Shimla city wide EV Demand Planning and EVCI Network Plan 2025-35

September 2024

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Convergence Energy Services Limited

HPDT
DEPARTMENT OF TRANSPORT

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Acknowledgement

We express our deepest gratitude to all those who have contributed to the fruition of this project, which aims to catalyse the integration and expansion of Electric Vehicles (EVs) and Electric Vehicle Charging Infrastructure (EVCI) across select cities in India. This endeavour has been made possible through the collaborative efforts of Convergence Energy Services Limited (CESL) and Ernst & Young LLP supported by Asian Development Bank (ADB).

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Foreword

As India makes significant commitments to combat climate change during COP26, Shimla's unique blend of culture heritage and vibrant spirit positions as a pioneer in Himachal Pradesh, spearheading the transition towards sustainable transportation. Shimla, with its breath-taking landscapes and rich cultural heritage, stands as a symbol of both tradition and progress. As one of the leading destinations in Himachal Pradesh, Shimla is uniquely positioned to drive the adoption of sustainable transportation solutions, making it an ideal location for promoting green and electric mobility.

The shift to electric mobility not only reduces emissions and pollution but also gives opportunities to various manufacturers and operators to set up businesses in the state. Through careful planning and collaboration with various stakeholders, we are leading the way toward a more environmentally friendly and sustainable transportation future. Given Shimla's unique geographical placement and topographic features, it is an ideal setting to demonstrate how modern technology can integrate with the city's endless grace.

As we stand at the threshold of a new era in transportation, the development of Electric Vehicle Charging Infrastructure (EVCI) is not just a technological advancement, but a crucial step toward a sustainable future. This report highlights our commitment to building a robust and accessible EVCI network that will pave the way for widespread electric vehicle adoption. By investing in this infrastructure, we are not only addressing today's environmental challenges but also setting the foundation for a cleaner, greener tomorrow. This report serves as a testament to our collective efforts and vision for a more sustainable world.

I am confident that this initiative from Department of Transport, Himachal Pradesh will significantly promote electric mobility in Shimla. Through deep analysis, proactive measures, and unwavering dedication, we are laying the foundation for a transportation revolution that will benefit our city and beyond. Let us embark together on this journey toward a cleaner, greener, and sustainable transportation in future.

D.C. Negi
Director Transport

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ABBREVIATIONS

2W	Two-wheeler
4Wp	Four-wheeler private
4Wc	Four-wheeler commercial
AC	Alternating Current
ACC	Advanced Chemistry Cell
ACoS	Average Cost of Supply
ADB	Asian Development Bank
AFC	Automated Fare Collection
BC	Before Christ
BCE	Before the Common Era
BEE	Bureau of Energy Efficiency
BEV	Battery Electric Vehicles
BSS	Battery Swapping Station
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditures
CCS	Combined Charging System
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CESL	Convergence Energy Services Limited
CNA	City Nodal Agencies
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
COP	Conference of the Parties
CPO	Charge Point Operators
DC	Direct Current
DHI	Department of Heavy Industries
DISCOMS	Distribution Companies
E2W	Electric 2-Wheeler
E3W	Electric 3-Wheeler
E4W (p/c)	Electric 4-Wheeler (private / commercial)
E-Bus	Electric Bus
EESL	Energy Efficiency Services Limited
EoI	Expression of Interest
EV	Electric Vehicles
EVCI	Electric Vehicles Charging Infrastructure
EVSE	Electric Vehicle Supply Equipment
EWCD	Elderly, Women, Children, and Disabled
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FI	Financial Institutions
FY	Financial Year
GCC	Gross Cost Contract
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIS	Geographic Information Systems
GoI	Government of India
ha	Hectare
HP	Himachal Pradesh
HPSEBL	Himachal Pradesh State Electricity Board Ltd
HRTC	Himachal Pradesh Road Transport Corporation
ICE	Internal Combustion Engine
IFI	International Financial Institutions
IT	Information Technology
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
kms	Kilometres
kW	Kilo-Watt
kWh	Kilo-Watt Hours
LLP	Limited Liability Party
LoA	Land Owning Agency
m	metres
MHI&PE	Ministry of Heavy Industries and Public Enterprises
MIS	Management Information System
mm	Millimetre
MNRE	Ministry of New and Renewable Energy

MoEF&CC	Ministry of Environment, Forest, and Climate Change
MOEFCC	Ministry of Environment, Forest, and Climate Change
MoF	Ministry of Finance
MoHI&PE	Ministry of Heavy Industries and Public Enterprises
MoHUA	Ministry of Housing and Urban Affairs
MOP	Ministry of Power
MoPNG	Ministry of Petroleum and Natural Gas
MoRTH	Ministry of Road Transport & Highways
MoST	Ministry of Science & Technology
MoU	Memorandum of Understanding
MSME	Ministry of Micro, Small & Medium Enterprises
MW	Mega Watt
MWh	Mega-Watt hours
NBEM	National Board for Electric Mobility
NBFC	Non-Banking Financial Companies
NCEM	National Council for Electric Mobility
NEMMP	National Electric Mobility Mission Plan
NH	National Highway
NHAI	National Highway Authority of India
NHPC	National Hydroelectric Power Corporation
NITI Aayog	National Institution for Transforming India
OEM	Original Equipment Manufacturer
OMC	Oil Marketing Companies
PCS	Public Charging Stations
PCU	Passenger Car Unit
PLI	Production Linked Incentive
PM	Particulate Matter
POI	Point of Interest
PPP	Public-Private Partnership
PSU	Public Sector Undertaking
R&D	Research & Development
R&M	Repair and Maintenance
RCC	Reinforced Cement Concrete
RDAs/UDAs	Regional/Urban Development Authorities
RE	Renewable Energy
ROI	Return on Investments
RTO	Regional Transport Office
RWA	Resident Welfare Association
SCM	Smart City Mission
SECI	Solar Energy Corporation of India Limited
SGST	State Goods and Services Tax
SMC	Shimla Municipal Corporation
SNA	State Nodal Agencies
sq.km.	Square Kilometre
SSCL	Shimla Smart City Limited
STU - P	State Transmission Utility
STU - T	State Transport Undertaking (Transport)
SWM	Solid Waste Management
TCO	Total Cost of Ownership
tCO_2	Total Carbon dioxide
UAs	Urban Agglomerations
UK	United Kingdom
ULBs	Urban Local Bodies
US	United States
UT	Union Territory
V2G	Vehicle-to-Grid
VAHAN	Vehicle in Sanskrit
('000)	in thousands
(E)	Estimated
°C	degree Celsius
°F	Degree Fahrenheit

Executive summary

During the COP26 climate summit, India, as one of the 42 participating leaders, supported the UK's Glasgow commitments and took on the role of co-convener for the Glasgow breakthrough on road transport, alongside the UK and the US. India made pledges to achieve net-zero emissions by 2070 and to decrease emission intensity by 45% from 2005 levels by 2030.

With India ranking as the fifth largest vehicle market globally, there are substantial opportunities for the adoption of electric vehicles (EVs). The establishment of public electric vehicle charging infrastructure (EVCI) is crucial in advancing Himachal Pradesh's (HP) shift towards sustainable transportation. A well-developed public charging network addresses concerns regarding range anxiety, a primary obstacle to EV uptake, by offering convenient and accessible charging facilities for EV owners.

As Himachal Pradesh implements policies to encourage EVs, Shimla can emerge as a leading city, inspiring other urban centers in the state to follow its example. Shimla holds significant importance in Himachal Pradesh's transition towards sustainable transportation for several reasons. As the capital city and a popular tourist destination, Shimla symbolizes the harmonious blend of modern advancements with natural beauty and colonial charm. By leading the way in the adoption of electric vehicles (EVs), Shimla can demonstrate the seamless integration of sustainable practices with the city's scenic and historical allure.

Shimla's distinctive geography and demographics make it an ideal location for testing EV infrastructure. As the capital city of Himachal Pradesh and a former summer capital of British India, Shimla's relatively compact size facilitates the establishment of an efficient public charging network, addressing concerns about range anxiety and promoting EV adoption. Additionally, Shimla's status as a major tourist destination attracts a diverse array of visitors, providing an opportunity to showcase the convenience and accessibility of EV charging facilities to a broad cross-section of the population.

The Transport Department of Himachal Pradesh is taking a proactive stance in addressing the pressing challenges confronting the city's transportation sector. With escalating pollution levels, growing energy demands, and the urgent need to combat climate change, EVs offer a promising avenue for cleaner mobility.

The Transport Department is spearheading a comprehensive initiative aimed at overcoming these barriers. Through meticulous market segmentation, sizing, and feasibility analysis, this initiative seeks to identify promising markets and assess the viability of EV deployment within Shimla.

Furthermore, by evaluating the city's charging infrastructure requirements, the Transport Department is laying the groundwork for the seamless integration of EVs into Shimla's transportation ecosystem. Through collaboration with key stakeholders and leveraging its resources and expertise, the department is driving meaningful change towards a greener and more sustainable transportation landscape in the city.

Demography:

Shimla, the capital of Himachal Pradesh, sits at an average elevation of 2,397.59 meters and has a rich history dating back to the early 19th century, notably serving as the British summer capital from 1864. With a warm temperate climate, it experiences average annual temperatures of 13.7°C and rainfall of 67.3 inches. Shimla's economy relies heavily on government services, agriculture, and tourism, employing significant portions of the workforce. As a major tourist destination, it attracted 2.57 million visitors in 2022, primarily domestic. The city's urban growth is shaped by its location on seven hill spurs, presenting challenges in managing water supply, waste disposal, and mobility. The transport

department is focusing on renewable energy solutions to address these issues. Shimla's population was 1,69,578 in 2011, with a projected increase to 2,89,000 by 2031, and a current population density of 4,197 people per square kilometer.

Key Government Stakeholders:

The city will have to strategically implement citywide EV charging stations and develop infrastructure for electric vehicles, enhancing accessibility and viability for electric transportation. Policy advocacy efforts will be bolstered through partnerships to offer incentives and regulations for EV adoption, while public awareness campaigns and educational initiatives will highlight the environmental and economic benefits of e-mobility. Fleet electrification, partnership collaborations, and monitoring mechanisms will further propel the city towards its goal. Integration of technology, pilot projects. Shimla's commitment to safety, compliance, and grid integration ensures a robust and sustainable e-mobility ecosystem, positioning the city as a model for sustainable urban transportation in the region.

Existing Transportation in Shimla:

The growth rate of different vehicle categories in Shimla from FY 2015 to FY 2024 reveals varied trends: two-wheelers grew at 3.54%, private four-wheelers at 5.75%, commercial four-wheelers at 5.87%, and buses saw the highest growth at 11.96%. In terms of EV penetration as of 2023, the rates remain modest across most categories: two-wheelers at 0.91%, private four-wheelers at 0.81%, and commercial four-wheelers at 0%. Notably, buses have a significant EV penetration rate of 12.15%, reflecting a substantial shift towards electrification in public transport.

Policy Framework:

The adoption of e-mobility as a sustainable transportation alternative is gaining momentum worldwide, prompting governments to develop frameworks and regulations. In India, the Ministry of Power (MoP) and the Department of Heavy Industries (DHI) are central to this transition, focusing on establishing widespread charging infrastructure and incentive programs. Designation of the Bureau of Energy Efficiency (BEE) as the Central Nodal Agency (CNA) underscores India's commitment to EV adoption. State Nodal Agencies (SNA) are also engaged in establishing supportive ecosystems. Various governmental bodies are formulating and implementing policies to promote EV proliferation, reflecting a collective determination to steer transportation towards sustainability and mitigate climate change impacts.

Himachal Pradesh's EV policy aims to promote electric vehicle adoption and reduce environmental impact through a comprehensive set of incentives and regulations. The policy includes subsidies for EV purchases, tax exemptions, and financial support for setting up charging infrastructure. It targets increased EV registrations by providing benefits to both buyers and manufacturers and focuses on expanding the state's charging network to address

range anxiety. Additionally, the policy encourages local production of EV components and infrastructure development, with a vision to position Himachal Pradesh as a leader in sustainable transportation.

Market Assessment:

EV Sales projections:

Vehicle category	EV penetration rate		EV Sales	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
e-2W	18% - 20%	33% - 35%	185 – 195	390 – 400
e-4W (private)	8% - 10%	18% - 20%	255 – 265	690 – 700
e-4W (commercial)	12% - 15%	23% - 25%	170 – 180	380 – 390
e-bus	45% - 50%	75% - 80%	10 - 15	50 - 55

Power Projections:

Vehicle category	Volume		Total Power Demand (MW)	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
e-2W	648 – 650	2,185 – 2,190	0.3 – 0.5	1.0 – 1.5
e-4W (private)	843 - 845	3,330 – 3,350	2.5 – 3.0	10.5 – 11.0
e-4W (commercial)	565 – 568	2,035 – 2,038	6.0 – 6.5	22.0 – 23.0
e-bus	60 - 65	240 - 245	6.0 – 6.5	24.0 – 26.0
Total	**2,120 – 2,130**	**7,790 – 7,800**	**15 - 18**	**57 - 60**

Additional power demand due to tourist four-wheeler (commercial) vehicles and electrification of Solid Waste Management vehicles

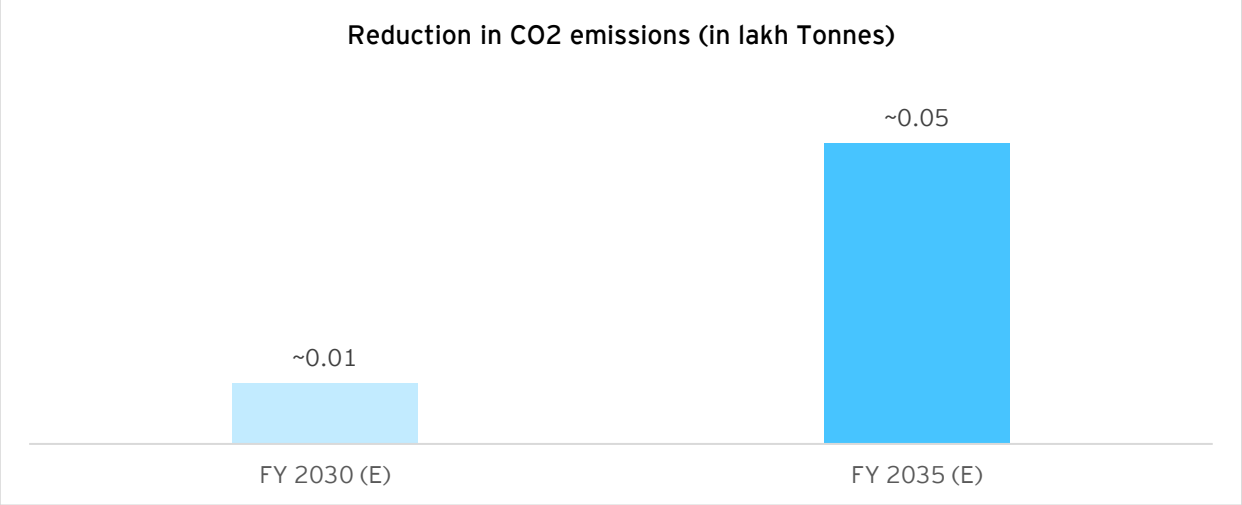
Vehicle category	Numbers		Total Power Demand (MW)	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
SWM vehicles (EV volume)	120 - 125	350 - 360	0.1 – 0.2	0.3 – 0.4
Tourist 4W Vehicle (EV influx '000)	17 – 18	45 - 46	2.5 – 3.0	7.0 – 7.5

Total number of chargers required by 2030 and 2035

Charger Rated Capacity	kW	Total Number of charger required by 2030	Total Number of charger required by 2035
LEV AC	10 (3*3.3)	6	11
IS-17017-2-6	7	6	11
CCS II	50	14	33
CCS II	180	10	18
Total		**36**	**73**

Impact on GHG emissions

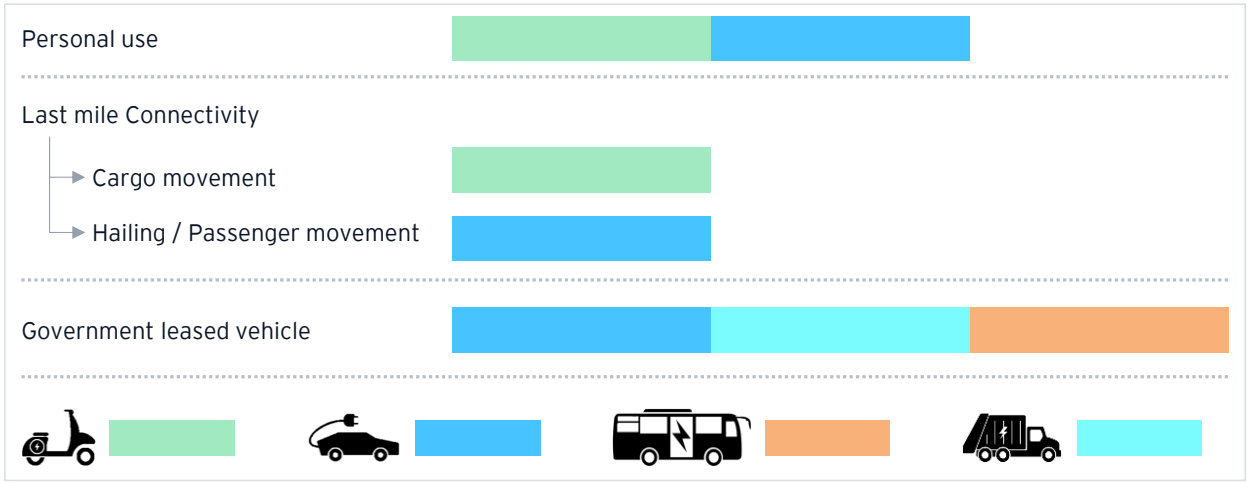
The link between decarbonization and the evolving vehicle landscape in Shimla is clear and significant. Projections indicate that the transition from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) could lead to a reduction in emissions ranging from 0.005 to 0.01 lakh tonnes by FY 2030. This noteworthy estimate is poised to experience a significant upsurge by FY 2035, culminating in a remarkable reduction in CO_2 emissions spanning from 0.03 lakh to 0.05 lakh tons.



Primary consultation with city level EV stakeholders:

In Shimla, the transport sector faces several challenges: four-wheeler sales average 800 annually, while two-wheeler sales are around 350, and EV registrations for four-wheelers are about 100. Service infrastructure for EVs is limited, and 30% of dealerships are hesitant to stock them despite government subsidies. Traditional motorbikes remain popular due to their performance on steep slopes. Parking regulations cause delays in vehicle registration, while e-bus drivers report satisfaction with route planning but seek better clearance and faster maintenance. Fleet operators are eager to switch to EVs but struggle with inadequate charging infrastructure and complex subsidy processes.

Use cases of different vehicle segments:



Role of STU in fleet electrification for intracity bus movement:

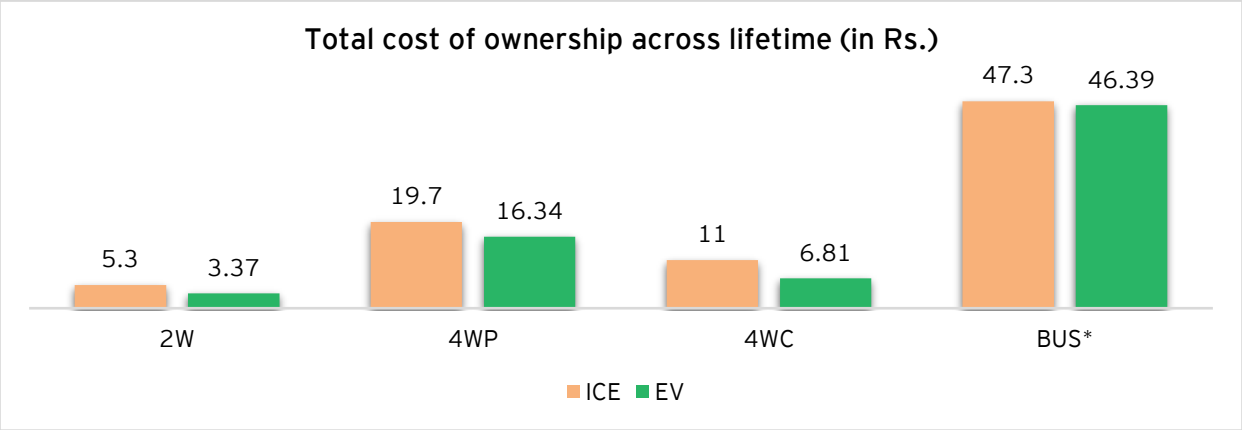
The Himachal Road Transport Corporation (HRTC) operates a fleet of 214 buses in Shimla, consisting of 146 internal combustion engine (ICE) buses and 68 electric vehicles (EVs). The shift towards EVs reflects a commitment to sustainable transport, supported by the Fame I and Fame II schemes. EV buses are procured in phases, with earnings of approximately Rs. 30 per kilometer and an average daily range of 80 to 100 kilometers. Charging infrastructure includes multiple operational chargers at the Old Bus Stand and a partially functional 120 KWh charger at Tutti Kandi, with a new facility under development. EVs do not top up mid-route due to impracticality, but a dual gun charger at Tutti Kandi enhances efficiency by allowing simultaneous charging. This mixed fleet approach balances environmental goals with operational needs, paving the way for greener public transport.

Business Model Analysis:

Government-leased vehicles in India use different procurement models: Wet Lease provides vehicles along with staff and maintenance, while Dry Lease only provides vehicles, leaving operations and upkeep to the lessee. The National E-Mobility Programme, led by CESL, aims to convert government fleets to electric vehicles, having procured 10,000 EVs and installed 256 chargers across 42 cities. City buses can be procured through Outright Purchase for long-term control or Gross Cost Contract, where a private operator manages the service. The PM e-bus Sewa scheme invests Rs. 57,613 crores to integrate electric buses into urban transport, focusing on infrastructure and pollution reduction in cities with over three lakh people.

Estimating Total Cost of Ownership:

The Total Cost of Ownership (TCO) of a vehicle encompasses all expenses from purchase to disposal, including purchase price, depreciation, fuel costs, maintenance, insurance, and financing fees. It guides decision-making by analysing factors such as **purchase price, depreciation, fuel efficiency, maintenance, insurance premiums, and financing costs.** Electric vehicles are cost effective in all segments of vehicle category, as demonstrated below.



**Subsidy for buses is not considered while estimating cost*

EV Charging Infrastructure:

Himachal Pradesh is advancing EV adoption with a detailed infrastructure plan. The state will install charging stations within every 1 km² grid in Mandi, Baddi, Shimla, and Dharamshala, and along highways at 25 km intervals on state roads and 50 km on national roads. A single-window system will streamline charger installation and permissions. The state will develop infrastructure under the PLI Scheme for ACC Battery Storage and allocate 100 to 200 acres for EV parks. HPSEBL will set charging tariffs. In hilly areas, charging stations will be strategically placed, weather-resistant, and powered by renewable sources, with collaboration from various stakeholders to ensure functionality and accessibility.

Potential Business Model for development of EVCI for fleet adoption:

Public charging infrastructure is essential for widespread electric mobility adoption. To promote EV awareness and alleviate range anxiety, affordable and accessible charging networks are crucial. In Shimla, the Land-owning Agency (LoA), such as Shimla Municipal Corporation or Shimla Smart City Limited, plays a pivotal role in deploying Electric Vehicle Charging Infrastructure (EVCI). Various government bodies can serve as the LoA. Different implementation models, including capital expenditure for charging equipment and land provision, are utilized for setting up public charging infrastructure.

LoA own and operate	LoA owns assets and operates on own land
PPP	CPO owns the assets and operates on land provided by LoA
CPO	LoA as CPO owns and operates assets, uses land by different player

Renewable energy integration:

Integrating Renewable Energy (RE) with Electric Vehicle (EV) charging infrastructure is key to sustainable transportation, addressing environmental concerns, energy security, and air quality. Globally, efforts are underway to use clean energy for EVs, with utilities piloting renewable-powered charging. In India, this integration helps reduce carbon emissions and manage grid stability. In Himachal Pradesh, the Solar Power Policy and Shimla's Waste to Energy plant showcase commitment to renewable energy. Effective integration involves supportive policies, public-private partnerships, and technological innovation, with key recommendations for governments, the private sector, and DISCOMs to enhance the adoption of RE in EV charging infrastructure.

Benefits of integrating EWCD friendly features:

Integrating EV Charging Infrastructure with services tailored to Elderly, Women, Children, and Disabled (EWCD) populations offers a range of benefits, promoting inclusivity, sustainability, and accessibility. By ensuring that transportation solutions are designed with diverse users in mind, barriers to mobility faced by EWCD populations can be addressed, fostering a more inclusive society. Key advantages include reducing greenhouse gas emissions, enhancing safety and security, and aiding services tailored to specific needs. Implementation measures include selecting accessible locations, providing well-lit and secure charging stations, and offering charging assistance services. Clear signage, child-proof features, and convenient parking configurations further enhance safety and usability. By prioritizing accessibility and safety considerations, EV charging infrastructure can become more inclusive and welcoming to all members of the community.

Recommendations:

Shimla's natural landmarks, like The Ridge and Mall Road, would benefit from public EV charging stations that enhance convenience and support sustainable mobility. Addressing the city's unique terrain and weather requires strategic planning and collaboration with Shimla Municipal Corporation and HPSEB. Simplifying regulations and offering incentives will attract Charge Point Operators (CPOs), while innovative strategies can boost usage. Key priorities include assessing charging locations, fostering partnerships, creating an EV accelerator cell, running awareness campaigns, and integrating with development plans. Medium-term goals involve regular policy updates and workplace charging incentives, while long-term efforts should focus on accessibility, data collection, and green parking initiatives.

Background

The report is designed to significantly boost electric vehicle (EV) adoption in Shimla by leveraging partnerships with the Asian Development Bank (ADB), and Convergence Energy Services Limited (CESL). Shimla's selection for this initiative is based on its conditions for integrating e-mobility solutions, such as its unique hilly terrain, existing EV deployments, and a potential for expanding electric mobility.

The project entails a comprehensive analysis of various vehicle segments to assess their suitability for Shimla. This includes evaluating the demand for different types of EVs, understanding supply dynamics, and reviewing the existing policy frameworks. Key elements of the analysis involve:

1. **Market Size and Demand Projections**: Estimating the current market size for EVs in Shimla and forecasting future demand trends up to 2030. This helps in planning for the growth of the EV market and understanding the economic potential.
2. **Charging Infrastructure**: Analysing the requirements for establishing a comprehensive charging network. This includes addressing the challenges posed by Shimla's geography, such as its hilly terrain, assessing the requirement of additional power due to EV charging, and exploring opportunities to integrate renewable energy sources into the charging infrastructure.
3. **Fleet Use Cases**: Identifying specific scenarios where electric vehicles can be effectively utilized, such as in public transportation, commercial fleets, and private ownership.
4. **Policy and Business Models**: Reviewing current policies and suggesting new ones to support EV adoption. The report also develops business models and strategies specifically tailored to Shimla's needs, covering aspects such as market assessment, network development, and economic viability.

The report offers detailed strategies for assessing the market, developing a charging network, and implementing business models that cater to Shimla.

Need

In Shimla, the urgency of transitioning to sustainable transportation is driven by multiple factors: mounting traffic congestion, escalating air pollution from internal combustion engine vehicles, and the pressing need to combat the global climate crisis. As a city with hilly topography and climatic challenges, Shimla's current transportation system exacerbates these issues. Adopting electric vehicles offers a viable pathway to reduce greenhouse gas emissions, lower noise pollution, and create a healthier urban environment. However, Shimla faces several barriers to EV adoption, such as inadequate charging infrastructure, a lack of consumer awareness, high upfront costs, and uncertainties in the local market.

This report aims to address these barriers by conducting a comprehensive market analysis that includes detailed segmentation and sizing to understand the demand and supply dynamics for EVs in Shimla. It will evaluate the feasibility of deploying EVs in both public and private transportation sectors, examining factors like consumer behaviour, vehicle availability, cost-effectiveness, and the readiness of the market for such a transition. The report will also delve into policy frameworks, assessing current regulations, incentives, and barriers to EV adoption, and identifying opportunities for policy reform to encourage greater uptake.

A crucial component of the report will focus on EV charging infrastructure. Given Shimla's challenging terrain and its seasonal variations, the report will analyse optimal locations for charging stations, considering factors such as accessibility. It will explore different types of charging technologies and their suitability for various use cases in Shimla. Additionally, the report will provide an assessment of the grid impact of widespread EV adoption and suggest necessary upgrades or modifications to ensure a reliable power supply.

The report will further propose sustainable business models for integrating EVs into Shimla's commercial fleets, including public transport, shared mobility services, and delivery vehicles. These models will consider local economic conditions, cost-benefit analysis, potential revenue streams, and partnerships with private and public entities. By leveraging local data and global best practices, the report will present actionable recommendations tailored to Shimla's unique circumstances.

Overall, this report is vital for guiding Shimla's journey towards sustainable transportation. By presenting a holistic view of the challenges and opportunities in EV adoption, it aims to provide a roadmap for decision-makers, stakeholders, and investors. The insights gained will help accelerate the deployment of EVs, foster innovation, and ultimately contribute to Shimla's goal of becoming a greener, cleaner city, in alignment with national and global sustainability targets.


CCS
UP TO
150 kW

Approach and methodology

EV Sales, power demand and EV charger estimates calculation

Methodology for estimating EV sales of 2W, 4W (private) and 4W (commercial)

A bottom-up approach is used to understand the trajectory of electric vehicles penetration, the power demand required for the EV charging, estimation on the number of chargers required and capital investment for deploying the required number of chargers till FY 2035.

The assessment starts with understanding the present demand of various vehicle segments such as 2W, 4W (private), 4W (commercial) and buses. To understand segment wise demand, the number of ICE vehicles registered from FY 2015 to FY 2024 are taken into consideration and then the number of ICE vehicles are projected till FY 2035 based on the previous year's CAGR.

To assess the EV projections till FY 2035, the present EV penetration is observed for various vehicle segments such as e-2W, e-4W (private), e-4W (commercial) and buses. Based on the growth rate of present EV penetration rate and government targets, assumptions are for future EV penetration. Based on the projected number of ICE vehicles are future EV penetration, the number of EVs are projected till FY 2035.

Methodology for estimating EV sales and number of charger required by buses operated by government for intracity movement

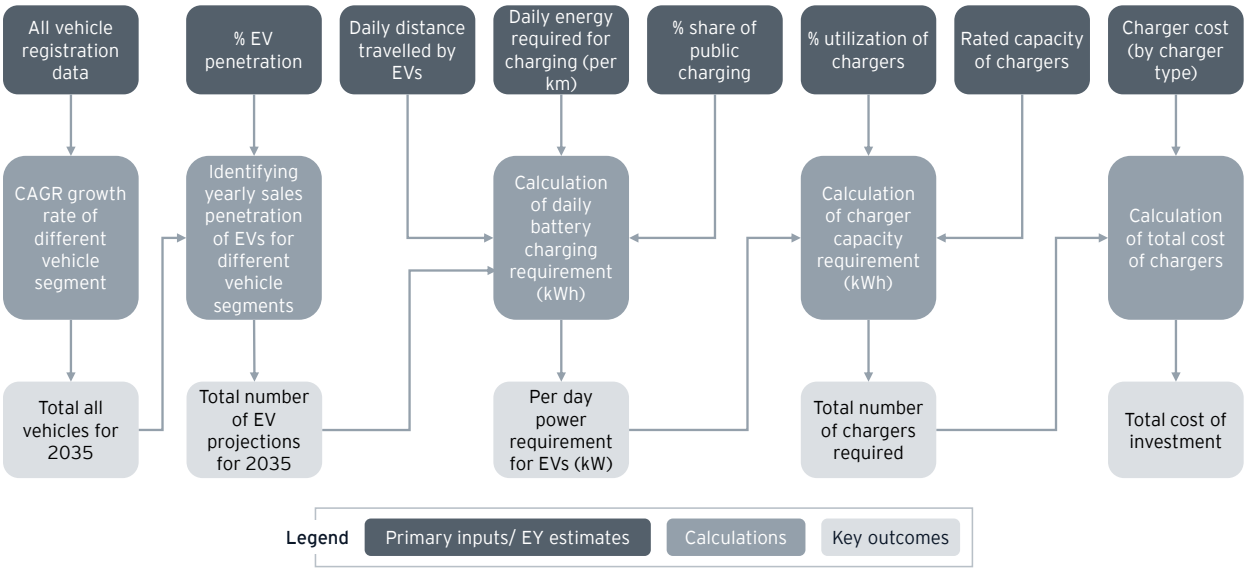
The assessment in this report focuses exclusively on government-operated intracity electric buses. According to primary consultations, the total bus fleet consists of 214 buses, with 68 of these being electric, representing approximately 30% of the fleet. This proportion is used as a baseline for the available bus data from the Vahan Portal. Our methodology has been applied to this 30% subset. Furthermore, the charger-to-bus ratio is maintained at the current trend of 1:5 to ensure that the charging infrastructure remains efficient and reliable.

Table 1: Assumption for Public Charging share by vehicle segment

Charging type	e-2W	e-4W (private)	e-4W (commercial)	e-Bus
Public Charging Share	20%	50%	30%	0%
Home charging	50%	10%	0%	0%
Captive charging	0%	0%	70%	100%
Workplace charging	30%	40%	0%	0%

The process flow for the assessment of EV sales projections, power demand from EVCI and cost estimation for deployment of projected number of EV chargers is presented below:

Figure 1: EV Charging Infrastructure Model



Power demand due to EV charging

Charging infrastructure is the backbone of any electric mobility implementation. The provision of an adequate, affordable, accessible, and reliable charging network is a prerequisite for the mass adoption of EVs. The provision of robust charging infrastructure solutions is key to promoting awareness and confidence in vehicle range among prospective EV users.

For an ambitious shift towards sustainable transportation, a comprehensive and easily accessible network of electric vehicle (EV) charging infrastructure is imperative. Infrastructure is a prerequisite to match up the pace of EV adoption as seen in the projections in the previous section. The Government has an important role to play in the planning and implementation of public charging infrastructure.

The power demand will increase in the future in tandem with more urbanization and an increase in the number of consumers. With an increase in EV penetration, the overall power demand will further rise due to the charging requirements of different segments of EVs. It has been estimated that e-buses with battery capacity in the range of 200 kWh – 240 kWh consume around 200 to 240 units while charging. This is equivalent to 100 to 120 household Air Conditioners (ACs) running for 1 hour1.

To understand the power requirement for charging of projected number of EVs in the years to come, certain assumptions are taken to assess the power demand. The percentage utilization of chargers is assumed to be 40% for FY 2030 which would increase to approximately 60% by FY 2035. Assumptions considered for estimating power demand due to EV charging by 2035 is mentioned below:

Table 2: Assumptions considered for estimating power demand due to EV charging by 2035

Assumptions[2]	e-2W	e-4W (private)	e-4W (commercial)	e-Bus
Average Daily run (in kms)	20	30	100	100
Battery capacity (kWh)	2.98	28.6	26	151
Daily battery charge requirement (kWh)	0.66	3.18	11	100.7

1https://www.hindustantimes.com/cities/delhi-news/dtc-to-launch-pilot-project-for-smart-charging-system-for-electric-buses-with-ai-software-to-reduce-grid-load-and-costs-101685729415393.html

[2] National Automotive Board (NAB) (heavyindustries.gov.in)

Projections for EV Charging infrastructure and estimated capital expenditure to deploy EV chargers

Different EV models and segments have different charging requirements. It is usually recommended to have a good mix of different charger types that can cater to existing and future demand. It is equally important to determine the quantity of chargers to be installed. Installing too many chargers will increase the cost and installing fewer chargers will create scheduling and access issues and will create a discouraging impact on the existing EV users and upcoming potential EV buyers.

The number of installed EV chargers in a charging station should aim to serve existing EVs as well as additional demand in the future. Several research papers suggest that fast charging a vehicle's battery on continuous basis depletes the battery life. Therefore, it is recommended to keep this factor in mind and choose a combination chargers to maximise the life of the battery of the vehicles. For the purpose of projecting the number of chargers to cater the EV charging power demand as per the projections in the previous section, the type of chargers is assumed in this report as provided below:

Table 3: Charger types for different vehicle segments & estimated cost

Type of charger	kW rating	e-2W	e-4W (private and commercial)	Bus
LEV AC	10 (3*3.3)	40%	-	-
IS-17017-2-6	7	60%	-	-
CCS II	50	-	100%	-
CCS II	180 (2*90)	-	-	100%

Reduction in CO_2 emissions

E-mobility plays a critical role in decarbonization of transport sector. The concerning levels of vehicular emissions underscore the pressing need to address and mitigate the adverse environmental impacts posed by the ICE vehicles. A transition to electric mobility has the potential to reduce the impact of vehicular emissions by road transport sector and it will help reduce oil imports as well.

To assess the impact of additional CO2 emissions reduction due to future penetration of EVs are estimated based on EV stock volume, which is the cumulative value of the year-on-year addition of EVs. The following assumptions are considered as provided in the table below:

Table 4: Assumptions for CO2 emissions calculations

ICE Vehicle type	Daily run (In kms)	Emission norms[3] (Grams CO_2/km)
Two-wheeler	20	28.58
Four-wheeler (Private)	30	139.52
Four-wheeler (Commercial)	100	139.52
Bus	100	787.72

While adoption of electric vehicles (EVs) can help in reducing the impact of tailpipe emissions within the city, it is also important to recognize that certain level emissions are also present at the point of electricity generation that fulfil the EV charging demand. Presently, a significant portion of electricity generation is derived from non-renewable sources like coal based thermal power. Therefore, the actual reduction in carbon emissions due to EV adoption is projected by taking into consideration, the impact of carbon emissions due to electricity generation as well. The assumptions for daily power requirement for each EV segment is provided in the Table 2.

[3] Appraisal guidelines for Metro rail projects proposals, Ministry of Housing & Urban Affairs, Government of India, September 2017

CEA Clean Development Mechanism

Based on the data of Central Electricity Authority (CEA) for Clean Development Mechanism (CDM), the weighted average emission factor for CO_2 based on power generation from grid connected power plants in India including Renewable Energy generation are:

Table 5: Weighted average emission factor for CO_2 based on power generation from grid connected power plants

FY	Carbon Emission factor of Grid Electricity (including RE) (tCO_2/MWh)[4]
2017-18	0.754
2018-19	0.744
2019-20	0.713
2020-21	0.703
2021-22	0.715

The above table shows the weighted average emission factor over the period from FY 2017-18 to FY 2021-22. The weighted average emission factor has been reducing by a factor of around 2% to 4% except for FY 2021-22 where it has increased slightly due to increase in total generation, where coal-based generation is increased compared to gas & hydro based generation as per the CEA emissions report.

However, with Clean Development Mechanism (CDM), generation of power will be more efficient with higher efficient technologies such as supercritical technology, integrated gasification combined cycle, renovation and modernisation of old thermal power plants and co-generation along with renewable energy sources. Therefore, it can be assumed that the weighted average emission factor will reduce slightly each year. The assumed weighted average emission factor for FY 2024 to FY 2035 is mentioned below assuming yearly reduction of 2%:

Table 6: Assumed weighted average emission factor for FY 2024 to FY 2035 Reduction in CO_2 emission

FY	Carbon Emission factor of Grid Electricity (including RE) (tCO_2/MWh)[5]
2023-24	0.701
2024-25	0.687
2025-26	0.673
2026-27	0.659
2027-28	0.646
2028-29	0.633
2029-30	0.621
2030-31	0.608
2031-32	0.596
2032-33	0.584
2033-34	0.573
2034-35	0.561

[4] https://cea.nic.in/wp-content/uploads/baseline/2023/01/Approved_report_emission__2021_22.pdf
[5] https://cea.nic.in/wp-content/uploads/baseline/2023/01/Approved_report_emission__2021_22.pdf

Heat map of all Point of Interests (PoI)

Step 1: Identification of key points of interest (PoI), including railway stations, airports, bus stands, hospitals, existing EV charging stations, commercial malls, government buildings, public parking lots, major 5-star hotels, e-rickshaw stands and potential parking lots.

Step 2: Assignment of weightage to each PoI based on various factors such as the type of charging it supports, charger type, and expected time spent at the charging station. Weightage values are defined in tables representing charger type, charging type, and time spent intervals.

Table 7: Assumed weightages for assigning weightages to PoI

Charging type	weightage
PCS	3
Captive	2
Private	1

Charger Type	weightage
Fast	3
Moderate	2
Slow	1

Time spent (In minutes)	weightage
0 - 30	4
30 - 60	3
60 - 90	2
> 90	1

Step 3: Normalization of weightage values to ensure uniformity and prevent data discrepancies.

Step 4: Visualization of the normalized weightage data as kernel density heatmap, providing insights into the distribution and significance of PoIs across Shimla.

Approach and methodology for tourist and SWM vehicle calculation

Tourist vehicles:

The total number of tourists arriving in Shimla from 2008 to 2022 has been analysed to estimate the influx of passenger vehicles. By converting this tourist data into Passenger Car Units (PCUs), assuming an average car occupancy of 5, and considering that 30% of these vehicles are intercity tourist cars while the remainder are buses and other types of transport, we project the influx of electric tourist cars for the years 2030 and 2035. This projection provides a clearer understanding of the future demand for EV infrastructure to accommodate increasing tourist traffic.

It is assumed that intercity tourist cars EV penetration will reach approximately 10% by 2030 and approximately 25% by 2035.

SWM Vehicles:

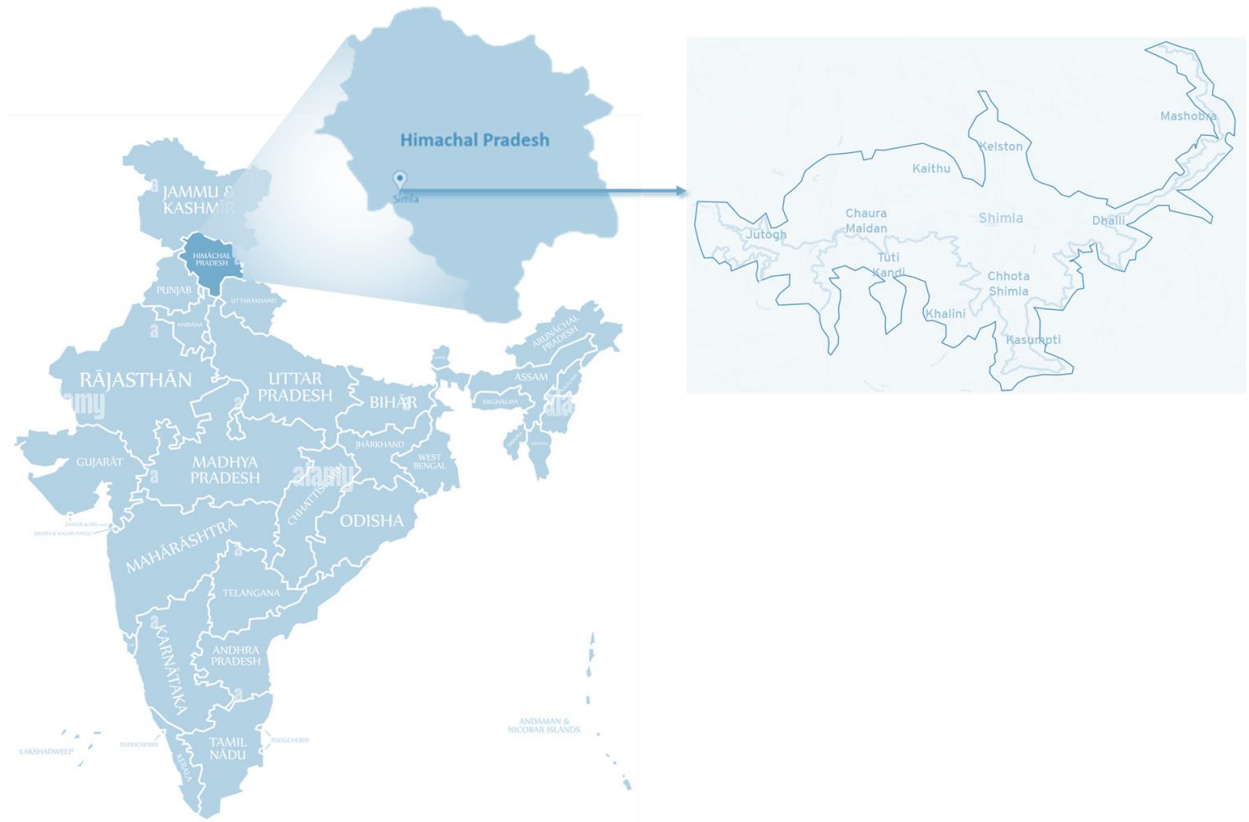
The total number of Solid Waste Management (SWM) vehicles in Shimla up to 2024 has been provided by the Municipal Corporation. To analyse future trends, a Compound Annual Growth Rate (CAGR) was applied. Based on this analysis, projections for the total number of electric SWM vehicles have been made for the years 2030 and 2035, offering insights into the anticipated shift towards electrification in waste management.

It is assumed that electric SWM vehicles penetration will reach around 50% by 2030 and approximately 80% by 2035.

1 Demographics of Shimla City

1.1. City Background

Geographical placement of Shimla city:



1.1.1. History

Shimla's history dates back to the early 19th century during the Anglo-Gurkha war. The Gurkhas, defeated by the Sikhs, assaulted areas around Shimla and erected several forts. Local hill people sought help from the British leading to a major battle at the Ramgarh fort, ending with a British win. Local chiefs that sided with the British were rewarded with territories and British protection.

Shimla, the capital city of Himachal Pradesh, India, was once the summer capital during British rule. Built on several hills, it's allegedly named after 'Shyamalaya', a blue house built by a faqir, or 'Shamla', another name for Goddess Kali, whose temple was relocated to the now famous Kali Bari Temple. The first British residence was constructed in 1819 and the first solid house in 1822. The construction of the Hindustan Tibet Road, beginning in 1850 increased its accessibility, and by 1864, Shimla was declared the summer capital of India. After independence, Shimla initially served as the capital of Punjab before becoming the capital of Himachal Pradesh in 1966. Notable for its colonial architecture, expanding town and stunning views, Shimla also holds historical significance as the 1946 site of a decisive Indian nationalist movement conference. The completion of the Kalka-Shimla railway in 1903 significantly boosted the town's development.[6].

[6]https://hpshimla.nic.in/history/#:~:text=Shimla%20District%20lies%20between%20the,from%20300%20to%206000%20metres.

