

# Methods to Estimate Vehicular Characteristics in Indian Cities

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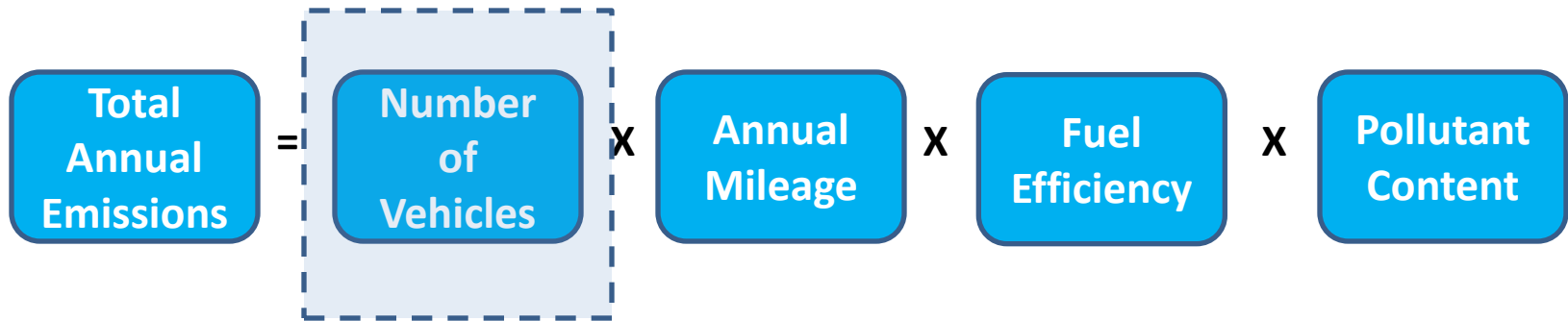
UNEP- Low Carbon Transport in India, Udaipur

