NITI Aayog

सत्यमेव जयते

MOVE

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MOVING FORWARD TOGETHER

ENABLING SHARED MOBILITY IN INDIA

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Outline

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Introduction

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India is at an inflection point in the development of its mobility system. As one of the most populous countries in the world[1], India has an opportunity to redefine personal mobility and set an example for other nations. India can develop a shared mobility system that creates benefits for all of its citizens by leveraging domestic strengths in data, connectivity, and entrepreneurship[2].

In order to realize a shared mobility future, some current trends must be addressed: Indian cities are currently witnessing increasing ownership of private vehicles and decreasing use of public and non-motorized transport[3]. These trends have implications on India's energy consumption, energy security and economy[4], pollution, congestion, health, and safety. The transportation sector in India accounts for 18% of commercial energy consumption and is highly dependent on oil imports[5]. India imported 80% of its oil at a cost of Rs. 4.2 lakh crore in 2015[6]. Additionally, private vehicle use has significant implications on land requirements for parking: in Delhi, for example, parking accounts for 8–10% of the available land pool[7].

Growth in vehicle ownership and demand for transportation is also leading to higher congestion in urban centers. The cost of congestion is estimated to be Rs. 1.47 lakh crore annually in Delhi, Mumbai, Kolkata and Bangalore[8], and vehicular emissions rates are increasing[9], with negative implications on human health and the environment[10].

A transition to shared mobility can help address these growing challenges. This shift will enable efficient asset utilization by transitioning from a model of ownership of private assets to usership of shared assets. Shared mobility has the potential to displace private vehicle ownership, which is typically costly[11], inequitable, and inefficient in comparison. This could unlock a transportation future that is more affordable, reliable, clean, and efficient.

India is uniquely positioned to embrace shared mobility. Several factors—including familiarity with shared services, strong digital infrastructure, and a vibrant entrepreneurial culture[12]—support India's opportunity to meet transportation demand with shared mobility solutions. This could enable a leapfrog of private vehicle ownership and avoid many of the associated negative consequences and externalities.

This report develops a common understanding of shared passenger mobility, discusses several factors that support and challenge the adoption of shared mobility in India, and provides suggestions to help develop and promote a shared mobility system. If pursued, such actions could support more efficient, equitable, and sustainable transportation systems for Indian communities.

02.

Defining shared mobility and various shared mobility models

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2.1 Defining shared mobility

This report adopts a broad definition of shared mobility—any mode of transportation that is shared by users on a as-needed basis, from bikes to 4-wheelers to mass transit can constitute shared mobility. Shared mobility includes the movement of both people and goods. Shared mobility leads to better fleet utilization—allowing more passengers and goods to travel in the same vehicle/vehicle kilometer travelled. By increasing occupancy of passenger vehicles, India has the potential to reduce vehicle kilometer demand by nearly 35%, accounting to 2000 billion kilometers in 2035[13]. This, combined with more efficient vehicle technologies, can cumulatively save above 1 gigatonne of CO_2 through 2030[14].

2.2. Types of shared mobility

Shared mobility includes numerous forms of transportation. Sharing includes both the simultaneous use of an asset or the independent use of shared assets, irrespective of asset (e.g. vehicle) ownership. In simultaneous use, multiple consumers are using the same asset at the same time, along a common route. In the independent use of shared assets, users get personal but temporary access to an asset to meet their mobility needs. Shared mobility services can be provided by vehicles registered for commercial use (such as taxis, auto rickshaws and buses) or or for personal use, if allowed by the regulatory ecosystem.

Mass transit

Mass transit includes high-capacity modes such as buses, metros, and trains that are typically operated by public agencies or the private sector for the public agencies. Mass transit has some of the highest throughput capacities; an on-street transitway (either bus or rail) can move as many as 10,000–25,000 people per hour as compared to 600–1,000 by private vehicles[15].

Publicly owned vehicles ranging from buses to ferries are important modes of transit for citizens. These modes efficiently and affordably move people along fixed route lines. India already has a high share of public transit (buses and trains), averaging 30% of the mode share in cities with populations above 5 million[16]. Although these statistics suggest a high bus share, public transit usership is on the decline[17]. This is in part due to a growing middle class that can afford personal vehicles, an increasing availability of intermediate paratransit like auto rickshaws and ride-hailing services and lack of adequate public transit capacity. Private buses, in several large cities like Bangalore, Delhi, Pune, etc., are being increasingly used for providing mobility services for the IT sector and similar companies using different business models. There has also recently been an emergence of private bus sharing platforms like Shuttl, which provides bus sharing services, aggregating independent bus owners on a common mobility platform.

Ridesourcing and ride-splitting

Ridesourcing: Ridesourcing refers to on-demand services that link riders to for-hire drivers who are using their own vehicles as commercial vehicles. These services use online platforms to link drivers with riders and facilitate direct payment. These services operate on dynamic routes (i.e. not fixed routes like most public transit) and fares. Some examples of ridesourcing operators, often called transportation network companies, include Lyft, Uber, and Ola. The services are often provided by cars or auto rickshaws in Indian cities.

Globally and in India, transportation network companies are growing rapidly, often disrupting traditional modes of transportation. From 2015 to 2016, Uber and Ola's ridership in India grew four-fold, serving around 70 million trips monthly[19]. Projections for 2018 suggest they will account for 66 billion vehicle kilometers traveled[20].

