



Power Shift:

Framework for Retrofitting Three-Wheelers in Telangana



About the Natural Resources Defense Council (NRDC)

With over 50 years of experience, the Natural Resources Defense Council (NRDC) combines the power of more than three million members and online supporters with the expertise of over 700 scientists, lawyers, and policy experts to drive climate and clean energy action, protect nature, and promote healthy people and thriving communities. NRDC works in the United States, China, India, and key geographies to advance environmental solutions. In India, NRDC partners with leading organizations issues related to clean energy access, energy efficiency, cooling, climate resilience and clean transportation. For over 10 years, NRDC has also worked with government officials at the national, state, and city level partnering with local groups and businesses to combine scientific research and policy acumen to implement impactful climate solutions.

<https://www.nrdc.org>; Twitter @NRDC

About the Administrative Staff College of India (ASCI)

Established in 1956 at the initiative of the government and the corporate sector, the Administrative Staff College of India (ASCI), Hyderabad, has pioneered post-experience management education in India. ASCI equips corporate managers, administrators, entrepreneurs and academicians with the skills to synthesize managerial theory and practice; and respond to the ever-increasing complexity of managerial issues confronting government, industrial enterprises and nongovernment organizations.

<https://asci.org.in>; Twitter @ASCIMEDIA

About International Copper Association India (ICA)

ICA India is a nonprofit organization engaged in the creating awareness of the beneficial usage of copper for safety, health, environment and energy efficiency, clean energy technology, throughout India, in collaboration with other organizations, institutions and trade bodies.

Authors and Researchers

NRDC: Nitish Arora, Meshak Bandela

ASCI: Amartya Awasthi, Bhuvaneshwari Peddi

Acknowledgments

The partners would like to thank government officials, business leaders and stakeholders for sharing their valuable inputs on advancing retrofitment solutions for converting existing Internal combustion engine (ICE) three wheelers to electric for decarbonizing road transport in Indian cities. We would also like to thank our esteemed peer reviewers: Gopalakrishnan VC (Director Automotive, Government of Telangana), Rani Srinivas (CEO, Zero 21), Sharif Qamar (Associate Director, The Energy and Resources Institute), KN Hemanth Kumar (Director, International Copper Association India), Charlotte Steiner, Ritika Kapoor, Sahana L, Smriti George, Sameer Kwatra (NRDC) and Rajkiran Bilolikar (ASCI). The authors are thankful for the support of the Electric Mobility Initiative in making this White paper possible.

POWER SHIFT

Framework for Retrofitting
Three-Wheelers in Telangana

Table of Contents

Abbreviations	v
1. Retrofitment of Autorickshaws – Telangana Case Study	1
1.1 Landscape Assessment of Autorickshaw Market in Telangana	1
1.2 Regulatory Process for Vehicle Retrofitment in Telangana	2
1.3 Enabling Scaled up Pilots: A Framework for Telangana	5
Conclusion	7
References	8

Abbreviations

ARAI	Automotive Research Association of India
BaaS	Battery as a Service
BMS	Battery Management System
BS IV/ BS VI	Bharat Stage Emission Standard
CFST	Citizen Friendly Services Telangana
CMVL	Central Motor Vehicle Laws
CMVR	Central Motor Vehicles Rules
CNG	Compressed Natural Gas
DC	Direct Current
e-3W	Electric 3 Wheeler
EGR	Exhaust Gas Recirculation
ELV	End-of-life Vehicles
ERFC	Electric Retrofitment Centre
EV	Electric Vehicles
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles
GARC	Global Automotive Research Centre
GHG	Green House Gases
GHMC	Greater Hyderabad Municipal Corporation
GST	Goods & Services Taxes
HC	Hydrocarbon
ICAT	International Centre for Automotive Technology
ICE	Internal Combustion Engine
LPG	Liquefied Petroleum Gas
MUDRA	Micro Units Development and Refinance Agency Limited
NA	Not Applicable
NATRiP	National Automotive Testing and R&D Infrastructure Project
NATRAX	National Automotive Test Tracks
NBFC	Non- Banking Financial Companies
NCAP	National Clean Air Programme
NGT	National Green Tribunal
NO_x	Nitrogen Oxides
NIAIMT	National Institute for Automotive Inspection Maintenance & Training
OEM	Original Equipment Manufacturer
PM	Particulate Matter
RC	Registration Certificate
REESS	Rechargeable Electrical Energy Storage System
RTA	Road Transport Authority
RTO	Regional Transport Office
SOC	State of Charge
TCO	Total Cost of Ownership
TGPWU	Telangana Gig & Platform Workers Union
TSREDCO	Telangana State Renewable Energy Development Corporation
VRDE	Vehicles Research and Development Establishment



