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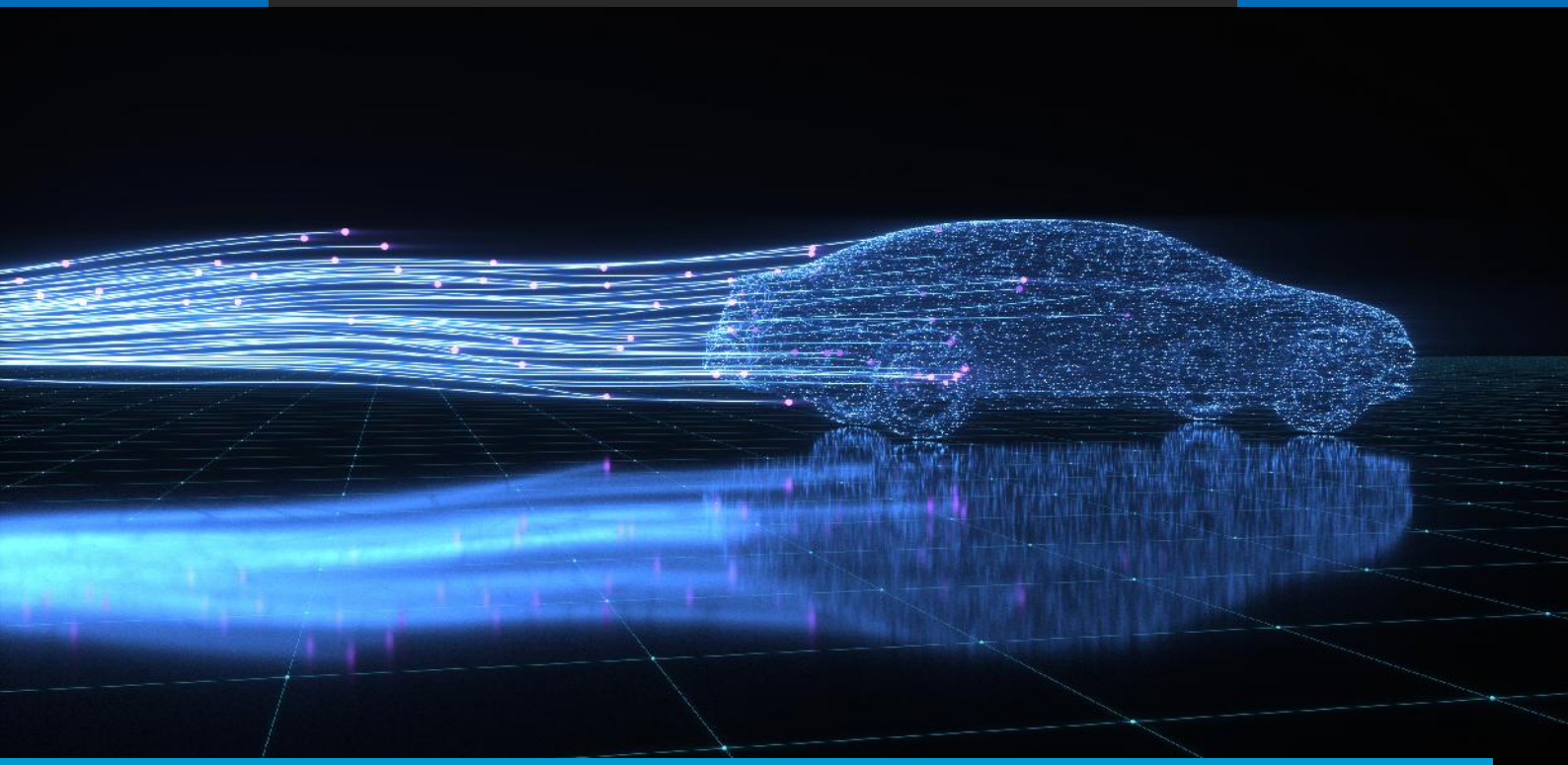
MOTICEN

A Centre of Entrepreneurship (CoE)
in Autonomous Connected Electric Shared (ACES) Mobility

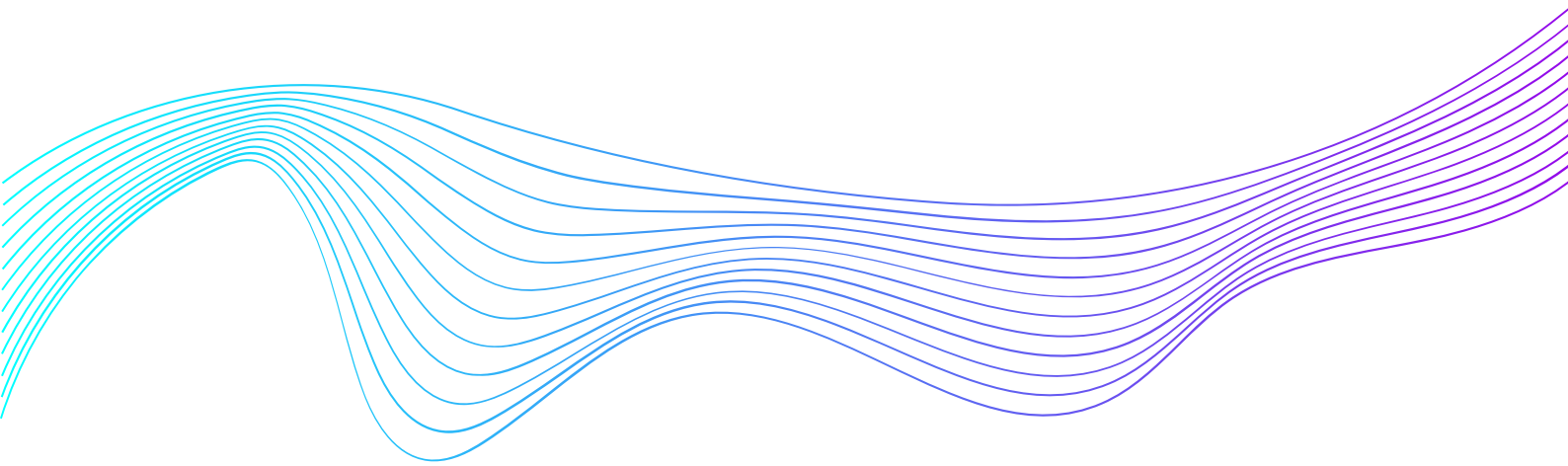


REDEFINING THE FUTURE OF MOBILITY:

AUTONOMOUS, CONNECTED, ELECTRIC AND SHARED (ACES) MOBILITY

POWERED BY

CMR
Insights powered by research



Message

At STPI, we have been at the forefront of fostering India's technology industry, and in doing so, enabling India's technology leadership and competitiveness.

We are committed to realizing the vision of the Hon'ble PM, Shri Narendra Modi on the promise and potential that start-up entrepreneurship holds. We are fostering this vision for a vibrant product start-up ecosystem through the STPI Centres of Entrepreneurship (CoEs).

Based at the auto hub of Pune, STPI MOTION is a CoE focused on fostering start-up entrepreneurship in mobility, and capitalising on emerging ACES (Autonomous, Connected, Electric and Shared Mobility) trends. MOTION will fuel and nurture the growth of the ACES Mobility sector in India. It will facilitate physical infrastructure and labs for development and validation of solution from design to prototyping to democratisation and commercialisation of innovation.

We, at STPI, will continue to fuel India's start-up potential, by supporting promising tech entrepreneurs in their journey from ideation to commercialization.

This report is a primer on the trends fuelling the ACES Mobility, and how start-ups can leverage upon it. I wish Team CMR the very best for all their future endeavours.

Arvind Kumar
Director General
STPI

Foreword

With ACES (Autotonomous, Connected, Electric and Shared) Mobility, there is a transformational technological shift underway that will reshape and redefine the way people and products are moved.

At its core, ACES will fuel a transformative change, whether it be through electrification of vehicles (EVs), or through the rise of the shared mobility. Together, these technology-driven trends will drive efficiencies and fundamentally disrupt the conventional mobility paradigms.

The ACES mobility ecosystem in India is at the throes of early and promising growth, driven by participation from industry majors, niche mobility start-ups, investor support, and championed by Government initiatives and support at the Centre and the State level.

The rapid digital transformation in mobility accords an unprecedented opportunity for Indian automakers as well as mobility start-ups to innovate, co-partner, create synergies and debut new disruptive innovations.

This report, powered by CMR, points to the promise and potential of the ACES technology trends, and the need to foster the start-up entrepreneurship around ACES.

There has never been a better time than now for start-up entrepreneurship to flourish, and drive the future of ACES mobility.

We do hope that you will find this report useful.

Dr Ganesh Natarajan
Chief Mentor
CoE MOTION

Foreword

Evolving technology trends and increased consumer expectations are radically transforming the automotive industry landscape.

In particular, the rise of autonomous, connected, electric and shared (ACES) mobility is having a transformational impact on the automotive industry. This technology-driven revolution has the potential to give a significant boost to technological as well as economic development.

With the conducive policy environment and rising investments, the automotive industry in India has an opportunity to be at the forefront of the ACES revolution, and contributing to new growth and employment opportunities.

At its core, with the rise of ACES trends, there will be greater opportunities for direct and indirect employment to skilled and unskilled labour alike, led by ACES startups.

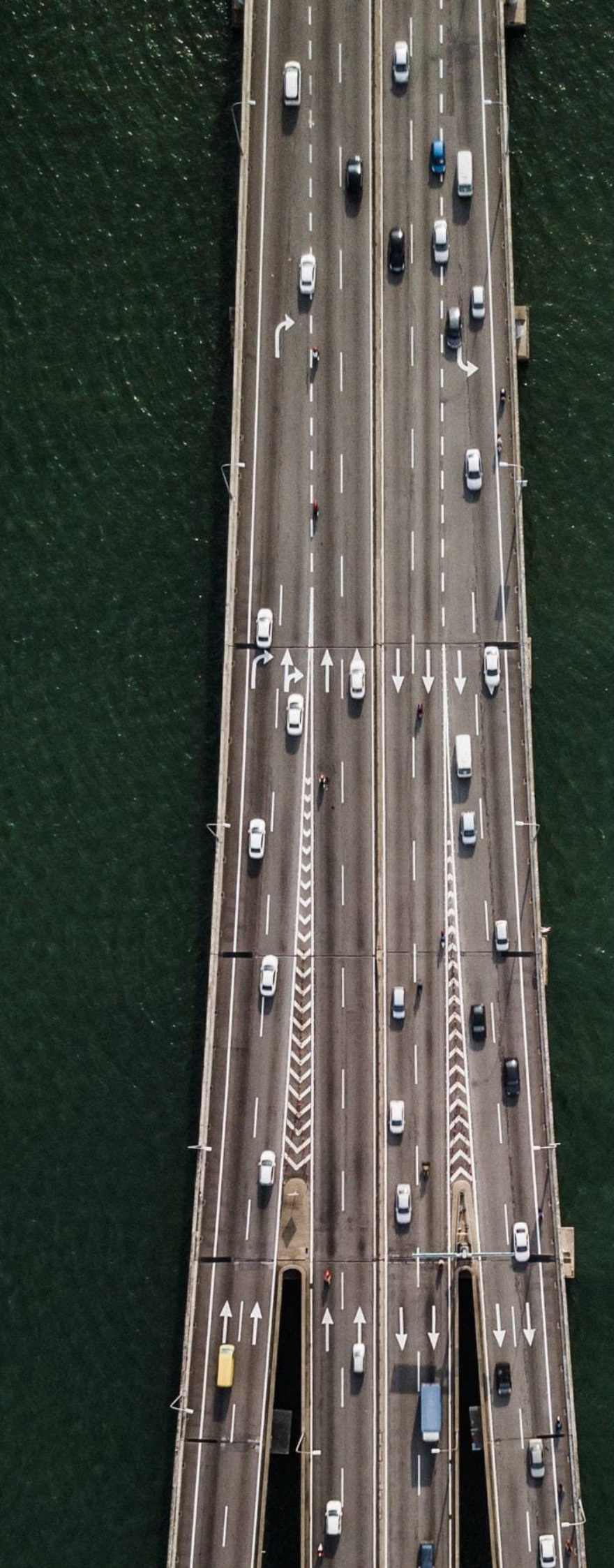
We, at STPI, are committed to nurturing and realising India's start-up potential. STPI MOTION is is leading ACES mobility entrepreneurship in India.

We welcome all entrepreneurs to connect with us, and lead India in the era of ACES mobility.

This report is a primer on the ACES mobility trends, and its potential for India.

Dr Sanjay Kumar Gupta
Jurisdictional Director
STPI Maharashtra & Goa

Shri Subodh Sachan
Director, STPI-HQ &
CEO, STPINEXT INITIATIVES



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Executive Summary

Driven by strong digital transformation, the automotive industry is in the early throes of metamorphosis to become a pure-play mobility industry, driven by the rise of transformative Autonomous, Connected, Electric and Shared (ACES) mobility. The rise of ACES mobility opens-up new avenues for entrepreneurs and mobility start-ups keen on solving current and future challenges in the automotive sector.

The Government of India is at the forefront of forging a paradigm shift by pushing ACES-based mobility. India is home to a vibrant automotive start-up ecosystem, with a conducive and enabling policy environment to foster mobility entrepreneurship.

This report maps the opportunities available for entrepreneurs in to ride the new mobility wave.

For instance, our research estimates point to the global **autonomous vehicle** industry growing to USD 0.8 trillion (INR 61.5 trillion) in 2027 at a CAGR of about 40% between 2021 to 2027.

The global **connected vehicle** industry will grow at a CAGR of 24% to USD 0.4 trillion (INR 30.7 trillion) in 2027. The connected vehicle market in India will grow at a CAGR of 20% from USD 0.1 trillion (INR 7.6 trillion) in 2021 to USD 0.4 trillion (INR 30.7 trillion) in 2027.

In value terms, the global **electric vehicle** sales would potentially grow at a CAGR of 22% to USD 0.6 trillion (INR 46.1 trillion) in 2027. The electric vehicle market in India is forecasted to grow at a CAGR of 44% until 2027.

The global **shared mobility** market is expected to grow to USD 2 trillion (INR 154 trillion) by 2027 at a CAGR of 16%. The shared mobility market in India will grow, at a CAGR of 57% from USD 0.02 trillion (INR 1.5 trillion) in 2021 to USD 0.4 trillion (INR 30.7 trillion) in 2027.

For entrepreneurs, the ACES Mobility transformation accords new opportunities to turbocharge the next wave of mobility through innovative technologies.

CHAPTER 1

Forces redefining Mobility

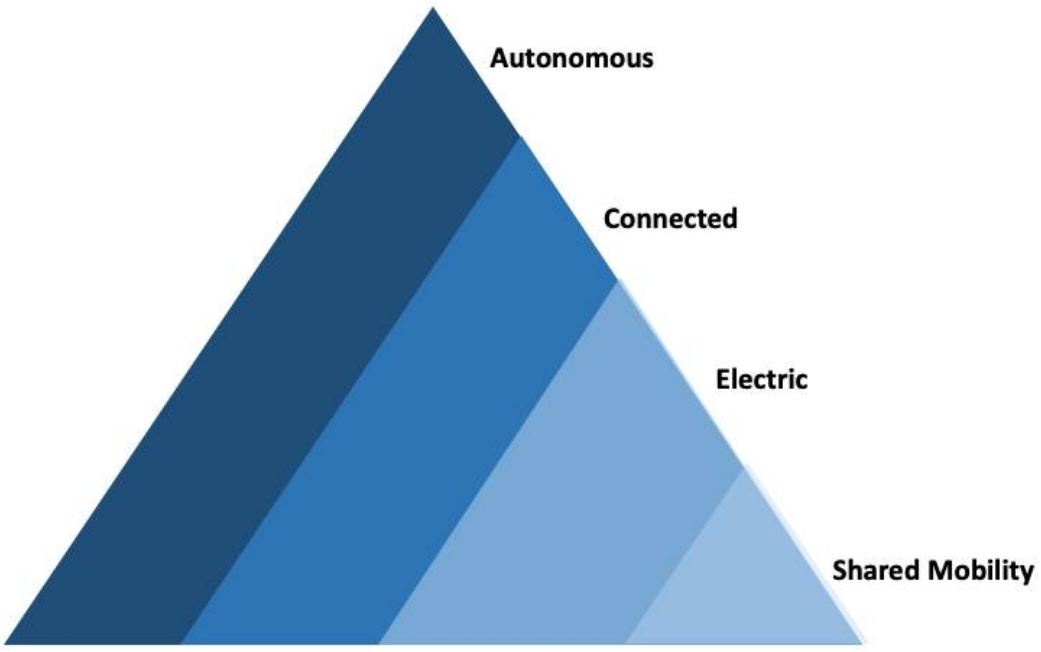
Understanding the Forces

The world is rapidly becoming digital and ever connected, driven by advances in 5G Internet of Things (IoT). Mobility is not an exception to this widespread trend of digitization. By leveraging technology, the opportunity is there to improve mobility services, enable predictive and preventive decision-making. As a consequence, mobility can become more efficient, safer and convenient.

The automotive and related industries are undergoing a fundamental transformation, due to the tectonic advances in the technology and rapidly changing consumer expectations. In doing so, it is opening up enormous opportunities and challenges for every player across the mobility ecosystem.

Four key trends are shaping the future of mobility.

ACES (Autonomous, Connected, Electric and Shared) mobility, is believed to be the most significant change, impacting the automotive and mobility industries, both in India, as well as worldwide. These trends are expected to completely transform the mobility systems, along with the mobility consumption and vehicle ownership patterns, create new industries as well as bring new dynamism to the world economy.



Key Trends Shaping the Future of Mobility

ACES Mobility

A

Autonomy: Computers are taking over the task of driving from humans, first through advanced driver assistance systems (ADAS) and then at some point with complete self-driving. Thanks to the increased data availability and processing power, advanced driver assistance (ADAS) features including anti-lock brakes (ABS), collision alert, lane keeping, pedestrian detection, and automatic parallel parking can be enabled. As more functionalities get automated, vehicles can potentially operate fully autonomously.

