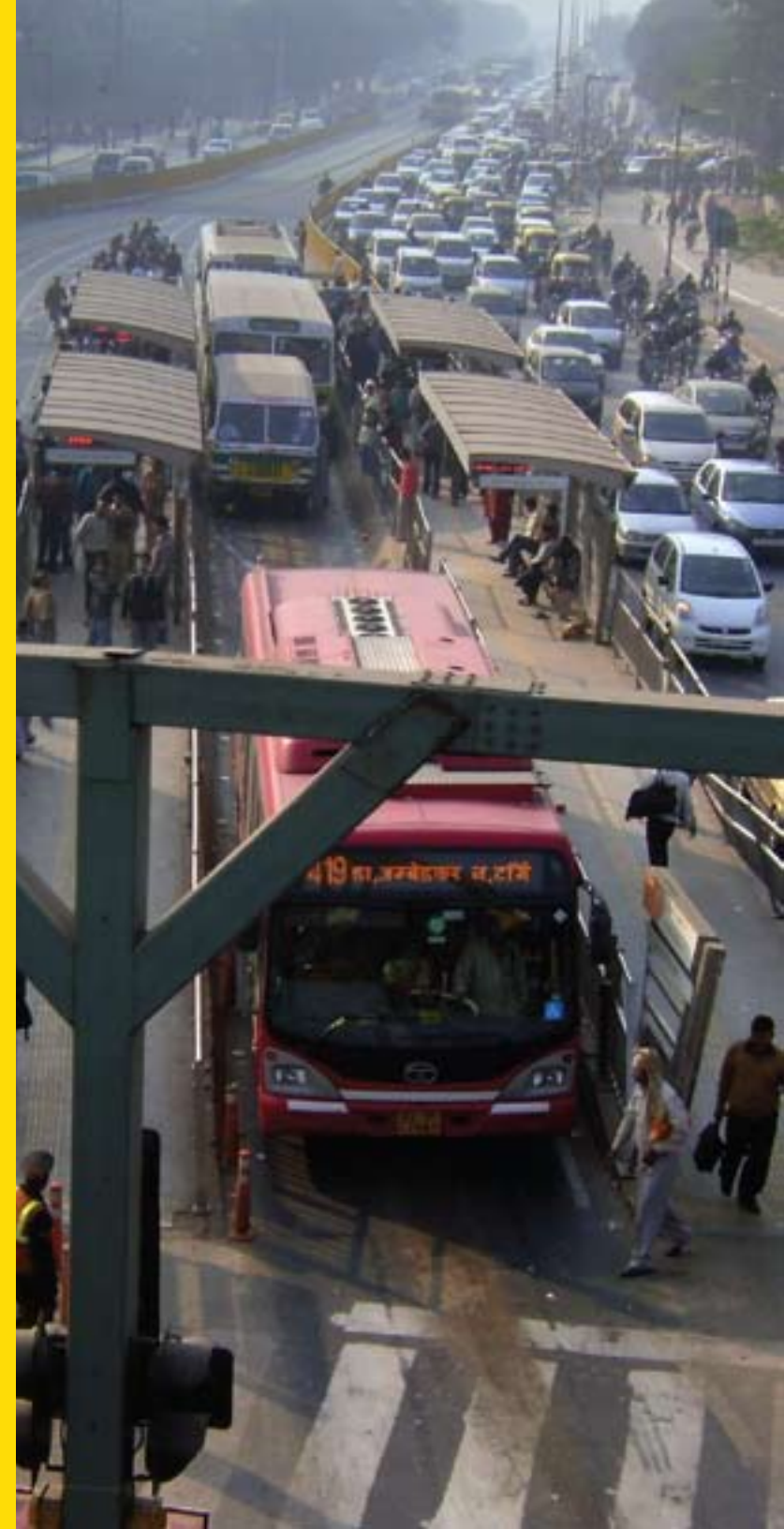


# The Delhi Bus Corridor

A Report by EMBARQ–The WRI Center  
for Sustainable Transport

May 2009





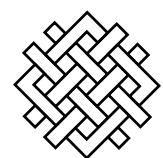
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## EMBARQ

EMBARQ—The World Resources Institute Center for Sustainable Transport—works with cities in the developing world to catalyze and help implement sustainable solutions to the problems of urban mobility. By working with EMBARQ, cities can reduce the cost, risk, time, and complexity of diagnosing transport problems and designing and implementing sustainable solutions. EMBARQ has also proven that sustainable transport in developing countries can translate into economic opportunities for the forward-thinking business.



WORLD  
RESOURCES  
INSTITUTE

## WRI

The World Resources Institute is an environmental think tank that goes beyond research to find practical ways to protect the earth and improve people's lives. Because people are inspired by ideas, empowered by knowledge, and moved to change by greater understanding, WRI provides—and helps other institutions provide—objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development.

## CST-India



Since 2006, The Centre for Sustainable Transport India (CST-India) has been working to diagnose and solve transport problems in Indian cities. Based in Mumbai, the Center achieved a significant milestone by conducting a critical review of Bangalore's traffic plan. It has since expanded into other areas of sustainable transport, taking on cycling and pedestrian projects. Legally incorporated in 2009, CST-India continues to provide technical support and capacity building activities to a growing roster of clients and partners at the national, state and city level.