Ride-splitting: Many transportation network companies also offer shared options, such as UberPOOL and Ola Share. The models are called ride-splitting and can be provided by privately-owned buses, cars, and auto rickshaws. Here, drivers enter into a contract for services with a passenger. Typically, the contract is amended (often through a technology platform) to include additional riders along a route, filling empty seats in the vehicle. Since riders split fares, ride-splitting offers transportation at lower prices than ridesourcing, albeit with some inconvenience due to longer travel times. As algorithms improve and more riders opt into the shared offerings, the algorithms match passengers with similar destinations, reducing the inconveniences of pooling

Ridesplitting reduces vehicle kilometers travelled and hence reduces congestion, pollution and saves fuel. For example, since its launch in India in 2015, UberPOOL has saved 32 million vehicle kilometers travelled (VKT)[21] and led to a potential reduction of 81,22,00 kgs of CO_2 emissions[22]. The benefits could be further enhanced, if higher occupancy vehicles like mini-buses and regular buses are promoted for use for shared mobility[23].
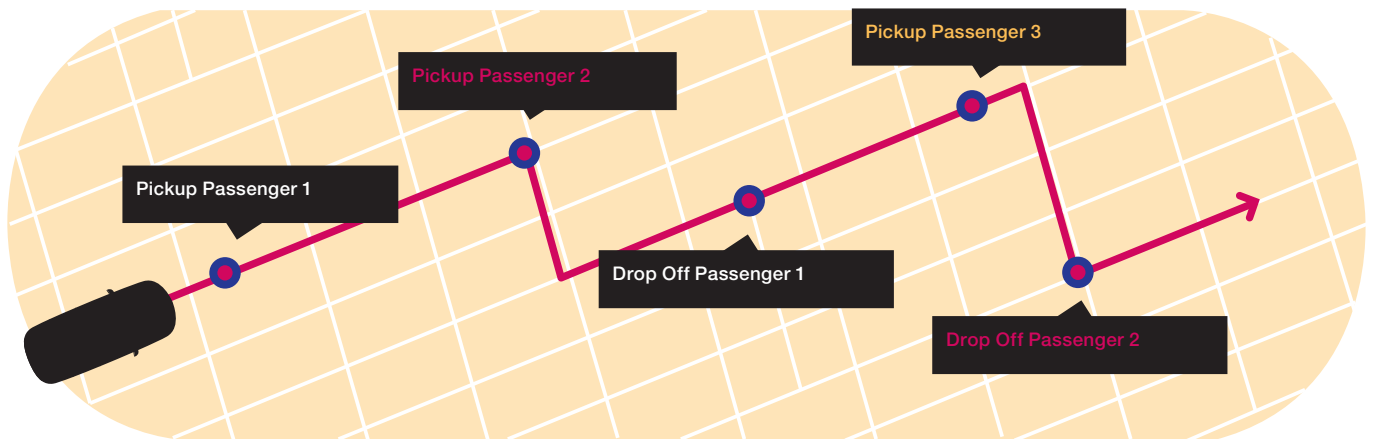

Figure 1: Ride-splitting with Uber POOL[24]

Ridesharing (carpooling and vanpooling)

Ridesharing is similar to ridesourcing, in which trips are shared by travelers, but with the exception that drivers are not considered "for-hire," though they can receive some forms of compensation to recover their cost[25]. Ridesharing can be acquaintance-based, organization-based, or ad-hoc[26]. In the case of ad-hoc, in Washington DC, drivers pick up additional passengers informally along their routes[27] to meet minimum occupancy requirements for high-occupancy vehicle lanes—thereby both making travel quicker and also decreasing VKT, congestion, and emissions.

Bike/cycle sharing, scooter sharing, carsharing

Many companies, in partnerships with cities, are providing bikes/cycles for public use. There are several forms of bike/cycle sharing—docked, dockless, and peer-to-peer. In docked systems, users can pay to obtain and return bikes at docking stations throughout the service area. In dockless systems, GPS enabled bikes need not be docked at the termination of a ride—users simply leave the bikes at the terminal point of their trip, and the bike locks with its own locking system. In peer-to-peer systems, users rent, or borrow bikes from owners. Online platforms, such as *cycle.land* are starting to facilitate the renting of bikes amongst peers, operating in a similar fashion to Airbnb[28]. Bike/cycle share programs are being tested in India—Ofo, a dockless bikeshare system is said to have completed more than one million rides across India[29]; Ola launched Ola pedal in 2017, piloting dockless bike systems at major campuses with plans to expand to cities. Bike/cycle sharing is a great low-cost option for first and last mile connectivity, being used to get to and from public transit and

other modes. Scooter-sharing is a new entrant into the shared mobility market. At present, users can rent scooters from scooter fleets operated by private companies.
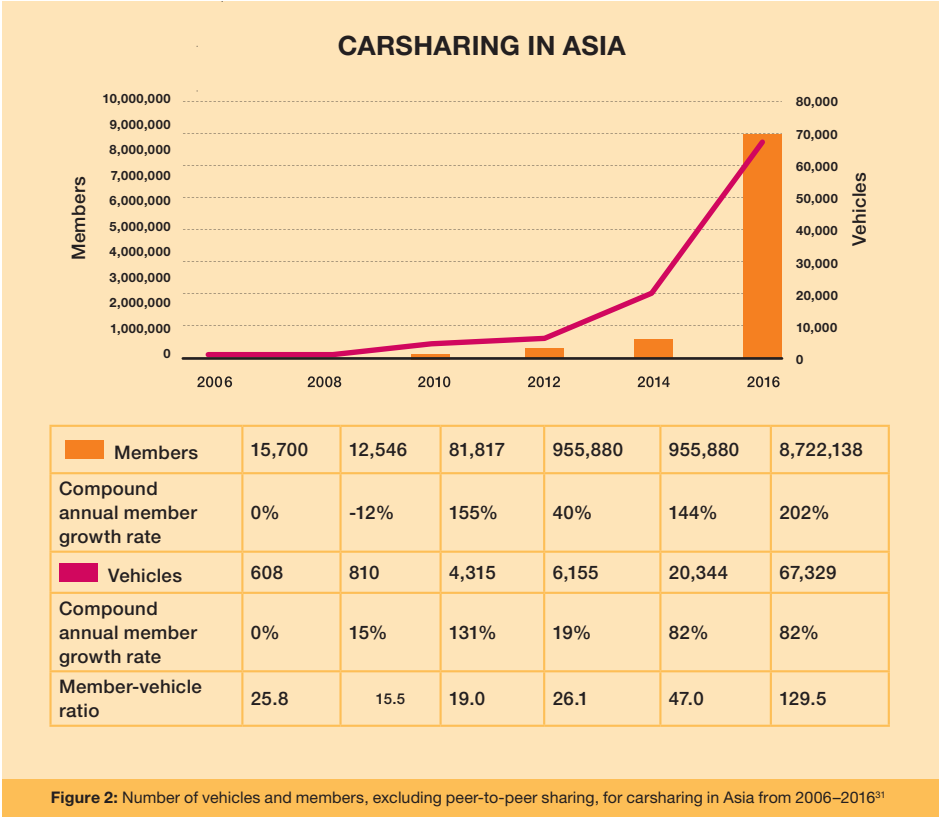
Carsharing