1.1.2. Climate

Shimla is situated in the Northern Hemisphere. Characteristics of Shimla's climate, indicate a warm and temperate weather pattern. Shimla experiences an average annual temperature of 13.7°C with an annual rainfall measure of 67.3 inches. The region exhibits a distinct difference in rainfall quantity between winter and summer. [7]

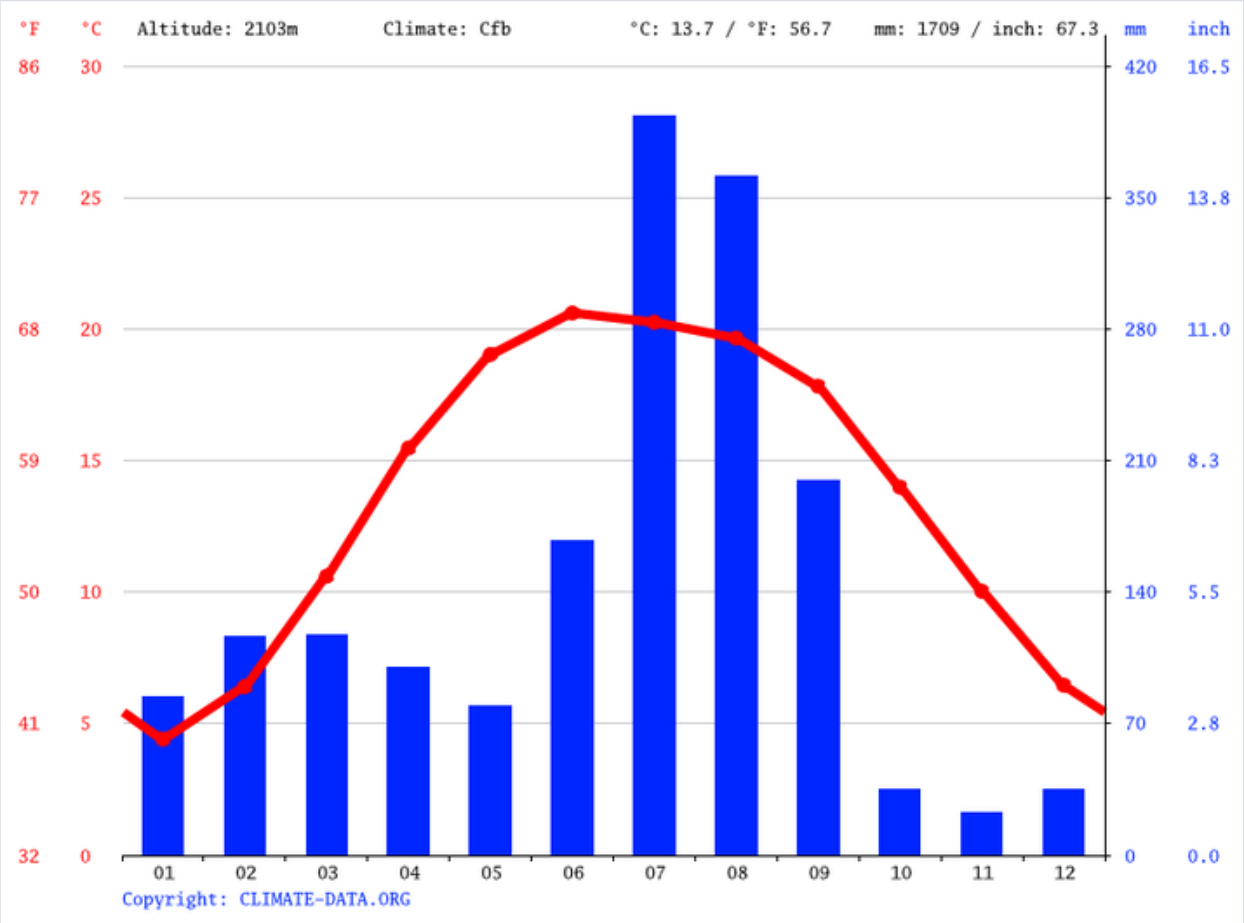
On the temperature front, June is the warmest month with an average temperature of 20.6°C, whereas January is the coldest month, when the average temperature dips to 4.4°C. The yearly temperature range in Shimla is 16.2°C (29.2°F). [8]

Summer spans from the end of June through September encompassing the months of June, July, August, and September. The precipitation disparity between Shimla's driest and wettest months - November and July - is substantial 15 inches. July registers the maximum rainfall while November is the driest with a minimal rainfall. [9]

Additionally, humidity levels fluctuate throughout the year. August is typically the most humid month with a relative humidity percentage of 89.00, while May records the lowest humidity levels at 49.52 percent. [10]

[7] Shimla climate: Weather Shimla & temperature by month (climate-data.org)
[8] Shimla climate: Weather Shimla & temperature by month (climate-data.org)
[9] Shimla climate: Weather Shimla & temperature by month (climate-data.org)
[10] Shimla climate: Weather Shimla & temperature by month (climate-data.org)

Graph 1: Climatic condition of Shimla



1.1.3. Economy, Trade and commerce

The mainstays of Shimla's economy are Government, Agriculture, and tourism. The town and its surrounding state possess an abundance of natural scenic beauty and rich resources. Particularly noteworthy are the dense forests that promote the cultivation and export of fruits and flowers. These sectors significantly contribute to the local economy. Shimla's evolution into a significant hub for distribution and collection has led to a noteworthy shift in the area's economic pattern[11].

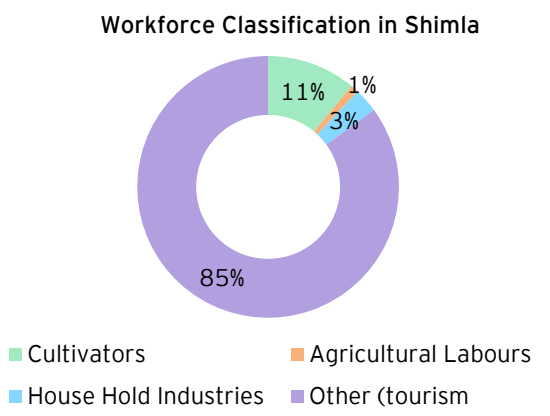
The average annual per capita income in Shimla city stands at INR 2,22,227[12]. The city's labour force comprises approximately 88777 workers which is 33% of the total population. The prevailing sectors in Shimla primarily consist of government employment, accommodating and the tourism industry, which employs approximately 85% of the city's workforce[13].

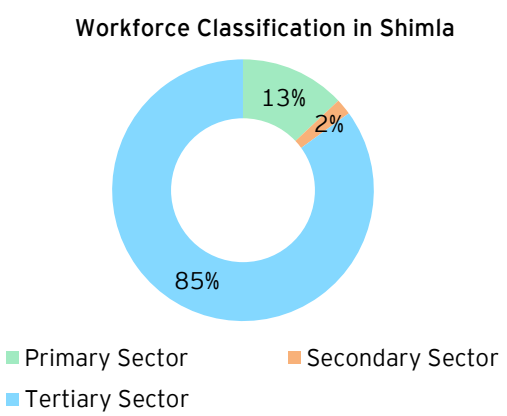
[11] https://www.shimlaonline.in/city-guide/business-and-economy-of-shimla

[12] https://himachalservices.nic.in/economics/pdf/ShimlaAbstract_2022_23.pdf

[13] https://mcslogin.hp.gov.in/SecureFileStructure/Notices/e76ba0c0-0ced-4953-b34b-b04e67f8928f.pdf

Graph 2: Economic sector distribution in Shimla and Distribution of Shimla's economy via Trade and Commerce





Primary sector:

This sector is responsible for providing raw materials and base products for goods and services, it is an unorganised sector. Examples of primary sectors are agriculture and Horticulture.

Secondary sector:

This industry manufactures natural products in various usable forms, it is an organised sector. Examples of the secondary sectors are the traditional small-scale industries like wool spinning, weaving, basket making and metal work.

Tertiary sector:

This sector provides services to both the primary and secondary sectors, it is an organised sector. Examples of tertiary sectors are Government jobs, Hospitality, and tourism related activities.

Tertiary sector activities predominate the city's overall economy, comprising 85% of total formal employment, followed by the primary sector at 13% and the secondary sector at 2%[14].

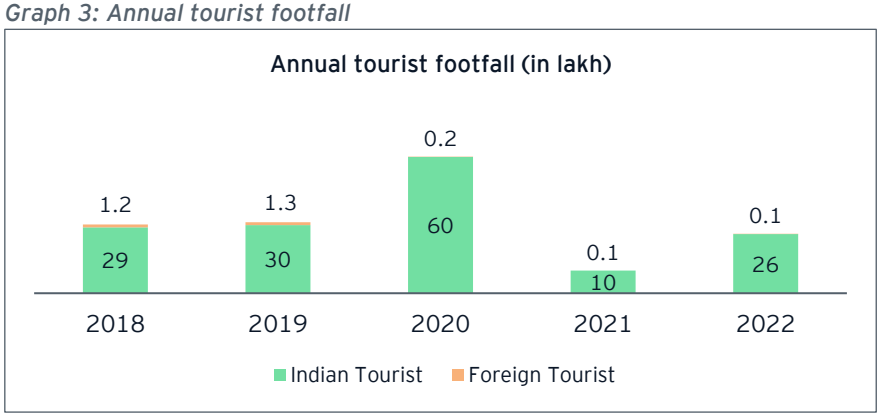
14 https://mcslogin.hp.gov.in/SecureFileStructure/Notices/e76ba0c0-0ced-4953-b34b-b04e67f8928f.pdf

1.1.4. Tourism

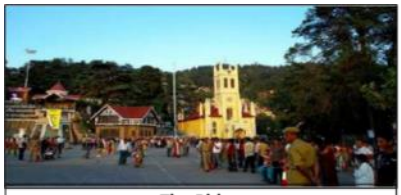
Located at 2200 m, Shimla is a prominent tourist destination in India, recognized for its aesthetic setup amid stunning hills and mystical woods. Once the British India summer capital, Shimla's breath-taking beauty and atmosphere create a profound impact on tourists. The city's fusion of colonial-style architecture and historical temples captivates every visitor.

Site type	Count
Heritage Buildings & Heritage Zones dating back to colonial era	98
Hotels, Homestays & Dharamshala	246
Eateries/restaurants	427

Graph 3: Annual tourist footfall



In 2022, Shimla saw the arrival of approximately 2.57 Millions tourists, 99% of whom were from India. The Covid-19 pandemic adversely impacted foreign tourism, as only 825 foreign tourists visited the city in 2021. This represented a nearly 99% drop compared to previous years, due to the enforced travel restrictions and lockdowns.[15]


The Ridge


The Mall Road


Kufri


Jakhu Temple


Sankat Mochan Temple


Indian Institute of Advanced Studies


Tara Devi


Shimla - Kalka railway line


Prospect Hills

[15] https://himachaltourism.gov.in/wp-content/uploads/2023/03/Tourist-Statistics.pdf

1.2. Spatial Extent and features

Shimla experiences urban sprawl due to various interconnected factors:

1. **Physical Location and Urban Growth:** Shimla, spread across seven hill spurs and connected by roads, has a development pattern dictated by topographical constraints such as steep slopes and forest areas. About 90% of Shimla is built on unstable slopes, resulting in scarcity of buildable land and the concentration of population on the more construction-friendly southern slopes. This burgeoning tourist destination is continuously grappling to maintain a balance between natural and man-made structures as it undergoes vast expansion.
2. **Infrastructure and Service Provision:** As an administrative and educational pivot, Shimla faces challenges in the management of critical services like water supply and waste disposal. The influx of tourists and temporary residents, particularly during the summer peak season, places an enormous strain on the city's infrastructure. An acute water shortage triggers Shimla's struggle, with per capita water supply plunging below the prescribed standards. Also, waste management is a serious issue, with merely 11% of the total sewage undergoing treatment, and untreated water causing environmental damage. Although door-to-door waste collection is available to 80% of the city, the increased waste during peak tourist times leads to overflowing bins and waste being dumped into open drains, subsequently blocking natural drainage pathways.
3. **Urban Mobility:** Like many hill towns, Shimla faces significant challenges with mobility due to limited land availability to manage the growing traffic. The city, with its varied elevations, places a high importance on vertical mobility. Nevertheless, public transport remains insufficient. Particularly during the tourist season, traffic congestion becomes prominent in Shimla, often leading to hours of complete standstill on major roads.
4. **Tourism:** Shimla, renowned as a top tourist destination, has seen a surge in visitor numbers in 2022, including both domestic and foreign tourists. This floating populace, mainly engaged in tourism and service sectors, has seen an uptick. Popular during summers and as a weekend retreat for nearby residents, Shimla's infrastructure is struggling under the increasing pressure. The peak tourist season strains resources like water supply, garbage disposal, and transportation. Furthermore, this transient population contributes to unauthorized constructions and encroachments on natural areas.
5. **Energy Needs:** The escalating energy needs in urban regions like Shimla form a significant part of urban management concerns. Shimla's energy demand peaks in the winter season for heating, and with the ban on using wood for this purpose, the city has transitioned towards renewable energy resources. Currently, renewable sources like hydropower fulfil the city's total energy requirements, alongside two solar plants producing a 35 KWP capacity under the solar city plan. A newly operational waste-to-energy plant also contributes to the energy pool with 1.7 MWH. Plans are underway to further harness solar energy by converting streetlights into solar-powered lamps.

Geographical location:

1. Located on a stretch of the Middle Himalayas, Shimla forms the last traverse spur of the Central Himalayas, bordered to the south by the Satluj River. Geographically positioned at 30° 6' North latitude and 77° 11' East longitude, Shimla's average elevation is approximately 2397.59m above sea level. According to IS-1893, Shimla lies within a seismic belt, specifically Seismic Zone IV[16].
2. Shimla extends from Chotta Shimla in the east to Boileauganj on its far western end. From the main ridge, a northern spur known as Elysium Hill juts out. Jutogh, an outlying hill, is situated five and a half kilometres from the western edge of the town. Shimla spans across seven interconnected hill spurs that are linked via a network of roads. A significant feature of this network is its connection to the Mall Road, stretching from Boileauganj to Chotta Shimla.[17].

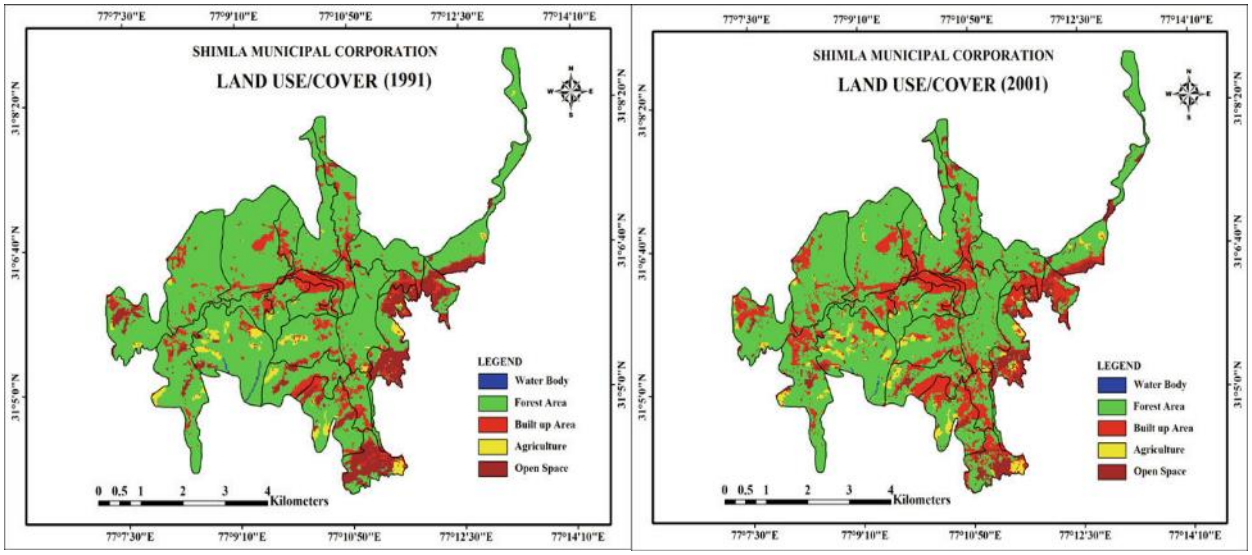
[16] https://shimlamc.hp.gov.in/News/Index/1057
[17] https://shimlamc.hp.gov.in/News/Index/1057

1.3. Area and Land use

Shimla, shaped like an irregular crescent, stretches across 9.2 km from one end to the other, occupying a total area of 19.55 square kilometres.[18]

The land cover data from Shimla between 1991 and 2001 show a noticeable increase in built-up area and agricultural land, signifying swift urbanization. In contrast, green belt areas and open spaces experienced a significant decrease during the same timeframe.[19]

Figure 2: Landcover map of Shimla

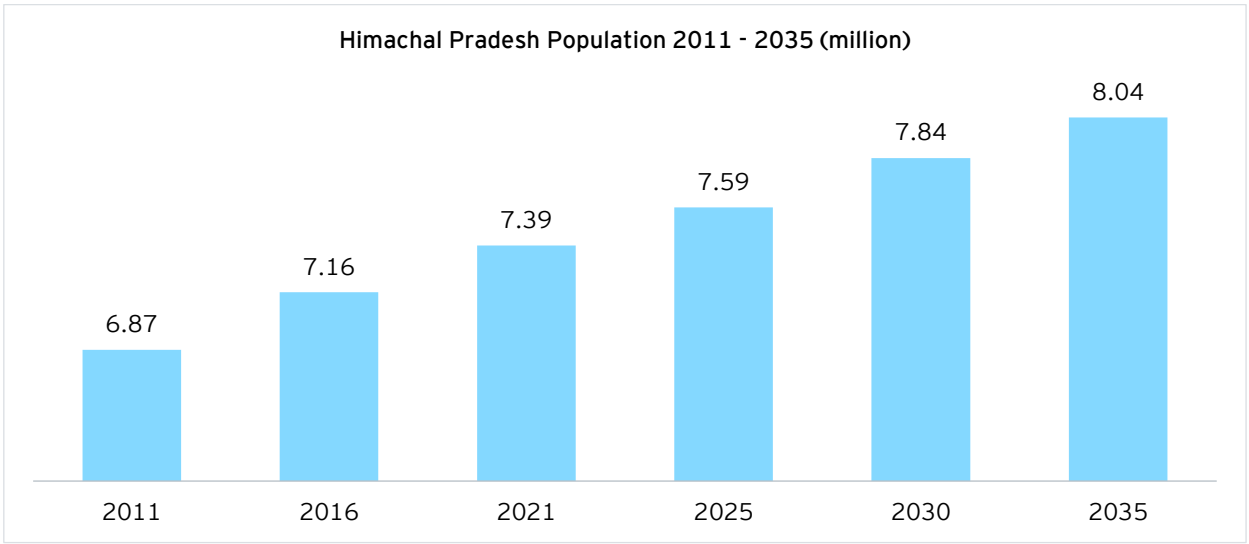


1.4. Population and Population density

1.4.1. Population

Himachal Pradesh's Population

Graph 4: Population of Himachal Pradesh

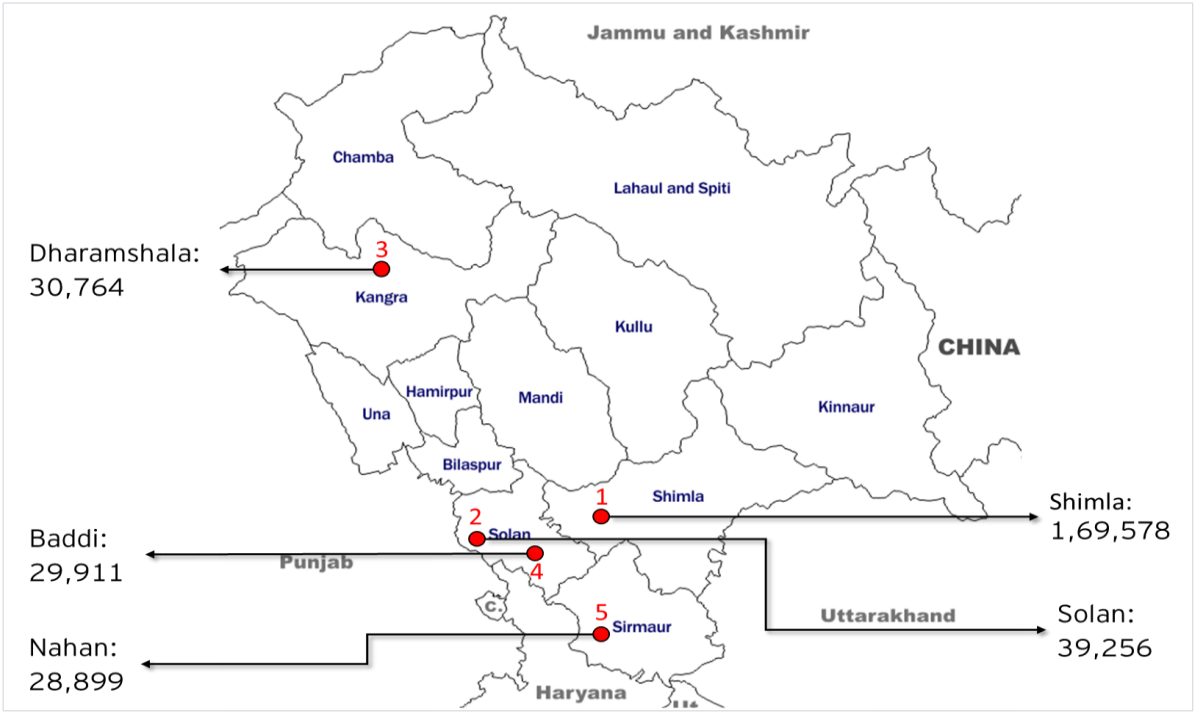


[18] https://shimlamc.hp.gov.in/News/Index/1057

[19] https://www.researchgate.net/figure/Land-use-cover-classification-of-Shimla-City-Source-Landsat-TM-1991_fig2_339664442

The top 5 most populous cities of Himachal Pradesh are as follows:

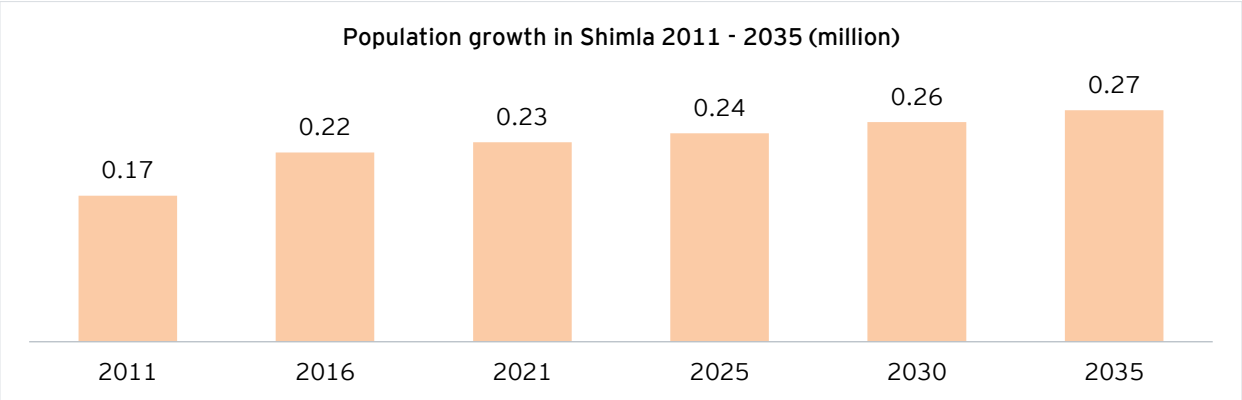
Figure 3: Top 5 most populous cities of Himachal Pradesh



Shimla ranks as the first most populous city in the state of Himachal Pradesh, it has a population of 1,69,578 (Census, 2011), with the total population of the state reaching 68,65,000[20].

Shimla city saw a population increase of 29% between 2011 and 2021, and a further increase of 5% from 2021 to 2023. Meanwhile, the anticipated population of Shimla city along with its surrounding areas is estimated to reach 28,9000 by the end of 2031.[21]

Graph 5: Population of Shimla



1.4.2. Population Density

Shimla's population density stands at 4197 people per square kilometre[22] which was 158.6 people per square kilometre in 2011[23].

[20] https://main.mohfw.gov.in/sites/default/files/Population%20Projection%20Report%202011-2036%20-%20upload_compressed_0.pdf

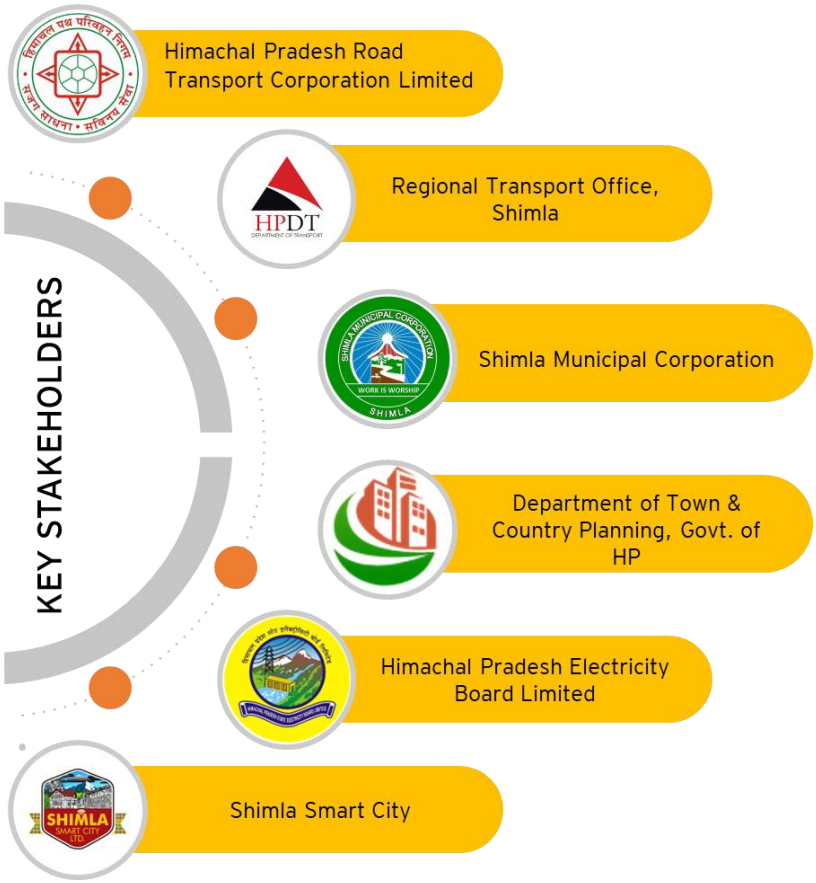
[21] https://www.census2011.co.in/census/city/4-shimla.html

[22] https://shimlamc.hp.gov.in/News/Index/1055

[23] https://citypopulation.de/en/india/himachalpradesh/0211__shimla/#:~:text=Shimla%20*%20814%2C010%20Population%20[2011]%20%

2

Key Government Stakeholders in Shimla related to EV transition



2.1. Shimla Municipal Corporation

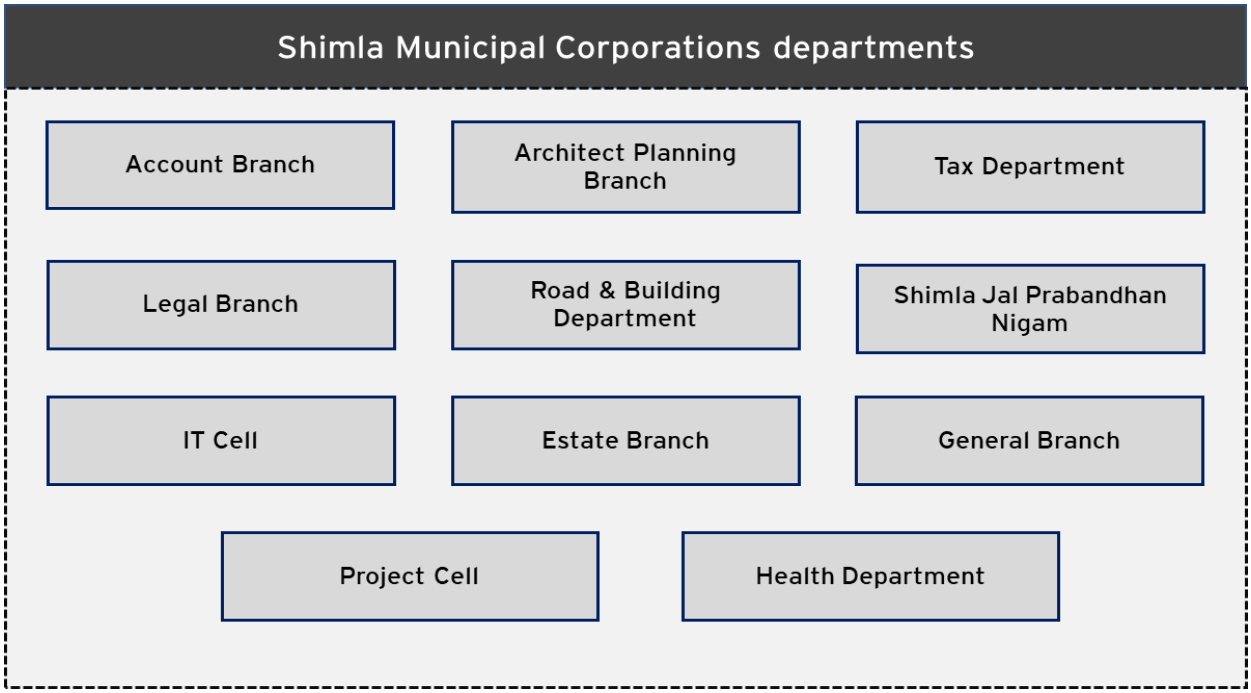
After erecting Shimla's first 'permanent' house in 1822, the city's civic governance evolved, commencing with law enforcement measures. By the 1830s, an ad-hoc system was in place for water supply management, leading to the Shimla Municipal Committee's formation in 1851, the oldest in pre-Independence Punjab. Initially, commissioners were appointed government officials, but elections started in 1855. The Committee achieved Class I Municipality status in 1871. Post-independence, Shimla adopted an adult franchise and adjusted its administrative structure with ward divisions, government interferences, and court orders.

The Shimla Municipal Corporation is comprised of an elected Mayor, Councillors, and a commissioner, alongside other officials. The body includes 39 councillors, with 34 elected directly and five appointed by the Himachal Pradesh Government. These elected bodies serve a five-year term, and from within, a Mayor and Deputy Mayor are chosen for a two-and-a-half-year term. The Municipal Corporation is responsible for managing city infrastructure and public amenities, as well as formulating and implementing plans for economic development and social justice[24].

The Shimla Municipal Corporation oversees 15 wards, collectively covering an estimated area of 19.55 square kilometres[25].

[24] https://shimlamc.hp.gov.in

[25] https://shimlamc.hp.gov.in/News/Index/33



Role of Shimla Municipal corporation in e-mobility[26]:

The Shimla Municipal Corporation plays a significant part in advancing e-mobility within the city. This includes promoting the adoption of electric vehicles for public transportation or city planning measures that accommodate electric vehicle charging stations. This also involves implementing policies that incentivize people to switch to electric vehicles, partnering with electric vehicle manufacturers and service providers, and generating awareness about the benefits of e-mobility.

- Infrastructure: Providing Land for charging infrastructure and Building Plan Approval for charging infrastructure.
- Policy: Amendment of building byelaws/ rules to include EV Provision
- Awareness: Conducting campaigns to highlight environmental and economic benefits.
- Fleet Electrification: Finalising EV Targets for the City.
- Partnerships: Collaborating with stakeholders to promote electric mobility.

[26] https://southasia.iclei.org/wp-content/uploads/2023/07/Shimla-City-Information-Note.pdf

2.2. Himachal Pradesh Road Transport Corporation:

Himachal was formed as a "C" class state through the merger of 33 hilly states at independence in 1948. By 1958, the "Mandi-Kullu Road Transport Corporation" was formed to oversee joint routes in Punjab and Himachal, which eventually merged with Himachal's government transport in 1974 to form the current Himachal Road Transport Corporation (HRTC). Since its inception, road network development has been a priority for the Himachal Government. As of December 2018, the HRTC operates 2,850 routes, a substantial increase from 379 in 1974, and the fleet strength has grown from 733 to 3,130.

Total Number of Intercity & Intracity Operational Bus by HRTC in the Shimla:

Total number of buses		Type of Bus	
		Normal Bus	Omni Bus
Diesel	1,033	963	70
Electric	68	68	-

*Information source: VAHAN Dashboard, accessed on 22 February 2024

Role of Himachal Pradesh Transport Corporation in e-mobility:

The Himachal Pradesh Transport Corporation (HPTC) plays a crucial role in fostering e-mobility in the region. It is responsible for introducing and managing electric buses within the public transportation system to reduce carbon footprint and enhance environmental sustainability. HPTC also oversees the installation and maintenance of electric charging infrastructure that caters to these electric vehicles. It is also responsible for training staff to handle the technical specifications and maintenance of electric vehicles.

- **Infrastructure:** Establishing charging infrastructure for E-Bus for the city.
- **Fleet Electrification:** Lead the procurement of e-buses when the city decides for the same[27].
- **Collaboration with Stakeholders:** HPTC partners with government agencies, private firms, to accelerate e-mobility adoption in Public Transport.

2.3. Himachal Pradesh State Electricity Board Limited:

In 1948, at the time of its formation, the state only provided electricity to the capital cities of the previous princely states, with a total connected load of less than 500 kW. The state's power utility organization started to form more recently with the first electrical division established under the Public Works Department in August 1953. Following this, in April 1964, the M.P.P & Power department was created. On 1st September 1971, the Himachal Pradesh State Electricity Board was formed in line with the 1948 Electricity Supply Act and was later transformed into the Himachal Pradesh State Electricity Board Ltd., effective from 14th June 2010, in accordance with the 1956 Company Act.

Himachal Pradesh State Electricity Board Limited has been designated as State Nodal Agency for the Electric Vehicle public Charging Infrastructure[28].

[27] https://southasia.iclei.org/wp-content/uploads/2023/07/Shimla-City-Information-Note.pdf

[28] https://evyatra.beeindia.gov.in/state-nodal-agencies-for-ev-charging-infrastructure/

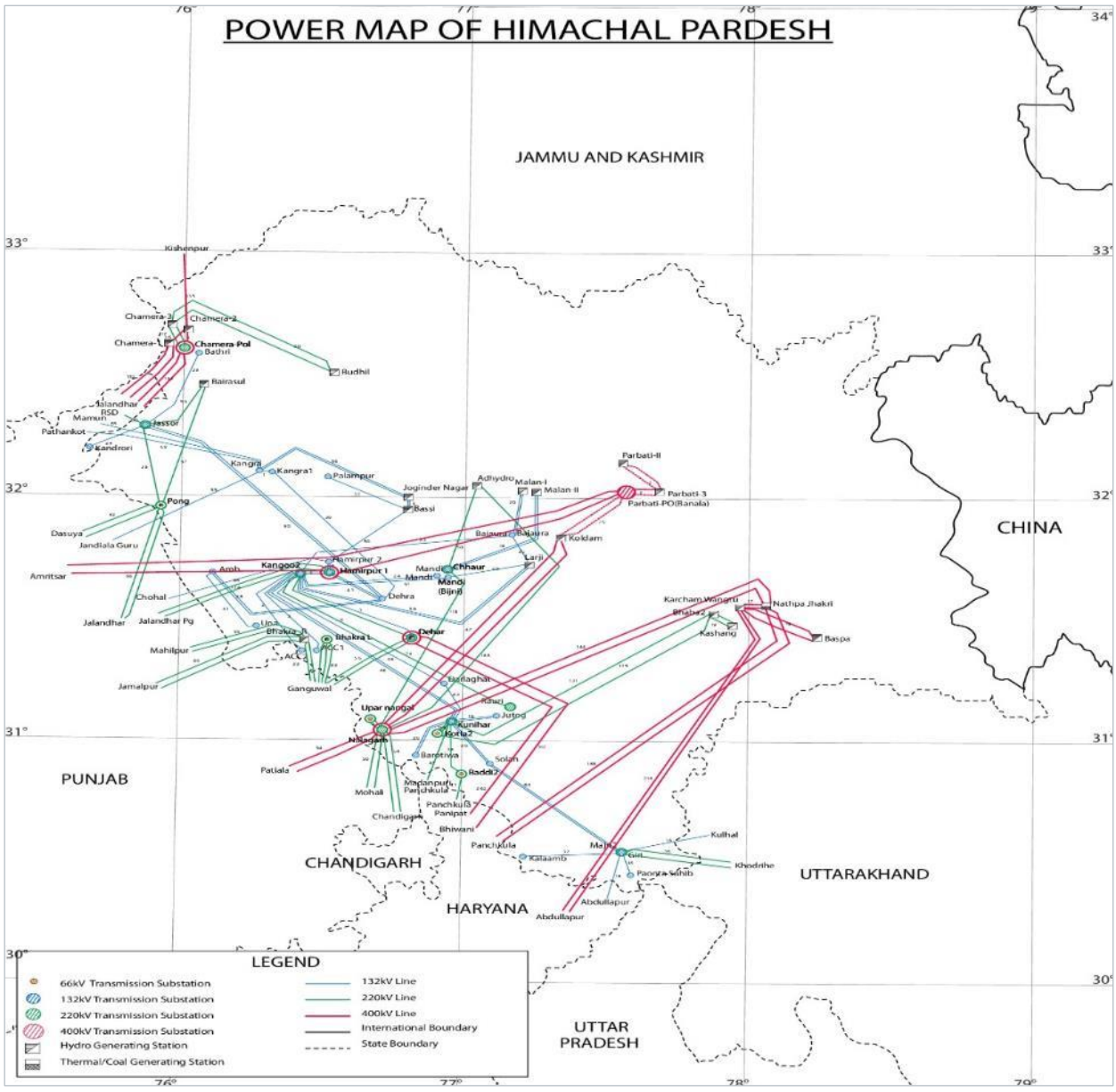
Vision:

- To be one of the most admired and reliable generating utilities in India to cater to the increasing demand at economical cost by adopting the best industry practices, thereby creating value for all stakeholders.

Mission:

- To remain the status of the biggest provider of reliable and economical power in Himachal Pradesh by timely capacity addition, performance improvement, cost reduction, better utilization of human resources, concentration on environmental protection
- To achieve 100% Rural Electrification Infrastructure for Electrification of Villages & Hamlets.

Power Distribution Map of Himachal Pradesh[29]:



[29] https://hpsldc.com/power-map/

Role of Himachal Pradesh State Electricity Board Limited in e-mobility:

The Himachal Pradesh State Electricity Board (HPSEB) has a significant role in enabling e-mobility in the region. They are principally responsible for providing the electrical infrastructure necessary for the charging of electric vehicles. This involves planning and installation of EV charging stations across the state, ensuring reliable power supply to these stations, and formulating tariff structures for EV charging.

- Regulation and Policy Formulation: The HPSEB formulates state policies related to public charging infrastructure in the Himachal Pradesh, including guidelines for electric vehicle (EV) operation and incentives for adoption.
- Tariff: Finalise tariff for EV charging[30].
- Grid Integration: It integrates charging infrastructure with the electrical grid for Ensuring timebound access of required load of electricity.
- Metering and Billing: It meters electricity usage at charging stations and accurately bills EV owners.
- Safety and Compliance: HPSEB ensures charging infrastructure meets safety standards through inspections and audits.
- Infrastructure Development: installs EV charging stations across its service area, ensuring convenient access for EV owners.
- Partnerships and Collaboration: Collaborating with stakeholders, the department partners with EV manufacturers and infrastructure providers to drive adoption and innovation.

2.4. Regional Transport Office - Shimla

Operating under the Motor Vehicle Act of 1988, the Transport Department is essentially tasked with enforcing this Act, along with the Himachal Pradesh Motor Vehicles Taxation Act of 1972 and their respective rules. It helps various organizations in augmenting transport facilities and aims to offer efficient, ample and cost-effective transport services for the transit of passengers and goods via roadways in Himachal Pradesh.

Role of Regional Transport Office (RTO) in e-mobility:

The Regional Transport Office (RTO) in Shimla plays a vital role in the promotion and regulation of e-mobility in the region. This includes issuing permits for electric vehicles, ensuring they meet the required safety and emission standards.

- Vehicle Registration: Registration of vehicles and prioritisation of EVs through single window clearance.

2.5. Department of Town & Country Planning, Government of Himachal Pradesh

Department of Town and Country Planning works under the government of Himachal Pradesh with the following objectives:

1. To encourage planned and systematic urban and rural growth in a comprehensive manner.
2. To stop haphazard construction
3. To make optimum use of precious urban land.
4. To create conductive conditions for encouraging planned constructions.
5. To Plan for creating essential urban infrastructure.
6. To sub serve the basic needs of poor and especially urban slum population.
7. To upgrade environment for conductive habitat
8. To preserve the hilly architecture and rich heritage of the state

[30] https://southasia.iclei.org/wp-content/uploads/2023/07/Shimla-City-Information-Note.pdf

Role of The Department of Town & Country Planning, government of Himachal Pradesh in e-mobility[31]:

The Department of Town and Country Planning, Government of Himachal Pradesh, plays a central role in planning and developing the framework required for e-mobility.

- Infrastructure Development: It provides approval for building plan for charging infrastructure for areas outside the municipal corporation boundary.
- Development Plan: Development and updating of Master Plan and formulation of city Development Plan and planning norms.

2.6. Shimla Smart City Limited

Shimla was selected as a Smart City under the Government of India's Smart Cities Mission in the third round of selections on June 28, 2017. This initiative aims to implement a range of smart city projects designed to transform Shimla into a more vibrant and sustainable urban environment.

The objectives of the Smart Cities Mission for Shimla include:

- Economic Growth: Positioning cities as engines of economic development by enhancing the quality of urban life through the creation of high-quality urban infrastructure.
- Quality Infrastructure: Developing modern infrastructure with assured service levels to support efficient governance and improve overall urban functionality.
- Vibrant Urban Habitat: Creating an economically vibrant, inclusive, and efficient urban space that promotes sustainability and enhances residents' quality of life.

Role of Shimla Smart City in e-mobility

- Charging Infrastructure: Expand EV charging stations throughout Shimla.
- Electric Public Transport: Implement electric buses and transit options.
- Private EV Adoption: Promote electric vehicles with incentives and awareness.
- Sustainability and Integration: Integrate e-mobility with renewable energy and smart traffic management to enhance sustainability and efficiency.

[31] https://southasia.iclei.org/wp-content/uploads/2023/07/Shimla-City-Information-Note.pdf

3 Existing Transportation in Shimla City

As a hill station, Shimla's transport sector is heavily reliant on road transport, with extremely limited access to other modes of transportation such as railways and civil aviation[32].

3.1. Air transport:

The Shimla airport is a fully developed airport situated in Jubbarhatti and stands approximately 22 km from Shimla city centre. It hosts regular flights to varied cities such as Kullu, Delhi, Mumbai, Jammu, etc. with limited functioning depending upon the seasonal/weather conditions. The airport is furnished with a single runway and its elevation, around 1,546 m above sea level, presents further limitations with respect to reach of domestic and international connectivity. Shimla's closest accessible airport is located in Chandigarh, approximately 120 km away.

[32] https://www.teriin.org/projects/green/pdf/HP-Transport.pdf

3.2. Rail Transport:

The city has very minimal rail transport. Despite the passage of time since independence, progress in rail transport remains unremarkable. Shimla has a connection to Kalka via a Meter Gauge, and the Kalka-Shimla rail line, which features 102 tunnels, provides a stunning view of the landscape as the train ascends into higher terrain. The Kalka Shimla Railway is recognized as a 'World Heritage' railway by UNESCO.

3.3. Road transport:

Shimla boasts impressive road links which include one national highway, one state highway, main roads, and local streets.

- The National Highway 22 (NH 22), also known as the Hindustan-Tibet Road and newly referred to as NH-05, links Jaurik and Ambala and goes through Shimla, Kalka, and Wangtoo as part of the Parwanoo-Solan section. This highway is a critical route for transporting apples from Kinnaur Valley to other parts of the country and also serves as a significant link to the Indo-Tibet Border.
- National Highway 88 (NH 88), which lies wholly within Himachal Pradesh, forges a link between Kangra and Shimla at the junction with NH 20, while also passing through Nadaun and Hamirpur.

3.4. Local transportation:

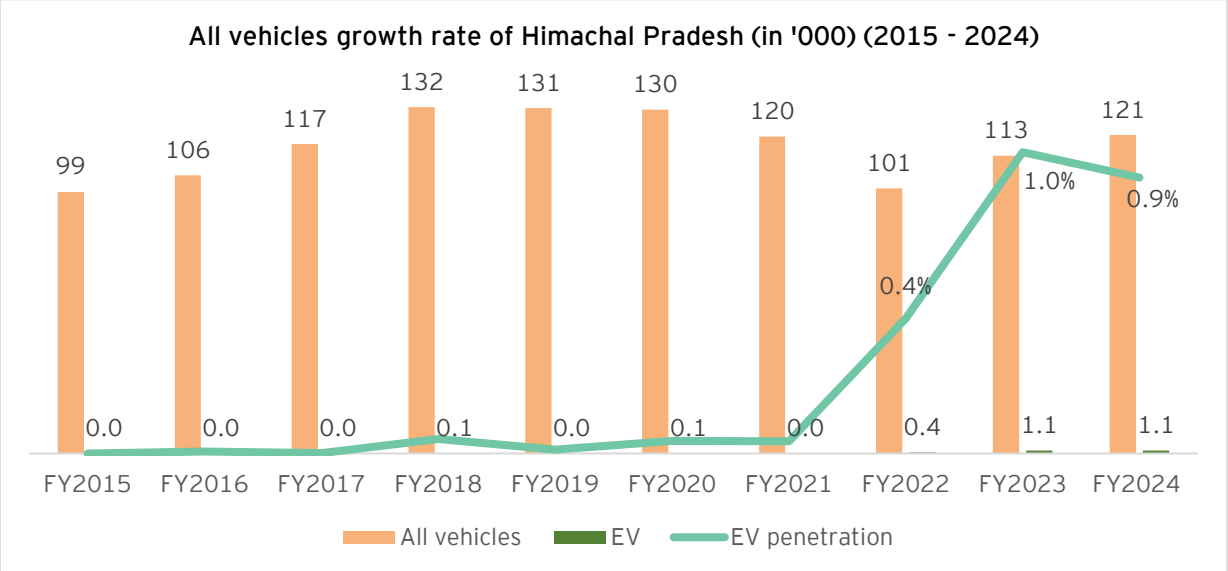
Shimla's local transportation heavily depends on various types of vehicles such as taxis, buses, private cars, and two-wheelers. Tourists often prefer local buses and taxis for travel. The Himachal Pradesh Tourism Development Corporation (HPTDC) provides daily tourist buses specifically for local sightseeing. The operation of the local bus service begins at 7 am and ends at 9 pm.

3.5. Existing challenges in Road Transport:

- Currently, over 90% of all roads are single lane roads. Consequently, as the density of vehicles increases, the road network is experiencing capacity limitations, and issues related to congestion have significantly intensified.
- Parking has become a significant issue due to the rising density of vehicles, the growing ratio of private vehicles (including two-wheelers and cars), and a constant influx of tourists and their vehicles in the city throughout the year.