# AUTHORS

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Dr. Hidalgo manages EMBARQ's team of transport engineers.

He has more than 16 years of experience as a transport expert, consultant and government official. He was Deputy General Manager of Transmilenio S.A., Bogota's renowned bus corridor system. As a consultant for international agencies and local governments, Dr. Hidalgo has taken part in projects in Argentina, Mexico, Peru, Chile, Colombia, Ghana, Turkey, India and Thailand. He has also taught training courses on bus corridor in China, Mexico, India, South Africa and Colombia.

Dr. Hidalgo has been a graduate-level lecturer in urban planning and is the author of a forthcoming book on 11 bus systems in developing countries.

He holds a Ph.D. in transportation planning from Ohio State University. He lives with his family in Washington, D.C.

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Mr. Pai is the lead transport engineer for the Centre for Sustainable Transport India.

Over the last 8 years he has participated in several complex and innovative transport projects as a researcher, consultant and trainer. Mr. Pai was a Regional Director at Citilabs, a transport planning Software Company where he headed their operations in South and South East Asia. He supported all activities in the region including program development and technical support. He has delivered training courses on Transport Modeling in India, Hong Kong, Thailand, Malaysia and USA.

In the San Francisco Bay Area, he spent four year working at Dowling Associates Inc., managing and executing several transport planning, transport modeling and traffic engineering projects. He also spent two years as a researcher at the Institute of Transport Studies at UC Berkeley, where he was involved in assessing the short and medium term impacts of City Car Share on travel behavior in the City of San Francisco.

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### EDITORIAL TEAM

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Prior to becoming the Information and Innovation Specialist for EMBARQ, Ethan was EMBARQ's Communications Specialist, during which time he was founder and editor of TheCityFix.com. He joined EMBARQ in January 2007. Prior to working with EMBARQ, he conducted research for the World Resources Report, the World Resources Institute's flagship publication.

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During her studies at Northwestern University, where she majored in journalism and international studies, she conducted independent research on Internet youth culture in China and won a scholarship from the Overseas Press Club. She has lived in China, Hong Kong, Taiwan, and Switzerland, and speaks Mandarin and French.



# The Delhi Bus Corridor Benefits and Achievements

## ➤ Moving more people, faster

The average time for motorized travel along the bus corridor decreased from 27 to 22 minutes. This is the combined effect of a reduction in travel time for bus users from 30 to 22 minutes, and a slight increase in travel time for car users from 22 to 26 minutes.

The average speed of buses along the pilot corridor has increased from about 12 kilometers per hour to 18 kilometers per hour.<sup>1</sup> As a result, the average travel time for bus users has decreased by 35 per cent.

## ➤ Satisfied Commuters

An overwhelming majority of bus commuters (88%), as well as pedestrians and cyclists (85%), said they were happy with the new system.<sup>2</sup> And about half of car drivers, two-wheeler and other commuters expressed similar sentiments.

## ➤ New space for pedestrians and cyclists

As a result of the pilot project, cyclists and pedestrians have, for the first time, a high-quality space for moving around Delhi. The effort has paid off; nearly 1,300 cyclists use the new cycle facilities every hour, during peak hours.<sup>3</sup>

<sup>1</sup> DIMTS, 2009 <sup>2</sup> [http://www.cseindia.org/AboutUs/press\\_releases/press\\_20080521.htm](http://www.cseindia.org/AboutUs/press_releases/press_20080521.htm) <sup>3</sup> DIMTS, 2009