Source: Freepik

Retrofitment of Autorickshaws – Telangana Case Study

1

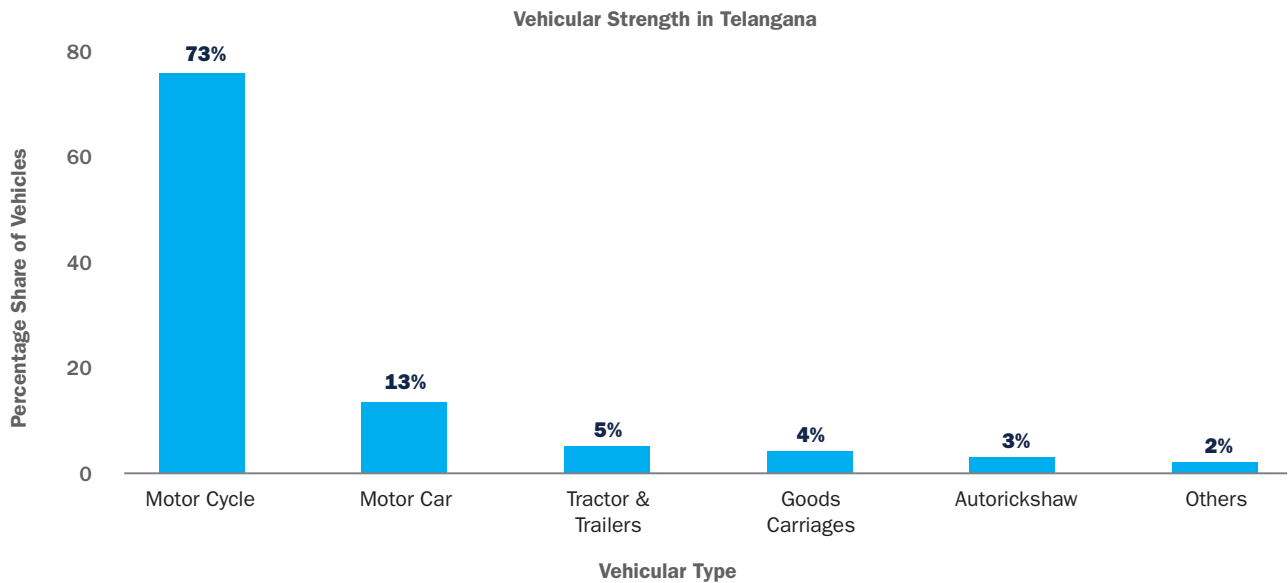
In the face of escalating urban pollution and the urgent need for sustainable transportation solutions, the state of Telangana is pioneering a transformative initiative aimed at retrofitting internal combustion engine (ICE) three-wheelers (3Ws) to electric vehicles (EVs). Recognizing the potential of retrofitting as a cost-effective and eco-friendly alternative to conventional vehicles, Telangana has developed a comprehensive framework to facilitate this transition. This document presents an in-depth case study of Telangana's approach, exploring the strategic integration of incentives, regulatory measures, and technological advancements that form the backbone of the state's retrofit ecosystem. By transitioning from combustion to current, the state is demonstrating the feasibility and benefits of converting

existing vehicle fleets to electric power. Telangana aims to not only reduce its carbon footprint but also set a benchmark for other regions aspiring to embrace sustainable urban mobility.

1.1 LANDSCAPE ASSESSMENT OF AUTORICKSHAW MARKET IN TELANGANA

As of November 30, 2023, figures from the Transport Department, Government of Telangana, show that the total number of vehicles in the state exceeds 16 million, encompassing both conventional and electric vehicles. The distribution across various categories is detailed below:

Figure 1: Registered Vehicles in Telangana Across Categories¹



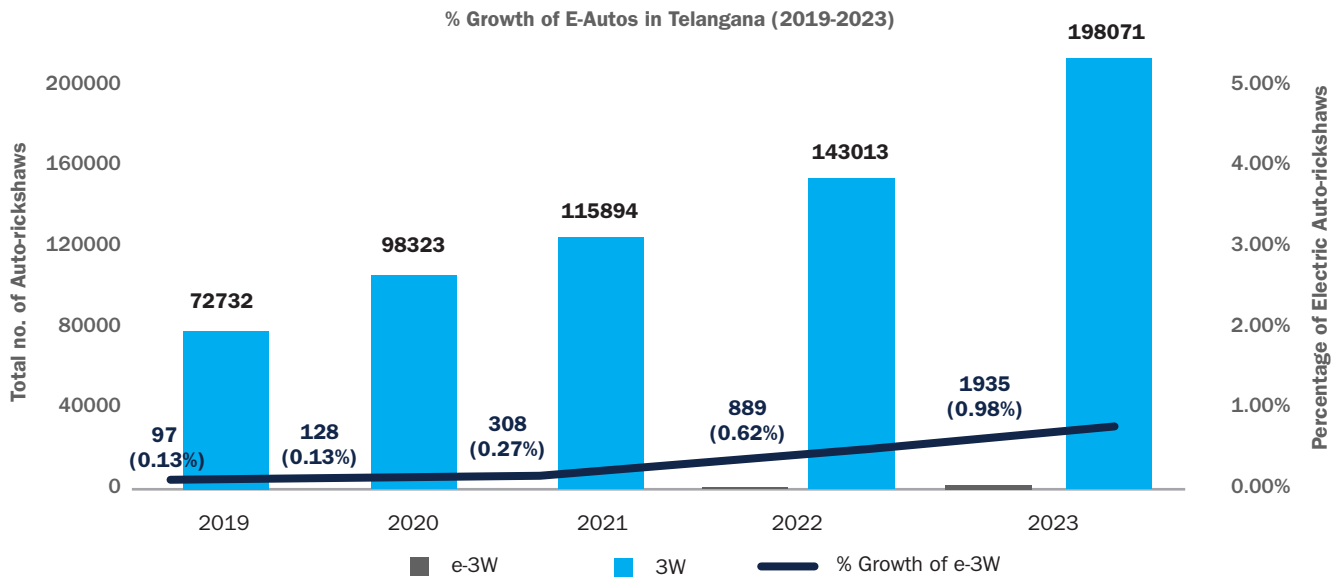
Of the total registered vehicles, Telangana currently boasts approximately 1,07,078 electric light-duty vehicles. The following table shows the percentage distribution of electric vehicles across various categories.²

Table 1: Electric Vehicles Strength in Telangana³

2 Wheelers	Personal 4 Wheelers	Auto Rickshaws	Others (cabs, light goods carrier)
87%	7%	1%	5%

Three-wheeler autorickshaws operate on diverse fuel types including battery, petrol, diesel, CNG, LPG, and hybrid combinations such as CNG-petrol, petrol-electric, and petrol-LPG, as well as diesel-LPG. These autorickshaws typically accommodate between 3 to 7 passengers. According to the Road Transport Authority (RTA) of Telangana, as of November 2023, autorickshaws make up 3% of the total vehicle count in the state. Of all autorickshaw registrations recorded in Telangana between 2019 and 2023, merely 0.92% are electric -powered.⁴

Figure 2: Sales of Electric Auto-Rickshaws as a Percentage of Total Auto-Rickshaws in Telangana (2019-2023)⁵



1.2 REGULATORY PROCESS FOR VEHICLE RETROFITMENT IN TELANGANA

The Transport Department of the Government of Telangana oversees vehicle registration and permits, including those for retrofitted vehicles, in accordance with section 213 of the Motor Vehicle Act, 1988 with following to the regulatory framework established by the Motor Vehicle Act, 1988, Telangana Motor Vehicles Taxation Act 1963, and associated rules, the department ensures adherence to prescribed regulations.

Under Memo.No.1812/Tr.I(1)/2021; dt: 17.05.2021, the Government of Telangana has issued guidelines for the implementation of the EV policy concerning new and retrofitted e-autorickshaws. These guidelines delineate the roles and responsibilities for retrofitment of autorickshaws by the Road Transport Authority (RTA) and the Government of Telangana.

Responsibility of Retrofitment Service Provider:

Manufacturers of retrofitment kits are required to register with the Transport Department, Government of Telangana. This

process involves submitting a “type approval” certificate from an authorized testing agency and payment of the requisite fee. Upon approval, the manufacturer is provided with login credentials for the Citizen Friendly Services Telangana (CFST) portal, where they can enter details of their inventory, including model name and kit number/serial number.⁶

