the social life of operators and provide/ manage the provision of training and awareness programs, etc. In this scenario, operators/owners have the regulatory rights of deciding routes, fare, waiting areas, parking areas, etc. (Table 4)

City government has maximum extent of control over e-rickshaw system and is a planned inclusion in case the city government plays the role of ‘operator’. In case the city government acts as a ‘promoter and facilitator’, e-rickshaw system is partially controlled by the city government and it is partially planned. In case of city government acting as a ‘regulator’, the e-rickshaw system is included as adhoc inclusion with least of control of city government.

Thus the city government may preferably play the role of facilitator and supporter to ensure efficient and regulated operation of e-rickshaws on ground. The vehicles would be owned, operated and maintained by private individuals but are supported and monitored by the city government.

Table 4: The options of roles available to a city to incorporate e-rickshaws in its mobility landscape along with the details of roles and stakeholders

	Roles	Regulator	Operator	Promoter and facilitator
1.	Acquisition			
	Rolling stock procurement	Private individuals	City government	Private individuals
	Financial assistance	Private individuals/ assistance from financial institutions	City/partnership with bank or any other financial institution.	City government with partnership with Bank/ financial organisation
	Provision of supporting infrastructure	City government	City government	City government
2	Deployment			
	Regulatory roles (route s,fare,taxation,registrati on, etc.)	City government	City government	Private individuals
3	Operation			
	Operation on ground	Private individuals but controlled by city government	City government/ City government may lease out to private individuals	Private individuals
	Maintenance	Private individuals	City government	Private individuals
4	Organisation			
	Associations/operator representation	City government	City government	City government
	Social benefits	City government	City government	City government
5	Monitoring			
	Standard monitoring	City government	City government	City government
	After life (reuse/ recycling of vehicle and its parts)	Private organisations/ City government/ City government+ private	Private organisations/ City government/ City government+ private	Private organisations/ City government/ City government+ private

# 7

## ACTIONS REQUIRED

**E**-rickshaws in India involves various aspects and actors as stakeholders for efficient deployment and operation on ground.

E-rickshaw deployment on ground requires support from the central government to local government. Municipal Corporations/Urban Local Bodies (ULBs) assist in implementation of projects including development of supporting infrastructure. Regional

Transport Authority (RTO) also helps in implementation through route rationalization and providing assistance in guideline development and awareness, Ministry of road transport and highways develop the policies and guidelines for deployment, operation and maintenance. Department of Heavy Industry provides subsidy through FAME scheme (faster Adoption and Manufacturing of Electric vehicles) and other financial institutions provide funding for development of infrastructure and other tasks to the ULBs. Safety certification is provided by ARAI/ICAT for ensuring safety of drivers and users of vehicle. These control the approval of assembly lines and vehicles design permit. Industry associations and driver associations give their inputs/feedback during engagement for policy development assisting in implementation of project.

Table 5: Various stakeholders and various actions required to be taken by them for supporting e-rickshaw deployment through planned inclusion in a city<sup>83</sup>:

	Stakeholders	Planning		Acquisition			Deployment and operation (Infrastructure, routes, fares, etc.)	Organisation (Association, social benefits, etc.)	Monito-ring
		Regulation/ policies	Certification& standards	Incentives	Subsidy	Funding			
Central level	Ministry of road transport and highways, MoHUA								
	Department of Heavy Industry								
State level	RTO								
	Energy supplier								
Local level	ULBs								
	Manufacturer								
	Traffic police								
	Financial institutions								
	Operator								
	Stakeholders including Industry Associations, Driver association (representation of drivers)								
All the above levels	ARAI/ICAT								

Least Important  Most Important

8

APPROACH FOR E-RICKSHAW DEPLOYMENT

In order to implement the project of e-rickshaw deployment, an approach is required. City may choose to adopt an approach from depending on the city size, route, population, infrastructure, issues and demand of the city but it should include pilot project implementation as a part of implementation.

Pilot project includes deployment of e-rickshaws on a pilot basis in a confined area. After the pilot project is implemented, the amendments and learning are utilised to scale up the project for larger area of the city. No policy setup is required for the pilot project to be implemented, it is required only after the scale up project is to be implemented. This may be an effective method for cities to develop an understanding of the project and utilise the learning for effective deployment results. After analysis of pilot project results, the city government may decide among the following two approach for deployment in city:

- Big bang approach
- Phased transition approach

Table 6: Difference in requirements, extent of control on system, investment and risk involved in big bang approach and phased approach:

	Initial requirements (Policy, infrastructure, etc.)	Extent of control	Investment	Risk level
Big Bang	High	High	High (required in single step)	High
Phased	Medium	Medium	Medium (in phases)	Low

8.1.

