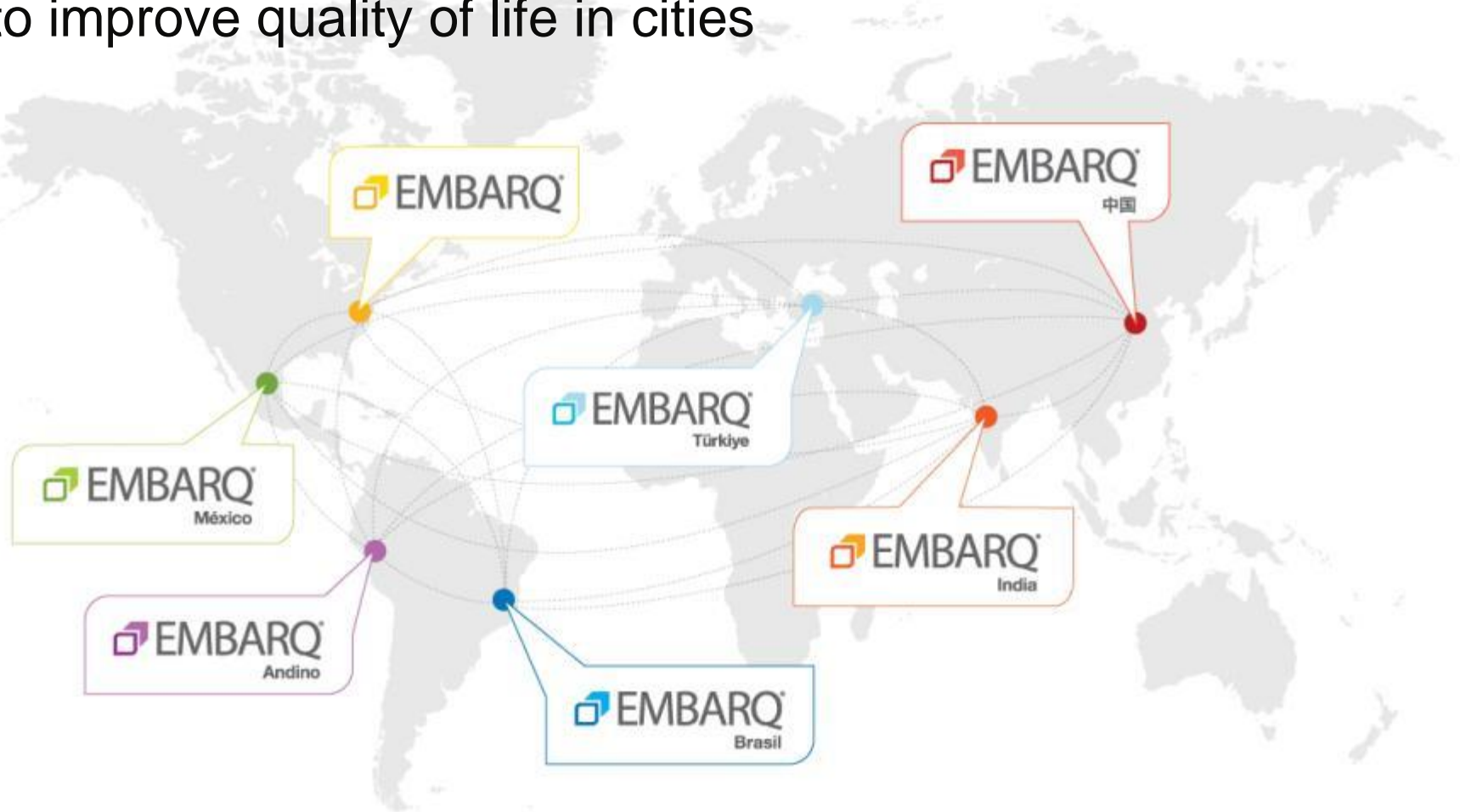


# Transportation

**Challenges and Opportunities  
for Green Growth in South Asia**

**Chhavi Dhingra**

➤➤ EMBARQ's mission is to catalyze and help implement environmentally and financially sustainable transport solutions to improve quality of life in cities

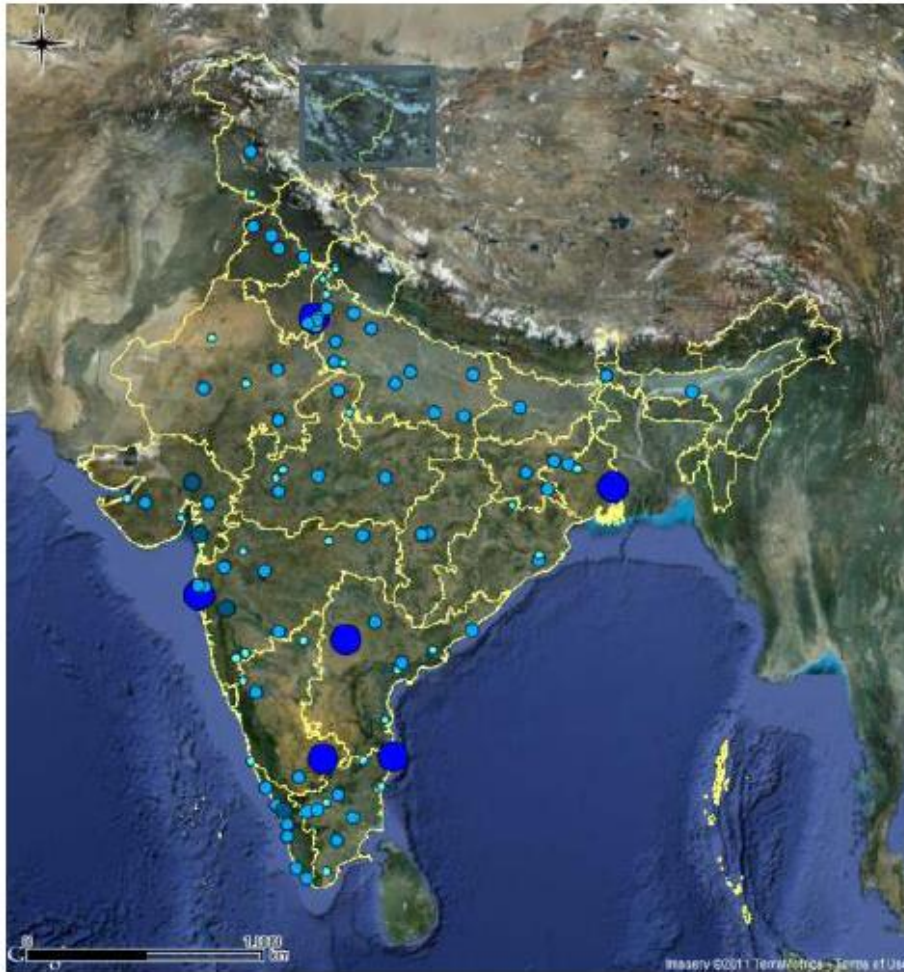


➤➤ Centers work together with local transport authorities to reduce pollution, improve public health, and create safe, accessible and attractive urban public spaces.

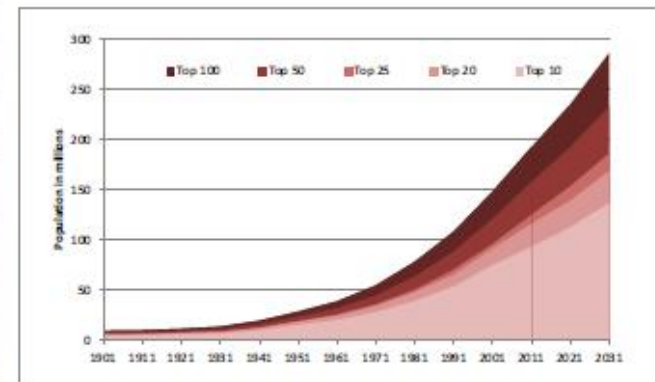
# CURRENT TRENDS

- **Challenges: Cost of car oriented development**
- **The opportunities of sustainable transport: Lower costs, more employment, value to the regional economy**

# Rapid Urbanization: 100 Million to 200 Million in the last 20 years



By 2031, it is projected that there will be 6 cities with a population greater than 10 million. A key question is how many Indians would live in how many medium and small towns - the bridge between a transforming rural and urban India?



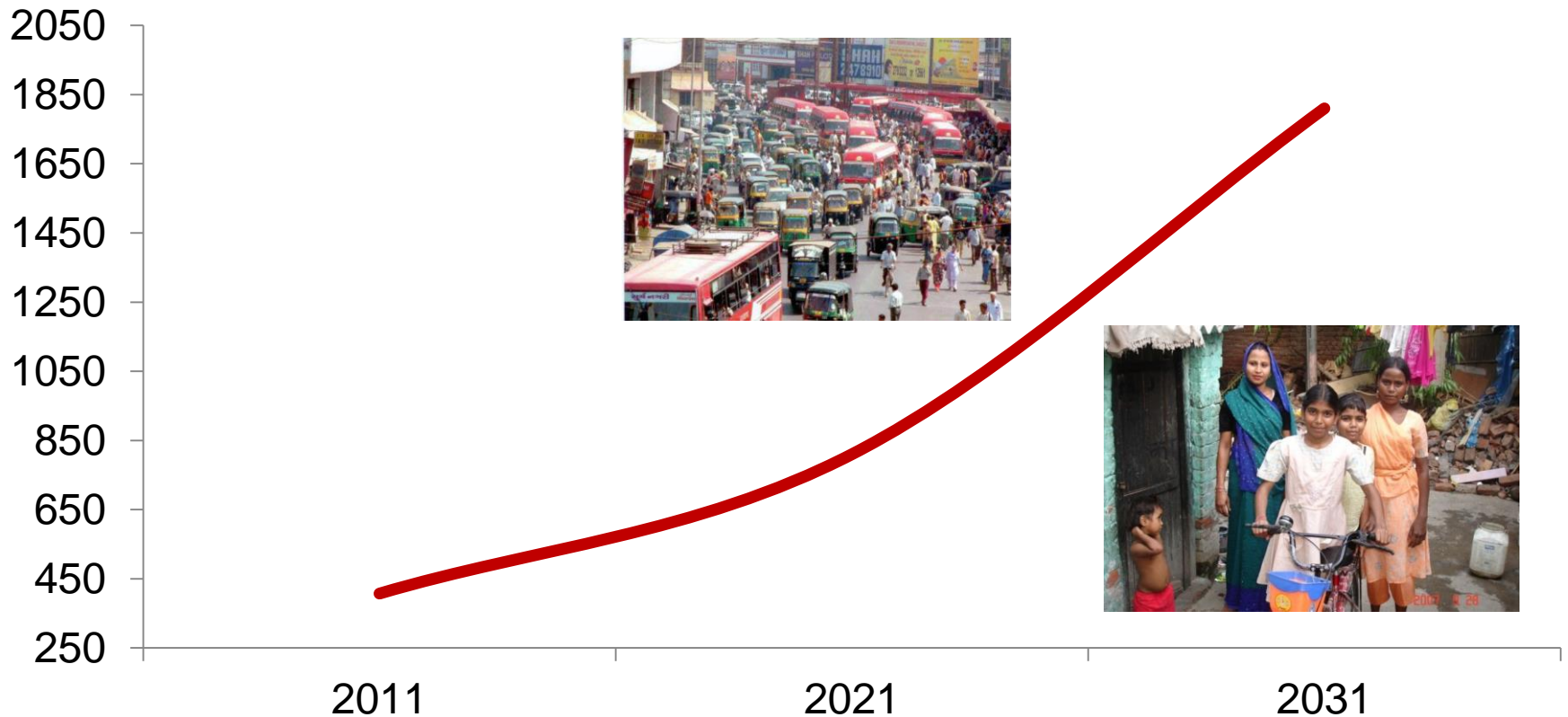
Cities Size Class by Population

- 0 - 0.1 million
- 0.1 - 1 million
- 1 - 5 million
- 5 - 10 million
- 10 - 30 million

Source: Source: IIHS Analysis based on Census of India. (Satellite Map, Google Inc.)