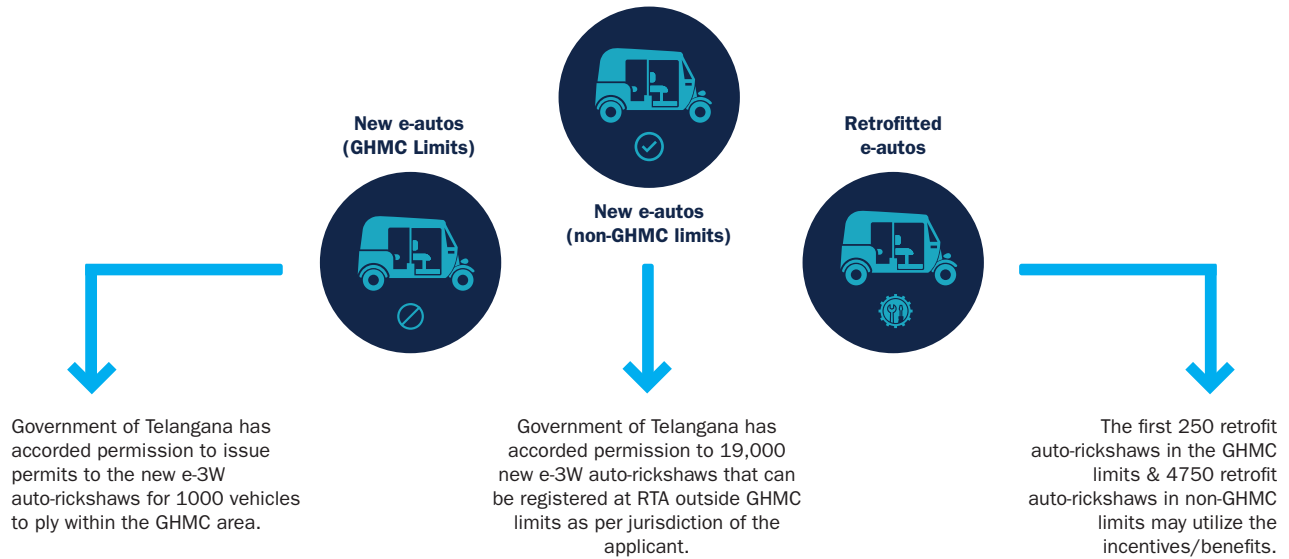
Authorickshaw Owner: ICE-auto owners seeking retrofitment must book a slot through the transport department portal and present their vehicle, fitted with the company retrofitment kit, to the designated Regional Transport Office (RTO) on the scheduled date and time. The vehicle undergoes inspection, during which the inspecting authority selects the appropriate make and serial number of the retrofitment kit from the CFST portal’s master list. Upon approval, the counter clerk and administrative officer verify the details and process the application, issuing a new registration certificate (RC) with the same registration number, now marked with a green number plate, to the vehicle owner.⁷

Permits and New RC Acquisition Process for Retrofitted

Vehicles: There are no restrictions on the number of existing permitted ICE autos that can undergo retrofitting within the Greater Hyderabad Municipal Corporation (GHMC) limits.

However, only the initial 250 retrofitted autos within GHMC limits are eligible for incentives provided by the Government of Telangana, as stipulated in the Telangana Electric Vehicle (EV) Policy.⁸

Figure 3: Distribution of Permits for New Electric and Retrofitted Autos within GHMC and Non-GHMC Limits



To obtain a new Registration Certificate for a retrofitted vehicle, the driver partner must follow an online booking process and submit the required documents. The vehicle owner must pay a registration fee of INR 1000 and an alteration/retrofitment fee of INR 1000 to the RTA, Government of Telangana, to avail a new registration certificate for the retrofitted autorickshaw.⁹

Applicants must provide the following details:

- Bank account number, bank name, branch name, and IFSC code;
- Invoice amount of the retrofitment, including the cost of the kit, battery, other required accessories, and labor charges; and
- Proof of Address.

Additionally, the owner must upload the following documents:

- Invoice copy of the retrofitment, detailing the cost of the kit, battery, other required accessories, and labor charges;
- Bank passbook or cancelled cheque of the registered owner of the vehicle; and
- Proof of Address as per Rule 4 of the Central Motor Vehicles Rules, 1989.



REVOLUTIONIZING THREE-WHEELER RETROFITMENT: THE JOURNEY OF ZERO 21

Zero 21, a prominent player in the three-wheeler retrofitment space based out of Hyderabad, has embarked on a transformative journey aimed at converting ICE vehicles to electric. Zero 21 has successfully retrofitted over 46 three-wheeler auto-rickshaws, collectively traveled more than 14,000 kilometers. Taking a technology-agnostic approach, Zero 21 provides retrofitment kits offering both fixed and swappable battery options. The vehicles retrofitted by Zero 21 in Telangana and across India have an average original registration date of 2009. The retrofitment has significantly improved driver experience by eliminating the need for frequent gear changes, reducing body vibrations, and extending vehicle lifespan. Moreover, operational cost savings and health benefits have contributed to overall driver satisfaction and acceptance of retrofitted vehicles.



ADDRESSING DRIVER CONCERNS: EXTENDING WARRANTY AND SERVICE SUPPORT BEYOND THE WARRANTY PERIOD

To address driver concerns about warranty and service support for retrofitted vehicles, Zero 21 offers battery and motor replacement if they are not functioning correctly. Otherwise, driver partners continue to utilize them for as long as possible. Typically, customers receive up to 18% to 20% of the new battery's cost back when exchanging an old battery. In response to apprehensions from auto drivers and owners regarding the converted vehicle's performance, Zero 21 pledges to provide 3 to 5 years of warranty and service support based on mutual agreement.