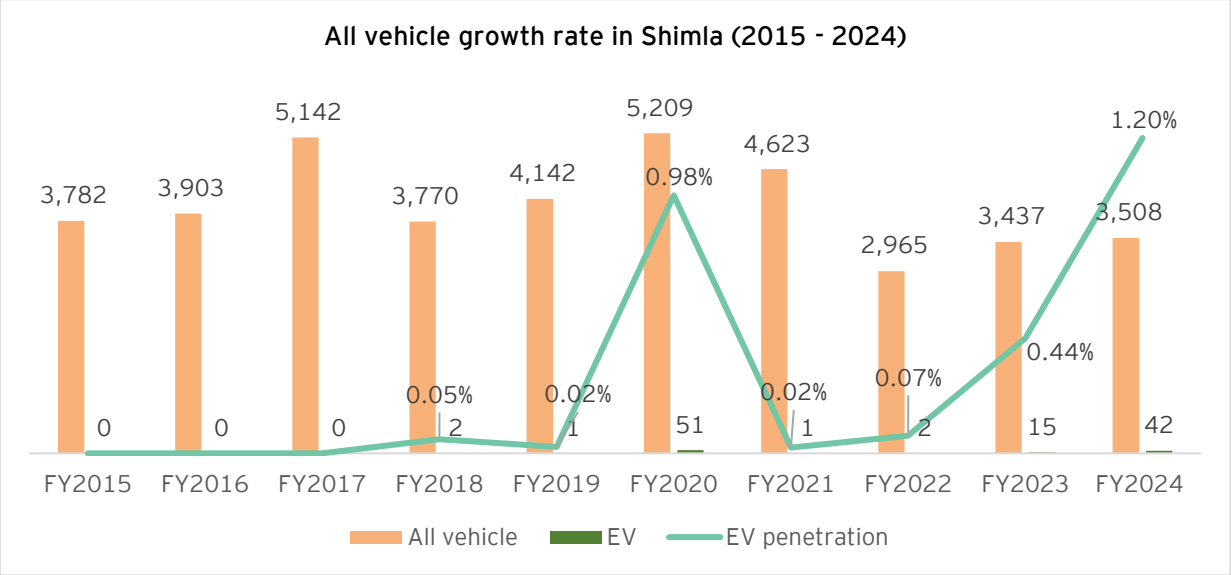
Growth trend of internal combustion engine vehicles in Himachal Pradesh and Shimla:

Graph 6: All vehicles growth rate trend in Himachal Pradesh (2015 - 2024)



In fiscal year 2024, ~1,100 electric vehicles were registered in Himachal Pradesh.

Graph 7: All vehicles growth rate trend in Shimla (2015 - 2024)

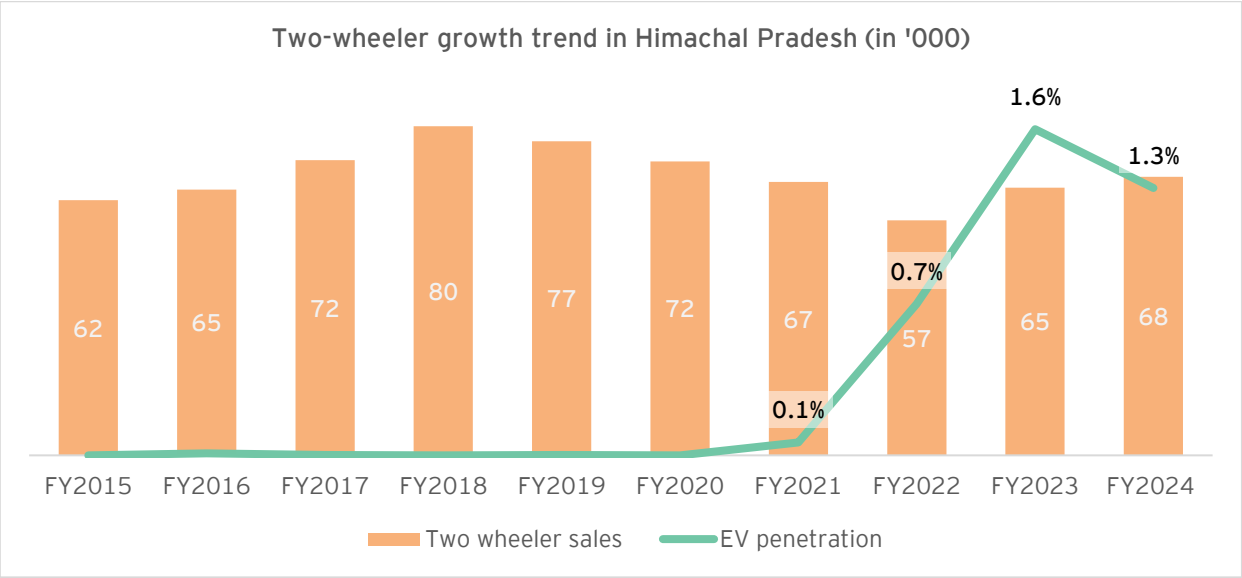


In fiscal year 2024, ~42 electric vehicles were registered in Shimla.

Two-wheelers growth trend

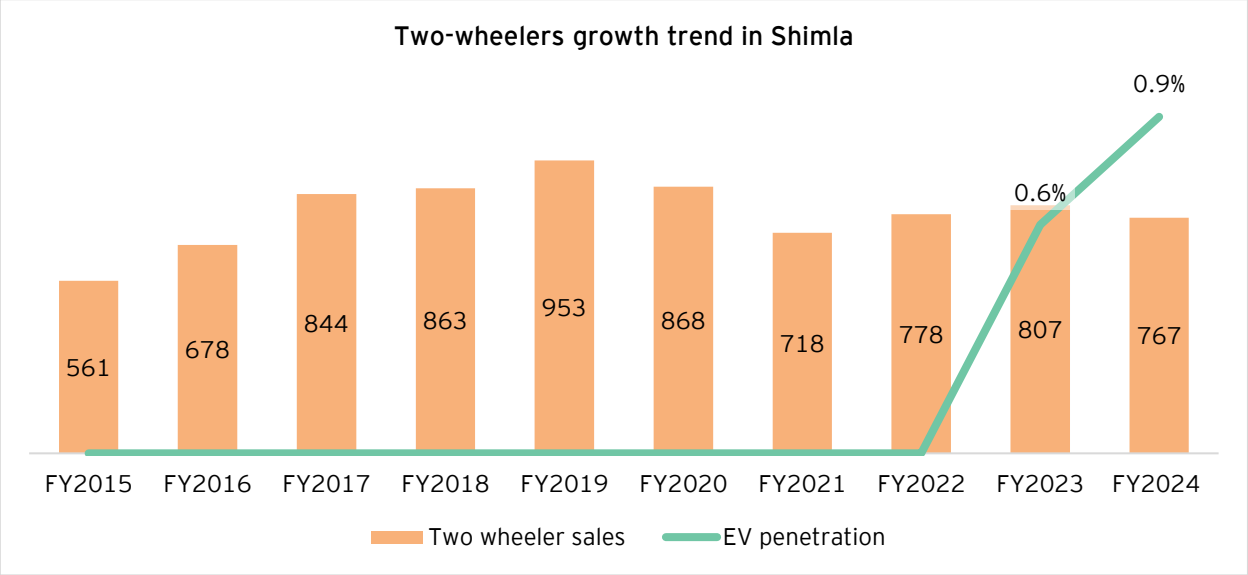
The growth of two-wheelers initially showed a steady upward trend, driven by their affordability and convenience as a primary mode of transportation for many people. However, in recent years, growth has slowed and even declined slightly, likely due to market saturation, economic constraints, or a shift in consumer preferences towards more sustainable options. The penetration of electric two-wheelers has been very recent and limited, suggesting that the market is still in its early stages, with adoption hampered by factors like limited charging infrastructure, higher costs.

Graph 8: Two-wheelers growth trend in Himachal Pradesh



In fiscal year 2024, ~900 electric two-wheelers were registered in Himachal Pradesh.

Graph 9: Two-wheelers growth trend in Shimla

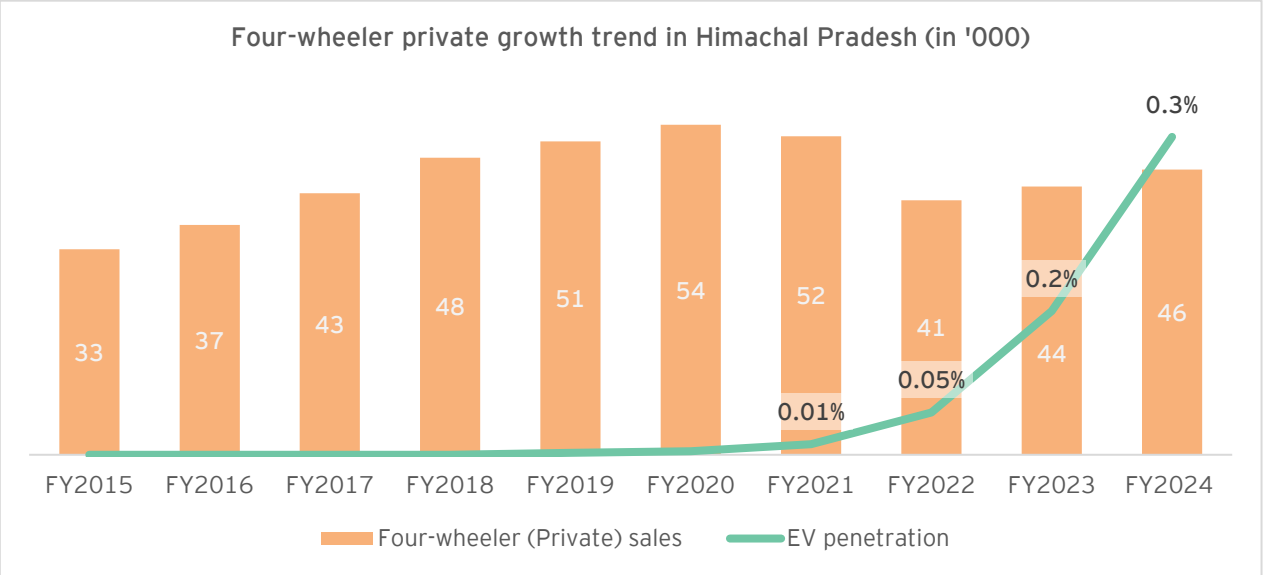


In fiscal year 2024, ~7 electric two-wheelers were registered in Shimla.

Four-wheeler private growth trend

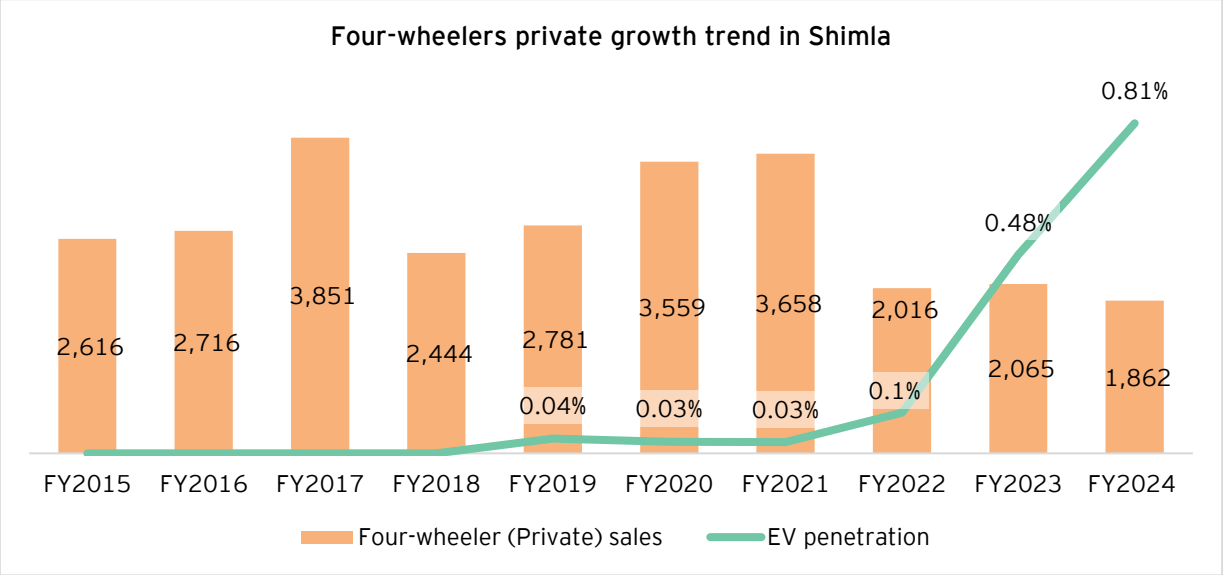
Private four-wheelers saw substantial growth over the initial years, reflecting increased incomes, urbanization, and a growing preference for personal vehicles. However, this growth has reversed recently, possibly due to economic challenges, rising fuel prices, or increased environmental awareness leading to a preference for more sustainable alternatives like public transport or electric vehicles. The penetration of electric private four-wheelers, while still low, shows a slow but steady increase, driven by factors such as government incentives, environmental consciousness, and the appeal of lower long-term operating costs.

Graph 10: Four-wheeler (private) growth trend in Himachal Pradesh



In fiscal year 2024, ~160 private electric four-wheelers were registered in Himachal Pradesh.

Graph 11: Four -wheelers (private) growth trend in Shimla

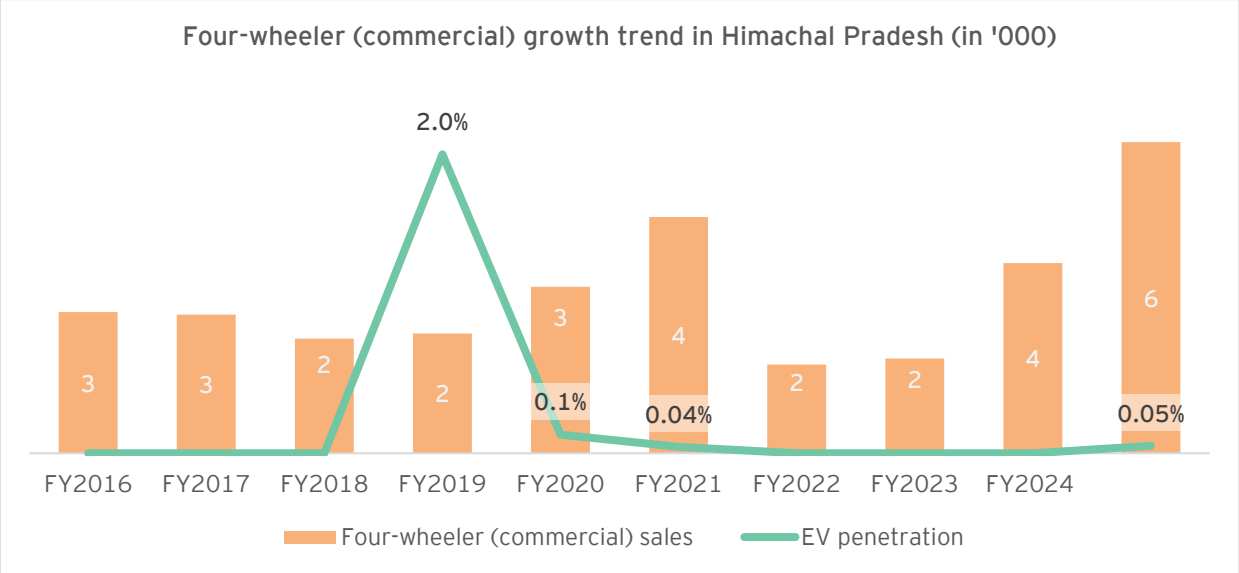


In fiscal year 2024, ~15 private electric four-wheelers were registered in Shimla.

Four-wheelers commercial growth trend

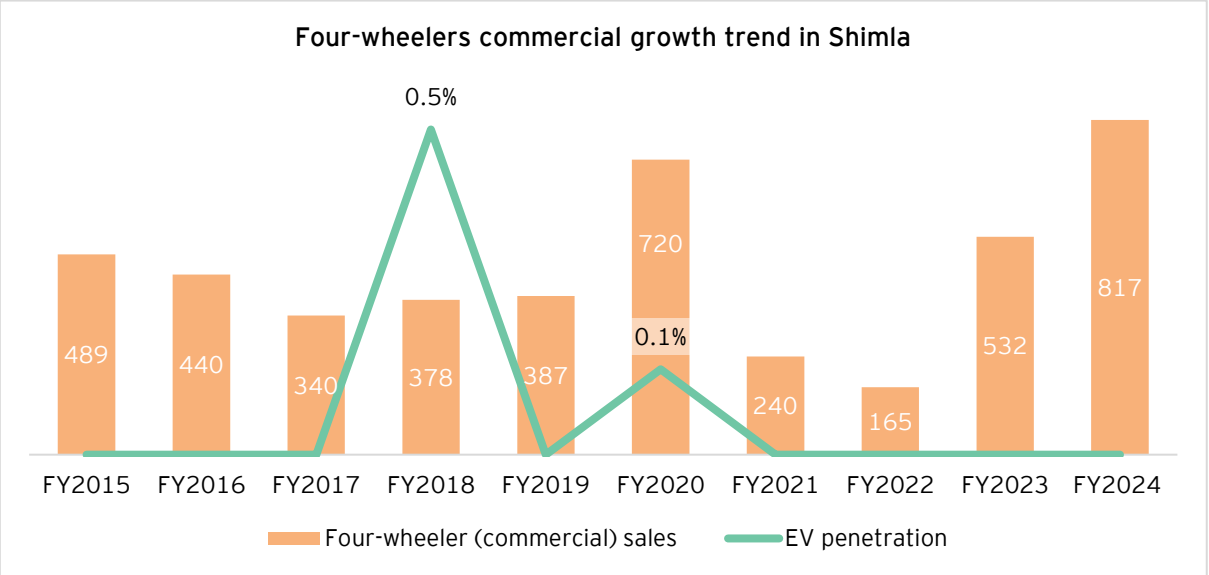
Commercial four-wheelers have experienced fluctuating growth, influenced by varying market conditions, regulatory changes, and demand for logistics and delivery services. Recent years have shown a resurgence, likely due to economic recovery and the expansion of e-commerce, which drives the need for more commercial vehicles. However, the adoption of electric commercial vehicles remains negligible, possibly due to higher initial costs, inadequate charging infrastructure.

Graph 12: Four-wheeler (commercial) growth trend in Himachal Pradesh



In fiscal year 2024, only 3 commercial electric four-wheelers were registered in Himachal Pradesh.

Graph 13: Four-wheeler (commercial) growth trend in Shimla

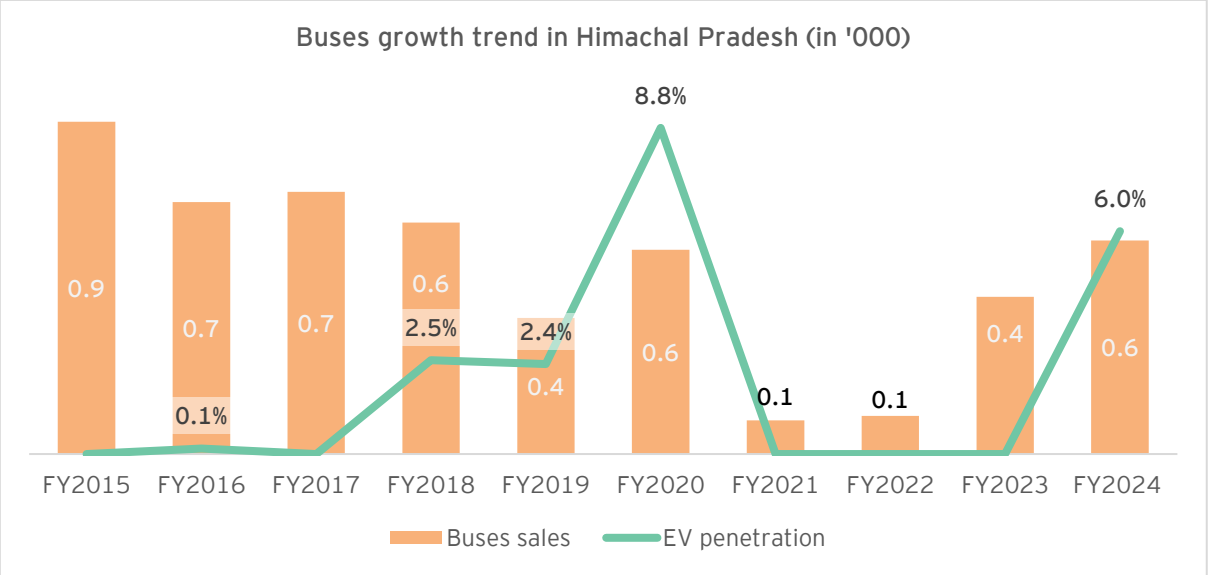


In fiscal year 2024, no commercial electric four-wheelers were registered in Shimla.

Buses growth trend

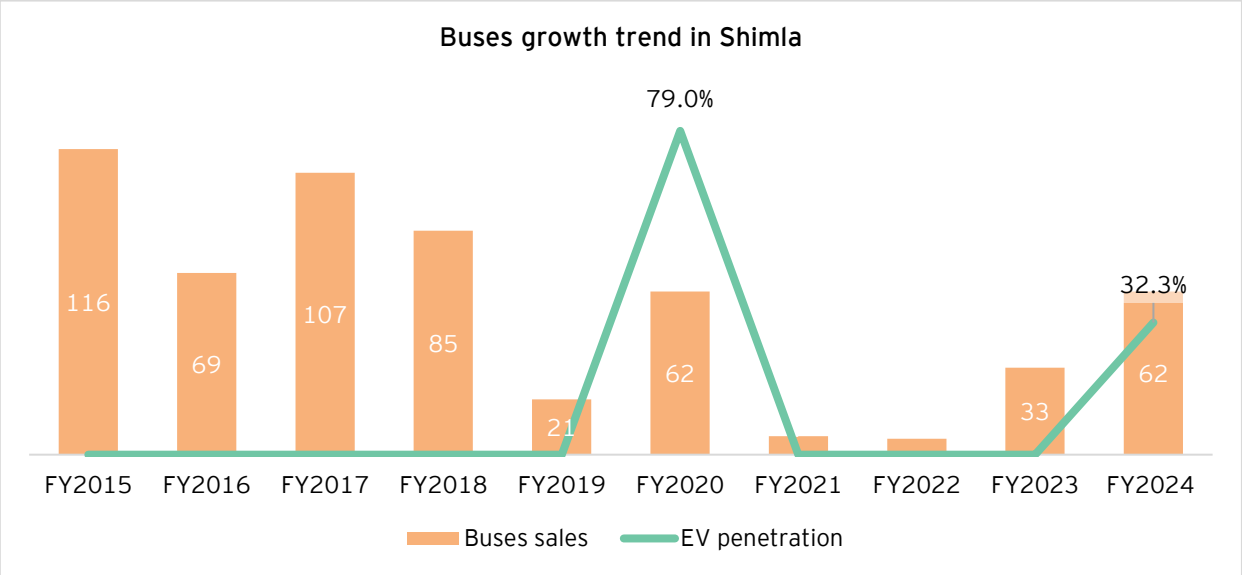
The number of buses has generally declined over the years. However, there has been a slight uptake recently, suggesting renewed interest in sustainable public transport, potentially driven by environmental policies or urban development initiatives. The adoption of electric buses shows sporadic but notable increases, indicating that specific government programs or partnerships are effectively promoting their use to reduce urban air pollution and greenhouse gas emissions.

Graph 14: Buses growth trend in Himachal Pradesh



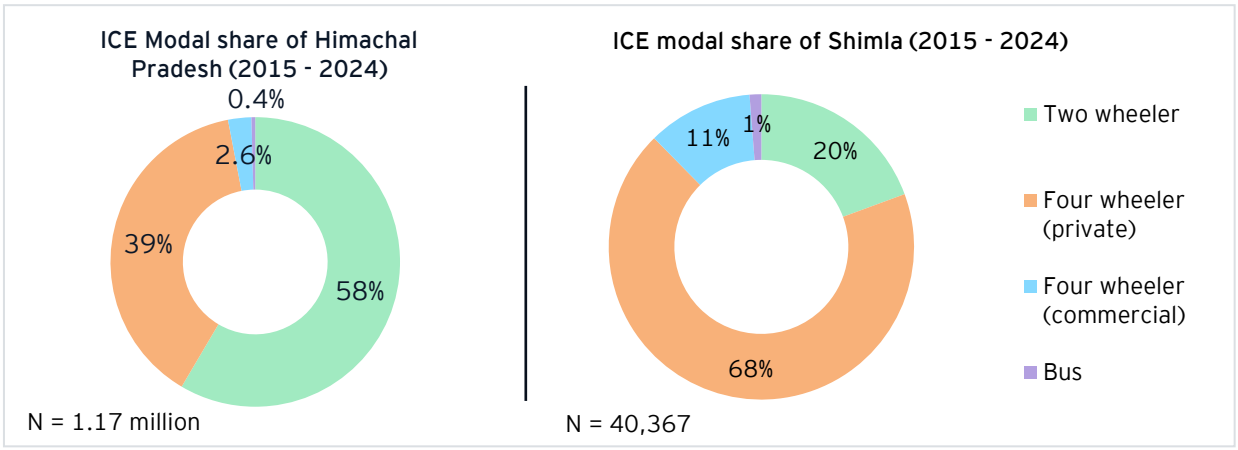
In fiscal year 2024, ~35 electric buses were registered in Himachal Pradesh.

Graph 15: Buses growth trend in Shimla

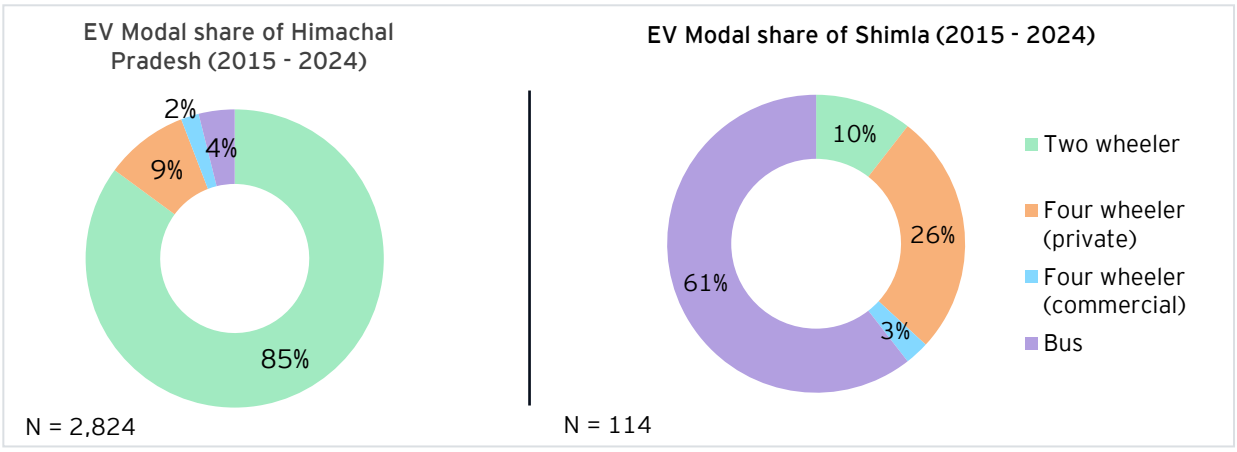


In fiscal year 2024, ~20 electric buses were registered in Shimla.

Graph 16: ICE Modal share of Himachal Pradesh and Shimla (2015 - 2024)



Graph 17: EV Modal share of Himachal Pradesh and Shimla (2015 - 2024)



Growth rate of different ICE vehicle segments:

To assess the growth rates of various vehicle segments, we used the Compound Annual Growth Rate (CAGR) from the FY 2015 to FY 2024 for two-wheelers and four-wheelers (commercial), for four-wheelers (private) the CAGR is considered for FY 2015 to FY 2021 while for buses the years considered are FY 2019 to FY 2023. Below are the segment-wise CAGR figures:

Vehicle category	Growth rate
	3.54%
	5.75%
	5.87%
	11.96%

EV penetration status of different vehicle segments:

Vehicle category	EV penetration rate in Year 2023
	0.91%
	0.81%
	0%
	12.15%*

**The EV penetration for buses is calculated based on the total volume of buses procured from FY2015 to FY2024, as buses are not procured annually, making yearly values potentially misleading.*

4 Policy framework

The pressing need to address climate change has sparked a significant shift in global climate policy, driving nations worldwide to embrace the transition toward a low-carbon economy as a vital step in mitigating the detrimental effects of environmental degradation. During the recent COP 26 summit, India reaffirmed its commitment by pledging substantial reductions, aiming to decrease the emissions intensity of its GDP by 45 percent by 2030 compared to 2005 levels. Simultaneously, India aims to achieve an admirable milestone of 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy sources by the same year.

On the international stage, the momentum to tackle climate change has catalysed policies and governmental incentives geared towards accelerating the adoption of e-mobility as a sustainable alternative for both freight and passenger transportation. This concerted effort has prompted Central and State Governments worldwide to develop comprehensive frameworks and regulations to facilitate the transition to electric vehicles (EVs). **In India, the Ministry of Power (MoP) has assumed a central role in orchestrating this transition, while the Department of Heavy Industries (DHI) has been tasked with establishing widespread charging infrastructure across the nation, leveraging various incentive programs.**

The MoP's designation of the Bureau of Energy Efficiency (BEE) as the Central Nodal Agency (CNA) for Public EV charging infrastructure underscores India's commitment to creating an enabling environment for EV adoption. Additionally, State Nodal Agencies (SNA) are actively engaged in establishing supportive ecosystems at the state level to streamline the transition to EVs.

Furthermore, beyond national endeavours, various governmental bodies, including the Ministry of Road Transport and Highways (MoRTH), Ministry of Housing and Urban Affairs (MoHUA), Ministry of Finance (MoF), Ministry of Science & Technology (MoST), and Ministry of Environment, Forest, and Climate Change (MoEF&CC), are actively formulating and implementing policies conducive to the proliferation of EVs. Together, these coordinated efforts reflect a collective determination to steer transportation toward sustainable solutions and mitigate the adverse impacts of climate change on a global scale.

The key central stakeholders in the E-Mobility sector are:

Figure 4: Timeline of e-mobility initiatives in India

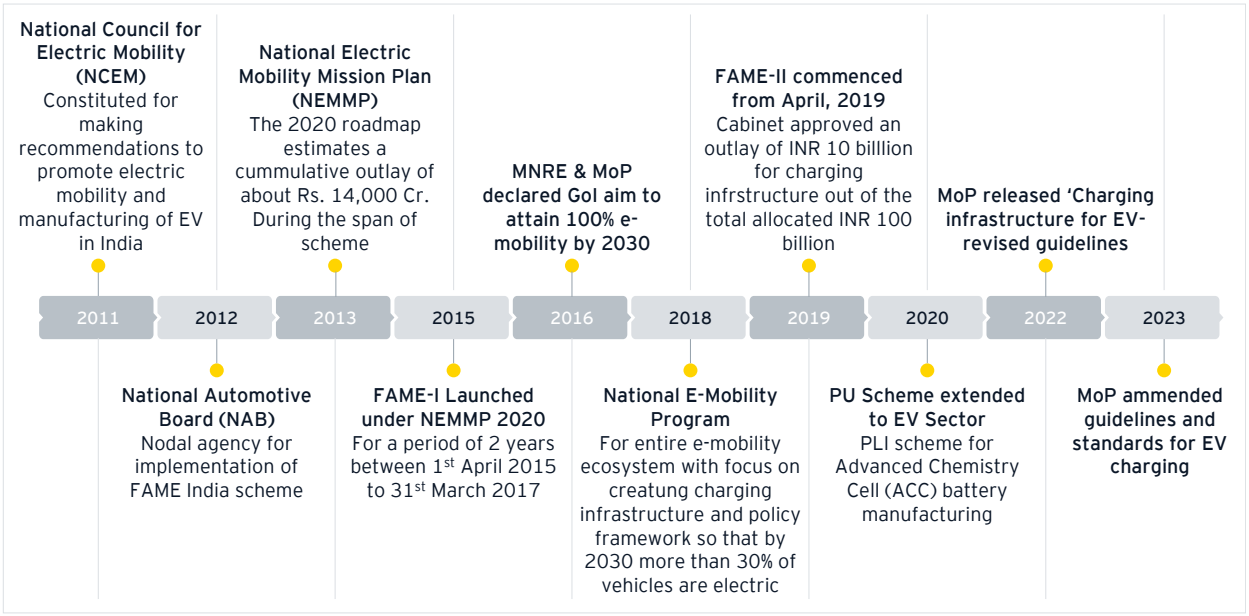
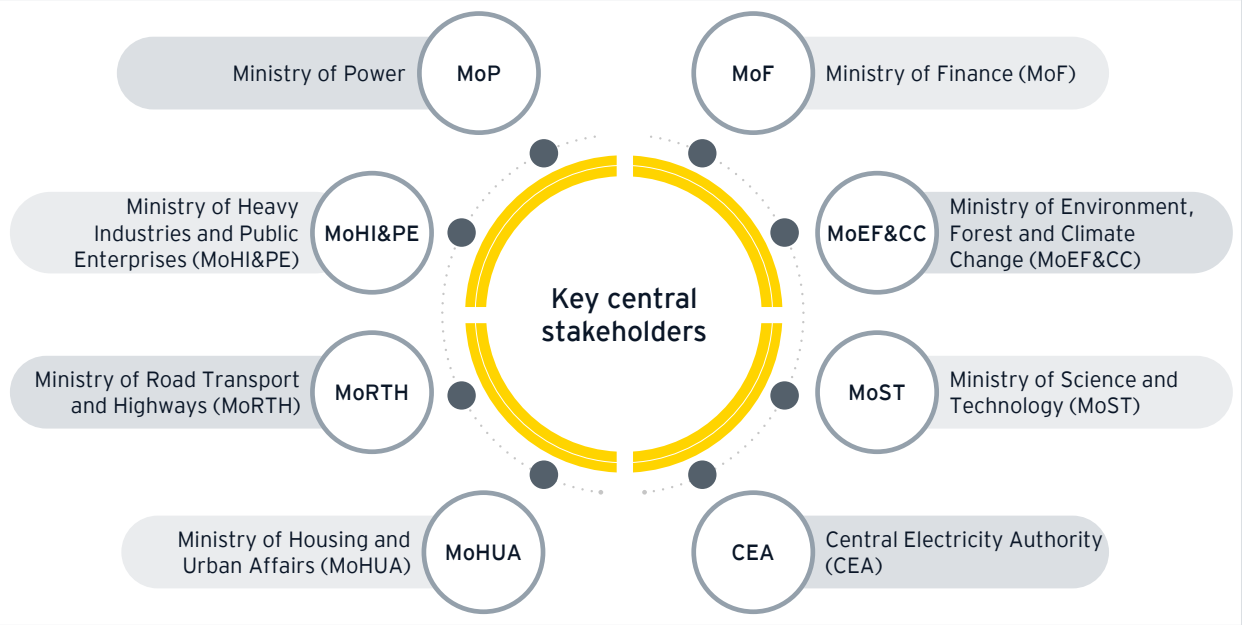


Figure 5: Key Central government stakeholders



1. Ministry of Power

The Ministry of Power (MoP) formulates policies and oversees power projects. In 2018, it issued guidelines for Electric Vehicle Charging Infrastructure, updated in 2022. The MoP appointed the Bureau of Energy Efficiency (BEE) as the Central Nodal Agency (CNA) for national charging infrastructure.

2. Ministry of Heavy Industries and Public Enterprises (MoHI&PE)

Electric mobility initiatives in India, led by the Ministry of Heavy Industries and Public Enterprises (MoHI&PE), began with the National Electric Mobility Mission Plan (NEMMP) in 2013, followed by the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India (FAME India) scheme in 2015. Phase-II of FAME India, introduced in 2019, built upon the insights from FAME-I. The Department of Heavy Industry (DHI) under MoHI&PE manages policy formulation and implementation to drive EV adoption in India.

The Ministry of Heavy Industries is launching the INR 500 Cr Electric Mobility Promotion Scheme 2024 (EMPS 2024) to boost EV adoption nationwide. Under EMPS 2024, subsidies up to INR 10,000 for two-wheelers and INR 25,000 for small three-wheelers will be provided. Large three-wheelers will receive up to INR 50,000. The scheme, active from April 1 to July 31, 2024, aims to accelerate the adoption of electric vehicles and promote advanced battery technology. It also implements the Phased Manufacturing Programme to strengthen the EV manufacturing sector, fostering a sustainable transportation future in India.

3. Ministry of Road Transport and Highways (MoRTH)

The Ministry of Road Transport and Highways (MoRTH) is tasked with developing policies and regulations related to road transport. It contributes to the promotion of electric vehicles (EVs) by designing nonfinancial incentives, such as facilitating parking infrastructure and providing priority lane access.

4. Ministry of Housing and Urban Affairs (MoHUA)

The Ministry of Housing and Urban Affairs (MoHUA) has been instrumental in revising building by-laws to accelerate the installation of charging facilities in commercial and residential complexes. It has also updated the 'Urban and Regional Development Plans Formulation and Implementation Guidelines- 2014' to encompass the establishment of norms and standards for charging infrastructure within city planning frameworks. These guidelines will serve as a reference for State Governments and Union Territories to integrate Electric Vehicle Charging Infrastructure standards into their building by-laws.

5. Ministry of Finance (MoF)

The Ministry of Finance has been pivotal in driving the adoption of electric mobility in India. In 2019, it streamlined customs duties for vehicles, battery packs, and cells across all categories to bolster the Make in India initiative.

6. Ministry of Environment, Forest, and Climate Change (MoEF&CC)

The Ministry of Environment, Forest, and Climate Change (MoEF&CC) is the principal union ministry involved in the 'National Electric Mobility Mission Plan 2020' initiative. Additionally, the ministry introduced the Battery Waste Management Rules, 2022, to enhance the system for managing and disposing of batteries throughout India. These rules aim to establish a robust mechanism for battery disposal while prioritizing public safety. They also seek to ensure accountability across the entire value chain, including central and state authorities.

7. Ministry of Science and Technology (MoST)

The Department of Heavy Industry (DHI) and the Department of Science & Technology (DST) under the Ministry of Science & Technology (MoST) have collaborated to establish the 'Technology Platform for Electric Mobility (TPEM)' aimed at bolstering research and development (R&D) efforts and technological advancements in electric mobility.

8. Central Electricity Authority (CEA)

The Central Electricity Authority (CEA) plays a crucial role in setting and enforcing technical standards across the power sector. It ensures safety and reliability in power grid infrastructure by establishing stringent guidelines for equipment and operational practices. Additionally, the CEA collaborates with stakeholders to promote efficient energy transmission, integrate renewable sources, and adopt emerging technologies. By upholding these standards, the CEA enhances the reliability, resilience, and sustainability of the nation's power infrastructure, ensuring uninterrupted electricity supply to industries, businesses, and households nationwide.

9. Bureau of Energy Efficiency (BEE)

The Bureau of Energy Efficiency (BEE) plays a crucial role in promoting e-mobility. As an agency focused on enhancing energy efficiency and sustainability, BEE is actively involved in developing policies, standards, and initiatives to support the adoption of electric vehicles (EVs) and charging infrastructure. BEE works closely with government agencies, industry stakeholders, and research institutions to implement measures that encourage the use of electric vehicles, improve charging infrastructure, and reduce greenhouse gas emissions from the transportation sector. Through its various programs and initiatives, BEE aims to accelerate the transition to e-mobility and contribute to India's energy security and environmental sustainability goals.

4.1. Overarching framework:

The framework for e-mobility governance in India involves both central and state-level agencies with distinct but interconnected roles.

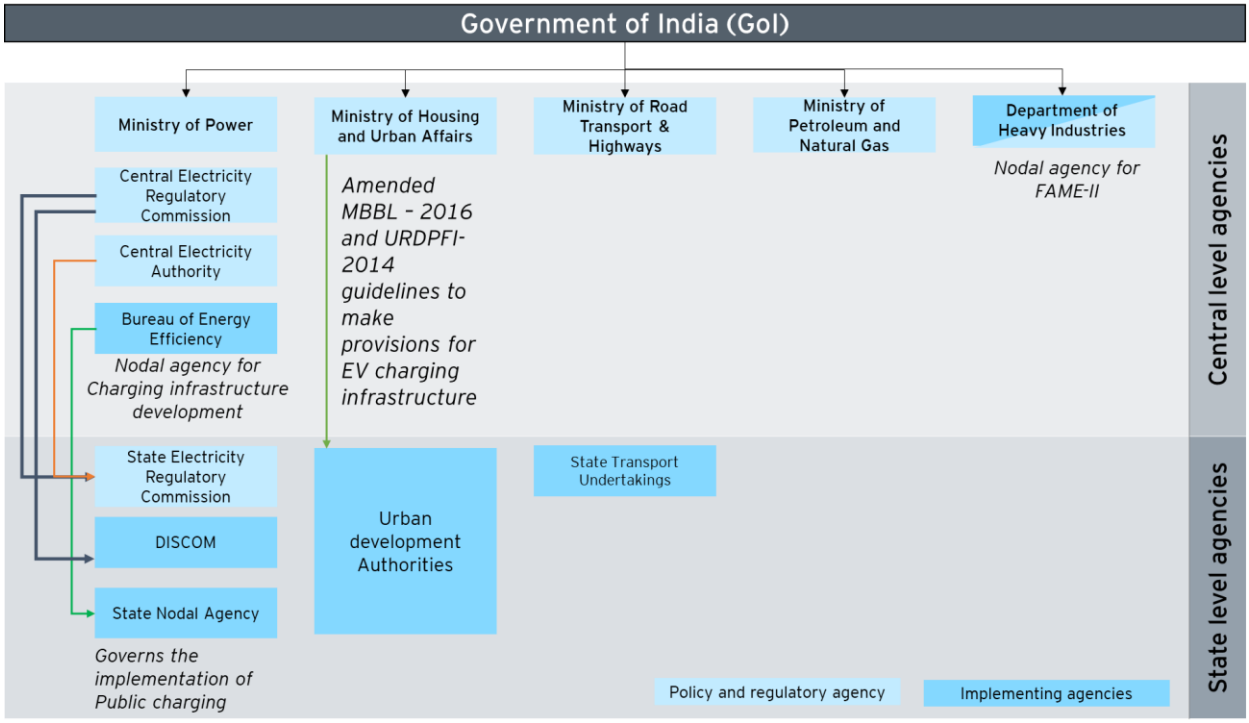
Central-Level Agencies

Central agencies focus on policy formulation, regulatory oversight, and providing funding and incentives for e-mobility initiatives. The Department of Heavy Industries (DHI) serves a dual role, acting both as a policy-making body and an implementing agency through programs like the FAME scheme.

State-Level Agencies

State agencies are responsible for implementing these policies locally. They adapt central guidelines to state-specific needs, develop infrastructure, and promote e-mobility among consumers.

Figure 6: Overarching framework



4.2. Himachal Pradesh State EV Policy

The government of Himachal Pradesh has created an Electric Vehicle (EV) policy on 10th January 2022 to promote the adoption of EVs and build an eco-friendly sustainable transportation system in the state of Himachal Pradesh. The policy aims to encourage the use of electric vehicles to reduce air pollution and decrease dependence on fossil fuels. The policy framework is intended to guide the next five years from its notification date while maintaining flexibility for necessary adjustments and amendments as the sector evolves, allowing the state government the adaptability it needs.

VISION:

The State envision to promote clean mobility solutions through faster adoption of EVs. It endeavours to establish Himachal Pradesh as a model State for Electric Vehicle adoption across segments (personal, shared and commercial) and create an ecosystem for manufacturing of Electric Vehicle (EVs) and its components and supporting infrastructure along with generating employment in the State.

MISSION:

- To save the environment by promoting clean modes of mobility
- To accelerate demand for EVs and promote manufacturing of EVs in the State
- To create a conducive environment for the shift from Internal Combustion Engine (ICE) vehicles to EVs.
- To generate new employment opportunities in the State.

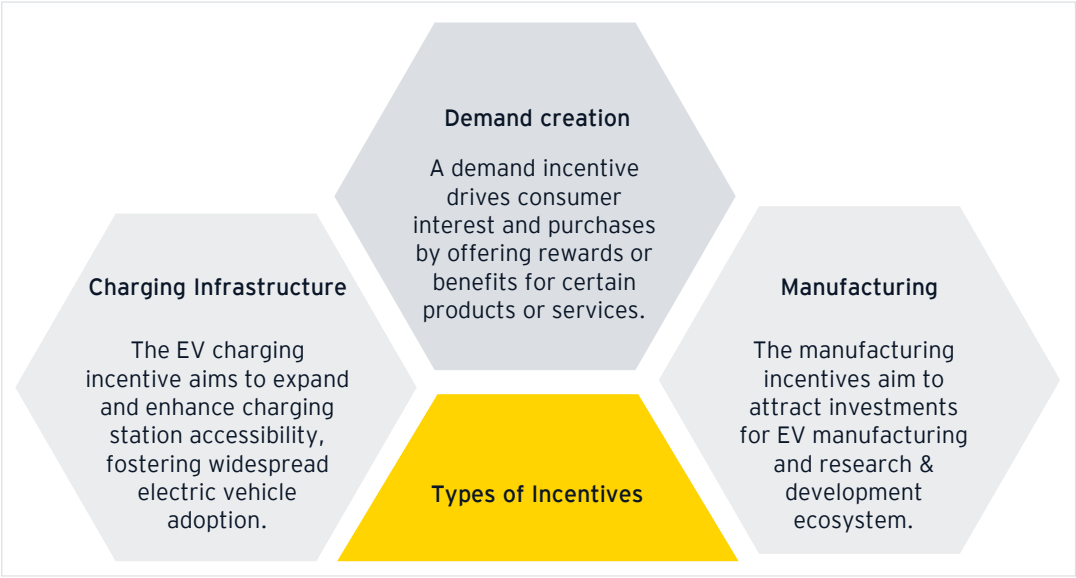
The policy broadly covers different facets of the electric vehicle ecosystem, including manufacturing aspects and the necessary mobility infrastructure needed for their use. It incorporates considerations for electric vehicles (EVs), their various components, batteries, and the crucial charging and battery equipment required for their efficient operation and upkeep.

Signifying the government's dedication to efficient implementation, the Himachal Pradesh Government Energy Development Agency, Himurja, has been appointed as the "Nodal Agency" tasked with monitoring the execution of the policy. This decision underlines the importance the government places on creating an environment that fosters electric vehicle manufacture, deployment, and mobility across the state. By working together and forming strategic alliances, the Himachal Pradesh government aims to drive the electric vehicle sector's growth and concurrently address environmental issues while promoting sustainability agendas.