# Exponential growth travel demand

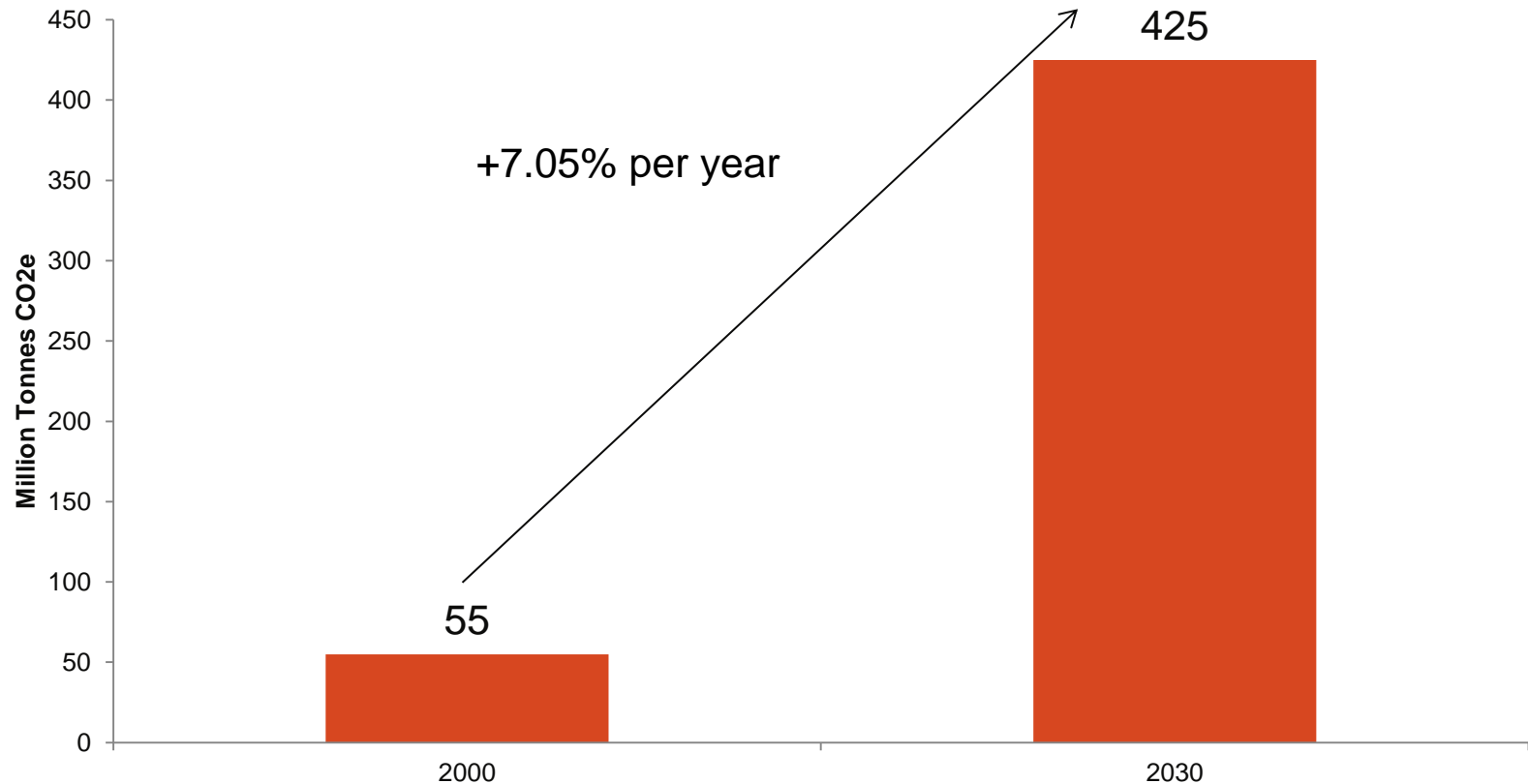
## Total Urban Travel Demand in India, 2011 - 2031 (Million Trips Daily)



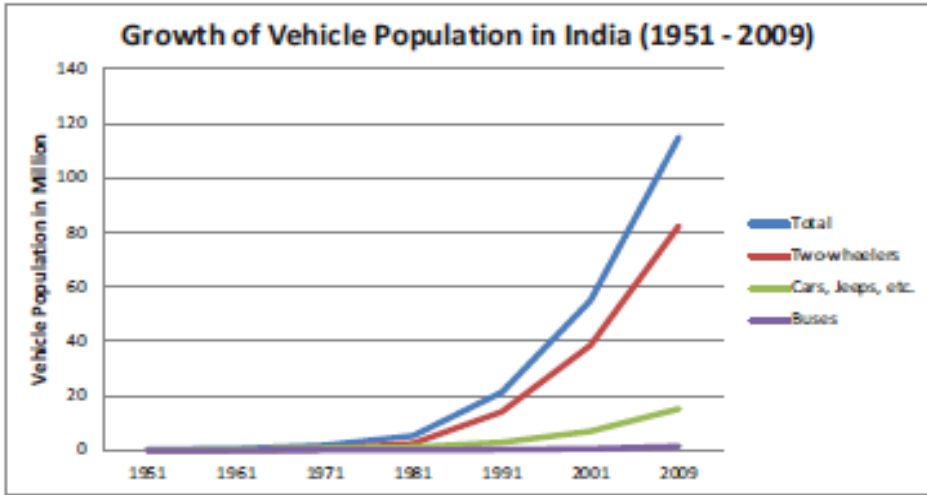
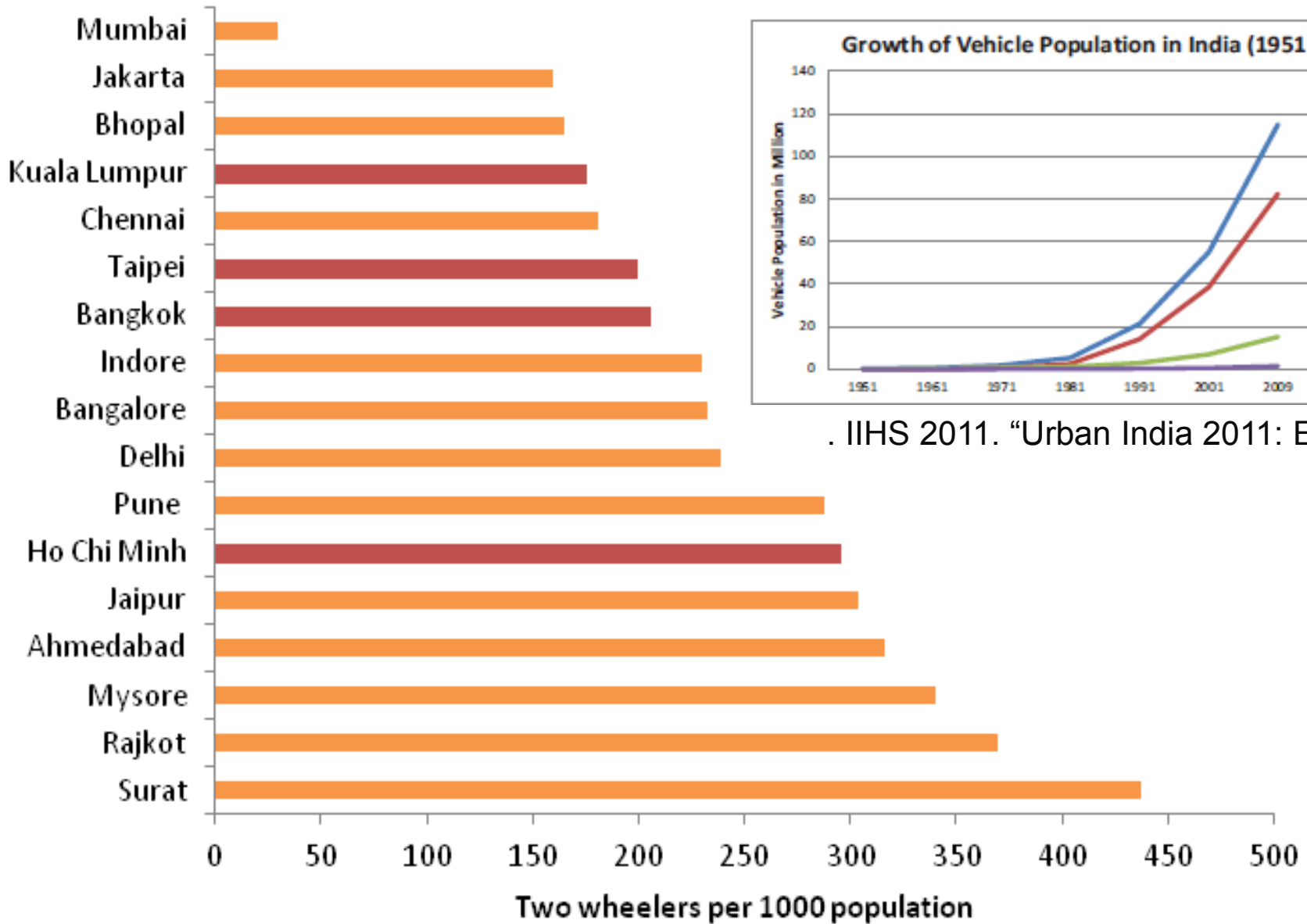
Source: EMBARQ India Analysis

