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The Role of Transportation in the Future of Urban Developing Asia: A Case Study of India

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EXECUTIVE SUMMARY

This paper examines the role of dominant transportation technologies in managing the mobility needs of differently sized cities in India and draws implications that are similar for other countries in developing Asia.

Main Argument

By 2050, continued urbanization will add 2.5 billion people to today's worldwide urban population, with nearly 90% of the growth concentrated in Asia and Africa. India, China, and Nigeria together will account for nearly 37% of the estimated increase of the total urban population. In order to ensure that the benefits of urbanization are equitably distributed, strong policy instruments are required. Emerging economies where much of the infrastructure is yet to be built offer a unique opportunity for low-carbon development. This is especially true in the case of the transportation sector. Designing cities for public transportation, walking, and cycling can offer affordable ways to meet mobility demands and cut global pollutants. Choosing an appropriate transportation technology can significantly affect the spatial structures of cities and ensure a more sustainable form of development. While large and medium cities can be designed for public transportation, smaller cities can be designed for active modes—cycling and walking. Using the case study of Bangalore, we demonstrate that opting for a balanced modal share (as opposed to the private automobile as the dominant mode) can reduce vehicle-kilometers traveled by 71 million and transportation sector carbon dioxide emissions by 5.3 million tons.

Policy Implications

- *One size does not fit all*. Small cities less than 50 square kilometers in area do not require heavy public transportation investments; investments in active modes would be more appropriate. By contrast, medium and larger cities require investments in public transportation and should consider concentrating development along transit corridors.
- *Transit-oriented development*. A key advantage of public transportation systems is that they can support higher densities through more efficient movement of passengers. In order to promote transit-oriented development in India, it is essential that the performance of public utilities, which are the major providers of the country's urban infrastructure, be improved and linked to land-management strategies.
- *Investment in public transportation and active modes*. City governments in India can now set aside funds for non-motorized transportation as part of their roads budgets. Some cities, such as Chennai, have constituted laws that require a portion of the roads budget to include non-motorized transportation, and such programs need to be scaled up across the country.
- *Improvements to fuel efficiency*. With two sets of emission standards—one for large cities and another for the rest of the country—purchase of vehicles (especially heavy commercial vehicles) now occurs mostly outside the large cities. Harmonizing emission standards, along with making fuel quality uniform across the country, is critical to mitigate air pollution and improve public health.

By 2050, continued urbanization will add 2.5 billion people to today's worldwide urban population, with nearly 90% of the growth concentrated in Asia and Africa. India, China, and Nigeria together will account for nearly 37% of the estimated increase of the total urban population.[1] The world's fastest-growing cities are in Asia and Africa, and the fastest-growing agglomerations in 2014 are cities with less than 1 million people. Typically, providing basic services, including public transportation, water and sanitation, and electricity, to more densely populated areas is cheaper than to rural populations. In order for governments to ensure more equitable distribution of the benefits of urbanization, it is critical that strong policies are implemented.

Emerging economies where significant infrastructure outlays are required to meet growing demand offer opportunities for low-carbon development. The transportation sector especially offers unique opportunities in this respect. Typically, large infrastructure projects lock in cities for 40–100 years. Designing cities for public transportation, walking, and cycling can offer more affordable ways to cut pollution and curb climate change.

Globally, transportation energy and carbon dioxide emissions have increased by 2% per year since 2000, and according to the International Energy Agency (IEA), this sector is not on target to meet the 2 degrees Celsius scenario.[2] The transportation sector clearly needs strong policy instruments in order to achieve this goal.

Treating India as a case study, this paper presents a more nuanced approach for managing the country's mobility needs for 2050. In many ways, India's urbanization trends mirror developing Asia's; the number of people living in small and medium cities is much larger than those living in megacities in both India and developing Asia more broadly. In this paper, we argue that a "one size fits all" approach would not be ideal and urban transportation policies need to be structured by considering the ideal transportation technology for different city sizes. Following this argument, we model India's future mobility needs and identify a way forward for low-carbon transportation planning. Finally, using the case study of Bangalore, we show the impact of

[1] UN Department of Economic and Social Affairs, *World Urbanization Prospects: The 2014 Revision. Highlights* (New York: United Nations, 2014).

[2] International Energy Agency (IEA), *Energy Technology Perspectives 2015* (Paris: IEA, 2015).

implementing the paper's recommendations. While this research focuses on India, we believe that the implications are similar for other countries in developing Asia.