4.2.1. Objectives of the Himachal Pradesh EV Policy:

Accelerate adoption of EV	The primary objective of the policy is to accelerate adoption of Battery Electric Vehicles (BEVs) in the State so that they contribute to 15% of new vehicle registrations by 2025.
Sustainable Transport System	To promote sustainable transport system for making Himachal a global hub for electric mobility development and manufacturing of Electric Vehicles (EVs).
Facilitating investments	To provide subsidies and incentives to the electric vehicle manufacturing industries for promoting electric mobility in the State.
Setting up manufacturing units	To create public and private charging infrastructure for EV's so that the manufacturers of electric vehicles unit are attracted to set up their manufacturing Unit in the State.
EV Readiness	To declare and work towards making Shimla, Mandi, Baddi, Dharamshala as model cities for EV readiness and adoption in the State.

The Himachal Pradesh State EV Policy, 2022 offers incentives in three categories:



4.2.2. Demand Creation Incentives:

The State Government provides two type of demand incentives to accelerate the uptake of EVs:

Purchase Incentives

- Governement provides 50% subsidy for purchase of e-Taxi/e-Trucks/e-Buses /e-Tempo travellers incentives on purchase of EVs under the Raiiv Gandhi Swarozgaar Yojna -2023
- At least 1 low/zero-emission zone where EVs, walking and cycling are permitted in four model cities.

Tax and fee waivers

- **Commercial permit fees** –State waives annual permit fee on commercial EVs in accordance with Ministry of Road Transport and Highways notification.
- **Road tax** –State exempts EVs from road tax (Token) in accordance with Himachal Pradesh Transport Department for the duration of the policy.
- **State toll taxes**–EVs registered in H.P. and other States are exempted from paying toll taxes on highways for the duration of the policy.

4.2.3. Charging infrastructure related incentives:

Himachal Pradesh State Electricity Board Limited (HPSEBL) has been designated as "State Nodal Agency" for setting up charging infrastructure.

Charging infrastructure target:

- At least 1 charging station/point within every 1kmx 1km grid in four model cities-Shimla, Mandi, Baddi and Dharamshala
- At least 1 charging station (on each side) every 25 km on State highways and at least 1 charging point (on each side) every 50 km on busy National Highways

Incentives:

- Incentive for charging Infrastructure shall be claim from the Production Linked Incentives (PLI) Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage of Ministry of Heavy Industries for amounting of Rs. 18,100/- Crore.

Tariff structure:

- HPSEBL is empowered to set tariff applicable for all EV charging and battery swapping stations

across the State. Current EV Tariff is 5.82 Rs/kwh.

Other Non-Fiscal incentives to support EV charging infrastructure:

- A single window system to expedite interconnection and installation permissions.
- Inter-operability through solutions such as open database and flexibility on charger specifications.

4.2.4. Manufacturing Incentives:

Allocation of 100 to 200 acres of land as per provisions in the State Industrial Policy of Himachal Pradesh for developing EV parks with adequate infrastructure, common facilities and necessary external infrastructure.

A single window clearance mechanism to provide adequate support to companies, especially start-ups, to setup factories and units in the (EV) park.

Infrastructure support to manufacturing firm to provide land, water, electricity and road connectivity

4.3. Standard Operating Procedure (SOP) for the purchase of e-Taxi/e-Trucks/e-Buses/e-Tempo Travellers

The policy encompasses detailed guidelines for implementing the "Rajiv Gandhi Swarozgaar Yojana-2023" for the purchase of e-Taxis, e-Trucks, e-Buses, and e-Tempo Travellers. It also outlines the Standard Operating Procedures (SOPs) for hiring e-Taxis under the same scheme by any government department, local authorities, autonomous bodies, boards, corporations, government undertakings, or any other establishments. These guidelines and procedures aim to ensure efficient, transparent, and standardized processes for adopting electric vehicles across various sectors in Himachal Pradesh, thereby promoting clean mobility and supporting the state's environmental and economic goals.

4.3.1. The detailed guidelines for implementation of "Rajiv Gandhi Swarozgaar Yojana-2023" for the Purchase of e-Taxi/e-Trucks/e-Buses/e-Tempo Travellers

Objective:

The initiative aims to save the environment by promoting clean mobility, boosting EV sales, creating employment, decarbonizing transport, and promoting ecotourism in Himachal Pradesh. This aligns with the "Himachal Pradesh Electric Policy, 2022," which provides a 50% subsidy for the purchase of various electric vehicles (EVs), including e-Taxis, e-Trucks, e-Buses, and e-Tempo travellers.

i. e-Taxi Purchase Procedure:

Applicability: Suitable for government departments, local authorities, autonomous bodies, boards, corporations, government undertakings, or similar establishments in need of new or replacement vehicles. In cases where a driver is not available, the department will publish the vehicle requisition in leading newspapers. Prospective applicants are required to commit to a three-year agreement with the department, extendable up to five years. Additionally, applicants must secure a contract carriage permit under the Motor Vehicles Act/Rules, supported by recommendations from the department, to be submitted to the Secretary of the Regional Transport Authority. To prevent misuse and ensure gainful utilization, the subsidy will be managed through financial institutions on a back-end basis.

Eligibility: The applicant must be a bona fide resident of Himachal Pradesh and provide an agreement from a government department, local authority, autonomous body, board, corporation, government undertaking, or other establishment. This agreement must list passengers, confirming the vehicle will be used exclusively for that contract, prohibiting other passengers. The applicant must obtain permission from the Secretary of the Regional Transport Authority and comply with all provisions of the Motor

Vehicle Act, 1988, Central Motor Vehicle Rules, 1989, and Himachal Pradesh Motor Vehicle Rules, 1999. Only valid license holders can drive these electric vehicles, which must be approved by the Director of Transport, Himachal Pradesh. The permission is restricted to the contract period, and the vehicle must only carry passengers or employees of the contracting agency.

ii. e-Maxi, e-Travellers, e-buses:

Eligibility for Purchase: The applicant seeking permission to operate vehicles must be a resident of Himachal Pradesh. They are required to obtain explicit approval from the Secretary of the Regional Transport Authority within the state. Furthermore, strict adherence to all regulations outlined in the Motor Vehicle Act of 1988, Central Motor Vehicle Rules of 1989, and Himachal Pradesh Motor Vehicle Rules of 1999 is mandatory. Only individuals possessing valid licenses are permitted to operate these vehicles in compliance with the law.

iii. e-trucks:

Eligibility for Purchase: The applicant seeking permission to operate vehicles must be a resident of Himachal Pradesh. They are required to obtain explicit approval from the Secretary of the Regional Transport Authority within the state. Furthermore, strict adherence to all regulations outlined in the Motor Vehicle Act of 1988, Central Motor Vehicle Rules of 1989, and Himachal Pradesh Motor Vehicle Rules of 1999 is mandatory. Only individuals possessing valid licenses are permitted to operate these vehicles in compliance with the law.

> The Secretary of the Regional Transport Authority will issue permission to applicants, which serves as an authentic document to obtain a 50% subsidy under the "Rajiv Gandhi Swarozgaar Yojana-2023." Applicants must then apply for the subsidy on the Industries Department's web portal after fulfilling all formalities.

4.3.2. Standard of Procedures (SOPs) for hiring of e-Taxi under "Rajiv Gandhi Swarozgaar Yojna-2023" by any Government Department/Local Authorities/Autonomous Body/ Board/ Corporation/ Government Undertaking or any other establishment.

The "Rajiv Gandhi Swarozgaar Yojana" promotes employment and reduces vehicular pollution in Himachal Pradesh by providing a 50% subsidy on e-taxi purchases, supporting the state's goal of environmental sustainability. Government departments can engage e-taxis for four years, extendable by two years, to meet their transportation needs. E-taxi demand and redistribution of drivers are managed through a Transport Department online portal. The scheme covers various e-taxi categories, such as sedans, SUVs, and luxury vehicles, with committee-set rates and reimbursement for charging costs. The Transport Department raises awareness through workshops to educate potential applicants. Interested individuals apply online, meeting criteria like residency, age, and licensing, with applications reviewed by RTOs. Approved demands are facilitated by the Industries/Designated Department, which arranges subsidies and loans through partner banks. Dealers handle the processing and invoicing for vehicle loans, ensuring compliance with the scheme's terms, including engagement duration, usage expectations, and legal obligations. Overall, the scheme supports sustainable transport while fostering local employment.

- **Objective of the Scheme:** The "Rajiv Gandhi Swarozgaar Yojana" **aims to provide 50% subsidy on e-taxi purchases** to foster employment and reduce vehicular pollution in Himachal Pradesh, promoting the state's transition towards becoming environmentally sustainable.
- **Engagement of e-Taxi**: Government departments and organizations can engage e-taxis for an initial four-year period, extendable by an additional two years, to meet their vehicle needs.
- **Demand of e-taxi:** The Consumer Department/Agency will communicate their specific e-taxi requirements to the Transport Department via a dedicated online portal, facilitating the redistribution of surplus drivers between departments as needed.
- **Category of Vehicle:** The e-taxi scheme includes categories such as Sedan, SUVs with varying ranges, Premium SUVs/MUVs, and Luxury Vehicles, each serving different operational needs.

- **Imparting education/awareness:** The Transport Department conducts workshops and awareness programs at the RTO level to educate potential applicants on the benefits and technicalities of e-vehicles.
- **Rates for engaging e-Taxi:** Committee-set rates govern the engagement of e-taxis by departments, with charging costs reimbursed at actuals by the e-taxi owners.
- **Procedure for applying for e-taxi permission:** Interested individuals apply through the Transport Department's online portal, undergoing authentication and receiving updates via SMS at each application stage.
- **Eligibility criteria:** Applicants must be bona fide Himachali residents, aged at least 23, possess a valid driving license, and meet educational qualifications outlined in the scheme, with allowances for special cases.
- **Selection process:** Applications are scrutinized by RTOs, with discrepancies requiring rectification within specified timelines to ensure eligibility for approval by a committee overseeing the issuance of e-taxi permissions.
- **Role of Consumer Department/Organization:** These entities upload specific e-taxi demands and necessary approvals to the Transport Department's portal, ensuring compliance with engagement terms.
- **Role of Industries/Designated Department:** Upon approval, demands for e-taxis are transferred to the Industries/Designated Department, which facilitates 50% subsidies for purchases and arranges vehicle loans through partnering banks.
- **Role of Dealer:** Dealers process approved demands for e-taxis, generating invoices that facilitate bank loans for successful applicants.
- **Terms & Conditions:** Conditions include a minimum four-year engagement period for e-taxis, running expectations, payment modalities, vehicle maintenance responsibilities, and adherence to legal and operational regulations.

5 Market Assessment

5.1. EV Sales projections

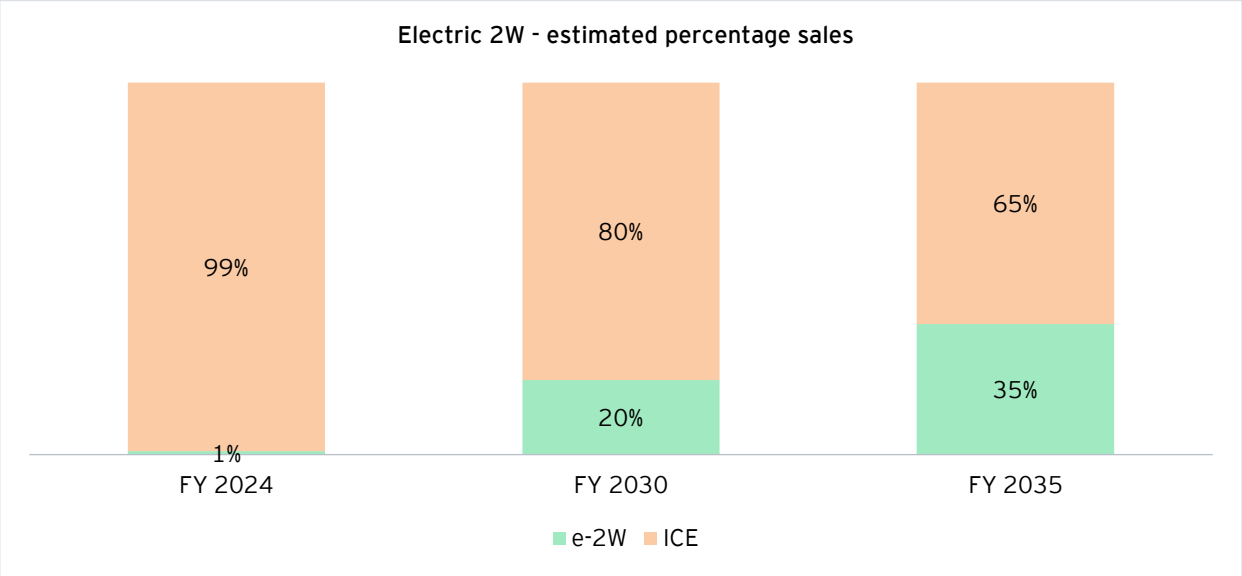
Table 8: EV Sales projections

Vehicle category	EV penetration rate		EV Sales	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
e-2W	18% - 20%	33% - 35%	185 - 195	390 - 400
e-4W (private)	8% - 10%	18% - 20%	255 - 265	690 - 700
e-4W (commercial)	12% - 15%	23% - 25%	170 - 180	380 - 390
e-bus	45% - 50%	75% - 80%	10 - 15	50 - 55

Electric Two-wheelers:

Electrifying two-wheelers in Shimla will be beneficial because it can significantly reduce air pollution and noise levels, contributing to a cleaner and quieter environment. Despite the current low adoption rate due to challenging terrain, insufficient charging infrastructure, and cold climate affecting battery performance, transitioning to electric two-wheelers offers long-term benefits in sustainability and public health. two-wheelers, being more numerous and frequently used for shorter, urban commutes, can significantly alleviate traffic congestion, and offer quicker adoption benefits in terms of reducing overall pollution levels.

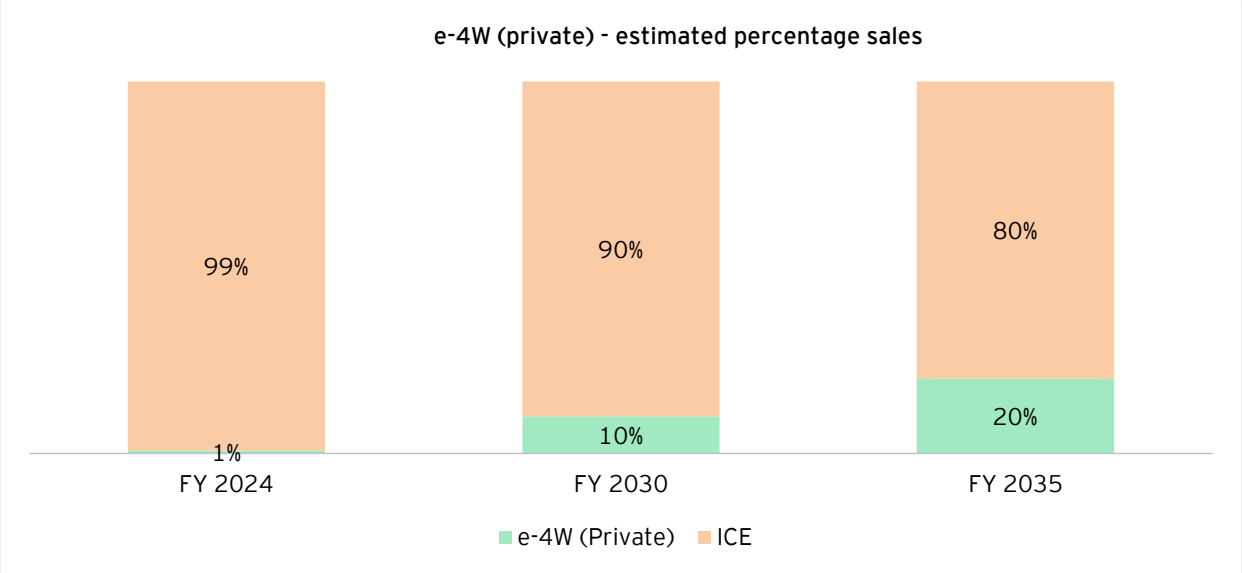
Graph 18: Estimated sales of Electric two-wheelers



Electric Four-wheeler (Private):

The low electrification rate of four-wheelers in Shimla is due to the challenging terrain and insufficient charging infrastructure. Electrification would be beneficial as it would reduce air pollution and dependency on fossil fuels, enhancing environmental sustainability and public health. Four-wheeler electrification offers greater reductions in emissions and fuel consumption due to their typically higher usage and greater fuel consumption compared to two-wheelers.

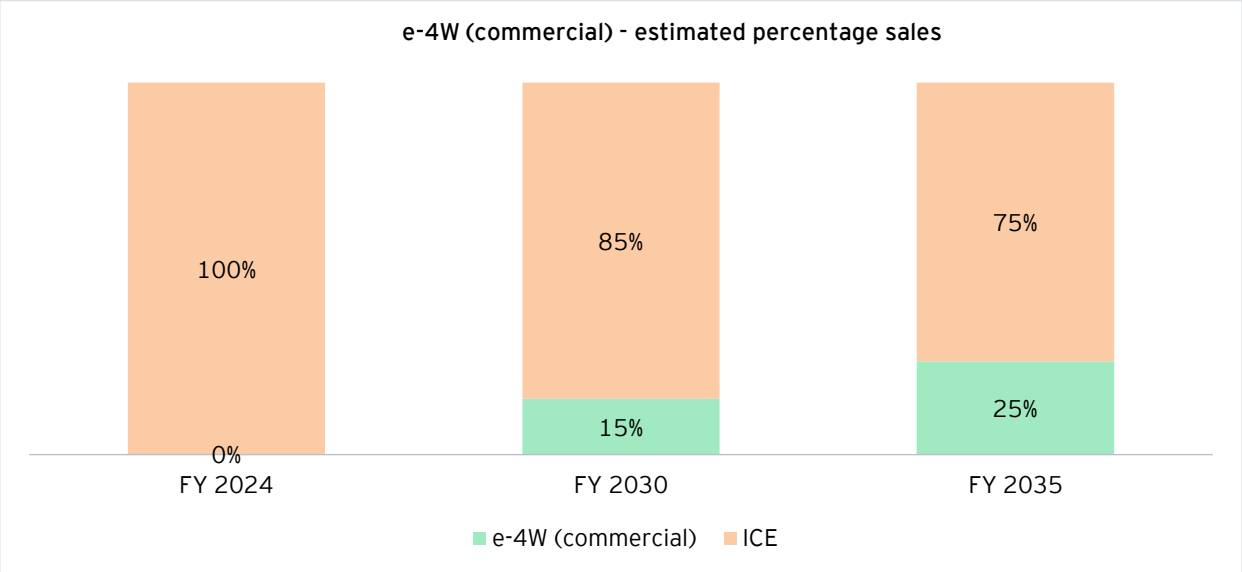
Graph 19: Estimated sales of electric four-wheeler (private)



Electric Four-wheeler (Commercial):

Taxis in Shimla should be electrified to significantly reduce air and noise pollution in this ecologically sensitive region, promoting a healthier environment for residents and tourists. Electric taxis offer lower operating costs and require less maintenance, providing economic benefits for drivers. Furthermore, with taxis being a primary mode of transport in Shimla, electrification can lead to substantial reductions in greenhouse gas emissions and fossil fuel dependency, supporting sustainable urban mobility and setting a positive example for broader adoption of electric vehicles.

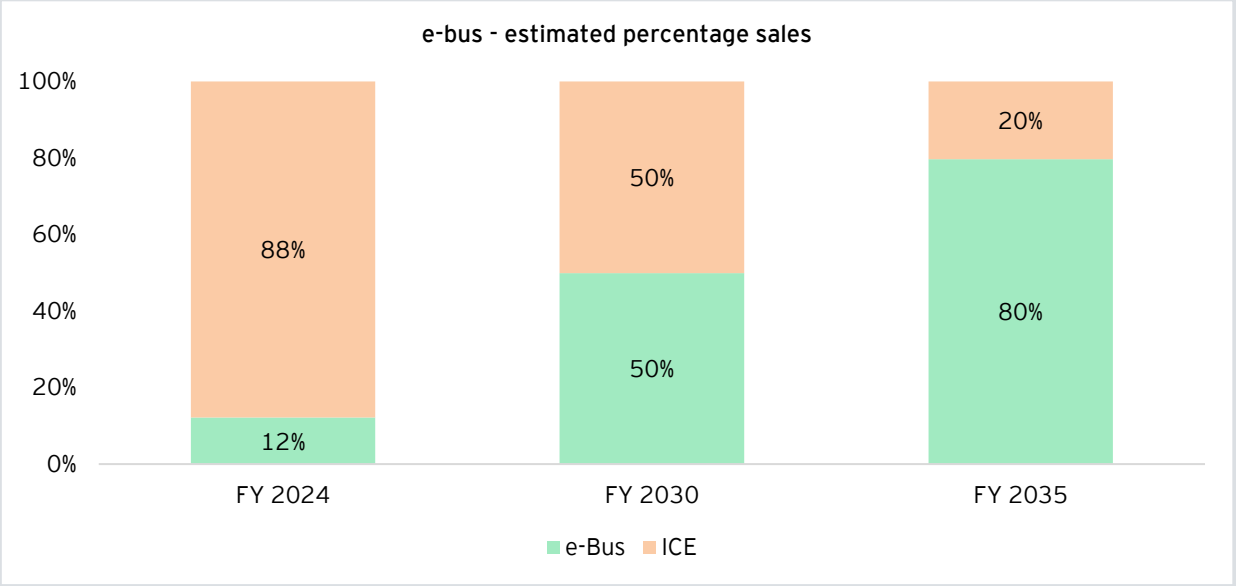
Graph 20: Estimated sales of electric four-wheeler (commercial)



Electric bus:

A major drawback of bus electrification in Shimla is the challenging hilly terrain, which can strain battery performance and reduce the range of electric buses. This issue may be curbed down in future with advanced battery technology with higher energy density and efficiency, ensuring that buses can handle steep inclines and longer routes. Additionally, establishing a robust network of fast-charging stations strategically located along bus routes can alleviate range anxiety and ensure reliable operation throughout the city.

Graph 21: Estimated sales of electric bus



5.2. Projection of power demand for different vehicle segment

Considering the overall stock of different segments of electric vehicles, the power requirements for charging electric vehicles is mentioned below table:

Table 9: EV stock volume & total power demand of Shimla in FY2030 and FY2035

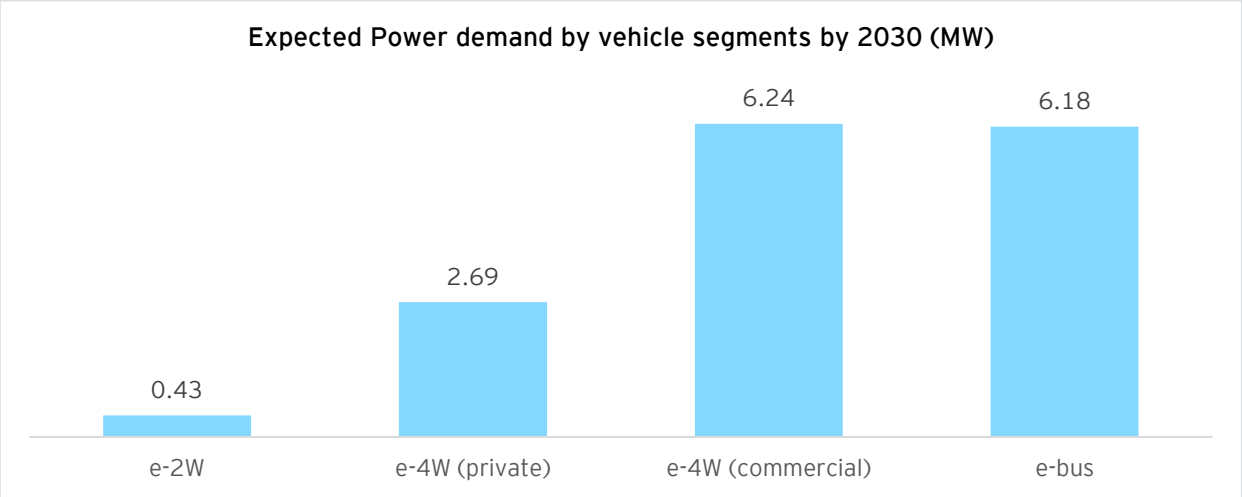
Vehicle category	Volume		Total Power Demand (MW)	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
e-2W	648 - 650	2,185 - 2,190	0.3 - 0.5	1.0 - 1.5
e-4W (private)	843 - 845	3,330 - 3,350	2.5 - 3.0	10.5 - 11.0
e-4W (commercial)	565 - 568	2,035 - 2,038	6.0 - 6.5	22.0 - 23.0
e-bus	60 - 65	240 - 245	6.0 - 6.5	24.0 - 26.0
Total	**2,120 - 2,130**	7,790 - 7,800	**15 - 18**	**57 - 60**

The share of public charging, home charging, captive charging and workplace charging are as follows:

Table 10: Charging type wise power demand in FY 2030

Power demand in 2030 (in MW)								
Vehicle category	Public charging share	Power demand from Public charging stations	Home charging share	Power demand from Home charging	Captive charging share	Power demand from captive charging	Work-place charging share	Power demand from workplace charging (2030)
e-2W	20%	0.09	50%	0.2	-	-	30%	0.13
e-4W (private)	50%	1.3	10%	0.3	-	-	40%	1
e-4W (commercial)	30%	1.9	0%	-	70%	4.4	-	
e-bus	-	-	-	-	100%	6.2	-	-
Total		**~3.25**		**~0.5**		**~10.5**		**~1.10**

Graph 22: Expected Power demand by vehicle segments by 2030 (MW)



Graph 23: Expected power demand share at different locations by 2030 (MW)

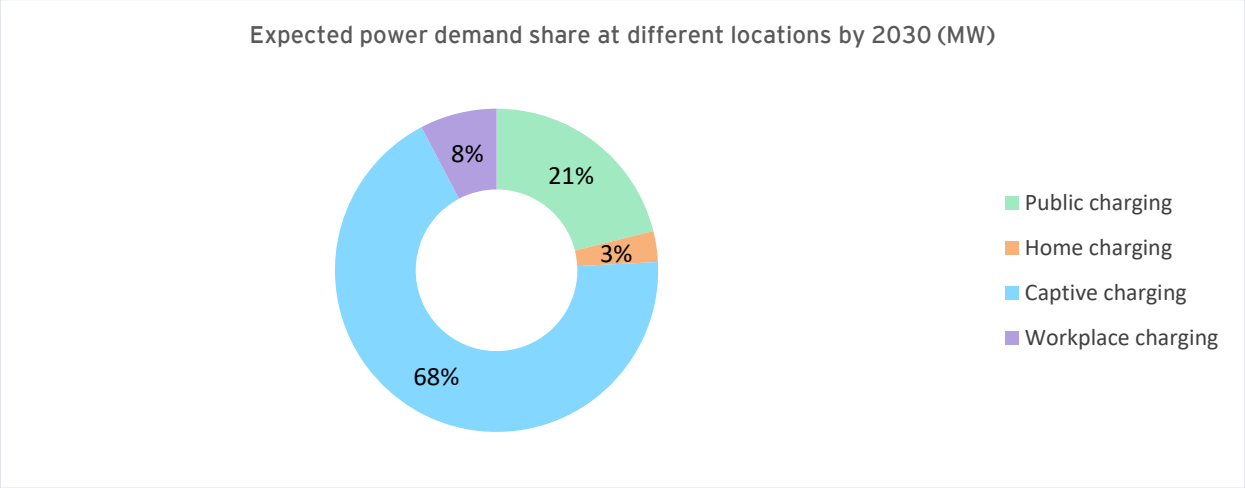
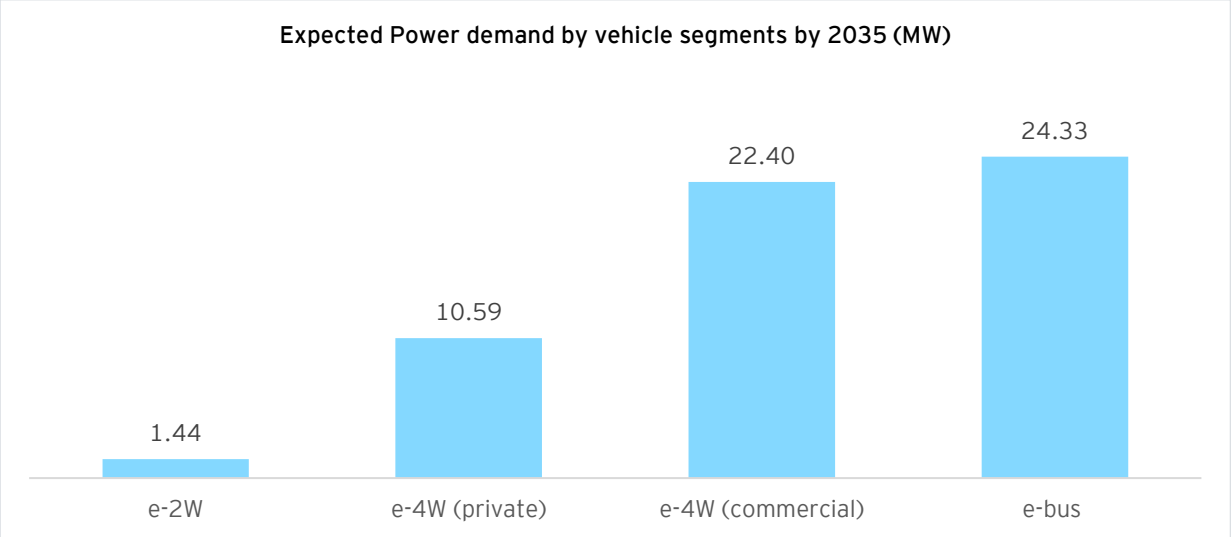


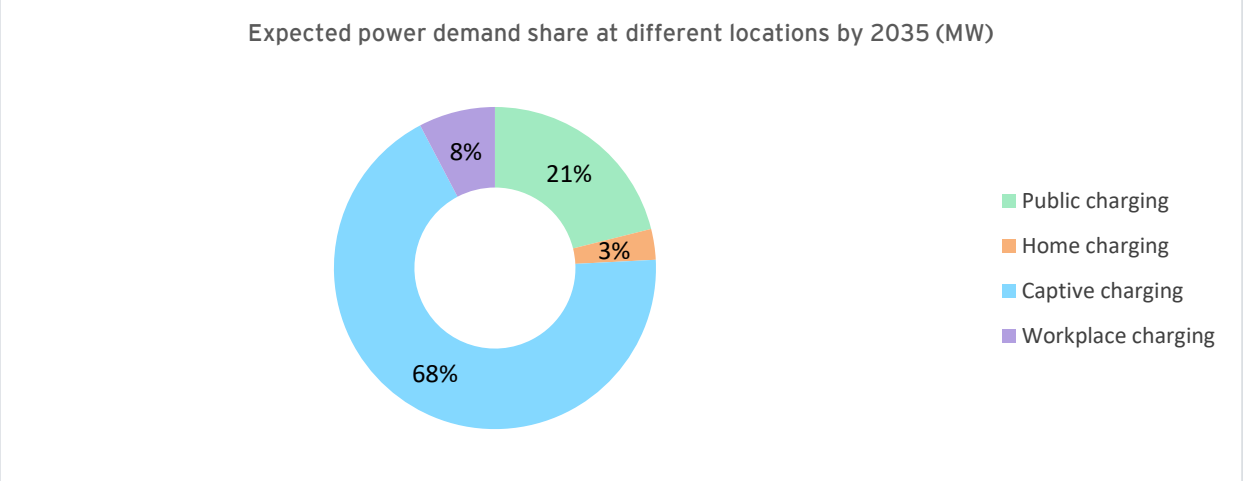
Table 11: Charging type wise power demand in FY 2035

Power demand in 2035 (in MW)								
Vehicle category	Public charging share	Public charging stations	Home charging share	Home charging	Captive charging share	Captive charging	Workplace charging share	Workplace charging (2035)
e-2W	20%	0.3	50%	0.7	-	-	30%	0.4
e-4W (private)	50%	5.3	10%	1.1	-	-	40%	4.6
e-4W (commercial)	30%	6.7	-	-	70%	15.7	-	
e-bus (govt intracity)	-	-	-	-	100%	24.3	-	-
Total		**~12.0**		**~2.0**		**~40.0**		**~5.0**

Graph 24: Expected Power demand by vehicle segments by 2035 (MW)



Graph 25: Expected power demand share at different locations by 2035 (MW)



Additional power demand due to electrification of Solid Waste Management vehicles

Vehicle category	Numbers		Total Power Demand (MW)	
	FY 2030 (E)	FY 2035 (E)	FY 2030 (E)	FY 2035 (E)
SWM vehicles (EV volume)	120 - 125	350 - 360	0.1 - 0.2	0.3 - 0.4
Tourist 4W Vehicle (EV influx '000)	17 - 18	45 - 46	2.5 - 3.0	7.0 - 7.5

5.3. Projection of EV Charging infrastructure and cost

The number of chargers required is projected on the basis of total power demand required for charging electric vehicles and assumed utilization rate. Accordingly, the numbers of chargers projected is around 80 by FY 2030 which would further double up to around 160 EV chargers by FY 2035.

The projected number of chargers for deployment is mentioned in the table below:

Table 12: Projected number of chargers required for public charging stations and bus depots by 2030

Charger Rated Capacity	kW	e-2W	e-4W (Pvt)	e-4W (Com)	e-Bus	Total
LEV AC	10 (3*3.3)	6				6
IS-17017-2-6	7	6				6
CCS II	50		6	8		14
CCS II	180 (2*90)				10	10
Total		**12**	**6**	**8**	**8**	**36**

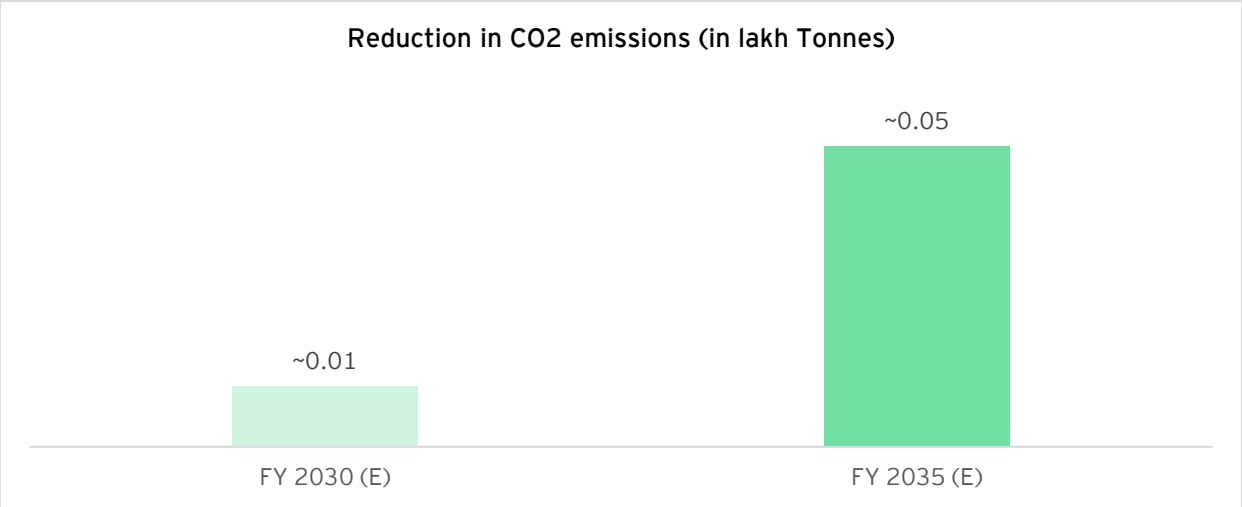
Table 13: Projected number of chargers required for public charging stations and bus depots by 2035

Charger Rated Capacity	kW	e-2W	e-4W (Pvt)	e-4W (Com)	e-Bus	Total
LEV AC	10 (3*3.3)	11				11
IS-17017-2-6	7	11				11
CCS II	50		15	18		33
CCS II	180 (2*90)				18	18
Total		**22**	**15**	**18**	**13**	**73**

5.4. Impact on GHG emissions

The link between decarbonization and the evolving vehicle landscape in Shimla is clear and significant. Projections indicate that the transition from Internal Combustion Engine (ICE) vehicles to Electric Vehicles (EVs) could lead to a reduction in emissions ranging from 0.005 to 0.01 lakh tonnes by FY 2030. This noteworthy estimate is poised to experience a significant upsurge by FY 2035, culminating in a remarkable reduction in CO_2 emissions spanning from 0.03 lakh to 0.05 lakh tonnes.

Graph 26: Reduction in CO_2 emissions



6

Primary consultation with **city level stakeholders**

Dealership:

The annual average sales for four-wheelers are approximately 800 internal combustion engine (ICE) vehicles, while for two-wheelers, the figure is around 350. In contrast, the annual registration of electric vehicles (EVs) for four-wheelers is about 100.

While service centres for ICE vehicles are widely available, there is a notable lack of service infrastructure for electric vehicles.

Additionally, about 30% of dealerships are hesitant to introduce EVs. They estimate that the demand for EVs is around 18% to 20% in the four-wheeler category and approximately 15% for two-wheelers.

Despite significant government subsidies that offer a 50% discount on taxis, many consumers seem unaware of these incentives. Car dealers believe that this lack of awareness is a major barrier to the adoption of subsidized vehicles.

The preference for traditional motorbikes over electric two-wheelers is especially pronounced in hilly regions like Shimla. Most two-wheeler dealers report that customers prioritize motorbikes for their superior pickup and speed, which are crucial for navigating steep inclines.

These factors collectively illustrate the current market dynamics and consumer preferences, highlighting the challenges and opportunities for increasing the adoption of electric vehicles and hybrids in various terrains and regions.

Challenge

In Shimla, prospective buyers of two-wheelers and four-wheelers must obtain a parking certificate before registering their vehicles due to severe parking issues in the hilly city. This requirement, aimed at managing congestion and parking shortages, often causes significant delays as obtaining the certificate can take weeks. Despite its intention to regulate vehicle ownership and parking, the bureaucratic process poses a considerable inconvenience to residents eager to purchase new vehicles.

Driver:

The feedback from e-bus drivers has been notably positive, with many expressing lack of concern regarding range anxiety.

> This confidence stems from the fact that their routes are meticulously planned based on the electric bus models' claimed range by the original equipment manufacturers (OEMs). This pre-planning ensures that the buses' daily operations align closely with their battery capacities, alleviating worries about running out of power mid-route. Such adherence to planned routes reflects a successful integration of electric buses into urban transport systems, promoting efficiency and reliability.

Conversely, drivers accustomed to traditional Internal Combustion Engine (ICE) buses have shown openness to transitioning to electric vehicles (EVs). However, they have highlighted the need for training in repairing and maintaining e-buses.

> This requirement underscores a crucial aspect of transitioning to EVs ensuring that mechanics and drivers receive adequate training to manage the different maintenance needs and technological aspects of electric vehicles. Addressing these training needs not only supports the successful adoption of EVs but also enhances the confidence and skillset of bus operators in managing this new technology effectively.

Overall, the feedback from both e-bus drivers and traditional ICE bus drivers highlights important considerations in the shift towards electric public transportation. It emphasizes the importance of route planning in mitigating range concerns for EVs and underscores the necessity of tailored training programs to facilitate a smooth transition to electric bus fleets.

Challenge

E-bus drivers have expressed concerns about the clearance of the buses they operate, suggesting that it should be increased for better manoeuvrability and to navigate rough terrain more effectively. However, experts from the original equipment manufacturers (OEMs) have countered this feedback, stating that

raising the clearance of the e-buses is not technically feasible due to design limitations or other engineering constraints.

Another significant issue raised by the drivers is the extended periods their buses spend in workshops for repairs or maintenance. During the initial phase of deployment, many buses reportedly spent between 2 to 6 months undergoing repairs or maintenance. This downtime is seen as impractical for private operators who need to maintain consistent service levels and minimize operational disruptions.

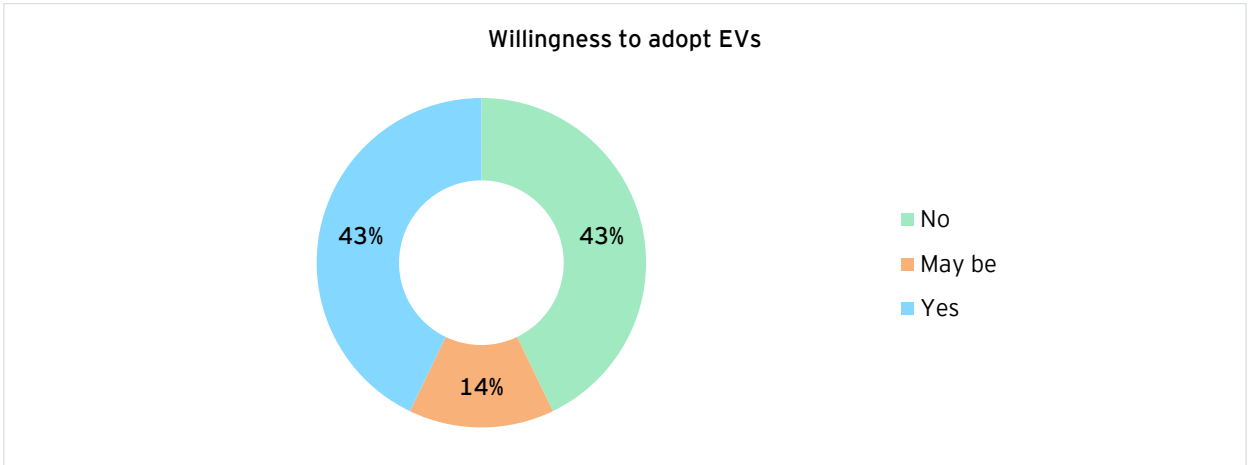
These challenges underscore the complexities involved in integrating electric buses into public transportation systems. While drivers advocate for design adjustments to enhance operational performance, OEMs face constraints that limit their ability to make certain modifications. Moreover, the prolonged downtime for maintenance poses a practical barrier to widespread adoption, especially for private operators who must balance operational efficiency with fleet maintenance requirements.

Addressing these concerns will require collaborative efforts between manufacturers, operators, and policymakers to optimize e-bus designs, streamline maintenance processes, and ensure that electric buses meet the reliability and operational standards necessary for sustainable urban transport solutions.

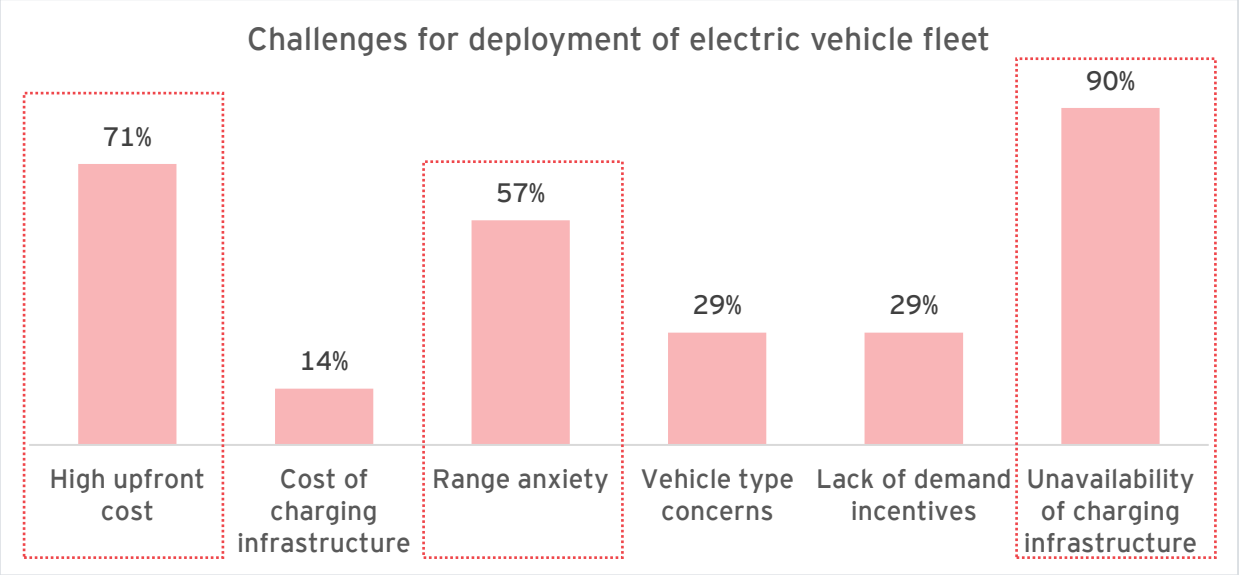
Fleet operators:

- There are three major unions responsible for the operation of 4W (four-wheeled) taxis within the region. Each union plays a crucial role in managing their respective fleets, ensuring that the supply of taxis aligns with the fluctuating demand throughout the year. The unions strategically deploy their fleets based on seasonal demand patterns to maximize efficiency and meet customer needs.
- The average fleet size consists of approximately 40 vehicles.
- The daily average distance travelled per vehicle is around 100 kilometres for intracity routes and about 250 kilometres for intercity routes.
- The daily earnings per vehicle are approximately Rs. 4,500.
- Most fleet owners do not have designated parking areas for their vehicles, leading to potential logistical challenges.

Graph 27: Fleet operators willingness to adopt EVs



Graph 28: Challenges for deployment of electric vehicle fleet



- During the peak or on-season periods, such as holidays, festivals, or tourist influxes, the demand for taxis significantly increases. Recognizing this surge, the unions ramp up their operations by putting more vehicles on the road. This proactive approach ensures that there is a sufficient number of taxis available to accommodate the increased number of passengers, thereby reducing wait times and improving service reliability.
- Conversely, during the off-season, when demand is lower, the unions may scale back their operations. This adjustment helps in optimizing operational costs and maintaining a balance between supply and demand. By dynamically adjusting their fleet sizes and operations, these unions effectively manage resources, ensuring that the taxi service remains efficient and responsive to customer needs year-round.
- This operational flexibility highlights the unions' ability to adapt to varying market conditions, ensuring that the transportation needs of the community are met consistently, regardless of seasonal fluctuations.

Fleet operators across various sectors have shown a readiness to transition their fleets from traditional vehicles to electric vehicles (EVs), recognizing the environmental and economic benefits of cleaner transportation. However, a significant hurdle they face in this transition is the inadequate infrastructure of charging stations. This shortage of charging infrastructure poses a critical challenge as it limits the practicality and feasibility of operating EVs on a large scale.

Without a robust network of charging stations, fleet operators express concerns about the reliability and accessibility of charging facilities.