# Increase in energy and emissions..

Estimated Growth in Emissions from Urban Transport – 2000 to 2030



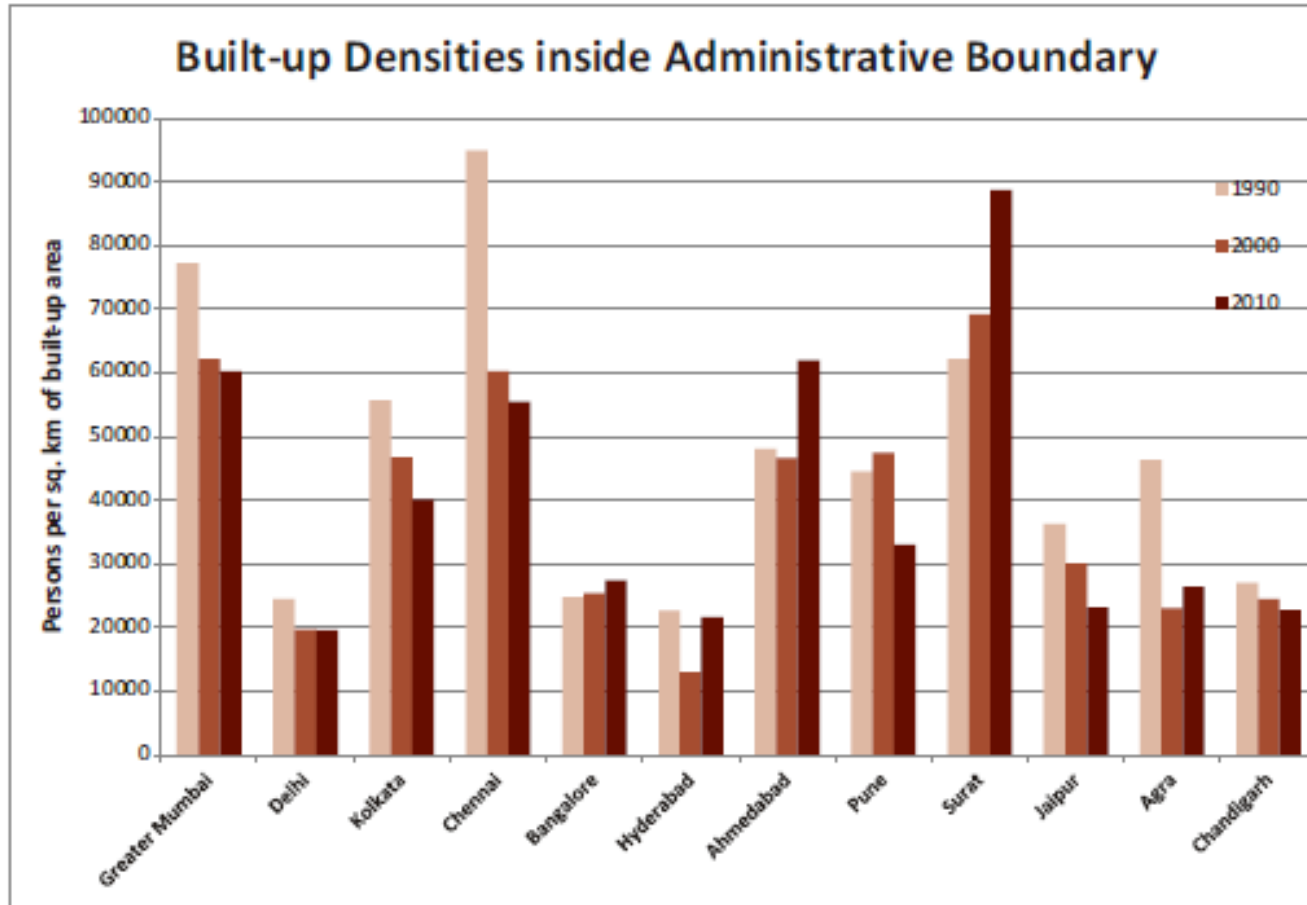
Source: Schipper et al 2008



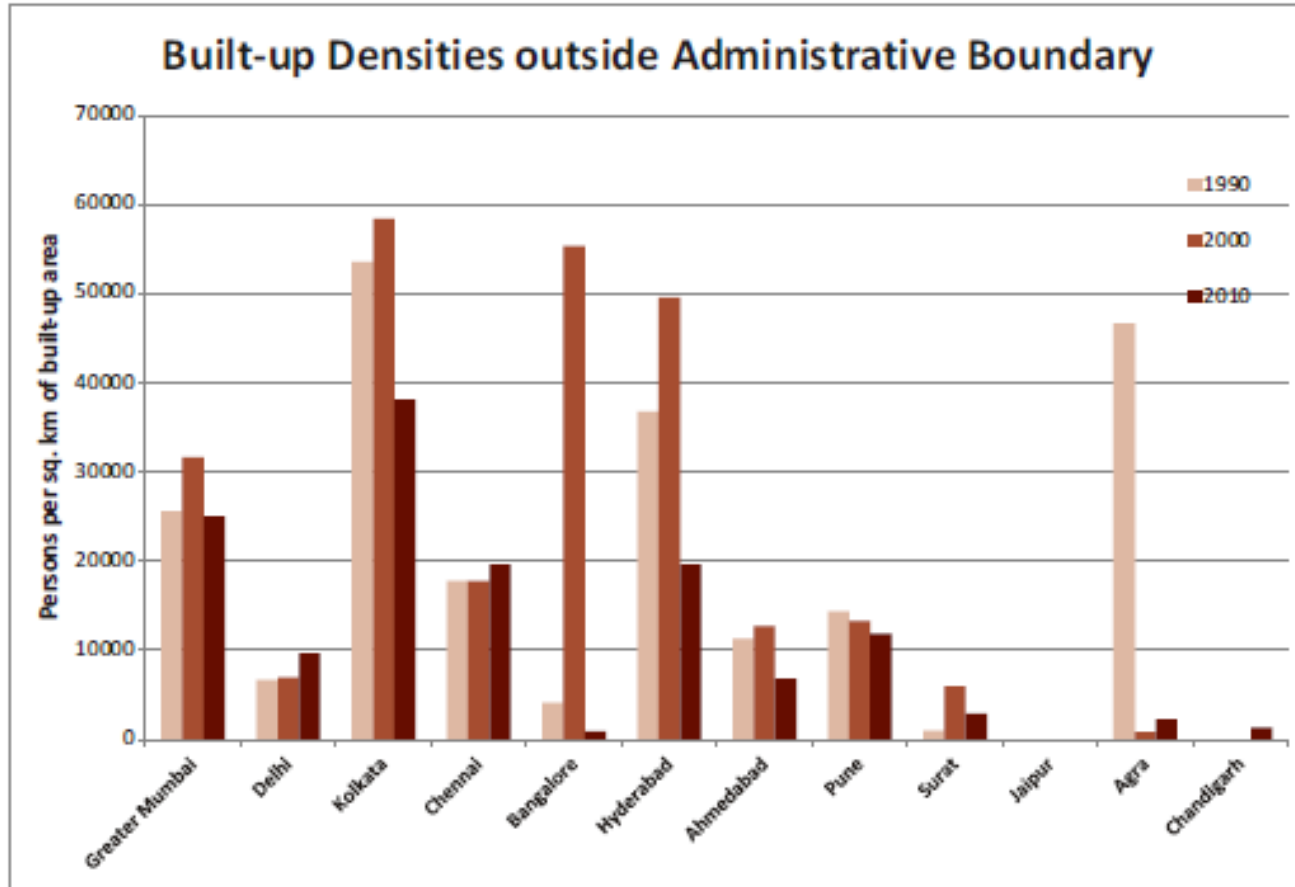
. IHS 2011. "Urban India 2011: Evidence"

Pai, M. 2010. "India Urban Transport Indicators"

# High density inside administrative boundary (200+ hab/ha), but declining in most places



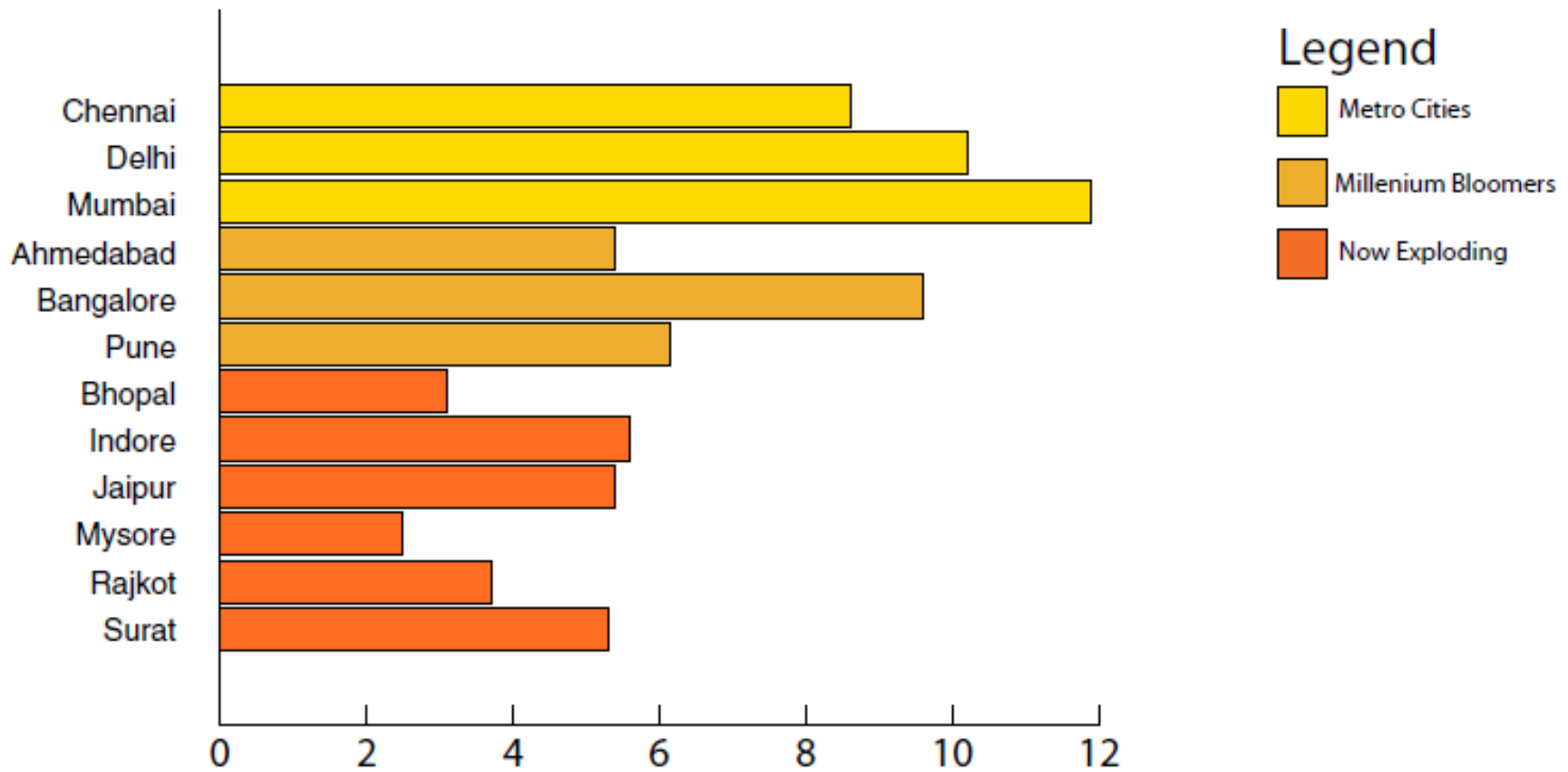
# Low density sprawl happening in all cities (<40 hab/ha)