# Transport Emissions

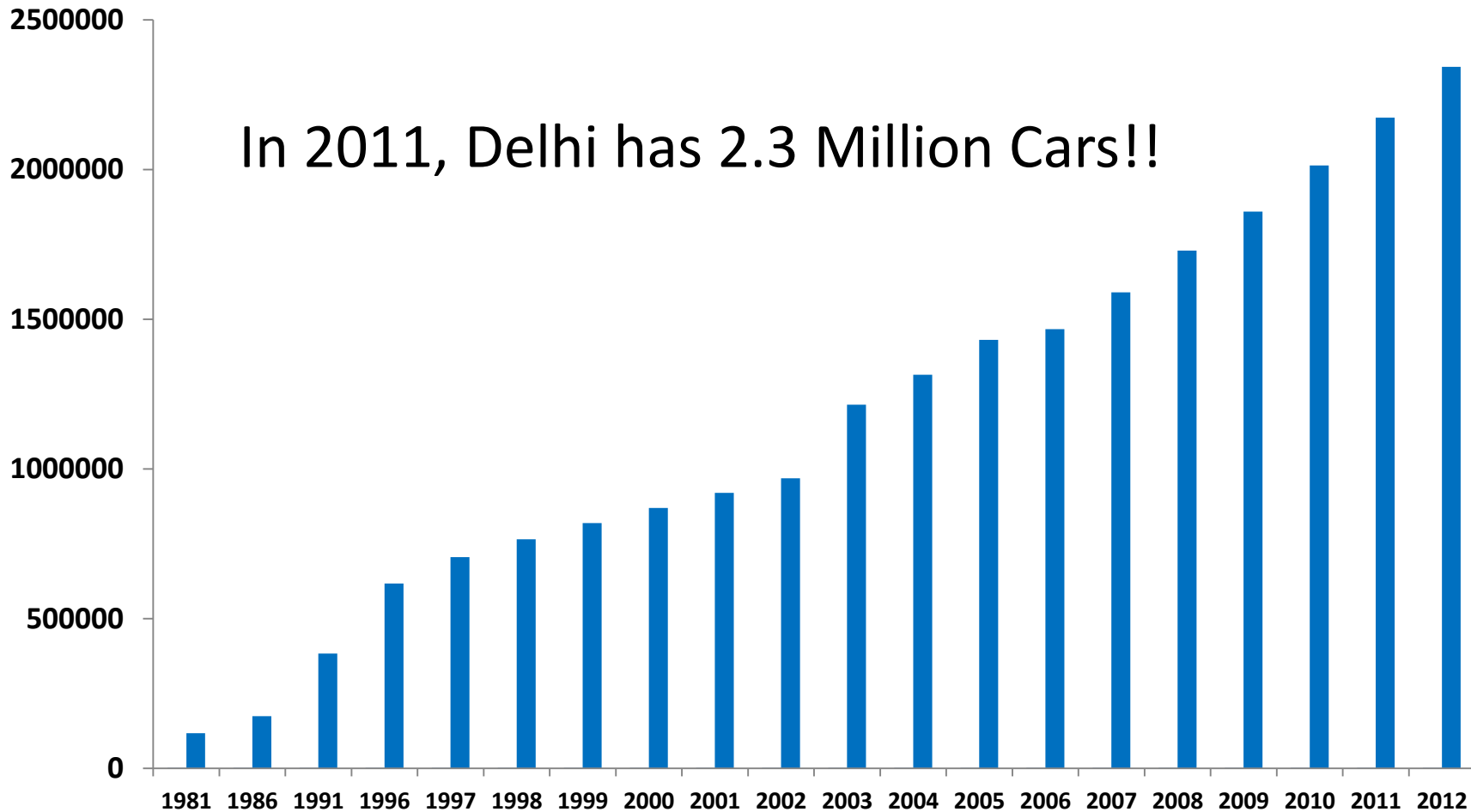


- Share of Fuel among Vehicles
- Age Profile of Vehicles

# Transport Emissions



# Number of Cars Registered in Delhi Cumulative Series



# Car Ownership in Delhi

Cars in Delhi (2011) = 2,300,000

Number of Households (Census 2011) = 3,440,000

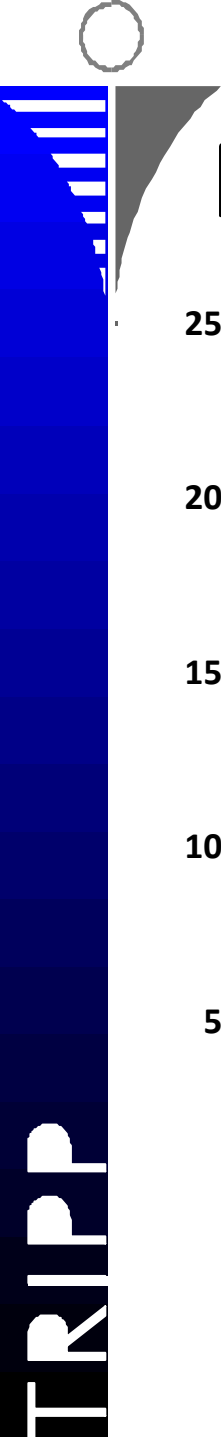
Average car per household = 1.3

Car Ownership ~ **50% !**

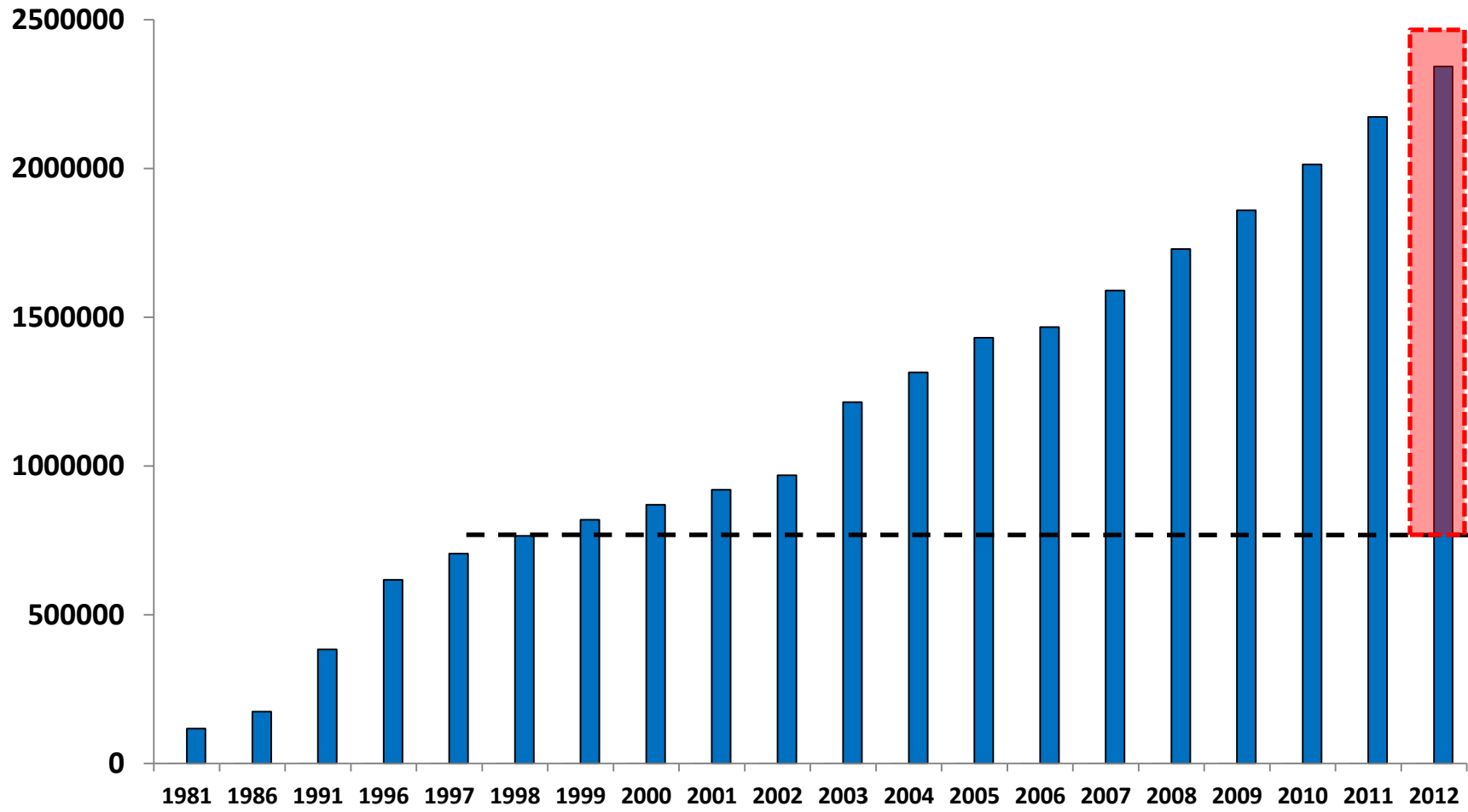
Delhi Car Ownership ~ **20% !** (Census 2011)

# Vehicles (like humans) aren't Immortal!





# Percent of Registered Cars in-use



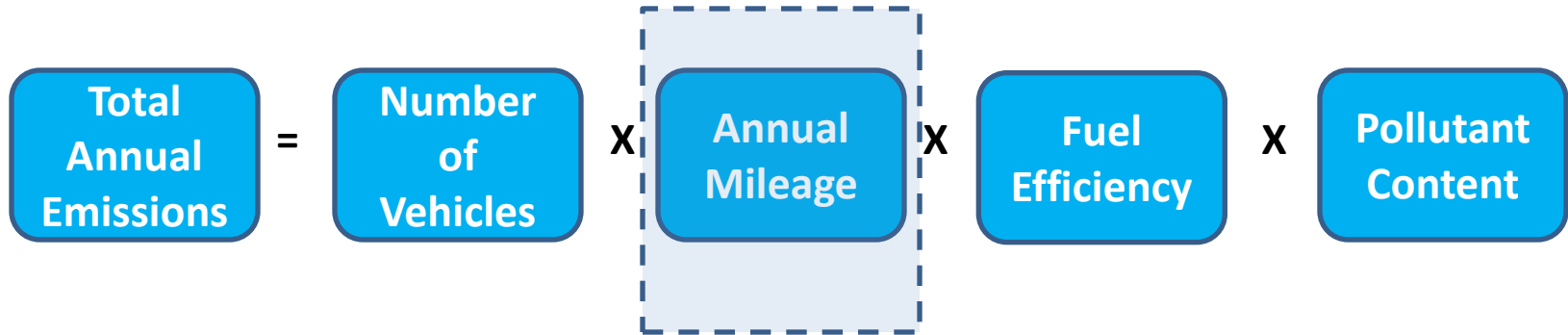


# Issues with Official Registration Data

- Private vehicles in India required to re-register after 15 years
- No mechanism in place to ascertain which vehicles have retired / taken-off the road
- Result: Registration data overestimates number of in-use vehicles
- How much overestimation? We don't know!