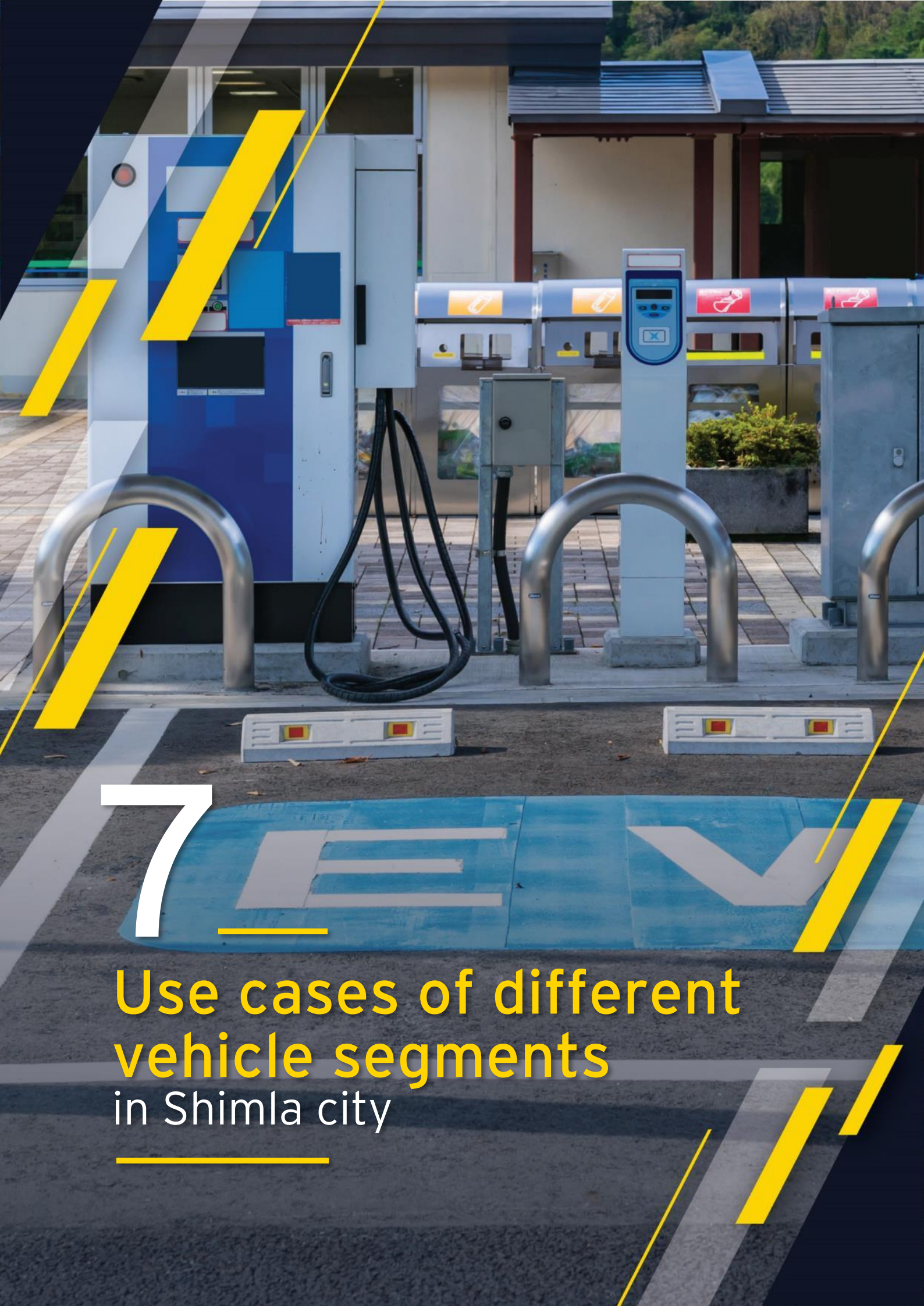
This issue is particularly acute for fleets that require continuous operation or have stringent schedules, such as delivery services or public transportation providers. The lack of convenient charging options not only hinders the adoption of EVs but also raises operational uncertainties and potential downtime, impacting overall fleet efficiency.

Additionally, despite the government offering subsidies aimed at promoting the adoption of electric vehicles, many fleet owners remain unaware of these financial incentives. Their primary concern revolves around the process and transparency of subsidy disbursement. The complexity and perceived opacity in accessing these subsidies create uncertainties and delays in decision-making for fleet operators who are considering transitioning to EVs.

The challenges are insufficient charging infrastructure and uncertainties surrounding subsidy disbursement, they highlight the multifaceted barriers that need to be addressed to accelerate the adoption of electric vehicles in fleet operations. Addressing these issues will require coordinated efforts from policymakers, infrastructure developers, and industry stakeholders to ensure that EV adoption is supported by adequate charging infrastructure and streamlined subsidy mechanisms. Such efforts are crucial for achieving sustainable and efficient transportation solutions in the transition towards a greener future.

Challenge

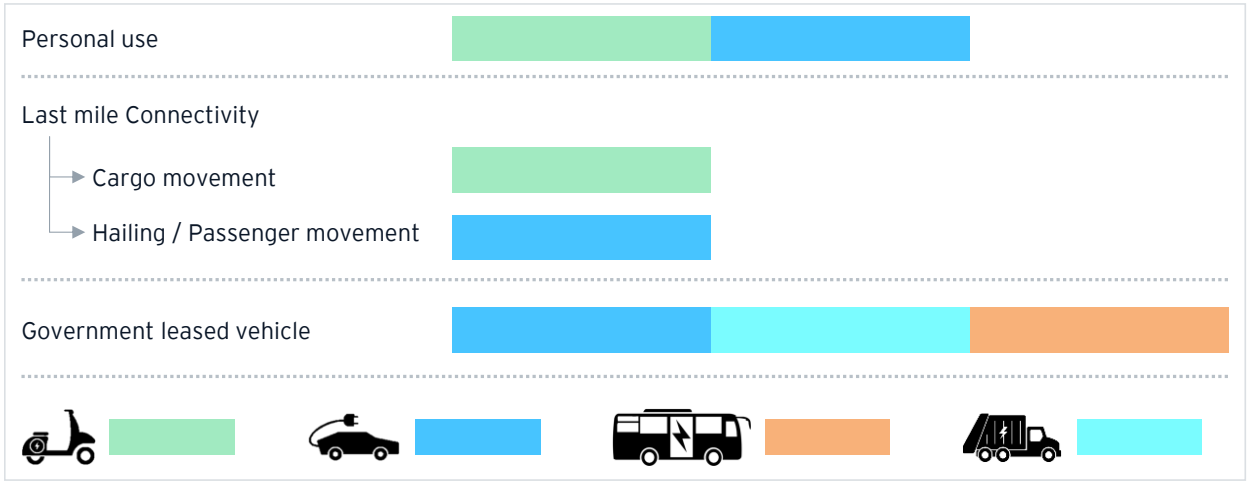
Fleet operators are eager to transition to electric vehicles (EVs) but cite the limited number of charging stations as a major obstacle. They emphasize that widespread availability of charging infrastructure is essential before they can fully embrace EVs. This shortage poses logistical challenges and concerns about operational reliability, crucial for sectors like logistics where punctuality is key.



7

Use cases of different vehicle segments in Shimla city

Mapping of different fleet use cases:



7.1. Personal use:

Two-wheeler:

Two-wheelers, including motorcycles and scooters, are popular choices of transportation for several reasons:

Two-wheelers are highly manoeuvrable vehicles, allowing riders to navigate through traffic congestion and narrow streets more easily compared to larger vehicles like cars.

Two-wheelers require much less space to park than four-wheelers. This makes them convenient for urban areas where parking space is limited and expensive.

Generally, two-wheelers tend to be more fuel-efficient compared to cars, which means they offer a cost-effective mode of transportation for short to medium distances.

In many cases, the initial cost of purchasing a two-wheeler is lower than that of purchasing a car. Additionally, maintenance and operating costs are usually lower for two-wheelers.

Two-wheelers come in various types and sizes, catering to different needs and preferences. From small scooters for local commuting to powerful motorcycles for longer trips, there is a wide range of options available to suit different lifestyles.

Why two–wheelers should be electrified:

Two-wheelers achieve cost parity with the lowest utilization among all vehicle segments due to several factors:

Sr. No.	Particulars	Details
1	**Operational Cost Savings**	Despite their minimal usage, two-wheelers offer substantial operational cost savings. The average round trip commute for office workers falls within the range of 30-40 kilometres. With a daily usage of around 30 kilometres, operational cost savings can exceed INR 25,000 annually when compared to traditional vehicles.
2	**Sufficient Range**	Two-wheelers typically offer ranges of 70-100 kilometres per charge, which is more than adequate for fulfilling daily personal transportation needs, including commuting to offices and schools. This range ensures that users can complete their daily trips without worrying about running out of charge.
3	**Consistent Commuting Patterns**	While personal usage of two-wheelers may vary, commuting to offices and schools remains consistently high over time. This consistent demand for transportation to and from key locations ensures that two-wheelers remain a practical and reliable mode of travel.
4	**Convenient Charging**	Charging electric two-wheelers at home is convenient and straightforward, requiring only a standard 15A power socket for their portable charger. Additionally, some models feature removable batteries, making indoor charging even more accessible and convenient for users.
5	**Minimal Parking Space**	Two-wheelers have a compact size that occupies minimal parking space, making them suitable for urban environments where parking is limited. This compact size also simplifies workplace charging setups, as they require less space for charging infrastructure installation.
6	**Enhanced EV Visibility**	Two-wheelers constitute the largest vehicle segment in many cities, and their electrification could significantly boost the visibility of electric vehicles (EVs) in urban environments. Increased visibility promotes awareness and acceptance of EVs among the general public.
7	**Word of Mouth Influence**	Word of mouth is highly effective in encouraging the adoption of unfamiliar technology such as electric vehicles. A single user of electric two-wheelers can serve as a positive example and motivate their co-workers and family members to consider electric vehicles as well, further contributing to the adoption of sustainable transportation options.

Steps to electrify personal two-wheeler segment

The Ministry of Housing and Urban Affairs (MoHUA) has issued guidelines regarding EV charging infrastructure, allowing individuals to use their residential power supply for charging electric vehicles via a standard 230V/15A socket. Workplaces can also set up similar charging points in their parking areas and construct standalone sheds for charging removable batteries. Safety guidelines include placing sockets in shielded areas, installing them as independent units with safety mechanisms, keeping fire extinguishers nearby, and ensuring installation by certified electricians. Prefabricated charging points with integrated safety features and app-based tracking are available, like the Bharat AC-001 chargers that can accommodate three vehicles simultaneously at 3.3 kW power.

Four-wheeler:

Four-wheelers, are popular choices of transportation for several reasons:

Cars generally provide better protection to occupants in the event of a crash compared to two-wheelers. They are equipped with safety features such as seat belts, airbags, and crumple zones designed to minimize the impact of collisions.

Cars offer more comfort and amenities compared to two-wheelers. They provide protection from weather conditions, noise, and pollution, and often come equipped with features like air conditioning, entertainment systems, and comfortable seating.

Cars typically offer more storage space than two-wheelers. They have trunks where passengers can store groceries, luggage, and other belongings securely, making them more practical for transporting goods and larger items.

Cars can accommodate multiple passengers comfortably, making them suitable for families and group travel. They offer seating for several people, along with ample legroom and headroom.

They can be locked securely, and many modern cars come equipped with advanced security features such as anti-theft systems and GPS tracking.

Cars are well-suited for long-distance travel, offering greater range and endurance compared to two-wheelers. They can travel extended distances without the need for frequent refuelling or recharging.

Steps to electrify personal four-wheelers:

- **Research and Choose an Electric Vehicle**: Research various electric car models available in the market. Factors such as range, charging infrastructure, pricing, and incentives to be assessed.
- **Evaluate Charging Infrastructure**: Assess the availability of public charging stations in area. Determine installation process of home charging station.
- **Financial Planning and Incentives:** financial options for purchasing, tax credits, rebates, and incentives offered by local and national governments to support electric vehicle adoption.
- **Charging Procedures:** Understanding the different charging levels (Level 1, Level 2, DC fast charging) and the time required for each type of charger.
- **Maintenance and Service**: Electric vehicles have different maintenance requirements compared to internal combustion engine vehicles, which typically involve fewer components and less frequent maintenance intervals.
- **Dispose of Old Vehicle**: selling it to a dealership or recycling it through a certified facility.

7.2. Last mile connectivity: Vehicle segment – Two-wheelers and four-wheelers

7.2.1. Cargo movement: Vehicle segment - two-wheelers

Last-mile cargo movement refers to the final stage of the logistics process, where goods and products are transported from a distribution centre or hub to the end destination, typically the customer's doorstep or a retail location. This stage of delivery is often considered the most crucial and challenging part of the supply chain, as it involves navigating through urban or suburban areas to reach individual customers or small businesses.

Two-wheelers vehicles are particularly well-suited for urban deliveries due to their compact size and agility. They can navigate through narrow streets, congested traffic, and tight alleyways, reaching destinations that might be inaccessible to larger vehicles. This makes them ideal for last-mile deliveries, where goods need to be transported from distribution centres to final destinations.

Compared to larger trucks and vans, two-wheeler vehicles are more affordable to purchase, operate, and maintain. They consume less fuel, require fewer maintenance costs, and often have lower insurance premiums. This cost-effectiveness makes them a preferred choice for small businesses, independent contractors, and delivery services looking to optimize their operational expenses.

Many two-wheeler vehicles run on alternative fuels such as electricity or compressed natural gas (CNG), reducing their environmental impact compared to traditional gasoline-powered vehicles. Electric two-wheelers, in particular, produce zero tailpipe emissions, contributing to improved air quality and reduced carbon footprint, especially in densely populated urban areas.

Advancements in technology, including GPS navigation, route optimization software, and telematics systems, have enhanced the efficiency and productivity of cargo movement using two-wheelers vehicles. These technologies help drivers optimize delivery routes, track shipments in real-time, and improve overall fleet management, leading to faster deliveries and enhanced customer satisfaction.

Key features and aspects of last-mile cargo services include:

- **Customer-Centric Focus**: Last-mile delivery is focused on meeting the specific needs and expectations of customers. It aims to provide timely, reliable, and convenient delivery options that enhance the overall customer experience.
- **Efficiency and Timeliness**: Last-mile delivery services prioritize speed and efficiency to ensure that packages reach their destination within the shortest possible time frame. This often involves optimizing delivery routes, utilizing technology for route planning and tracking, and employing efficient delivery methods.
- **Flexibility and Adaptability**: Last-mile delivery services must be adaptable to various delivery scenarios and customer preferences. This includes offering multiple delivery options such as same-day or next-day delivery, flexible delivery time slots, and the ability to reroute packages in real-time based on customer requests or changes in delivery instructions.
- **Technology Integration**: Technology plays a significant role in last-mile delivery services, enabling route optimization, real-time tracking, electronic proof of delivery, and communication between delivery personnel and customers.
- **Cost-Effectiveness**: Last-mile delivery services strive to optimize costs while maintaining service quality. This includes minimizing fuel consumption, reducing delivery times, maximizing vehicle capacity utilization.
- **Sustainability**: With increasing concerns about environmental impact, last-mile delivery services are increasingly focused on adopting sustainable practices. This may include using electric vehicles, optimizing delivery routes to minimize emissions, implementing eco-friendly packaging

solutions, and exploring alternative delivery methods such as bicycle or pedestrian couriers.

- **Collaboration and Partnerships**: Last-mile delivery services often involve collaboration and partnerships between logistics companies, retailers, e-commerce platforms, third-party delivery providers, and technology companies. These partnerships help streamline operations, expand delivery networks, and improve service offerings.

Three distinct delivery modes are employed to fulfil the diverse delivery requirements of businesses, either in isolation or in conjunction with each other:

- **Business-Owned**: In this model, vehicles are acquired and managed directly by the delivery platform, store, or e-commerce entity. This approach necessitates a substantial initial investment and is most suitable for entities experiencing consistent demand and maintaining high utilization rates for each vehicle.
- **Service Contracts**: Under this arrangement, vehicles are owned by service providers contracted to manage deliveries. It's a lighter asset approach with ongoing payments, either time-based or performance based. This model is adaptable for businesses of all sizes as they can delegate operational intricacies to service providers and adjust service utilization based on actual demand.
- **Driver-Owned**: In this model, vehicles are owned and managed by drivers themselves, who are contracted by businesses. This primarily encompasses smaller vehicles, as private ownership of larger delivery vehicles is uncommon. Typically, gig workers without long-term contracts with the business opt for this model, offering maximum flexibility to match demand. Although it's a lighter asset model for businesses, it entails significant investment and risk for drivers, including vehicle wear and tear, increased insurance premiums, and accident risks. Additionally, drivers may lack the training and operational efficiency needed for delivery services, necessitating guidance from businesses to operate effectively.

Steps to electrify Last-mile cargo vehicles:

- **Upfront Costs and Funding Accessibility**: The initial expenses play a critical role for both companies and electric vehicle (EV) service providers. Subsidies and incentives associated with programs like FAME II and the state EV Policy provides indispensable support in this regard. It is essential to raise awareness about the available benefits and streamline the application process. Financial institutions, often cautious about investing in new technologies, require education on the proven operational advantages of electric vehicles. Government encouragement can motivate these institutions to offer loans, with publicly owned banks leading by example through specialized financial assistance for EV purchases.
- **Range and Reliability**: Businesses need to carefully analyse their delivery patterns to identify areas of high utilization where EVs can be introduced initially. This allows for first-hand evaluation of their reliability. EV service providers should actively showcase their capabilities and be ready to offer vehicles for trial periods. Contracts with EV service providers should include provisions for minimum payment guarantees to mitigate adverse effects during low utilization periods. However, since EVs offer maximum savings in high-utilization scenarios, businesses inherently aim to minimize instances of low utilization.
- **Fragmented Service Landscape**: As time progresses, EV service providers will expand their operations. To accelerate this growth, businesses should nurture deeper partnerships with service providers and support their expansion through investments and long-term contracts. This collaborative approach fosters the development of large service providers proficient in meeting partner companies' specific needs, even as they expand into new territories. Such partnerships also position businesses as pioneers in zero-emission delivery, expediting the attainment of economies of scale.

7.2.2. Hailing service: Vehicle segment – Four-wheelers

Taxis play a crucial role in modern transportation systems and offer several benefits that make them important for individuals, communities, and economies. Here are some reasons why taxis are considered essential:

- **Accessibility and Convenience**: Hailing vehicles provide accessible transportation options for individuals who may not own a vehicle or have access to public transit systems. They offer door-to-door service, making it convenient for passengers to travel directly to their desired destinations without the need for transfers or additional transportation modes.
- **Flexibility and On-Demand Service**: They operate on an on-demand basis, allowing passengers to request a ride whenever and wherever they need it. This flexibility is particularly valuable in situations where public transportation options are limited, or when individuals require immediate transportation for urgent matters or emergencies.
- **Accessibility for Tourists and Visitors**: They play a vital role in catering to the transportation needs of tourists and visitors in cities and tourist destinations worldwide.
- **Support for Local Economies**: This industry creates employment opportunities for drivers, dispatchers, maintenance personnel, and other support staff, contributing to local economies and livelihoods. Additionally, these services generate revenue through fares, taxes, and licensing fees, which support public infrastructure and services.
- **Accessibility for Individuals with Mobility Challenges**: They serve as an important transportation option for individuals with mobility challenges or disabilities who may require assistance or accommodations when traveling.

7.3. Government leased vehicle: Vehicle segment – Four-wheelers, Solid waste management (SWM) vehicles and buses.

Four Wheelers:

Leased vehicles for government agencies offer a flexible and cost-effective solution for meeting transportation needs while minimizing upfront capital investment.

Leasing allows government agencies to access vehicles without the significant upfront costs associated with outright purchase. Lease agreements typically involve fixed monthly payments, making budgeting and financial planning more predictable for government departments.

Leasing provides flexibility in fleet management, allowing agencies to adjust the size and composition of their vehicle fleets according to changing needs. Government agencies can lease a variety of vehicles, including sedans, SUVs, vans, and specialty vehicles, to accommodate diverse operational requirements.

Leasing enables government agencies to access newer vehicle models equipped with advanced safety features, improved fuel efficiency, and enhanced technology. By leasing vehicles on a rotational basis, agencies can ensure that their fleets remain up-to-date and compliant with evolving regulatory standards.

Many lease agreements include maintenance and service packages, relieving government agencies of the burden of managing vehicle upkeep. Maintenance contracts may cover routine servicing, repairs, and roadside assistance, ensuring optimal vehicle performance and reliability.

Leasing simplifies administrative tasks associated with vehicle ownership, such as registration, insurance, and compliance with regulatory requirements. Government agencies can streamline administrative processes and focus on core responsibilities without the administrative complexities of vehicle ownership.

Leasing helps mitigate the risks associated with vehicle depreciation, resale value fluctuations, and technological obsolescence. Lease agreements may include provisions for vehicle disposal at the end of the lease term, transferring residual value risk to the leasing company.

Leasing newer, more fuel-efficient vehicles can contribute to environmental sustainability goals by reducing greenhouse gas emissions and fuel consumption. Government agencies can prioritize the adoption of electric vehicles through leasing arrangements.

There are currently 2 widespread models for leasing of government vehicles, which are dry lease and wet lease:

- **Dry lease:** It is a contractual agreement where the government entity leases vehicles for utility work or for their staff from another party without additional services included. In this arrangement, the entity would solely receive the vehicles and be responsible for deploying their own staff or manpower to operate and maintain the vehicles.
- **Wet lease:** This type of model entails a more comprehensive arrangement. In this case, the government entity not only procure the vehicles on a lease but also avail additional services of drivers. This model grants the leasing company greater control over the entire operation of the vehicles, including personnel management and maintenance schedules.

Solid waste Management vehicle

SWM vehicle door-to-door collection is a systematic method used by municipalities to collect household waste directly from residences, aiming to streamline waste collection, enhance efficiency, and improve community sanitation. This involves dedicated vehicles equipped for waste segregation, operated by trained personnel along designated routes and schedules. Key components include waste segregation at the source, scheduled collections, segregated transportation, and promoting compliance and awareness among residents. Benefits encompass improved sanitation, environmental sustainability through recycling, and protection of public health by preventing disease spread.

WHY electrify SWM vehicles?

- **High emissions**
  - Diesel fleet
  - Low fuel efficiency
  - Increasing waste generation
- **High cost**
  - High fuel cost
  - High maintenance cost
  - Low vehicle life

Potential to electrify

- Fixed origin and destinations (routes)
- Fleet ownership level (single agency or limited agency in play for all fleet)
- Major stakeholder is ULB

Potential barriers in electrification

- Overloading
- Usage tracking, smart technology integration
- Road gradients
- Lack of trained drivers

Solid waste Management (SWM) vehicle electrification case:

Vijaywada:

In 2017, Vijayawada, a city in the Indian state of Andhra Pradesh, emerged as a pioneer in the adoption of electric three-wheelers. This move marked a significant shift towards sustainable transportation solutions. The decision to introduce electric three-wheelers was likely influenced by the growing concerns over pollution, particularly in urban areas where traditional fossil fuel vehicles contribute significantly to air and noise pollution.

Following Vijayawada's lead, Coimbatore, another city in India, took a step towards embracing eco-friendly transportation by integrating 50 electric three-wheelers into its fleet in 2019. This adoption demonstrates a broader trend across various Indian cities towards embracing cleaner modes of transportation.

The commitment made by the Andhra Pradesh government to purchase 7500 electric three-wheelers for garbage collection further underscores the state's commitment to environmental sustainability. By opting for electric vehicles for garbage collection, the government aims to reduce carbon emissions and promote cleaner streets and neighbourhoods. The timeline set by the Andhra Pradesh government to procure electric three-wheelers for garbage collection by December 2019 highlights a sense of urgency and determination to transition towards greener alternatives rapidly.

Pune:

PMC possesses approximately 1,400 vehicles, comprising both three and four-wheelers as well as heavy-duty vehicles, dedicated to garbage collection and transportation. Among these, about 750 vehicles are heavy-duty, primarily utilized for the purpose of collecting and transporting solid waste.

The Pune Municipal Corporation procured 10 electric tipper trucks from Eka Mobility for the purpose of collecting garbage throughout the city.

The price of each vehicle amounts to approximately ₹17 lakh, equipped with a 30-kilowatt battery. The company asserts a mileage of 180 kilometres on a full battery charge.

Charging station is established within the premises of sewage treatment plant on Sinhagad Road. Currently, the plan is to deploy these vehicles in the Sinhagad Road area for the collection and transportation of solid waste.

Steps to electrify SWM vehicles:

1. **Mandated Replacement of ICE Vehicles:**
   - Emphasis on replacing ICE vehicles.
   - Focus on ICE mini-trucks approaching end of life to expedite EV adoption.
   - Minimum replacement rate of 10% annually targets oldest and least efficient ICE vehicles for gradual transition to EVs.
2. **Procurement Strategies:**
   - Bulk purchases and tendering processes to address EV acquisition costs.
3. **Training Program Development:**
   - Feedback-driven training program ensures proficient EV operation, maintenance, and longevity.
   - Enhances operational efficiency and sustainability of expanding EV fleet.
4. **Charging Infrastructure Expansion:**
   - Overnight charging at depots and parking lots aligns with practical EV operational needs.
5. **Maintenance Contracts and OEM Partnerships:**
   - Crucial for securing technical support and spare parts for growing EV fleet.
   - Encourages OEMs to develop tailored models addressing specific market demands.

Buses

Electric buses are sustainable public transportation vehicles powered by electricity instead of fossil fuels. They offer benefits like reduced emissions, lower operational costs, and quieter operation. Advancements in battery technology and charging infrastructure support their feasibility. Governments worldwide are investing in electric buses to promote sustainability, offering incentives and subsidies. Challenges include the need for charging infrastructure and higher upfront costs.

Steps to electrify Buses:

- **Feasibility Study**: Conduct a feasibility study to assess the viability of electrifying STU buses. Factors such as budget, infrastructure requirements, route characteristics, and operational considerations to be assessed.
- **Policy and Regulatory Framework**: Policies and regulations to support the electrification of STU buses. This may include incentives, subsidies, and mandates to encourage the adoption of electric buses and support the development of charging infrastructure.
- **Procurement Process**: This involves issuing requests for proposals (RFPs) or tenders to select manufacturers or suppliers of electric buses. Factors such as bus specifications, range, charging capabilities, warranty, and after-sales support to be considered.
- **Charging Infrastructure**: Assess the charging infrastructure requirements for electric buses. Determination of the locations for installing charging stations, considering factors such as bus depots, terminals, and route endpoints. Selection of appropriate charging technologies, such as slow chargers, fast chargers, or opportunity chargers, based on operational needs.
- **Infrastructure Development**: Development of the necessary infrastructure to support electric bus operations. This includes installing charging stations, upgrading electrical systems, and implementing smart grid technologies to manage energy consumption and optimize charging schedules.
- **Training and Capacity Building**: Provide training and capacity building programs for STU staff, drivers, and maintenance personnel. Ensuring that personnel are equipped with the necessary skills and knowledge to operate, maintain, and troubleshoot electric buses and charging infrastructure effectively.
- **Pilot Testing and Evaluation**: Conduct pilot testing of electric buses to evaluate their performance, reliability, and suitability for STU operations. Gather feedback from drivers, passengers, and stakeholders to identify areas for improvement and optimization.
- **Deployment and Integration**: Deploy electric buses into STU fleets and integrate them into existing operations. Develop plans for phased deployment to minimize disruptions and ensure a smooth transition from conventional buses to electric buses.
- **Monitoring and Evaluation**: Establish monitoring and evaluation mechanisms to track the performance and impact of electric buses. Monitor key performance indicators such as energy consumption, emissions reduction, operational efficiency, and passenger satisfaction.

8

Role of STU
in fleet electrification for intracity bus movement

Brief on Himachal Road Transport Corporation (HRTC):

1949	In July 1949, Himachal Pradesh saw the nationalization of its passenger and goods services for the first time.
1958	in 1958, the "Mandi-Kullu Road Transport Corporation" was established under the Road Transport Corporation Act of 1950 through a joint effort by the governments of Punjab, Himachal Pradesh, and the Railways, to operate joint routes in both states.
1966	Following the reorganization of Punjab in 1966, several hilly areas of Punjab were merged into Himachal Pradesh, resulting in the operational areas of the Mandi-Kullu Road Transport Corporation falling entirely within the expanded state of Himachal.
1974	On October 2, 1974, the Himachal Government Transport was merged with the Mandi-Kullu Road Transport Corporation and was subsequently renamed the Himachal Road Transport Corporation (HRTC).

In 1974, HRTC operated 379 routes, which expanded to 2,325 routes by March 2016. The fleet size also grew from 733 buses in 1974 to 2,645 buses in 2016. Presently, HRTC has an extensive road network across Himachal Pradesh.

> Buses remain the primary mode of passenger transport in the state due to the negligible presence of railways. The narrow-gauge lines, such as those connecting Pathankot with Jogindernagar and Kalka with Shimla, are slow and carry a minimal percentage of traffic, leaving bus transport as the mainstay for passenger traffic.

- Since its inception, the Himachal Road Transport Corporation has significantly contributed to the social and economic development of the state. HRTC has established a comprehensive bus route network in remote and inaccessible areas such as Lahaul-Spiti, Chamba, Kullu, Kinnaur, Sirmour, and Keylong.
- Besides passenger services, HRTC has also operated goods transport services, delivering food and essential commodities to remote regions where private truck owners were reluctant to go. This has played a crucial role in the economic development of Himachal Pradesh.
- In 1994, HRTC began its computerization journey by installing one server (486 EISA Machine) along with five terminals at its Head Office, marking the beginning of technological integration in its operations[33].

Himachal Road Transport Corporation (HRTC) operation in Shimla:

Bus fleet:

- The fleet of buses managed by the transportation authority consists of a total of 214 vehicles. This fleet is divided into two categories: 146 of these are internal combustion engine (ICE) buses, and the remaining 68 are electric (EV) buses.
- The substantial number of ICE buses in the fleet highlights the traditional reliance on fossil fuel-powered vehicles, which have been the backbone of public transportation for decades.
- The 68 electric buses represent a significant step towards adopting more sustainable and environmentally friendly transportation solutions. This transition to EV buses is a proactive measure to reduce the environmental impact of public transportation. They operate

[33] https://hpsdma.nic.in/WriteReadData/LINKS/DMP%20-%20Himachal%20Pradesh%20Road%20Transport%20Corporation%20-%2020181c06125a-3c9b-4c3a-942b-dd7c58b199fe.pdf

more quietly than their ICE counterparts, reducing noise pollution in urban environments.

The inclusion of electric buses in the fleet aligns with global trends and governmental policies aimed at promoting cleaner transportation options to combat climate change and reduce dependency on fossil fuels. By integrating EV buses, the transportation authority not only addresses environmental concerns but also positions itself as a leader in sustainable public transport. This mixed fleet approach allows the authority to maintain the reliability and coverage provided by traditional ICE buses while progressively increasing the share of clean energy vehicles, thereby working towards a greener future.

Bus procurement:

- The e-buses were procured in two major phases: during the years 2018-19 and 2022-23.

Scheme under which the e-buses were procured:

- The procurement of E-buses was facilitated under two schemes: Fame I and Fame II. These schemes aim to promote faster adoption and manufacturing of electric vehicles in India, providing financial incentives to support this transition.

Earning per kilometre:

- Payments for the operation of electric buses are structured on a per-kilometre basis, meaning operators receive compensation for each kilometre the bus travels. The earning rate is approximately Rs. 30 per kilometre.

This model encourages efficient operation and route planning, as higher distances travelled directly translate into increased revenue for the operators.

Per day average distance travelled:

E-buses generally operate between 80 to 100 kilometres each day.

This daily range allows for efficient use of their battery capacity while accommodating typical urban transit routes. The distance covered ensures they meet the public transportation demands in cities without a need for top up recharging, balancing operational efficiency with energy management.

Charging infrastructure of e-bus fleet of HRTC in Shimla:

Charging infrastructure for e-buses:

1. Old Bus Stand:
   - **Charger Types:** This location is equipped with chargers of varying capacities: 60 KWh, 120 KWh, and 180 KWh.
   - **Operational Status:** All these chargers are fully operational.
   - **Exclusivity:** These charging facilities are exclusively available for the Himachal Road Transport Corporation (HRTC) E-buses. This ensures dedicated and efficient charging without the competition from other vehicles.

The availability of multiple and fully operational chargers ensures that E-buses can be charged efficiently, reducing downtime, and supporting consistent service.

Figure 7: Old Bus stand chargers

A new charging facility is being developed in New Bus Stand.

Do buses top up their charge during the day?

- E-buses typically cover a route of 80 to 100 kilometres before returning to charge, as there are no facilities for top-up charging during the day. Drivers have indicated that mid-route charging, which would require 3-4 hours, is impractical given their current schedules. This system ensures that buses can complete their routes on a single charge, but it necessitates precise planning and route management to avoid disruptions.

While mid-route charging could theoretically extend the buses' operational range, the significant downtime required would reduce the number of trips each bus can make, negatively impacting service reliability and efficiency.

Charger type:

The charging station in Tutti Kandi is equipped with a dual gun charger, a feature that significantly enhances the efficiency of the charging infrastructure.

This advanced charger allows two vehicles to be charged simultaneously, effectively doubling the station's capacity, and reducing waiting times for E-buses. By facilitating concurrent charging, this dual gun charger optimizes the utilization of the available charging equipment, ensuring that more buses can be serviced in a shorter period.

This is particularly beneficial during peak operational hours when the demand for quick and efficient charging is at its highest, thereby supporting the smooth and continuous operation of the E-bus fleet.

9

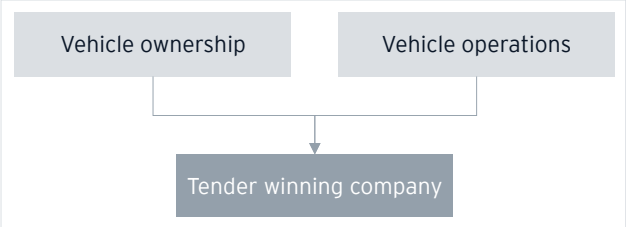
Business model
Analysis

9.1. Government leased vehicles – Vehicle segment – Four-wheelers, Solid waste management vehicles

Procurement Model 1: Wet Lease

This type of model entails a more comprehensive arrangement. In this case, the winning company of the tender not only provides the vehicles but also offers additional services such as hiring and managing staff, maintenance, and possibly other operational aspects. This model grants the leasing company greater control over the entire operation of the vehicles, including personnel management and maintenance schedules.

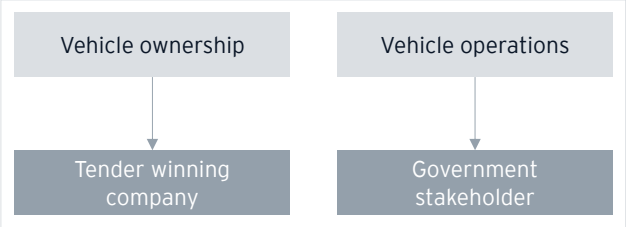
Figure 8: Wet Lease procurement model



Procurement Model 2: Dry Lease

This type of tender refers to a contractual agreement where the government entity, typically the urban local bodies, leases vehicles for utility work or for their staff from another party without additional services included. In this arrangement, the ULBs would solely receive the vehicles and be responsible for deploying their own staff or manpower to operate and maintain the vehicles.

Figure 9: Dry lease procurement model



Role of CESL in converting existing government fleet to electric

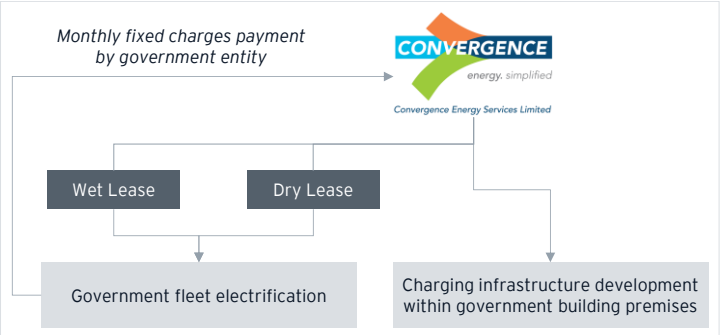
Convergence Energy Services Limited

The National E-Mobility Programme, initiated by the Ministry of New and Renewable Energy (MNRE) on March 7th, 2018, represents a strategic effort to drive the adoption of electric vehicles (EVs) throughout India. The primary objective of the program is to transition towards sustainable and environmentally friendly modes of transportation while reducing dependency on traditional fossil fuel-powered vehicles.

Central to the program is the role of the CESL which acts as a key facilitator in implementing various initiatives aimed at promoting e-mobility. One of the core strategies employed by CESL involves the aggregation of demand for electric vehicles by procuring them in bulk. By purchasing a large number of EVs at once, CESL leverages economies of scale to make the adoption of electric vehicles more financially viable for government agencies and other stakeholders.

As part of the procurement process, CESL issued a tender for the acquisition of 10,000 electric cars. These vehicles were intended to replace existing petrol and diesel vehicles used by various government departments and agencies across the country. By transitioning to electric vehicles, these entities not only contribute to reducing greenhouse gas emissions and air pollution but also set an example for sustainable transportation practices.

Furthermore, the deployment of electric vehicles is complemented by the establishment of a robust charging infrastructure. CESL, in collaboration with other stakeholders, has installed 256 public chargers in strategic locations across 42 cities. This infrastructure development is crucial for addressing range anxiety among EV users and ensuring the seamless integration of electric vehicles into the existing transportation network.

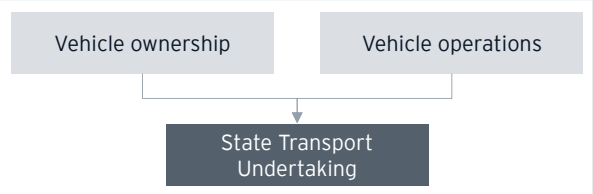


9.2. Government leased vehicles – Vehicle segment – Buses

9.2.1. City transport bus

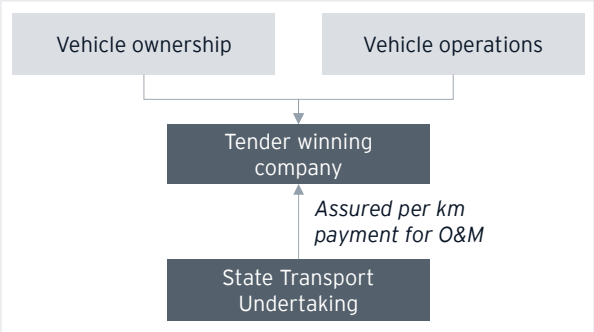
Procurement Model: Outright Purchase Model

The outright purchase model of bus acquisition offers significant control and potential long-term cost savings but requires a substantial initial investment and ongoing maintenance commitment. This model is well-suited to entities with stable financial resources and the capability to manage a fleet over the long term. It is particularly advantageous for those seeking to maintain full control over their operations and customize their vehicles to meet specific needs.



Procurement Model: Gross Cost Contract Model

The gross cost contract model for buses is a procurement and operational approach used in public transportation systems. Under this model, a contracting authority pays a fixed amount to a private operator to provide specified bus services for a defined period. The operator manages all aspects of the service, including fleet operation, maintenance, and scheduling, while adhering to service specifications outlined in the contract. The operator may retain revenue from fares, and the contracting authority monitors performance to ensure compliance with service standards. The model offers flexibility, risk transfer to the operator, and aims to deliver reliable, cost-effective bus services that meet the needs of communities.



PM e-bus Sewa

PM e-bus Sewa is a central government initiative designed to revolutionize urban transportation by integrating electric buses into city networks. The program operates with the primary objective of curbing air pollution and decreasing reliance on fossil fuels. The scheme, estimated at Rs. 57,613 crore, with Rs. 20,000 crore support from the Central government, will operate for 10 years. It targets cities with a population of over three lakh as per the 2011 census, including all Union Territory capitals, the North-eastern Region, and Hill States, with priority given to those lacking organized bus services. Expected to generate 45,000 to 55,000 direct jobs.

The scheme consists of two segments:

- Segment A focuses on augmenting city bus services in 169 cities
- Segment B emphasizes Green Urban Mobility Initiatives (GUMI) in 181 cities.

The scheme aims to promote e-mobility, improve infrastructure, and reduce pollution by supporting bus priority infrastructure, charging infrastructure development, and adoption of electric buses.

10

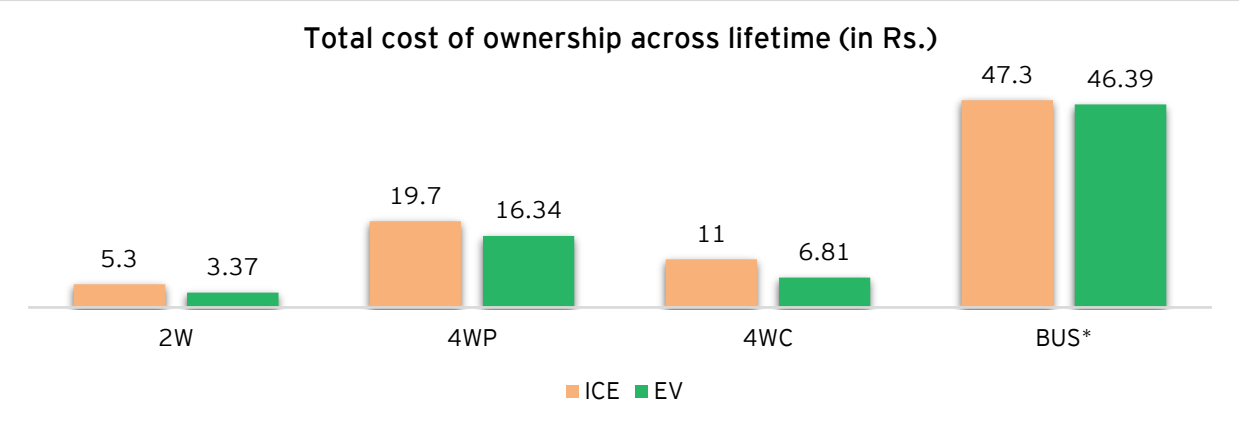
Estimating Total Cost of Ownership

The total cost of ownership (TCO) of a vehicle encapsulates both present and future expenses associated with owning and operating it over its lifespan. This comprehensive analysis relies on carefully chosen assumptions to forecast the vehicle's usage patterns and its corresponding costs. Key components of TCO include capital expenditure, operational costs, and maintenance expenses. Operational costs entail fuel expenses, while maintenance costs cover repair and maintenance (R&M) expenditures. The salvage value of the vehicle at the conclusion of its life cycle is determined by assessing its depreciation over time due to usage and market inflation.

The parameters are comprehensively explained below:

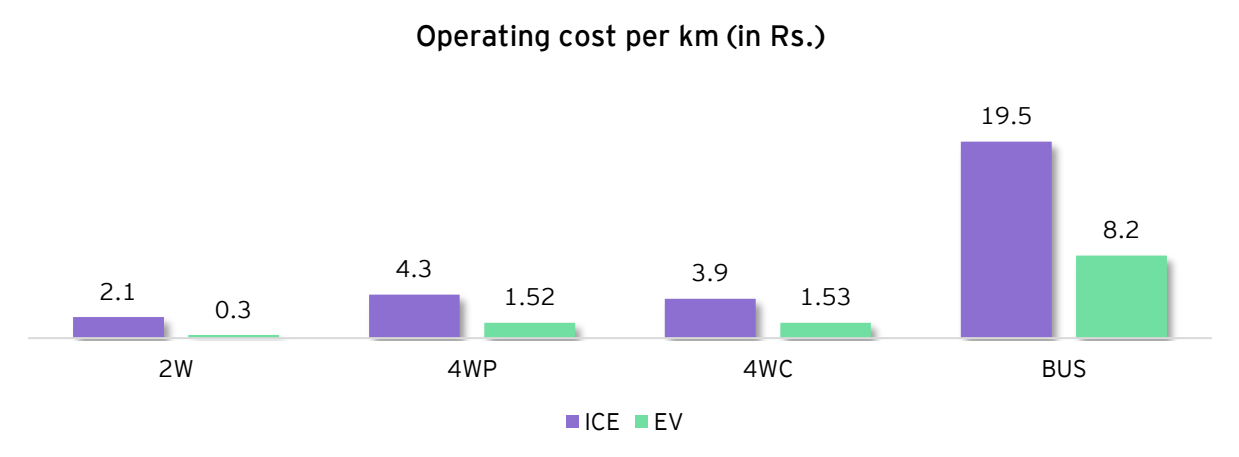
1. **Purchase Price:** This is the initial cost of buying the vehicle, which includes the negotiated price, taxes, registration fees, and any additional charges.
2. **Depreciation:** Depreciation represents the decrease in the vehicle's value over time due to factors such as age, mileage, wear and tear, and market conditions. It is one of the most significant costs of vehicle ownership.
3. **Fuel Costs:** The amount spent on fuel over the vehicle's lifetime depends on its fuel efficiency, the distance driven, and fuel prices.
4. **Maintenance and Repairs:** Regular maintenance such as oil changes, tire rotations, brake replacements, and repairs for wear and tear are ongoing costs associated with vehicle ownership.
5. **Insurance:** Insurance premiums vary depending on factors such as the vehicle's make and model, the driver's age and driving record, location, coverage options, and deductibles.
6. **Financing Costs:** If the vehicle is financed through a loan, the interest payments and any financing fees are part of the TCO.

Graph 29: Total cost of ownership across lifetime (in Rs.)



**Subsidy not considered for buses category*

Graph 30: Operating cost per km (in Rs.)



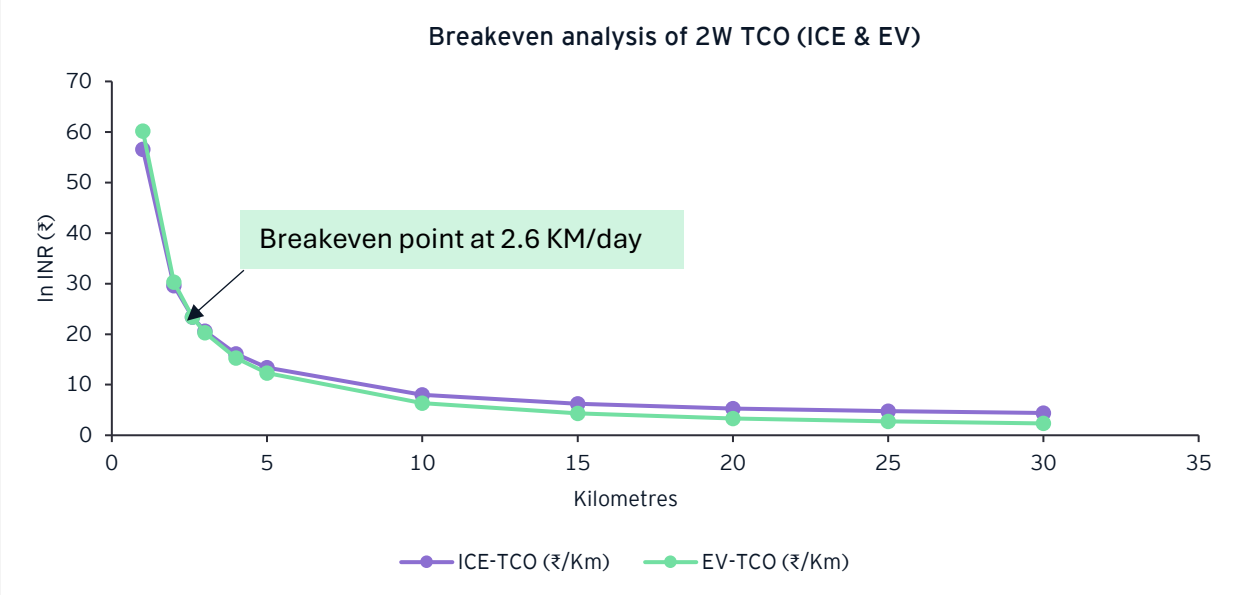
10.1. Break-even Analysis of different modes:

A breakeven analysis of the Total Cost of Ownership for internal combustion engine vehicles versus electric vehicles was calculated based on kilometres of use. By calculating the TCO over a set number of kilometres, it becomes evident that the lower operating costs of EVs can offset their higher initial investment. The breakeven point, where the cumulative savings from reduced fuel and maintenance costs balance out the higher purchase price, varies based on factors such as fuel prices, electricity costs, and driving patterns.