C

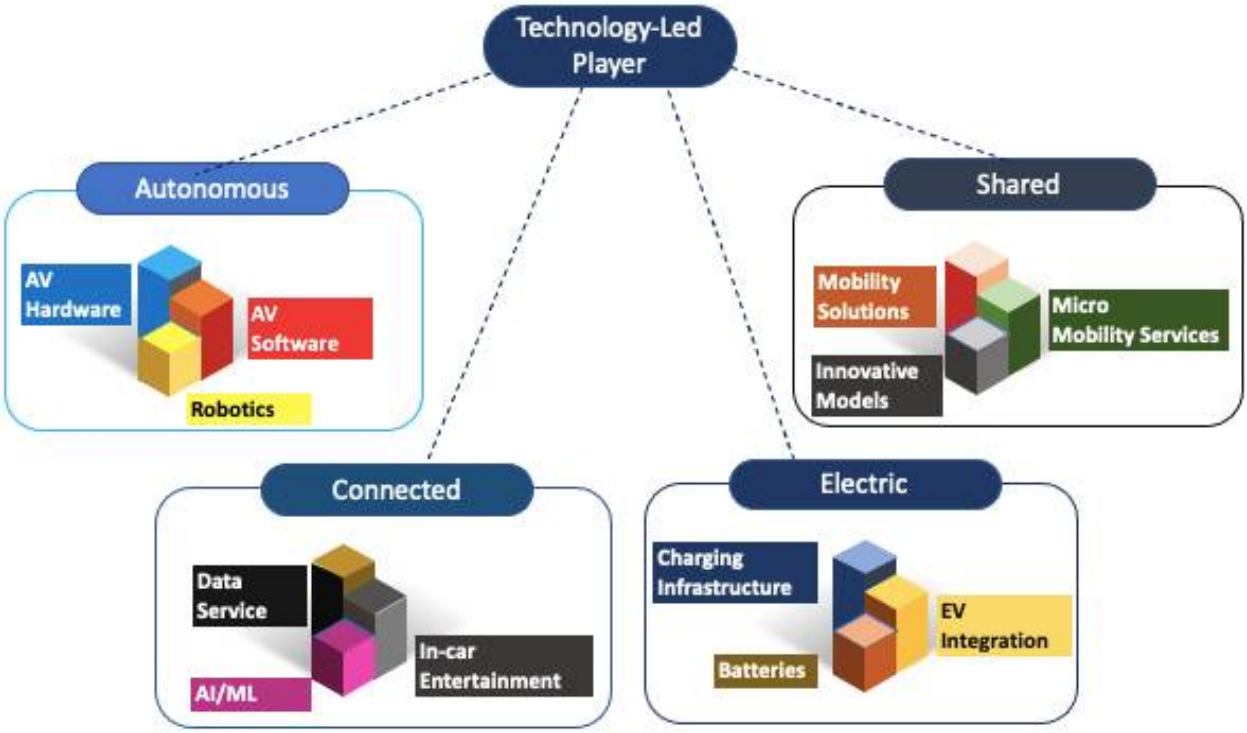
Connectivity: Vehicles are increasingly exchanging data with a central hub and with one another through means of cellular, WiFi, satellite among others. In an ever-connected world, consumers seek infotainment, as well as capabilities to communicate, shop online, navigate journeys from their vehicles. Beyond entertainment and convenience offerings on the market, emerging connectivity themes focus on maintenance and safety functionalities.

E

Electrification: Traditional mechanical and fossil-fuel-powered vehicle driveline components are increasingly being replaced by electrical components. This trend is driven by a desire to reduce reliance on fossil fuels, reduce emissions, and improve energy efficiency. The spectrum includes hybrid electric vehicles (HEV), plug-in HEV (PHEV), battery-based electric vehicles (EV), and hydrogen fuel-cell vehicles (FCV). Suites of sensors and complex control algorithms are employed to optimize e-motor performance, reduce maintenance costs, safely charge batteries, and maximize distance travelled per charge.

S

Shared Mobility: By leveraging the power of mobile computing, various new models of car-sharing, ride-sharing, micro-mobility have emerged. These transportation models leverage the power of mobility, offering instant access, competitive and convenient payments, and flexible work opportunities. The shared mobility has the potential to reduce personal vehicle ownership in exchange for easy access to vehicles.



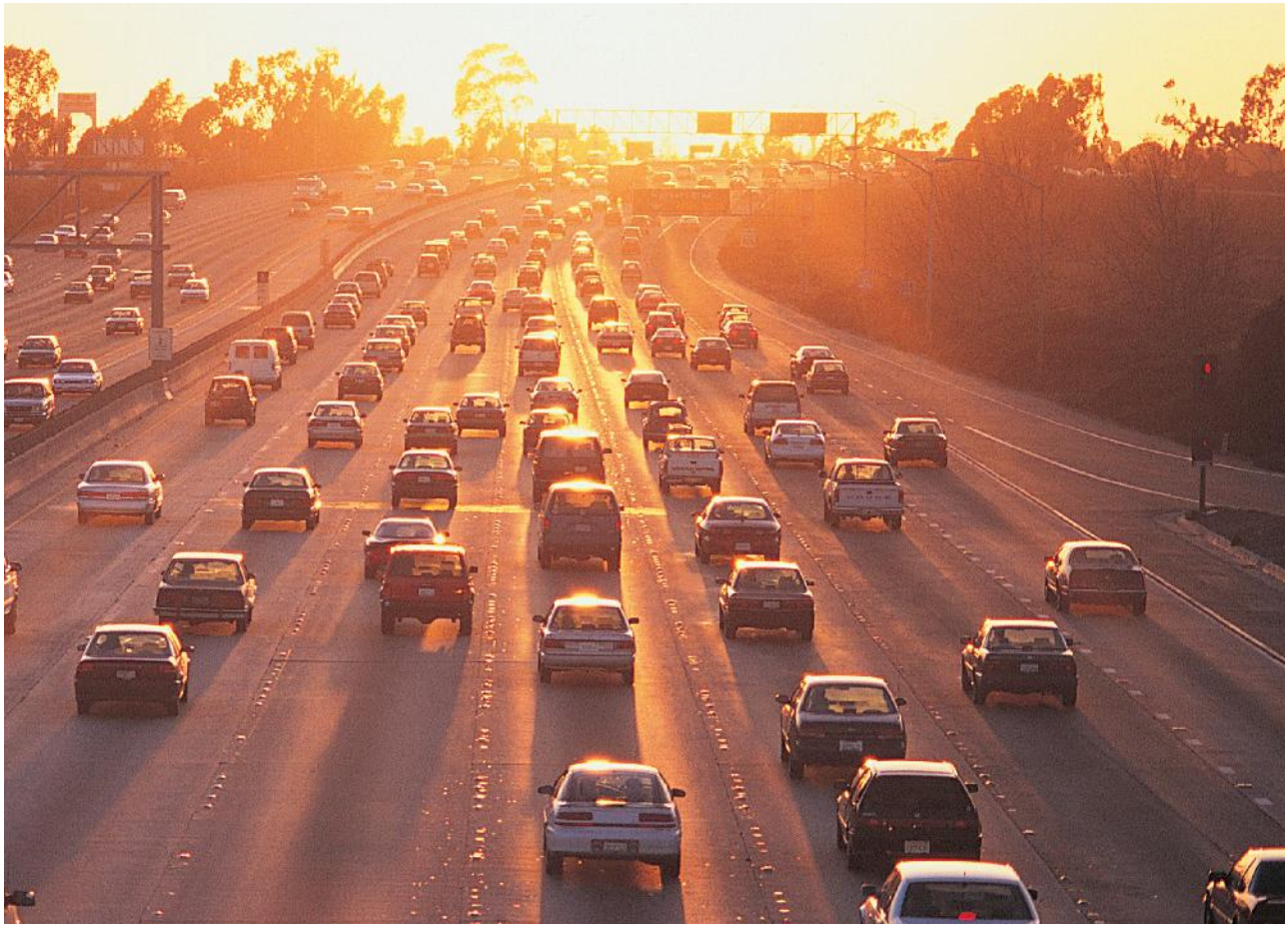
The Emerging Tech-enabled Mobility Ecosystem

Study Methodology

In this report, CyberMedia Research (CMR) has identified and mapped the key trends shaping-up the ACES mobility revolution, both at the global as well as national level.

We drilled down into perspectives from automotive and ACES mobility industry's CxO community in order to explore how ACES is redefining mobility at scale, and what are the emerging opportunities therein.

We conducted in-depth interviews with industry participants, including the CxOs of leading automobile giants and ACES tech start-ups. This, in turn, was supported by industry insights and analysis from professionals at CMR's Smart Mobility Practice and backed by extensive secondary research.



"Tata Motors began to develop a Connected Vehicle Platform (CVP) with a structured and layered approach."

Rajendra Petkar,
President & CTO,
Tata Motors

"The disruptive consequences of COVID-19 have prompted automakers to develop high-tech mobility solutions that best fulfil the consumers' growing preference for safety, sustainability and staying connected during times of social distancing. Staying true to its pioneering repute, Tata Motors identified the emerging trend of "Connected" and began working on it, back in 2018. Soon after, the company began to develop a Connected Vehicle Platform (CVP) with a structured and layered approach. In an industry first, it has been developed as a common platform across commercial, passenger and electric vehicles (CVs, PVs and EVs).

Also, the company continues to give impetus to India's electrification efforts through products like the Nexon EV, which incidentally set an industry record last year with 220% growth despite the 'lockdown'. Having secured high GNCAP ratings for our new range of PVs, Tata Motors remains focused on delivering holistic mobility solutions that not only sets precedence for unparalleled customer safety, but also pave the way for green mobility."

"We are developing a product roadmap to support the transformation of the automotive industry globally, and in India with ACES-based mobility."

Uday Dodla,
Senior Director, Business Development,
Qualcomm India

"Technologies like ACES have potential to disrupt the highly competitive automotive market in India and bring about a paradigm shift in the products offered by manufacturers. With the government pushing strongly for the development of ACES-based mobility, many players across the automotive ecosystem would now be eyeing the Indian market as a hub for innovation and a source of growth.

Qualcomm is developing a product roadmap to support the transformation of the automotive industry, which entails increased connectivity, autonomous driving, shared vehicle ownership, and electrification."

"With the transition to ACES, India is well-positioned as a strong engineering services and manufacturing hub."

Shaju S,
Head of Transportation Business Unit,
Tata Elxsi

"The transportation industry is undergoing a radical transformation around the world, fueled by technological advancements such as ACES (Autonomous, Connected, Electric, and Shared), and global automakers are rethinking India's position as an emerging market and engineering services and manufacturing hub. With its differentiated engineering and design services, Tata Elxsi is well-positioned to ride this transition surge, helping automotive OEMs and suppliers."

"India is witnessing early adoption of ACES, and we bring scale and dependability to support ACES implementation. "

Anup Sable,
CTO,
KPIT Technologies

"The global automotive mobility industry is going through a massive transformation by adopting Autonomous, Connected, Shared & Electric (ACES) technologies. Climate changes, tech innovations, shifts in consumer demands for connected and sustainable products are driving these trends. The Indian market is witnessing early adoption and interest in electric vehicles, comfort and connectivity features, and more awareness about safety and driver assistance. These growing CASE trends have software at its heart – making automobiles the most complex engineered products and provide the opportunity of a lifetime for tech enthusiasts to work on these. KPIT, as independent software development and integration partner, brings scale and dependability to accelerate the implementation of ACES technologies."

Key Emerging Themes

When it comes to actualising the future of ACES mobility, some of the key emerging themes include the following:

A) Investments in ACES Mobility Providers

Driven by the rapidly growing ACES technology trends and favourable policy environment, many new mobility start-ups have entered the mobility industry. Identifying the promising start-ups and investing in them, is a key challenge for automobile OEMs, especially when it comes to identifying the long-term sustainable mobility innovations, and how well the start-ups align with the vision of automobile OEMs.

B) Diversification into Mobility Services

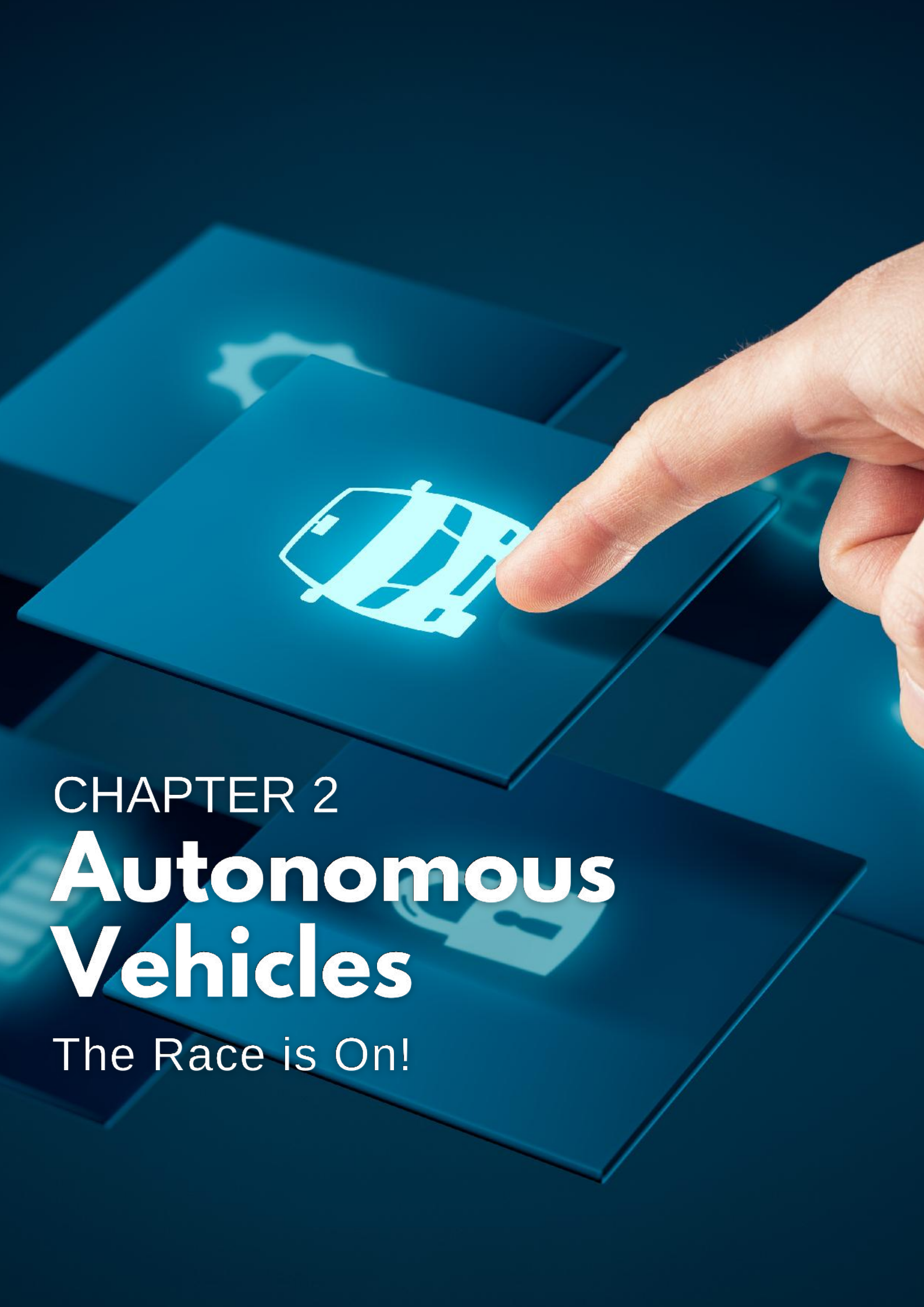
When it comes to diversifying into ACES Mobility, a key question for automobile OEMs, is on whether they should diversify into mobility services themselves or by partnering with, investing in, or acquiring new tech start-ups operating in the ACES Mobility industry. The main factors considered here are technology capabilities and preparedness of OEMs, business vision of OEMs, investments needed and, most importantly, market demand going forward.

C) Partnerships and Alliances

It involves identifying the right start-ups for forging partnerships, with respect to ACES mobility. The key factors considered here are the nature of the disruptive technologies, the early-stage prototypes, products or services offered by such start-ups. Alongside, some other pertinent themes include on how do such start-ups fill the gaps in the current portfolio of automobile OEMs, the technological capabilities of automobile OEMs for embracing ACES mobility, and the business strategy of automobile OEMs and the current and future market scenarios for ACES Mobility.

D) Mergers and Acquisitions of ACES Mobility Providers

The technological capabilities of start-ups, in terms of their intellectual property (IP) and innovation, their products and service offerings, the current market scenarios, and the right valuation are some key themes for consideration.



CHAPTER 2

Autonomous Vehicles

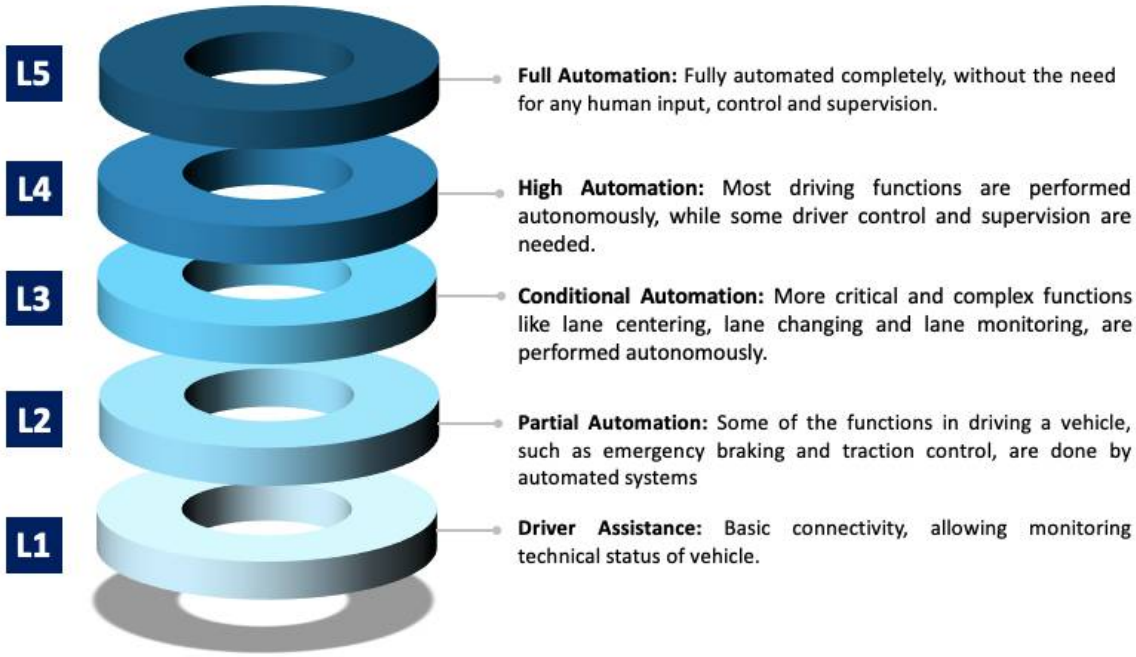
The Race is On!