India: Current Challenges and Potential Promise

In India, the transportation sector accounts for 15% of all greenhouse gas emissions. While per capita transport emissions in India are still lower than the global average, rising mobility and motorization rates mean that this number is bound to increase. This trend is especially a concern because fossil fuels account for nearly 98% of all energy demand for transportation. An added consequence of fossil fuel dependence is the impact on air quality in Indian cities; six of the ten most polluted cities in the world are in India.[3]

India's National Action Plan for Climate Change recognizes this problem and has identified eight missions "that promote our development objectives while also yielding co-benefits for addressing climate change effectively."[4] The National Mission on Sustainable Habitat, which is one of the country's eight core missions, has been set up to promote energy efficiency measures in urban planning. The mission calls for incentives for use of public transportation, as well as strengthening fuel economy standards and pricing measures to encourage the purchase of more efficient vehicles as ways to yield climate benefits. Recently, India's Intended Nationally Determined Contributions identified sustainable and green transportation as a key measure to mitigate greenhouse gas emissions.[5] The Indian government is also promoting several measures to meet passenger and freight transportation demand while delivering climate and environmental benefits.

A recent report by the UN Environment Programme on promoting low-carbon transportation in India recommended a range of new policies, including improving the penetration of alternative fuels and vehicles, promoting public and non-motorized transportation, and supporting urban

[3] World Health Organization (WHO), WHO Global Ambient Air Pollution Database, 2016, available at http://www.who.int/phe/health_topics/outdoorair/databases/cities/en.

[4] Government of India, *National Action Plan on Climate Change* (New Delhi, 2008), http://www.nicra-icar.in/nicrarevised/images/Mission%20Documents/National-Action-Plan-on-Climate-Change.pdf.

[5] "India's Intended Nationally Determined Contribution: Working towards Climate Justice," UN Framework Convention on Climate Change, 2015, http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf.

planning measures such as transit-oriented development, among others.[6] Yet while this report models future scenarios for low-carbon transportation in India and identifies policy recommendations, it does not offer detailed guidance on the implementation of these policies. Similarly, the IEA has developed the 2 degrees Celsius scenario, which identifies that 874 billion passenger-kilometers (km) must be avoided by 2050 in order for India to meet this target.[7] This is in addition to reducing energy demand through the use of efficient vehicles, building capacity to handle energy diversification, and implementing quality specifications to improve the carbon intensity of fuels.

These studies clearly point to two major areas of action: (1) promote the use of low-energy intensive modes such as public transport and (2) improve automobile fuel efficiency. These action areas are consistent with national policy dialogues. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM), a city modernization scheme initiated by the Indian government in 2005, provided funding to cities to procure buses and operate city bus service. Currently, over 60 cities offer organized city bus services, up from 20 in 2006. Despite this program's success, the share of public transportation vehicles registered has decreased to 1.1% of all registered vehicles, down from 11.1% in 1951.[8] One of the reasons for this decline could be that few state public transportation undertakings are making operational profits, which limits their ability to increase fleet size. A more nuanced approach to promoting sustainable transportation options is required, and one answer could involve the way national schemes and programs target cities.

One Size Does Not Fit All

Different city sizes require different transportation systems to function optimally. Transportation emissions are clearly a function of vehicle-km, and managing vehicle-km can reduce both global pollutants and air pollution, which adversely affect health. In small cities where trip lengths are shorter, active modes such as walking and cycling might be more viable.

[6] Subash Dhar, Minal Pathak, and P.R. Shukla, *Transport Scenarios for India: Harmonising Development and Climate Benefits* (Nairobi: UN Environment Programme, 2015).

[7] IEA, *Energy Technology Perspectives 2015.* A passenger-km is the total distance traveled per passenger. For example, if two passengers travel 1 km in a vehicle, the total vehicle-km is 1 km and the passenger-km is 2 km.

[8] National Transport Development Policy Committee (India), *India Transport Report: Moving India to 2032* (New Delhi: Routledge, 2014).

Alternatively, in large cities where travel distances are longer, the number of passenger-km traveled per vehicle-km could be increased by opting for more intensive modes such as mass transit. The choice of dominant transportation technology thus can play a key role in managing demand more efficiently.

Drawing on an analysis by Zahavi and Ryan that examined the relationship between the trade-offs in travel times and travel costs for developing new systems,[9] we propose that planning for future Indian cities can be optimized based on expected size and density. This approach finds that cities fall into one of three types when considering optimal transportation systems:

1. *Active mode city*. Population density is higher than average; city size is typically less than 50 km^2; modal distribution of trips is balanced, with a predominance of active modes of transportation such as walking and cycling; and average trip length is shorter (2–5 km).
2. *Transit city*. Population density is moderate; city size is between 50 and 150 km^2; modal distribution of trips is balanced, with development concentrated along transit corridors and frequent pedestrian pockets around transit stations; and the average trip is medium in length (5–10 km).
3. *Balanced city*. Population density is high; city size is upward of 150 km^2; modal distribution of trips is balanced, with a predominance of transit modes; and average trip length is longer (greater than 10 km).