HOW POLICY & FINANCE CAN MAKE THE COST STRUCTURE A LUCRATIVE VALUE PROPOSITION FOR THE DRIVER PARTNER

Primary challenges hindering the retrofitment industry's growth include permit costs, particularly in regions like Telangana, where permits can exceed INR 2 lakhs per vehicle. This financial barrier discourages owners and drivers from embracing retrofitment, representing a significant obstacle to industry expansion. For instance, fleet operators have also shown interest in 3W

retrofitment opportunities, however concerns regarding permits and financing have impeded the integration of retrofitted vehicles into their fleets. Besides permits, financing stands as the second significant barrier.

Zero 21's retrofit kits are priced at INR 65,000 plus GST (5%) alongside additional costs for batteries and transportation. While national and state-level policies and financial incentives could significantly improve cost economics, here incentives up to INR 25,000 per vehicle can prove to be game changing. Zero 21 advocates for the involvement of development financial institutions in supporting the retrofitment ecosystem. They suggest revising loan criteria to prioritize vehicle ownership over credit scores and offering concessional interest rates to mitigate financial risks associated with retrofitment projects. Support from institutions like SIDBI, nationalized banks, and NBFCs, with streamlined registration processes and reduced permit costs could accelerate adoption without solely relying on incentives.



ADVANCING RETROFITMENT SOLUTIONS: ECOSYSTEM-LEVEL INTERVENTIONS AND INITIATIVES BY ZERO 21

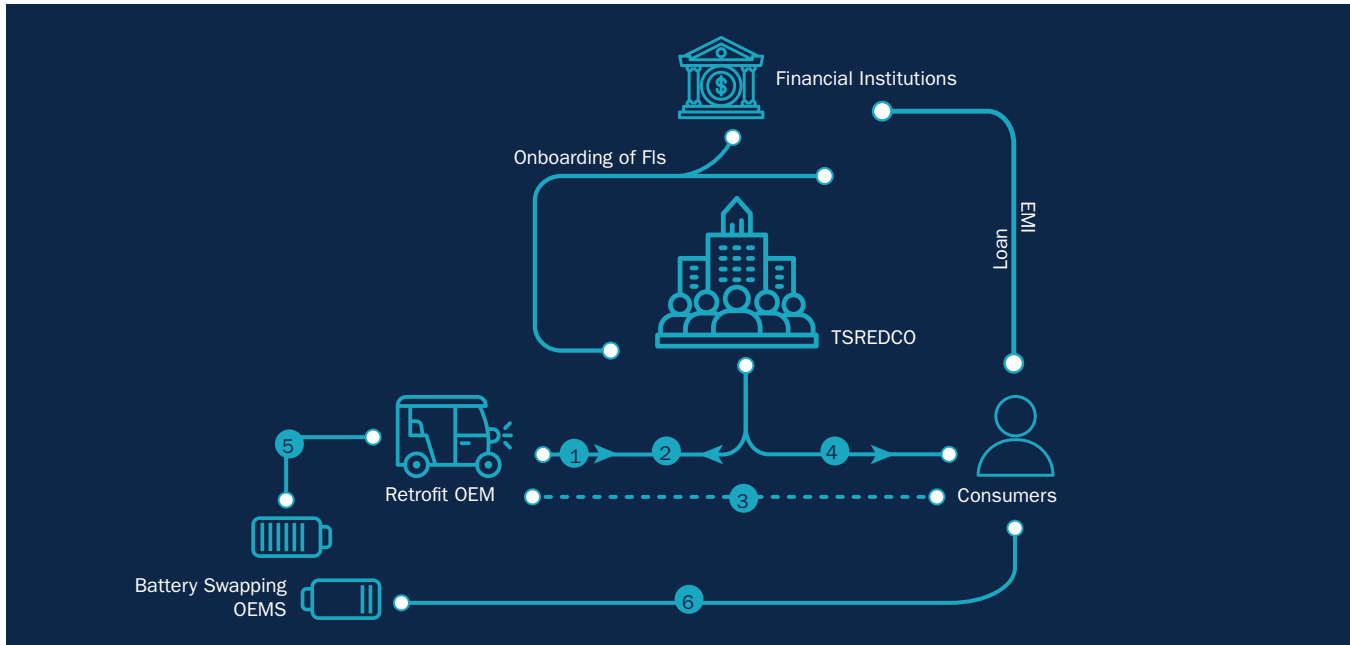
To scale retrofitment efforts, Zero 21 proposes several interventions. These include providing warranties and guarantees for converted vehicles, implementing innovative financing solutions, leveraging subsidies from various sources, and raising awareness about the benefits of conversion kits through targeted campaigns and initiatives like "RE-NEW" and "Drive Differently."

To instill confidence in financiers to invest in this technology, Zero 21 has developed a software solution capable of managing vehicle operations and charging based on payment status. This system offers the option to "Immobilize" or "Mobilize" vehicles depending on the receipt of EMIs, allowing driver partners to utilize the vehicle as long as they maintain their payment schedule. On the financing front, the establishment of a state-level risk-sharing ability and the implementation of concessional interest rates can bridge the gap and support the financing of retrofitment projects.