Attempting a Moonshot with Autonomous Mobillity

Autonomous mobility involves computers taking over the task of driving from humans, first through advanced driver assistance systems (ADAS) and then at some point with complete self-driving. The computers driving the vehicles are aided by the combination of advanced Artificial Intelligence (AI) based software and an array of sensors, cameras and microchips, to achieve vehicle autonomy.

Technology entrepreneurs are currently focused on overcoming technology hurdles, and establishing proof-of-concepts around autonomous vehicles.

We have identified five levels of connectivity, each involving incremental degrees of functionality that enrich the consumer experience, as well as a widening potential for new revenue streams, cost savings, and passenger safety and security. These levels reflect the potential for connectivity to stretch from today's increasingly common data links between individuals and the hardware of their vehicles to future offerings of preference-based personalization and live dialogue.



The Five Levels of Autonomous Mobility

The Five Stages of Vehicle Autonomy

Level 5

The whole process of driving a vehicle is automated completely, without the need for any human input, control and supervision. Automated Guided Vehicles (AGVs) used for material handling in large manufacturing plants, roller coasters in amusement parks and driverless metro trains used in public transits are some of the examples of Level 5 vehicle autonomy.

Level 4

Most of the driving functions are performed autonomously, while some driver control and supervision are needed. Autopilot is the best example of Stage 4 vehicle autonomy. O

Level 3

More critical and complex functions like lane centering, lane changing and lane monitoring, are performed autonomously. Cruise control systems, reverse parking cameras, parking sensors, and navigation systems are some of the examples of Stage 3 vehicle autonomy. Most of the luxury and premium vehicles sold today, are equipped with some kind of Level 3 vehicle autonomy. This stage is also called as ADAS (Advanced Driving Assistance Systems).

Level 2

Some of the functions in driving a vehicle, such as emergency braking and traction control, are done by automated systems. Anti-Lock Braking Systems (ABS), Electronic Braking Distribution (EBD) systems, Hill Assist systems are some of the examples of Level 2 vehicle autonomy systems. Most of the vehicles sold today are equipped with such systems.

Level 1

All the functions involved in driving a vehicle like steering, braking, turning the vehicle, changing lanes and monitoring them, overtaking other vehicles on the road, reversing and parking the vehicle, are performed manually, by the driver of that vehicle, without the assistance of any kind of automation.

"With ADAS, we can improve safety on roads today. This is a large opportunity for Indian start-ups."

Saurabh Chandra,
Co-founder,
Ati Motors

"Autonomous technologies are scripting a quiet success in the industrial and warehousing space. The workforce challenges of pandemic have further pushed their adoption in industry. In the eCommerce space, there is an explosion of demand that cannot be addressed by simply adding people, technology is the only way to handle the scale. On public road, autonomous technology is available today in the form of ADAS (assisting the driver) features and we are still lagging behind this in India where it can improve safety on roads today. This is a large opportunity for Indian start-ups and regulators today. Full self-driving on roads is still in the far future."

"We are engineering Autonomous Vehicles to be robust and safe in the unique traffic conditions of India."

Gagandeep Reehal,
Co-founder and CEO,
Minus Zero

"With a tremendous scale of impact & need, the autonomous vehicle industry has the potential to make India a global technology leader. With its chaotic & unique set of traffic conditions, it complements as one of the toughest testing grounds for autonomous vehicles. Turning this into reality in India calls for a collaborative effort from all stakeholders involved.

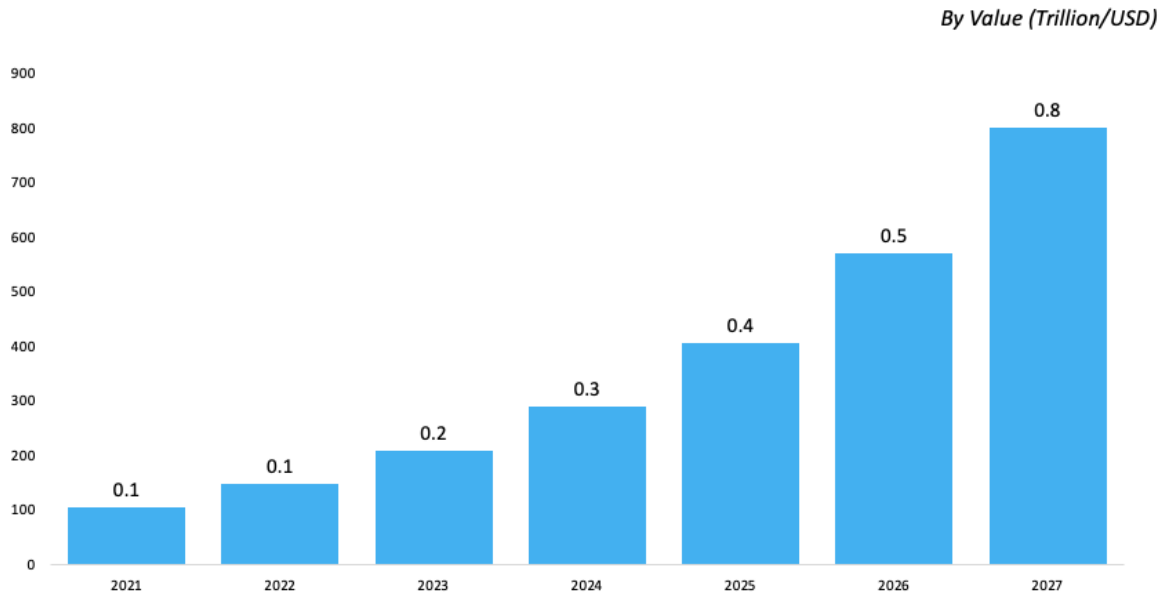
We, at Minus Zero, are devoted to solve the technological end of this problem by engineering AVs to be robust and safe in this diverse traffic."

The Global Market Scenario

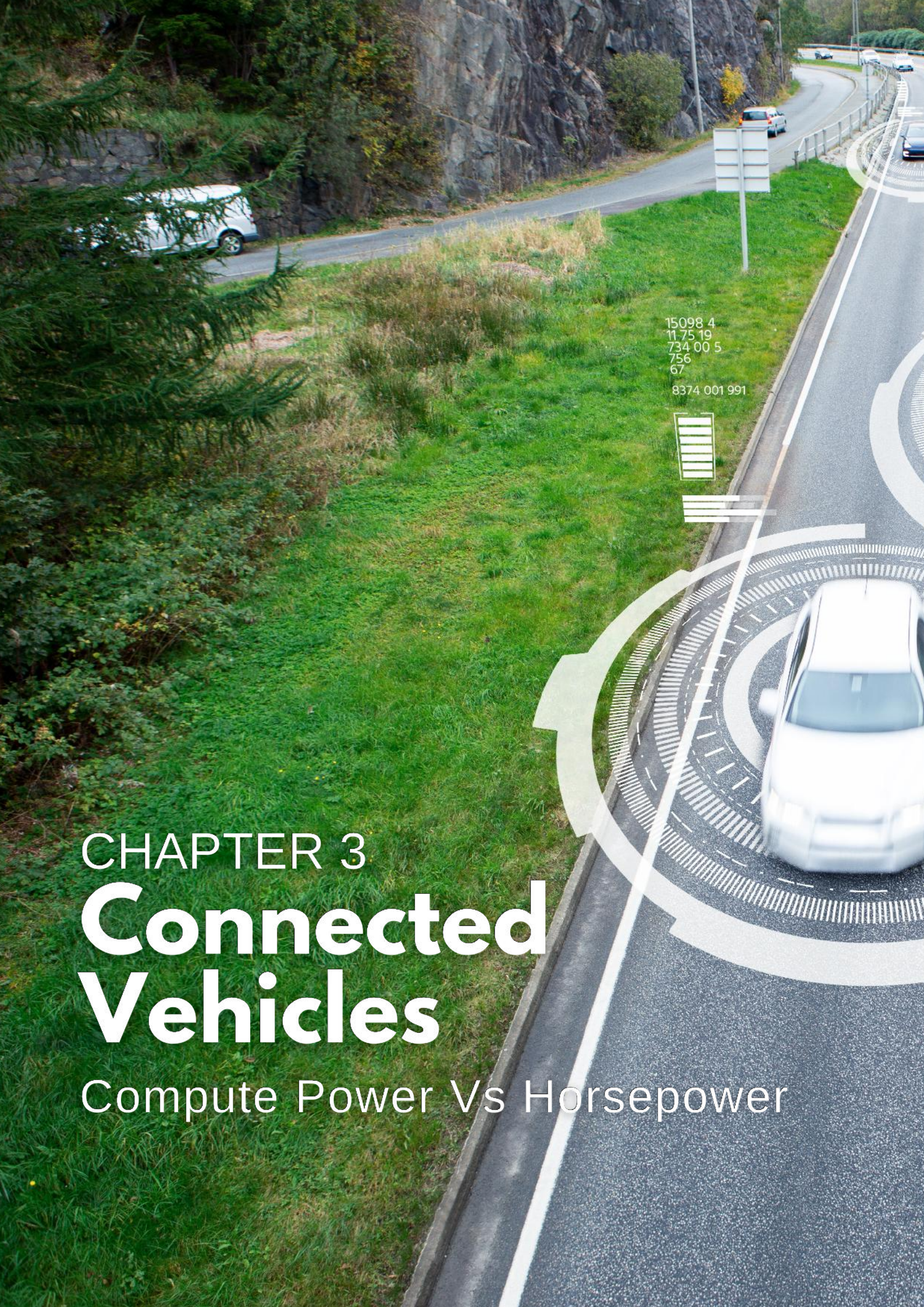
The global market for autonomous vehicles is still at the early stages of development. Across major markets, China continues to have a favourable policy focus on AV testing. On the other hand, US is yet to forge a national policy. Across the board, different states in the US have different norms and policy rules in place.

Our projections point to a positive future for the global market for autonomous vehicles. China continues to lead the market for autonomous vehicles, driven by a spurt in investments, increasing consolidation and collaboration between automotive manufacturers, government spending, and backed by strong consumer acceptance.

The global autonomous vehicle industry is forecasted to grow from USD 0.1 trillion (INR 7.6 trillion) in 2021 to USD 0.8 trillion (INR 61.5 trillion) in 2027, with a CAGR of about 40%.



Projected Growth in Global Autonomous Mobility
Source: CMR Estimates



CHAPTER 3

Connected Vehicles

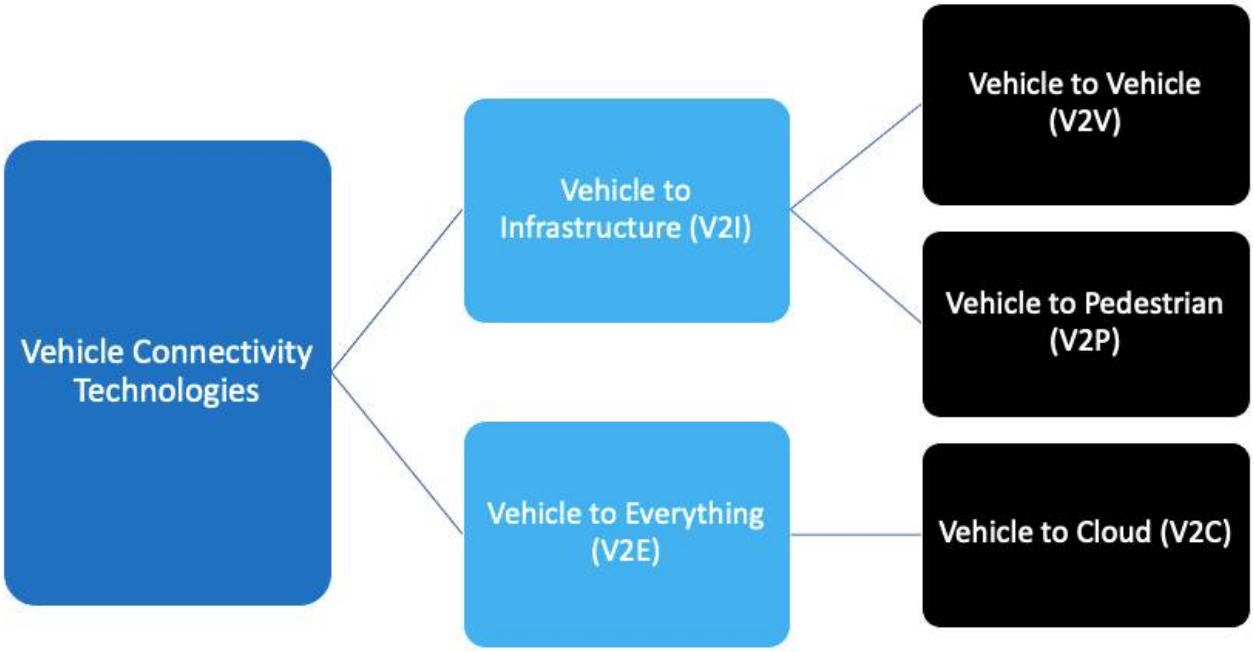
Compute Power Vs Horsepower

Connectivity as an Enabler

Connectivity will be at the heart of the next-generation vehicles. Connected vehicle and smart transport applications have the potential to bring substantial benefits to consumers, including making travel safer, reducing congestion, and providing real time information to passengers.

Connected cars connect with other vehicles on the road, as well as with other infrastructure around them like hospitals, emergency centers, restaurants, supermarkets and places of leisure and entertainment, providing the related data to the occupying passengers of connected cars, so that the passengers can utilize these services, whenever they are needed. Connected vehicles also share the data regarding road and traffic conditions, local weather, visibility on the road, nearby places of interest, number of pedestrians and cyclists on the road, as well as local traffic rules, with each other and the passengers riding in them, as and when needed.

All the data collected by a connected vehicle is stored in a cloud computing environment and analyzed by a business intelligence system, to be presented before the end user, in easily readable format.



Types of Connected Mobility

Types of Connected Vehicle Technologies

V2I

Vehicle to Infrastructure (V2I) captures data generated by the vehicle and provides information about the infrastructure to the driver. The V2I technology communicates information about safety, mobility or environment-related conditions.

V2V

Vehicle to Vehicle (V2V) communicates information about speed and position of surrounding vehicles through a wireless exchange of information. The goal is to avoid accidents, ease traffic congestions and have a positive impact on the environment.

V2C

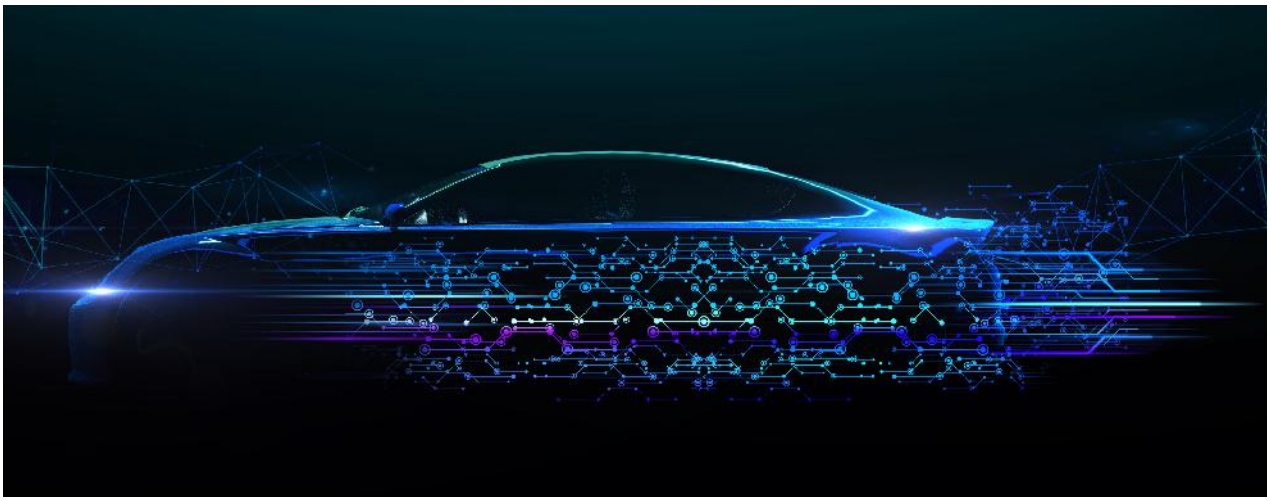
Vehicle to Cloud (V2C) exchanges information about and for applications of the vehicle with a cloud system, allowing the vehicle to use information from each other, through the cloud connected industries like energy, transportation and smart homes and make use of Internet of Things (IoT).