# Short to medium average trip lengths (2-12 km/trip)

## Average Trip Length

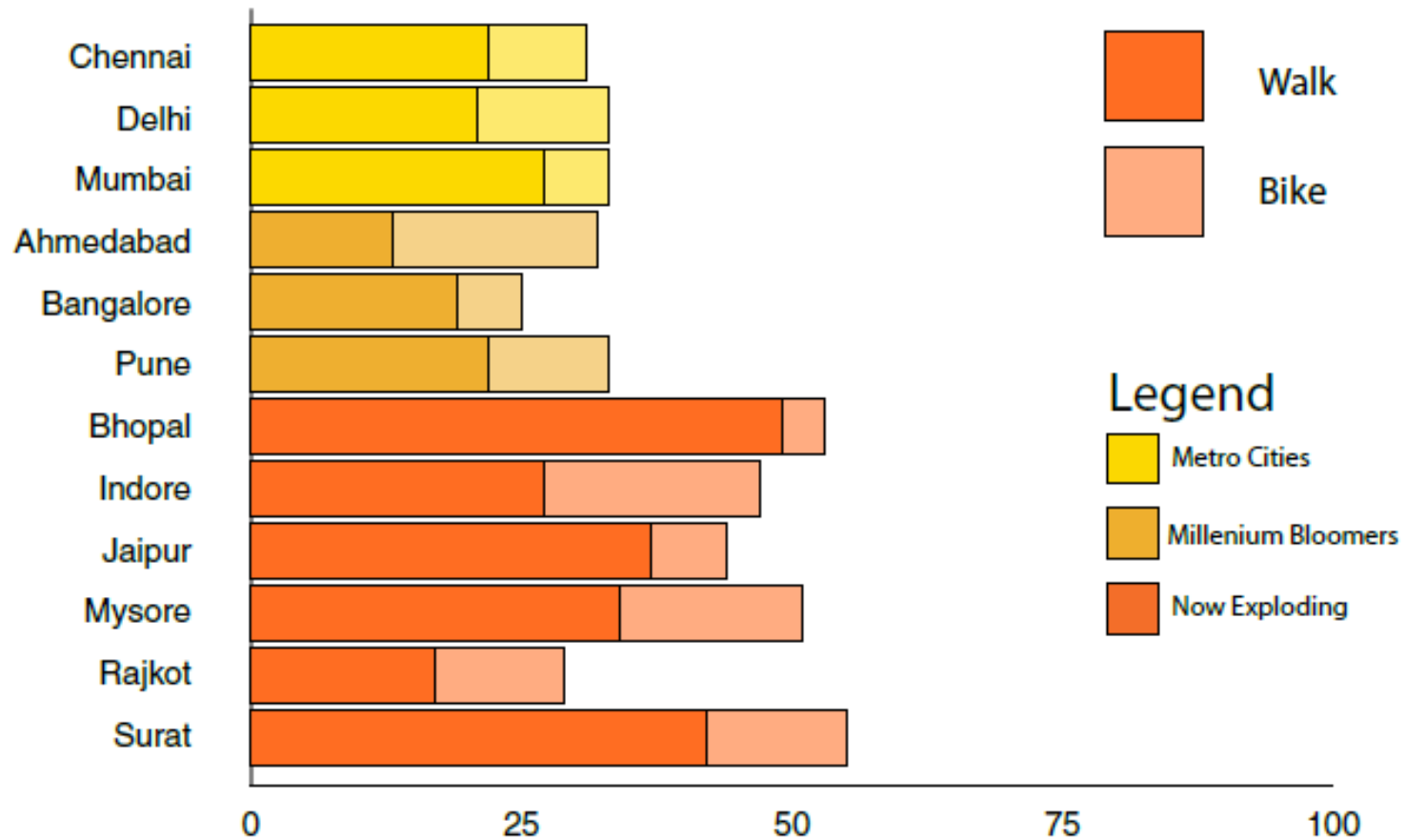
kilometers



Based on CMPs 2006-2007

# High to very high non-motorised modal share (25-55%)

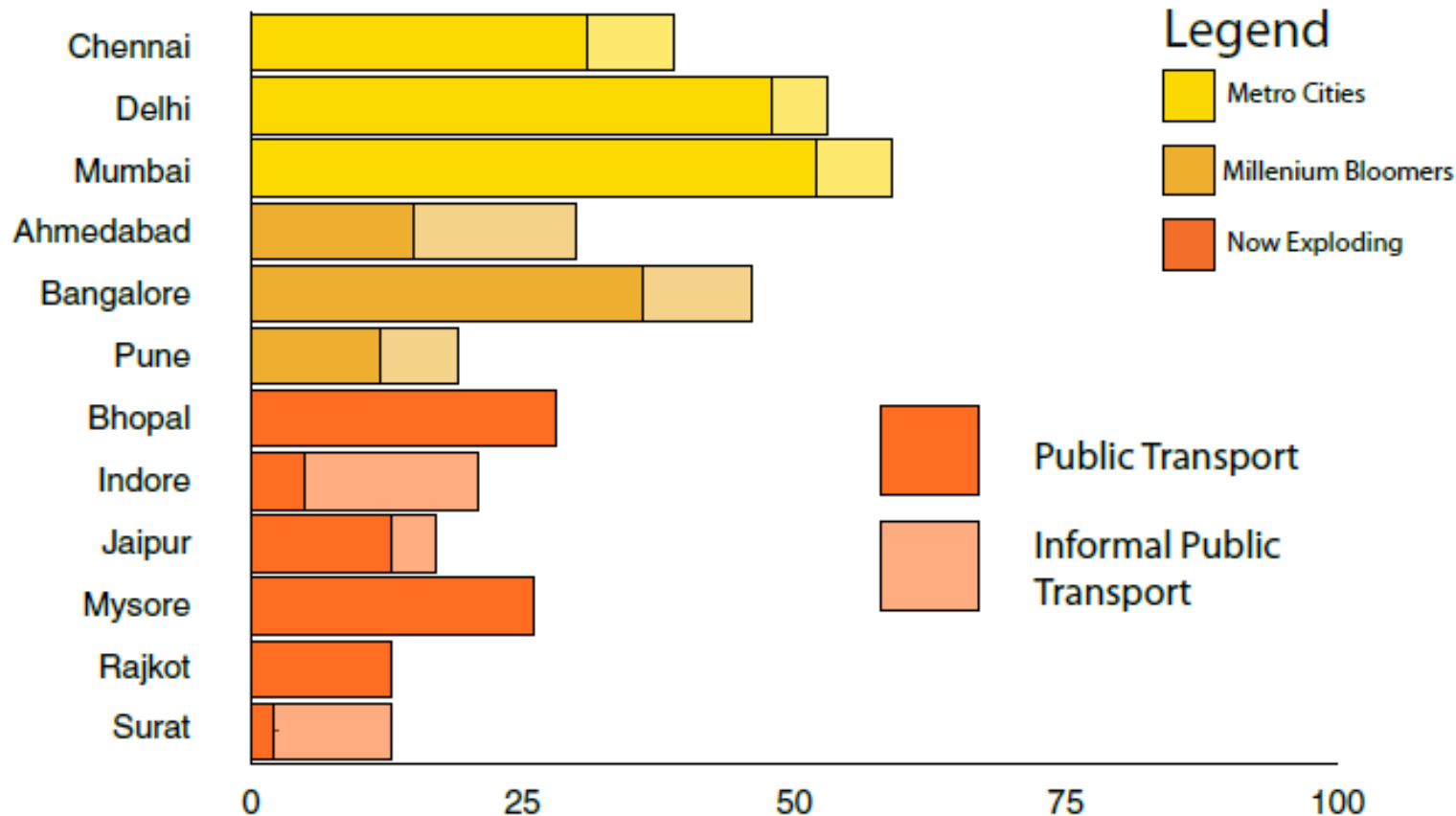
## Non-Motorized Transport Mode Share



Based on CMPs 2006-2007

# Low to medium public transport modal share (12-60%)

## Public Transport & Intermediate Public Transport modal share



Based on CMPs 2006-2007

# The Challenge



# What do we usually do?

## Capital intensive solutions vs. Cost effective 'local' solutions

- Give greater capacity to the road network to relieve congestion

USA Highway  
Photo: FPPQQ



**Bangkok developed an extensive roadway network, but road construction could not keep up with demand. Road building is an expensive way of dealing with travel demand. We cannot build our way out of congestion!**



# What can we do instead?

## Change paradigms

- Restrict indiscriminate motorization
- Give priority to non motorized transport and bus-based public transport

Amsterdam, The Netherlands

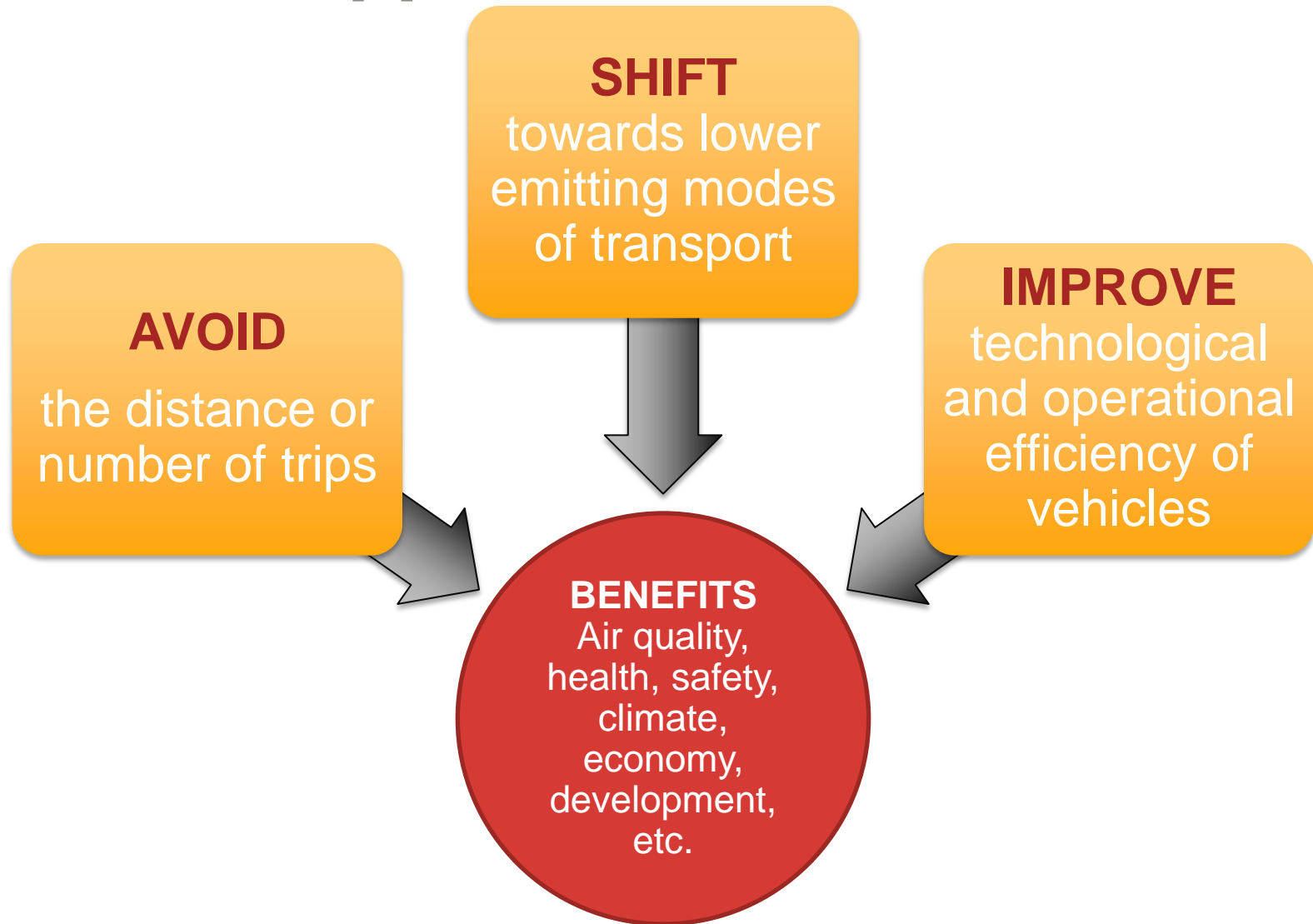
Photo: FPPQQ



# DEFINING GREEN TRANSPORT

# ASI FRAMEWORK

# The A-S-I approach



# The push and pull

## Measures with push-effects

Area-wide parking management, parking space restrictions in zoning ordinances, car limited zones, permanent or time-of-day car bans, congestion management, speed reductions, road pricing...

## Measures with pull-effects

Priority for buses and trams, high service frequency, passenger friendly stops and surroundings, more comfort, park-and-ride, bike-and-ride..., area-wide cycle-networks, attractive pedestrian connections...



## Measures with push- and pull-effects

Redistribution of carriageway space to provide cycle lanes, broader sidewalks, planting strips, bus lanes..., redistribution of time-cycles at traffic lights in favour of public transport and non-motorized modes, public-awareness-concepts, citizens' participation and marketing, enforcement and penalizing...

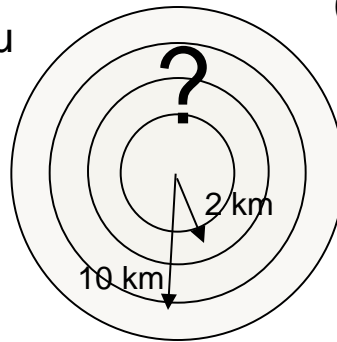
Source: Müller, P., Schleicher-Jester, F., Schmidt, M.-P. & Topp, H.H. (1992): Konzepte flächenhafter Verkehrsberuhigung in 16 Städten", Grüne Reihe des Fachgebiets Verkehrswesen der Universität Kaiserslautern No. 24.

# Example of ASI- Shopping



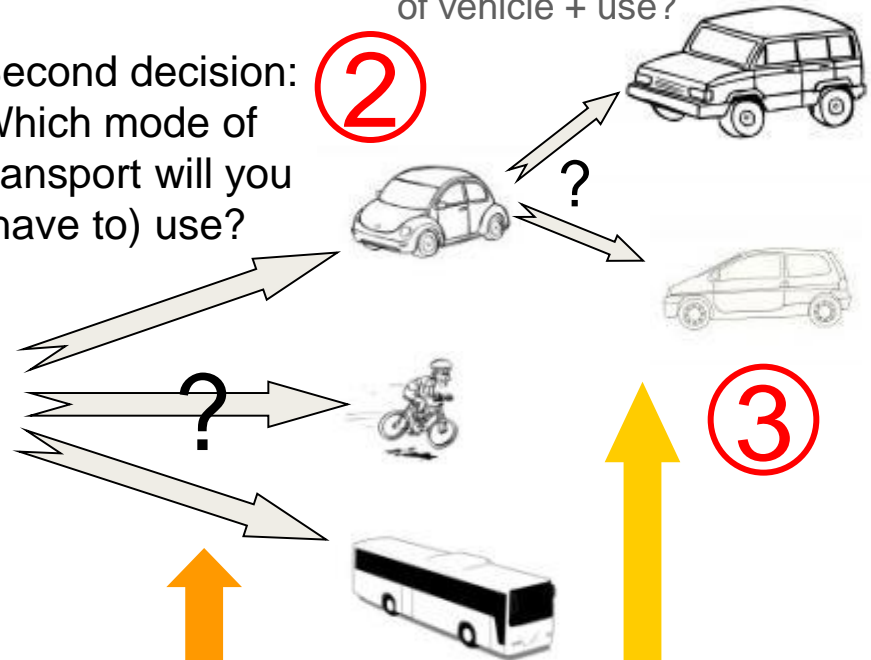
First decision:  
How far do you  
have to go?

①



Second decision:  
Which mode of  
transport will you  
(have to) use?

②



Third decision:  
Which type  
of vehicle + use?