### Quick Facts

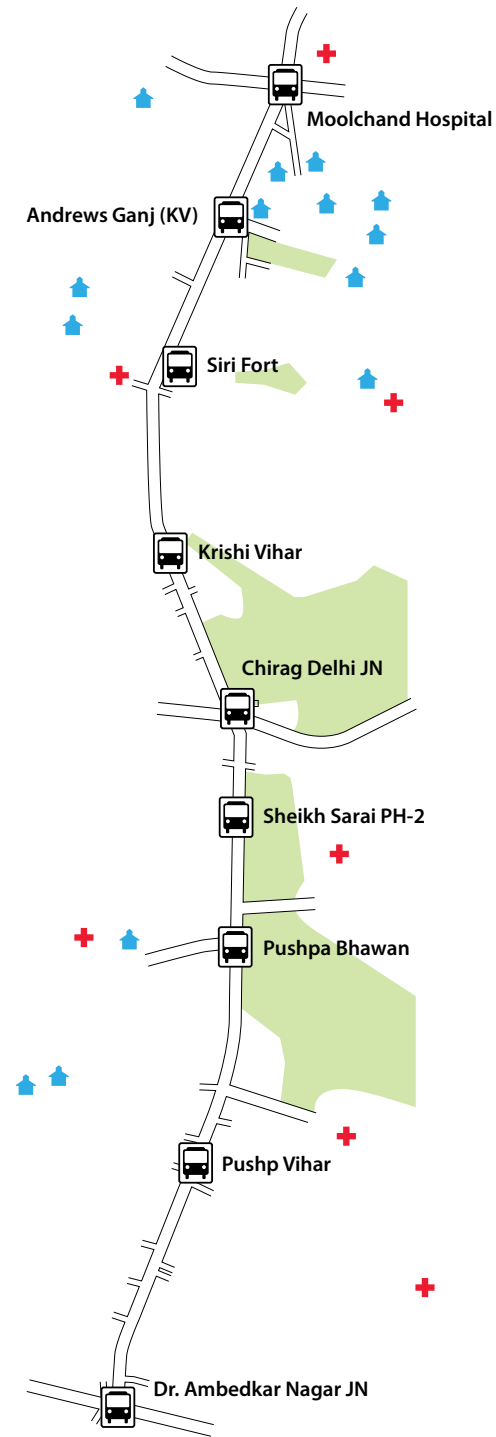
#### DELHI Bus corridor

Date of launch	April 20, 2008
Length	5.6 kilometers
Number of stations	9
Number of different routes	57
Peak ridership	6,500 passengers per hour (in each direction)
Frequency	120 buses per hour
Average Commercial speed	18 km per hour (during peak hours)
Total infrastructure investment	Rs. 14 crores per km
Average bus fare	Rs. 1 to Rs. 4 per passenger citywide

Source: Delhi Integrated Multi Modal Transit System Ltd., February 2009



# Promising Beginnings



**With the launch of its new bus corridor system in April 2008, Delhi took the first step toward developing a sustainable transport network for the city.**

The 5.8-kilometer pilot corridor stretches from Moolchand to Ambedkar Nagar in South Delhi, giving priority to public buses on segregated lanes and creating dedicated spaces for bicycles, cycle-rickshaws and pedestrians.

As a result of the project, bus speeds on the corridor have increased considerably, moving more commuters than ever before. Bus riders have responded positively to the new bus corridor, with an overwhelming majority (88%) indicating that they are happy with the service. Pedestrians and cyclists have also benefited from the Delhi bus corridor, with 85% of them saying the same. And about half of car drivers, two-wheeler and other commuters said they are also happy.



**Yet, despite these successes, the pilot project experienced several setbacks during the first months of operations. Problems included congestion in non bus lanes, high incidents of bus breakdowns in the segregated lanes, confusion about where passengers should board and exit buses, unauthorized pedestrian street crossings (jaywalking) and faulty traffic signals.**

**T**hese setbacks put the Delhi bus corridor under the microscope of the media, generating negative attention throughout India. The initial response to the project by some media outlets and opinion makers was negative and a political firestorm ensued. Critics of the system attacked the Delhi Government, accusing it of botching the city's highly anticipated bus corridor.

In response to mounting public pressure, the Delhi Integrated Multi Modal Transit System (DIMTS), the city agency in charge of managing the bus corridor, took several steps to improve the system and calm the critics. At key intersections, it deployed additional traffic wardens to organize vehicle flows and checked traffic violations that slowed traffic. It also began upgrading traffic signal technology and modernizing

the bus fleet in an effort to improve the entire system.

To help the city make additional improvements, transport experts from EMBARQ - The World Resources Institute Center for Sustainable Transport, conducted an independent evaluation of the corridor in February 2009. The evaluation was made possible with the support of the Centre for Science and the Environment and the financial support of ClimateWorks.

Through technical observations and interviews with key stakeholders, EMBARQ has concluded that Delhi's inaugural bus corridor succeeded in meeting some of its key objectives. Yet, the system can still be improved through gradual and systemic efforts to enhance bus operations. In the following pages, EMBARQ details its findings.