Carsharing gives users access to vehicles as needed, often renting vehicles on an hourly or daily basis or paying monthly dues for use. Types of carsharing include: round-trip, point-to-point, and peer-to-peer. With round-trip carsharing, users pick up and drop off the vehicle at the same location. In point-to-point carsharing, pick up and drop off points are different. In peer-to-peer carsharing, the owners of cars can rent their vehicles to users.

Global trends for carsharing

Globally, shared mobility, particularly carsharing, is on an upward trend, exhibiting significant growth in all major regions over the past several years. In October 2016, carsharing was operating globally in 2,095 cities across 46 different countries, serving 15 million passengers with nearly 157,000 vehicles. This represents 76% increase in users (passengers) and a 23% increase in vehicles since 2014. Asia accounts for 58% of carsharing members and 43% of the shared car fleet. As shown in figure 2, the number of passengers opting for carsharing has increased from 81,000 to 87 lakhs between 2010 and 2016 and the number of vehicles on this platform has grown from 4,315 to 67,329[30].

Carsharing compliments public transportation and ridesourcing, effectively serving different mobility requirements. Ubiquitous availability of and access to vehicles, real-time information availability, competitive pricing structures, and availability of multiple options for vehicle types, can enhance the usability and attractiveness of carsharing.

CARSHARING IN ASIA

	2006	2008	2010	2012	2014	2016
Members	15,700	12,546	81,817	955,880	955,880	8,722,138
Compound annual member growth rate	0%	-12%	155%	40%	144%	202%
Vehicles	608	810	4,315	6,155	20,344	67,329
Compound annual member growth rate	0%	15%	131%	19%	82%	82%
Member-vehicle ratio	25.8	15.5	19.0	26.1	47.0	129.5

Figure 2: Number of vehicles and members, excluding peer-to-peer sharing, for carsharing in Asia from 2006–2016[31]

Microtransit

Microtransit refers to private companies operating shared vans, where drivers and riders are linked via IT-enabled applications. Although similar to vanpooling, with microtransit, drivers are hired by companies or individuals directly. Microtransit covers a spectrum of operating modes, from fixed route and schedules to on-demand and dynamic routes. Shuttl is an example of a fixed route and fixed schedule operator. Other companies such as Via offer on-demand service such as routing.

Similar to microtransit, but with no or limited IT-enabled applications to link driver and riders, are shuttles. Shuttl is an example of a fixed route and fixed schedule operator, such as those operated by private companies to help employees commute to work.

Microtransit solutions can be used to meet structured and predictable mobility needs in cities. Microtransit solutions like shared vans and minibuses, where drivers and riders are linked via IT-enabled applications can be used to meet these structured mobility needs. Although similar to vanpooling, with microtransit, drivers of minibuses and other similar vehicles are hired by companies or individually by the employees to provide transportation.

Courier Network Services

Shared mobility services extend beyond moving passengers in vehicles—courier network services are for-hire freight delivery, in which consumers can hire freight services to move goods either intra-or inter-city. Some examples include Doordash, a company specializing in intra-city food delivery and Roadie, which moves many types of goods either locally or inter-city. Several transportation network companies are also offering courier network services, such as Uber Freight.

2.3. Benefits of shared mobility

Shared mobility has a number of potential benefits, most of which arise from an increase in system efficiency through higher asset utilization and improved connectivity. Whereas private vehicles often sit idle, or with low occupancy, shared vehicles are often better utilized, with more passengers and goods in available vehicle space and higher utilization, leading to reduction in total vehicle kilometer travelled, lower fuel consumption, reduced emissions and lower cost of transportation.

Efficient travel

With a focus on moving people, not vehicles, cities can promote high-capacity modes and increased asset utilization by reducing vehicle downtime and filling space or seats in vehicles.

For example, a study by Massachusetts Institute of Technology and Cornell University found that in New York City, 3,000 shared 4-passenger vehicles could meet the same demand usually served by 13,000 taxis while still meeting quality of service (e.g. in-trip delay, time to pick up)[32]. Each 'carsharing vehicle removes between 9 and 13 other vehicles from the road,' including both cars that are taken off the road and not purchased[33].