1.3 ENABLING SCALED UP PILOTS: A FRAMEWORK FOR TELANGANA

Based on consultations with various departments and nodal agencies in Telangana, an optimal business model was devised, outlining the functions of each department.

Figure 4: Potential Approach for Structuring Pilot



As a pivotal government stakeholder, the Telangana State Renewable Energy Development Corporation (TSREDCO) can act as the central agency for overseeing the pilot implementation. TSREDCO can adopt a strategy of enlisting various retrofit OEMs via a tendering process and evaluating the supply-side market for retrofit kits based on the interests and capacities of existing retrofit players. The below section outlines key steps and a potential approach to operationalize pilots:

- **Empanelment Criteria for Retrofit OEMs:** To ensure robust after-sales service to auto drivers, TSREDCO, in collaboration with Transport department/RTO, should establish stringent criteria for empanelment. This includes requiring retrofit service providers to offer comprehensive warranties covering kits and battery packs for a minimum of three years. Additionally, service providers can operate dedicated retrofitment service centers to be eligible for any incentives.
- **Tendering Process and Cost Reduction:** Following empanelment, TSREDCO can consider initiating a tendering process to procure retrofit kits. Tender documents should delineate kit specifications, required quantity, and additional criteria. TSREDCO should procure retrofit kits from chosen OEMs through a competitive tendering procedure, ensuring transparency

and equity in supplier selection while fostering market competitiveness. Such a process on account of economies of scale would also enable TSREDCO to significantly reduce overall costs. This cost-saving advantage, coupled with retrofitting subsidies, can be passed on to drivers, thereby making the transition to e-3Ws more economically viable.

- **Selection of OEMs and Awarding Tenders:** TSREDCO should meticulously select and award tenders to OEMs for the procurement of retrofit kits. Selected OEMs must meet stringent criteria, including certification, after-sales support, and servicing capabilities.
- **Vehicle Retrofitting Process:** Drivers/owners can select their desired OEM from the empaneled list to retrofit their ICE auto-rickshaws with electric propulsion kits.
- **Subsidies and Financing:** As per the Telangana Electric Vehicle & Energy Storage Policy 2020-2030, TSREDCO, as the nodal agency for retrofitment, is mandated to provide subsidies of INR 15,000 per auto retrofit kit to customers. To further incentivize retrofitment, TSREDCO can consider increasing the subsidy to INR 25,000 which can reduce the upfront cost of retrofitment kit by 12-17%, acting as a substantial incentive for auto owners, encouraging them to opt for retrofitment. Additionally,

TSREDCO can consider collaborating with financial institutions to offer affordable financing options to customers, facilitating easier adoption of retrofitment solutions. Further the state can tap into the funds allocated under National Clean Air Programme wherein about INR 463 crores was allocated to “non-attainment” cities in the state, including Hyderabad, Nalgonda, Patancheruvu, and Sangareddy, of which about INR 93 crores remain unspent.¹⁰

➤ **Ensure Level Playing Field for Fixed & Swappable Battery Technology:** TSREDCO can also consider promoting collaborations between battery swapping providers and retrofit OEMs to reduce the upfront costs associated with fixed battery model. Through such partnerships, swappable batteries can be made accessible to autos equipped with battery-swappable capabilities.

