

# Green Transportations Systems – A Step Towards Sustainable Cities

Shanu Raina, Bhagyalaxmi Madapur, Reshmi Manikoth Kollarath

**ABSTRACT**--- According to the census 2011, Indian is the second most populated country with population of over 1.21 billion people. In the last decade (from 2001- 2011) the acceleration in urbanisation level has increased from 27.81% to 31.16%. According to some documents by the United Nations and the International Energy Agency, India will probably witness the largest increase in urban population in the next four decades followed by China. With the rapid urbanisation and increased income levels, the mobility of people and freight will become even more critical. The quality of the mobility is a key factor in determining the quality of life in any city or town.

Many factors such as inadequate public transportation, high fare, no last mile connectivity, poor city bus services etc. contribute to the people choosing personalised mode of transportation over public transportation. There is a dire need to encourage cities to adopt sustainable transportation systems.

This paper attempts to understand the challenges and needs of developing sustainable transportation system in Indian cities. The paper examines the case of three mega cities Copenhagen, Tokyo and New York and explores the efforts taken by these cities for making cities more sustainable through green transportation systems. The aim of the paper is to chalk out the possible strategies for green transportation systems which could be followed in Indian cities to make cities more sustainable.

**Keywords**— Urbanization, Green transportation systems, Sustainability

## I. INTRODUCTION

According to the census 2011, Indian is the second most populated country with population of over 1.21 billion people. In a decade (from 2001- 2011) the acceleration in urbanisation level has been from 27.81% to 31.16% [1]. According to some documents by the United Nations and the International Energy Agency, India will probably witness the largest increase in urban population in the next four decades followed by China [2]. With the rapid urbanisation and increased income, the mobility of people and freight will become even more critical. the quality of the mobility is a key factor in determining the quality of life in any city or town. Many factors such as inadequate public transportation, high fare, no last mile connectivity, poor city bus services etc. contribute to the people choosing personalised mode of transportation over public transportation.

Improving carbon footprint/ecological footprint is very vital from the climate change perspective. Studies conducted in UK and US show that approximately 25% of the carbon dioxide emission is resultant of road transportation. There is a dire need to encourage cities and towns to adopt green

transportation systems. This serious challenge can be turned into an opportunity for the developing nations like India if the road map of green transportation systems is followed.

## II. WHAT IS GREEN TRANSPORTATION SYSTEM?

Green Transportation System Hierarchy was proposed by Chris Bradshaw in 1994. The Green transportation system include cycling, walking, shared mode of transport, public transport etc. From the perspective of vehicle of transportation, green transportation vehicles include various low-pollution vehicles, such as dual-energy vehicle, natural gas vehicle, electric vehicle, hydrogen power vehicle and solar energy vehicle. Green transportation also includes different kinds of electrified mass transportation vehicles such as trolley bus, tram car, light rail and subway [3]. The concept of green transportation is proposed together with the concept of sustainable development, which is the transition from “vehicle-oriented” to a “people oriented” approach [4].

## III. ENVIRONMENTAL IMPACT OF TRANSPORTATION

The transport sector consumes 30% of the global energy. The idea of travel has changed tremendously, especially after industrial revolution. Multiple mode of transportation is now available which are cheaper and faster, increasing the number of people moving and the number of freights. Unlike European countries, the impact of transportation systems on environment has been larger in developing nations. The Direct impact such as noise pollution and emission of the harmful gases is more tangible. At the same time on other hand indirect impact from the incomplete combustion in an internal combustion engine are known to cause serious health hazard. The Cumulative impact takes its toll on the very ecosystem we live in. Climate change, with a complex causes and consequences, is the cumulative impact of several natural and anthropogenic factors, in which transportation plays a vital role [5].

## IV. CURRENT SITUATION OF INDIAN CITIES

The Automotive sector is a major contributor to the Gross Domestic Product in India. It is projected that automotive sector will be one of the biggest employments providing sector by 2026. The rapid growth of the Vehicular owner and ridership in Indian cities is alarming, to note that during the period 1961 to 2011, while the number of cities in India increased three fold (from 2,363 in to 7,935) and the population increased 5 times (from 79 million to 377

**Revised Manuscript Received on July 10,2019.**

**Shanu Raina**, BMS College of Architecture, Bangalore, Karnataka, India. (raina.architect@gmail.com)

**Bhagyalaxmi Madapur**, BMS College of Architecture, Bangalore, Karnataka India. (bhagyalaxmi.arch@bmsce.ac.in)

**Reshmi Manikoth Kollarath**, BMS College of Architecture Bangalore, Karnataka, India. (reshmimk@gmail.com)

million), the vehicular population marked a whopping increase of approximately 200 times (from 0.7 million to 142 million) [6].

Rising income and less car penetration make India a very lucrative place for the automobile manufacturers. As per the latest data published by Society of Indian Automobile Manufacturing Report (SIAM), domestic automobile production in the country has increased at 7.08% CAGR between FY13-18. Approx. 29.07 million vehicles were manufactured in financial year FY17-18.