## A Global Trend

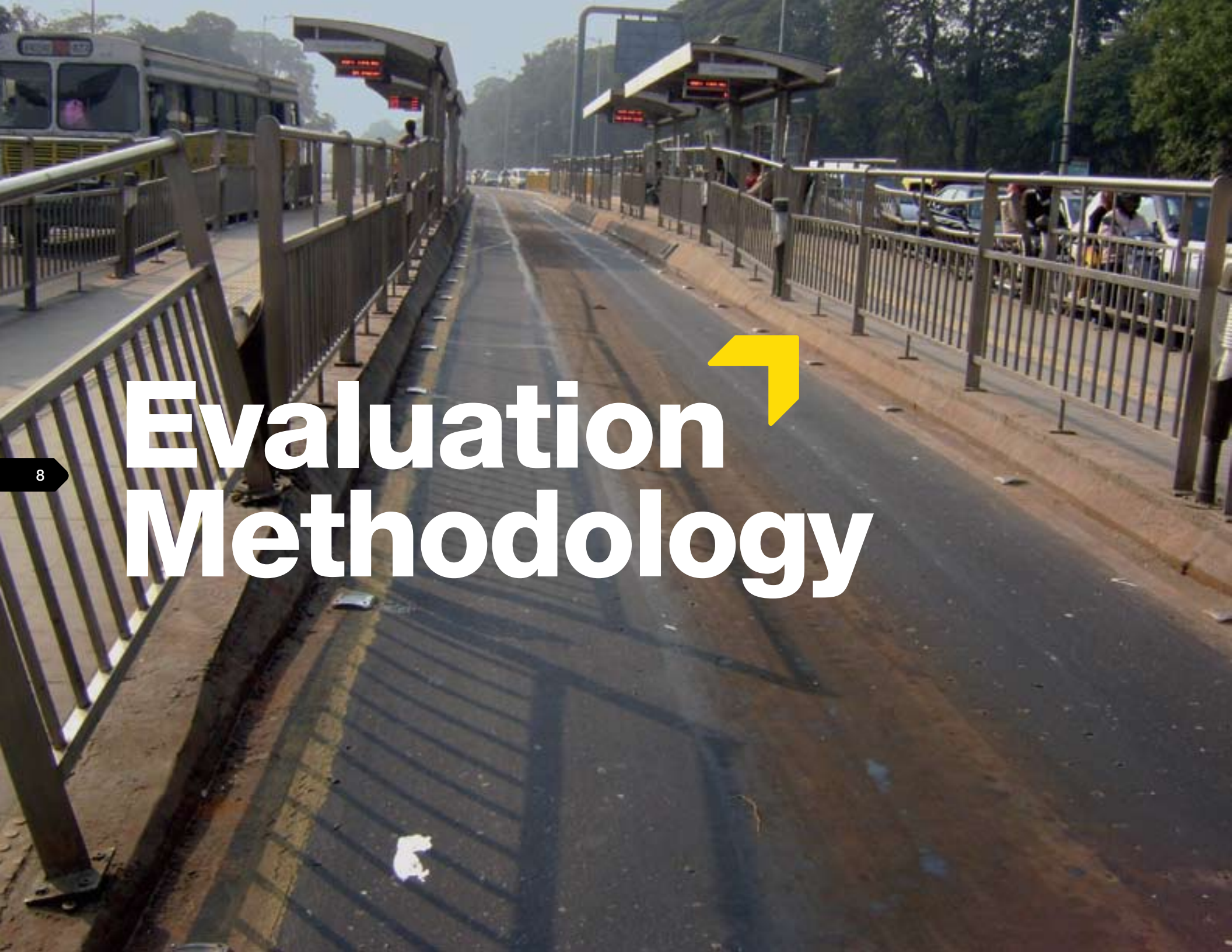


The most famous cities around the world are expanding mass transit and promoting cycling and walking to reduce congestion and improve air quality.

Under the leadership of Mayor Michael Bloomberg, New York City built the city's first bus corridor, segregated cycle facilities, and pedestrian-only streets. The Mayor has also called for banning all cars in Times Square, making it a space where people can walk uninterrupted by traffic. Los Angeles, one of the world's most car-centric cities, is also turning things around. In 2007, it opened a thriving bus corridor line with a cycle path segregated from motorized traffic.

A number of large cities outside the United States, including Beijing, London, Paris, Istanbul, Bogotá, México and Sao Paulo, have taken similar steps, which have been successful and popular.

Indian cities can – and should – do the same.