BIG BANG APPROACH

In this approach, all the conventional ICE auto rickshaws/ other ICE IPT modes would be replaced by e-rickshaws in one step. It requires a massive change in infrastructure, mind-set of people and involves huge investment to setup the entire requirements.

Policy support is also required before taking steps to implement this approach.

**Pros:** If the deployment project is carried out keeping in mind all the requirements, then it may help in better last mile connectivity and transform the city in a big step.

**Cons:** If the project fails due to any reason, it may result in a massive wastage of funds and infrastructure.

8.2.

PHASED TRANSITION APPROACH

This includes rolling out the old ICE IPT vehicles, gradually introducing electric rickshaws. The annual cycle of auto rickshaws demanded in a city should be analysed and should be replaced with e-rickshaws in areas where e-rickshaws are feasible. This approach may be adopted in cities as this requires investment to be developed overtime which may be ensured by various funding sources.

Policy can be developed and incorporated with time.

**Pros:** This would be helpful for cities which don't have huge investment for e-rickshaw project and wish to integrate e-rickshaws as an IPT mode in mobility system.

City government may preferably opt for phased transition approach as it is feasible economically, cities may develop the policies and improve deployment operation depending on the learning through issues analysis and resolution.



# 9

## WAY FORWARD

### ACTION PLAN FOR E-RICKSHAW DEPLOYMENT

E-rickshaw deployment requires city government to take actions in a phased manner which can be categorized under short term, medium term and long term action plans as follows:

#### 9.1. SHORT TERM ACTION PLAN (3 - 6 MONTHS)

- 1. Background study:** This includes understanding of current situation in a city government with assessment of ridership demand, modal mix, current auto-rickshaw/rickshaw operation, trip length, public transport system and plans, topographic study of the area, road hierarchy, etc. If the terrain is hilly or have high speed corridor routes, e-rickshaws may not be an efficient option (due to their speed limitation of 25kmph).
- 2. Identification of city government role:** City government may decide the role (operator/regulator/facilitator) preferred in deployment and operation of e-rickshaw depending on its requirements and resources. Approach and probable plan for deployment process may also be decided at this stage. Licensed manufacturers should be identified to control the standards of e-rickshaws entering the market.  
Existing policy background (standards, guidelines, policies) should be analysed to find the gaps and provide recommendation for filling them.
- 3. Support:** Financial and institutional support is required for procurement of e-rickshaws by operators. If city government/ RTA provide this support, issue for operator is reduced. This support may be detailed as follows:
  - 3.1. Acquisition support:** ULBs/city government can partner with financing institutions like non-banking financial corporations (NBFC) or other government schemes to assist operators in procurement of e-rickshaws and in infrastructure development. This can be considered as an alternative for ULBs investing upfront. Insurance and subsidy assistance may also be financial assistance to operators.
  - 3.2. Supporting infrastructure development:** Charging infrastructure, roads for access, parking infrastructure, waiting areas and parking areas for pilot project. ULBs may allocate land for these supporting infrastructures and can work with the electricity board for provision of electricity to meet charging demands.
- 4. Deployment assistance:** Licensing and registration assistance may be controlled and provided by the city.
- 5. Developing integrated PT and IPT route network plan for city:** Public transport routes may be integrated with EV last mile connectivity modes. This would help in serving the demand of current and upcoming travel pattern demands efficiently.

#### 9.2. MEDIUM TERM (6 MONTHS - 2 YEARS)

- 1. Operation:** Operation of e-rickshaw involves development of supporting infrastructure (including charging, parking, service centres, etc.), fare fixation and development of association or representative of e-rickshaw operators. ULBs/ city authorities should develop these through direct involvement or indirect involvement through PPP mode.
  - 1.1. Fare fixation:** Fares may vary with area of operation leading to irregularity in operation as more operators would be attracted in the areas where they could get more fare. Fare fixation may control fare hike and help in uniform operation.
  - 1.2. Halt points:** Pick up and drop point should be designated by the ULBs according to the rationalized routes ensuring the e-rickshaws halt at these designated points. This would help in regulating the traffic to an extent.
  - 1.3. Charging stations:** Charging stations may be set up at major location of city to provide services to operators.
- 2. Permit relaxation for replacing diesel three vehicles with EV:** The city should promote the shift to EVs though local level reforms or state level reforms like easing the permit issuance and renewal mechanism, waving the taxes etc. States like Karnataka, Kerala, Maharashtra, etc. have already issued reforms to support EVs.
- 3. Awareness and training:** Awareness and training sessions should be organized for the drivers to improve their knowledge of road rules, and for operators/ drivers/ owners of e-rickshaws to improve their understanding for registering their vehicle.