V2P

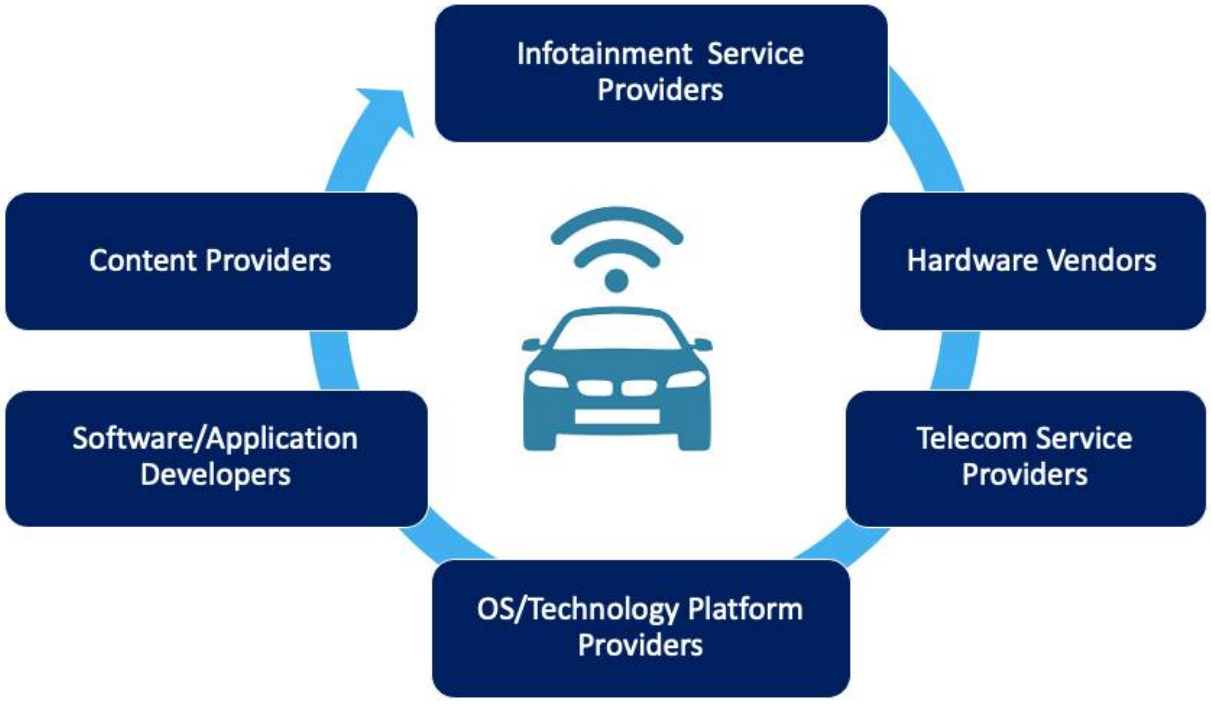
Vehicle to Pedestrian (V2P) senses information about its environment and communicates it to other vehicles, infrastructure and personal mobile devices. This enables the vehicle to communicate with pedestrians and is intended to improve safety and mobility on the road.

V2E

Vehicle to Everything (V2E) interconnects all types of vehicles and infrastructure systems with another. This connectivity encompasses cars, highways, ships, trains and airplanes allowing everything to share data with everything, for the purposes of safety, convenience, mobility and environment related conditions.



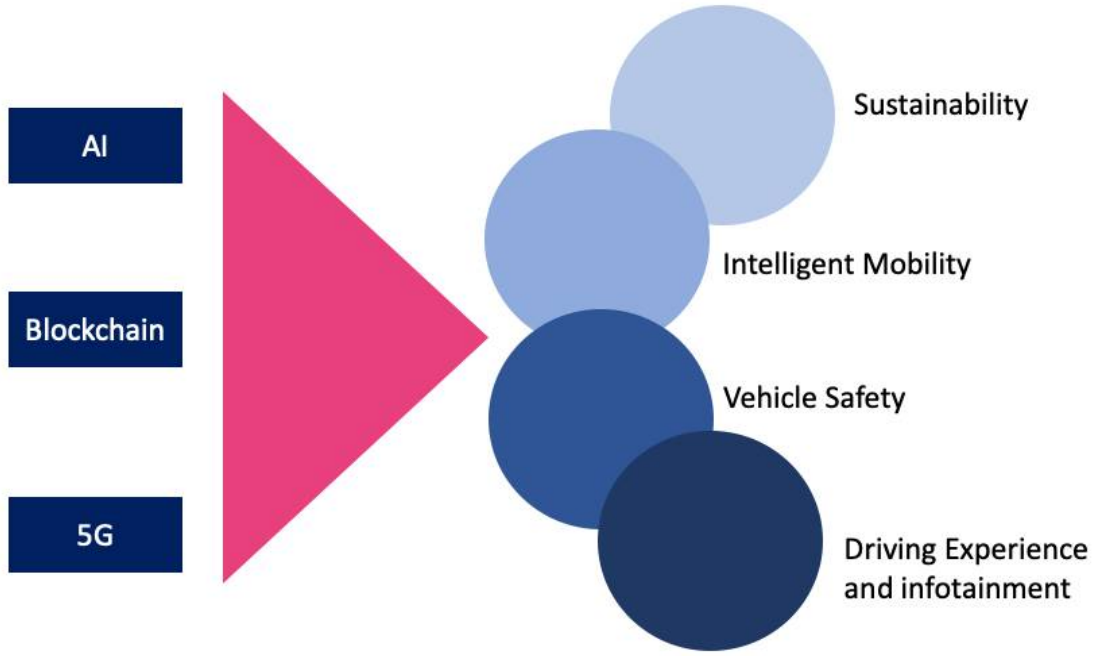
The connected vehicle ecosystem includes an array of ecosystem players. For OEMs to succeed, they will need to map the emerging competitive tech landscape, and forge new alliances with an array of market players. The ecosystem for connected vehicles include the automotive players, telcos, as well as those from technology, energy and utilities, among others. In addition, an array of start-ups are entering the fray. Such new entrants potentially possess the right technological skills, and need not be viewed as competition.



Connected Vehicle Ecosystem

With advances in AI and blockchain, software and electronics architecture is getting redesigned, enabling new connected vehicle paradigms to emerge. Many new AI-supported human–machine interfaces have emerged focused on enabling different levels of user experience possible. Some of the representative use cases include infotainment, vehicle safety, and leading upto intelligent mobility. While doing so, over-the-air updates at scale have been enabled by many connected players.

By leveraging AI, driver experience can be streamlined through voice assistants and AI-enabled assisted driving and parking. Similarly, the advent of blockchain and 5G posit a future of intelligent mobility, where in-car navigation can be optimised with precise positioning and real-time updates.



Connected Mobility: Key Drivers and Use Cases

Telematics	Remote services	Infotainment and navigation	Hardware and software	Data platform	Safety and security
• Fleet management • Emergency calling	• Remote diagnostics • Over-the-air software updates • Theft alerts	• Music streaming • Parking lot locators	• Diagnostic Readers • SIM cards • Microchips	• Operating Systems	• Advanced Driver Assistance Systems (ADAS)

Key Service Functions within Connected Vehicles

"We are developing a robust infrastructure to incorporate the data and technologies to make mobility safer and smarter."

Abhijit Sengupta,
Director & Head of Business,
India, SAARC region & Southeast Asia
HERE Technologies

"Among many fascinating advancements towards smart and sustainable mobility is the influx of spatial data and connectivity. At HERE, we are committed to exploring co-innovation opportunities with our partners and the Indian government, both at the central and state level, to develop a robust and cohesive infrastructure to incorporate the data and technologies to make mobility smarter, safer, and more manageable. Over the next decade, we will see a huge demand to embed location intelligence solutions across all stages of the automotive customer experience and we will continue to work on capacity building at various levels, providing better opportunities to developers, spatial data specialists and skilled geospatial resources to the country."

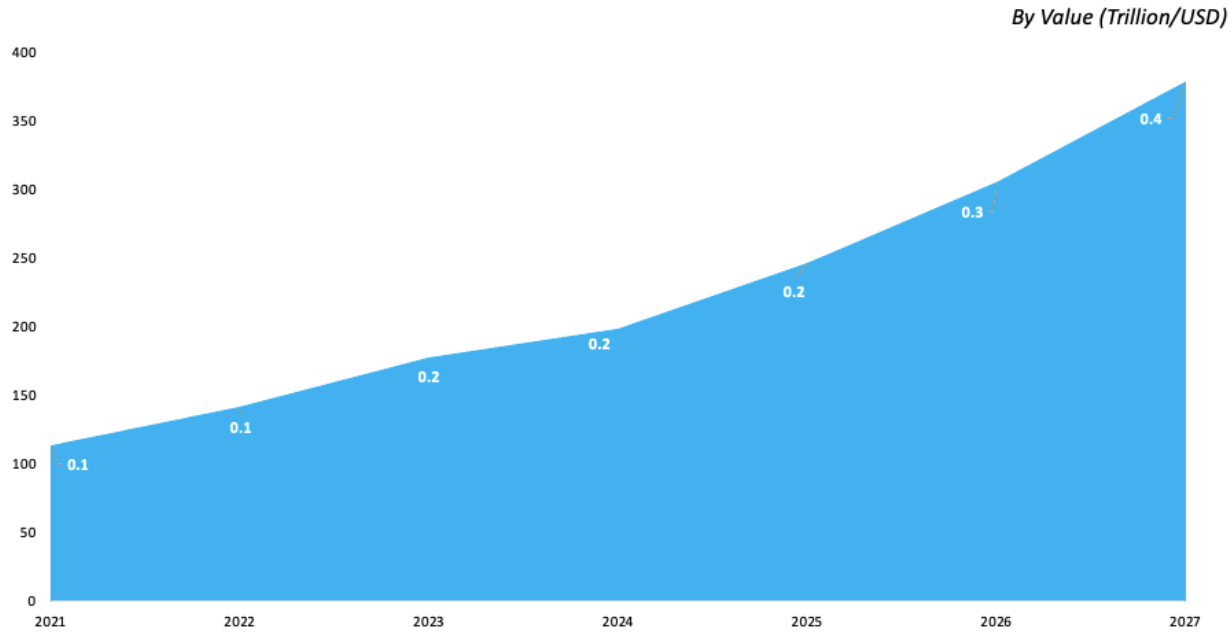
"We have invested heavily into building the Connected Experience Platform to power the next generation eBikes."

Raghu Kerakatty,
Co-Founder & CEO,
Toutche

"The key to building an efficient urban transport system in India is to ensure the right mix of personal mobility, shared mobility, and mass-rapid-transit systems. That led Toutche to embark on its pursuit to build best-in-class Electric Bicycles which also bring the dimension of active lifestyle into the mix.

Toutche's strategy is to lead with Technology. We have invested heavily into building the Connected Experience Platform to power the next generation eBikes with an aim to change the face of urban commuting and lifestyle."

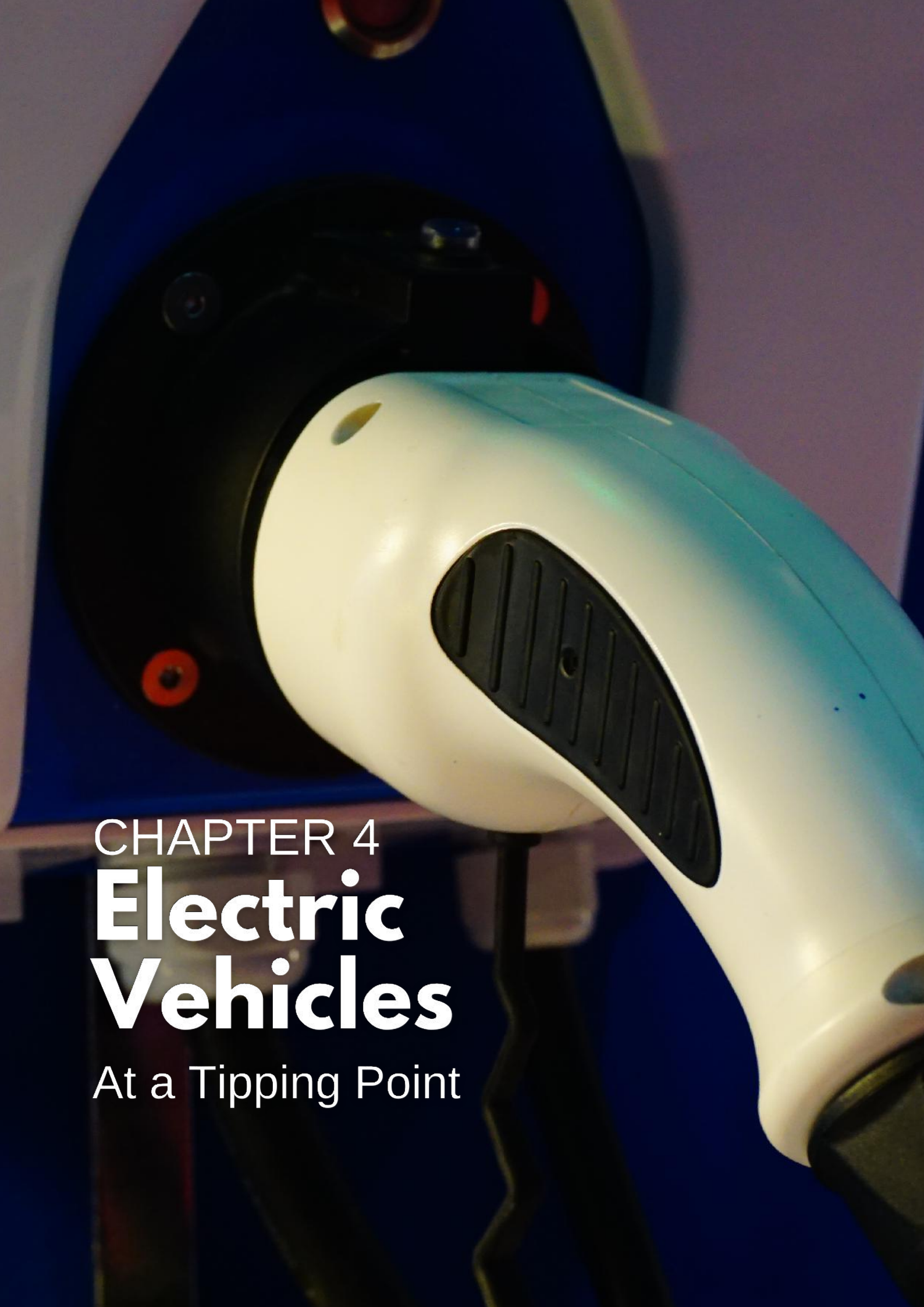
The Global Market Scenario



Projected Growth for Global Connected Mobility

Source: CMR Estimates

Globally, connected vehicles are becoming a key focus market for the automotive industry, with CMR estimates pointing to a rapid growth in the segment. CMR estimates point that connected car market will grow at a CAGR of 24% from USD 0.1 trillion (INR 7.6 trillion) in 2021 to USD 0.4 trillion (INR 30.7 trillion) in 2027.



CHAPTER 4

Electric Vehicles

At a Tipping Point

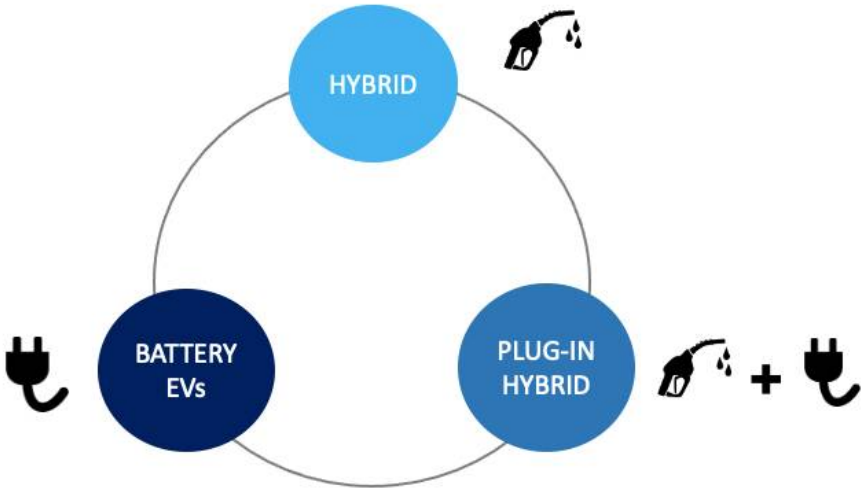
The Rise of Electric Vehicles

Electric vehicles represent one of the most mature ACES trends. This is a technology that has reached the point of disruption. The electric vehicle industry benefits from both established industry players and new start-ups focused on building-up technologies, manufacturing plans, and establishing partnerships across the value chain.

Electric vehicles utilize electric motors for their propulsion, which are powered by energy stored in rechargeable batteries. Electric vehicles are increasingly favored by the consumers today, due to rising pollution levels, increasing fuel prices and significantly lower operating costs offered, over the Internal Combustion Engine (ICE) vehicles.

The battery remains the key part of an electric vehicle. With demand rising, players across the value chain need to scale up sustainable battery production A key challenge for the electric vehicle industry remains EV batteries and raw materials for them. Another key challenge is to make electric vehicles profitable.

Alongside, the electric vehicle players are working with the Government on building the enabling charging infrastructure.



Types of Electric Vehicles

Ravneet S Phokela,
Chief Business Officer,
Ather Energy

"The EV industry is at a really exciting phase and is growing massively. There is a strong consumer awareness and demand; the government has been extremely supportive with increased Fame 2 subsidy with some states topping it up with their own subsidies; and OEMs introducing exciting products to fuel consumer desire further. In addition to that, public charging infrastructure is also beginning to scale up. There's never been a better time to be in the EV business.