Cities with an area under 50 km^2 will make up the largest number of Indian cities in 2050. These cities do not require heavy public transportation funding; instead, investments in active modes would be more appropriate. Medium and larger cities, by contrast, require investments in public transportation. These cities also need to consider concentrating development along transit corridors.

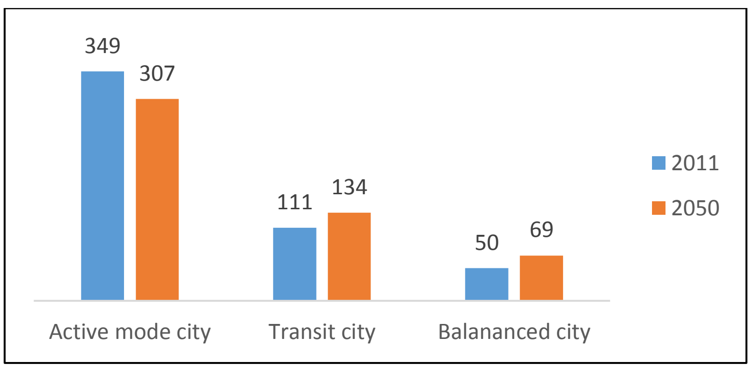
[9] According to Zahavi and Ryan, who studied a sample of world cities, the average time spent in transportation and the travel budget were constants. This means that with an increase in travel speed and reduced costs, urban dwellers travel further and cover greater distances. For example, a bicycle with an average speed of 15 km per hour would permit a range of 175 km^2 (a circle with a 7.5 km radius), while a car with an average speed of 40 km per hour would permit a range of 1,250 km^2. See Y. Zahavi and J. Ryan, "Stability of Travel Components over Time," *Transportation Research Record*, 1980.

The Evolution of Indian Cities: From Now to 2050[10]

According to the 2011 census, there are 510 cities in India with a population greater than 100,000 persons. The area of these cities varies from 1.3 km^2 to 751 km^2, accounting for a total of 224.7 million persons. Of these cities, 349 have an area less than 50 km^2 (small), 111 have an area between 50 and 150 km^2 (medium), and the rest have an area larger than 150 km^2 (large). **Figure 1** charts these cities based on the three city types outlined above—active mode (small), transit (medium), and balanced (large)—and includes a comparison of growth projections through 2050.

Even in 2050, small cities will still outnumber medium and large cities, and policymakers need to be cognizant of this fact and tailor policies for cities of varying scales. In this research, we use a simplified "what if" framework to evaluate the impacts of developing Indian cities along these three types. This research is developed on the premise that vehicle-km are the main reason for transportation sector emissions, and reductions in vehicle-km will automatically reduce emissions from this sector.

Figure 1 *Number of Cities in India by Classification (2011 and 2050)*



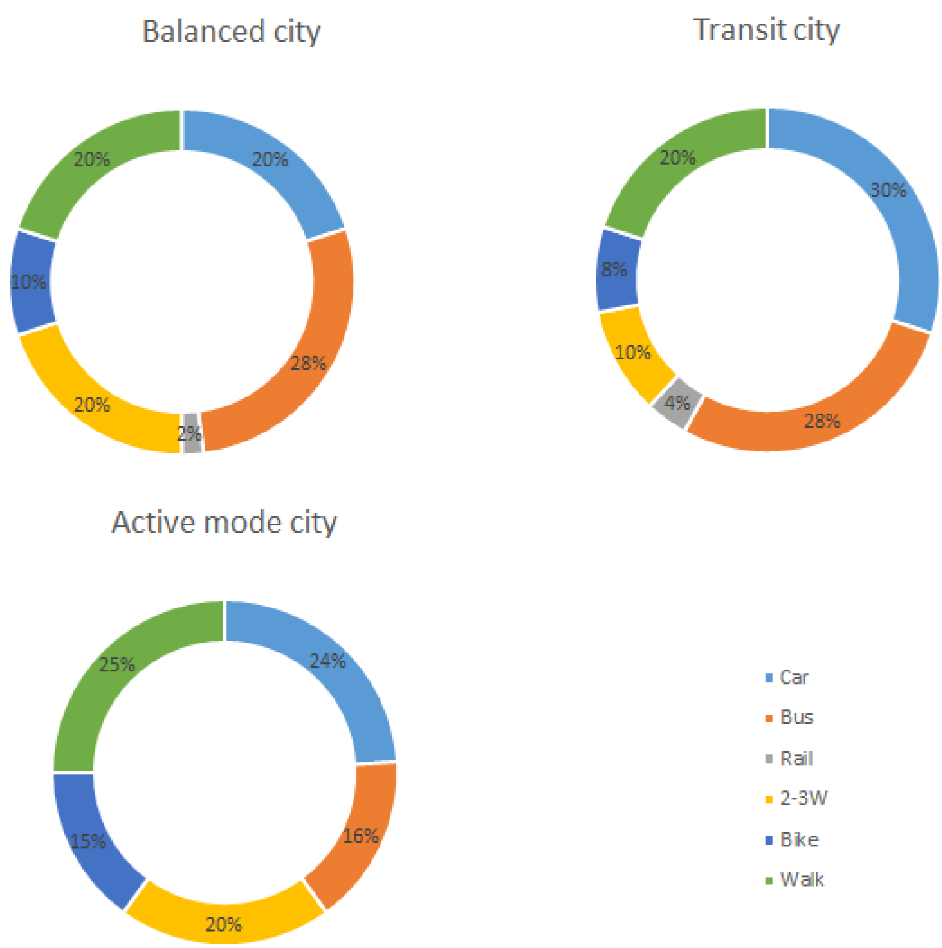
Source: Census 2011 and authors' projections.