#### 9.3. LONG TERM (BEYOND 2 YEARS)

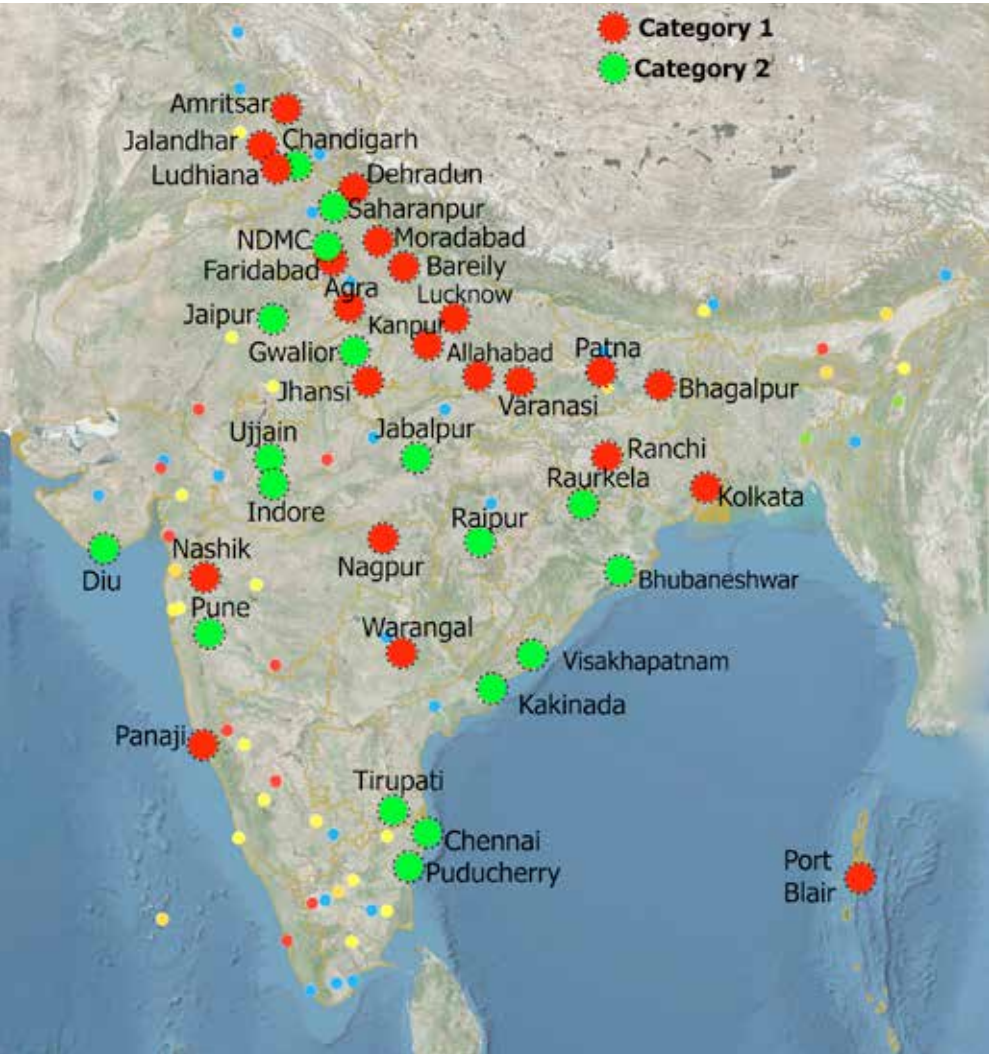
- 1. City wide provision of charging infrastructure:** Locations for installing charging infrastructure have to be identified according to the demand of IPT routes. These should be distributed in the city so that the issue of e-rickshaw distance range could be reduced. E-rickshaw operators can charge their vehicles wherever they are operating, improving last mile connectivity in a city.
- 2. E-rickshaw ecosystem:** Effective e-rickshaw operation requires development of sustainable ecosystem for the same. This includes accessibility to technologically updated models, parts (including batteries) and supporting infrastructure.
- 3. Monitoring:** E-rickshaw safety standards have been specified by ARAI/ ICAT and have to be followed during manufacturing. Monitoring of e-rickshaw standards from time to time is required to control the market of illegal parts and assembling existing in current scenario. This can be ensured by the local traffic police if the e-rickshaws are registered and have a valid license. At the time of renewal, e-rickshaws are assessed to ensure that they comply with standards for operating on roads, strict implementation of this process may be ensured by cities.