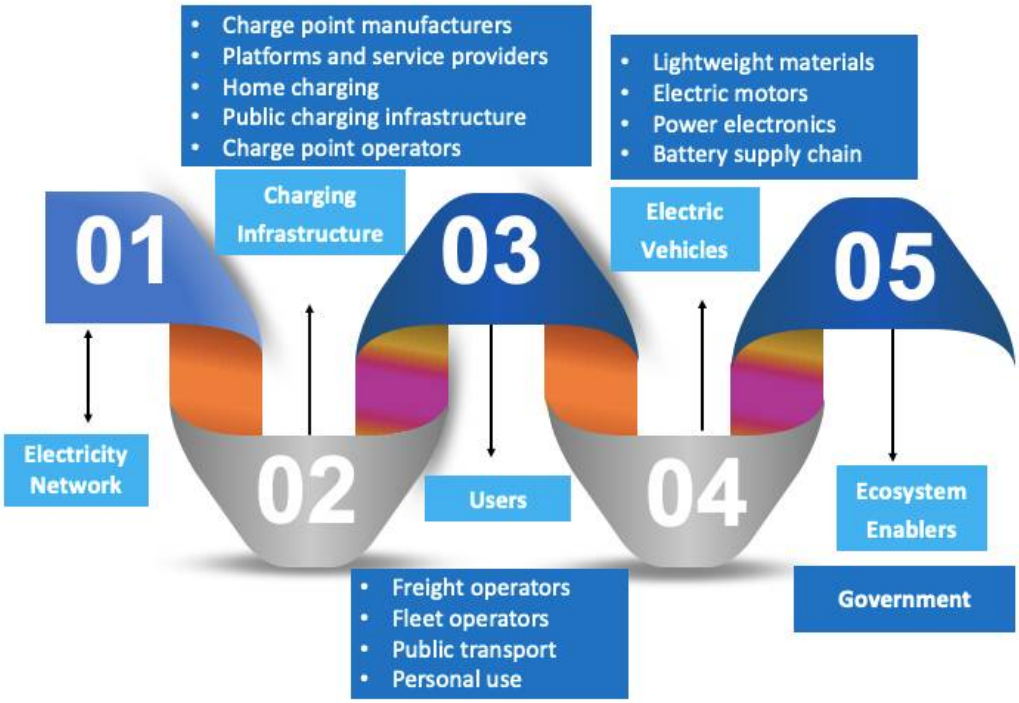
We at Ather Energy have been investing in building the EV ecosystem holistically. Recognizing the nascent stage of the industry, we invested in experience centres focused on consumer education. We built public charging infrastructure when there were very few players investing in it. To drive interoperability in public charging solutions, we released the IP on our charging connector so that all OEMs can come on the same platform. We've also worked with our vendor partners to localize the supply chain as a result of which, other than cells, 99% of our bill of materials is locally sourced. We continue to be vested in playing a leading role in driving EV adoption."

"Other than cells, 99% of our Bill of Materials is locally sourced.

We continue to be vested in playing a leading role in driving EV adoption."

The EV ecosystem comprises of three different cohorts. These include the charging infrastructure used by EVs, the end users who leverage these EVs, and finally, the EVs and their components. Powering it all, is the electricity network.

Today, OEMs are making progress in developing EVs with greater range, more power, and superior styling, the industry still needs to overcome several challenges to accelerate growth and scale EVs in a sustainable way.



The Emerging EV Ecosystem

Suman Mishra,
CEO,
Mahindra Electric Mobility Ltd.

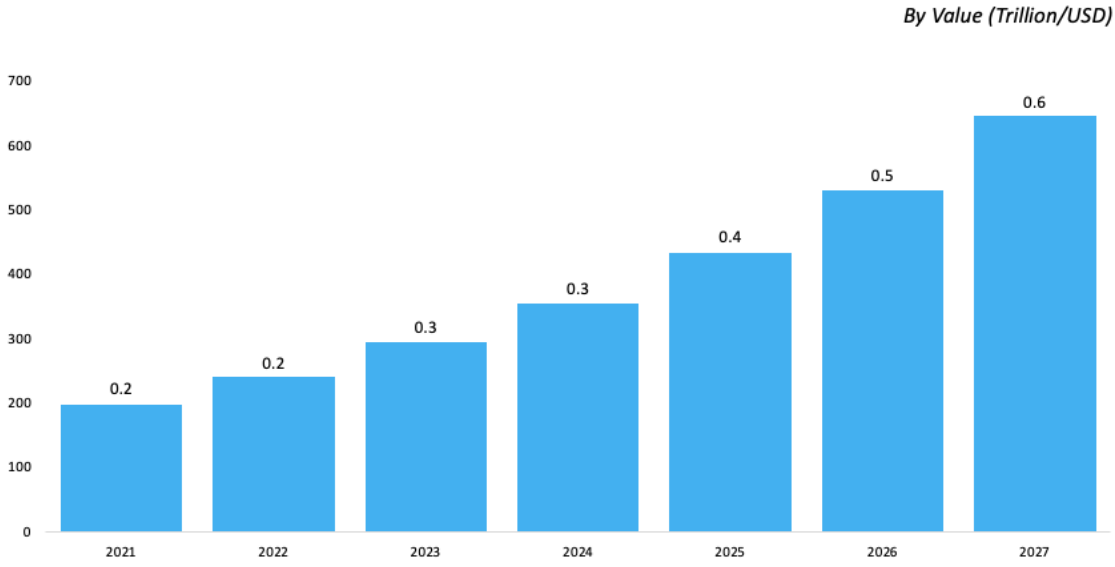
"Increasing use of machine learning and neural network algorithms in connected mobility solutions is playing a vital role in augmentation of EVs."

"Various Central and State government policies have not just helped to accelerate the EV adoption but has also enabled for development and manufacturing of globally competitive EV technologies in the country. Increasing use of machine learning and neural network algorithms in connected mobility solutions is playing a vital role in augmentation of electric vehicles.

With embedded software at the core of mobility innovation, we can use digital twins to simulate and continuously improve the EV efficiency and performance by "Over The Air" updates. These new-age solutions also help us the understand the economics of EVs better and help our customers and various other stakeholders to instil confidence in EVs."

The Global Market Scenario

In value terms, CMR estimates that the global electric vehicle sales growth would potentially grow at a CAGR of 22%, from USD 0.2 trillion (INR 15.3 trillion) in 2021 to USD 0.6 trillion (INR 46.1 trillion) in 2027.



Projected Growth for Global Electric Mobility
Source: CMR Estimates

Amit Gupta,
CEO and Co-Founder,
Yulu

"ACES is in different stages of development in India, and EVs are most likely to become the largest pie of the share, followed by shared mobility. Automated and Connected vehicles will see more investment in building the technologies before they are ready for Indian roads.

The urgent need, however, is for a mix of low-cost, emission-free automobiles with environmental advantages. Hence, an ideal and sustainable solution is electric two-wheel vehicles for shared mobility.

While State Governments have begun framing their regulatory roadmap and incentives for production of EVs, they must also invest in a robust charging infrastructure to prepare for shared mobility infrastructure. Yulu is an example of customer confidence in shared-mobility, as the safest and most affordable mode of transportation during the current pandemic. Hence, to meet our environment and economic goals, civic bodies should consider intermodal hubs that could assist in smoother interchange between micro-mobility and public transport; while providing policy support to encourage customer adoption."

"Civic bodies should consider intermodal hubs that could assist in smoother interchange between micro-mobility and public transport; while providing policy support to encourage customer adoption."

Anirudh Arun
Chief Operating Officer (COO),
BluSmart Mobility

"We have each set up hundreds of accessible EV Chargers in prominent areas, and many have opened these up for the public and other fleets."

"Our PM Shri Narendra Modi has stated that the future of mobility will be based on the 7 Cs: common, connected, convenient, congestion-free, charged, clean and cutting-edge. At BluSmart, we aim to exemplify this future with our 100% electric, clean, convenient mobility service in Delhi-NCR.

The pace of four-wheeler EV-adoption is picking up and fleets like BluSmart are leading the way as these EVs have lower operating costs than ICEs and lead to better TCO (total cost of ownership) for taxis. Of the few remaining challenges in the path of massive penetration of EVs, the most prominent are range-anxiety and the low accessibility of chargers. To address this, companies like BluSmart have each set up hundreds of accessible EV Chargers in prominent areas, and many have opened these up for the public and other fleets. This collaborative growth of charging infrastructure as well as tailwinds on the cost of EVs will undoubtedly lead India into a cleaner, congestion-free future."

CHAPTER 5

Shared Vehicles

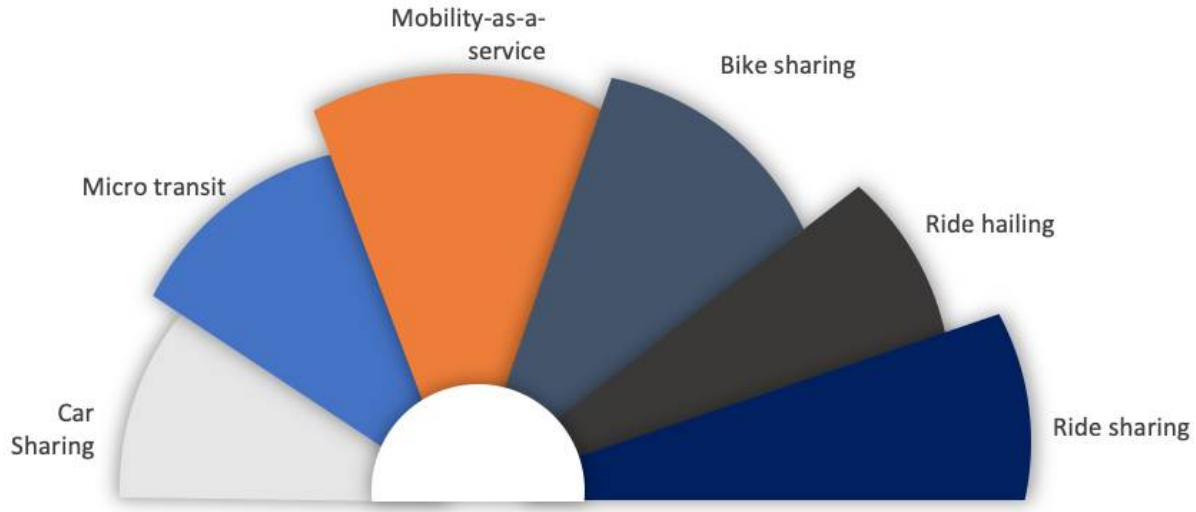
Lets Move Together

The Success of Shared Mobility

Shared mobility is defined as the mode of transportation, wherein commuters share the mobility asset as a group (for example, carpooling and ride hailing services) or for a fixed period by an individual commuter or group of commuters (for example bike sharing services) as rentals, thus creating a combination of personal and public transport, which leads to the sharing of travelling costs, in the process.

The biggest advantage of shared mobility is that it provides the commuters, mobility services on the as needed basis, without any need to own the mobility assets, by the commuters. This leads to massive cost savings for the commuters, as it frees them from the fixed and variable costs associated with the vehicle ownership.

Shared mobility is growing worldwide owing to the rapid urbanization, rising congestion in the cities, lack of parking spaces in the urban areas, ever increasing fuel prices and growing cost of vehicle ownership.



Types of Shared Mobility

Shared mobility operates on the following business models:

P2P

P2P (Peer to Peer) shared mobility: The owner of the mobility asset, shares his asset with his peers, to meet their commuting needs, in return for a fixed fee.

B2C

B2C (Business to Consumer) shared mobility: Owners of the mobility assets and the consumers of mobility are connected with each other, through online aggregators. Ride hailing services and online cab aggregators like Uber are best example of this business model.

B2B

B**2B (Business to Business) shared mobility:** Online aggregators of mobility bring together the fleet owners and businesses having mobility needs, for a fixed fee.

G2C

G2C (Government to Consumer) shared mobility: The state as well as national governments offer mobility services to their citizens, for a fixed fare or in some cases free. Public transport systems like city bus services and metro/subway systems fall under this category of shared mobility.

"Most distances in India, of >7km, do not have a direct public transport option. As a consequence, shared mobility is on the rise."

Mohit Sharma,
Founder and CEO
OYE! Rickshaw

"Mobility in India is broken. Over 82% of Indians do not own a vehicle. Most distances in India, of >7km, do not have a direct public transport option. As a consequence, shared mobility is on the rise.

Oye! Rickshaw offers an affordable, convenient and environment-friendly option so that everyone has access to efficient mobility. Through our shared e-rickshaw, we provide the cheapest ways to travel to the nearest public transport and back."

Sanchit Mittal,
Co-founder and CTO,
Vogo

“The ACES trends has emerged out of the needs of the society. At one end, our cities are bursting at the seams due to increasing population, inadequate infrastructure and increasing pollution, while at the other end, there is a need for faster, flexible, economical and environment-friendly travel solutions from the customers.

The shared mobility industry meets all these requirements and is therefore witnessing rapid uptake. Going ahead, with more EVs entering this space, the technology integration will increase even more, enabling mobility players to offer highly optimized, and economical commute options. We are running several pilots, testing out low powered EVs and intend to go all-electric over the next 3 years. We currently have a 10% fleet of EVs and will transition to all electric over the next 2 years."

"We are running several pilots, testing out low powered EVs and intend to go all-electric over the next 3 years."

CA Samkit Shah
Co-founder and CEO
Jitendra Ev TECH

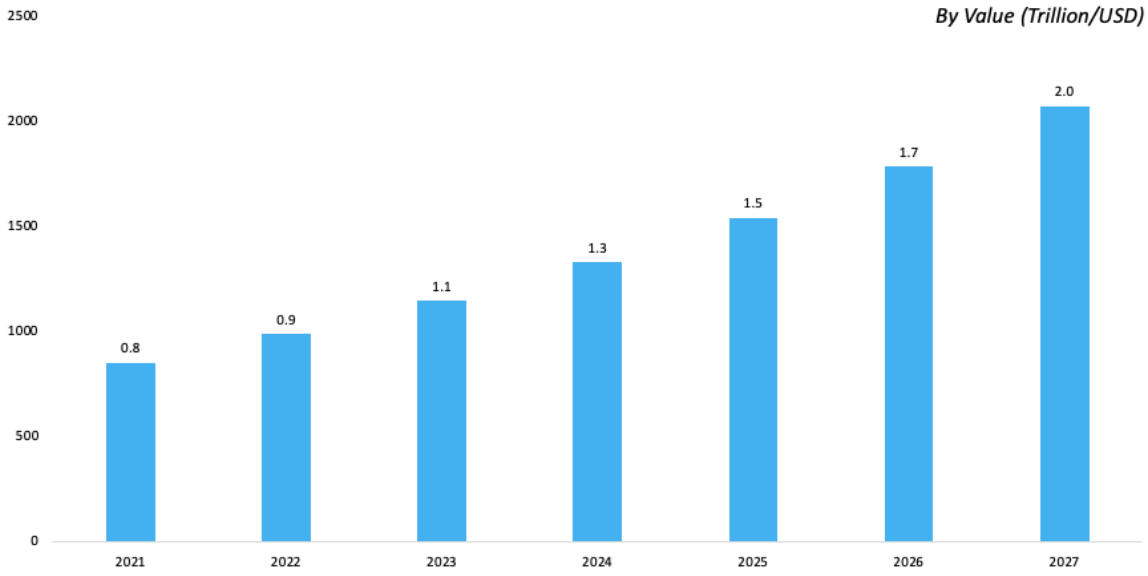
"The scene for take off of EVs is set now. Each one has to play its role in sync with the other to really have a huge impetus. Shared Mobility will bring in desired volumes if Manufacturers increase the service network, and make dependable quality products to install confidence in the customer. For its part, the Government will have to enable the charging infrastructure."

"The scene for take off of EVs is set now. For its part, the Government will have to enable the charging infrastructure."

Shared mobility is increasing due to rising cost of vehicle ownership, increasing digitization of mobility, rising fuel prices and growing environmental concern.

The Global Market Scenario

As per estimates by CMR, the global shared mobility market is approximately USD 0.8 trillion (INR 61.5 trillion) in 2021 and expected to reach about USD 2 trillion (INR 154 trillion) by 2027, growing at a CAGR of 16%.



Projected Growth for Global Shared Mobility

Source: CMR Estimates

Though shared vehicles are a recent emerging trend, it did influence consumers to embrace it. From personal vehicles, consumers started seeking shared mobility. The disruption unleashed by shared mobility will open-up new avenues for an array of mobility ecosystem players, ranging from automakers, suppliers and technology businesses, among others.

Yogender Verma
CTO
Carzonrent India Pvt. Ltd.

"We are moving from an ownership model to a technology-driven personalised on-demand model of consumption."

"We are moving from an ownership model to a technology-driven personalised on-demand model of consumption in all aspects of our lives and the same goes true for mobility. And this trend of shared on-demand mobility would further be reinforced by the need of the world for more and more sustainable modes of transportation and reduction in the overall carbon footprint.

There will definitely be a shift towards higher safety, security and hygiene-related requirements in the post-COVID world of travel; but with the help of technology these requirements would be inherently fulfilled by the OEMs or by the shared mobility players like us. And on the other end, the new modes of vehicle ownership like the self-drive cars or car subscriptions would be there to pacify the craving of the people who love driving the latest models or change their cars frequently."

CHAPTER 6

ACES in India

Unlocking Infinite Possibilities

3x Increase in average household income from USD 6,393 (INR 4,74,574) in 2010 to USD 18,448 (INR 13,69,403) in 2020.