# Transport Emissions

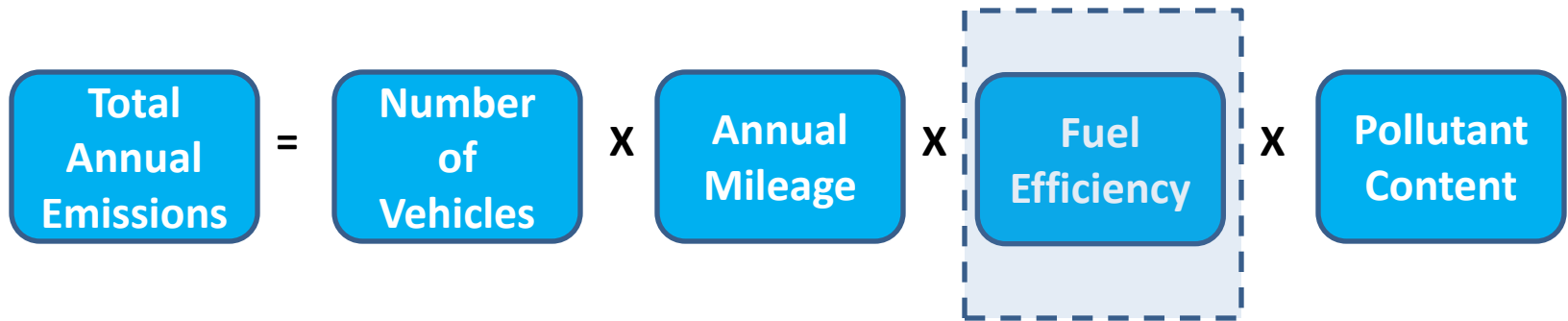


# Annual Mileage

- Annual kilometers-travelled
- Varies for different vehicle types and cities



# Transport Emissions





# Fuel Efficiency

- Auto manufacturers - fuel efficiency values - often an overestimate
- Possible due to differences in the driving cycle- actual and lab
- For fleet in the city- fuel efficiency values need to be weighed proportional to their share



# Surveys and Databases

- Fuel Station Surveys
- Pollution under Control (PUC) Database
- Road side survey
- Vehicle Registration Data- Time Series

# Fuel Station Surveys- Sampling

- Suitable sample locations for a representative sample
- Sampling of locations – critical for a representative sample
- Highways/by-passes within city boundaries will bias results due to high proportion of taxis and inter-city traffic





# Fuel Station Surveys- Sampling in Delhi

- Covered Land-use types:
  - Major urban arterial
  - Residential
  - Mixed Use
- And, geographical areas:
  - South, North and North-West Delhi

# Fuel Station Surveys

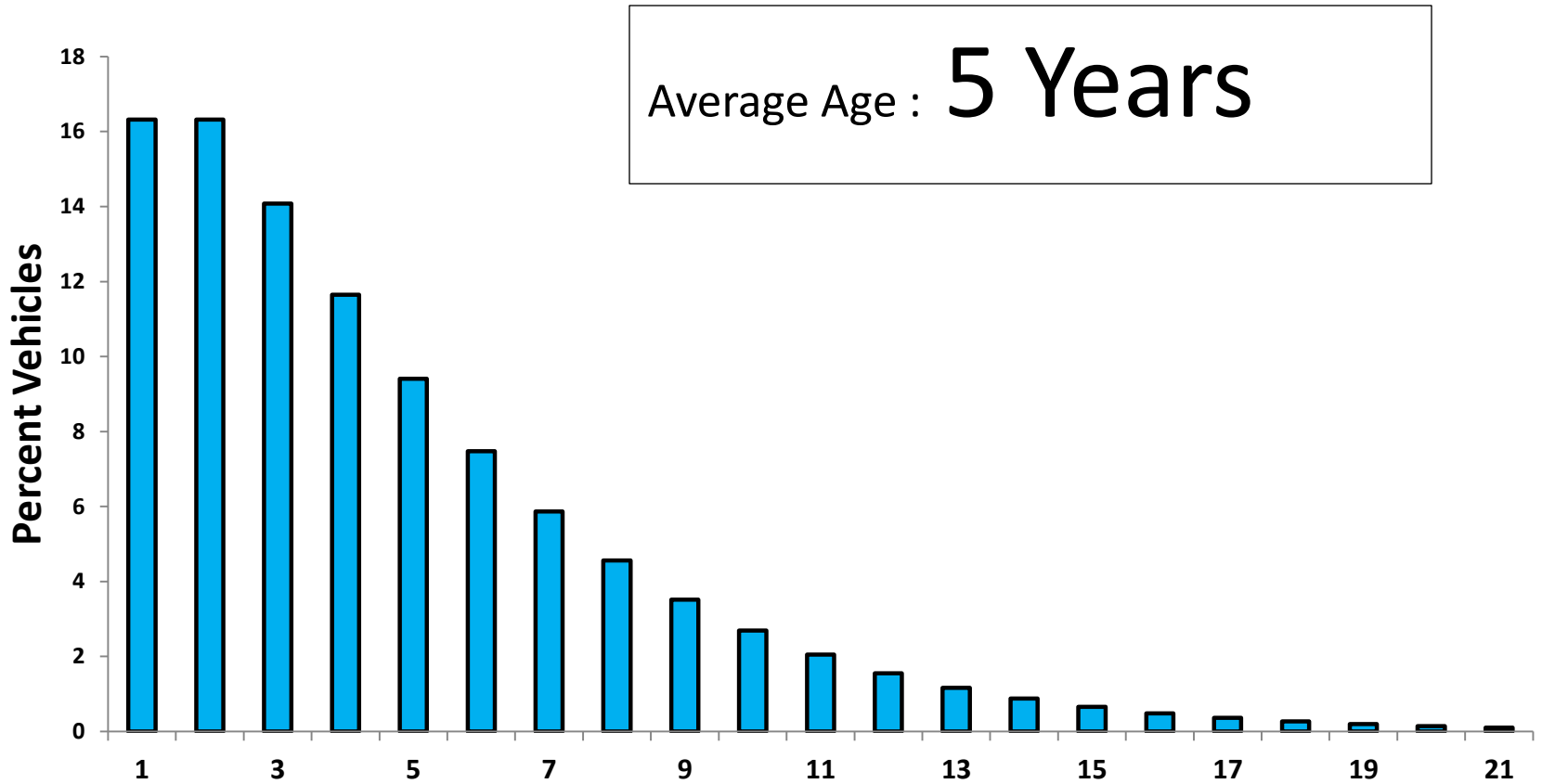
- Selected a sample of fuel stations in Delhi
- Interviewed a sample of drivers arriving for re-fuelling

- Make and Model
- License Plate Number
- Type of Vehicle
- Fuel Type
- Model Year