Two-wheelers

For two-wheelers in Shimla, the breakeven point is reached at 2.6 kilometres per day, which is steadily low throughout the average daily distance travelled by two-wheelers in the city.

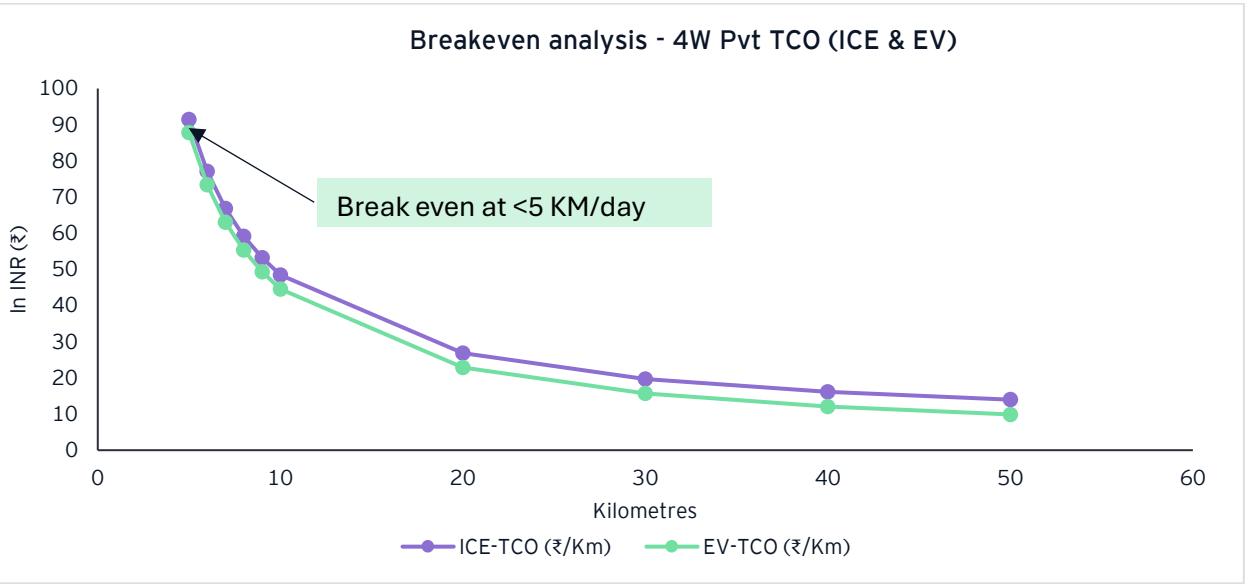
Graph 31: Breakeven analysis of 2W TCO(ICE & EV)



Four-wheelers (Private)

For four-wheelers (private) in Shimla, the breakeven point is reached at less than 5 kilometres per day, which is steadily low throughout the average daily distance travelled by two-wheelers in the city.

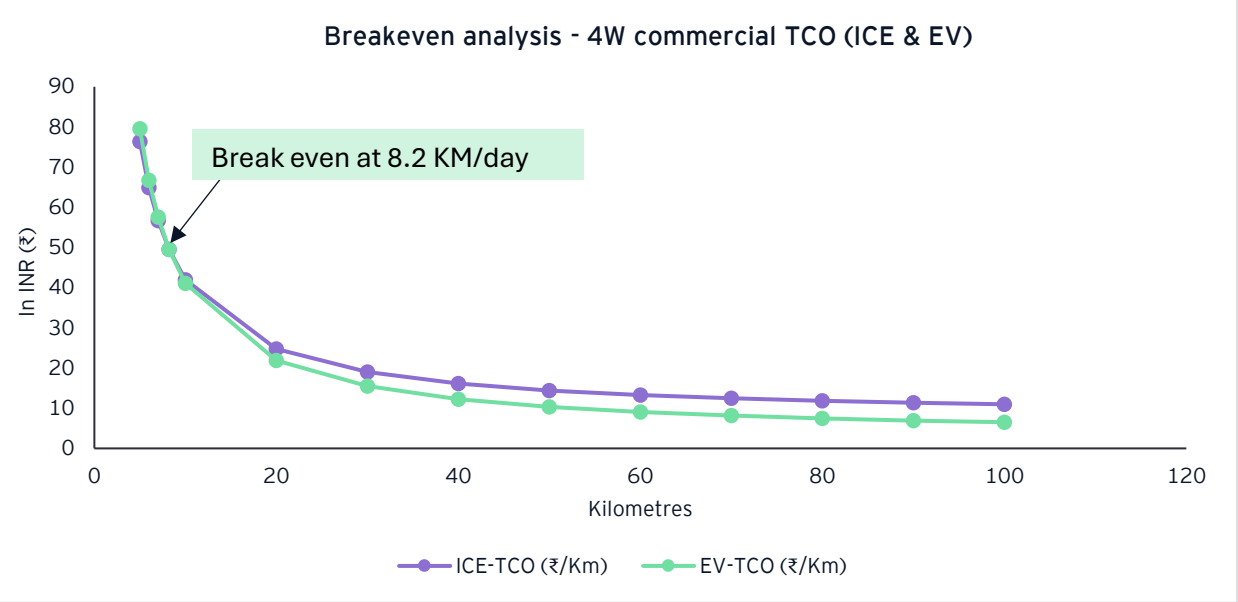
Graph 32: Breakeven analysis - 4W Pvt TCO (ICE & EV)



Four-wheelers (commercial)

For four-wheelers (private) in Shimla, the breakeven point is reached at less 8.2 kilometres per day, which is steadily low throughout the average daily distance travelled by two-wheelers in the city.

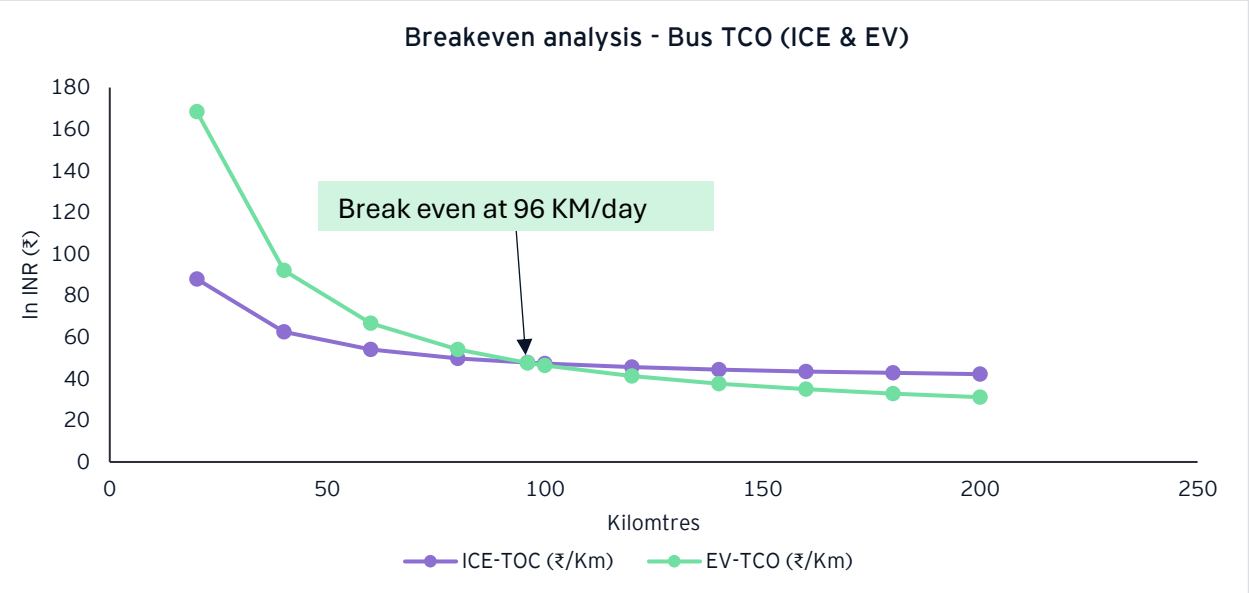
Graph 33: Breakeven analysis - 4W commercial TCO (ICE & EV)

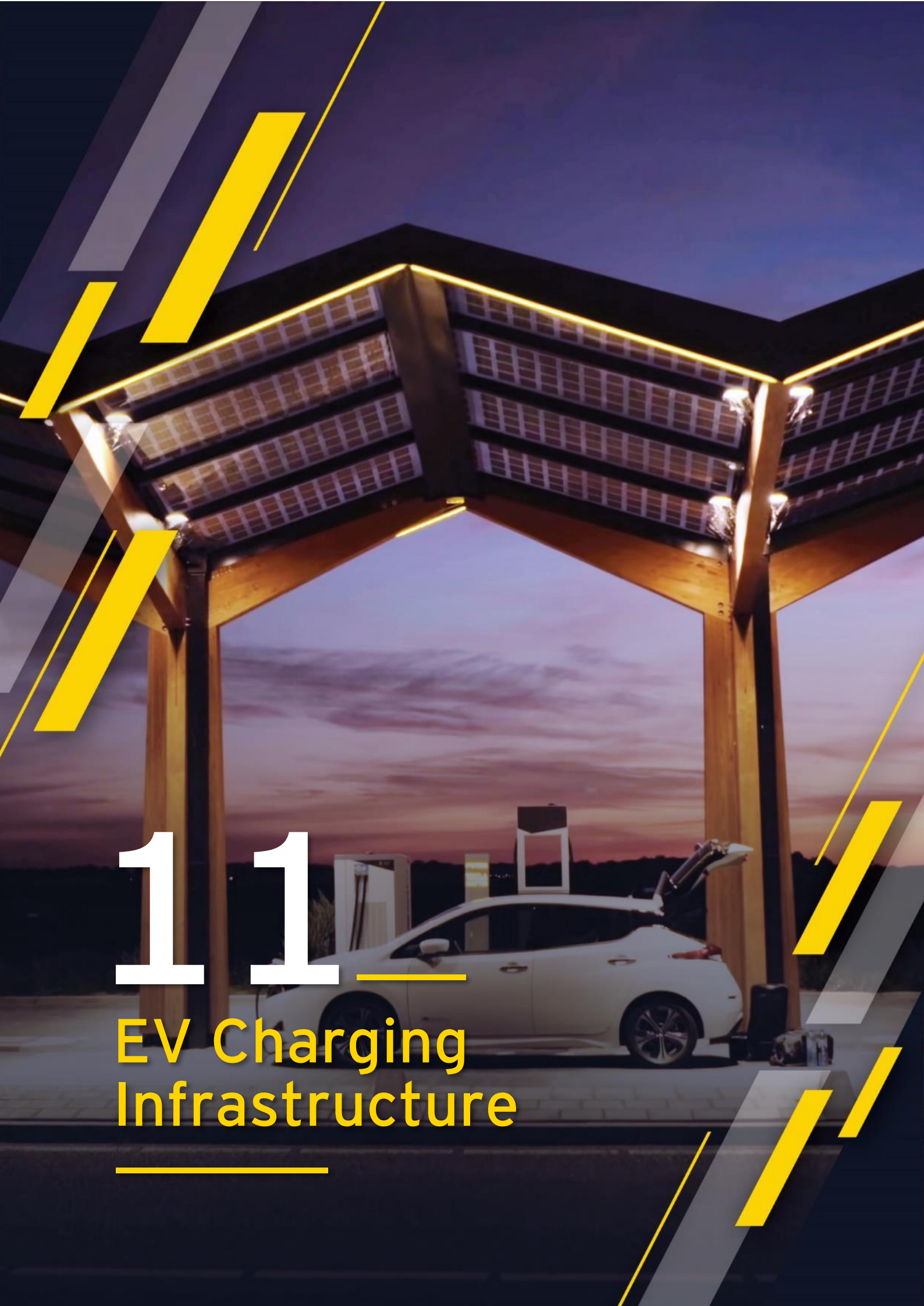


Buses

For buses in Shimla, the breakeven point is reached at 96 kilometres per day, which is steadily low throughout the average daily distance travelled by two-wheelers in the city.

Graph 34: Breakeven analysis - Bus TCO (ICE & EV)





11 EV Charging Infrastructure

11.1. EV charging introduction

Himachal Pradesh is driving the adoption of electric vehicles through a comprehensive and interconnected EV infrastructure strategy. The state aims to establish at least one charging station within every 1 km x 1 km grid in the model cities of Mandi, Baddi, Shimla, and Dharamshala. Additionally, there will be a charging station every 25 km on state highways and every 50 km on national highways. To streamline the process, a single-window system will facilitate the installation of chargers and the granting of necessary permissions. The state government will develop charging infrastructure under the Production Linked Incentives (PLI) Scheme for the National Programme on Advanced Chemistry Cell (ACC) Battery Storage by the Ministry of Heavy Industries. Furthermore, Himachal Pradesh will allocate 100 to 200 acres of land for EV parks with adequate infrastructure, as outlined in the State Industrial Policy. The Himachal Pradesh State Electricity Board Limited (HPSEBL) will set the tariffs for all EV charging and battery swapping stations across the state. This integrated approach ensures widespread availability, ease of installation, and supportive policies for sustainable transportation[34].

11.2. Setting up EVCI in hilly terrain

Setting up electric vehicle (EV) charging infrastructure in hilly regions presents unique challenges and opportunities. The topography and climate necessitate robust and adaptable solutions. Key considerations include the strategic placement of charging stations to maximize accessibility and convenience for EV users. Locations should be chosen based on traffic patterns, tourist spots, and areas with reliable power supply. Moreover, the infrastructure must be resilient to extreme weather conditions, such as heavy snowfall and landslides. This may involve using weather-resistant materials and ensuring that stations are regularly maintained and easily accessible even in adverse conditions.

Additionally, leveraging renewable energy sources, like solar, can be particularly advantageous in hilly areas, where these resources are often abundant. Integrating battery storage systems can further enhance the reliability of the charging network.

Collaboration between government bodies, local communities, and private companies is essential to address logistical challenges and ensure the infrastructure meets the needs of both residents and visitors. Overall, a well-planned and executed EV charging network in hilly regions can significantly boost the adoption of electric vehicles, contributing to cleaner air and a more sustainable environment.

[34] https://beeindia.gov.in/sites/default/files/Himachal-Pradesh.pdf

11.3. Need for location assessment for setting up of EVCI

Assessing the location for setting up an Electric Vehicle (EV) charging station is crucial for several reasons:

Accessibility and Convenience: The location should be easily accessible. It should be strategically placed along commonly used routes or near major point of interests. This accessibility encourages more EV adoption and ensures drivers can charge their vehicles conveniently during their daily activities.

Infrastructure Compatibility: Assessing the location involves considering the existing infrastructure such as electrical grids and utility connections. Ensuring that the location can support the power demands of charging stations without overloading the grid or requiring extensive upgrades is essential for the station's efficient operation.

Parking Availability: Availability of parking space is critical for EV charging stations, especially for longer charging sessions. Locations with ample parking space or dedicated EV parking spots are preferable to accommodate EV drivers.

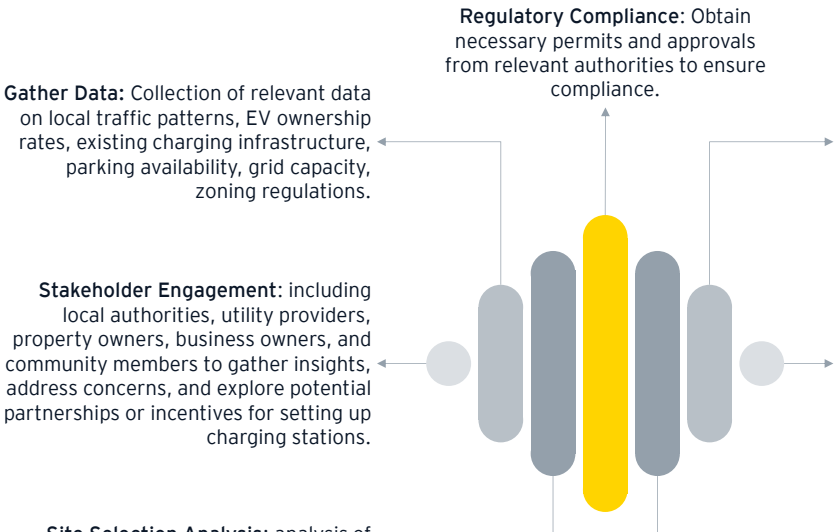
Safety and Security: The safety and security the charging station and EV owners is critical. Assessing the location involves considering factors such as adequate lighting, visibility, and proximity to emergency services to ensure a safe charging experience for users.

Regulatory Compliance and Permits: Assessing the location involves obtaining necessary permits and ensuring compliance with local regulations.

Business Viability: For public charging stations, assessing the location includes evaluating the potential for generating revenue and achieving profitability. Factors such as nearby amenities, expected footfall, and competitive landscape play a crucial role in determining the station's business viability.

11.4. Approach for location assessment for setting up EVCI

To systematically assess locations for setting up Electric Vehicle (EV) charging stations, the following approach can be employed:



Regulatory Compliance: Obtain necessary permits and approvals from relevant authorities to ensure compliance.

Gather Data: Collection of relevant data on local traffic patterns, EV ownership rates, existing charging infrastructure, parking availability, grid capacity, zoning regulations.

Infrastructure Assessment: Assessment of the electrical infrastructure of potential sites to ensure compatibility with charging station requirements. Evaluation of grid capacity, voltage levels, transformer capacity, and distance to power distribution lines.

Stakeholder Engagement: including local authorities, utility providers, property owners, business owners, and community members to gather insights, address concerns, and explore potential partnerships or incentives for setting up charging stations.

Financial Analysis: financial analysis to evaluate the potential costs and revenue streams associated with each location. Factors such as installation costs, equipment expenses, operational costs, pricing strategies, and projected revenue from charging fees or additional services should be considered.

Site Selection Analysis: analysis of potential sites based on the defined criteria. Evaluation of factors such as proximity to major roads/highways, population density, commercial activity centres, public transportation hubs, all other major point of interests.

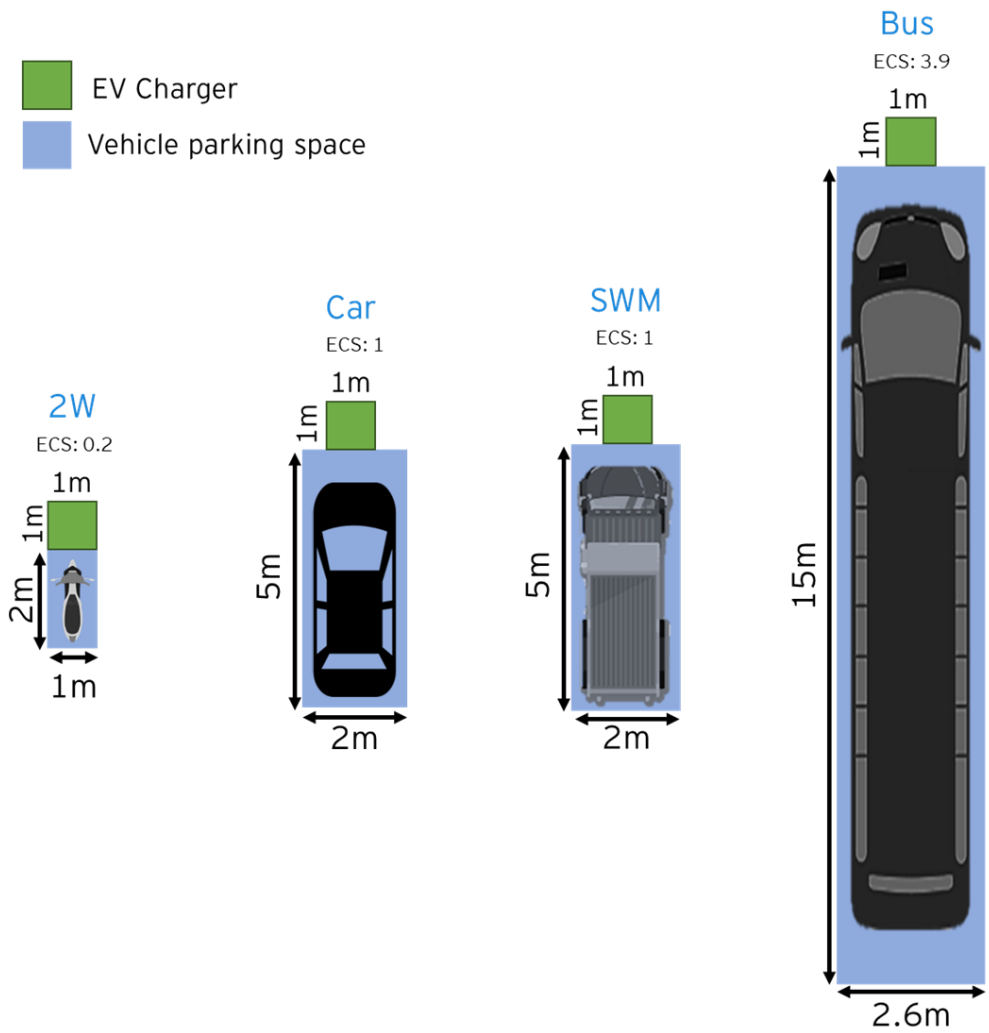
Implementation and Monitoring: Once locations are chosen, installation of charging stations and associated infrastructure is the next step. Continuously monitor the performance of charging stations, gathering feedback from users, and adjusting as needed to optimize operations to ensure customer satisfaction is required.

11.5. EV ready Parking space requirements

EV parking spaces are specially designated areas in parking lots or garages equipped with electric vehicle charging stations. These spaces provide convenient and accessible locations for EV owners to charge their vehicles while they shop, work, or reside. By offering dedicated charging infrastructure, EV parking spaces support the growing adoption of electric vehicles. Furthermore, these spaces often come with features like reserved parking and proximity to building entrances, enhancing the overall convenience and appeal for EV drivers.

- Clearance: Additional clearance around the vehicle may be required to ensure that the charging cable can be easily connected and to allow for accessibility features such as wheelchair access. This might mean an extra 3 to 4 feet (about 1 meter) of space.
- Height: For covered parking, a minimum height clearance of about 8 to 10 feet (2.4 to 3 meters) is usually sufficient to accommodate most electric vehicles and charging infrastructure.
- Signage and Markings: Clear signage and ground markings should indicate that the space is reserved for EV charging. This helps in preventing misuse by non-EV vehicles and ensures that EV drivers can easily locate the charging spots.

The below figure visualises the space required by each vehicle segment for an EV ready parking.



11.6. Location assessment for mapping potential EVCI locations

The process of mapping existing EV charging infrastructure involves four steps:

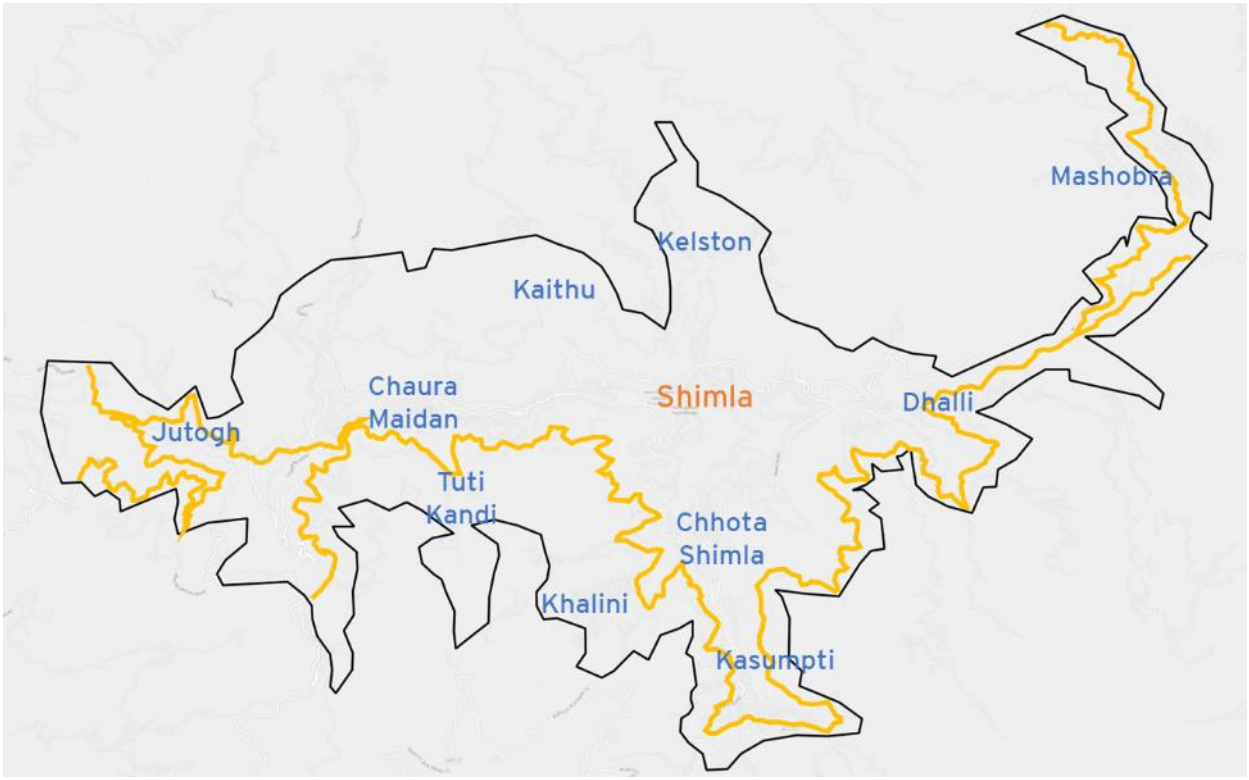
- **Step 1 - City Boundary Mapping:** Delineate city's municipal boundary to establish the geographical scope.
- **Step 2 - Identification of Key Points of Interest:** Identify and mark major points of interest, including significant government buildings and key stakeholders' facilities and existing EV charging station, to ensure comprehensive coverage.

> By executing the first two steps, valuable insights into the current EV charging infrastructure landscape can be gained. Moreover, this comprehensive mapping approach enables to project future requirements for EV charging infrastructure based on demand and availability trends.

- Step 3 – Heat map representing the demand areas for EVCI installation
- Step 4 – Identify potential EV charging infrastructure implementation locations

Step 1: City Boundary mapping

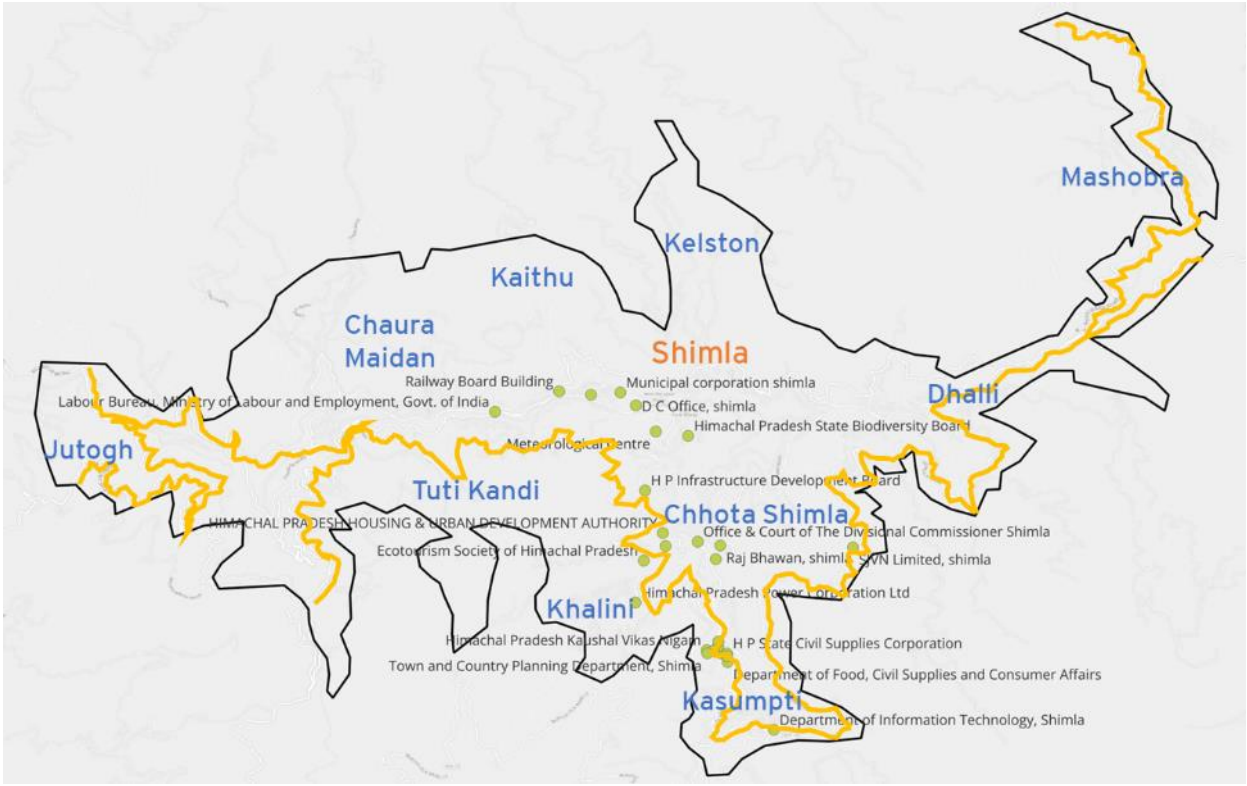
Figure 10: Shimla city boundary map



Step 2: Identification of Key Points of Interest

Government Offices

Figure 11: Government offices in Shimla

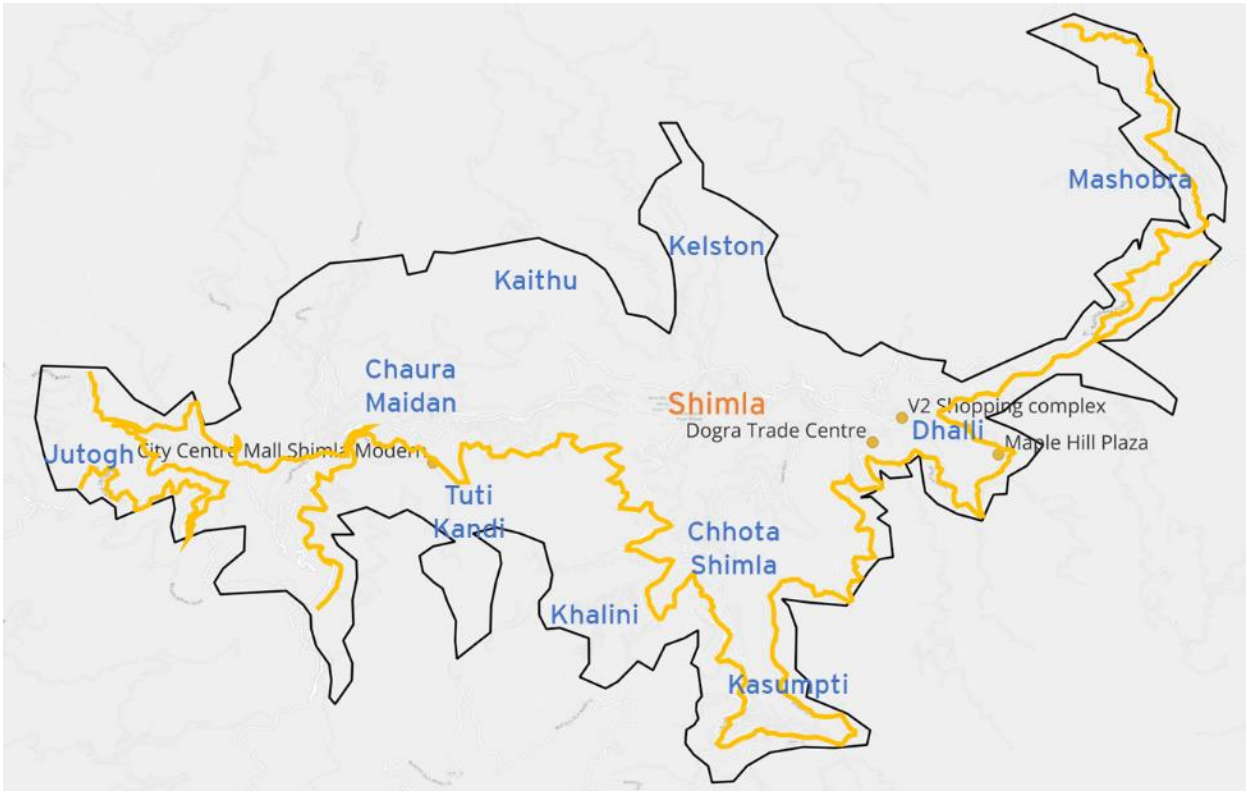


Transport Hubs

Figure 12: Transport hubs in Shimla

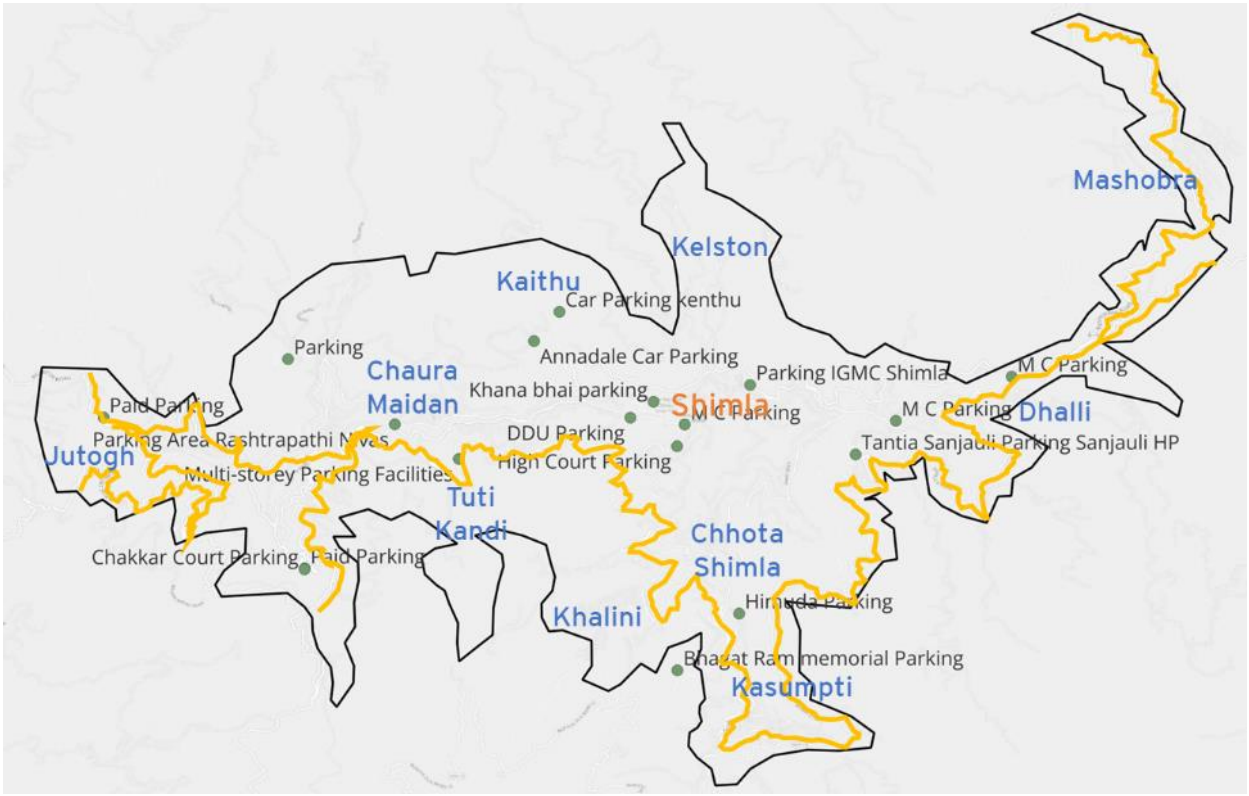
Malls

Figure 13: Malls in Shimla



Public Parking Lot

Figure 14: Parking lots in Shimla

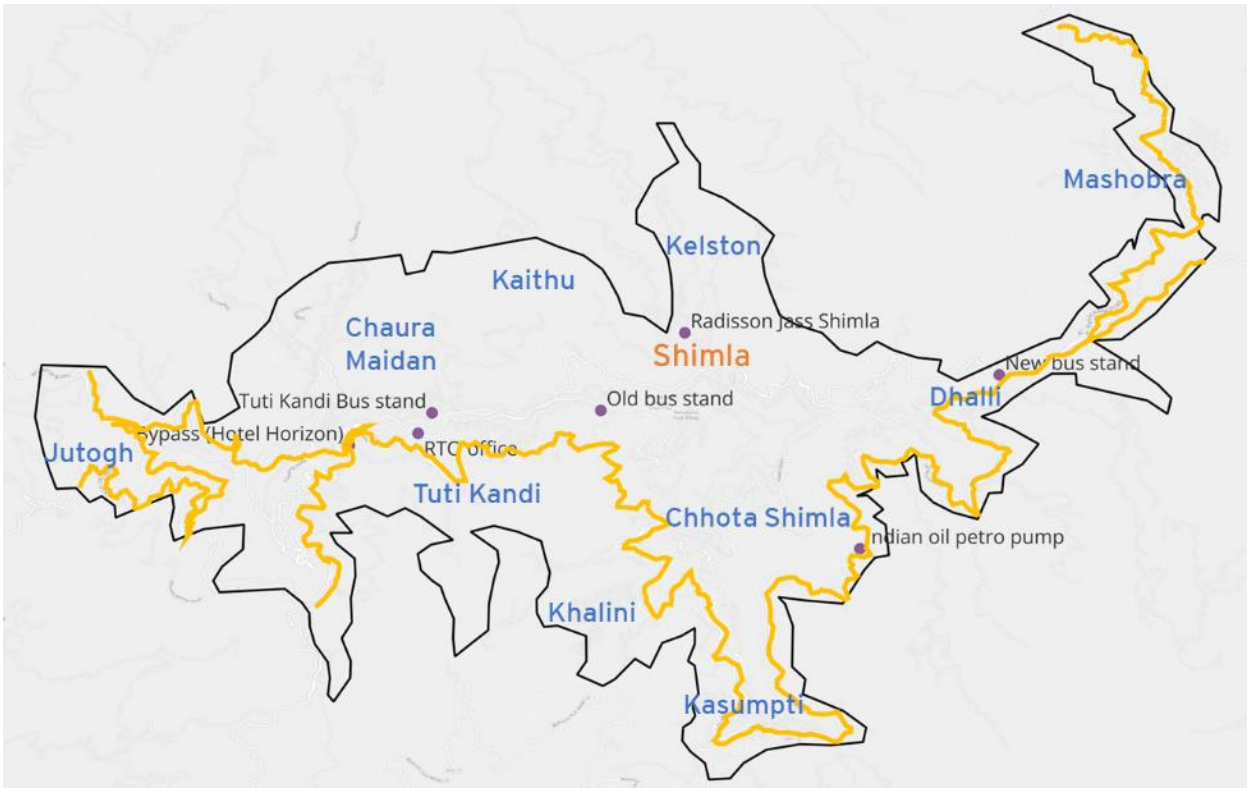


Five-star hotels

Figure 15: Five-star hotels in Shimla

Existing EV Charging stations

Figure 16: Existing EVCI in Shimla



11.7. Analysing existing usage, charging pattern and power demand of existing charging stations (on sampling basis)

Bypass – Hotel Horizon:

- **Charger Capacity:** This area features three chargers, each with a capacity of 120 KWh.
- **Operational Status:** Unfortunately, none of these chargers are currently operational.
- **Deployment:** The chargers at this location were deployed by three different entities: HRTC, the Municipal Corporation (MC) of Shimla, and Horizon Hotel. This collaboration indicates a multi-stakeholder effort to support E-bus operations, **the charging station is yet to be operational**.

Sr. No.	Charger type	Charger rating (kW)	Number of Chargers	Remark
1	CCS II	120kW	2	Installed by HRTC, MC Shimla and Horizon (Hotel)

Figure 17: Bypass - Hotel Horizon

Hotel Radisson:

Sr. No.	CPO	Charger type	Charger rating (kW)	Number of Chargers	Remark
1	Sunfuel	CCS II	15kW	1	Installed by Radisson Hotel, in their parking for guests

Figure 18: Radisson hotel existing Chargers

Near SJVN petrol pump:

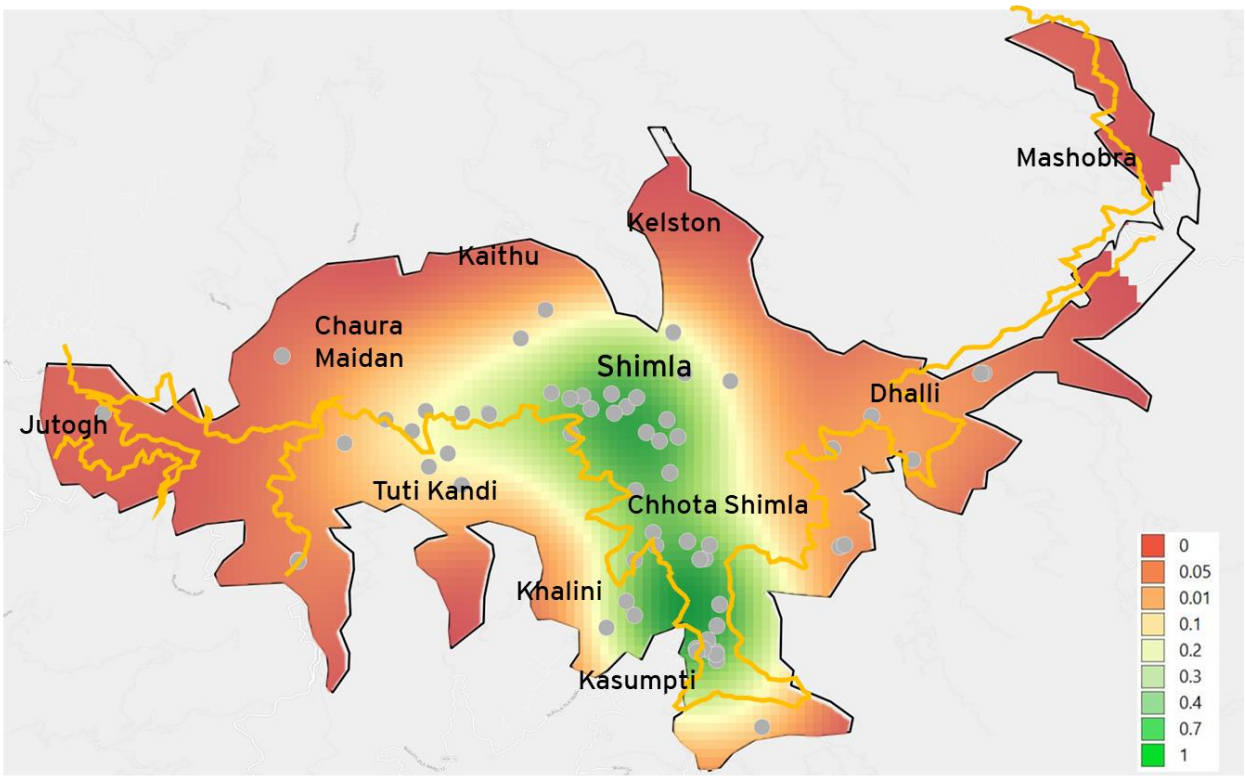
Sr. No.	CPO	Charger type	Charger rating (kW)	Number of Chargers	Remark
1	Okaya	Bharat DC 001	15	1	Not operational, connector type to be upgraded

Figure 19: EVCI near SJVN petrol pump

Step 3: Heatmap of all Point of Interests (PoI)

This heatmap provides a visual representation of the concentration of points of interest. Each point of interest is assigned a normalized weight, indicating its significance or frequency within the dataset, ranging from 0 to 1. The color scale employed in the heatmap ranges from red to green which is based on proximity of each point of interest of 1km, with varying shades representing different weight values. Red hues signify areas with lower weightage or fewer points of interest, gradually transitioning to green, which indicates higher weightage or a denser concentration of points.

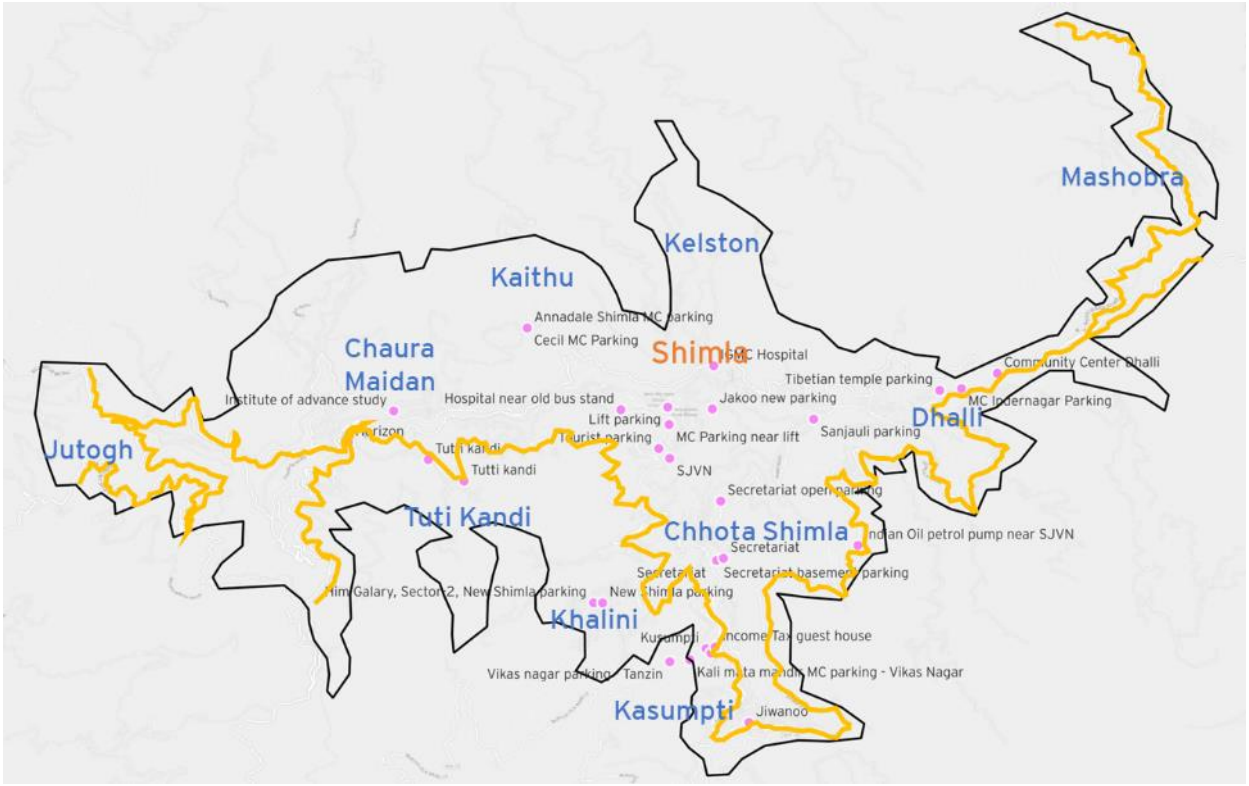
Figure 20: Heatmap of Shimla



Step 4: Potential locations for setting up E-charging infrastructure for different vehicle segment

A comprehensive site assessment was conducted, and 25 potential locations deemed suitable for the installation of EV charging stations. These locations have been meticulously analysed and selected based on various factors such as accessibility, demand, infrastructure, and feasibility to ensure optimal placement and effectiveness of the charging stations in facilitating the transition towards sustainable transportation.