# 10 ROADMAP FOR CITIES

Based on the above action plan, following chart briefly states the steps involved in e-rickshaw deployment in two categories of cities detailed as below:

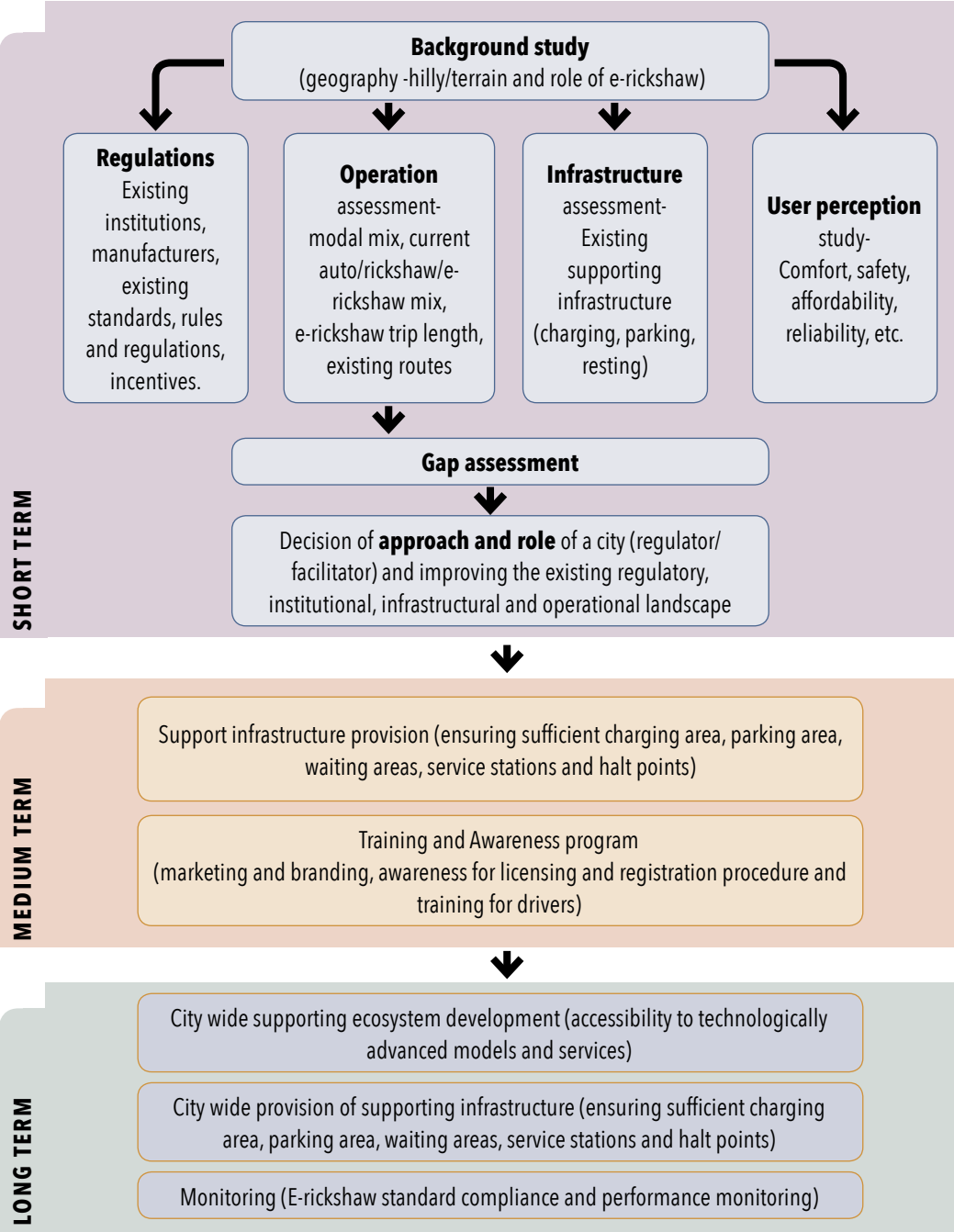
- Category 1- Cities which already have e-rickshaws operating in their city (marked by red dots)
- Category 2- Cities which are planning to introduce e-rickshaws as a part of SCP (marked by green dots)

Figure 5: Map illustrating the two categories of smart cities in India interested in e-rickshaw deployment or improvement of operation.