Reducing the number of vehicles on the road has the potential to reduce congestion, which in turn can save time, fuel and money due to fewer vehicle kilometers travelled. A recent study suggests that congestion in the U.S. costs USD $160 billion, accounts for 7 billion hours of lost time, and unnecessarily consumes 3 billion gallons of fuel annually[34]. Additional research, especially at the city-level, is needed to identify the impact of shared mobility on congestion. There is no guaranteed unique solution to reduce congestion, but shared mobility is a step in the right direction to help manage the demand for road space[35].
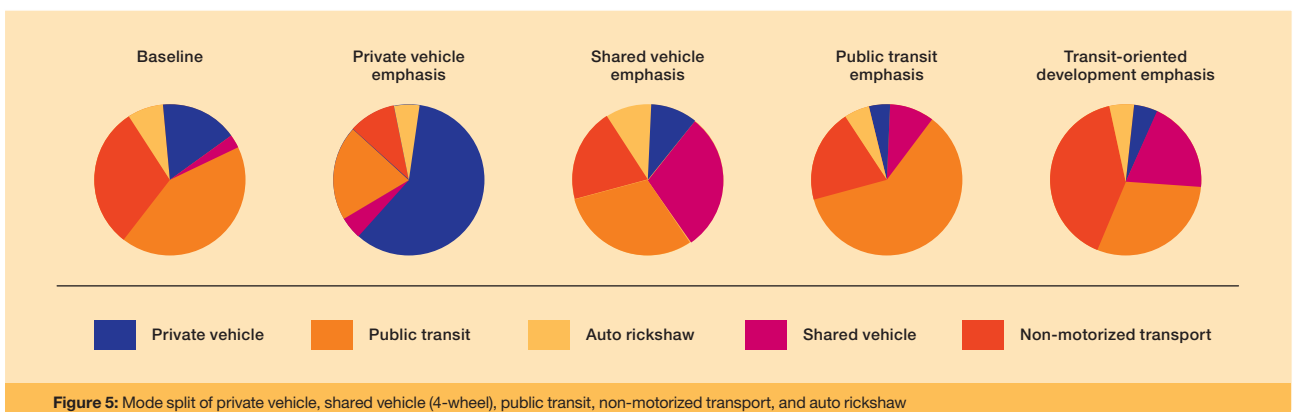
Figure 3: Street space required to move the same number of people by bike, car, or bus. Image taken in 1991 by Munster and available online[36]
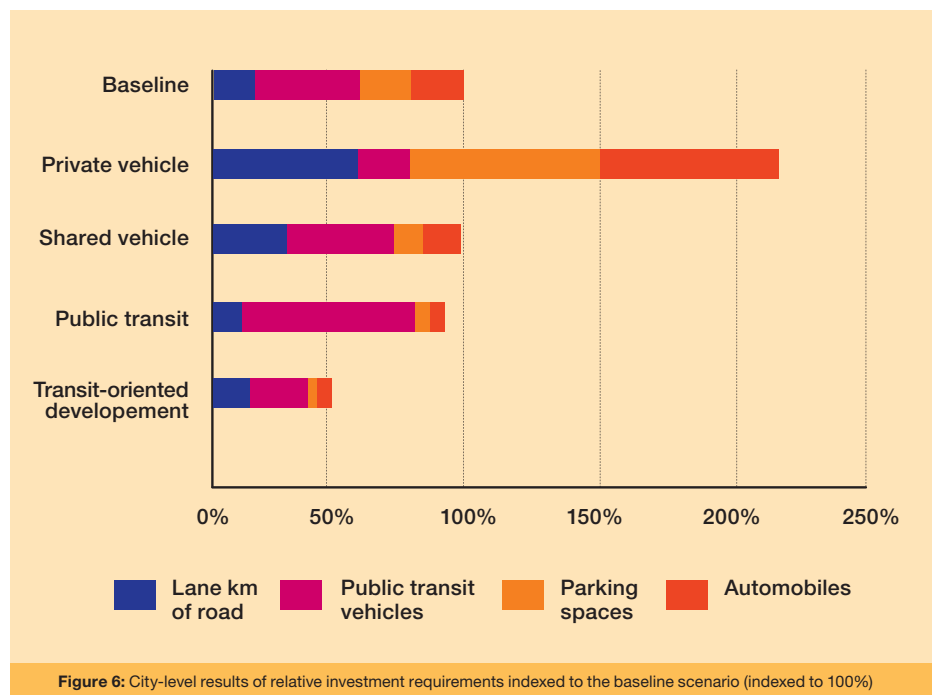
Reduction in transportation cost

In the U.S., vehicle ownership is the second highest annual expense for an average household[37], yet the vehicles are often underutilized, sitting parked around 95% of their lifetime[38] and generally underloaded when in use[39]. Shared mobility reduces the cost of transportation as users pay for transportation on demand when needed. The opportunity exists to monetize currently underutilized assets through such models as peer-to-peer carsharing. The authors developed a city level model to create estimates for capital investments required to realize different mobility paradigms in urban environments. This model assumes a relatively developed, hypothetical city with 1 crore inhabitants.

City demographics	
POPULATION	1,00,00,000
DENSITY	11,000/SQ. KM.
SIZE	910 SQ. KM.
TRAVEL DISTANCE	10 KM/CITIZEN/DAY

Figure 4: Model assumptions for population, density, size, and inhabitant daily travel distance

Baseline	Private vehicle emphasis	Shared vehicle emphasis	Public transit emphasis	Transit-oriented development emphasis

■ Private vehicle   ■ Public transit   ■ Auto rickshaw   ■ Shared vehicle   ■ Non-motorized transport

Figure 5: Mode split of private vehicle, shared vehicle (4-wheel), public transit, non-motorized transport, and auto rickshaw

Figure 6: City-level results of relative investment requirements indexed to the baseline scenario (indexed to 100%)

Legend: Lane km of road, Public transit vehicles, Parking spaces, Automobiles

Categories: Baseline, Private vehicle, Shared vehicle, Public transit, Transit-oriented developement

X-axis: 0%, 50%, 100%, 150%, 200%, 250%

New jobs

The growing shared mobility ecosystem has the potential to create new jobs as the mobility system shifts from product-centric to service-centric[41]. A shared mobility future will require infrastructure, technological, and operational developments, which will drive employment in these sectors.

These new mobility business models emphasize the number of vehicle kilometers driven rather than the volume of vehicles sold[42]. Although higher asset utilization may lead to fewer vehicles on the road, high-mileage service vehicles, even with advanced technologies, will incur wear and tear at higher rates, leading to faster turnover. According to the analysis, the majority of this growth will be in China and India.