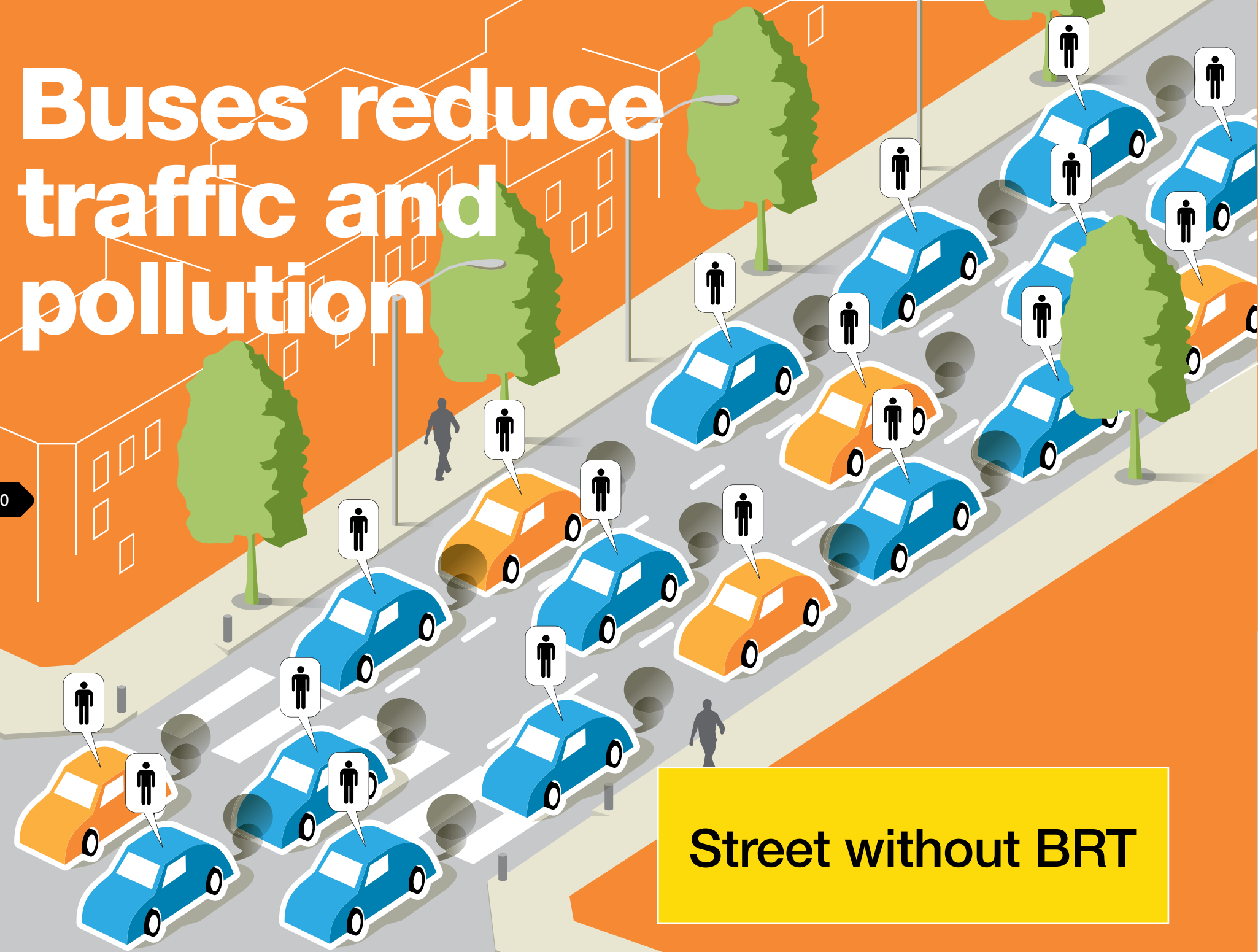


# Evaluation Methodology

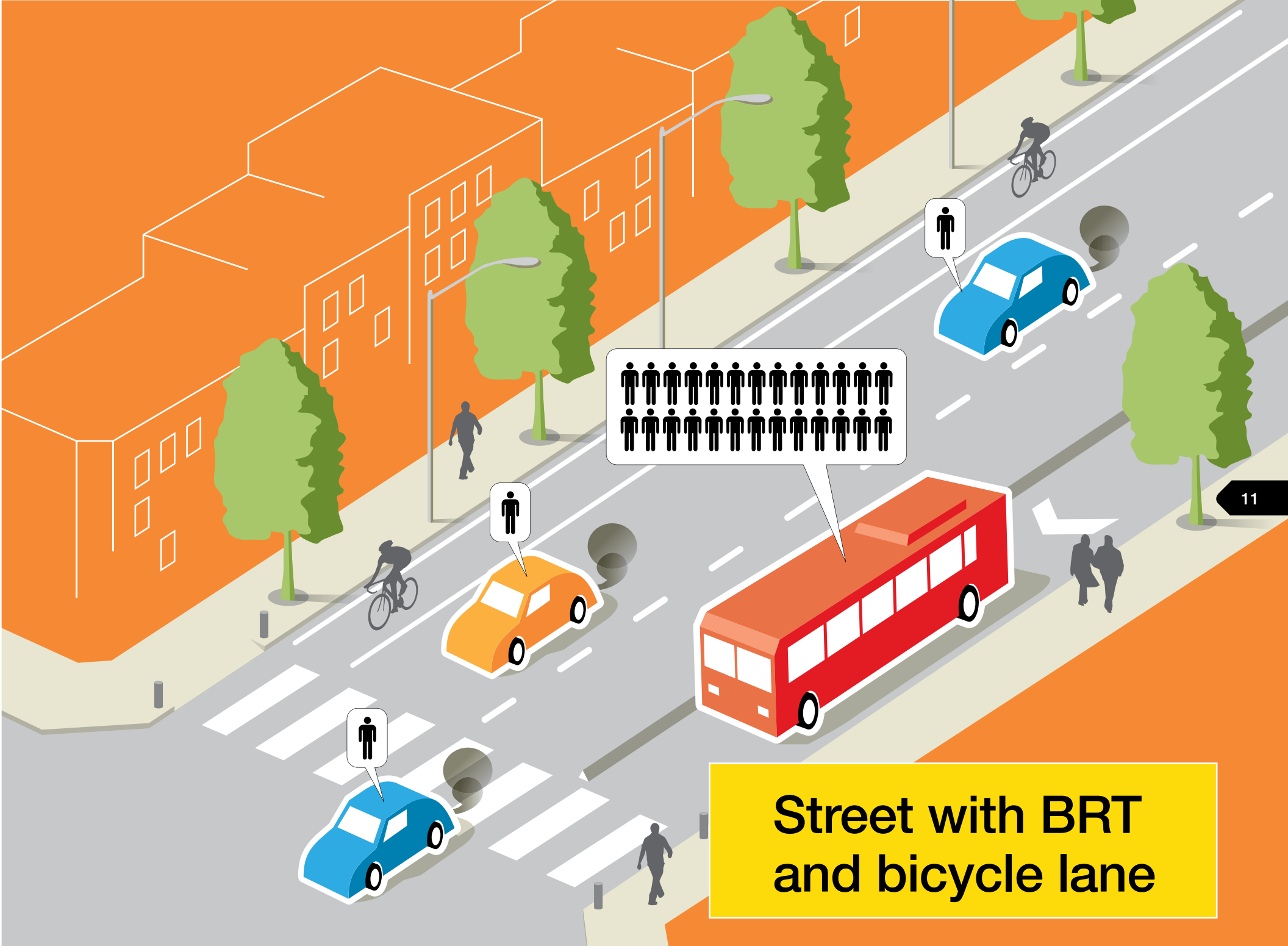


**E**MBARQ transport experts Dr. Dario Hidalgo and Madhav Pai conducted the Delhi bus corridor evaluation in February 2009. A set of meetings and interviews with local planning and implementing agencies formed the basis of recommendations and analysis presented in this report. On three separate occasions, Dr. Hidalgo and Madhav Pai visited the bus corridor, where they examined pedestrian and cycle facilities, bus lanes and stations, and motor vehicle lanes. Although the study is primarily intended for a technical audience, it also addresses several of the major concerns raised by the general public and news media. Its findings were presented to Rakesh Mehta, chief secretary of the Delhi Government and DIMTS.