Figure 21: Potential EVCI Locations in Shimla

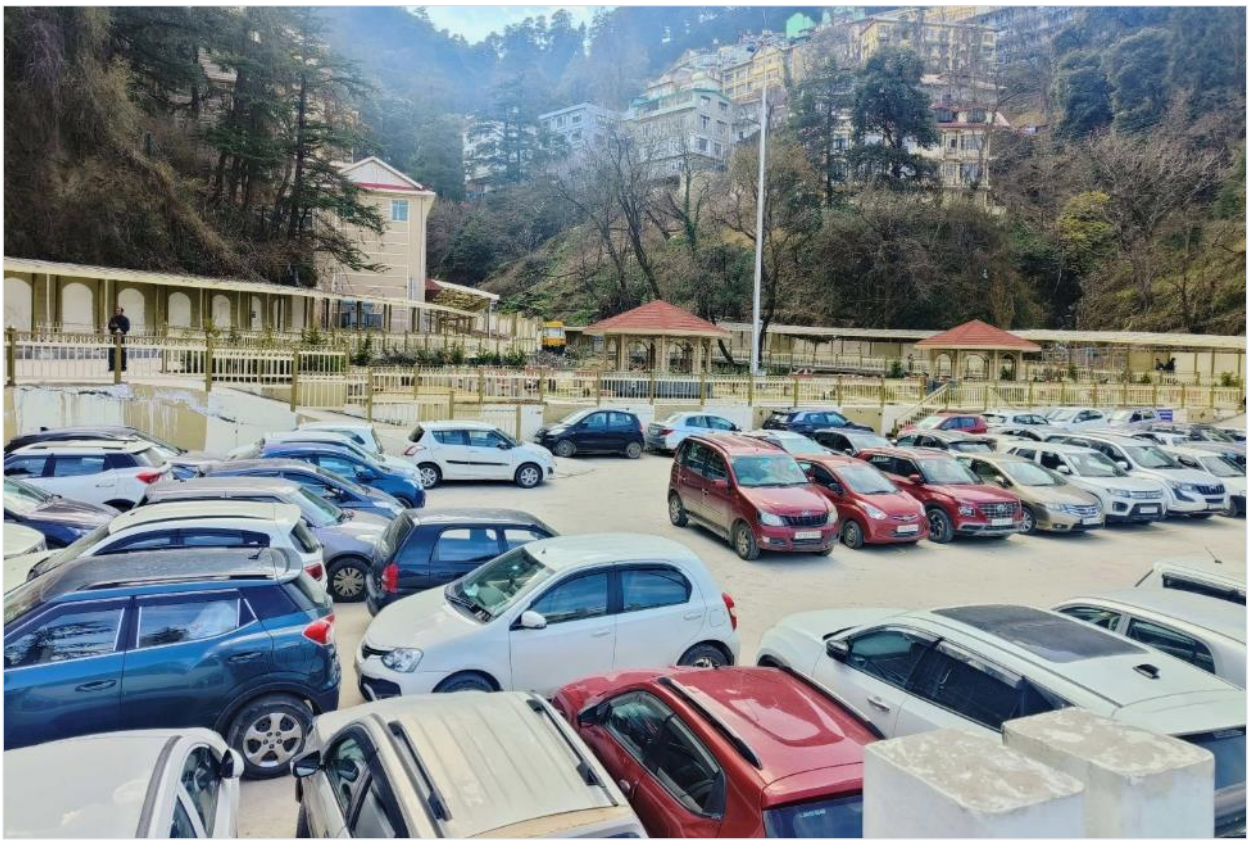


PROPOSED PUBLIC CHARGING STATION LOCATIONS

1. Hospital near old bus stand and gurudwara

Site location address	Hospital near old bus stand and gurudwara
Latitude	31.10342
Longitude	77.17078
Visibility of EV charging station	Medium-low
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	Open 24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete / Tile
Visibility from Road/Highway	High-Medium
Distance from Road/Highway	0 Mtr
Advertisement potential (high/low)	Medium
Public amenities available nearby.	Gurudwara, Old bus stand, Mall road parking
Suitability for solar installation (canopy structures)	No
Total no. of parking capacity in parking area	20-30

2. IGMC Hospital

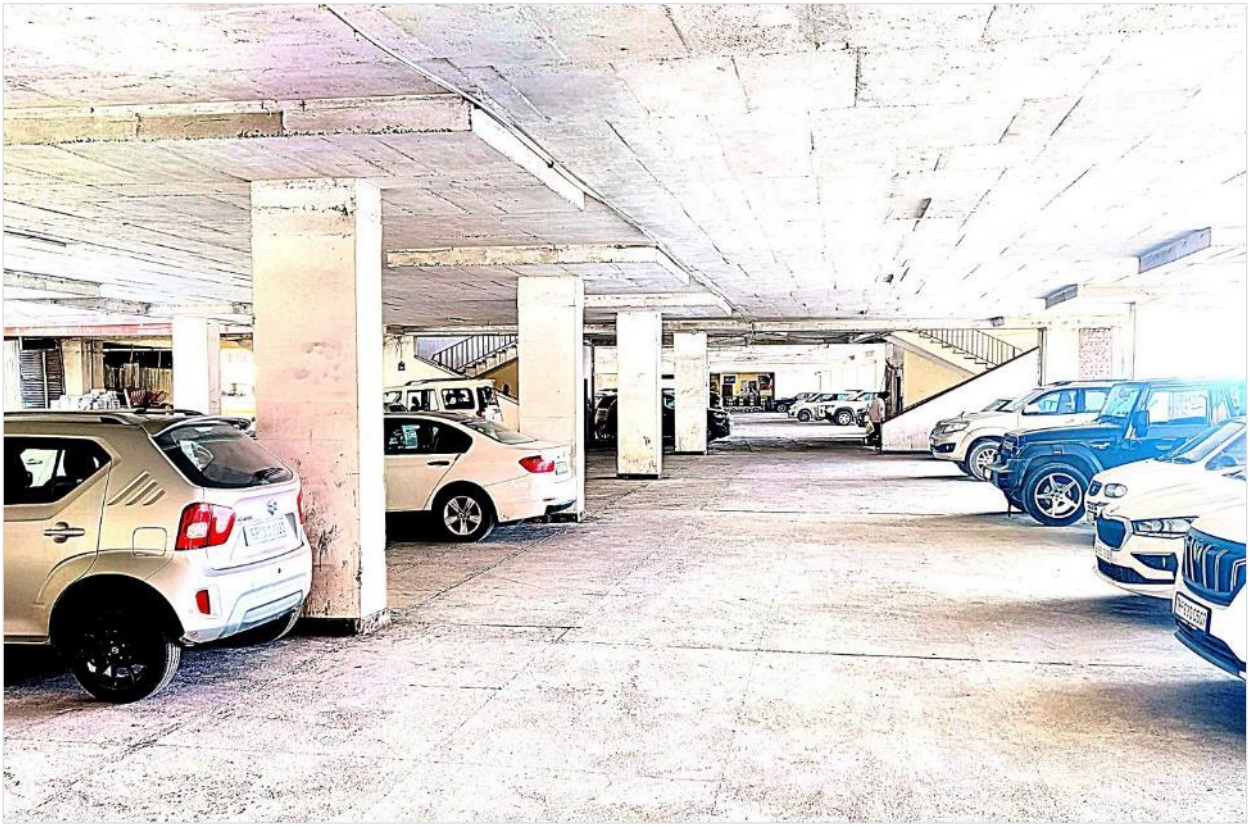


Site location address	IGMC Hospital
Latitude	31.10797
Longitude	77.18038
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	Yes
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	0 Mtrs
Advertisement potential (high/low)	High
Public amenities available nearby.	IGMC Hospital
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	40-50

3. Indian Oil petrol pump near SJVN

Site location address	Indian Oil petrol pump near SJVN
Latitude	31.0894
Longitude	77.19531
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	Only during the petrol pump is operational
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	Medium
Public amenities available nearby.	SJVN office
Suitability for solar installation (canopy structures)	Medium

4. MC Parking near lift:

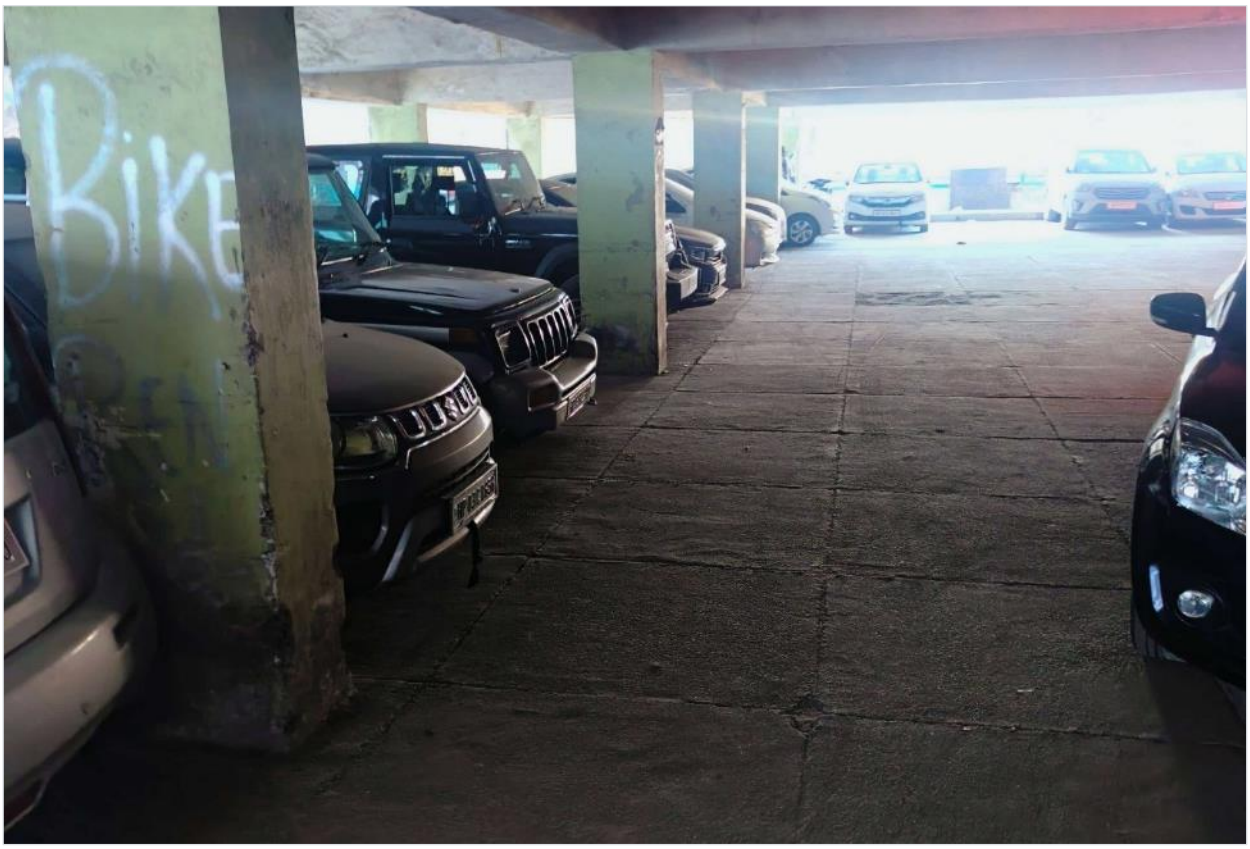


Site location address	MC Parking near lift, Sood
Latitude	31.10189
Longitude	77.17577
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	0 Mtrs
Advertisement potential (high/low)	Medium
Public amenities available nearby.	Mall road
Suitability for solar installation (canopy structures)	No
Total no. of parking capacity in parking area	50-80

5. Horizon

Site location address	Horizon
Latitude	31.10004
Longitude	77.14258
Visibility of EV charging station	High - medium
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid (2hrs - INR 24)
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	High
Public amenities available nearby.	bypass, private busses halt here, near bus stand
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	100 per floor, 11 floors

6. Tourist parking



Site location address	Tourist parking
Latitude	31.0994
Longitude	77.1747
Visibility of EV charging station	Medium
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid (2hrs- INR 200)
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	0 Mtrs
Advertisement potential (high/low)	Medium
Public amenities available nearby.	Mall road
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	40

7. Institute of advance study

Site location address	Institute of advance study
Latitude	31.10329
Longitude	77.14727
Visibility of EV charging station	Medium
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid (2hrs - INR 20)
Whether the location is open to public (24x7) or restricted operating hours.	Tourists spot (10:00am to 5:00 pm)
Floor type (concrete, tiles, mud etc.) at the proposed location	Asphalt + concrete
Visibility from Road/Highway	Low
Distance from Road/Highway	Medium - inclined slope
Advertisement potential (high/low)	Medium-low
Public amenities available nearby.	Tourist spot
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	35

8. HP Petrol pump

Site location address	HP Petrol pump
Latitude	31.07827
Longitude	77.18009
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	5:00 am - 11:30 Pm
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	Yes
Distance from Road/Highway	1 Mtrs
Advertisement potential (high/low)	High
Public amenities available nearby.	Local restaurants
Suitability for solar installation (canopy structures)	Yes

9. New Shimla parking

Site location address	New Shimla parking
Latitude	31.08345
Longitude	77.16889
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	Narrow road - 10 Mtrs
Advertisement potential (high/low)	High
Suitability for solar installation (canopy structures)	Yes
Ownership of the land and its maintenance agency.	Shimla Municipal Corporation
Total no. of parking capacity in parking area	15

10. Tutti Kandi

Site location address	Tutti Kandi
Latitude	31.09826
Longitude	77.15085
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24X7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	1 Metre
Advertisement potential (high/low)	High
Public amenities available nearby.	Yes
Suitability for solar installation (canopy structures)	Yes
Ownership of the land and its maintenance agency.	Shimla Municipal Corporation
Total no. of parking capacity in parking area	10- 15

11. MC Indernagar parking

Site location address	MC Indernagar parking Dhalli
Latitude	31.10561
Longitude	77.20602
Visibility of EV charging station	Low
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Mud
Visibility from Road/Highway	Low
Distance from Road/Highway	No
Advertisement potential (high/low)	High
Suitability for solar installation (canopy structures)	Yes
Ownership of the land and its maintenance agency.	Shimla Municipal Corporation
Total no. of parking capacity in parking area	5 - 15

12. Sanjauli parking

Site location address	Sanjauli parking
Latitude	31.10244
Longitude	77.19073
Visibility of EV charging station	Yes
Type of parking (free parking or paid parking operated by parking concessionaire)	High
Whether the location is open to public (24x7) or restricted operating hours.	Paid
Floor type (concrete, tiles, mud etc.) at the proposed location	No
Visibility from Road/Highway	Concrete
Distance from Road/Highway	High
Advertisement potential (high/low)	High
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	200+

13. Jakoo new Parking

Site location address	Jakoo new Parking
Latitude	31.1035
Longitude	77.18025
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	0 Mtrs
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	Yes
Ownership of the land and its maintenance agency.	Shimla Municipal Corporation
Total no. of parking capacity in parking area	20

14. Income tax Guest house parking

Site location address	Income tax Guest house parking
Latitude	31.07889
Longitude	77.18054
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Paved road
Visibility from Road/Highway	Mediu,
Distance from Road/Highway	20 Mtrs
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	30

15. Parking near SJVN

Site location address	Parking near SJVN
Latitude	31.09839
Longitude	77.17583
Visibility of EV charging station	Low - Medium
Type of parking (free parking or paid parking operated by parking concessionaire)	Free for Employees and Guests
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Under construction
Visibility from Road/Highway	Medium
Distance from Road/Highway	10 -50 MTRS
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	No
Ownership of the land and its maintenance agency.	SJVN OFFICE
Total no. of parking capacity in parking area	200

16. Secretariat, Parking-01

Site location address	Secretariat
Latitude	31.08784
Longitude	77.1807
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	Office hours
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	0 Mtrs
Advertisement potential (high/low)	Medium - High
Suitability for solar installation (canopy structures)	Yes – Medium
Total no. of parking capacity in parking area	50

17. Secretariat parking-02

Site location address	Secretariat
Latitude	31.08806
Longitude	77.18139
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free only for employees
Whether the location is open to public (24x7) or restricted operating hours.	Office hours
Floor type (concrete, tiles, mud etc.) at the proposed location	Paved road
Visibility from Road/Highway	Low
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	Yes
Total no. of parking capacity in parking area	20-30

18. Secretariat, parking-03

Site location address	Secretariat
Latitude	31.08784
Longitude	77.1807
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free for employee
Whether the location is open to public (24x7) or restricted operating hours.	Office hours
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	1 metre
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	no
Total no. of parking capacity in parking area	150+

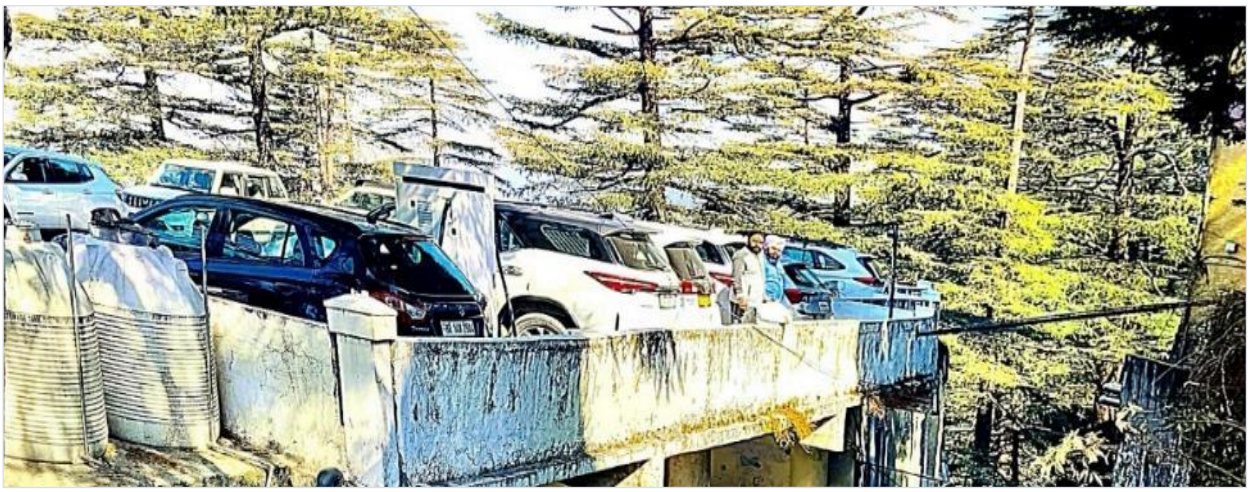
19. Secretariat. parking-04

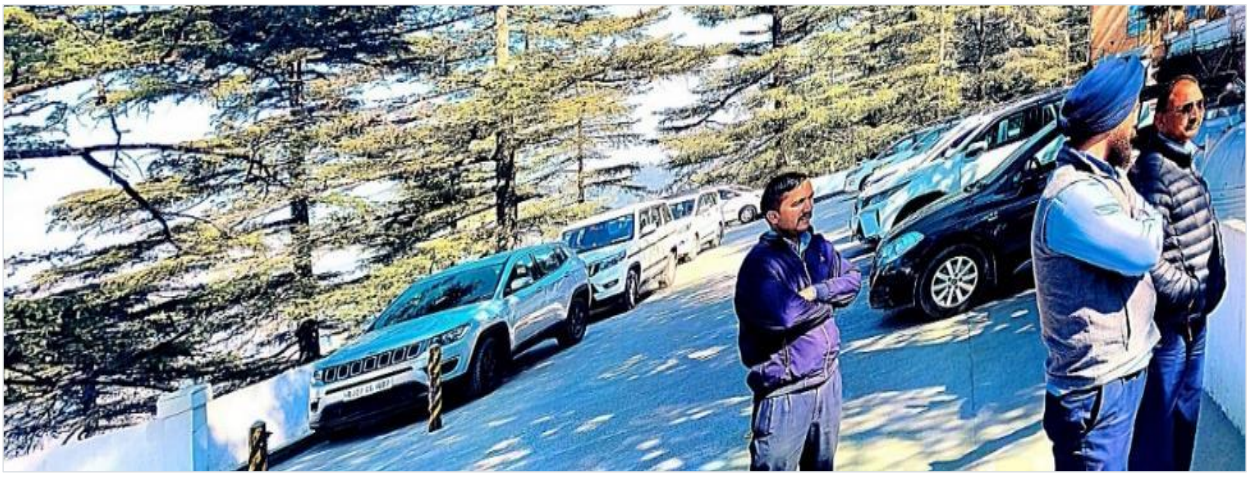
Site location address	Secretariat
Latitude	31.09397
Longitude	77.18111
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	Medium
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	300-350

20. Vikas Nagar Parking - Tanzin

Site location address	Vikas Nagar Parking - Tanzin
Latitude	31.07736
Longitude	77.17584
Visibility of EV charging station	Under construction
Type of parking (free parking or paid parking operated by parking concessionaire)	Under construction
Whether the location is open to public (24x7) or restricted operating hours.	Under construction
Floor type (concrete, tiles, mud etc.) at the proposed location	Under construction
Visibility from Road/Highway	Low
Distance from Road/Highway	50 Mtrs
Total no. of parking capacity in parking area	Under construction

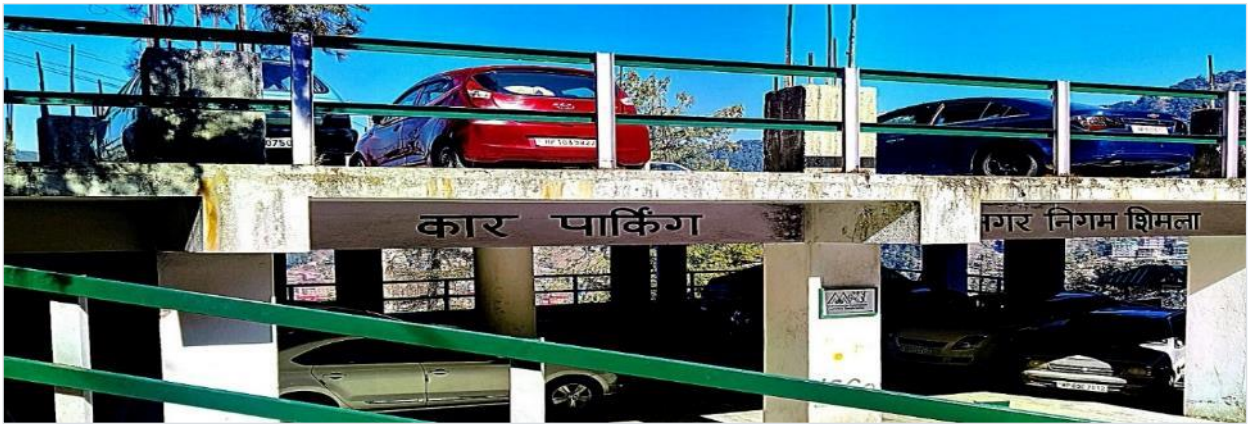
21. Cecil MC parking





Site location address	Cecil MC parking
Latitude	31.11187
Longitude	77.16109
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	medium-high
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	100

22. Morning view Parking



Site location address	Morning view Parking
Latitude	31.11187
Longitude	77.16109
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Free
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	10 Mtrs
Advertisement potential (high/low)	High
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	20-30

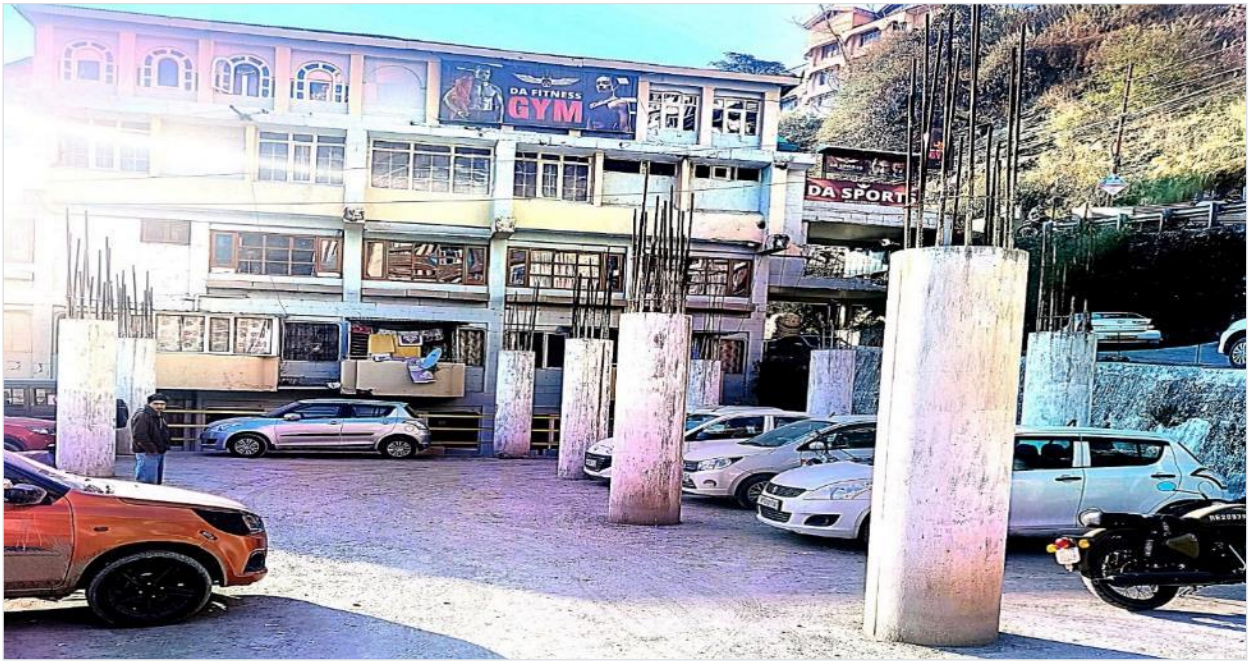
23. Lift Parking

Site location address	Lift Parking
Latitude	31.10369
Longitude	77.17563
Visibility of EV charging station	High
Type of parking (free parking or paid parking operated by parking concessionaire)	Paid
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	1-2 Mtrs
Advertisement potential (high/low)	High
Public amenities available nearby.	Mall road
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	150 on each floor, Total 5 floors

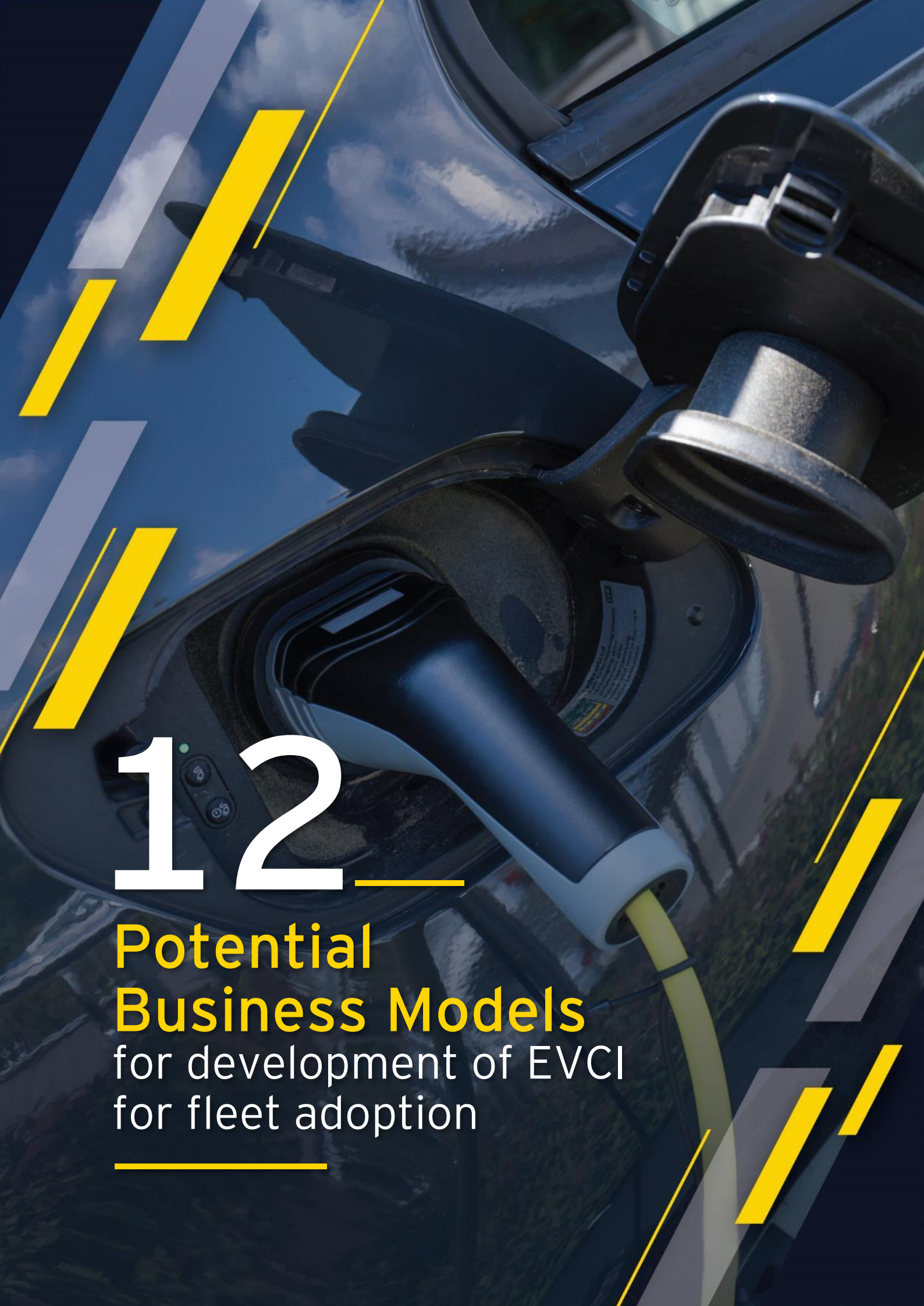
24. Jiwanoo

Site location address	Jiwanoo
Latitude	31.07108
Longitude	77.18404
Visibility of EV charging station	Medium – High
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	Medium
Distance from Road/Highway	5-10 Mtrs
Advertisement potential (high/low)	Low - Medium
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	60 (20 ON EACH FLOOR)

25. Kusumpti



Site location address	Kusumpti
Latitude	31.07871
Longitude	77.1796
Visibility of EV charging station	Medium
Whether the location is open to public (24x7) or restricted operating hours.	24x7
Floor type (concrete, tiles, mud etc.) at the proposed location	Concrete
Visibility from Road/Highway	High
Distance from Road/Highway	50 Mtrs
Advertisement potential (high/low)	Yes - High
Suitability for solar installation (canopy structures)	Yes (on top floor)
Total no. of parking capacity in parking area	50



12

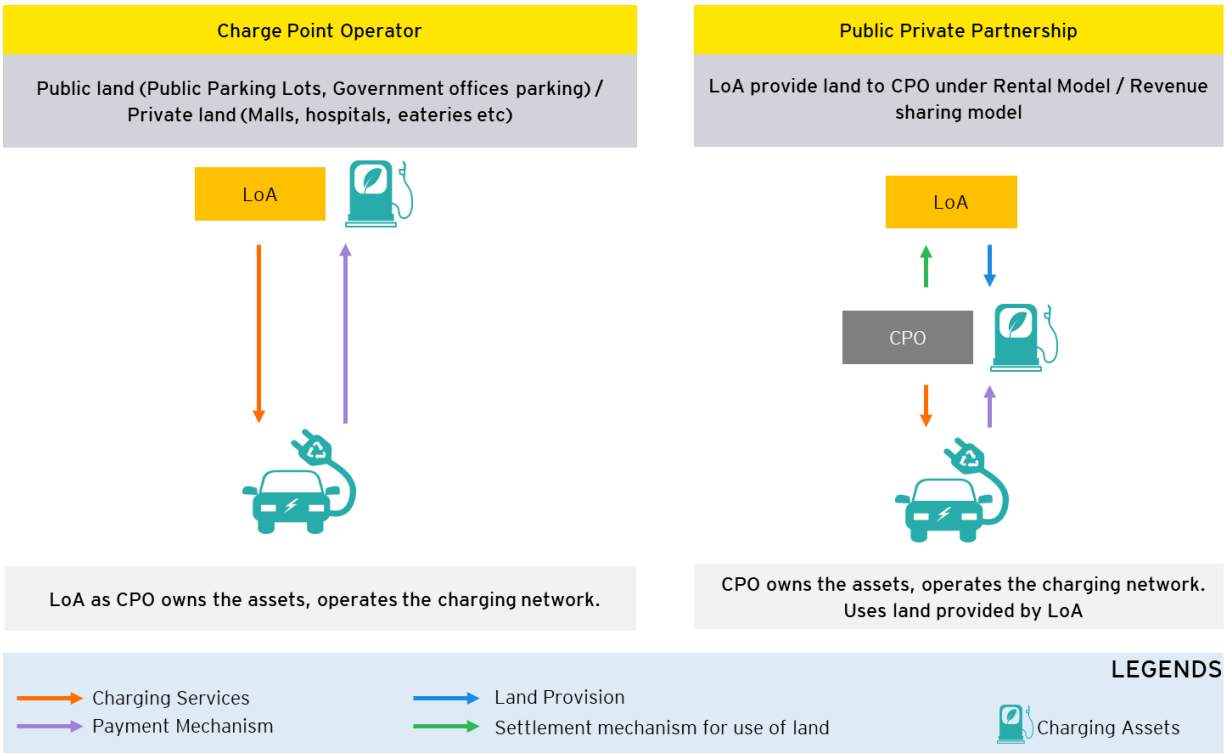
Potential Business Models

for development of EVCI for fleet adoption

Public charging infrastructure is the backbone of any electric mobility implementation. The provision of adequate, affordable, accessible, and reliable charging networks is a prerequisite for mass EV adoption and could help promote awareness and reduce range anxiety among potential EV users. To facilitate a sustainable electric mobility ecosystem in India, the role of Land-owning Agency (LoA) will be a leading one, especially in deploying EVCI within Shimla city.

The Land-owning Agency in case of Shimla can be any suitable government stakeholder such as Shimla Municipal Corporation, Himachal Pradesh Electricity Board Limited, Himachal Pradesh Road Transport Corporation Limited or any other potential government body.

Different types of implementation models may be used to set up and scale public charging infrastructure. A typical charging infrastructure implementation model comprises of multiple components, including the capital expenditure for charging equipment, provision of land, supply of electricity, and the day-to-day operations and maintenance of facilities and services. The different types of EV charging business models are:

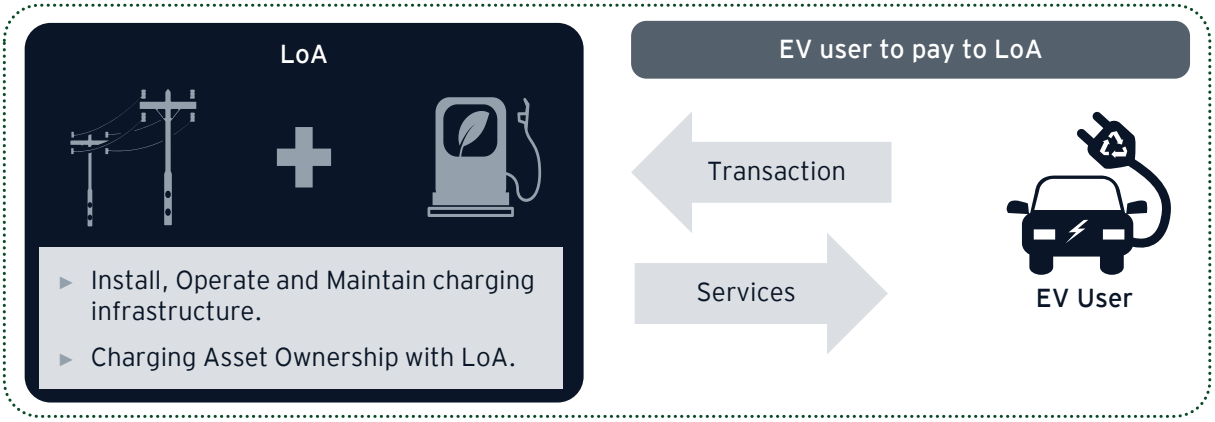


In regard to the investment required for setting up a public charging station, there are various cost components such as installation costs for procuring and installing EV charging equipment, cost incurred for making provision of land to set up the charging station, costs incurred in maintaining and operating the charging station, costs of manpower that will be required to efficiently oversee the daily operations of the charging station etc.

In terms of revenue generation through the EV charging business, there are certain direct methods such as charging user fees to customers for energy use either on a per-user basis or a subscription basis. Further, there are certain additional factors that will improve the financial viability of EV charging such as revenue from advertisement at the charging station and retail co-location by setting up EV charging stations alongside pre-existing retail stores. This will increase the visibility of a charging station which will result in achieving better utilization of the charging stations. The different types of business models are discussed below:

Business Model 1: LoA own and operate public charging station on public land and private land

To establish an EV charging business, provision of land is one of the key requirements and from the perspective of lighthouse cities, availability of affordable land is very low. In this scenario, Land owning Agency (LoA) can play a leading role in setting up public charging stations at their premises itself. The ULB owns the EVSE and operate the public charging station.



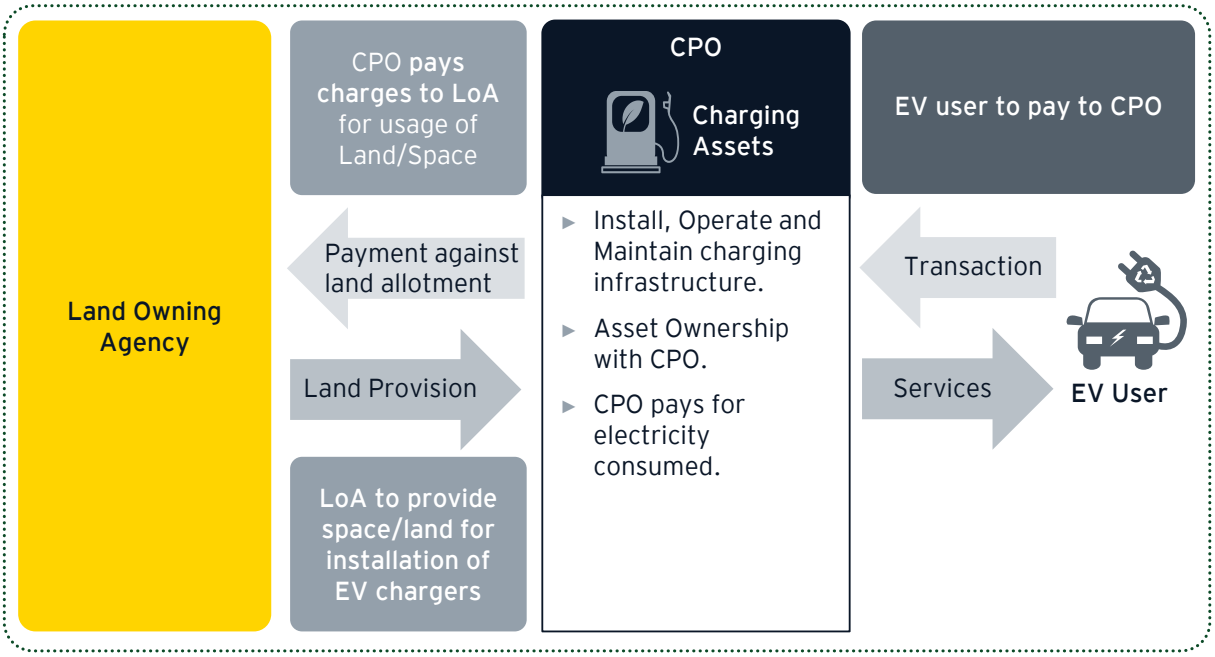
Pros	Cons
► More control of LoA over pricing policy and type/make/capacity of chargers deployed ► Option for enhancing revenue through advertisements by using available space	► Demand risk lies with LoA ► Requires LoA to invest ► ULB may lack prior expertise in running EV charging business

Business Model 2: Land-Owning Agency

The government body can act as a Land-Owning Agency (LoA) and can provide the land to Charge Point Operator (CPO) to install and operate public charging stations within its license area after suitable locational planning. There can be multiple ways to implement this type of business model. ULB can either provide land to CPO on **rental basis** or ULB can enter into a **revenue sharing** agreement with CPO.

Business Model 2a: LoA - CPO Rental Arrangement Model

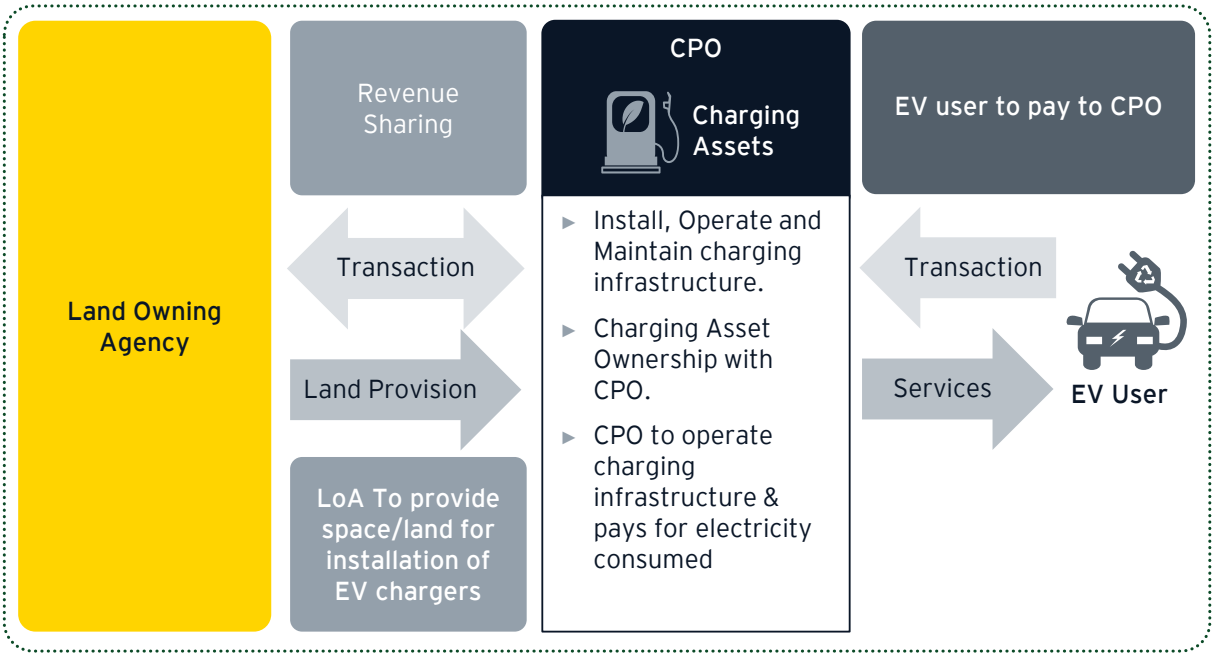
In urban areas, the cost of land is high and buying separate land to set up public charging stations significantly reduces the business viability. Arranging land on a rental basis is a better option where the land required for establishing the charging station is provided by the Land-Owning Agency (LoA). The Charge Point Operator (CPO) engages in a rental arrangement with the LoA, securing permission to utilize the land for charging infrastructure deployment. By the established terms of this agreement, the CPO disburses rental payments to the v. The CPO's role is installation, operation, and maintenance of the charging infrastructure, and retains full ownership of the charging station. Moreover, the CPO takes up the financial responsibility of covering the costs incurred by electricity consumption.