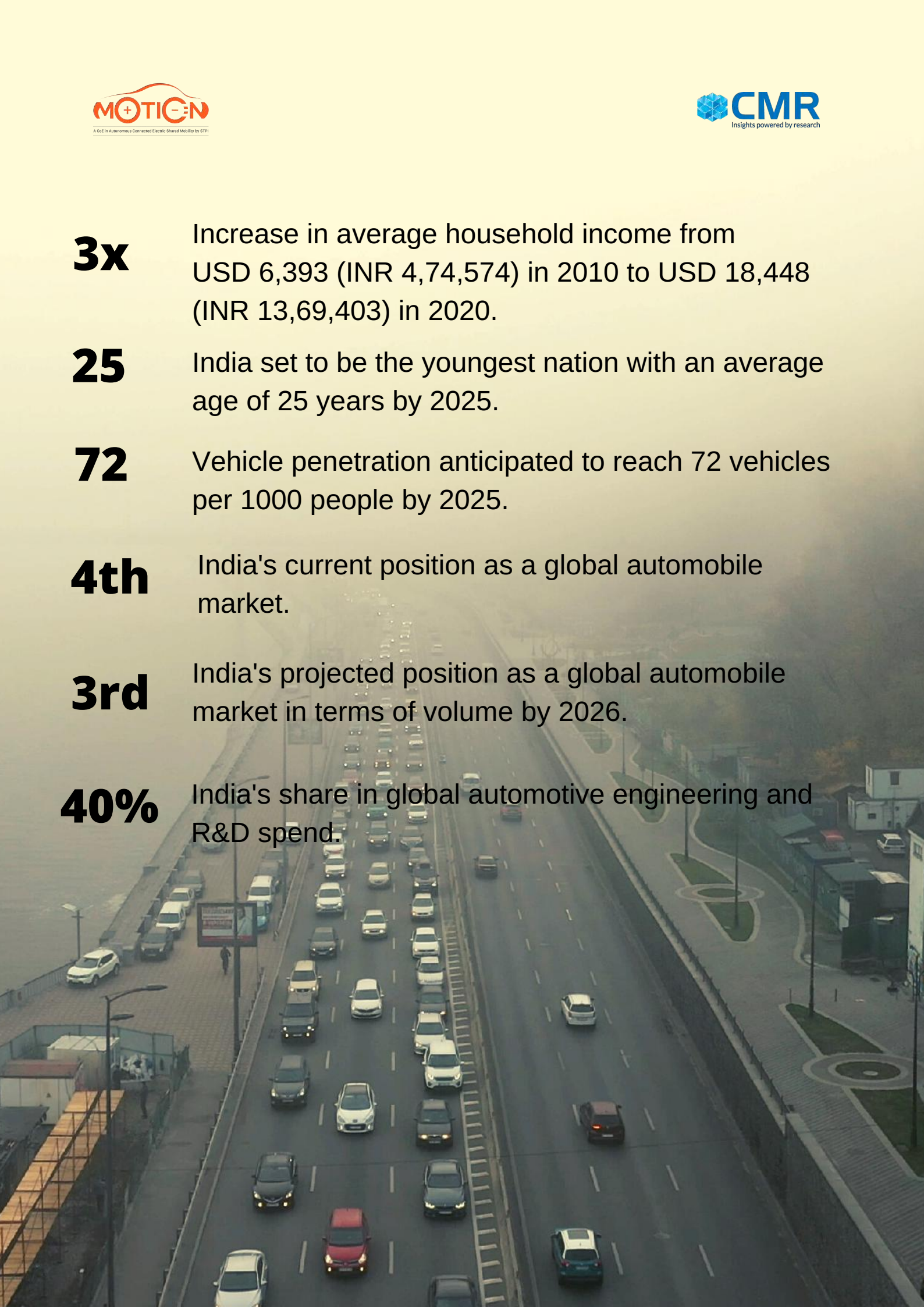
25 India set to be the youngest nation with an average age of 25 years by 2025.

72 Vehicle penetration anticipated to reach 72 vehicles per 1000 people by 2025.

4th India's current position as a global automobile market.

3rd India's projected position as a global automobile market in terms of volume by 2026.

40% India's share in global automotive engineering and R&D spend.



Realizing ACES in India

Over the past few decades, coinciding with economic growth, the transportation sector has witnessed a rapid growth. This growth in the transportation sector has significantly led to an uptick in the mobility of the population. Yet, on the downside, there has been a significant cost to human well-being and sustainability. Today, roads in India are bursting at their seams, and the city infrastructure is crumbling. Across major cities, there has been a rise in traffic congestion alongwith rise in record-breaking pollution levels.

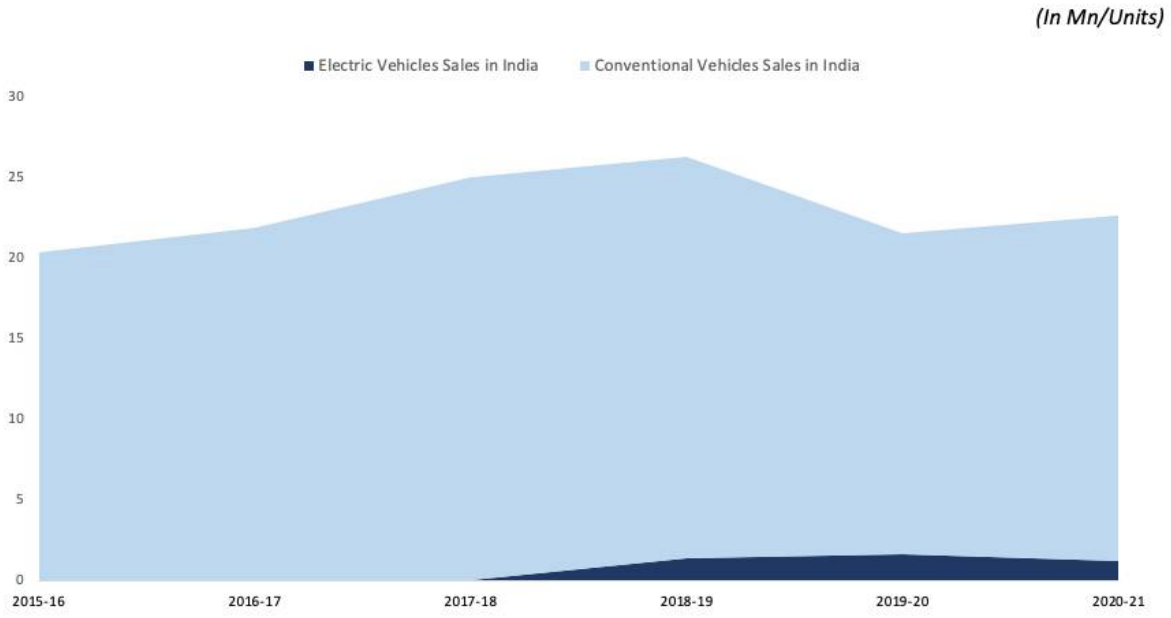
As a vibrant young nation, India is on the move. It is already the fourth largest automobile market in the world. In the near future, India is also slated to become one of the top three markets globally.

As new technologies disrupt the future of mobility, India is on the cusp of a revolution. With advances in autonomous, connected, electric and shared (ACES) mobility, India has the potential to leapfrog conventional mobility models, and enable clean, sustainable and efficient mobility solutions for India.

India has unique strengths in technology and manufacturing to ride the ACES wave. In embracing ACES, India has the potential to create jobs, reduce environmental footprint, and swiften the shift from coal to renewable electricity, and empower the whole economy

Electrification of the mobility sector has been given a major push, out of the ACES trends, to combat rising air pollution as well as achieve a greater degree of energy independence, since India imports 92% of its oil requirements.

India has set an ambitious target of EV sales penetration of 30% of private cars, 70% of commercial cars, 40% of buses and 80% of two and three-wheelers by 2030. In order to achieve this goal, a number of both fiscal and non fiscal measure have been adopted.

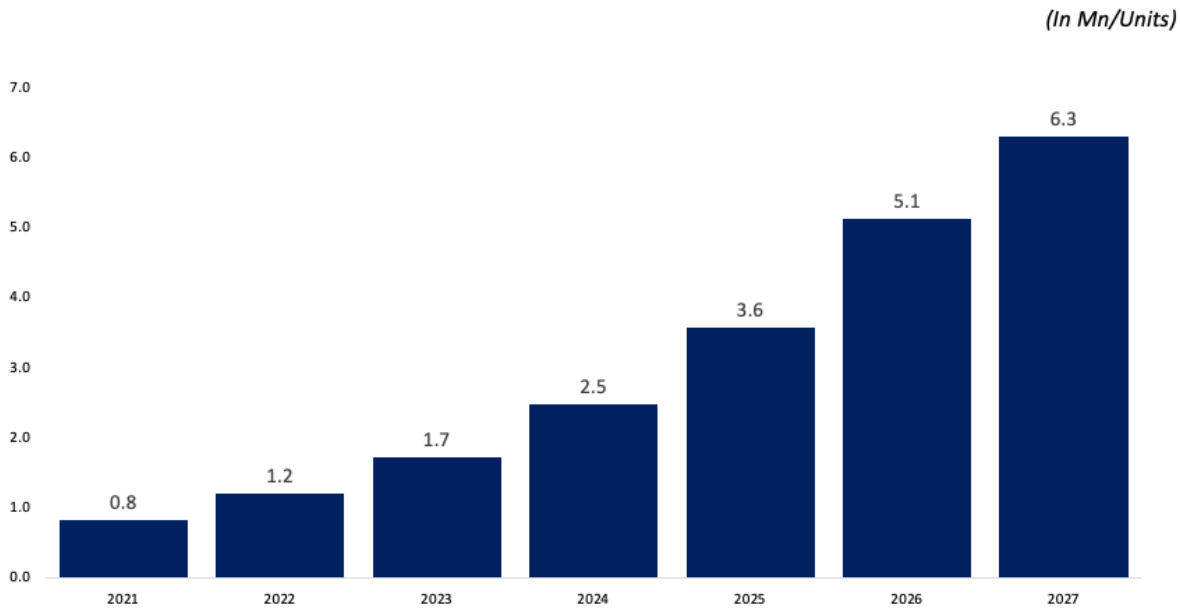


Rise of EVs vs Conventional Vehicles in India

Source: CMR Estimates

Electric Vehicles

As per CMR estimates, the electric vehicle market in India is forecasted to reach about 6.3 million units by 2027, at a CAGR of 44%, during the period 2020-2027.



Projected EV Sales in India

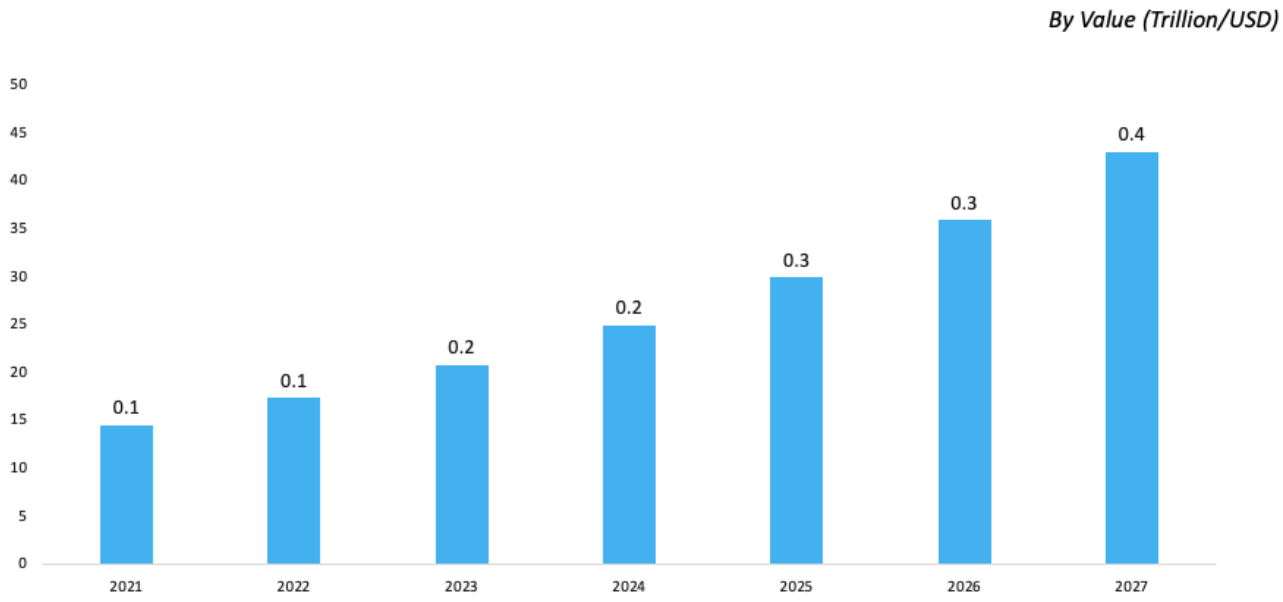
Source: CMR Estimates

The annual battery demand is predicted to grow by 30% to 104GWh, by 2027, with around 90GWh, to be contributed by lithium-ion batteries. In revenue terms, battery market will grow from USD 0.003 trillion (INR 0.23 trillion) in 2021 to USD 0.02 trillion (INR 1.53 trillion) in 2027 at a CAGR of 40%.

Connected Vehicles

As per CMR estimates, there are over 500 million internet subscribers in India. Connected vehicles are a fairly new trend in India, with less than 5% of the total cars sold in India, featuring internet connectivity. Despite being a nascent trend, sales of connected cars are growing very rapidly, with India poised to be one of the fastest growing markets for connected cars, globally.

According to CMR estimates, connected vehicle market in India will grow at a CAGR of 20% from USD 0.1 trillion (INR 7.6 trillion) in 2021 to USD 0.4 trillion (INR 30.7 trillion) in 2027.

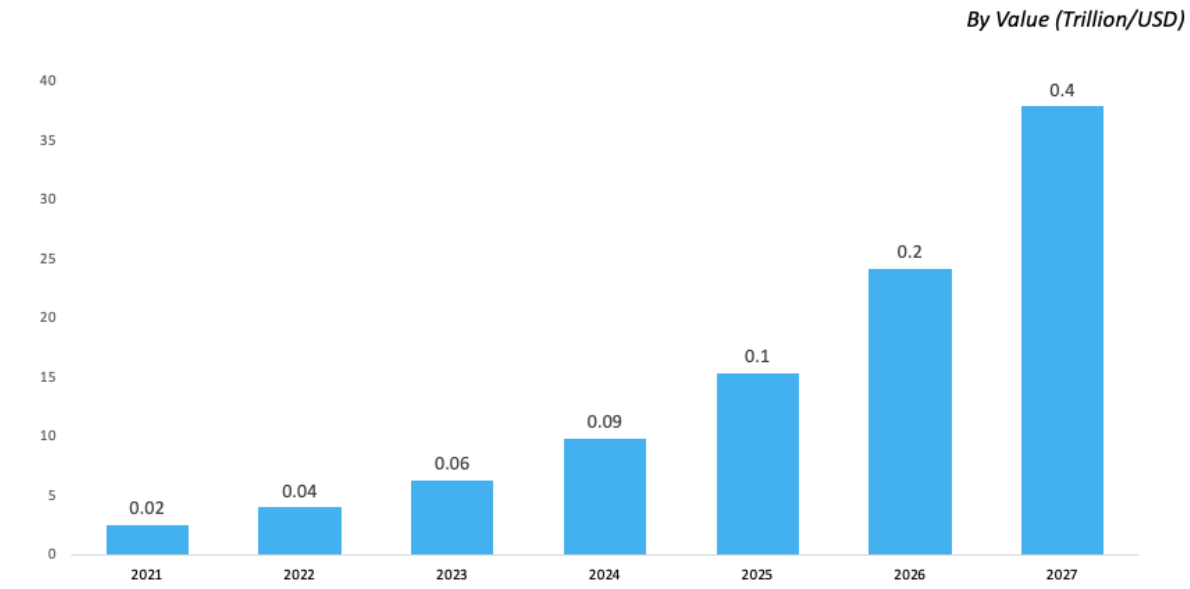


Projected Connected Vehicle Sales in India
Source: CMR Estimates

Shared Mobility

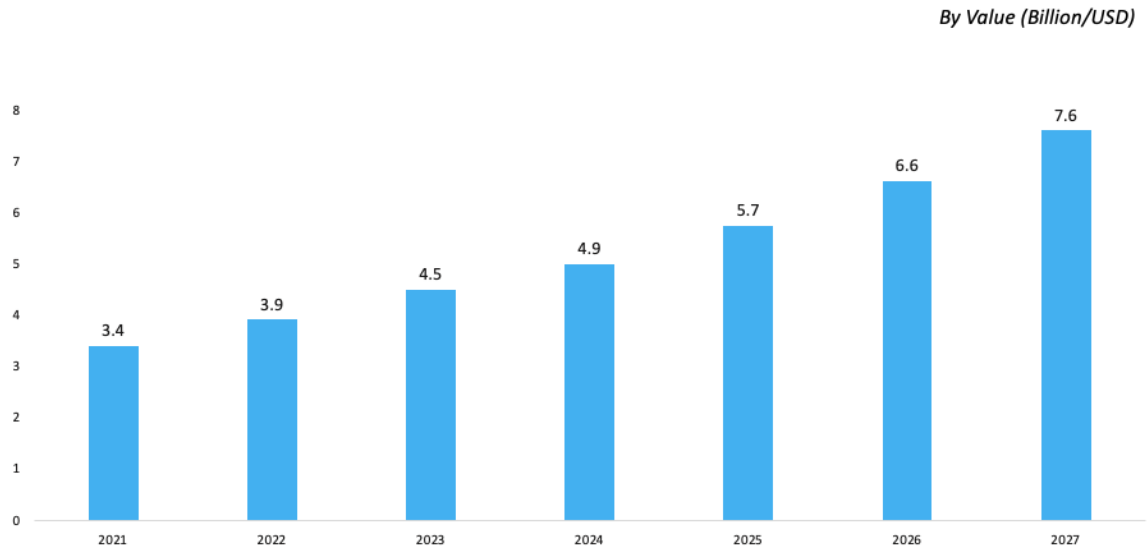
Shared mobility is one of the most promising solutions to address these challenges and India can emerge as a model example of redefining the personal mobility, by encouraging use of shared mobility, as a government policy.

According to CMR estimates, shared mobility market will grow, with a CAGR of 57% from USD 0.02 trillion (INR 1.5 trillion) in 2021 to USD 0.4 trillion (INR 30.7 trillion) in 2027.



Projected Growth for Shared Vehicles in India
Source: CMR Estimates

According to CMR estimates, the ride-hailing services market in India is anticipated to grow at a CAGR of 15% from USD 0.3 trillion (INR 23 trillion) in 2021 to USD 0.7 trillion (INR 53.8 trillion) in 2027.

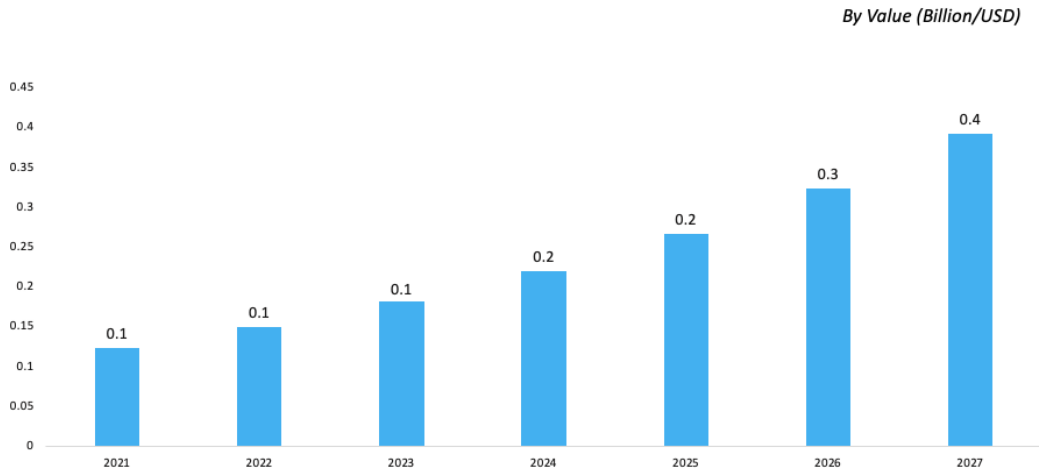


Projected Forecast for Ride-hailing services in India

Source: CMR Estimates

Car sharing is another growing form of sharing mobility in India. The primary factor behind the growth of car sharing in India, is the high costs of car ownership, which leads to very low levels of car ownership in India.