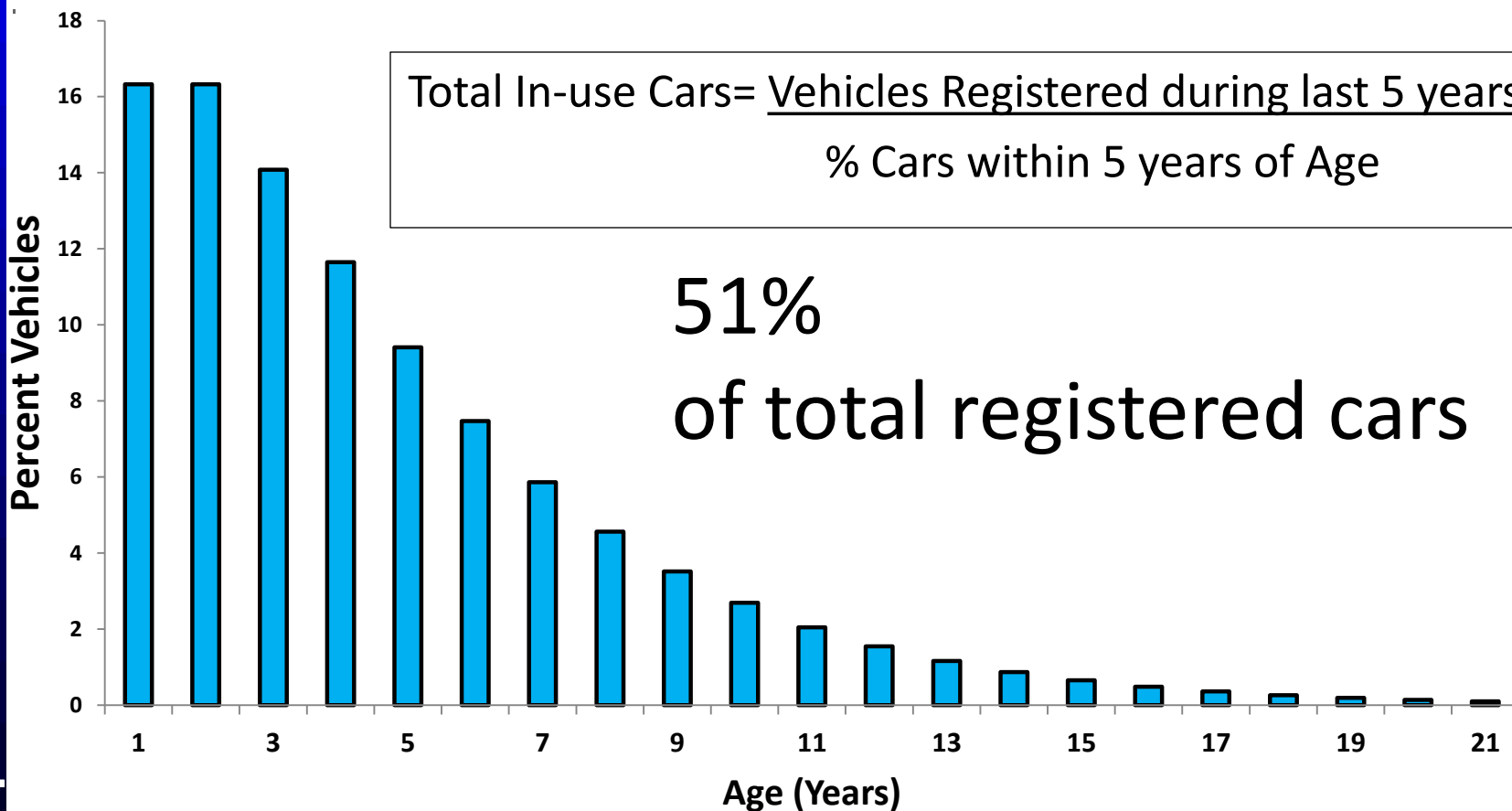
← Questionnaire



# Age Distribution of Cars



# Correction Factor



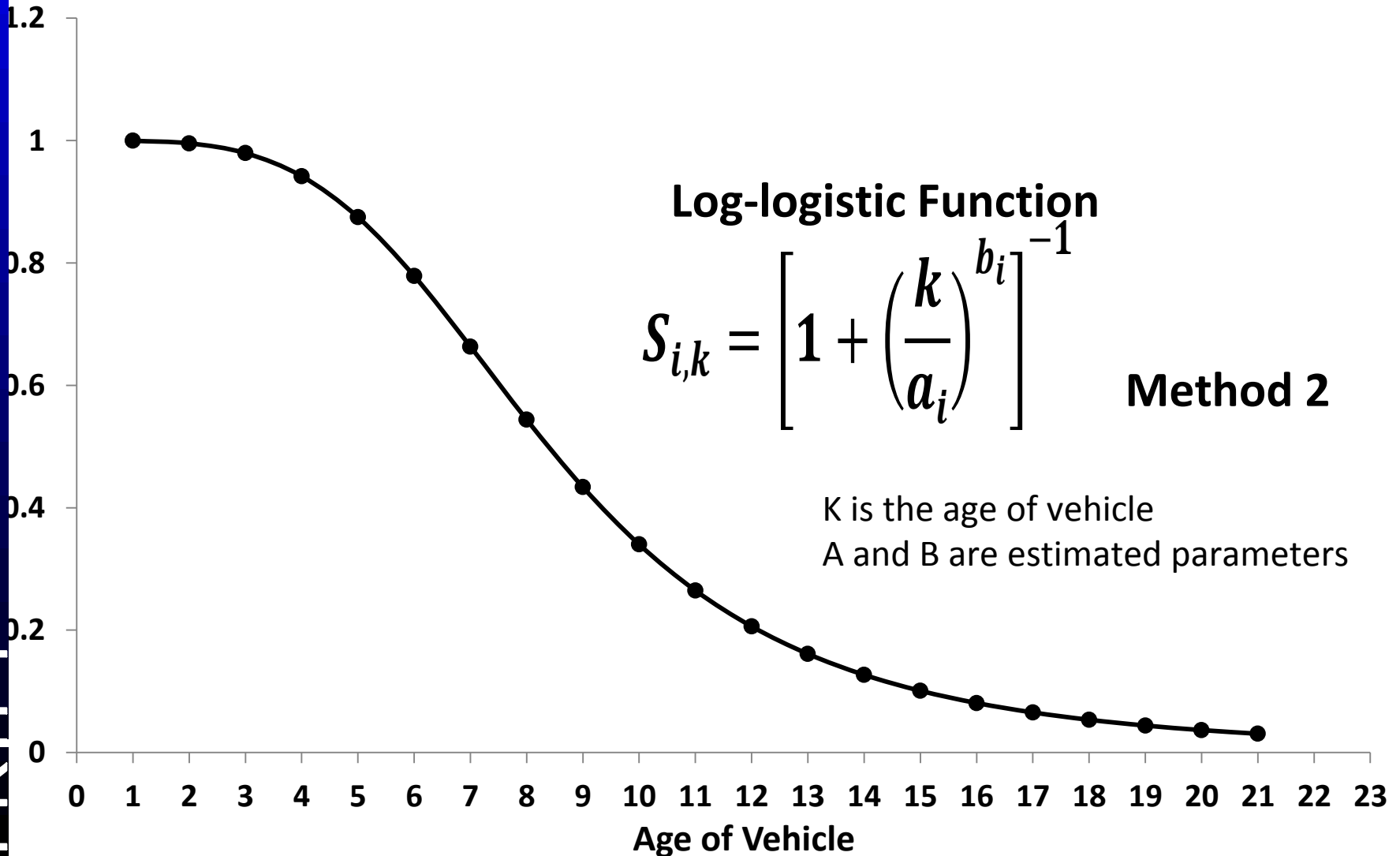
**Method 1**

# Survival Function of Vehicles

- Probability of a car surviving till age  $k$  years

Model Year	Vehicles Registered	Age Distribution (%)	Vehicles In-Use	Survival Rate
2011	169,790	15.8	160,458	99%
2010	159,643	15.4	157,214	97%
2009	154,310	14.4	143,595	95%
2008	129,675	12.1	128,875	89%
2007	139,823	10.6	113,296	83%
2006	123,231	8.6	97,265	75%
<b>Total In-use</b>			<b>1,405,800</b>	