③

Starting point:  
A household  
requires a wide  
range of goods,  
At various times  
of the day

Compact land-use  
planning: Reduces  
need for motorized  
travelling  
**AVOID**

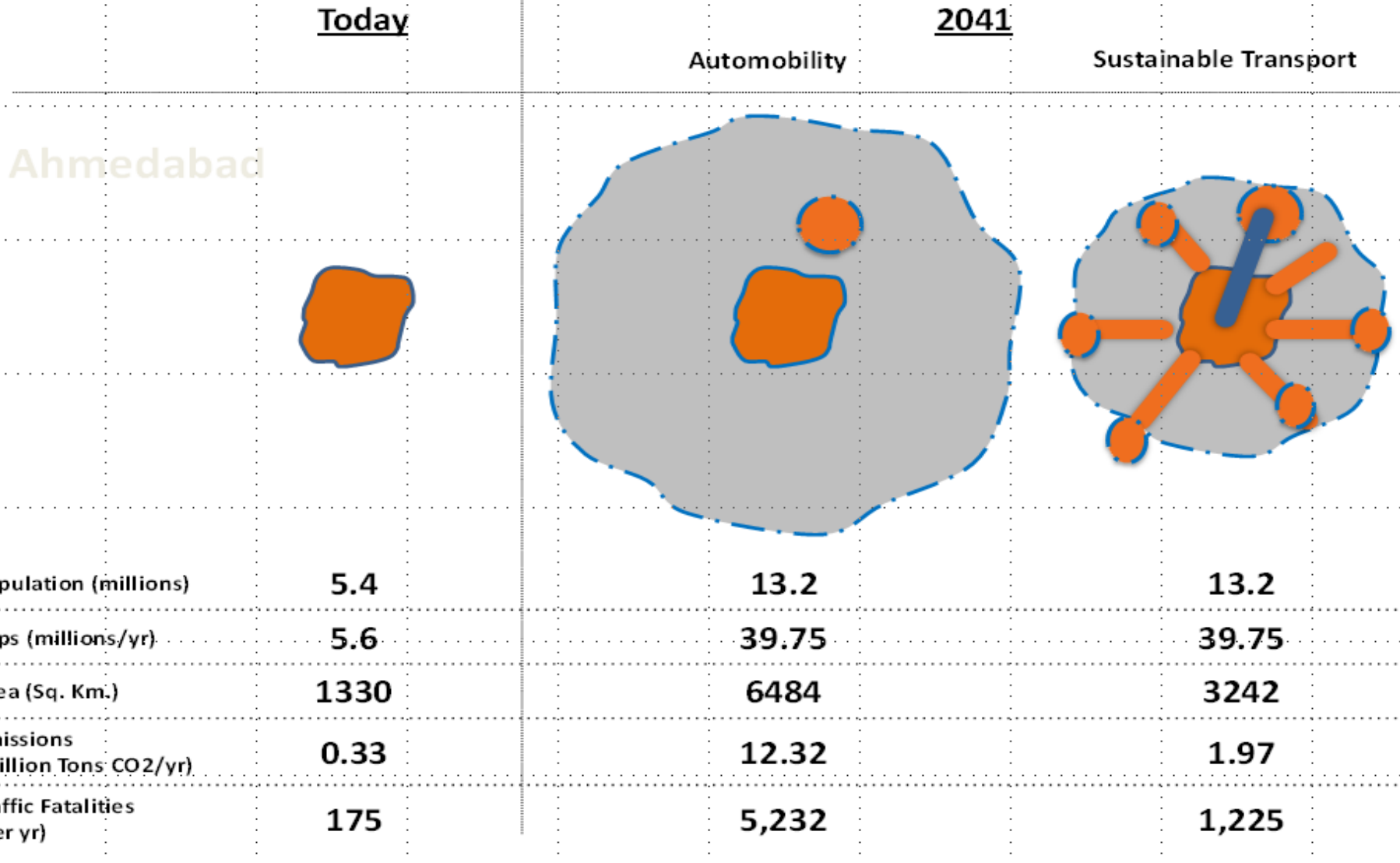
Encourages use of  
non-motorized and  
public transport  
over cars

**SHIFT**

Improves vehicle  
technology and  
uses  
cleaner fuels  
**IMPROVE**

# ASI strategies in practice





# WORLD ASPIRATION



# Transport Oriented Development



# Bus Rapid Transit

# What is a Bus Rapid Transit system?

**“Is a flexible, rubber-tired form of rapid transit that combines stations, vehicles, services, running ways and ITS elements into an integrated system with strong identity”**

*TCRP Report 90 – Bus Rapid Transit – Volume 2: Implementation Guidelines 2003*

**“It is a high quality public transport system, oriented to the user that offers fast, comfortable and low cost urban mobility”**

*BRT Planning Guide – ITDP, 2007*



Karl Fjellstrom, ITDP

Photo: Karl Fjellstrom - ITDP

# Bus Rapid Transit (BRT)

Centralized Control

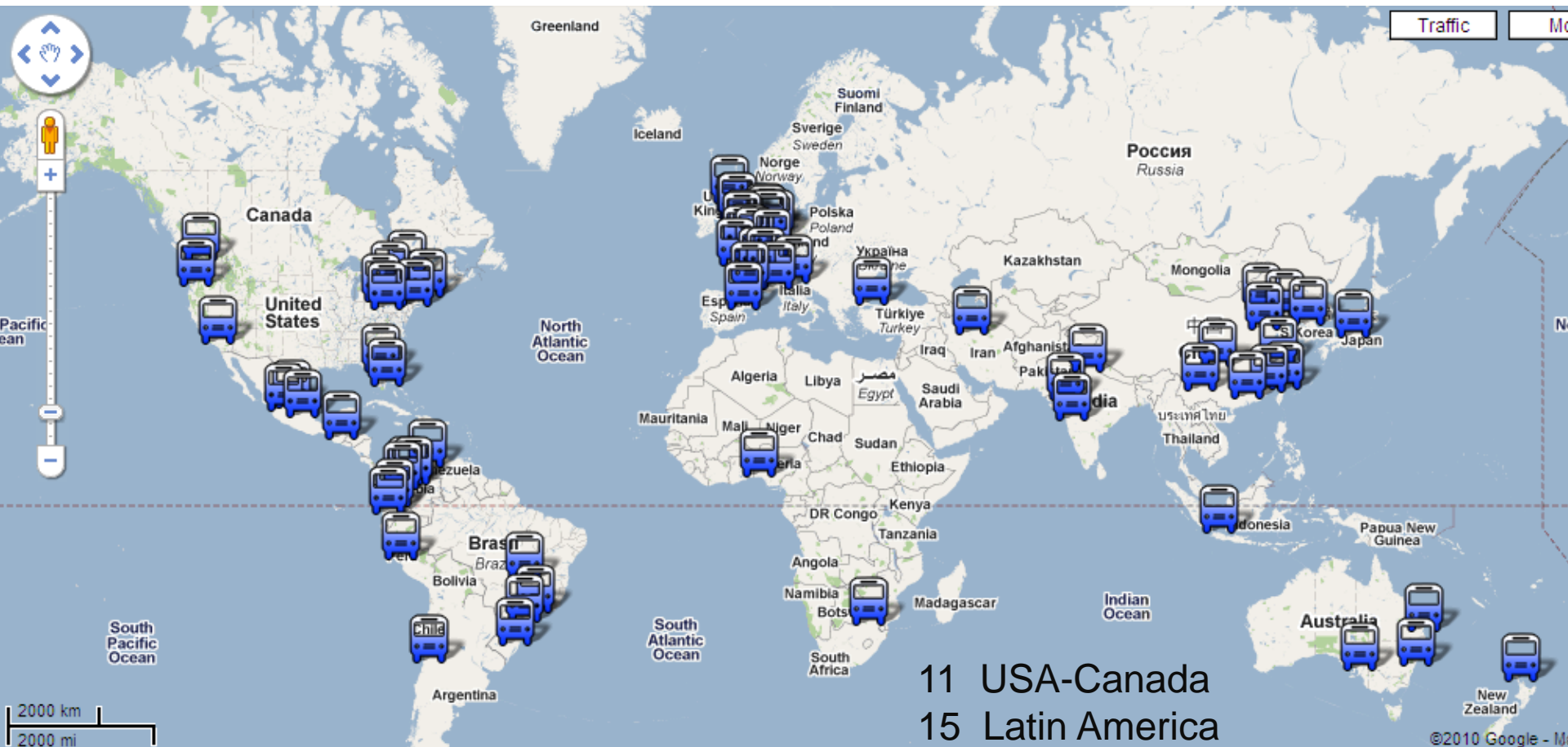
Large Buses  
Multiple Wide  
Doors

Distinctive Image

Stations with  
Prepayment and Level  
Boarding

Segregated  
Median  
Busways

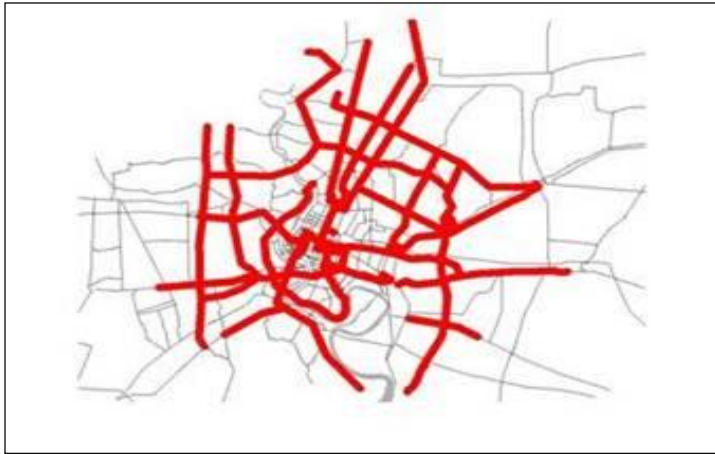
# About 68 systems in developed and developing countries



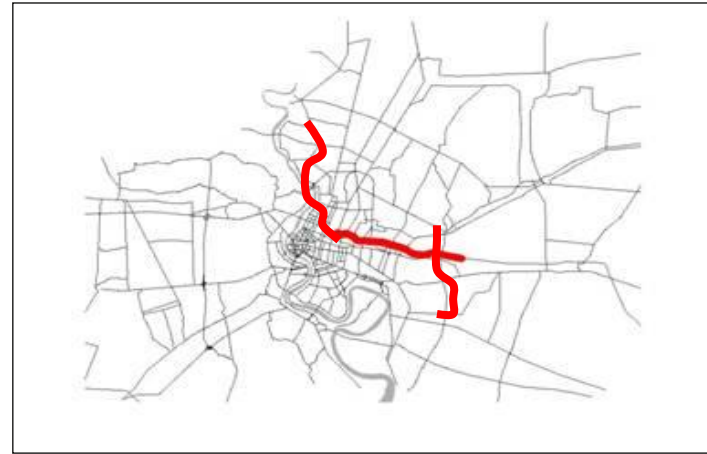
- 11 USA-Canada
- 15 Latin America
- 20 Europe
- 2 Africa
- 16 Asia
- 4 Australia-New Zealand

# Financial Benefit-What a city can have for 1Bn US\$?

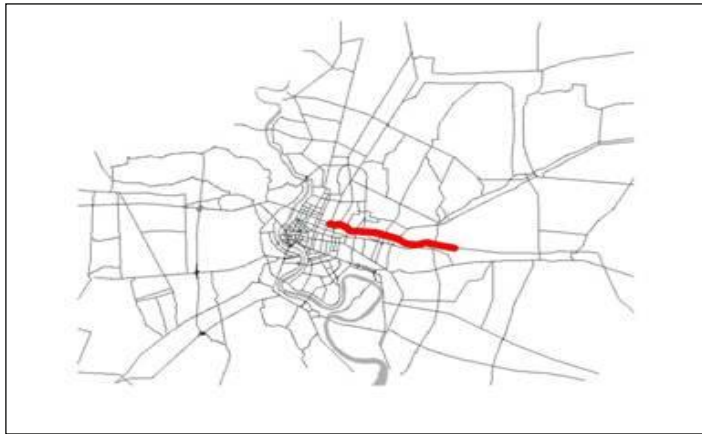
## Make a choice...