Given the nascent but fast-growing shared mobility market, manufacturers are shifting to designing and manufacturing purpose-designed shared vehicles, developing new service-centric business models as providers of vehicles for rent, and developing online platforms for shared mobility. These new mobility business models emphasize the number of vehicle kilometers driven rather than the volumes of vehicles sold[43].

The goal behind shared mobility is to provide on-demand mobility tailored to the needs of the user—depending on what they want, when they want it, and where they want it. Since individuals would no longer rely on driving themselves to their destinations, this has the potential to create a large workforce of vehicle owners and drivers. The supply model should allow service providers to easily select in and out of a supply pool to respond to dynamic demand conditions. The flexible labor supply model has the potential to increase self-

employment[44]. Shared mobility models provide flexibility in terms of work hours and hence can also serve to supplement income for drivers.

As shared mobility continues to grow, reductions in congestion could lead to increased earning potential for drivers. Increased geographic coverage of affordable transportation can support an increase in opportunity for employment for citizens who previously lacked access of and/or choice of modes of transportation. For example, Koala Kabs is a premium taxi service offered by women drivers for women, children and senior citizens in Delhi NCR.

Reduction in fuel consumption and tailpipe emissions

Internal combustion engine (ICE) vehicle fuel economies are increasing, driven in part by national standards, technological improvements in drivetrain technology, and consumer behavior. In a shared mobility paradigm with fewer vehicle kilometers traveled, a significant reduction in fuel consumption relative to business as usual can be achieved, with implications on fuel imports and national energy security.

As fossil-based fuel consumption is reduced relative to business as usual in a shared mobility paradigm, tailpipe-based GHG emissions and other harmful pollutants such as sulfur dioxide and nitrogen oxide will also directly decrease.

Although critics suggest that the availability and accessibility of convenient transportation may increase total trips or travel demand, this can be offset by higher vehicle occupancies and a shift to mass transit.

A quantitative analysis of the environmental impact of sharing

To better quantify the economic and environmental impacts of shared mobility in India, Rocky Mountain Institute has developed a national-level quantitative analysis tool. The model investigates the effect of vehicle electrification and vehicle sharing on total number of vehicle kilometers travelled nationwide and its environmental impact. The tool considers several enablers for shared mobility, including supportive policy outlook towards shared mobility, transit-oriented development as well as penetration of non-motorized transport options. The reported results are for three scenarios are on the following page.

Scenario	Description
Business-as-Usual	Market outlook based on current policy and historical trends
Shared electric mobility future	A supportive policy environment encouraging shared mobility, vehicle electrification, and transit-oriented development
Shared mobility future with high renewable energy penetration	A supportive policy environment encouraging shared mobility, vehicle electrification and transit-oriented development, accompanied with high share of renewable energy penetration

Preliminary results show that by reducing transportation demand through transit-oriented development and improving asset utilization with high adoption of ridesharing and public transit, India can reduce annual mobility demand by nearly 1800 billion vehicle km in 2035. Figure 7 shows total vehicle kilometers travelled to meet motorized transportation demand in BAU and shared mobility futures.

EFFECT OF SHARING ON VEHICLE KILOMETERS TRAVELED IN INDIA

Figure 7: Total vehicle kilometers travelled to meet motorized transportation demand in BAU and shared mobility futures
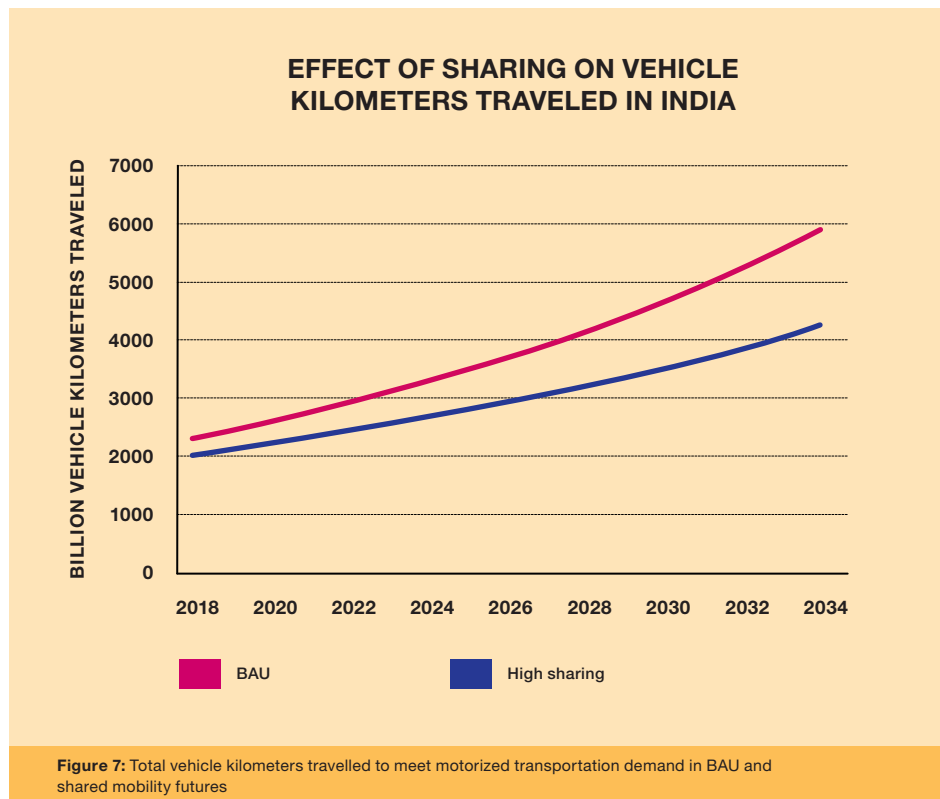
Reduced vehicle kilometers travelled, combined with electrification of fleet, translates to a reduction in CO_2 emissions. India can cumulatively save up to 1.5 gigatonnes of CO_2 through 2035 if sharing and vehicle electrification is promoted. An additional 100 megatons of CO_2 can be saved if India meets its stated NDC targets by sourcing electricity generation from renewable sources. Figure 8 shows CO_2 emissions in BAU, shared mobility future, and shared mobility future with high renewably sourced energy generation.