# Survival Function of Cars





# Survival Function- Issues

- Calibrated for Delhi- a large metropolitan, and relatively affluent
- Once calibrated for smaller urban areas, could potentially be used as a generic curve for Indian scenario
- Can be used to estimate current in-use vehicles as well as for forecast

# Pollution Under Control (PUC) Data

- Vehicle Type
- Make and Model
- Engine Type
- Fuel Type
- Date of Manufacture
- Date of Test
- Pollution Numbers- Carbon Monoxide and Hydrocarbon

**Clean & Green**  
Transport Department Govt. of NCT of Delhi  
SIAM in pa

Partnership with Transport Department, Government of Delhi

[Pollution in Delhi](#)  
[Emission Standards](#)  
[Effects of pollution](#)  
[Puc certificates](#)  
[Pollution checking centres](#)  
[Compressed natural gas](#)  
[Computer's Requirements](#)  
[Do's & Don'ts](#)  
[Circular](#)  
[Operator Request Form](#)

The Transport Department of Govt. of NCT of Delhi is entrusted with the responsibility of providing an efficient public transportation system, control of vehicular pollution, registration of vehicles in Delhi, issuance of Driving licences, issuance of various permits, collection of road taxes. The department also entrusted in policy-making, co-ordination, implementation, monitoring and regulatory functions of all the Transport related aspects of National Capital Territory of Delhi.---

 The vehicular pollutants have damaging effects on both human health and ecology. The human health effects of air pollution vary in the degree of severity, covering a range of minor effects to serious illness, as well as premature death in certain cases.  
[>> more information](#)

 A vehicle, not carrying a valid PUC Certificate is liable to be prosecuted under Section 190(2) of the Motor Vehicles Act. A penalty of Rs.1000/- for first offence and Rs.2000/- for every subsequent offence of violation has been provided.  
[>> more information](#)

**HelpLine No. 011-23830240,9971384749**

Copyright Government of Delhi, Transport Department, Pollution Control Division,  
Best viewed in internet explorer 4.0 or above with 800x600 resolution.

**Vehicular Pollution in Delhi**  
Delhi's registered vehicular population has nearly doubled from 4.5 million from 2.2 million in 1990-91. The number of Motor Vehicles are two-wheelers. Vehicular pollution is considered to be a major cause of air pollution in Delhi. As per the Central Pollution Control Board, the vehicular pollution load in Delhi has increased by nearly 50% from 1990-91. However, the increase has been witnessed in recent years with the implementation of various control measures. Vehicular pollution load reported by the Central Pollution Control Board is as follows:

**Alternate Fuel to Control Vehicular Pollution Compressed Natural Gas (CNG)**  
CNG (short for Compressed Natural Gas) is emerging as an alternative fuel due to its burning characteristic and low amount of exhaust pollutants.

# PUC Compliance

## Petrol Report

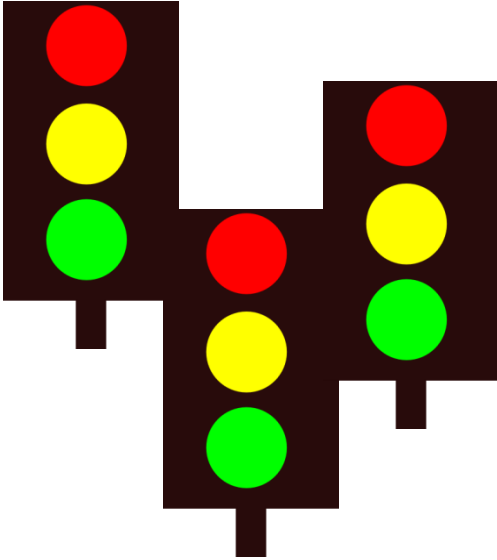
Note: Please enter the vehicle registration number to get the details of the vehicle.

Enter Vehicle Registration No.:

By Vech no.

S.No.	Customer name.	Center Name	Puccno	Reg.No	Reg.date	Model	Category	TestDate	Valid Date	Result
1	NA	MOOLCHAND SHRIPAL JAIN	<a href="#">P642106096</a>	DL5CF0414	Wednesday, July 07, 2004	CAR	4 W	Tuesday, September 14, 2010	Monday, December 13, 2010	Pass
2	NA	BATRA OIL COMPANY	<a href="#">P532104261</a>	DL5CF0414	Monday, February 07, 2000	SX4	4 W	Friday, January 07, 2011	Wednesday, April 06, 2011	Pass
3	NA	BATRA OIL COMPANY	<a href="#">P532105479</a>	DL5CF0414	Monday, February 07, 2000	SX4	4 W	Wednesday, June 08, 2011	Wednesday, September 07, 2011	Pass
4	NA	BATRA OIL COMPANY	<a href="#">P532112399</a>	DL5CF0414	Monday, February 07, 2000	CAR	4 W	Saturday, January 05, 2013	Thursday, April 04, 2013	Pass
5	NA	Fortune Service Station	<a href="#">P507141701</a>	DL5CF0414	Wednesday, July 04, 2007	SX4	4 W	Wednesday, April 03, 2013	Tuesday, July 02, 2013	Pass
6	NA	A M AUTOMOBILES	<a href="#">P638101621</a>	DL5CF0414	Wednesday, July 04, 2007	SX4	4 W	Friday, August 02, 2013	Friday, November 01, 2013	Pass