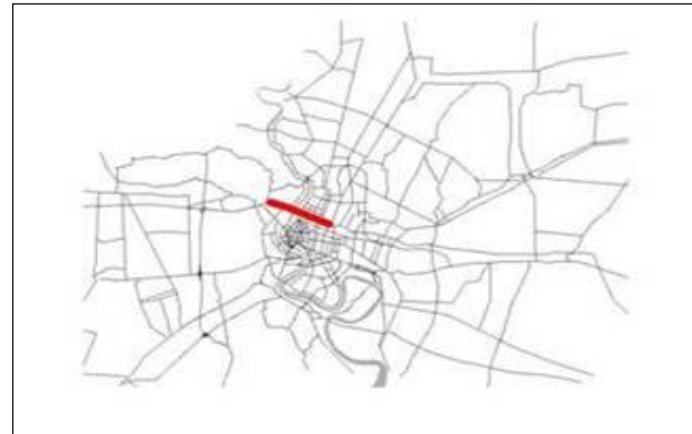
426 kilometres of BRT



40 kilometres of LRT



14 kilometres of elevated rail



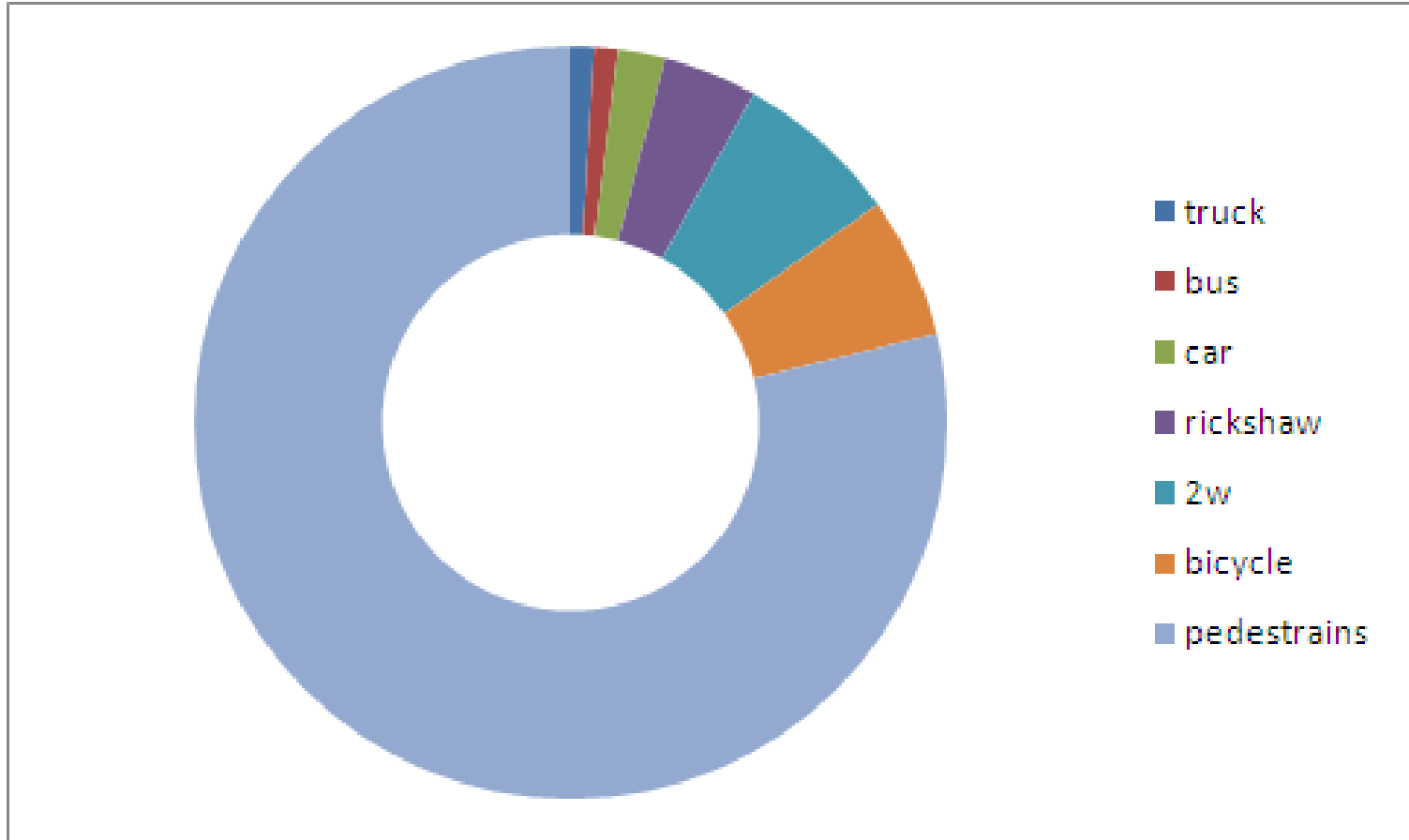
7 kilometres of underground rail

\* Source: GIZ- Actual data from systems built or proposed in Bangkok, Thailand

# Non-Motorized Transport



# Road fatalities by victims- in the present day car-centric scenario



Pedestrians represent 78% of road fatalities in Mumbai

# Main Public Health Interventions



Helmets



Alcohol



Seat-belts



Speed



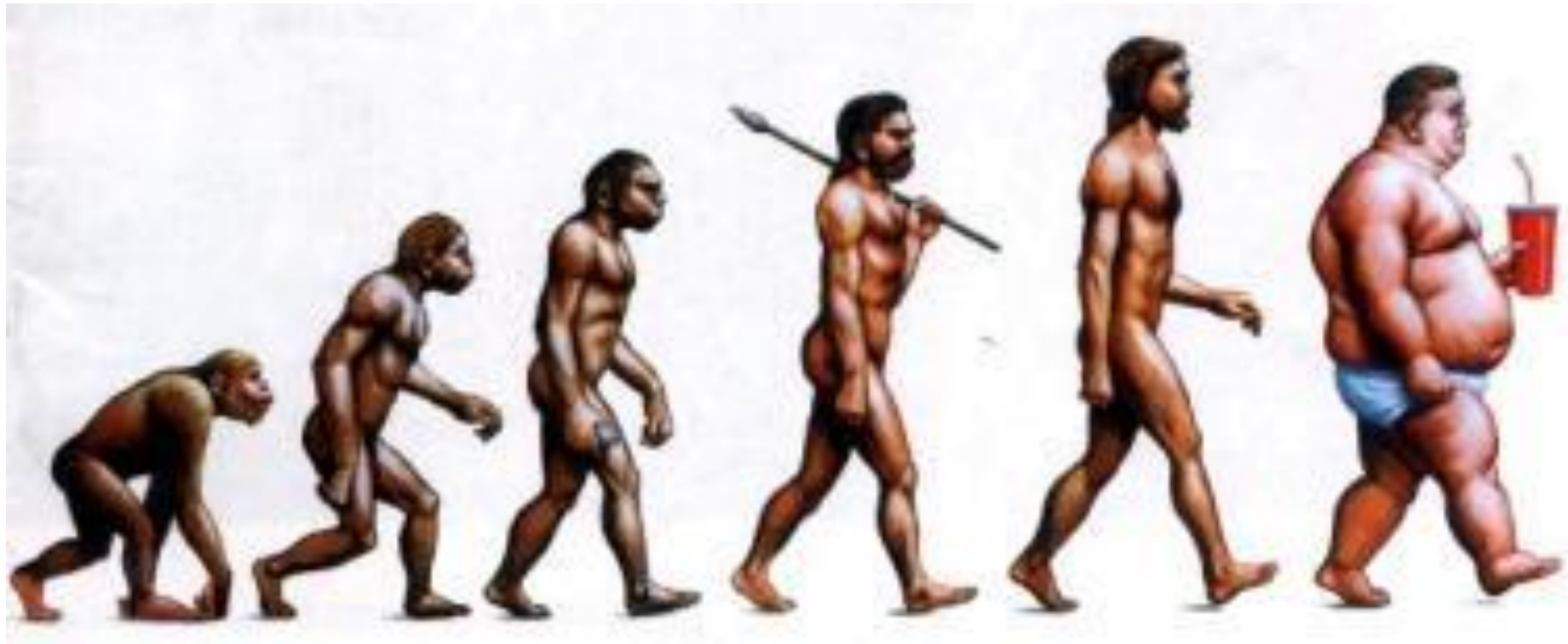
Visibility

# Health and Road Safety improvement – a holistic view



- **Avoid:** Add mass transport, walking and biking trips rather than vehicle trips that can cause more crashes, sedentary life
- **Shift:** Reduce driving and crashes through moving people to mass transport, walking, biking
- **Improve:** Mainstream road safety, emission technologies, facility designs, public space