Typically, small and medium cities in India have predominant mode shares of walking and cycling (greater than 30%), whereas larger cities have mode shares of public transportation (which

[10] According to the 2011 census, more than 60% of India's urban population lives in small cities and towns (populations of less than 500,000 people). The share of public transportation in these cities is much lower than that of larger cities (0%–15.6% in cities with populations less than 500,000 compared with 35.2%–54.0% in cities with populations more than 8,000,000). These small cities have not received the required support from either national or state governments. According to the United Nations, even by 2030 cities with less than 500,000 people will account for 42% of the total urban population. Clearly, the mobility of these urban dwellers needs to be thought through.

includes bus and rail) in excess of 35%.[11] **Figure 2** shows the modes shares for the three city classifications in 2050.

Figure 2 *Projected Distribution of Mode Shares by City Classification in 2050.*



Source: Authors' estimates.

In order to estimate the total vehicle-km traveled, we have modeled the trip lengths of various modes in each city above a population of 100,000 persons for 2050. **Table 1** presents the minimum and maximum trip lengths of various modes in each city classification.

[11] National Transport Development Policy Committee (India), *India Transport Report*.

Table 1 *Trip Lengths for Various Modes by City Classification (in km)*

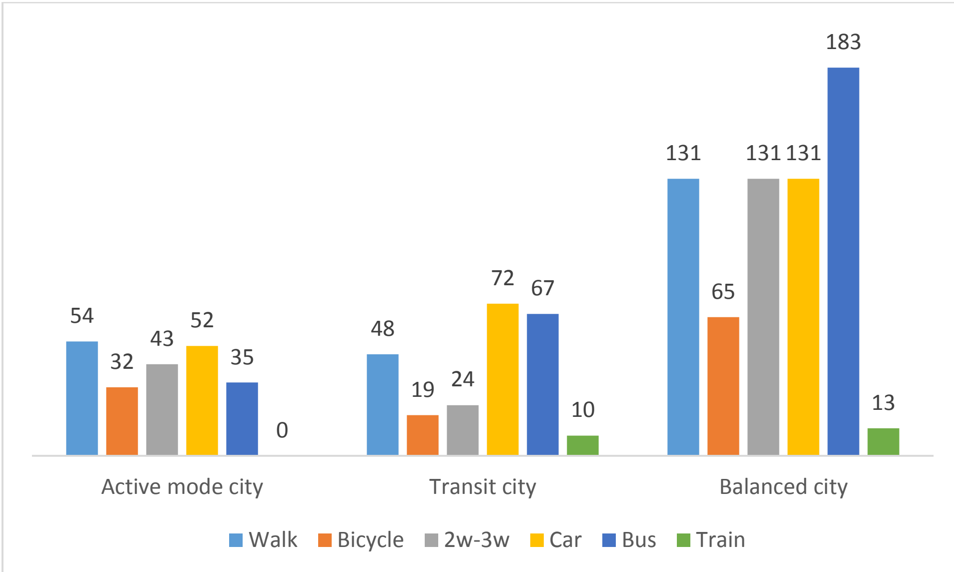
Mode	Trip lengths (km)					
	Active mode city		Transit city		Balanced city	
	Min	Max	Min	Max	Min	Max
Walk	0.15	0.27	0.28	0.48	0.48	1.56
Bicycle	0.57	1.06	1.06	1.83	1.83	5.98
Car	1.13	2.10	2.10	3.63	3.64	11.88
2w-3w[12]	1.14	2.12	2.12	3.67	3.68	12.00
Bus	2.15	3.99	3.99	6.91	6.92	22.59
Train	-	-	6.54	11.31	11.33	36.98

Source: Authors' estimates.