Figure 5: Proposed Structure of the Pilot in Telangana

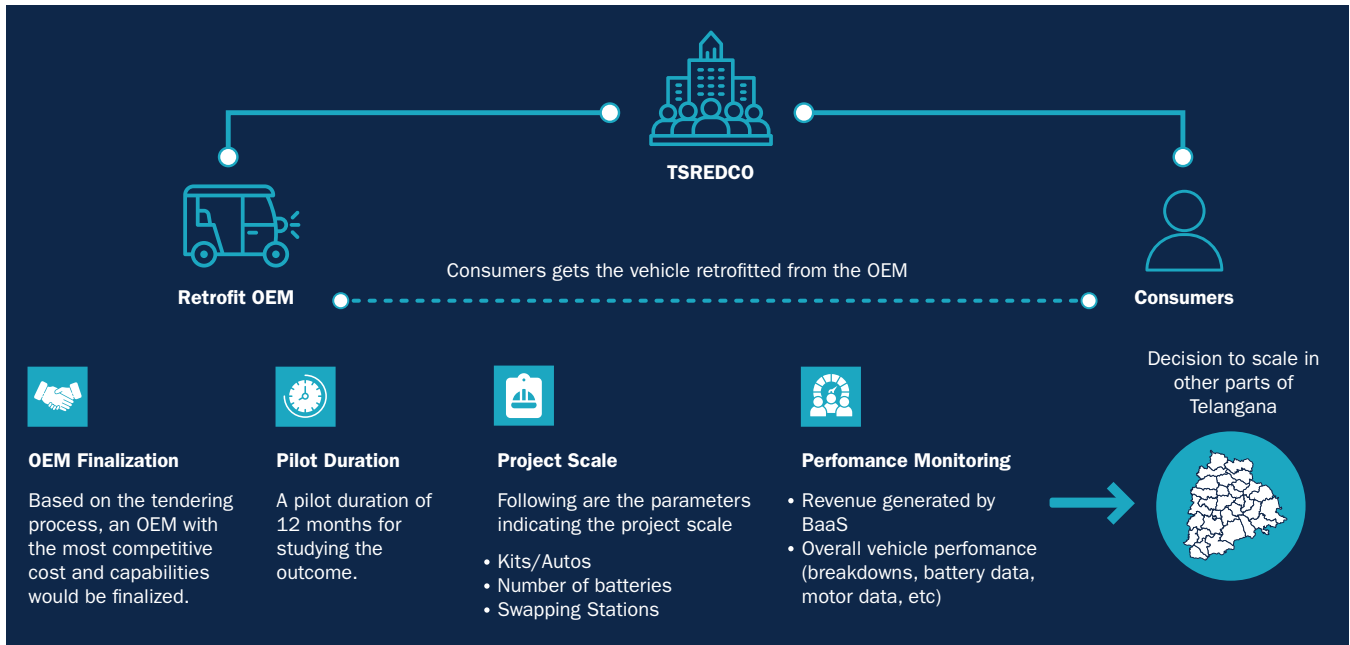
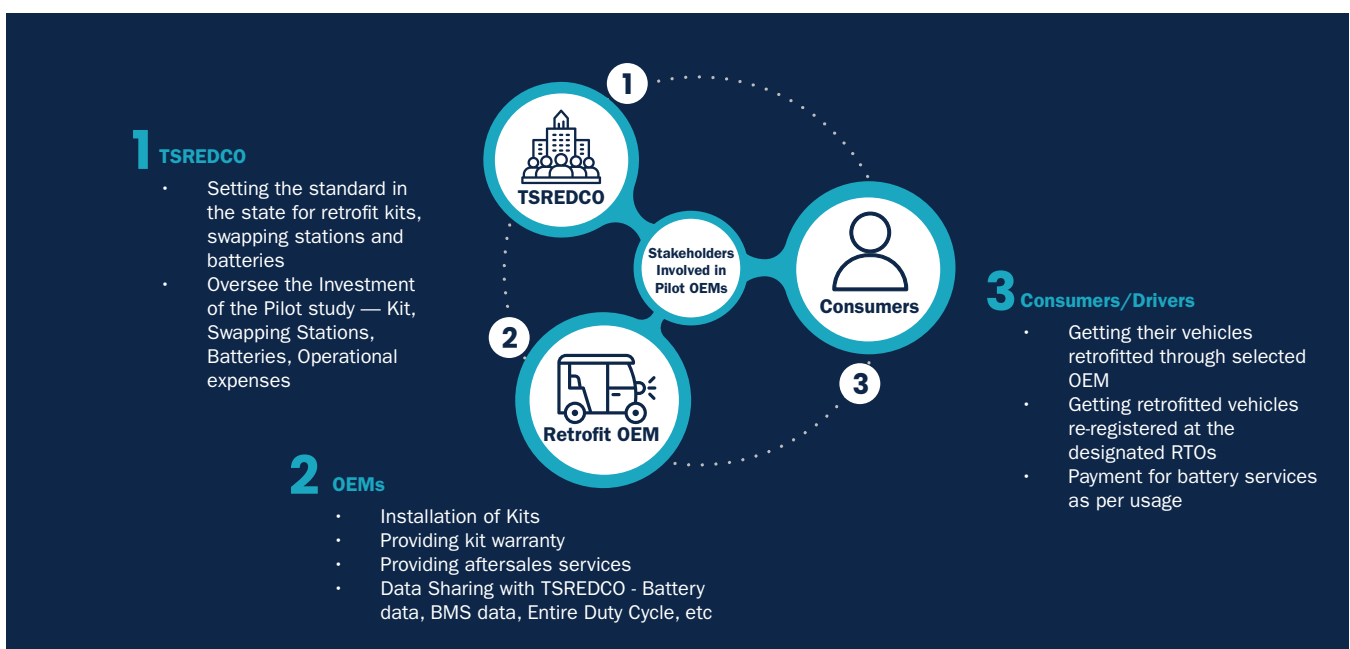