# Buses reduce traffic and pollution



Street without BRT



Street with BRT and bicycle lane



# Answering the Public's Questions

12

## 55%

Percent of people who commute through the Chirag Delhi intersection by bus.

## 2%

Percent of vehicles that pass through the Chirag Delhi intersection that are buses.

## 6 km per hour

Reported increase in speed when buses drive in median lanes.

**Q:** Has the Delhi bus corridor increased congestion, making it more difficult for people to get around Delhi?

**A:** Simply put, congestion in Delhi is caused by too many private vehicles on the road. The Delhi bus corridor actually reduces congestion by increasing the speed and quantity of people who move on the road. At the Chirag Delhi Junction, for example, buses in the bus corridor account for only 2% of all vehicles but move 55% of the people. By contrast, private cars and two wheelers account for a staggering 75% of the vehicles but move just 33% of the people.

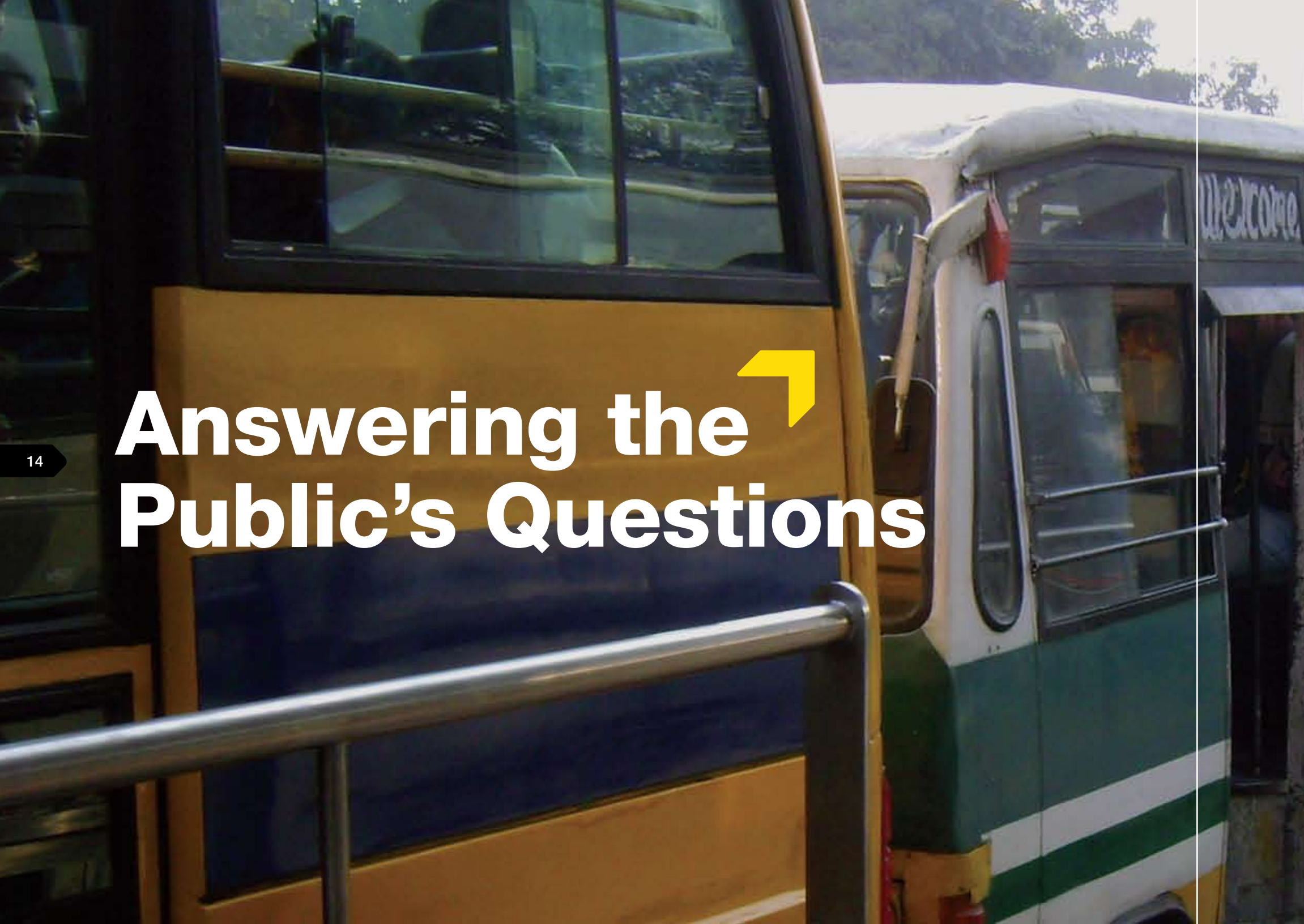
**Recommendation:** Delhi can adopt a number of measures to discourage private vehicle use, the main cause of congestion. These measures include parking restrictions, parking fees, congestion and pollution charges, fuel taxes and administrative restrictions on vehicle use in certain parts of the city. These policies can be accompanied by more mass transit, like bus corridors, so that people have an alternative mode of transport.