Based on the modeled trip lengths and mode shares, we have estimated the total passenger-km that will be traveled in 2050 (see **Figure 3**). Active modes—cycling and walking—will together account for the largest share of total passenger-km (31%) in these cities, followed by buses and cars, respectively. In total, bus transportation will account for 284 million passenger-km, which translates to roughly 56 million bus-km (requiring approximately 247,000 buses). In 2011, state transportation undertakings operated 130,000 buses, which included intercity travel (the larger share of the fleet). Significant investments in procuring and operating buses are thus required in order to meet the projected bus-km target by 2050.

[12] Two-wheeled and three-wheeled vehicles

Figure 3 *Passenger-km Traveled (in Millions) by City Classification and Travel Modes in 2050*



Source: Authors' estimates.

These 510 cities currently have a total of 386,214 km of urban roads, and by 2050 these cities will need a 547,761 km road network.[13] Research suggests that increasing the mode shares of active modes requires both social and spatial (i.e., infrastructure) interventions.[14] National policies thus need to invest significantly in urban roads and provide efficient pedestrian and cycling pathways in order to achieve the estimated target of 384 million passenger-km.

Further Improvements in Fuel Efficiency

India has achieved significant reductions in particulate matter (PM) emissions through its Auto Fuel Policy. Despite this, there are gaps between Indian standards and international standards, and there are opportunities for further improvements. Currently, with India's two sets of standards—one for large cities and another for the rest of the country—vehicle purchases (especially heavy commercial vehicles) are occurring mostly outside large cities because these drivers can still operate within major cities. Harmonizing automobile emission standards is critical

[13] If road density (km of roads per km^2 of area) is assumed to be a constant, the 510 cities are expected to require a road network length of 547,761 km by 2050.

[14] Tim Schwanen and Patricia L. Mokhtarian, "What Affects Commute Mode Choice: Neighborhood Physical Structure or Preferences toward Neighborhoods?" *Journal of Transport Geography* 13, no. 1 (2005): 83–99.

to achieve further emission reductions. In addition, fuel quality needs to be uniform across the country to ensure that vehicles fueling outside large cities are compliant with norms, which will help further improve air quality and public health. The promotion of alternative fuels, such as compressed natural gas, needs a holistic approach of working with industry to ensure a market transformation.

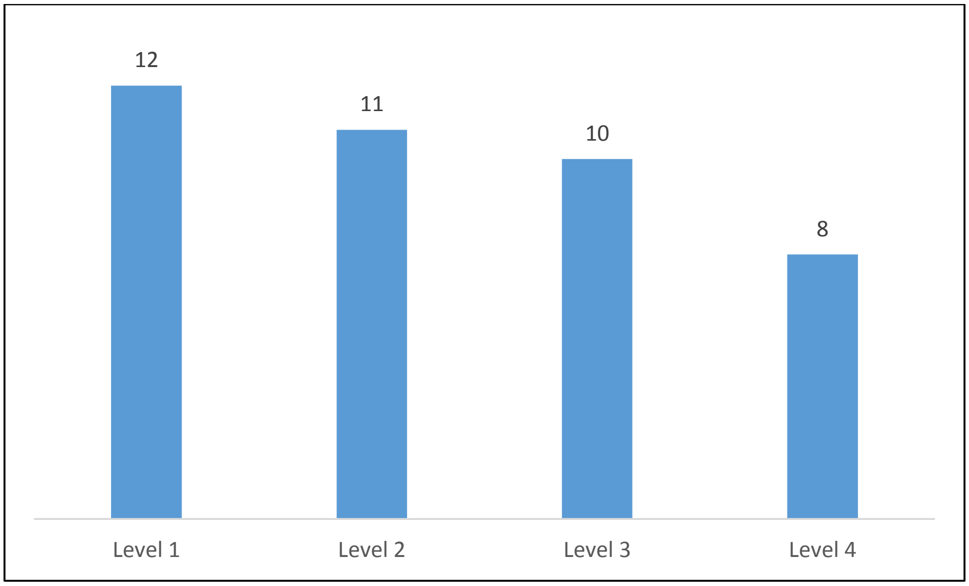
The Global Calculator—a tool funded by the United Kingdom's International Climate Fund and the European Union's Climate-KIC that provides a model of global energy, food, and land systems—considers four alternate scenarios for fuel efficiency improvements globally:[15]