# PUC Compliance- On-road Survey



Cars have a compliance rate of 73%



# Estimation of Total In-Use Vehicles

Number of Unique Cars Checked at PUC

Compliance Rate

59%

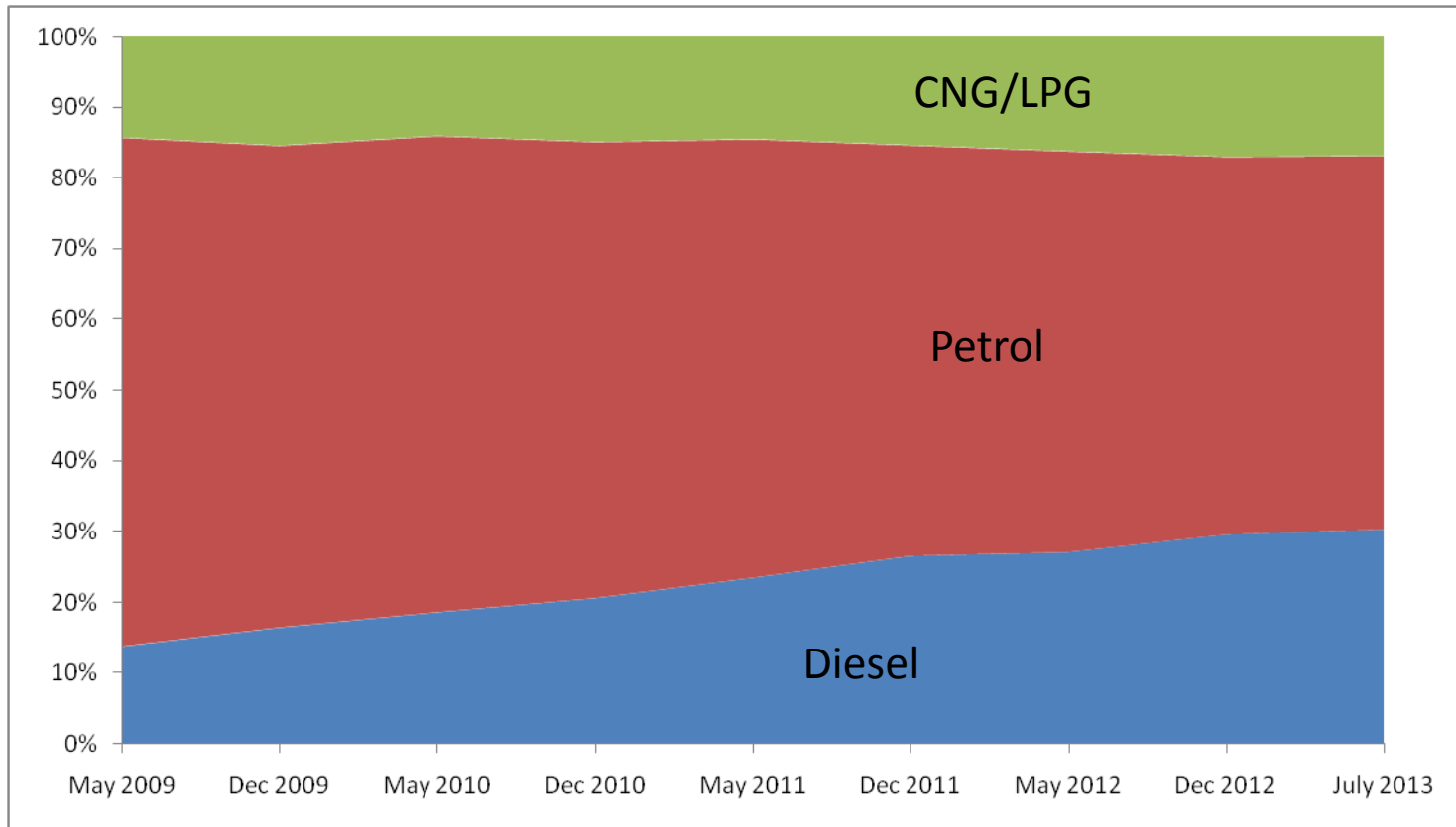
Of total registered cars

Method 3

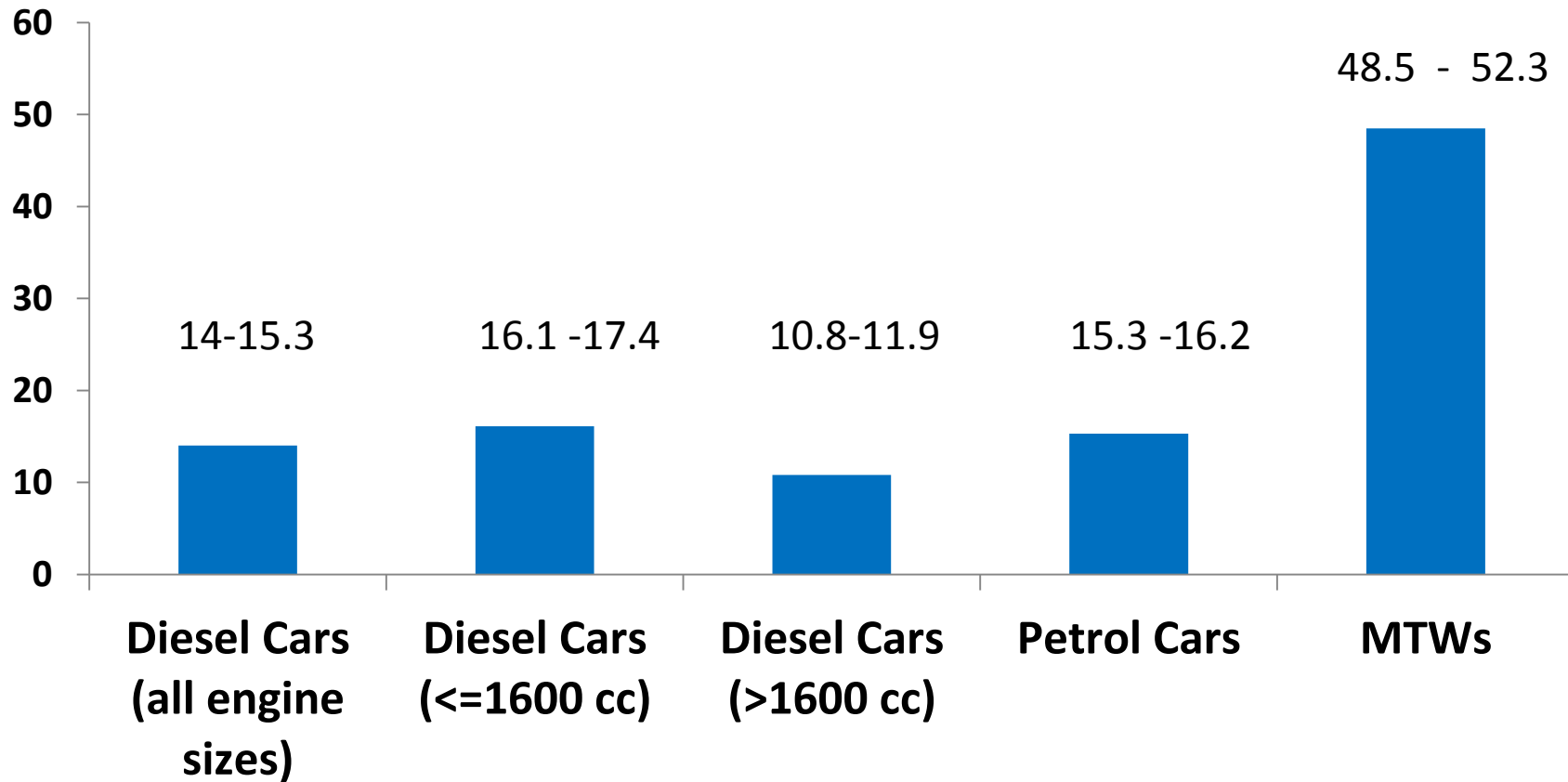
# Correction Factor for Registration Data