# Sustainable Transport is a public health strategy





# Traffic Demand Management

# Transportation Demand Management



# Congestion Pricing: A key emerging TDM strategy



# Public Space

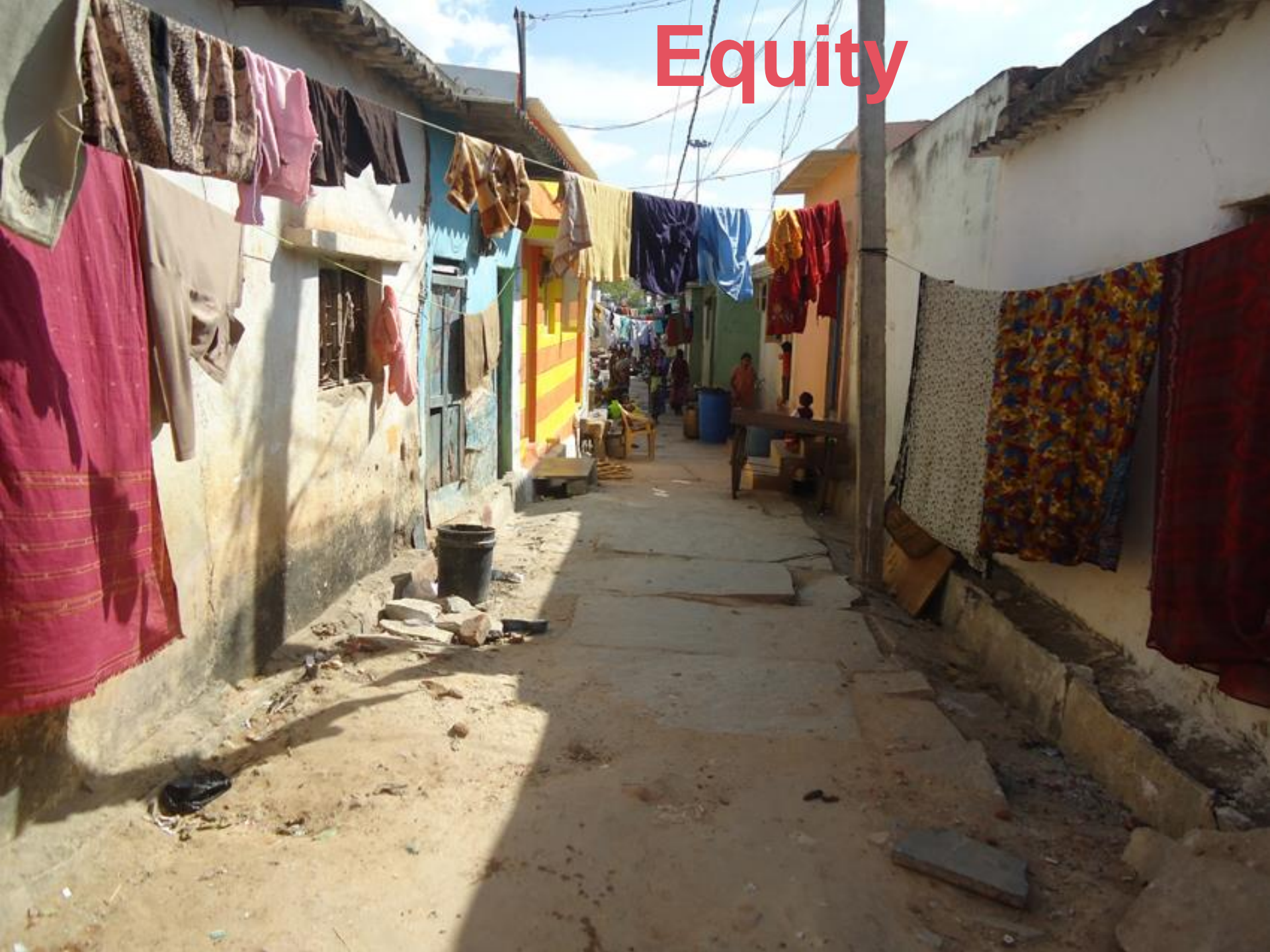


Source: Arora and Gadepalli, 2012



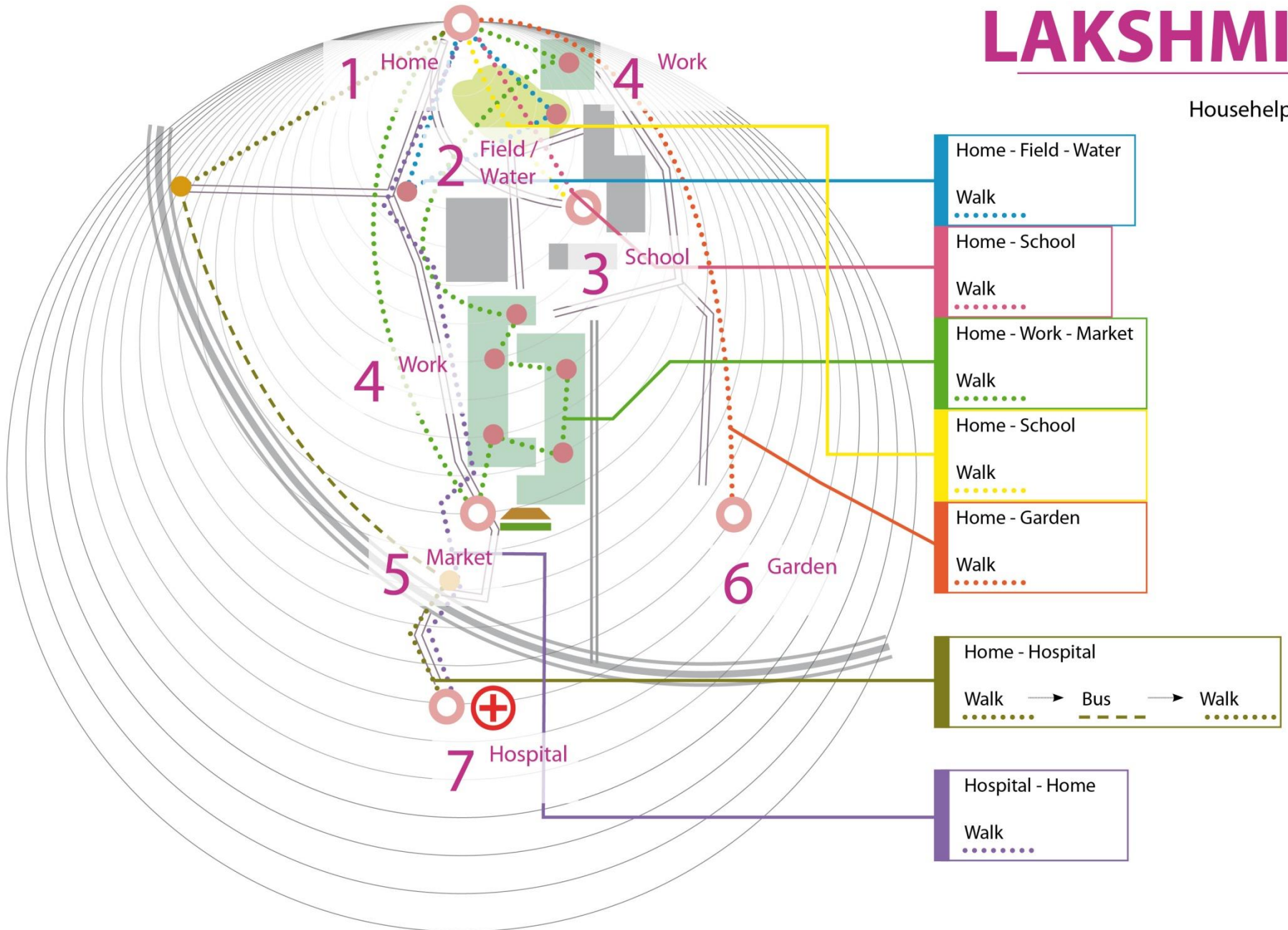
Clean Fuels &  
Clean Vehicles

# Equity



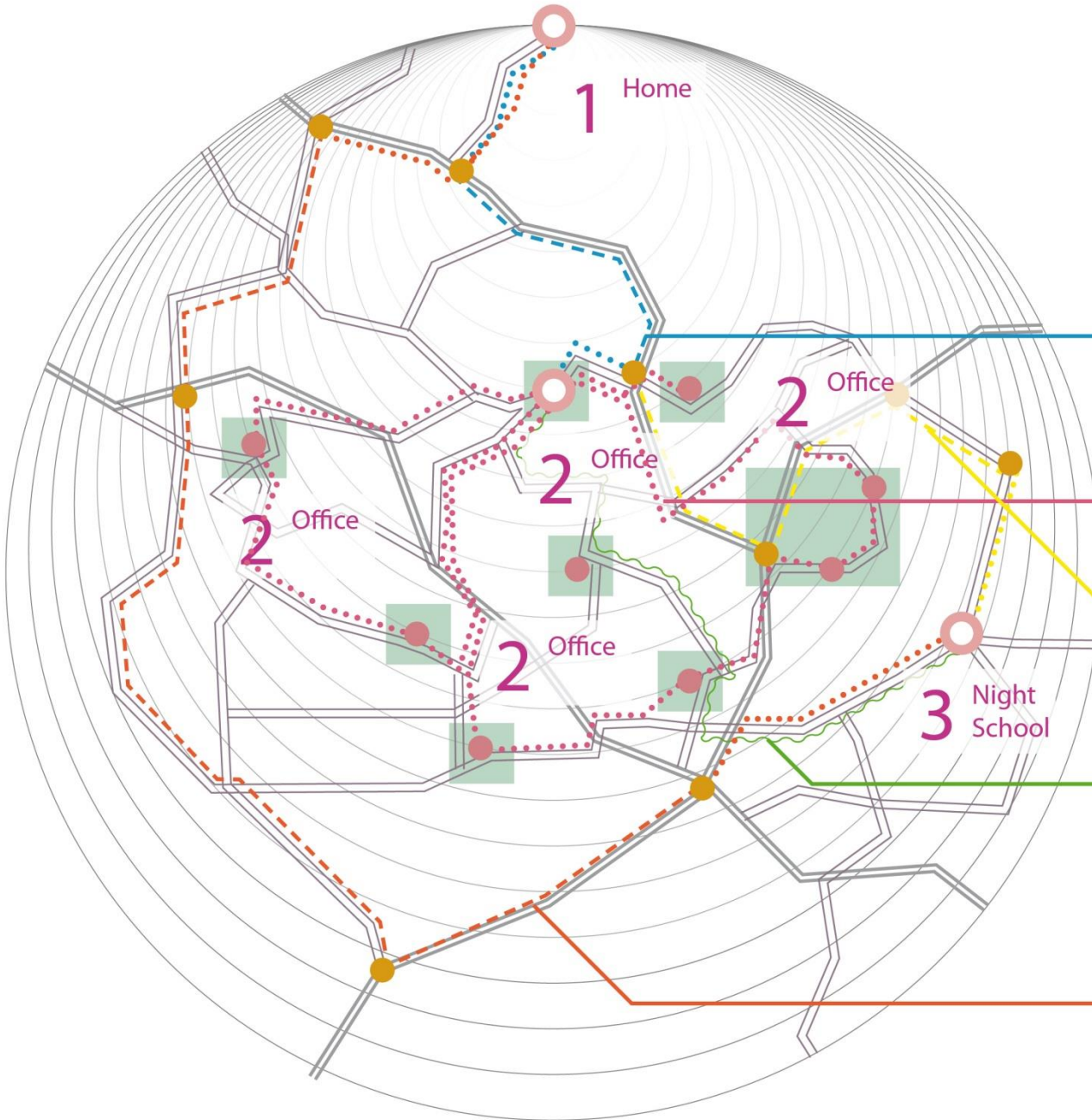
# LAKSHMI

Househelp



# SHAHEED

Office Boy



Home - Office  
Walk → Bus → Walk

Office  
Walk

Work - Night School  
Walk → Bus → Walk

Work - Night School  
Auto Rickshaw

Night School - Home  
Walk → Bus → Walk

# Access for all

- **Physical accessibility – infrastructure for all, for the differently abled, location/spacing, weather resilient**
- **Economic accessibility – cost**
- **Temporal accessibility – frequency, hours, reliability**
- **Safety and security – to and from station, on vehicles/space (especially for women and children)**
- **Comfort – cleanliness, crowds**
- **Longer term – environmental, financial, and political sustainability**



# Green Freight

**What is the  
Government  
doing?**

# National Urban Transport Policy

- Focus on moving people not vehicles
- 1 Billion USD for BRT projects
- Over 1 Billion USD to procure buses

2006



|   | PHASE 1             | PHASE 2  |
|---|---------------------|--|
|  | Line 1              |  ELEVATED     |
|  | Line 2              |  UNDER GROUND |
|  | Line 3              |  |
|  | Interchange Station |  |

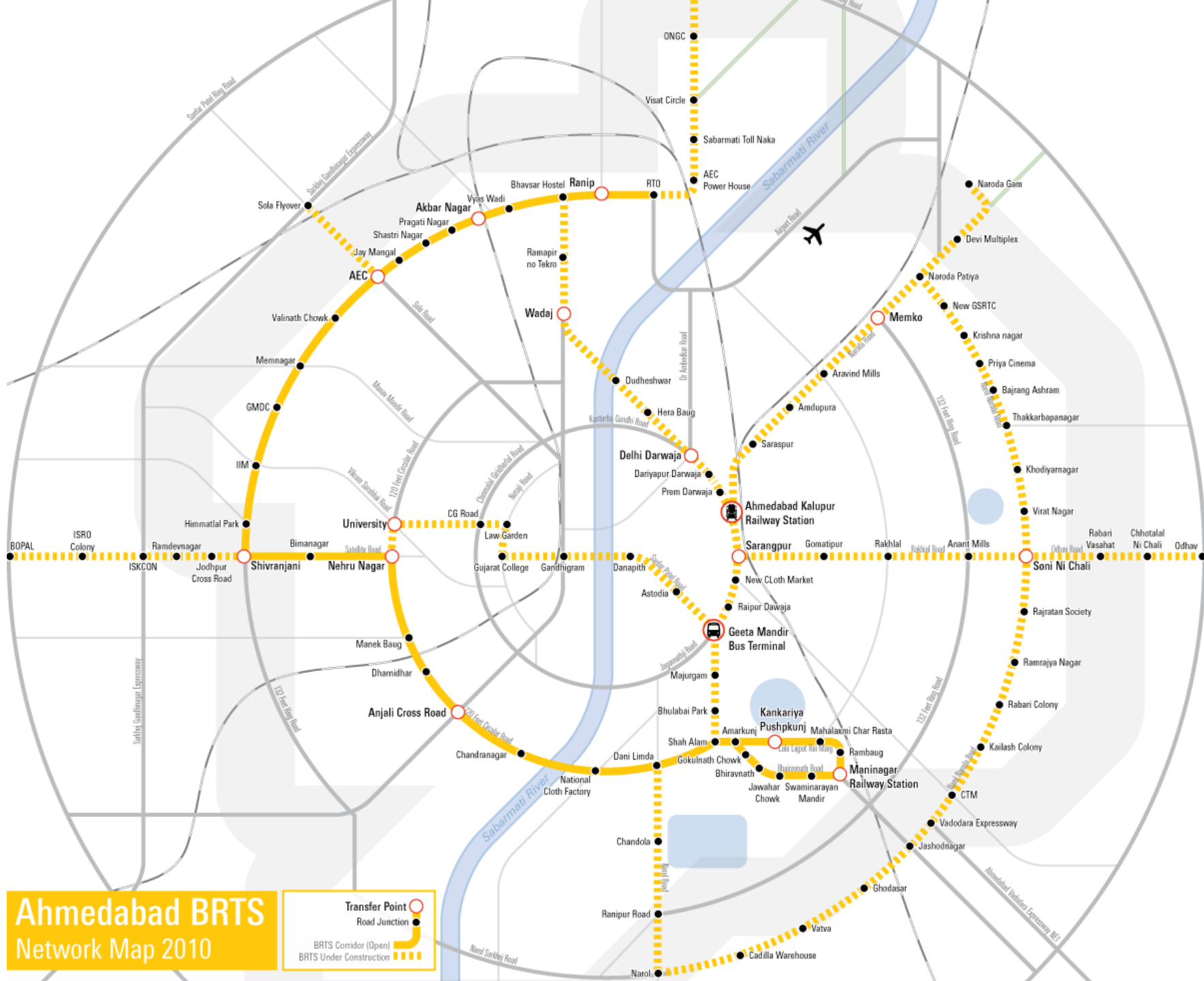




# Janmarg - Ahmedabad

- Opened Oct 2009
- 39 kms – 100,000 riders per day (Dec 2010)
- 90 kms – 400,000 riders per day (Dec 2014)