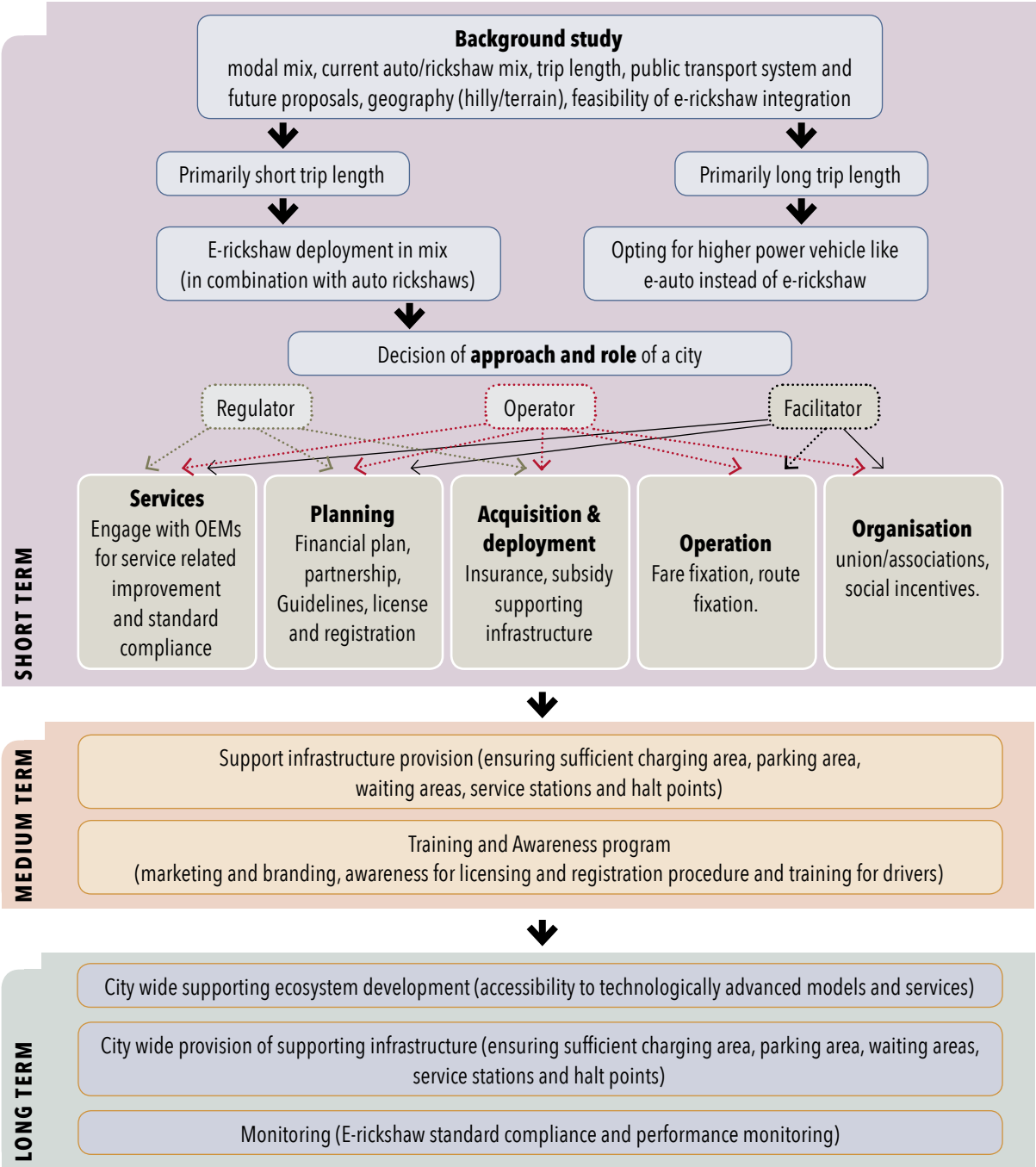
## 10.1. CATEGORY 1:

This category includes the cities where e-rickshaws are already operating. In these cities, there is a need to conduct the feasibility study to analyse the existing status of e-rickshaw operation in the city, issues with operation further ensure its regulated operation. Further the city has to build a mechanism for monitoring performance of e-rickshaws and assuring their compliance to standards. In case the city improves e-rickshaws, following flowchart details the actions required to be taken by city:



10.2. CATEGORY 2:

This category includes the city which is interested in deploying e-rickshaws in an area, they are not operating at present. A city planning to deploy e-rickshaw, has to conduct a background study to ensure that the deployment is feasible. Next step is to ensure policy landscape for deployment and operation followed by provision of supporting infrastructure. After ensuring and fulfilling the requirement, e-rickshaws can be deployed on ground. Following flowchart details the process:



11  
AFTERWORD

This report is prepared on the basis of existing evidences from secondary sources. It may require further updation, according to the policy and reforms which develop in the country from time to time at various levels.

12  
E-RICKSHAWS IN NEWS

- Operation and regulation**
- E Rickshaws exempt from CMVR(18 June 2014)<sup>84</sup>
  - Delhi High Court bans e-rickshaws in till august 18 (31 July 2014)<sup>85</sup>
  - HC pulls up government for not enforcing its notification on e-rickshaws (21 August 2014)<sup>86</sup>
  - Over a lakh e-rickshaws but no legal charging points in Delhi (3 November 2016)<sup>87</sup>
  - E-rickshaws causing snarls, worsen Delhi's air quality: SC panel (3 August 2017)<sup>88</sup>
  - E-rickshaws can use domestic supply (1 September 2017)<sup>89</sup>
  - Just 1 of 10 e-ricks in India registered, big concern for government (31 October 2017)<sup>90</sup>
  - Regulation a must for electric rickshaws (4 April 2018)<sup>91</sup>
  - More than 1 lakh illegal e-rickshaws ply on Delhi's roads (2 August 2018)<sup>92</sup>
  - India has more e-rickshaws than China's e-vehicles fleet (26 October 2018)<sup>93</sup>
  - Drive against illegal e-rickshaw dealers soon (Patna, 30 December 2018)<sup>94</sup>
  - Delhi Discoms losing Rs.150cr annually to power theft by e-rickshaw owners (27 January 2019)<sup>95</sup>
  - Crackdown on unregistered e-rickshaws by January end (Bareilly, 15 January 2019)<sup>96</sup>
  - 25 e-vehicle charging stations set up in Delhi; to open in March(26 February 2019)<sup>97</sup>
  - Delhi to get 131 charging stations for electric vehicles (25 March 2019)<sup>98</sup>
- Aggregators**
- SEG Automobile introduces motor for e-rickshaws (14 January 2019)<sup>99</sup>
  - OLA will add 10000 electric rickshaws to its fleet over next year.(April 2018)<sup>100</sup>
- Alternative mode - Electric auto**
- Mahindra launches e-alfa mini electric rickshaw for passenger movement (8 September 2017)<sup>101</sup>
  - E-autorickshaws possible in 1 year: Expert (14 February 2019)<sup>102</sup>



# 13

## RECOMMENDED READINGS

- E-rickshaw pilot operation in Udaipur and case studies at Delhi and Siliguri
- E-rickshaw operational and deployment strategy : Case of Kakinada
- Operationalising E-rickshaw in Gwalior under Smart City Mission
- Procedural Guidelines for licensing/ registration/ fitness/ grant of permit of e-rickshaw
- E-rickshaw standards
- Safety standards for e-rickshaw and e-carts
- Specifications of 2-seater electric rickshaw
- Notifications related to e-rickshaws

# 14

## APPENDIX

**B**attery swapping concept is a recent development sector on which organisations are working<sup>103</sup>. Lithion is an organisation working towards battery swapping concept in India catering to battery needs of about 200 e-rickshaws.

Battery swapping concept involves replacement of discharged batteries/power depleted batteries with fully charged batteries while depleted batteries are charged in a storage area<sup>104</sup>.

Currently battery swapping concept is available for lithium ion batteries only as lead acid battery swapping is not considered viable economically and technically.<sup>105</sup> E-rickshaw operators may opt for swapping as lead acid batteries (currently used in majority of e-rickshaws) can easily be replaced by Li-ion batteries without any retrofitting in vehicle.