- Level 1: 5.9 liters per 100 km (assumes less improvement in efficiency than has been achieved over the last decades)
- Level 2: 5.3 liters per 100 km (roughly corresponds to annual improvements achieved over the last decades)
- Level 3: 4.9 liters per 100 km (supersedes annual improvements achieved over the last decades)
- Level 4: 3.6 liters per 100 km (doubles the fuel efficiency in 2011 by 2050)

These levels are based on global trends; India currently does not have fuel efficiency standards. **Figure 4** shows the total fuel consumed by passenger cars. If fuel efficiency standards to achieve a Level 2 improvement were implemented in India, close to 1 million liters of fuel could be saved, while a Level 3 achievement could reduce fuel use by 2 million liters. These estimates assume that passenger cars in 2050 have the same occupancy as those in 2011. With increasing trends of car-sharing in cities, it is possible to even further reduce the fuel consumed by passenger cars.

[15] The Global Calculator is available at http://www.globalcalculator.org.

Figure 4 *Fuel Consumed by Passenger Cars in 2050 (in Millions of Liters)*



Source: Authors' estimates.

A Case Study for Development: Bangalore

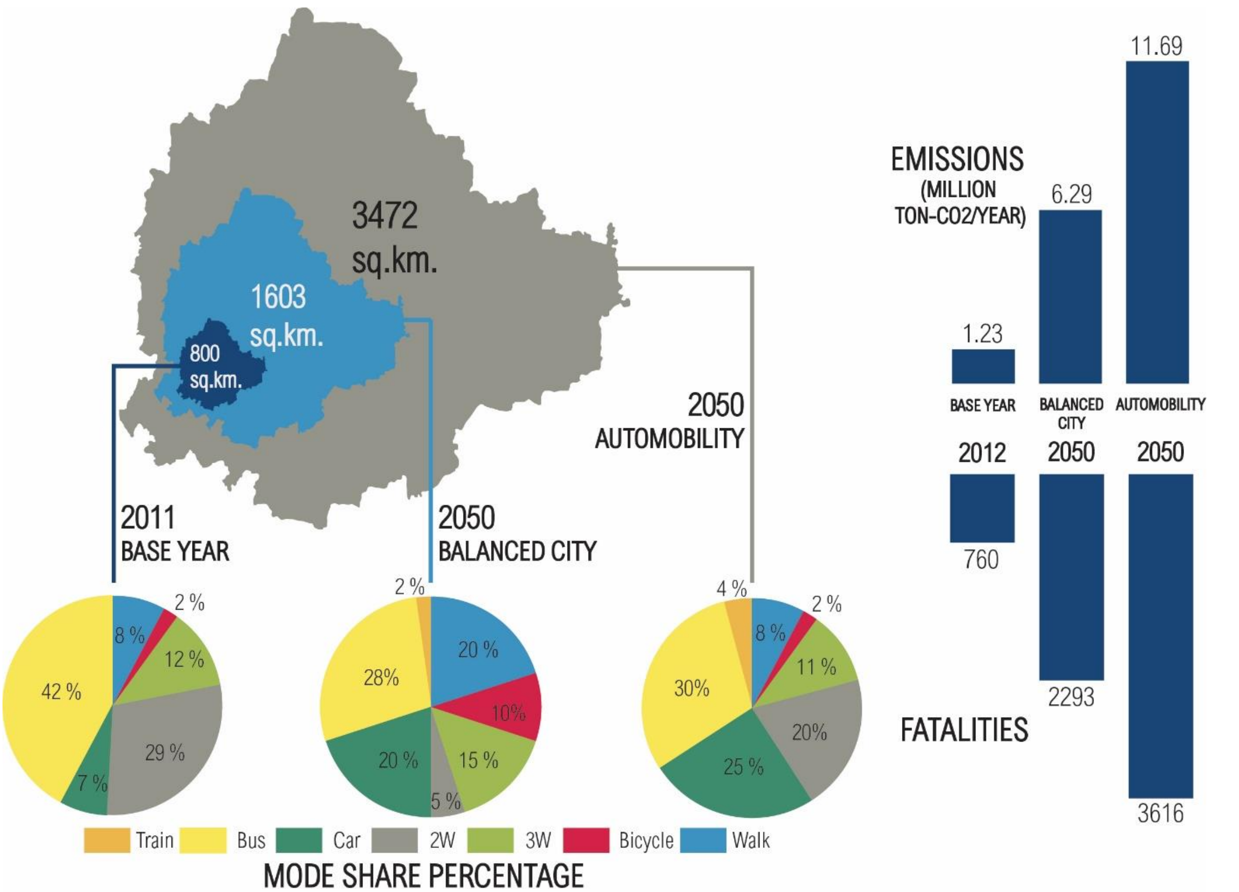
As the previous section highlights, the adoption and development of particular transportation modes can have a significant impact on both the overarching trajectory of a city's development and how it can think through strategies to address transportation-related pollution. In order to ensure that development supports sustainable economic and environmental security strategies, both national and subnational policies need to be tailored according to specific city scales. In this section, we present a case study of Bangalore and show the impact of developing a balanced city. These policies need to be adapted for other cities in India and could be deployed in other settings across developing Asia.