<b>City</b>	<b>MTWs</b>	<b>Cars</b>
Delhi	<b>40-45</b>	<b>51-59</b>
Visakhapatnam	<b>44</b>	
Rajkot	<b>51</b>	

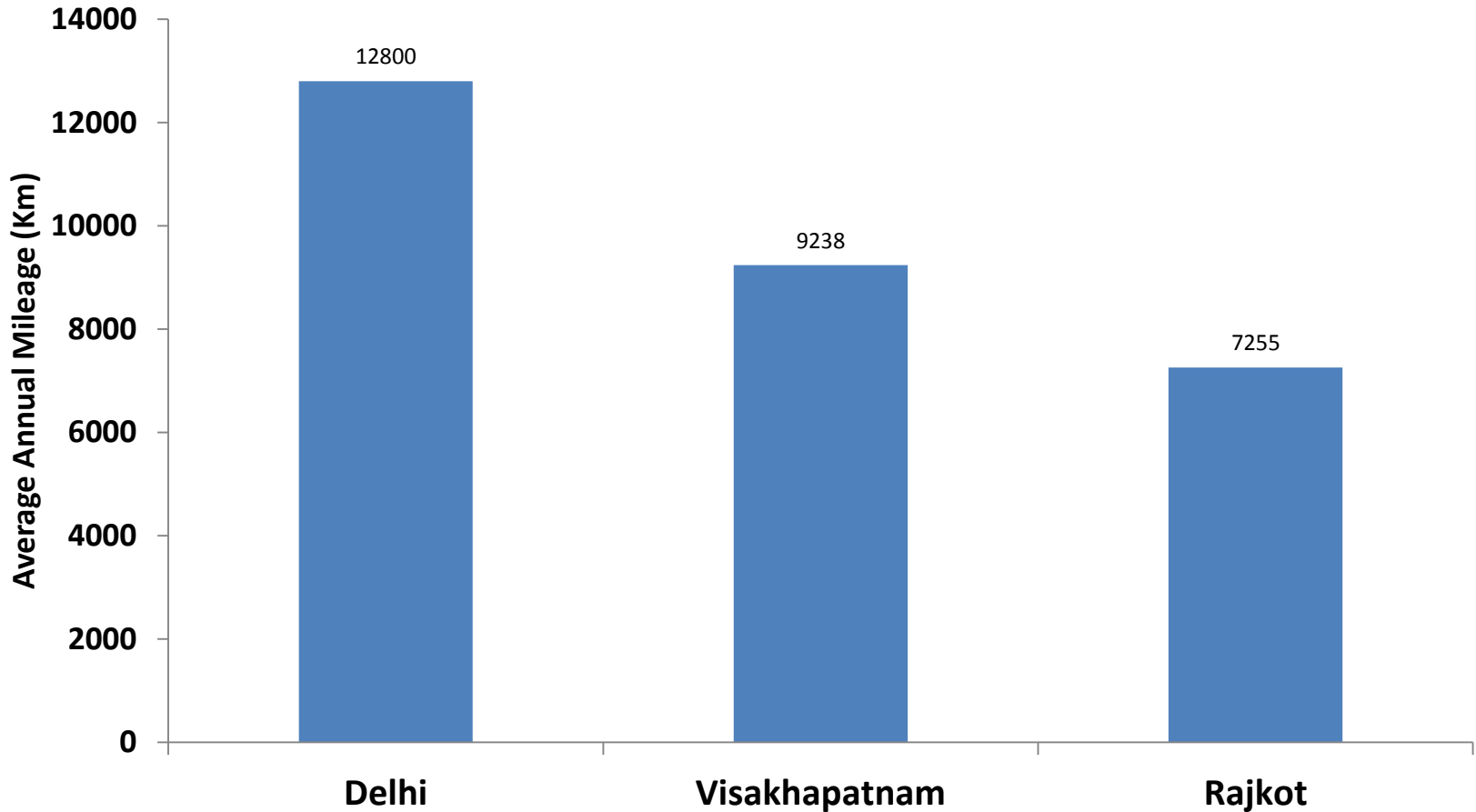
# Fuel Share of Cars in Delhi



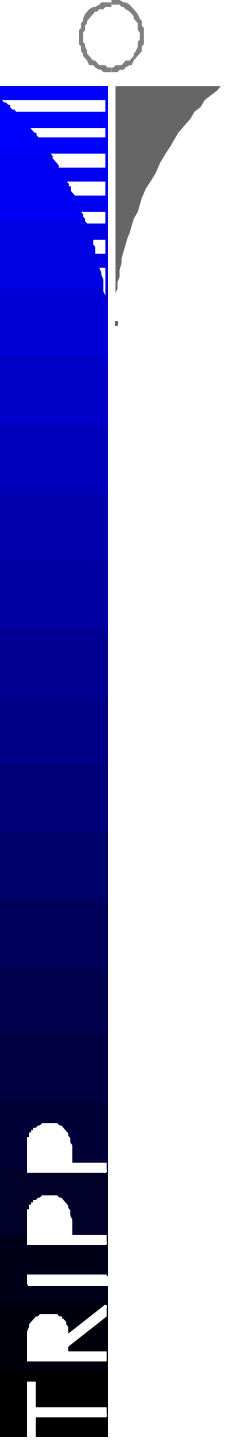
# Fuel Efficiency (Km/Litres)