CO$_2$ EMISSIONS

Figure 8: CO_2 emissions in BAU, shared mobility future, and shared mobility future with high renewably sourced energy generation
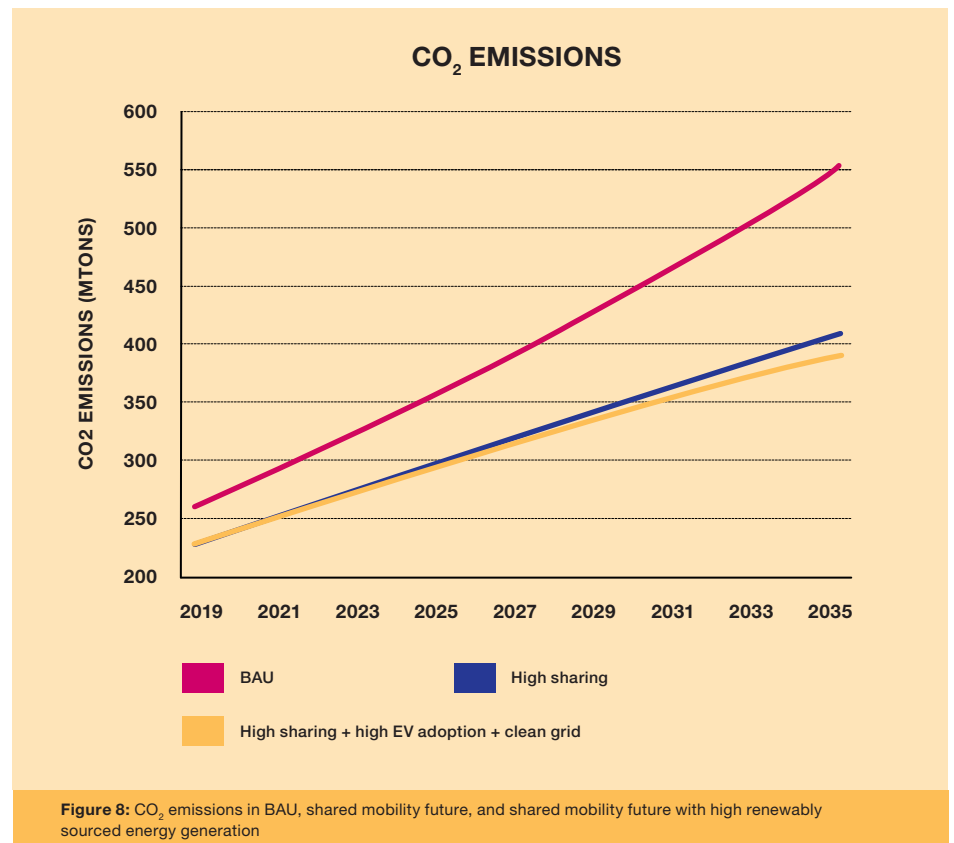
Vehicle electrification for high-mileage vehicles
Electric vehicles typically have higher upfront costs but lower operating costs than internal combustion engine vehicles, due to the relatively lower cost of electricity compared with gasoline. The time it takes to make up for the higher upfront cost with the operating cost savings depends on how frequently the vehicle is used. In the case of privately owned vehicles, which typically sit unused for 95% of their lives, the length of the payback period may not make electric vehicles an attractive option for many consumers. However, in the case of service vehicles, this payback period shrinks considerably as a result of the massive increase in vehicle use. Due to lower operating costs, the total cost of ownership for high-mileage vehicles is already lower for EVs than for ICEs, and this difference will only increase over time. Figure 9 illustrates this trend in India.

TOTAL COST OF OWNERSHIP

Figure 9: Total cost of ownership in INR for shared, high-mileage vehicles in India
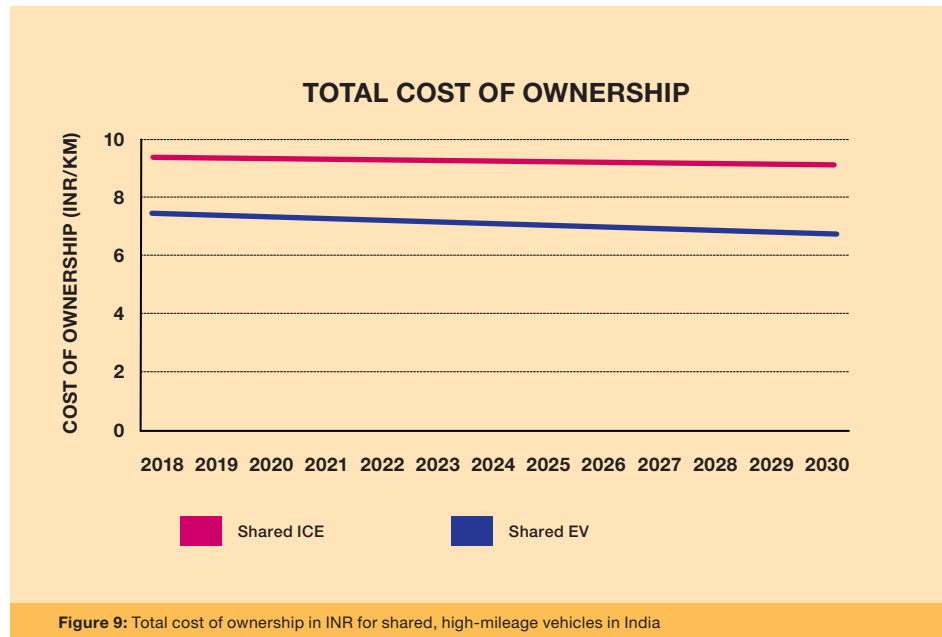
A whole systems approach can help realize the benefits of shared mobility. Integration of various modes of transit as well as seamless multimodal transit are keys to convenient and affordable transportation.