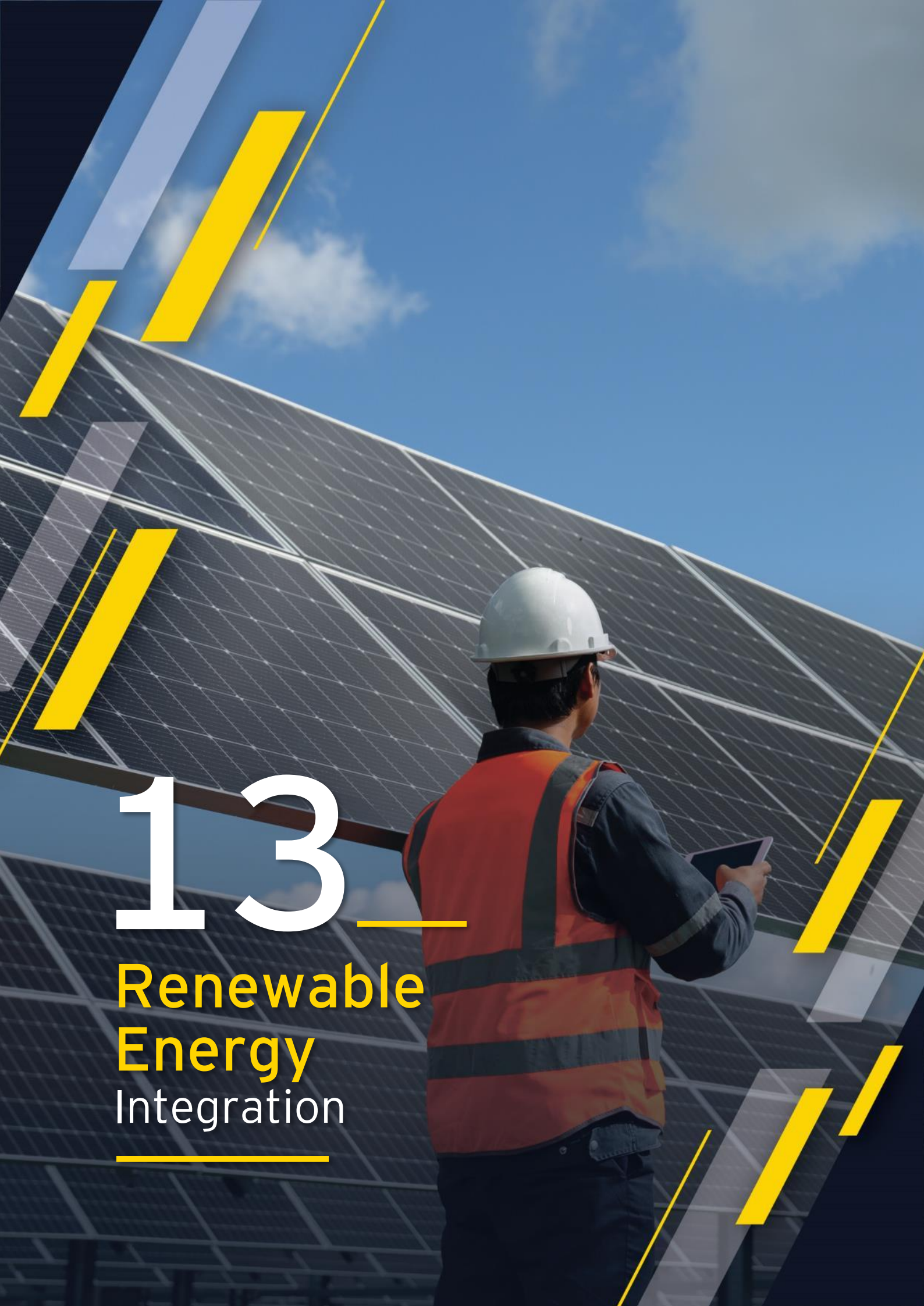
Pros	Cons
▸ Demand risk lies with CPO ▸ Requires CPO to invest ▸ Assured monthly revenue for LoA from un-utilized space available	▸ Less control of LoA over pricing policy ▸ LoA has limited control over type/make/capacity of chargers deployed

Business Model 2b: LoA - CPO Revenue Sharing Arrangement

A business model which is widely used for its financial benefits to both, the LoA and the CPO is a revenue-sharing business model. In this scenario, the ULB extends the use of their land to the CPO for the installation of a charging station. A mutually agreed upon revenue sharing agreement is established between the LoA and the CPO, wherein a specified percentage of the revenue generated from service charges, paid by EV users for their charging requirements, is passed on to the LoA. Remaining consistent, the CPO takes on the responsibilities of installation, operation, and maintenance of the charging infrastructure while retaining ownership of the assets. The CPO remains accountable for covering the electricity expenses incurred by the charging station. As before, EV users directly remit their payments to the CPO for the charging services they utilize.



Pros	Cons
▸ Requires CPO to invest ▸ LoA has control over pricing policy and type/make/capacity of chargers deployed ▸ Generate revenue for LoA from un-utilized space available	▸ Demand risk shared by LoA & CPO both



13

Renewable Energy Integration

13.1. Introduction

The integration of Renewable Energy (RE) with Electric Vehicle (EV) charging infrastructure represents a pivotal stride towards sustainable and eco-friendly transportation solutions. In response to global environmental concerns and a collective commitment to reduce carbon emissions, the amalgamation of clean, renewable energy sources such as solar and wind power with EV charging systems has emerged as a transformative strategy. This synergistic approach not only aligns with India's pursuit of a low-carbon future but also addresses critical challenges related to energy security, air pollution, and grid management. In this context, the integration of RE with EV charging infrastructure becomes a linchpin, fostering a harmonious convergence of transportation and energy sectors for a cleaner, greener tomorrow.

At the global level, governments are implementing programs to transition away from traditional energy sources and towards clean energy to power EVs. Many utilities are introducing new pilot programs that enable EV users to utilize renewable energy for their charging needs. Integrating renewable energy with electric vehicle (EV) charging infrastructure in Shimla holds significant importance for several reasons such as environmental sustainability, reduced carbon footprint, and long-term energy cost savings. By harnessing renewable energy sources, the electric vehicle charging ecosystem becomes more sustainable and aligns with the overall goals of transitioning to clean energy.

> For India, a country with abundant sunlight and increasing emphasis on sustainability, the integration of renewable energy into EV charging infrastructure can play a pivotal role in shaping a cleaner and more resilient energy future.

13.1.1. Benefits of Integrating RE with EV charging

Implementing renewable energy integration in EV charging infrastructure can contribute to:

- **Environmental Benefits**: India, like many other countries, aims to reduce its carbon footprint to combat climate change. The integration of renewable energy sources, such as solar and wind power, with EV charging can significantly reduce carbon emissions associated with transportation. This is particularly crucial since the power sector is one of the largest contributors to carbon emissions.
- **Energy Security**: India heavily relies on imported fossil fuels to meet its energy needs. The integration of renewable energy sources for EV charging can enhance energy security by reducing dependence on imported fossil fuels. This, in turn, helps mitigate the risks associated with price volatility and geopolitical tensions.
- **Air Quality Improvement**: India grapples with severe air pollution issues in numerous cities, largely stemming from vehicular emissions. Shifting to electric vehicles charged with renewable energy holds the potential to enhance air quality by eliminating tailpipe emissions, which are major contributors to respiratory illnesses and other health concerns.
- **Grid Stability and Peak Demand Management**: The integration of EV charging infrastructure has the potential to exert stress on the electricity grid, especially during peak demand hours. By incorporating renewable energy sources into EV charging systems, grid load management becomes more effective, allowing a reduction in peak demand. Furthermore, the implementation of smart charging systems enables the scheduling of charging activities during off-peak hours or periods of abundant renewable energy generation.
- **Promoting Renewable Energy Investments**: The integration of renewable energy with EV charging infrastructure can establish synergies between the transportation and energy sectors, fostering investments in renewable energy projects. This has the potential to expedite the deployment of renewable energy projects in India, aligning with the country's sustainability targets and generating employment opportunities.
- **Technological Innovation and Economic Growth**: The integration of renewable energy with EV charging necessitates technological advancements, including smart grids, energy storage solutions, and vehicle-to-grid (V2G) systems. These innovations can catalyse economic growth by stimulating investments in research and development, nurturing entrepreneurship, and generating job opportunities in emerging industries.
- **Utilization of Solar Energy Surplus**: India has significant solar energy potential, particularly with its abundant sunlight throughout the year. However, solar power generation typically peaks during the daytime when electricity demand is relatively low. By coupling EV charging stations with solar installations, surplus solar energy can be effectively utilized to charge electric vehicles, maximizing the use of solar infrastructure, and reducing curtailment.
- **Cost Savings**: Solar energy is becoming increasingly cost-competitive with conventional sources of electricity generation in India. Leveraging solar power for EV charging presents an opportunity for vehicle owners and charging station operators to potentially reduce their electricity costs over the long term. By relying less on grid electricity, especially during daylight hours when solar generation is plentiful, they can achieve greater cost-effectiveness.
- **Scalability and Flexibility**: Solar-powered EV charging infrastructure exhibits a remarkable versatility, accommodating various scales ranging from residential installations to expansive public charging stations. This adaptability facilitates the widespread expansion of EV charging infrastructure, encompassing urban areas, highways, and even remote locations with limited grid connectivity. This, in turn, contributes significantly to the nationwide promotion of EV adoption.

13.2. Solar Energy adoption in Shimla

The H.P. Solar Power Policy-2016 applies primarily to Solar Photovoltaic (PV) technology, with potential expansion to Solar Thermal and other technologies as their efficiency improves. The policy remains valid until March 31, 2022, unless modified or extended. Its objectives include promoting solar energy for sustainable development, enhancing energy security, supporting the state's clean electricity consumption policy, and contributing to national renewable energy goals. It aims to decentralize solar power, encourage private investment, meet renewable purchase obligations (RPOs), and raise awareness about renewable energy's benefits.

The policy distinguishes solar power projects from other renewable sources like small hydro, biomass, and municipal waste. Solar projects have minimal environmental impact, are not site-specific, and can be established on wasteland. Key features of the policy include:

1. Investment: The policy requires substantial investment, estimated at Rs. 7 Crores per MW, primarily from the private sector, promoting both small and large projects.
2. Investment Treatment: Solar power investments are treated as industrial projects, with simplified approval processes.
3. Government Facilitation: The state government will streamline procedures for statutory clearances.
4. Land Allocation: Efforts are underway to develop a land bank for solar parks.
5. Power Purchase Preference: Preference will be given to purchasing solar power generated within the state to meet RPOs.

Himachal Pradesh aims to establish approximately 700 MW of solar capacity by 2022, including 220 MW for RPOs. Strategies include promoting rooftop solar, encouraging distributed generation, and developing larger projects near industrial centres through competitive bidding. Collaboration with SECI and the creation of medium-sized solar parks are also planned.

Solar power producers in Himachal Pradesh have flexibility in disposing of generated power. HPSEBL can purchase power from any source ensuring cost-effective delivery. The policy prioritizes project locations near load centres and promotes mini-grid solutions in remote areas. Tariffs for HPSEBL purchases up to 5 MW are set by HPERC, with competitive bidding for capacities above 5 MW. Solar generators have Open Access rights under HPERC regulations, and adequate evacuation infrastructure is prioritized.

HIMURJA serves as the State Nodal Agency for project registration and coordination, while HPSEBL manages Power Purchase Agreements and grid interconnections. Approximately 2 hectares of land per MW is required for solar PV projects, with adjustments for hilly terrains. Land can only be leased, with private land transfer requiring State Government approval under Section 118 of the HP Tenancy and Land Reforms Act. Non-utilized land reverts to the government after three years.

Shimla's initiative for renewable energy: Waste to Energy (W2E)

Municipal Corporation Shimla set up India's first Waste to Energy Plant using Refuse Derived Fuel (RDF) and Gasification Technology on a Public-Private Partnership (PPP) model. Located at Bhariyal, this innovative plant was designed to process 70 tons of municipal solid waste (MSW) per day to generate 1.7 MWh of electricity.

To achieve this, two Refuse Derived Fuel (RDF) lines were made functional. These lines process the MSW, converting it into RDF, which is then used for electricity generation. The plant incorporates advanced Gasification Technology, which involves heating the RDF to produce a syngas that powers generators to produce electricity.

Grid connectivity was established through the HP State Electricity Board, Limited, ensuring that the electricity generated could be efficiently integrated into the local power grid. Although the MSW was processed daily from the start, full-scale electricity generation began after thorough testing and commissioning of all equipment, including gasifiers and engines.

The plant, operational from July 2017, represents a significant step towards sustainable waste management and renewable energy production in India, demonstrating a practical solution to urban waste challenges while contributing to the state's energy needs.

Approach for integrating Renewable Energy within EV Charging

Globally, governments are spearheading initiatives to shift from conventional energy sources to cleaner alternatives to power Electric Vehicles (EVs). In tandem with this, numerous utilities are launching pilot programs to facilitate EV users in utilizing renewable energy for their charging needs. The integration of renewable energy with EV charging has been approached through various strategies across the globe as mentioned below:

Renewable Energy Certificates (RECs)	On-Site Solar Installations	Green Tariffs and Time-of-Use Rates
Community Renewable Energy Programs	Smart Charging Infrastructure	Incentives and Subsidies

Approach for integrating RE with EV Charging

EV Charging with On-Site Renewables	EV charging is paired with an on-site renewable energy generation, most commonly by co-locating EVs with on-site solar energy systems.
Network charging	Network charging approach allow EV users to use electricity exclusively from Renewable sources to charge their EVs at the charging stations.
Shift Charging	EV charging is encouraged during off-peak periods or when renewable energy generation is high.
Managed Charging	Utilities and consumers can control the timing of EV charging to align with renewable energy availability and requirements of the electricity grid.
Time of Use based EV Charging with Renewables	Utilities provide discounted rates encourage customers to charge EVs when excess renewables are on the grid. Customer cannot claim the renewables.

These diverse approaches highlight the global commitment to transitioning towards cleaner energy sources for powering EVs, fostering a sustainable and eco-friendly mobility ecosystem.

Solar power, with its abundant availability and the feasibility of on-site installation, has emerged as an increasingly popular and suitable form of renewable energy for integrating with Electric Vehicle (EV) charging stations. This preference for solar energy extends beyond the charging infrastructure to homes and businesses, driven by a desire to reduce carbon footprints and achieve energy cost savings.

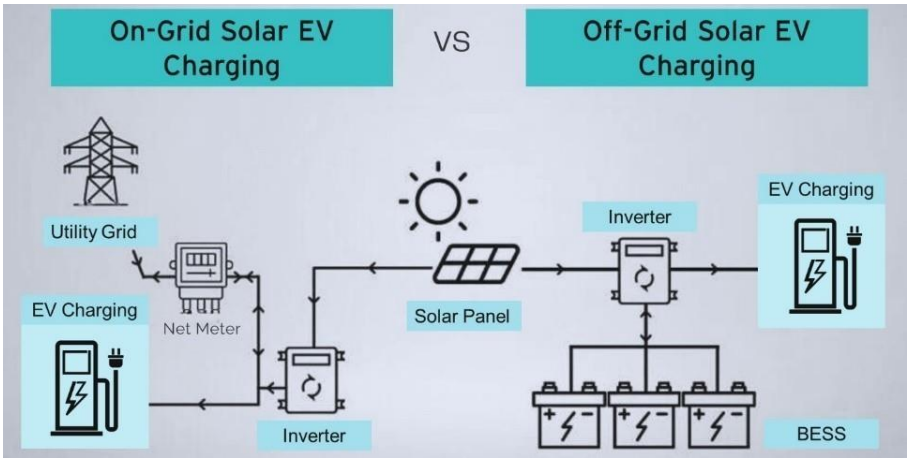
There are two primary categories of on-site solar power systems, each offering distinct advantages:

1. On-Grid Solar Power Systems:

On-grid solutions augment the electricity supply obtained from the utility grid by integrating solar power. Solar panels installed at the EV charging station feed excess energy back into the grid, contributing to the overall grid capacity. This approach ensures a continuous and reliable power supply, with any surplus energy being utilized beyond the charging station's requirements.

2. Off-Grid Solar Power Systems:

Off-grid solutions operate independently of the utility grid, relying on battery storage to store excess solar energy. These systems are self-sufficient and do not draw power from the grid. Off-grid solar power is particularly advantageous in remote locations or areas with unreliable grid connectivity, providing autonomy and resilience.



Parameter	On-Grid Solar System	Off-Grid Solar System
Connection to the Grid	Are connected to the electricity grid. They generate power during the day and give excess power back into the grid. When the solar panels are not generating electricity, the system takes power from the grid	Are connected to the electricity grid. They generate power during the day and give excess power back into the grid. When the solar panels are not generating electricity, the system takes power from the grid
Energy Storage	Do not require batteries to store excess energy for use during cloudy days or at night	Require batteries to store excess energy for use during cloudy days or at night
Maintenance	Maintenance for on-grid systems is generally simpler, as they do not require battery maintenance	Requires more maintenance
Assurance of Energy & Cost	When the grid is operating properly, it has a high degree of reliability. They could, however, experience power disruptions if the grid fails. Less expensive than off-grid.	Offers reliable energy, even during grid outages, making them suitable where grid access is unreliable. More expensive due to the cost of batteries & associated equipment.

The choice between the two depends on factors such as location, grid accessibility, energy requirements, and the level of desired autonomy, with each system presenting unique advantages and considerations.

Moreover, both on-grid and off-grid solar systems incorporate an EV Charging system. The EV charging system typically includes three main types of charging: DC charging, AC charging, and battery swapping. The system comprises charging guns, a power distribution controller, and protective appliances. In the battery swapping mode, the battery can be replaced using automatic or semi-automatic mechanical equipment, with replacement times typically ranging from 2 to 10 minutes.

13.3. Recommendations for Renewable Energy integration

The successful integration of renewable energy with EV charging in India requires a collaborative effort among both government and private stakeholders to establish an economically self-sustaining RE-integrated EV charging business. Key stakeholders include state and local governments, utilities, property owners/managers overseeing workplace charging and public parking, as well as participants from the solar and EV charging industries.

13.3.1. Recommendations for Government Sector

The government can play a crucial role by setting supportive policies and regulatory frameworks is key to fostering the successful integration of renewable energy with EV charging.

Sr. No.	Initiatives	Description
1	**Incentive Programs**	► Establish comprehensive incentive programs to encourage the installation of renewable energy-integrated EV charging infrastructure. This could include tax credits, grants, or subsidies for businesses and individuals adopting these systems.
2	**Regulatory Support**	► Develop and implement supportive regulations to streamline the permitting and approval processes for renewable energy and EV charging projects. Clear and efficient regulations can accelerate project timelines
3	**Public-Private Partnerships**	► Foster collaborations between the government and private sector entities. Public-private partnerships can leverage resources, expertise, and funding for large-scale deployment of renewable energy-integrated EV charging stations.
4	**R&D Investments**	► Allocate funds for research and development initiatives focused on advancing technologies related to renewable energy and EV charging. This could include improving energy storage solutions, enhancing charging efficiency, and reducing costs.
5	**Standardization**	► Establish industry standards for the integration of renewable energy sources with EV charging infrastructure. Standardization can promote interoperability, ensuring that different systems work seamlessly together.
6	**Education and Awareness**	► Implement awareness campaigns to educate the public about the benefits of renewable energy-integrated EV charging. This can drive adoption and create a positive perception of sustainable transportation solutions
7	**Grid Modernization**	► Invest in upgrading the electricity grid to accommodate the increased demand from EV charging stations. Grid modernization efforts can enhance reliability and flexibility in managing renewable energy inputs
8	**Demonstration Projects**	► Initiate pilot projects or demonstrations to showcase the feasibility and benefits of renewable energy-integrated EV charging. These projects can serve as models for future deployments
9	**Financing Programs**	► Develop financing programs to support the deployment of renewable energy-integrated EV charging infrastructure. This could involve low-interest loans or financial instruments to make investments more attractive.
10	**Policy Alignment**	► Ensure that existing policies related to renewable energy and electric vehicles align with the goal of integration. Identify and address any regulatory barriers that might hinder progress.

13.3.2. Recommendations for Private Sector

For the private sector to actively participate and contribute to the successful integration of renewable energy with EV charging, several strategic actions and initiatives can be undertaken. The private sector actors (solar and EV industries in particular)) can create initiatives to capture RE+EV value in its products and services. The private players can create suitable RE+EV market products to enhance the value-added opportunity of pairing the two technologies.

Sr. No.	Initiatives	Description
1	**Investment in Renewable Energy Infrastructure**	▶ Private businesses should consider investing in on-site renewable energy infrastructure, such as solar panels or wind turbines, to power their EV charging stations. ▶ Explore partnerships with renewable energy providers or developers to facilitate the integration of green energy sources.
2	**Green Certifications and Labels**	▶ Obtain and showcase green certifications or labels for EV charging stations powered by renewable energy. ▶ Communicate the commitment to sustainability and environmental responsibility to attract environmentally conscious consumers
3	**Collaboration with Renewable Energy Companies**	▶ Form partnerships with renewable energy companies to procure green energy for EV charging operations. ▶ Explore power purchase agreements (PPAs) or other collaborative models to ensure a reliable and sustainable energy supply.
4	**Development of Smart Charging Infrastructure**	▶ Invest in smart charging technologies that optimize charging schedules based on renewable energy availability and grid demand. ▶ Implement advanced energy management systems to enhance the efficiency of renewable energy usage.
5	**Community Engagement and Education**	▶ Engage with local communities to raise awareness about the benefits of renewable energy-integrated EV charging stations. ▶ Conduct educational campaigns to inform customers about the environmental impact of choosing renewable-powered charging options
6	**Incentive Programs for Employees and Customers**	▶ Create incentive programs for employees and customers who choose to charge their EVs using renewable energy sources. ▶ Offer discounts, loyalty rewards, or other perks to encourage sustainable charging practices
7	**Participation in Government Initiatives**	▶ Participate actively in government-led initiatives that promote the integration of renewable energy with EV charging. ▶ Advocate for supportive policies and incentives that benefit both private businesses and the broader renewable energy ecosystem
8	**Adoption of Energy Storage Solutions**	▶ Consider the integration of energy storage solutions, such as batteries, to store excess renewable energy for later use. ▶ Explore opportunities for peak shaving and grid support through the deployment of energy storage systems
9	**Demonstration Projects and Pilots**	▶ Undertake demonstration projects or pilot initiatives to showcase the viability and benefits of renewable energy-integrated EV charging. ▶ Share results and best practices with industry peers and stakeholders.
10	**Green Financing and Grants**	▶ Seek green financing options or grants that support renewable energy projects for EV charging infrastructure. ▶ Leverage available financial instruments to reduce the upfront costs associated with incorporating green energy sources.
11	**Monitoring and Reporting**	▶ Implement robust monitoring and reporting systems to track and transparently communicate the renewable energy performance of EV charging stations. ▶ Share data on energy usage, carbon savings, and other relevant metrics to build trust and credibility.

13.3.3. Recommendations for DISCOMs

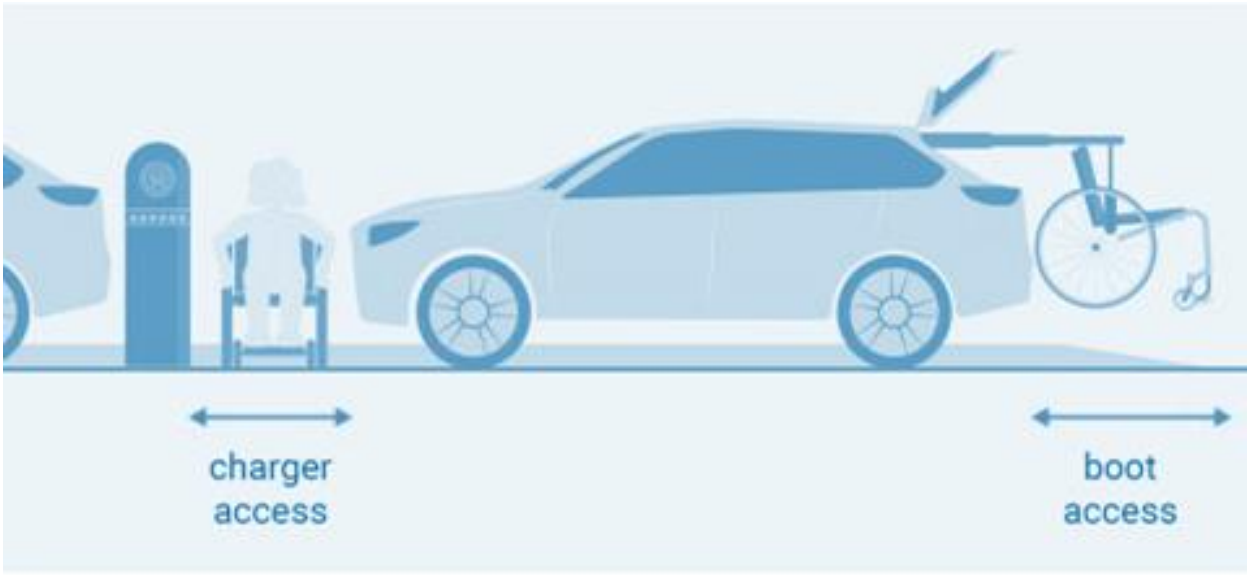
DISCOMs being the most critical stakeholders for the power supply system have a crucial role to play in supporting integration of RE with EV charging. DISCOMs must design supportive EV charging utility rates and incentives that enable potential demand charge savings, grid benefits, and bulk power benefits.

Sr. No.	Initiatives	Description
1	**Collaboration with Renewable Energy Developers**	▶ Form partnerships with renewable energy developers to facilitate the installation of solar or wind power projects that can directly supply energy to EV charging stations.
2	**Net Metering Policies**	▶ Implement and streamline net metering policies that allow EV charging stations to feed excess renewable energy back into the grid. ▶ Provide clear guidelines and incentives for entities contributing to the grid through renewable energy generation
3	**Time-of-Use Tariffs**	▶ Introduce time-of-use tariffs that encourage EV charging during periods of high renewable energy availability, thereby optimizing grid usage and promoting sustainable practices.
4	**Demand Response Programs**	▶ Develop demand response programs that incentivize EV charging stations to adjust their energy consumption based on grid conditions and renewable energy availability
5	**Grid Modernization**	▶ Invest in grid modernization initiatives to enhance the capacity and flexibility of the grid to accommodate the increased demand from EV charging stations powered by renewable energy.
6	**Dynamic Pricing Models**	▶ Implement dynamic pricing models that reflect real-time changes in electricity costs, encouraging EV charging during periods of lower demand or higher renewable energy production
7	**Interconnection Standards**	▶ Establish clear interconnection standards and procedures for integrating renewable energy sources with EV charging infrastructure. ▶ Streamline the process for obtaining grid connection approvals, ensuring a seamless integration process.
8	**Educational Campaigns for Consumers**	▶ Conduct educational campaigns to inform consumers about the benefits of using renewable energy for EV charging and how it contributes to a sustainable energy ecosystem
9	**Incentives for Renewable-Powered Charging Stations**	▶ Offer financial incentives or reduced tariffs for EV charging stations that derive a significant portion of their energy from renewable sources. ▶ Create tiered incentive structures based on the percentage of renewable energy used.
10	**Collaboration with Government Initiatives**	▶ Collaborate with government initiatives promoting the integration of renewable energy with EV charging stations. ▶ Provide input and feedback to policymakers to shape supportive regulations and incentive programs.
11	**Data Sharing and Monitoring**	▶ Implement data-sharing mechanisms to monitor the performance and impact of renewable energy-integrated EV charging stations on the grid. ▶ Use collected data to optimize grid operations and plan for future renewable energy integration.
12	**Development of Charging Hubs**	▶ Identify strategic locations for developing charging hubs powered by renewable energy. ▶ Prioritize areas where the integration of renewable energy and EV charging aligns with broader urban planning and sustainability goals
13	**Community Engagement**	▶ Engage with local communities to address concerns and build support for the integration of renewable energy with EV charging infrastructure. ▶ Foster a positive perception of clean energy solutions and their role in driving sustainable transportation.

14

Benefits of integrating EWCD friendly features **while planning EVCI**

Integrating Electric Vehicle (EV) Charging Infrastructure with services tailored to Elderly, Women, Children, and Disabled (EWCD) populations offers a range of benefits that cater to their specific needs and contribute to a more inclusive and accessible transportation system. Here are some key advantages:



1. **Inclusivity:** Integration promotes inclusivity by ensuring that transportation solutions, including EV charging infrastructure, are designed with diverse users in mind. This helps to address barriers to mobility and transportation faced by EWCD populations, thereby fostering a more inclusive society.
2. **Sustainability:** Encouraging the use of electric vehicles through integration with EWCD services aligns with broader sustainability goals by reducing greenhouse gas emissions and reliance on fossil fuels. This benefits not only current but also future generations, including children and vulnerable populations, by mitigating the impacts of climate change.

Integration of EV Charging infrastructure can be done by the following measures:

1. Opting for a location with a paved surface is advisable to guarantee accessibility regardless of weather conditions and to facilitate the delineation of buffer zones.
2. Selecting a parking spot adjacent to open space is highly recommended as it enhances accessibility and manoeuvrability.
3. Safety and Security: Providing well-lit, easily accessible EV charging stations with enhanced security features ensures a safe environment, particularly for vulnerable groups like the elderly and children.
4. Assistance Services: Helping services such as on-site personnel or digital support for charging assistance can be particularly beneficial for elderly individuals or those with disabilities who may require help navigating the charging process or handling charging equipment.
5. Clear Indication of Compatibility: In situations where multiple chargers are available, it's crucial to ensure that users can easily identify which charging point is suitable for their specific vehicle or equipment. By prominently displaying notices at each charging point, clearly indicating compatibility with AC or DC charging, users can quickly determine the appropriate charging station to use, reducing confusion and streamlining the charging process.
6. Distinct Differentiation of Rapid Charging Points: Rapid charging points, operating at 500V DC, pose unique hazards compared to conventional charging points. Therefore, it's essential to

distinctly differentiate them to prevent accidental misuse and ensure user safety. Implementing measures such as unique signage and physical barriers can effectively communicate the differences and prevent potential accidents.

7. Positioning for Flood/water logging Resilience: Electric vehicle charging points should be strategically positioned to mitigate the risk of water damage, especially in flood-prone/ waterlogging prone areas. Ensuring that the socket-outlet of supply is at least 800 millimetres above the Highest Flood level helps safeguard the infrastructure against water ingress, minimizing the risk of electrical hazards and infrastructure damage during flooding events.

8. Convenient Parking and Charging: Electric vehicle parking spaces should be designed to optimize convenience for users during the charging process. By positioning the parking space within a five-meter radius of the charging point, users can easily access the charging infrastructure without needing to navigate significant distances, enhancing user experience, and promoting widespread adoption of electric vehicles.

9. Safety Considerations for Children: To ensure the safety of children, charging points should incorporate child-proof features and be situated away from designated play areas. By implementing safety measures such as child-proof enclosures and positioning charging points away from areas frequented by children, the risk of accidents or injuries can be significantly reduced, promoting a safer environment for all users.

10. Prominent Signage and Markings: Clear signage and markings are essential for guiding users to the charging bays and ensuring efficient use of the infrastructure. By prominently displaying signage and markings on the ground, users can easily locate and navigate towards the charging points, minimizing congestion and facilitating a smooth charging experience. Additionally, ensuring that charging cables are of sufficient length helps prevent damage and ensures compatibility with various types of vehicles and equipment, further enhancing user satisfaction and usability of the charging infrastructure.

11. The public charging station requires installation on a flat, stable surface with good traction. Surrounding surfaces should vary to indicate orientation and obstacles.

15 Recommendations

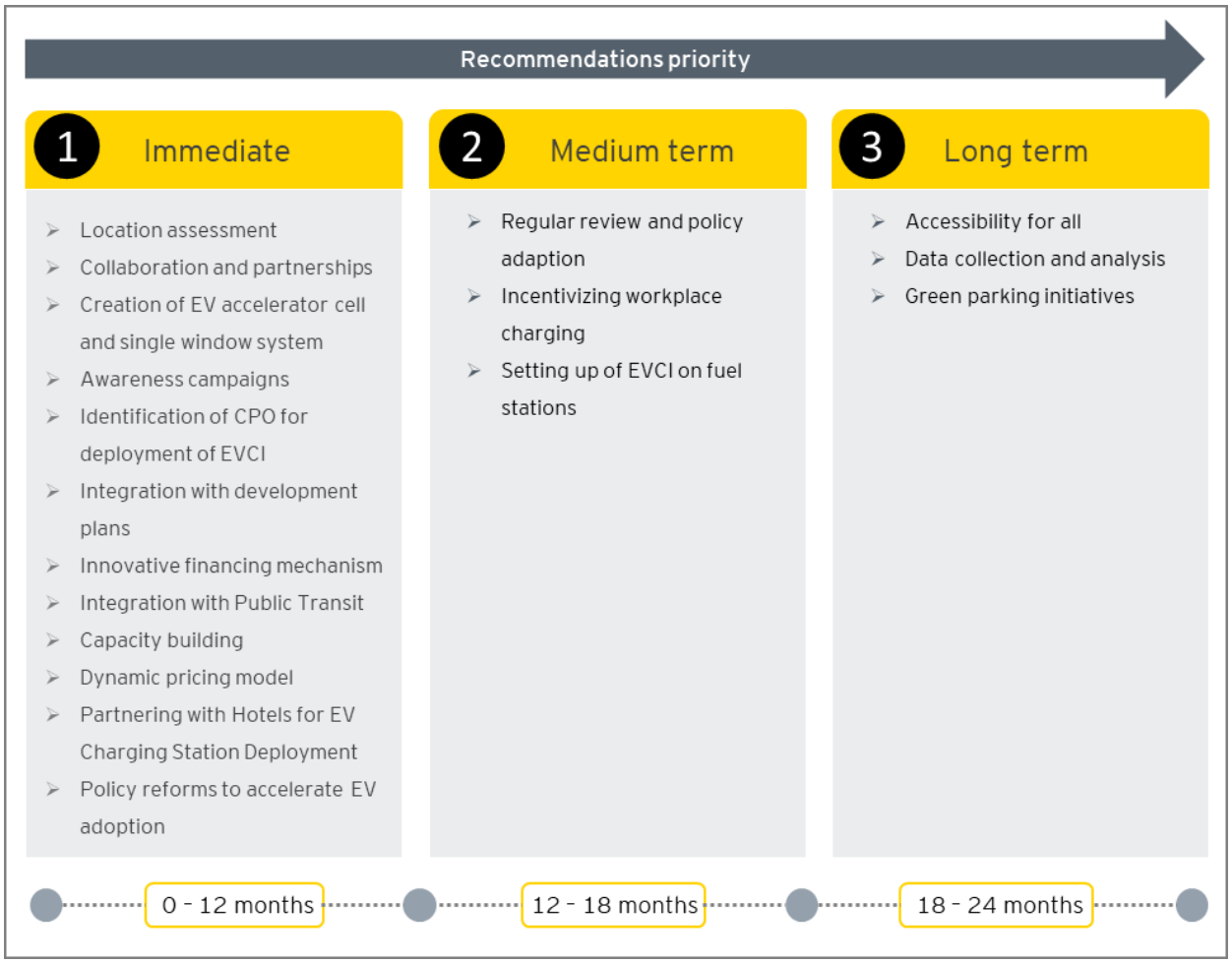
Shimla's charm lies in its accessible spots brimming with natural significance, such as The Ridge, Mall Road, and Christ Church. Providing public charging stations near these landmarks not only enhances convenience but also promotes sustainable mobility, blending tradition with technology. Additionally, the hilly terrain and cold winters of Shimla present unique challenges for EV performance and infrastructure, necessitating careful planning and durable solutions.

To seamlessly integrate EVs into Shimla's hilly terrain and variable weather conditions, stakeholders must prioritize strategic planning and collaboration, with the Shimla Municipal Corporation and the Himachal Pradesh State Electricity Board (HPSEB) leading the way.

Currently, Charge Point Operators (CPOs) encounter barriers in setting up charging stations due to regulatory hurdles and the challenging geography. Simplifying regulations and offering incentives can encourage their involvement, fuelling the growth of EV charging networks. Over time, boosting charger usage is vital for the economic viability of EV charging businesses. Innovative strategies like flexible pricing and local partnerships can maximize charger usage, improving financial prospects for CPOs.

The shift towards electric mobility in Shimla is not just about embracing innovation; it's about preserving heritage, fostering inclusivity, and building a sustainable future for generations to come. Through strategic planning, collaboration, and innovation, Shimla can lead the charge towards a greener and more vibrant tomorrow.

Recommendations for adoption of e-Mobility in Shimla:



Immediate Priority recommendations:

1. **Location assessment:** Shimla needs to strategically plan the deployment of public charging infrastructure by considering factors such as accessibility, footfall, parking availability, and future development plans.
2. **Collaboration and Partnerships:** Collaboration between stakeholders, including Shimla Municipal Corporation, land-owning agencies, and Charging Point Operators (CPOs), is crucial. Partnerships can be fostered through concessional land offerings and revenue-sharing mechanisms.
3. **Creation of EV accelerator Cell and single window system:** Establishing an EV accelerator cell focusing upon strategizing growth of electric mobility and charging infrastructure in Shimla. Example, capacity-building efforts, creation of single window system for obtaining necessary permits and approvals.
4. **Awareness Campaigns:** Comprehensive awareness campaigns are vital for promoting understanding and adoption of EV charging infrastructure among residents. Shimla can employ diverse communication channels and community engagement strategies to foster a culture of sustainable mobility.
5. **Identification of CPO for deployment of EVCI:** it can be conducted through a competitive tendering process by floating a Request for Proposal (RFP) with Additions, to ensure public safety at charging stations, measures like adequate lighting, security cameras, and emergency call boxes are implemented, ensuring the safety and security of EV owners and the infrastructure.
6. **Integration with Development Plans:** Integrating public EV charging infrastructure planning with overall development plans ensures alignment with urban mobility strategies and sustainability goals.
7. **Innovative Financing Mechanisms:** Explore innovative financing mechanisms, such as public-private partnerships, or green bonds, to mobilize investment capital for the deployment of EV charging infrastructure in Shimla.
8. **Integration with Public Transit:** Integrate EV charging infrastructure with existing public transit systems, such as bus terminals, to encourage multi-modal transportation and provide EV owners with convenient charging options while utilizing other modes of transit.
9. **Capacity building:** Provide training programs and educational resources for EV owners, charging station operators, and maintenance personnel to ensure safe and efficient operation of EV charging infrastructure and promote user awareness and confidence.
10. **Dynamic Pricing Models**: Implement dynamic pricing models for EV charging, such as time-of-use or demand-based pricing, to incentivize off-peak charging and optimize resource utilization, thereby reducing strain on the electrical grid during peak hours.
11. **Partnering with Hotels for EV Charging Station Deployment**: Partnering with hotels to install EV charging stations offers a chance to promote sustainable travel and enhance guest experiences. This collaboration supports the growing number of EV users, reduces carbon footprints, and attracts eco-conscious travellers by providing convenient charging options, positioning hotels as leaders in green initiatives.
12. **Policy reforms to accelerate EV adoption:** Policy reforms are crucial for accelerating the adoption of electric vehicles (EVs). By implementing incentives such as tax breaks, subsidies, and infrastructure development grants, governments can lower the cost barriers and encourage consumers and businesses to switch to EVs. Additionally, policies that promote the expansion of charging infrastructure and support local manufacturing of EV components can further enhance market growth.

Medium term Priority recommendations:

1. **Regular Review and Policy Adaptation:** Regular review processes and the introduction of city policy are integral to maintaining effectiveness and relevance. Shimla should evaluate EV policy targets, incorporate public feedback, and adapt to changing dynamics and technological advancements.
2. **Incentivizing Workplace Charging:** Encourage businesses and employers to install EV charging stations at workplace parking facilities through incentives, subsidies, or tax benefits, promoting EV adoption among employees and reducing emissions from commuter vehicles.
3. **Setting up of EVCI on fuel stations:** It is recommended that the Ministry of Petroleum and Natural Gas (MoPNG) conduct a feasibility study to assess the potential for installing EV chargers at fuel stations in high-demand zones.

Long term Priority recommendations:

1. **Accessibility for All:** Ensure that EV charging infrastructure is accessible to all segments of the population, including individuals with disabilities, elderly and women, by incorporating accessible design features and providing designated parking spaces with charging facilities. Also, designed in a way that it is child proof and away from children's play area.
2. **Data Collection and Analysis:** Implement systems for collecting and analysing data on EV charging usage, user demographics, and trends, real time monitoring dashboard for enabling informed decision-making.
3. **Green Parking Initiatives**: Introduce green parking initiatives that incentivize EV owners with preferential parking spots, discounted parking fees, or extended parking durations at locations equipped with EV charging stations, encouraging EV adoption and utilization of charging infrastructure.

Annexures

ICE vehicle segment and their specifications:

Table 14: ICE vehicle segments and their specifications for TCO calculation

Parameters	2W	4W (private)	4W (Commercial)	Bus
Fuel type	Petrol	Petrol	Petrol	Diesel
Vehicle Model	Honda activa 125	Swift Dzire ZXI Plus	Swift Dzire ZXI Plus	Tata star bus LPO 7.5
Vehicle Cost	91,233	10,16,000	10,16,000	30,00,000
Range in full tank	243.8	829	829	540
Max. speed (kmph)	93	165	165	80
Engine capacity (cc)	124	1,197	1,197	3,300
Kerb weight	110	985	985	8,500
tank Capacity (ltr.)	5.3	37	37	120
Mileage	46	22.41	22.41	4.5
Fuel Consumption/100KM (Ltr)	2.17	4.46	4.46	22.2
Fuel consumption/KM (Ltr)	0.02	0.044	0.044	0.22

Electric vehicle segment and their specifications:

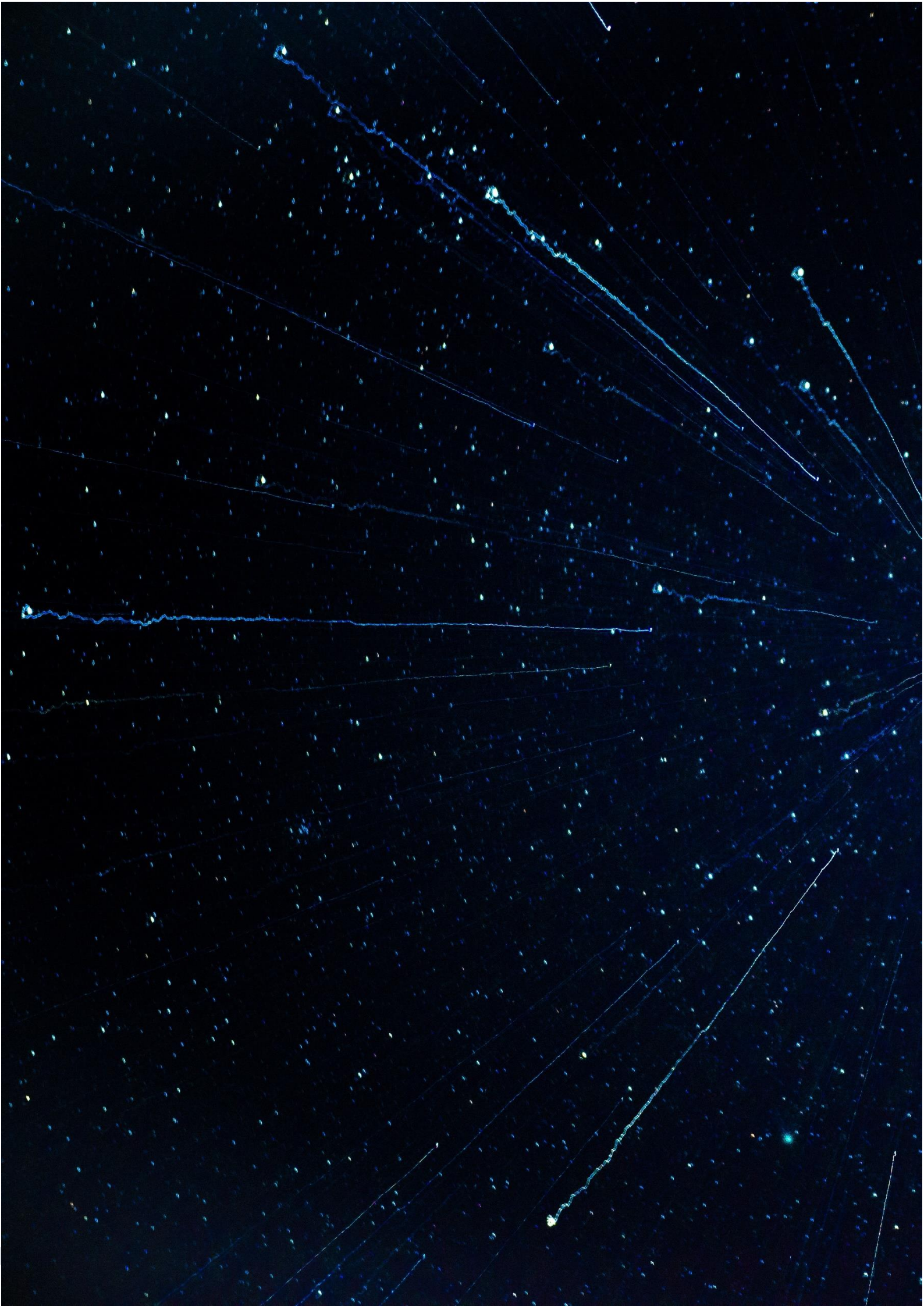
Table 15: Electric vehicle segment and their specifications for TCO calculation

Parameters	e-2W	e-4 (private)	e-4W (commercial)	e-Bus
Vehicle Model	Ola s1	Tata Nexon EV XM	Tata tigor EV XE	PMI Regio-9m
Vehicle Cost	1,30,000	14,49,000	13,74,000	1,00,00,000
Range	141	312	314	150
Max. speed (kmph)	75.3	80	116.5	80
Acceleration (m/s2)	1.32	1.7	1.4	
Kerb weight	125	1,235	1,235	
Battery Capacity (kWh)	2.98	30.2	26	151
Battery type	Nickel Manganese Cobalt Oxide	Lithium-ion Iron Phosphate	Lithium-ion Iron Phosphate	Adv Lithium ion
Energy Consumption/100KM (kWh)	3.3	10.6	11	100.67
Energy Consumption/KM (kWh)	0.033	0.106	0.11	1.01

Assumptions for calculation of TCO:

Table 16: Assumptions for calculation of TCO

	Parameter	Unit	e-2W	e-4W (private)	e-4W (commercial)	Bus
General	Lifecycle of Vehicle	years	10	10	10	10
	Lifecycle of Battery	years	5	5	5	5
	Cost of Battery	$/kWh	133	133	133	133
	Dollar to INR	Rs.	83.4	83.4	83.4	83.4
Financial	Loan Tenure	years	5	5	5	5
	Rate of Interest	pa	19.50%	9.30%	9.30%	9.30%
	Equity		30.00%	30%	30%	30%
	Debt		70.00%	70%	70%	70%
	Insurance Amount Annually- ICE	PA	1.30%	1.30%	1.30%	1.30%
	Insurance Amount Annually- EV	PA	1.30%	1.30%	1.30%	1.30%
	Maintenance Cost ICE + repairs	INR/PA	4,800	24,000		
	Maintenance Cost EV + repairs	INR/PA	2,000	8,200		
	Maintenance Cost ICE + repairs	INR/km			2.075	10.02
	Maintenance Cost EV + repairs	INR/km			0.83	4.43
	Depreciation of Vehicles	PA	10%	10%	10%	10%
	YoY escalation on maintenance		5%	5%	5%	5%
Operational	Operational Days in a year	days	350	350	350	350
	Months in a Year	months	12	12	12	12
	Distance travelled per day	kms	20	30	100	100
	Home Charging/ EV Tariff	INR/kWh	5.87	5.87	5.87	-
	Public charging / Depot Charging for buses	INR/kWh	12.21	20.42	20.42	9
	YoY escalation of public / depot charging		5%	5%	5%	5%
	Cost of conventional fuel	INR/Litre	94.84	94.84	87.99	90.08
	YoY escalation of conventional fuel		5%	5%	5%	5%
	GST on ICE vehicles		28%	28%	28%	28%
	GST on EV		5%	5%	5%	5%



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Department of Transport, Himachal Pradesh

The Department of Transport, Himachal Pradesh, oversees the regulation and development of transportation infrastructure and services across the state. It manages vital functions such as road maintenance, public transportation systems, vehicle registration, and traffic management. Dedicated to improving mobility and safety, the department strives to enhance the efficiency of transport networks, ensuring a smooth and reliable journey for residents and visitors alike.

Convergence Energy Services Limited

Convergence Energy Services Limited (CESL), a subsidiary of EESL, focuses on renewable energy, electric mobility, and climate change. CESL delivers renewable energy solutions for agricultural pumps, lighting, and cooking appliances in rural India. It also promotes battery-powered electric mobility and infrastructure to boost electric vehicle adoption. CESL is also the implementing agency for ADB GEF7 program.

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