Since the cost difference between Li-ion batteries is almost 4-5 times the cost of and lead acid batteries, vehicles may be sold without battery (as CNG vehicles are sold without the cylinders). This may reduce the cost of vehicle and later e-rickshaw owner/operator may approach any battery swapping service operator, deposit security amount and get a battery on lease. Battery when discharged can be swapped by another charged battery at any other similar service provider station. This concept has following advantages over charging concept:

- It would improve the range as issue of restricted range would be solved by easily swapping discharged batteries with charged ones without wasting much time.<sup>106</sup>
- Waiting time would be reduced.
- Controlled charging of batteries may improve battery life.
- In this concept, batteries would be charged at almost all the time of the day/night which may address the issue of peak demand or overloading on electricity grids.<sup>107</sup> It may also use renewable energy source for electricity generation reducing the load on electricity grid.
- Maintaining battery standards, illegal operation and manufacturing of low quality batteries may be controlled.
- Initial investment cost in e-rickshaws may be reduced (as battery contributes to about 50% of vehicle cost<sup>108</sup>) in case the vehicle is sold without batteries.

As per the interactions and discussion with an organisation working on development of battery swapping concept, it was understood that batteries may include features like GPS and monitoring mechanism which would help in standard maintenance and tracking, ensuring their batteries are not exchanged or stolen<sup>109</sup>.

Major issues involved in battery swapping concept are as follows:

- **Commercial viability:** Currently government provides tax exemption on import of Li-Ion components and selling, but battery swapping concept involves leasing of batteries and are ineligible for this tax exemption. Further no other incentive is provided to battery swapping service provider to encourage the business model<sup>110</sup>.
- **Regulatory:** There is lack of eligibility criteria specified by the government to setup a battery swapping station. This may again result in creation of an unregulated market with time if not controlled<sup>111</sup>.
- **Capacity:** Battery swapping operation would require updated skills and technology and may be affected in case of lack of the same.





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4. (Subash Dhar, Minal Pathak, Priyadarshi R. Shukla 2017)
5. (ET Now 2019),
6. (Town and Country Planning Organization, MoHUA, GoI February 2019)
7. (Recharging India's electric vehicle ambition by electrifying public transport February 2019)
8. Details of policies/initiatives in Delhi is provided in section of 'emerging policy landscape'
9. Detailed in the section of existing 'Emerging policy landscape' in this report.
10. (ICLEI South Asia 2018)
11. (Recharging India's electric vehicle ambition by electrifying public transport February 2019)
12. Developed by ICLEI South Asia on the basis of SCP prepared and submitted by these 100 cities
13. (P&S Intelligence January 2019)
14. (P&S Intelligence January 2019)
15. The details of survey results and deployment is explained in the previous report of ICLEI 'E-rickshaw pilot operation in Udaipur and case studies at Delhi and Siliguri, E-rickshaw operational and deployment strategy : Case of Kakinada'
16. (Anil K. Rajvanshi October 2014)
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18. Nimbkar Agricultural Research Institute (NARI)
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54. (Telangana Government 27 september 2017)
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56. (Sneha Verma 2018)
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58. (Gujarat Energy Development Agency, Gandhinagar 2018-19)
59. (Sneha Verma 2018)
60. (Dipen Pradhan 2019)
61. (Bloomberg 2018)
62. (Debi Prasad Dash, 2015
- \* Source- Author (ICLEI), information from secondary online sources and news articles.
63. (Dipak Dash 2017)
64. (Nisarg Suthar 19 July 2017)
65. (Automotive Industry Standards Committee 10 April 2015)
66. As per an interaction with manufacturer, it was evident that in case of legal manufacturers all the parts are manufactured in the company except controller which is imported from neighboring countries, while all parts are imported in case of illegal manufacturers/ legal assemblers.
67. (Kartik Kumar & Suyash Gabriel, Indian Express 20 March 2014)
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70. (Official 2019)
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72. (ICLEI) (ICLEI SA 2018)
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76. Calculation based on data collected during sample survey by ICLEI team
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82. Guido Bruggeman, 2016
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96. (Maria Khan 2019)
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103. ICLEI South Asia interacted with an organisation working towards battery swapping concept for e-rickshaws to develop an understanding of the concept.
104. (Parag Diwan 19 June 2018)
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## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.