# Annual Mileage for MTWs

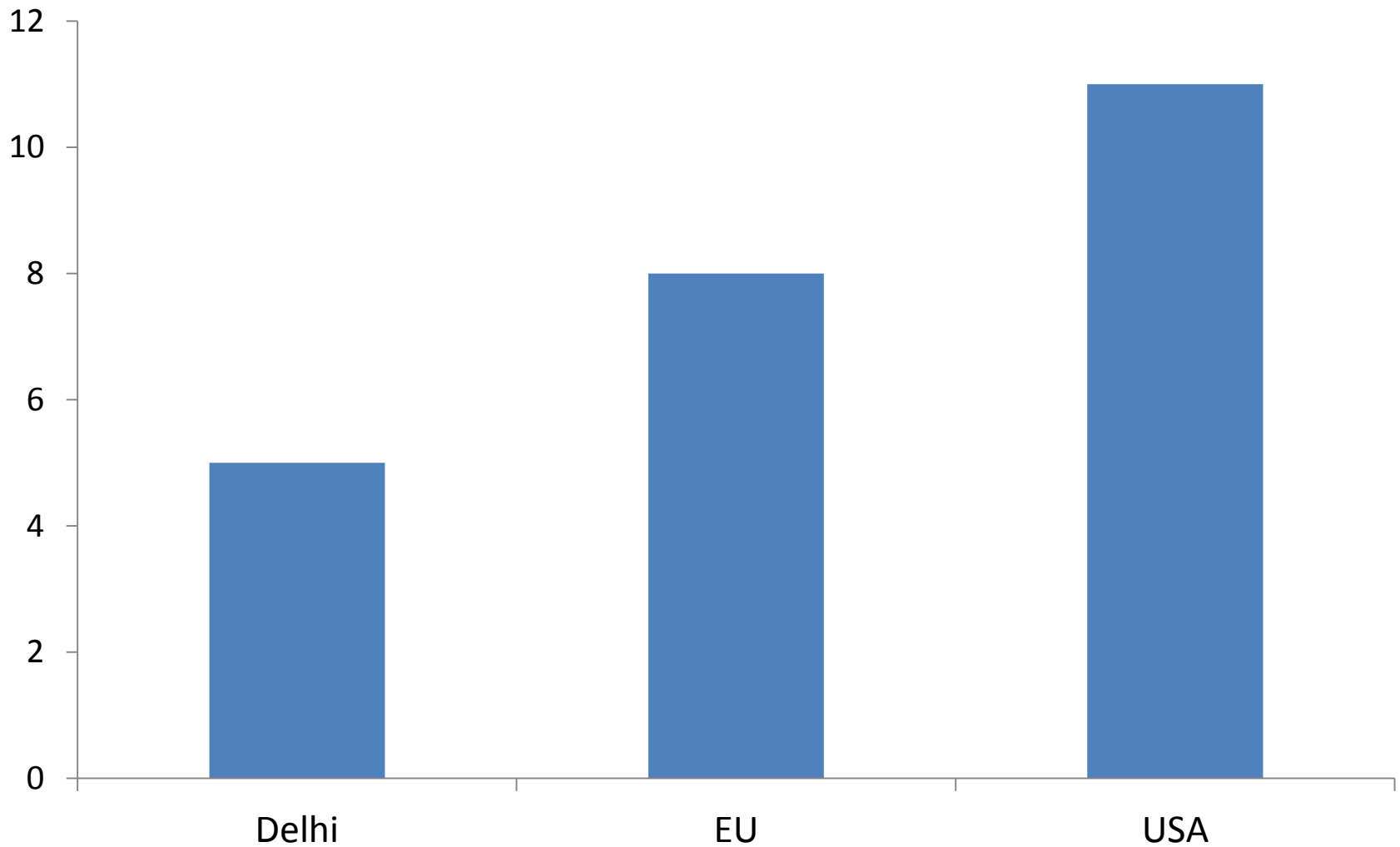


The difference can partially be explained by city structures

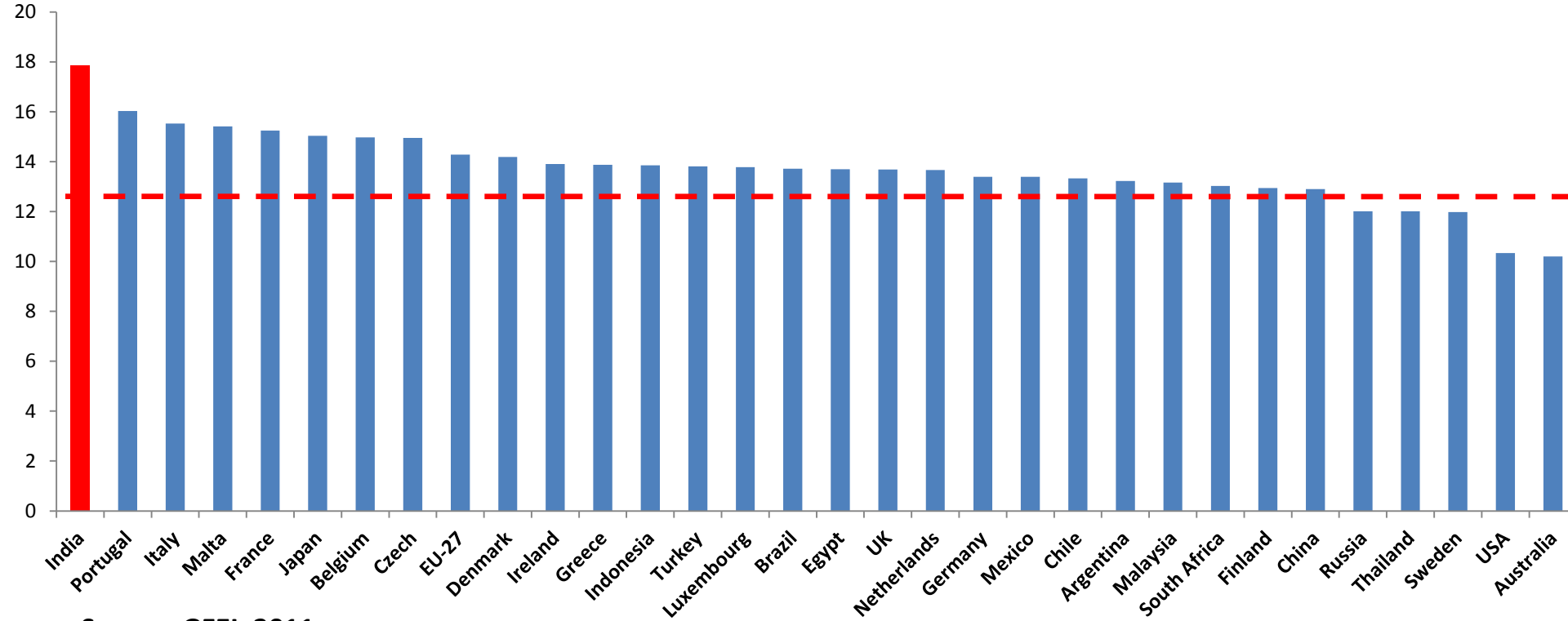


# International Perspective

# Average Age of Cars



# Fuel Efficiency



Source: GFEI, 2011

- Highest share of small cars
- 75% in the small car segment, globally it is 25%
- Lowest average weight of the cars



# Summary

## Fuel Station Surveys

- Number of In-use Vehicles
- Fuel Efficiency
- Annual Mileage
- Age Distribution

## PUC Data

- Number of In-use Vehicles
- Compliance Rate
- Share of Vehicle Models
- Share of Fuels

Questions?