**Q:** Should the Delhi bus corridor use painted side lanes like those used by bus systems in the United States and Europe?

**A:** Middle lanes, not side lanes, are the international standard for bus corridor systems. Unlike middle lanes, side lanes can easily be invaded by hawkers, taxis, and auto rickshaws, significantly slowing bus traffic. It shouldn't come as a surprise that buses operating in middle lanes travel faster and provide more reliable service than buses in side lanes.

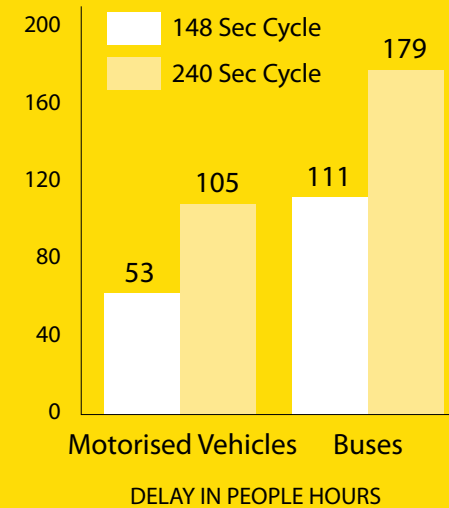
**Recommendation:** The expansion of the Delhi bus corridor should use segregated middle lanes, not painted side lanes. If the city were to use painted side lanes, it would need to double the size of its bus fleet in order to maintain the frequency of buses and accommodate the same number of passengers. It would also experience a drop in the reliability of service. As a result, traffic congestion would continue to deteriorate.

13



# Answering the Public's Questions

## SHORTER SIGNAL CYCLE REDUCES WAITING



**0**  
The ideal number of traffic accidents or fatalities

**Q:** Should the traffic signal cycles be longer in order to shorten the queues at intersections?

**A:** In fact, the opposite is true; increasing the signal cycle increases the waiting time for all users. Moreover, increasing the signal cycle has the biggest negative impact on bus riders, who comprise the majority of people traveling on the corridor. It also increases the likelihood of impatient pedestrians crossing the street at the wrong time.

**Recommendation:** In order to reduce the length of traffic queues, the signal cycle must be shortened. This strategy will also reduce delays for pedestrians waiting at intersections, and the potential accidents resulting from waiting times longer than 60 seconds.

**Q:** Is the Delhi bus corridor dangerous?

**A:** The Delhi bus corridor is as safe as other traffic corridors in the city. EMBARQ's analysis shows there is no statistical difference between the number of current fatalities on the corridor and those before the bus line was implemented. What's more, DIMITS reports a gradual decrease of traffic accidents since the start of the operations.

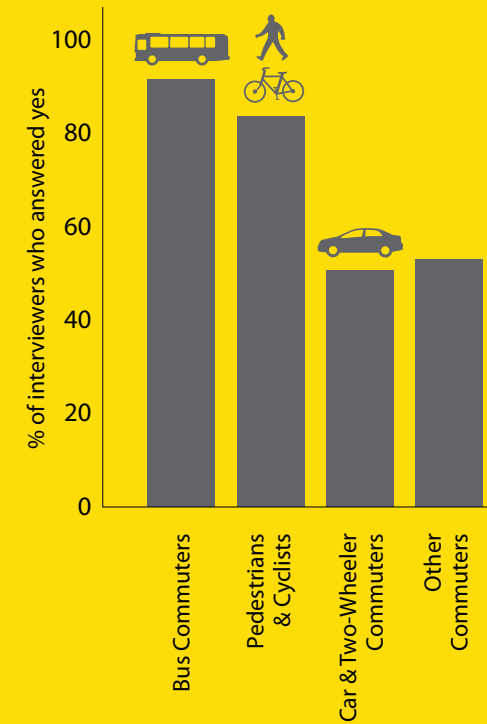
**Recommendation:** The aim of all bus corridor is to bring the number of traffic fatalities and accidents to zero. The city should continue to make pedestrian crossings safer, prevent jaywalking, improve the management of bus operations to reduce spillover at the bus stations and increase public education and enforcement.





# Answering the Public's Questions

## POLL: ARE YOU HAPPY WITH THE BUS CORRIDOR AND DEDICATED BUS LANE SYSTEM?



Source: Centre for Science and Environment

## Q: Is the Delhi bus corridor safe for school children who ride in buses in the median lane?

**A:** With proper management and operations, the Delhi bus corridor is safe for all people, including children, the elderly and passenger with special needs.

**RECOMMENDATION:** The city can implement a special management program for school buses. It should study specific bus routes and define the points of departure from the middle bus lanes to gain access to the side and the colonies. Parents and the schools should be consulted throughout this process.

## Q: Should space for pedestrians and cyclists be given over to cars in order to reduce traffic congestion?

**A:** Pedestrians and cyclists are important to the function of the entire system. At the Chirag Delhi Junction, nearly 1,300 cyclists use the cycle lane every hour, representing nearly 11% of people on the corridor. Space for pedestrians and cyclists takes up relatively small amount of total road space and moves people in the most socially and environmentally friendly way.