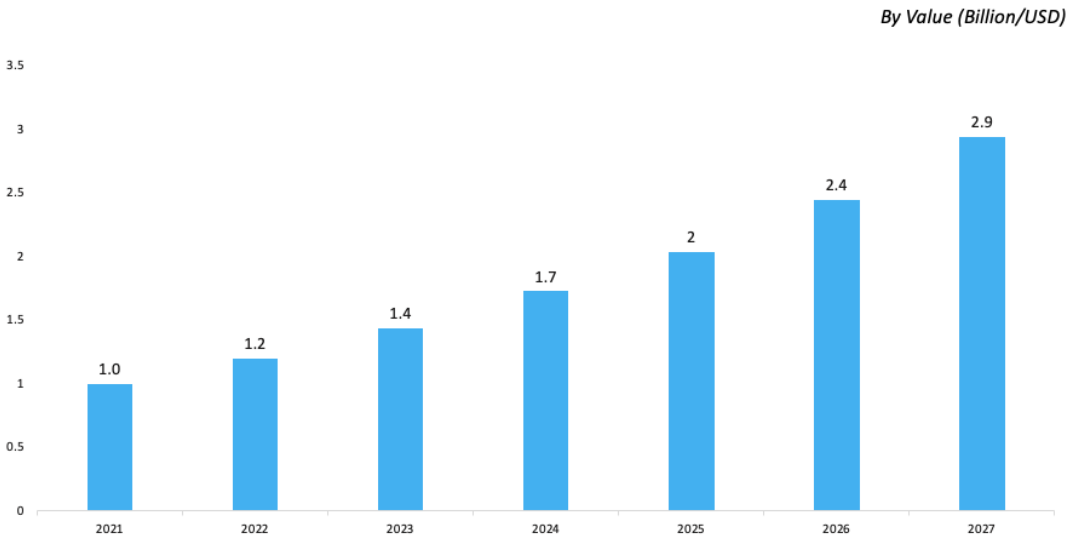
According to CMR estimates, **car sharing services market** in India is expected to grow at a CAGR of 21.5% from USD 0.01 trillion (INR 0.76 trillion) in 2021 to USD 0.04 trillion (INR 3 trillion) in 2027.



Projected Forecast for Car Sharing Services in India

Source: CMR Estimates

According to CMR estimates, the **micro mobility market** in India is expected to grow at a CAGR of 20% from USD 0.1 trillion (INR 7.6 trillion) in 2021 to USD 0.3 trillion (INR 23 trillion) in 2027.



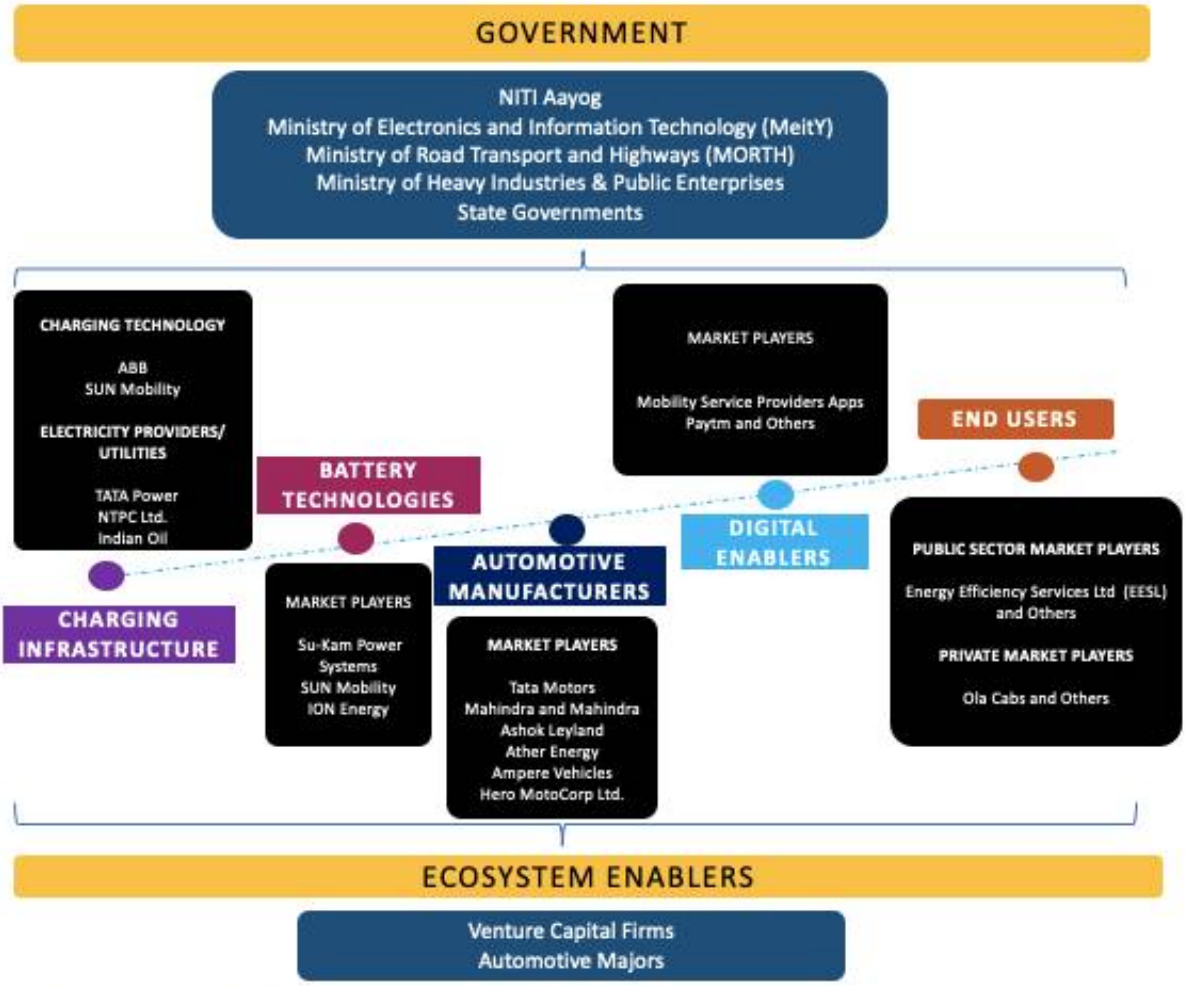
Projected Forecast for Micro Mobility Services in India

Source: CMR Estimates

Government as an Enabler

The Government is a key enabler of the electric vehicle ecosystem. Alongside, the EV ecosystem comprises of an array of players, ranging from battery manufacturing companies to charging technology providers, from automotive manufacturers to end mobility users.

The ecosystem for mobility is enabled by market enablers, who provide access to tech, and access to capital.



The Ecosystem for Electric Vehicles in India

The Central and State Governments are focused on enabling electric mobility through various policy Incentives.

NITI Aayog

NITI Aayog has released a handbook to guide state governments and local bodies to frame policies and norms towards setting up charging networks for electric vehicles (EV). The Handbook for Electric Vehicle Charging Infrastructure Implementation has been jointly developed by NITI Aayog, Ministry of Power (MoP), Department of Science and Technology (DST), Bureau of Energy Efficiency (BEE), and World Resources Institute (WRI) India.

Ministry of Road Transport and Highways (MoRTH)

MoRTH announced that battery-operated vehicles, both private and commercial, will be given green license plates. MoRTH announced that it will facilitate the import of 2500 electric vehicles compliant with international standards without the need for homologation. MoRTH has also amended Central Motor Vehicles Rules (CMVR), 1989 to allow driving licenses to be issued for age group 16–18 years to drive gearless electric scooters and bikes up to 4 kWh battery size.

Ministry of Housing and Urban Affairs (MoHUA)

MoHUA released new decree of building code and town planning rules for provisioning of electric vehicle charging stations in private and commercial buildings. Government of India has incorporated two schemes FAME 1 (Faster Adoption and Manufacturing of Hybrid and Electric vehicles) and FAME 2 schemes, as an integral part of National Electric Mobility Mission Plan (NEMMP), to establish India as pioneer in the manufacturing and adoption of electric mobility.

Ministry of Finance (MoF)

MoF has reduced the customs duty for all categories of vehicles, battery packs and cells to support Make in India and incentivize the adoption of electric vehicles.

Ministry of Electronics and Information Technology (MeitY)

MeitY has released a paper on National Strategy for Additive Manufacturing that has great relevance for Automotive Sector in the production of end-products (engines, spare parts, other interior, and exterior parts). MeitY has invited feedback from all stakeholders.

MeitY has also released a major policy initiative through National Policy on Electronics (NPE 2019) that has a direct bearing on Electronics System Design and Manufacturing (ESDM). The NPE 2019, prepared after extensive stakeholder consultation, envisages to position India as a global hub for ESDM with thrust on exports by encouraging and driving capabilities in the country for developing core components, including chipsets, and creating an enabling environment for the industry to compete globally.

In Jul-Aug 2021, MeitY has also released amendments and notifications, to Electronics & IT Goods Order 2012, to bring clarity and bring standardization as per BIS guidelines.

The Faster Adoption and Manufacturing of Hybrid and EV (FAME)

The FAME 1 program, was first implemented in 2015 with an outlay of USD 0.01 trillion (INR 0.76 trillion). The FAME 2 was introduced in 2019, with an outlay of USD 0.13 trillion (INR 10.4 trillion) for a period of three years.

86% of total budget outlay has been spent towards demand creation of electric vehicles. FAME 2 aims to generate demand for 7,000 electric buses, 5,00,000 electric 3 wheelers, 55,000 electric cars and 10,00,000 electric 2 wheelers. The policy will incentivize only battery advanced (lithium ion batteries) and registered vehicles.

In addition, FAME 2 also emphasizes provision of clean eco-friendly public transport to the masses, as it will be mainly applicable for 3 wheelers, 4 wheelers and buses, registered for commercial purpose or used in public transport. Privately registered electric 2 wheelers are also eligible, for this scheme.

Electric batteries are at the heart of electric vehicles.

India today imports almost 100% of its electric battery requirements, particularly in lithium ion batteries. Although India recently discovered 1600 tons of lithium deposits at Mandya in Karnataka, these are deemed to be insufficient to meet the future demand for lithium ion batteries in India.

In order to overcome this anomaly, India on 12th May 2021, announced the National Program on Advanced Chemistry Cell (ACC) Battery Storage policy, which provides incentives for battery manufacturers, to set-up giga factories for battery manufacturing in India. The plan is to set up 50 giga watt hour (GWh) manufacturing capacity for advance chemistry cell batteries by attracting investments totalling USD 6.12 billion (INR 47.07 billion). One GWh of battery capacity is sufficient to power around 30,000 electric cars. Each selected ACC battery storage manufacturer would have to commit to set up an ACC manufacturing facility of minimum 5GWh capacity and ensure a minimum 60% domestic value addition at the project level within five years, under this scheme. The government also aims to extend the PLI (Production Linked Incentive) scheme for manufacturing electrolysers, used for producing green hydrogen.

Policy Initiatives at the State Level

At the state level, various State Governments are forging ahead with focus on electric mobility.

Andhra Pradesh

Andhra Pradesh have aimed to put 10,00,000 electric vehicles on road, by 2024. Andhra Pradesh will celebrate designated 'green days' to commemorate electric vehicles.

Andhra Pradesh aims to achieve 100% electrification of the buses by 2029, with first phase in four major cities targeted by 2024.

Bihar

The Bihar government policy towards electrification of vehicles is centered on rickshaws, as rickshaws are the most preferred mode of personal transport, in the state. Bihar aims to convert all human powered rickshaws operating in the state to electric rickshaws, by 2022.

Delhi

Delhi will prioritize 2 wheelers, 3 wheelers, taxis and buses, for electrification. Delhi aims to introduce 50% electric buses, in its fleet of public transport, by 2023. The State will introduce various de-registration incentives and scrappage policies for more than 15 years old vehicles and high polluting vehicles like trucks and buses. Delhi plans to introduce common mobility card payment system, for energy operators offering electric charging and battery swapping services.

Karnataka

The Government of Karnataka has focused on manufacturing of electric vehicles and battery storage systems. Karnataka also plans to create a secondary market for batteries. Karnataka has also established a separate venture capital fund, which will invest only in start-ups, engaged in electric mobility space. Karnataka has also planned to retrofit all the 3 wheelers, operating in the state, with electric motors, to reduce air pollution.

Kerala

The Government of Kerala has aimed to put 1 million electric vehicles on road by 2022. Kerala has also set a target of inducting 6,000 electric buses, into public transport fleets, by 2025. Kerala has also made electric vehicle component manufacturing, a priority. Kerala also provides viability gap funding for electric buses and government fleets.

Maharashtra

The Government of Maharashtra EV policy provides incentives focused on demand creation for EVs, attracting new investments in EV manufacturing and expansion of the charging infrastructure. Some non-fiscal measures have also been announced to develop the skilled manpower required for the transition from conventional vehicles to EVs, in the state.

Tamil Nadu

Tamil Nadu aims to position itself as a premier electric vehicle manufacturing hub. Tamil Nadu offers 50% subsidy on land for electric vehicle manufacturers in its southern districts and 15% in other parts.

Tamil Nadu aims to create 1,50,000 jobs in electric vehicle manufacturing and associated industries.

Telangana

The state of Telangana has prioritized shared mobility, public transport and institutional transport vehicles, as cornerstone of its electric vehicle policy.

Telangana has also initiated retro-fitment of passenger vehicles and 3 wheelers, with electric motors and started promoting electric rickshaws.

Uttarakhand

Uttarakhand has based its electric vehicle policy on the basis of manufacturing. The state of Uttarakhand has also announced to induct 600 electric buses, in its public transport fleet, by 2030.

Uttar Pradesh

The Government of Uttar Pradesh has centered its electric vehicle policy on manufacturing of electric vehicles, electric vehicle batteries and components. Uttar Pradesh has announced plans to set-up 0.2 million (fast, slow and swapping) electric charging stations, by 2024. Uttar Pradesh has also aimed to put 1 millon electric vehicles on its roads and convert 70% of public transport to electric mobility by 2030.

CHAPTER 7

The Startup Surge

Ready to accelerate

Mobility Start-ups to the fore

At the centre of the mobility revolution, is the start-up ecosystem that is home to entrepreneurs daring to take the leap and solve the grand challenges of mobility in India.

The ACES mobility trends are creating significant shifts in how mobility has been traditionally perceived, and in doing so, fundamentally changing business models, and opening avenues for non-automotive, primarily technology-led players, to enter the industry.

Today's entrepreneurs are innovating across technology domains, including in electric, connected, shared and even autonomous mobility, propelling the mobility sector forward.

In the new mobility landscape, both traditional automotive players as well as the new mobility start-ups would need to build technological capabilities, and consistently stay ahead of the changing technological dynamics, to be positioned for success in the forthcoming future of ACES mobility.

The Indian start-up ecosystem landscape in India has undergone a tectonic growth over the past decade. The mobility start-ups constitute a small, but significant cohort, currently in the early throes of growth. They drive innovation to fill gaps in infrastructure, address grand challenges, and meet consumer needs and aspirations.

Across the length and breadth of India, mobility start-ups are at the forefront of addressing unique challenges. As a result, new start-up hubs around mobility are emerging.

Enabling the mobility start-up ecosystem is a stable and progressive policy environment. As part of Start-up India, the Government is providing avenues for start-ups to tap mentorship, capital and market connect opportunities.

Traditionally, access to capital has been a major challenge for start-up entrepreneurs. With funding from over 2,000 active investors, India's entrepreneurial ecosystem has been growing. Over the past decade, driven by their earlier successes, investors have also been able to increase their risk appetite.

Some of the leading investors that have been investing in the Indian mobility start-ups include the likes of Blume Ventures, Sequoia Capital, IDG Ventures India, Matrix Partners, Softbank Vision Global Fund, Indian Angel Network, and Elevation Capital, amongst others.

Some of ACES Mobility start-ups which have recently raised investments include Ati Motors (USD 3.5 million/ INR 0.26 billion), Swayatt Robots (USD 3 million/ INR 0.23 billion), Etrio (INR 3 million/ INR 0.23 billion), BLU Smart Mobility (USD 7 million/ INR 0.53 billion), Cell Propulsion (USD 2 million/ INR 0.15 million), Okinawa Scooters (USD 21 million/ INR 1.61 billion) and Ather Energy (USD 35 million/INR 2.6 billion), amongst others.

Illustrative List of Indian Mobility Start-ups

"Energy for mobility is a very interesting domain specifically as EVs are becoming the preferred platform for transportation/"

Kartik Hajela
Co-Founder and COO
Log 9 Materials

"Energy for mobility is a very interesting domain specifically as EVs are becoming the preferred platform for transportation. Also what we at Log 9 have realised is that it's not a "one solution fits all" market where multiple technologies and solutions will exist depending on the target application. Hence we also have rapid chargeable solutions for intra city last mile logistics space and have Aluminium Fuel Cell as a solution for inter city or long haul applications."

"Our IoT based solutions and sensors onboard are used to predict the diesel theft taking place in the commercial vehicles."

Gaurav Kumar,
Founder
Cyrrup

"Connected Mobility is observing rapid innovations globally. Complement this with Electric Vehicles and Drones, and we see a host of solutions for sustainability and last mile logistics. The current subsidies offered by the Govt of India has accelerated the growth of the EV segment.