Transit-Oriented Development: A Case Study of Bangalore

Today, Bangalore is at an inflection point in the pursuit of its goals for sustainable development. The following discussion considers two scenarios: (1) an automobile scenario in which motorized vehicles, two-wheelers, and cars are the dominant transport technology, and (2) a balanced city scenario in which public transportation has the highest share, but there is a balanced distribution between all modes (see Figure 2) in order to show the impact of choosing a balanced mode share.

In the balanced city scenario, we anticipate that the gross density of Bangalore increases from 109 persons per hectare to 115 persons per hectare, compared with 53 persons per hectare in the automobile scenario.[16] In order to accommodate this population increase, the total land area required in 2050 is 1,603 km^2 (twice the land area in 2011). Compared with the automobile scenario, the balanced city scenario will reduce total vehicle-km traveled by 71 million, road fatalities by 1,322 incidents, and carbon dioxide emissions by 5.3 million tons (see **Figure 5**).

Figure 5 *Alternate Development Scenarios for Bangalore*



Source: Authors' estimates.

In order to achieve these impacts, it is critical that policymakers increase investments in rapid transportation and impose regulations on development that concentrate future employment

[16] While modeling densities for each of the 510 cities, the upper limit for gross density has been capped at 150 persons per hectare. Bangalore currently has a gross density of 109 persons per hectare, and based on the model we estimate that the city's gross density could increase up to 115 persons per hectare by 2050.

and residential opportunities around transit stations. In 2050, Bangalore will have 540 km of arterial and ring roads.[17] These roads are potential rapid transit corridors. In addition, by carefully regulating the floor space index and zoning policies, transit-oriented development can be implemented in Bangalore. A key challenge for providing higher-density development is the excessive demands on urban infrastructure. According to Alain Bertaud and Jan Brueckner, while low water pressure and high leakages might be acceptable in low-density developments, the same would create unacceptable living conditions in high-density developments.[18] The Bangalore Water Supply and Sewerage Board, the public supplier of water in Bangalore, reports that 49.5% of its water is supplied as nonrevenue water.[19] This high leakage, reduces the revenue collection of the public agency. Given that higher density would require significant investments in urban infrastructure, it is essential that the performance of public utilities is linked to land management strategies.

Lessons Learned: Increased Investment in Public Transportation and Support for Active Modes

The JNNURM was a key milestone in urban transportation planning. Yet while it was successful in increasing the number of cities that operate city bus services, the program was limited to only 67 cities. Cities with better technical capacities were able to leverage significant portions from the JNNURM, whereas small and medium cities, which did not have the capacity to implement the required reforms, were not as successful. One of the reforms required under the JNNURM was formulating a comprehensive mobility plan, which aims to put city agencies at the forefront of urban transportation planning. The results of plans prepared by cities were mixed. Although Pune, a city in Maharashtra, had a target of 50% for trips by non-motorized transportation and 40% for public transportation, budget allocations did not mirror these targets. The city allocated 61% of its budget to motor vehicle–related projects, while spending only 18% and 9% on public transportation and non-motorized transportation, respectively.

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[17] Arterial roads deliver traffic from collector roads (which move traffic from local streets) to freeways. Ring roads, also known as beltways or loops, are connected roads that encircle a city.

[18] Alain Bertaud and Jan K. Brueckner, "Analyzing Building-Height Restrictions: Predicted Impacts, Welfare Costs, and a Case Study of Bangalore, India," World Bank, Policy Research Working Paper, April 2004.

[19] Bangalore Water Supply and Sewerage Board (BWSSB), "About BWSSB," https://bwssb.gov.in/content/about-bwssb-2.