**Recommendation:** Additional space for cars and other private motor vehicles should not come at the expense of space for pedestrians and cyclists. Already, a left hand turn lane at the Chirag Delhi Junction cuts into pedestrian and cycle space, threatening cyclists and compromising the integrity of the entire system.



# Improving Bus Operations

## EMBARQ'S RECOMMENDATIONS

With much of the Delhi Bus corridor's infrastructure in place, the city can turn its attention to bus operations and management. Successful bus corridors in other cities focus on the following strategies, each of which will be explained in the following pages:

- ① **Measuring to manage**
- ② **Adjusting to changing circumstances**
- ③ **Serving the customer**
- ④ **Marketing the product**



# Measuring to Manage

1

## EMBARQ'S RECOMMENDATIONS

### Delhi needs to continuously collect a set of transport indicators.

Indicators allow officials to measure performance of a system and guide operational changes that are needed to improve the service. The process of determining indicators and collecting data should always involve external stakeholders.

User surveys, which transport agencies typically conduct every 4 to 6 months, are also a valuable tool for evaluating bus performance and user satisfaction and identifying service shortcomings.

### Sample Indicators

- User ratings
- Travel time
- Reliability
- Comfort
- Productivity
- Bus frequency
- Passengers per vehicle
- Fleet size
- Monthly revenue
- Average user fare
- Monthly operational costs
- Fuel consumption
- Average commercial speeds
- Annual fatalities involving buses



# Adjusting to Changing Circumstances

## EMBARQ'S RECOMMENDATIONS

②

**When ridership numbers increase or decrease and stations become more or less crowded, service should be adjusted.**

During peak hours, service should be increased to reflect the increased demand. Similarly, during off-peak hours, service should be decreased to match lower demand.

One of the things that makes BRT so innovative is that a service plan can be easily modified at very little cost. For example, Delhi could introduce flexible route planning, using short loop routes and express routes that bypass certain stations to make the service as efficient as possible.





# Serving the Customer

3

## EMBARQ'S RECOMMENDATIONS

**For the Delhi bus corridor to be an attractive alternative to other forms of transport, like driving, it must continually meet the needs of bus passengers.**

Bus passengers want a service that is clean, reliable, fast, safe and comfortable. If buses are slow and don't arrive on time, passengers will find other ways to commute.

To improve reliability, the city should maintain a steady dispatch of buses and control bus intervals along the corridor. It should also use advanced IT systems and global positioning systems (GPS) on buses to manage operations in real time.

Because buses are generally crowded, especially during peak hours, the city can consider running more buses in the corridor. The bus terminals should be located near other mass transport hubs so that passengers

can seamlessly transfer between different modes of travel.

Making improvements to bus terminals is another important way to improve the quality of service. Crowds at terminals that spill into the streets can be managed by building wider and larger stations. Terminals are best kept clean, well maintained and well lit. Locating a security guard at every terminal can improve safety and comfort. User information, like maps, bus schedules, routes, fares and bus arrival times should be put in prominent locations in every terminal. They should be clear and well designed so that even the youngest riders can understand them.



# Marketing the Product

## 4

### EMBARQ'S RECOMMENDATIONS

**Delhi can benefit from a sophisticated marketing strategy to promote the Delhi bus corridor and mass transit in general.**

Having branded buses, terminals, maps, fare schedules, websites and videos to engage and educate the public is essential. It is also imperative for cities to constantly explain – in laymen’s terms – the importance of bus corridors as tools for reducing traffic congestion and air pollution and improving overall quality of life. They should have strategies to engage print and news media. In some cases, a public relations firm may be best equipped to help a city with this task.

#### Case study

##### ➤ Macrobus

Macrobus, a twenty kilometer BRT line in Guadalajara, Mexico, is an exceptional example of a bus corridor system that has effectively used marketing strategies to engage the media and the general public. It has a unique logo prominently displayed on every bus, which are also heavily branded, differentiating the bus corridor from ordinary buses on Guadalajara’s streets. It has also created a website (macrobus.gob.mx) targeting bus riders, providing them with all the information they need: routes, fares, a system map, and scheduling information. An entertaining video even explains to the public the importance of the project and how it will improve their daily lives. Not only was Macrobus a successful engineering project, it was also a successful marketing and public relations project.



**WEBSITE:** [www.macrobus.gob.mx](http://www.macrobus.gob.mx)



# Additional Challenges

- **Bus breakdowns in bus lanes**
- **Pedestrian “jaywalking”**
- **Encroachment of bus lanes by motor vehicles**
- **High bus occupancy levels during peak hours**
- **Unreliable bus operations**
- **High number of bicycles in motor vehicle and bus lanes**



## Acknowledgements

### Interviews with representatives of:

- Government of Delhi
- Center for Science and Environment
- Traffic and Injury Prevention Program (TRIPP) at the Indian Institute of Technology (IIT) Delhi
- Delhi Integrated Multimodal Transport Systems (DIMTS)
- Delhi Transport Corporation
- Delhi Traffic Police
- Center for Science and the Environment
- Climate Works
- Shell Foundation
- Caterpillar Foundation



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