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Case studies

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There are many examples of shared mobility solutions, the most notable being Uber and Ola, with operations in over 300 cities[45] and 110 cities[46] around the world, respectively. There are also over one million bike-share bicycles globally[47]. However, solution providers are only one piece of the puzzle in creating a functional ecosystem that provides efficient, convenient, and affordable mobility[48]. Cities are becoming the focal points for the deployment of shared mobility solutions, though they are still in the nascent stages of testing and adapting shared mobility solutions to local conditions, integrating solutions to function together, and deploying the integrated solutions at larger scales.

Shared mobility will take different forms in every city given the different mobility needs and local conditions present. Global experiences can raise many important questions and help identify key considerations for scaling.

3.1. Helsinki, Finland: A leading example of shared mobility deployment

Helsinki, Finland is one example at the forefront of the shift to shared mobility. Helsinki has set an ambitious target of making private vehicles obsolete by 2025 by shifting to shared mobility, integrating all shared and public transport into a single linked network with easy payment using digital platforms. A recent study[49] by the International Transport Forum found that shifting to shared mobility in Helsinki could reduce CO_2 emissions by 34% and congestion by 37%, and increase rail/metro ridership between 15% and 23% as a result of better first- and last-mile connectivity.

3.2. One stop routing, booking, and payment for multimodal transit: How Whim is helping create seamless, multimodal transit in Helsinki

To increase the convenience of shared mobility for users, online applications are being developed and deployed that provide one stop support for routing, booking, and payment across multiple modes of transportation in a city. One such example is Whim, an app developed by MaaS Global that is currently being deployed in Helsinki.

Whim offers users access to several modes, including bikes, taxis, car rentals, and public transit. Based on user preferences and trip details, the app provides routing by mode so that users can visualize transit options and compare cost and time estimates side-by-side. Users have the option to pay as they go, or subscribe to packages offering different levels of service billed monthly. Applications like Whim can also benefit service providers as they receive access to a larger pool of customers.

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Understanding the supportive environment and challenges for shared mobility in India

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4.1 Opportunities for shared mobility in India

India is uniquely positioned to leapfrog personal vehicle ownership, and is expected to be a leader in shared mobility with shared miles expected to reach 35% of all the miles travelled by 2030 and 50% by 2040[50]. This shift from ownership to usership is supported by a number of factors as discussed below.

Low per capita vehicle ownership and a high share of public transit

Personal vehicle ownership in India is very low. Per 1000 people, personal car ownership is as low as 32 as compared to 797 in the USA[51]. Around 60% of the mobility demand in India is served by public transportation modes like buses and metros and non-motorized transport modes (walking and cycling)[52]. The high mode share in favour of existing forms of shared transport, including buses and intermediate paratransit modes like shared autorickshaws, can support the transition to shared mobility solutions.

Supportive framework for shared mobility

India is starting to put in place supportive policies for shared mobility and digitization, and several states have developed policies to regulate the shared mobility ecosystem. In December 2016, the Ministry of Road Transport and Highways published taxi policy guidelines (MoRTH guidelines)[53]. The report highlights the need to liberalize the existing taxi permit systems, recognizes various forms of sharing of private and commercial vehicles, and promotes

sharing of buses, motorcycles among other recommendations. Taking a cue from the MoRTH guidelines, several state governments such as Rajasthan and Tamil Nadu have started recognising the various shared mobility models and the need for regulatory ecosystem to support them. Several other key government policies such as the National Urban Transport Policy (2014) promote the concept of shared mobility given its vision to move people and not vehicles. National Data Sharing and Accessibility Policy promotes a technology-based culture of data management and data sharing and access[54]. These and similar other policies provide the necessary ecosystem for introducing and promoting shared mobility.

The proposed Motor Vehicles Amendment Bill 2017 also focuses on better utilization of transportation assets, increasing the accessibility and mobility of people, improving urban transport, and reducing traffic congestion at the state level.

Young population and growing entrepreneurial culture
More than 50% of the population in India is below the age of 25 and more than 65% is below the age of 35. A young population may be more inclined to adopt new and innovative ideas[55]. India's emerging entrepreneurial culture further supports the development of innovative shared mobility solutions.

Growing smartphone penetration and internet connectivity
India is recognized as a world leader in technological development and innovation and has a high penetration of data-supported technologies. Smartphone penetration in India is expected to grow to 530 million active users while the number of internet users is expected to reach 450–465 million by 2019[56]. High penetration of smartphones and better internet connectivity boosts the adoption of shared mobility solutions and services.

4.2 The current challenges for shared mobility in India

Mobility demand in India is growing with increasing GDP, rapid urbanization, and urban sprawl. India is expected to have nearly 14 times growth in passenger kilometer travelled (PKT) from 1400 billion passenger kilometer (BPKM) to 18,750 BPKM between now and 2030[57]. While India is expected to be a world leader in shared mobility, there are several barriers that need to be overcome to promote solutions and services. The barriers to increasing shared mobility in India can be grouped into four main categories: infrastructure and services, policy and regulatory, behavioral, and data.

Infrastructure and services
Several Indian cities lack adequate mass transit infrastructure and services, which limits adoption of these modes[58]. Additionally, cities lack infrastructure for non-motorized transport, which may limit adoption of bike/cycle sharing

schemes[59]. Lack of other infrastructure like vehicle pick-up and drop-off points, auto-rickshaw stands, parking spaces, etc. could also be a bottleneck to proliferation of new shared mobility solutions.