A number of lessons can be learned from the JNNURM. This is especially important since it is clear that cities require some sort of funding support from either the national government or the subnational governments in order to promote public transportation systems and infrastructure for active modes. These policies should target not just large cities but small and medium cities as well. For small and medium cities, infrastructure for cycling and walking needs to be funded, whereas for larger cities funding of public transportation infrastructure should be made a priority. A key advantage of public transportation systems is that they can support higher density through more efficient movement of passengers. Public utilities are the major providers of urban infrastructure in India, and they are plagued by inadequate revenues and huge debts. In order to promote transit-oriented development, it is thus essential that the performance of public utilities is linked to land management strategies.

In order to increase the share of active modes and fund infrastructure for non-motorized transportation, urban street design also plays a critical role. The proposed Indian Roads Congress revision seeks to include provisions of non-motorized transportation in its national design standards. This is a significant step forward, and some cities, such as Chennai, have gone one step further and instituted a law requiring that all road budgets include provisions of non-motorized transportation infrastructure. Thus, some headway is being made toward increasing shares of active modes. In order to achieve the active mode objectives by 2050, more cities need to build on the example set by Chennai.

Few transportation initiatives by Indian states are profitable, which limits their ability to increase fleet sizes for public transportation systems. A key reason for the financial unviability of bus-based systems is the high rate of various taxes. In Bangalore, the public transportation operator is charged a percentage of the total revenue as an annual tax, whereas other modes—such as cars and two-wheelers—pay a fixed percentage of the purchase cost as a lifetime tax. This inequity needs to be addressed, with cities either reducing or removing all taxes on public transportation systems. Even after eliminating these taxes, significant investments would be required in order to increase fleet sizes and provide the necessary infrastructure. One option to transform the transportation sector could be to mobilize private operators to compete with the public operator. While many app-based companies, such as Ola Shuttle and Shuttl, are already operating in some Indian cities, the current regulatory system restricts their ability to operate legally. Modifying existing regulations could help mobilize private sector investments in public transportation.

Where the Bangalore Model Could See Further Growth: Fuel Efficiency Improvements

Fuel efficiency standards have been used in many countries as a mechanism to restrain the growth of fuel use in the transportation sector. It is clear that the market for production, purchase, and use of vehicles needs to be tilted toward fuel savings over larger and more powerful vehicles. India has made significant progress through its 2003 Auto Fuel Policy; due to the reduction in PM2.5 emissions, 6,500 premature deaths were prevented in 2010.[20] Despite this success, there remains a significant gap in vehicle emissions and fuel quality standards between India and the world. Because India has two sets of standards—one for major cities and another for the rest of the country—vehicles that are purchased in smaller cities under lower standards can still operate in major cities. This is especially a problem for heavy commercial vehicles, which constitute a significant portion of the total vehicle-km traveled. Harmonizing vehicle emissions and fuel quality standards could thus significantly reduce air pollution. In addition to this, India needs to establish an in-use compliance and enforcement strategy to ensure that vehicles are operating at their original standards.

By adopting a nuanced approach to mobility planning, significant reductions in vehicle-km are possible. In order to achieve this goal, however, major investments in public transportation and infrastructure for active modes are critical. As demonstrated through the case study of Bangalore, reducing emissions requires coordination between various agencies, land management strategies, and strong fuel efficiency and emissions standards. Policymakers in both India and the rest of developing Asia need to be cognizant of these linkages while designing instruments to plan for future mobility.

Conclusion

Traditionally, national transportation policies have focused on large cities and have provided very little funding to small and medium cities. Yet in the case of India, cities with a surface area under 150 km^2 will constitute the largest number of cities even in 2050. Thus, there is a critical need to change the mindset of decision-makers on what strategies and priorities they pursue. Since dominant transportation modes strongly affect city spatial structures, it is essential that national

[20] Gaurav Bansal and Anup Bandivadekar, "Overview of India's Vehicle Emissions Control Program: Past Successes and Future Prospects," International Council on Clean Transportation, 2013.

and subnational policies are tailored to city scales and prioritize appropriate technologies. While larger cities are appropriate for public transportation investments, smaller cities (less than 50 km^2 in scale) could be designed to work with active modes as the dominant transportation technology (similar to how Copenhagen and Dutch cities are structured).

National policies such as the JNNURM and the Auto Fuel Policy have produced mixed results. Lessons can be learned from these initiatives about reducing emissions from the transportation sector on a larger scale. Recent directives from national and subnational governments clearly point to India's commitment to addressing greenhouse gas emissions from this sector. Significant benefits are possible, but achieving the goals of these policies also requires that decision-makers be cognizant of the particular development and investments needed for each city type.