2009



# Ahmedabad BRTS Network Map 2010

**Transfer Point**   
**Road Junction**   
**BRTS Corridor (Open)**   
**BRTS Under Construction** 

# City Buses - Indore

- Opened Mar 2010
- 105 Buses
- 90,000 Pax per day

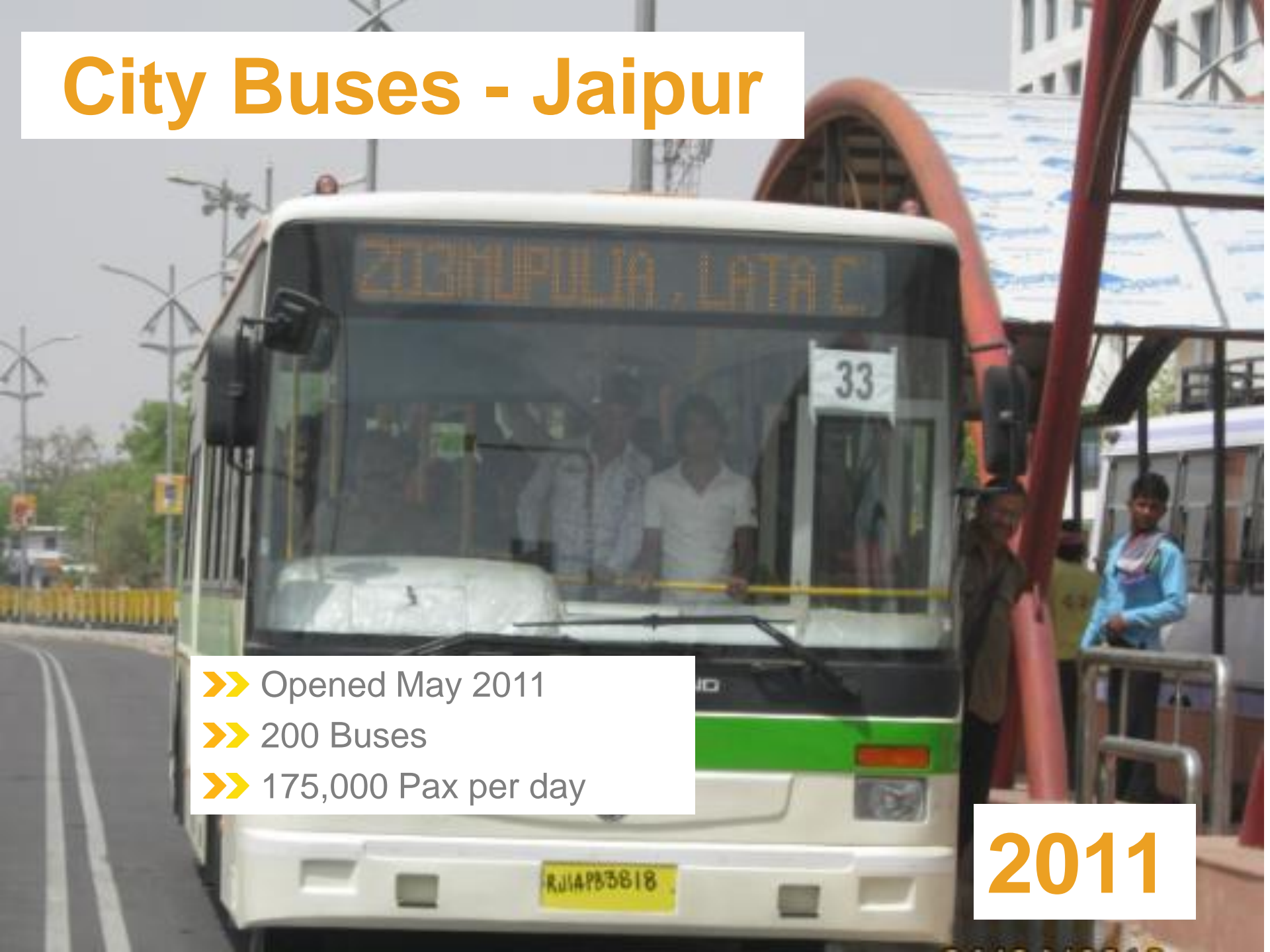
2010



# City Buses - Jaipur

- Opened May 2011
- 200 Buses
- 175,000 Pax per day

2011



# Rickshaws- Rajkot



2012

# Namma Cycle - Bangalore



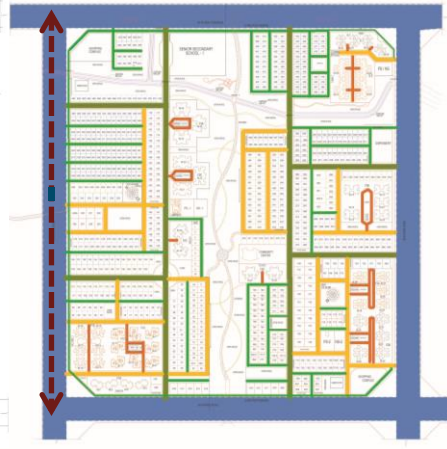
2012

# TOD in Naya Raipur

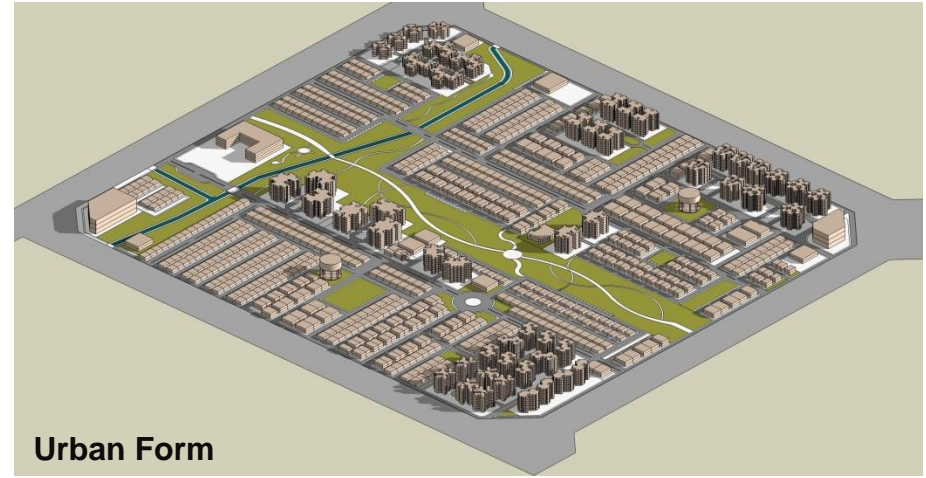
Various parameters of analysis of an existing sector to understand strengths / weaknesses



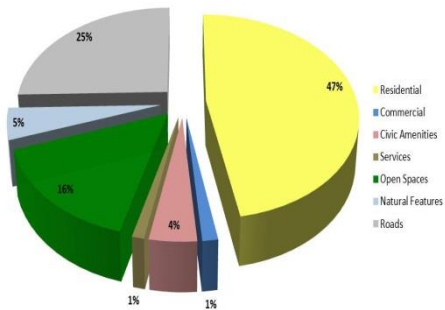
FSI and densities



Road network and hierarchy



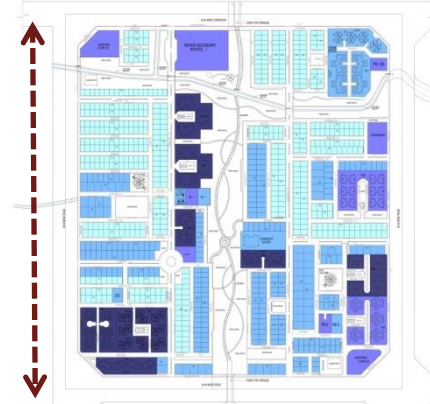
Urban Form



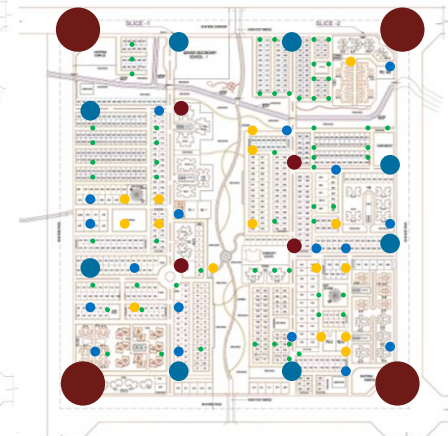
Land use



Open space/ public space

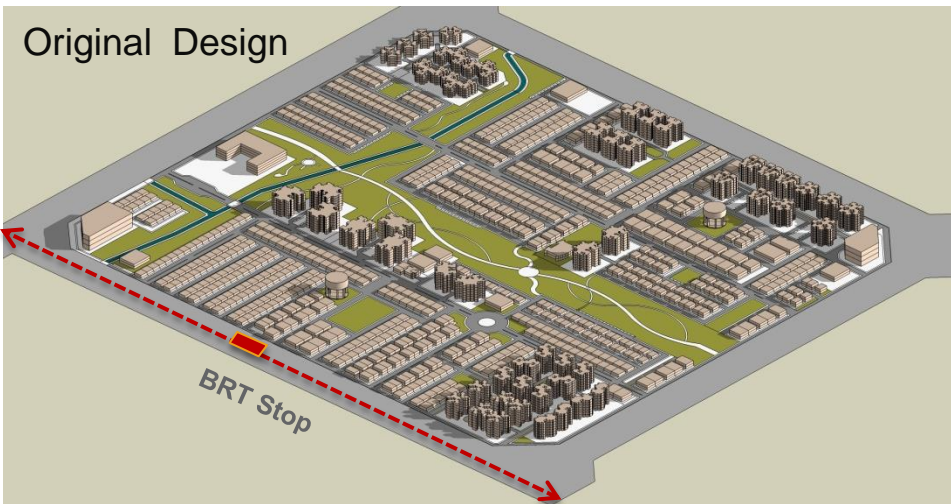


Dwelling unit density



Junction hierarchy

# Naya Raipur – Comparative Indicators



| Criteria                                  | Original Design        | Proposed Design  |
|---|------------------------|------------------|
| Transit station adjacent density          | 100 ppH                | 600 ppH          |
| Transit corridor density                  | 300 ppH                | 500 ppH          |
| Transit adjacent mixed use                | 20%                    | 50%              |
| 5 min walk distance to transit stop       | 30% population         | 50% population   |
| Walk trip distance to amenities           | 5 to 10 mins           | 2 to 5 mins      |
| Hierarchy of greens                       | Centrally concentrated | Well distributed |
| Natural features and contour conservation | 50%                    | 80%              |
| Population accommodated in sector         | 11,000                 | 15,000           |
| Connectivity across quadrants             | Poor                   | Good             |
| Legibility of urban form                  | Poor                   | Good             |

# Namma Metro – Improving Access



*Indiranagar Metro Station on CMH*

# Namma Metro – Improving Access

## Indiranagar Metro Station area



- Project area: 500m radius influence zone around the metro station., with a population 3.33lakhs and 7,255 households
- Detailed proposals focussed on a 150m radius around station.
- Surveys conducted for 350 residents, 180 visitors and 180 passersby

| TOD Principles                           | Existing Situation  |
|--|---|
| Transit                                  | Metro station as trigger for development (Along commercial spines CMH Road and 100ft road)  |
| Non Motorised Transport                  | Poor access to the metro station. No physical planning for transfer to feeders. No special treatment / lanes for bicycles.        |
| Public Spaces                            | Exist, but not inter connected nor easily accessed through pedestrian routes  |
| Density                                  | Densification occurring along main roads. FAR not utilized completely on internal roads. FAR 4.00 being explored along alignment. |
| Mixed Use                                | Mixed use is increasing rapidly and is largely retail commercial and offices.   |
| Demand Management, Parking & Road Safety | No demand management. Widespread street parking. Internal streets used as thoroughfares   |
| Participation                            | No participation. Opposition from local businesses to metro alignment   |

# Enigmas

**-12,000 Bicycles**  
**- 2,000 Rental & Repair Shops**  
**- Out of town vendors, day laborers**









RECNO

RECNO

OLRF  
5805

OLRF  
7345

OLRF  
4422

# Way ahead

# Thank you

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# PUBLICATIONS

Transport in Cities

# INDIA

**BUS KARO**  
A GUIDEBOOK ON  
BUS PLANNING &  
OPERATIONS