Figure 6: Roles and Responsibilities of Stakeholders Involved in the Pilot

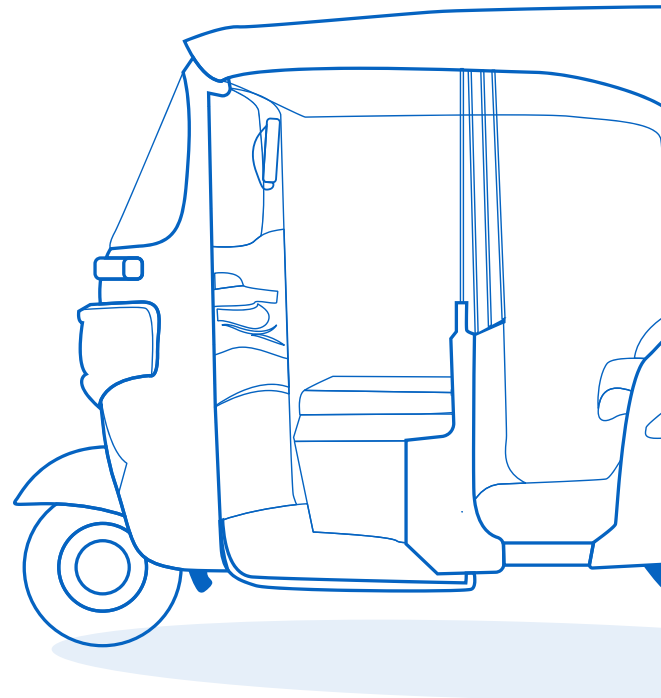


Conclusion



As the pioneer in recognizing and including incentives for retrofitting three-wheeler passenger auto-rickshaws in its EV policy, Telangana has set an example for many other states to follow. The state holds a first-mover advantage with 70% of retrofit kit manufacturers based out of Hyderabad, supplying kits across the country. However, the modest EV penetration of 0.92% in the 3W segment indicates that the benefits of this incentive are not yet fully realized.

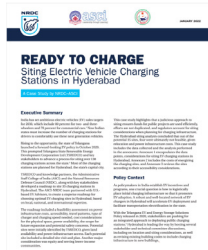
This case study encapsulates the framework for operationalizing the retrofit ecosystem in the state of Telangana. To cultivate an enabling ecosystem for retrofitting ICE 3-wheelers to electric vehicles, Telangana should prioritize fiscal incentives, streamline state processes (including incentive disbursement), facilitate affordable financing, and address regulatory challenges related to permits and registration. It is crucial to ensure a level playing field for both fixed and swappable battery models, integrating them into the incentive structure to foster inclusivity in the retrofit ecosystem. Through concerted efforts and collaborative action, the proposed framework for Telangana can serve as a guiding beacon for other states, propelling the nation towards a sustainable and electrified future in the transportation sector.



References

- 1 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 2 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 3 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 4 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 5 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 6 CFST, <https://www.transport.telangana.gov.in/html/citizens-charter.html> (accessed on April, 2024)
- 7 SIAM, 2023, ELV Recycling, Status of Circular Economy in India. <https://www.siam.in/uploads/filemanager/377ChakriyaContextPaper.pdf>
- 8 Consultations with Telangana state RTO
- 9 Source: RTA Telangana
- 10 Telangana fails to utilise Rs 73 crore from central funds for 'clean air', <https://timesofindia.indiatimes.com/city/hyderabad/t-fails-to-utilise-73cr-from-central-funds-for-clean-air/articleshow/107540365.cms> (accessed on April, 2024)

Highlighted Reports



Ready to Charge
Siting Electric Vehicle
Charging Stations in
Hyderabad



How to Manual
Siting Electric Vehicle
Charging Stations in
India



**Plugging into a
Clean Energy Future:**
Effective Deployment
of Telangana's Electric
Vehicle Policy



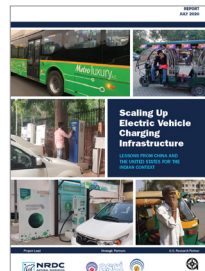
**Transitioning to
Electric Mobility in
Gujarat: Impacts and
Benefits - Report**



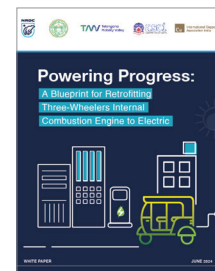
Energizing Freight:
Policy Toolkit
for Medium and
Heavy-Duty Truck
Electrification in
India



Location Is Everything:
Approaches to Siting
Electric Vehicle
Charging Infrastructure
for the Indian Context -
Issue Brief



**Scaling up Electric
Vehicle Charging
Infrastructure -
Report**



Powering Progress:
A Blueprint for
Retrofitting Three-
Wheelers Internal
Combustion Engine to
Electric



Copyright © 2024 Natural Resources
Defense Council

All rights reserved. No part of this publication
may be reproduced, stored in a retrieval
system or transmitted, in any form or by any
means, electronic, mechanical, photocopying,
recording or otherwise, without prior
permission