At Cyrrup, our IoT based solutions and sensors on board are used alongwith ML algorithms to predict the diesel theft taking place in the commercial vehicles and thus reducing their opex. Our Made In India solution, guarantees after sales service."

Network of Incubators and Accelerators

The mobility start-up ecosystem is getting a fillip through a network of incubators and accelerators. They support nascent as well as mature start-ups with access to learning, mentorship, capital, and market linkages.

Indian automobile manufacturers are also keenly investing in Indian ACES mobility start-ups and have engaged with mobility incubators to enable the emerging new mobility startups in India. For instance, Maruti Suzuki has partnered with Hyderabad-based innovation intermediary and business incubator, T-Hub to identify and partner with both early-stage and established start-ups with ready product and an attractive consumer base.

On the other hand, Tata Motors introduced a new platform, Tata Motors AutoMobility Collaboration Network 2.0 (TACNet 2.0), that will propel advanced technology sourcing through new start-up partnerships or business models in collaboration with technology companies.

Hero MotoCorp set-up HeroHatch that provides an incubation platform aimed at fostering innovation from within the Hero ecosystem.

Maruti Suzuki partnered with the Nadathur S Raghavan Centre for Entrepreneurial Learning (NSRCEL), the start-up hub at Indian Institute of Management Bangalore (IIMB) to nurture 26 mobility start-ups over a 9-month extensive incubation program.

Institutions of Higher Learning

Supporting the development of the mobility market ecosystem, are the Indian institutes of higher learning.

For instance, the IIT Madras Research Park breaks down the silos between industry and academia. It provides a platform for start-up entrepreneurs to create and advance new innovations, by leveraging the expertise of IIT Madras. Similarly, the Technology Innovation & Development of Entrepreneurship Support (TIDES) Business Incubator hosted at Indian Institute of Technology, Roorkee provides a conducive environment for start-up entrepreneurship.

"We blend advanced electronics and analytics with deep domain expertise in energy storage."

Akhil Aryan,
Co-Founder,
ION Energy

"The proliferation of connected mobility (sharing mobility, SIM-powered telematics, personalized infotainment, autonomous vehicles, etc.) and collaboration of multiple stakeholders (OEMs, component manufacturers, policymakers, etc.) to develop an ecosystem that can efficiently and sustainably manage the rapidly changing mobility landscape will be critical for the advancement of India's electric mobility ecosystem.

ION Energy gives companies access to a technology infrastructure that blends advanced electronics and analytics with deep domain expertise in energy storage. Driven by its vision to lead the building of cleaner, safer, and efficient electric mobility, ION Energy plans to shepherd the industry seamlessly transition to the AI/ML-driven new business model."

"We deploy AI assistance for avoiding collisions and thereby, helping logistics companies in minimizing their losses."

Nisarg Pandya,
CEO,
drivebuddyAI

"India is growing in adoption of technology in the automotive industry. We at drivebuddyAI are implementing driver safety and connected mobility ecosystem with our product DRISHTI that deploys AI assistance to the drivers, thereby avoiding collisions and helping fleets and logistics companies, and in doing so, minimizing their losses. The idea is to bring complete transparency amongst all the stakeholders, utilising cutting-edge technology, AI and Computer Vision."

"Electrification and connected mobility will help India to sustainably grow and become a world leader."

Sahil Chawla
Co-founder & CEO
Tsecond Inc.

"Millennial India requires a tailored network to precisely be designed based on users increased consumption choices and convenience. Electrification and connected mobility will help India to sustainably grow and become a world leader by addressing the global issue of climate change.

"Data is the new oil" and Tsecond aims to innovate disruptive technology that brings the distributed computing paradigm closer to the source thus addressing the limitations of latency, bandwidth, data privacy and autonomy. With BRYCK, Tsecond aims to become a one stop solution for mission-critical applications like connected mobility and customer-facing situations where speed, predictive analytics and uptime are crucial."

"The future of commuting will follow a hybrid model where people will choose to carpool to work."

Lakshna Jha,
Founder & CEO,
sRide

"With a strong emphasis on vaccination drives, easing up of lockdowns and businesses such as offices and malls reopening, the pandemic with its various impacts, has opened up the options for Carpooling in India. Carpooling gives one the combined benefit of a cost-efficient ride by collectively saving on fuel expenses, a safe environment as you travel with the people you are familiar with, and have the option to avoid extreme public exposure.

sRide has seen a recovery rate of >60% after the second wave of COVID-19. The future of commuting will follow a hybrid model where people will choose to carpool to work thrice or four times a week depending on the requirement to travel."

Some other notable institutes of higher learning providing incubation interfaces, include the Society for Innovation and Entrepreneurship (SINE) at the Indian Institute of Technology Bombay (IIT-B), the Innovation and Incubation Program at Indian Institute of Technology Delhi (IIT-D), and the Innovation Park at Indian Institute of Management Calcutta (IIM-C), amongst others.

Government enabling mobility start-up culture

Several state governments are encouraging and enabling new mobility start-ups to come to the fore. They have set-up several incubators and accelerators. Some of these, include Kerala Start-up Mission, StartupTN by Tamil Nadu Government, Maharashtra State Innovation Society, Start-up Karnataka, Start in UP by Uttar Pradesh, iStart by Rajasthan and iCreate by Gujarat, amongst others.

Government of India is also supporting mobility start-ups by setting up MOTION Centre of Entrepreneurship by Software Technology Parks of India (STPI) and creating Accelerating Growth of New India's Innovations (AGNii) Program by Invest India.

STPI MOTION CoE

"MOTION" is a Centre of Entrepreneurship (CoE) in ACES Mobility, an initiative of Software Technology Parks of India (STPI), Ministry of Electronics & Information Technology at Pune.

Incubation Infrastructure at MOTION

MOTION offers specialized state-of-the-art incubation facility and domain specific physical laboratories for ACES Mobility start-ups where the highest-standards and best-practices in terms of infrastructure, technology, leadership, mentoring, training, research & development, funding, networking for the given focus area is made available.

STATE OF THE ART INFRA

MOTION Chief Mentor

Dr Ganesh Natarajan
Chief Mentor
CoE- MOTION

MOTION Leadership

Dr Sanjay Kumar Gupta
Jurisdictional Director
STPI Maharashtra & Goa

Shri Subodh Sachan
Director, STPI-HQ &
CEO, STPINEXT INITIATIVES

MOTION Partners

MOTION Start-up Profiles

Start-up	Domain	Brief about the Start-up
Aeidth	Battery System and Charging Infra	AEIDTH Technologies provide modern world solutions for Electric Vehicles and its Charging solutions. Aeidth has achieved expertise in developing Electric Vehicle parts (like ON Board Chargers, BMS, and Motor Driver etc.) to Smart Electric Vehicle charging stations. **Web:** http://www.aeidth.com/
AutoBox	Connected / Electric Charging Station App	AutoBox is an Auto-Tech start-up from Mumbai, AutoBox envisions to be the market leader in the connected car space with IoT and Connected Car tech for all brands under one roof, instantaneously upgrading ones existing car to a SMART car with a cost-effective plug & play device. **Web:** https://www.autoboxapp.in/
COMBAT Robotics Battle Ready Unmanned Systems	Battery System and Charging Infra	Focused on manufacturing and designing of charging solutions for two-wheeler and three-wheeler EVs. **Web**: http://combatroboticsindia.com/
COULOMB Li Tech	Battery System and Charging Infra	Coulomb is into manufacturing and tech development of Lithium Batteries for mobility and storage application. Coulomb has a completely in-house developed tech stack ranging from proprietary battery management systems, chargers and online analytics and monitoring platform. **Web**: https://www.coulomblitech.com/

Start-up	Domain	Brief about the Start-up
Eidikos Business Enterprises Pvt. Ltd.	Electric Vehicle Charging Solutions	Eidikos is making Level 2 AC Electric vehicle charging kiosks. CAPTIVE CHARGING One time charges - Product price - Installation charges - Spares Recurring charges - Annual Maintenance charges CHARGING AS A SERVICE (CAAS). **Web:** https://eidikosbusiness.in/
	Electrical Vehicles	Electromotion E-Vidyut, is developing instant retrofitting kits for auto rickshaws. **Web**: http://www.evidyut.com/
ERANEXT	Battery System and Charging Infra	Integrated with cameras and Real-time sync sensors. Calling up Emergency Response Services automatically on the spot incase of major accidents. Increasing Fuel efficiency by suggesting On-Screen Traffic signal timings and shorter routes. **Web**: https://www.eranext.in/
EVCFinder	Battery System and Charging Infra	Creating a network of Electric Vehicle Charging Stations pan India. • Service of integration of charger with the software solution • Sale of Chargers • Software Solution service fees on every charging session **Web**: https://www.evcfinder.com/
EXA	Shared Mobility	Exa Mobility plans to strengthen the Public transit system of the city by providing First and Last mile connectivity through their Intelligent E-Scooters and Fleet Services through mobile app Exa Ride **Web**: https://www.exa-mobility.com/

Start-up	Domain	Brief about the Start-up
GO VIDYOUTH	Electric Vehicle(2W)	Developing India's first extended range electric two-wheeler (scooter). **Web:** https://igovidyouth.com/
Jeev	Shared Mobility	JEEV MOBILITY will provide smart urban mobility solution for first and last mile connectivity. Their mission is to make daily commute fun, enjoyable, stress-free and easy while reducing air pollution and traffic congestion. **Web**: https://www.jeevmobility.com/
Krishigati	An innovative vehicle for intercultural operation	Axle-less battery powered vehicle for agriculture application (Multipurpose inter-cultivator) It also act as on-road and off-road condition with manually, engine powered.
KSHEMIN LABS	Autonomous Vehicle	Kshemin Labs calculates driver performance and vehicle health through 30+ vehicle parameters coming from the OBD module like Speed, Engine RPM, Engine Load, etc. **Web:** http://ksheminlabs.com/
REVELEC AUTOMOTIEV	Electrical Vehicle	Building indigenous electric two-wheelers. Customers have options to choose range and top speed starting from 45-135 km and 25-80 kmph. **Web**: www.revelec.co/
SENS-ie	IIOT and Electric Mobility	Logistics tracking & Monitoring devices and sensor solutions for tracking shipments, assets and products on factory floor, warehouse, packaging and retail outlet. **Web**: https://sensietech.com/

Start-up	Domain	Brief about the Start-up
VAMOS	Electric Vehicle	Vamos Motors is building electric two-wheelers. **Web:** http://vamosmotorsindia.com/
Vayve	Electric Vehicle	Vayve Mobility is developing an Electric three-wheeler vehicle for urban personal mobility and last-mile delivery. USP - Comfort, Safety, Sustainability A three-wheeled fully-covered vehicle with car-like comfort and driving experience. **Web:** https://www.vayve.in/
Vi INNOVATIONS	Connected Vehicle (4W)	Automobile Device Control System IoT (Electronic Device + App) (Indian patents pending). An innovation which can transform a normal car to smart-connected car. **Web:** https://viinnovations.com/

CHAPTER 8

The Road Ahead

Realizing the ACES future

The advent of ACES will re-shape the road ahead for the automotive industry. The proactive enabling government policies alongwith a vibrant start-up ecosystem will give wings to India realizing a transformed ACES mobility future. Already, India is witnessing a vibrant electric mobility that is a key component of embracing the overall ACES trends. Towards this end, India needs to support start-up entrepreneurship around new mobility models, and build the requisite infrastructure to facilitate realizing the ACES future.

Ecosystem Partnerships. As new entrepreneurs and mobility start-ups emerge, they will impact the mobility ecosystem. For such start-up entrepreneurs to succeed, they would require strategic partnerships and alliances to enable them to overcome tech challenges and attain scale swiftly.

Conducive Policy Framework. A favourable regulatory regime is required to create a conducive environment for mobility to grow sustainably. An enabling infrastructure to support the forthcoming mobility revolution is required. Over the long-term, this infrastructure should support not just connected vehicles, but also prepare for the advent of autonomous vehicles at scale, enabling new efficiencies to be realized.

Consumer Awareness. Lastly, to prepare for the future of mobility, consumer awareness and consumer expectations are key. Customer expectations around mobility will enable mobility providers to build and deliver the services customers want.

List of Abbreviations

ABS	Antilock Braking Systems
ACES	Autonomous, Connected, Electric and Shared
ADAS	Advanced Driver Assistance Systems
AGV	Autonomous Guided Vehicles
AV	Autonomous Vehicles
B2B	Business to Business
B2C	Business to Consumer
BEV	Battery Electric vehicles
CVP	Connected Vehicle Platform
EBD	Electronic Braking Distribution
EV	Electric Vehicles
FCEV	Fuel Cell Electric Vehicles
G2C	Government to Consumer
HEV	Hybrid Electric Vehicles
ICE	Internal Combustion Engine
IOT	Internet of Things
IIOT	Industrial Internet of Things
IP	Intellectual Property
MaaS	Mobility as a Service
P2P	Peer to Peer
PHEV	Plugin Hybrid Electric Vehicles
V2C	Vehicle to Cloud
V2I	Vehicle to Infrastructure
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to Everything

STPI

Software Technology Parks of India (STPI) is a premier S&T organization under Ministry of Electronics and Information Technology (MeitY) engaged in promoting IT/ITES Industry, innovation, R&D, start-ups, product/IP creation in the field of emerging technologies like IoT, Blockchain, Artificial Intelligence (AI), Machine Learning (ML), Computer Vision, Robotics, Robotics Process Automation (RPA), Augmented & Virtual Reality, Animation & Visual effect, Data Science & Analytics for various domains like Gaming, FinTech, Agritech, MedTech, Autonomous Connected Electric & Shared(ACES) Mobility, ESDM, Cyber Security, Industry 4.0, Drone, Efficiency Augmentation, etc.

https://www.stpi.in/

STPINEXT INITIATIVES

AIC STPINEXT INITIATIVES is a section 8 company incorporated by STPI to act as the nodal agency and common implementation vehicle for various start-up and entrepreneurship activities at STPI.

http://www.stpinext.in/

CMR

CyberMedia Research (CMR) offers industry intelligence, consulting and marketing services, including but not limited to market tracking, market sizing, stakeholder satisfaction, analytics and opportunity assessment studies.

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This report includes forward-looking statements, such as market estimates, and market projections about emerging industries and trends. Such forward looking statements involve uncertainties because they relate to events that may or may not occur in the future.

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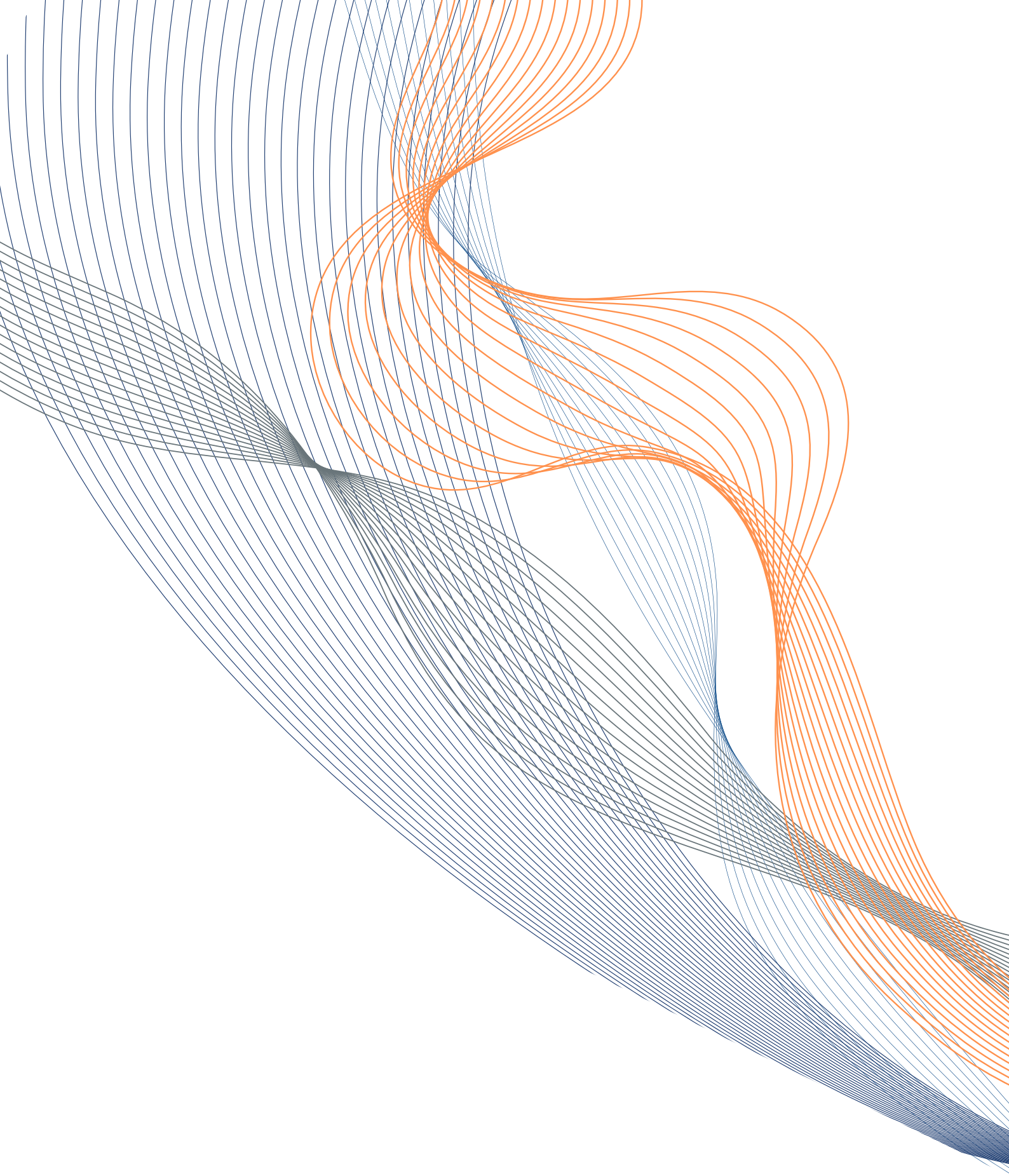

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