Policy and regulatory
The Motor Vehicles Act of 1988 is the principal act that governs and regulates the road transport ecosystem, including permits, registration, and insurance[60]. Given the emergence of business models, regulatory barriers may need to be addressed to support and promote new and shared mobility solutions.

Behavioral
Owning a private vehicle is aspirational and a symbol of status[61]. Lack of awareness about the societal and environmental costs of private vehicle use could be a barrier to adoption of shared forms of mobility.

Data
Inconsistencies exist in data standards and guidelines for best practices between public and private transportation providers, which can be a barrier for promoting shared mobility. Also, there are limitations with regard to collection and processing of mobility data.

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Suggestions to help achieve a sustainable and equitable shared mobility future

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The future of mobility will be increasingly interconnected, rely on shared assets, and be supplied by clean sources of energy.

The portfolio of suggestions below has been developed to support this vision. These suggestions and next steps are designed to be inclusive of all modes and stakeholders while also being technology agnostic and allowing for flexibility in implementation. Suggestions for encouraging shared mobility:

1. Promote mass transit
Special attention should be given to improving access to efficient public transit in India to ensure that all citizens have reliable and affordable transportation. As public transit operates on fixed routes and schedules, improving first- and last-mile connectivity will be paramount in maintaining, or improving India's existing mode share of public transit[62]. Improving public transit efficiency and convenience with route rationalization and better vehicles will also support public transit.

2. Promote high share of non-motorized transport modes
Non-motorized transport modes, such as walking and cycling, not only promote health, but are also affordable, clean, and efficient. Cities should support these active modes by developing safe, non-motorized transport environments, promoting cycle sharing schemes and improving their connectivity to motorized forms of shared mobility. Cities can continue to incorporate planning guidelines published by the Sustainable Urban Transport

Project of the Ministry of Housing and Urban Affairs[63], and other national and international expert agencies for promoting use of non-motorized modes[64,65].

3. Build the infrastructure needed to support emerging shared mobility solutions

As cities shift away from private vehicles, less area will be required for parking lots and roadways. To support the smooth flow of people and goods in a shared mobility paradigm, cities will need to update and create new infrastructure, including walking and cycle friendly streets, parking lots, pickup and dropoff for shared mobility vehicles, and multimodal hubs.

Cities should initiate investment in shared mobility infrastructure to prevent bottlenecks in the adoption of shared mobility services.

4. Promote high occupancy vehicles

For promoting high occupancy vehicles, contract carriage permit systems may need to be reviewed in order to allow more flexibility to state governments to support different types of shared mobility models. Some of the recent examples like Tamil Nadu Motor Vehicle Rules recognizing the usage of auto-rickshaws with contract carriage permits for shared mobility are regulatory initiatives that could encourage shared mobility models. There is also a need to increase awareness regarding the existing regulatory provisions that could support some of the shared mobility models. For example, to promote motorcycle-based shared models, there is a need to increase awareness of the ability of Transport Departments to issue contract carriage permits for motorcycles.

5. Facilitate the integration of different modes

Shared modes of transportation should complement each other to provide a comprehensive system where users can take multiple modes in an efficient manner, meeting their transportation expectations and needs. Linking different modes, can lead to seamless multimodal transit where users have a choice to take their preferred modes. This can be enabled by data sharing.

6. Enhance data availability and sharing

Data can be a key enabler in a shift to shared mobility and multimodal integration. For example, sharing transit data being collected by cities and solution providers can expand transportation markets, link users with solution providers, help city planners, and enable multimodal transportation. A clear policy for collecting, standardizing, aggregating, and sharing transit data can increase the interoperability of data.

7. Promote micro-entrepreneurship

Measures should be considered to promote individual entrepreneurs to enter the shared mobility market. As recommended by MoRTH[66], this could be by way of review and rationalisation of permit systems and fees.

8. Ensure wider geographic coverage

Shared mobility services should have wider geographic coverage to ensure that they are accessible and provide the much-needed first- and last-mile solutions. In areas which are underserved, this could be done by introducing fiscal and non-fiscal measures that enhance demand and supply creation.

9. Develop a mobility digital infrastructure

Similar to other 'public digital infrastructure', the government could consider developing a 'common mobility digital infrastructure' that might help solve some of the key challenges associated with data sharing. This infrastructure could provide a platform to connect various forms of mobility to provide seamless multimodal transport across services. It could enable innovation and allow development of new mobility service offerings.

10. Consider fiscal and non-fiscal measures to support the adoption of shared mobility

Incentives may help shift users from private vehicle use. To encourage the use of shared modes, cities should test incentives that support adoption of shared services and promote higher occupancy of vehicles.

11. Create a framework to ensure safety and security of shared mobility services

Initiatives to promote shared mobility must consider the safety of drivers, riders, and pedestrians. Regulations should be developed to ensure the safety of drivers and passengers as well as the quality vehicles.

12. Measure state performance in transport reforms

To further the uptake of shared mobility, KPIs could be developed to measure the impact of actions taken by states and districts to promote innovative mobility solutions.

06.

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Conclusion

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An efficient and comprehensive transportation system is essential to supporting a well-functioning and prosperous community. Transitioning to a shared mobility future will allow India to build a transportation system that is more efficient, cleaner, and meets the needs of its growing population.

In order to achieve this goal, the private and public sector must work together to develop policies and business models that support shared mobility. The guidelines presented in section 5 may serve as a framework for initiating next steps to achieve this goal.

The government can take the lead in catalyzing a shared mobility future through supportive policies. Doing so will enable accessible, equitable, efficient, and safe transportation options. These policies should be developed with future demand growth in mind, and appropriate milestone goals should be set to ensure that progress is being made.

In working towards the goal of shared mobility, India will set itself up for clean, liveable cities and set an example for other nations of how to sustainably meet the transportation needs of a growing global population.

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