India aims to have 6 mn electric and hybrid vehicles on the roads by 2020. Under FAME – Faster Adoption & Manufacturing of Electric Hybrid Vehicles – the Government of India has shortlisted 11 cities in Dec 2017 to have electric vehicles based public transport system. The government would be extending grants of INR 1.05 bn to each city under this for buying electric vehicles. Additional funds would be provided for creation of charging infrastructure [7]. The Government of India approved National Policy on Biofuels in 2018 to provide the necessary push for production and establishing supply chains for biofuels in the country. The Policy has earmarked INR 50 bn as viability gap funding (VGF) of 2<sup>nd</sup> generation ethanol refineries [8].

#### V. CURRENT CHALLENGES RELATED TO URBAN TRANSPORTATION IN INDIA

- Poor integration of land use and transportation networks.
- Huge gap between the demand and supply of public transportation primarily due to rapid urbanisation.
- Over lapping and almost no coordination between different government bodies.
- Poor quality of road infrastructure.
- Dependence on combustible fuel, thus increased air pollution.
- Undermining the potential of water transportation.
- Incompatible mix of motorised and non-motorised vehicles. Vehicles moving with different speeds causes accidents and congestion on roads.
- The usage of intelligent transportation system (ITS) is restricted and limited to few cities.

#### VI. SUCCESSFUL CASE STUDIES OF GREEN TRANSPORTATION SYSTEMS IN CITIES & RESULTS

Three cities namely Copenhagen, Tokyo and New York have been studied to understand the steps taken to promote Green transportation systems at planning and policy level.

##### *Copenhagen*

##### *Planning interventions*

- Built first Pedestrian Street known as “Stroget”.
- Five- Finger Plan.
- Urban Traffic Consumption Plan – details out the bicycle development goal for the city.
- The newly built offices should be at a distance of 600 metres from the office blocks.

##### *Policy interventions*

- Bicycle policies 2002 – 2012.
- Good, better and best Copenhagen Bicycle Development Strategies 2011-2025.

Result: 36% of the population uses bicycle as daily mode of commute and it was projected that 50% of the city will be commuting on bicycles by 2015.

##### *Tokyo*

##### *Planning interventions*

- City is dominated by rail transit system as a primary mode of commute.
- Designated space for sidewalks and cycle lane.
- Designated special bicycling lane.
- By 2020 the total road mileage would be 221km.

##### *Policy interventions*

- Strict control over vehicular ownership.
- Strict parking management with heavy penalty for violation.
- Japan has many laws on Road Traffic Law, Urban Planning Law, Vehicular Custody Space Law, Parking Lot Law & Tokyo Parking Regulations.

Result: The 5th traffic survey on Tokyo Metropolitan Area (2008) indicated that the main means of transportation was urban rail traffic, the share ratio of which increased from 23% in 1978 to 30% in 2008, becoming the means of transportation with the largest increase [8].

##### *New York*

##### *Planning interventions*

- High density intense development along the Metro lanes.
- Special bicycling lanes.
- 1800 miles of bicycle trail proposed by 2030.
- Creation of pilot walking projects across the city.
- New York Broadway Avenue – a special pedestrian lane.
- 9th Avenue reconstruction project.

##### *Policy interventions*

- Vision Zero – Aims to eliminate severe traffic injuries and fatalities.
- Citi Bike system is the most effective and used system in North America.
- Safe education in schools.
- Initiatives like Bike smart, Bell & light giveaway, Bicycle Helmet giveaway’s, Citi bike street skills, heads up safety campaign, “LOOK” Safety campaign, “Don’t be a Jerk” campaign.

Result: With completion of the 9th Avenue reconstruction project drastic increase in number of cyclist using that lane was observed. The number of bicyclists riding for 12 hours on business days increases from 780 prior to implementation to 1100 after implementation. The city envisages increasing bicycle facilities for citizens to 80 – 90% by 2022. The cycling has increased to 150% in over a decade.

## VII. RELEVANT SUGGESTIONS ON THE CONSTRUCTION OF GREEN TRAVELLING SYSTEM

- Integrated approach to planning and transportation.
- Smart mobility with car sharing and electric vehicles – The smart mobility with car sharing and electrical vehicles is a concept which is already being explored in many of the cities internationally and nationally.
- Alternative fuel – Solar powered vehicles, Bio fuels, ethanol and compressed natural gas should be promoted.
- Awareness and advocacy for Green Transportation System.
- Make public transportation system more lucrative and attractive.
- Connecting public transportation system to internet of things.
- Branding of public transportation system
- Use of intelligent transportation system –
  - a. Creating and updated bicycle maps with all bicycle and pedestrian networks.
  - b. Integrated ticketing and smart cards.
  - c. Setup Electronic toll collection and traffic monitoring.
  - d. Real time parking management
- Subsidised rates for Public Transportation for the users: The subsidised pricing mechanism for the public transportation can be used to make it feasible for the users of various economic groups. The affordability of the public transportation will encourage more use of the public transport.
- Non- Motorised Transportation Policies - The northern European cities are the best example of the non-motorised transportation policies. The following is the list of few of such initiatives: -
  - a. Vehicle free zones in the city centre, especially areas which are adorned with heritage value and attract tourist.
  - b. The right of ways with designated space for cyclist and pedestrians.
  - c. Penalties for any kind of traffic violation by the pedestrians, motorist and cyclist.
  - d. Elaborate network of the pedestrian and cyclist lanes.
  - e. Integrating the cyclist and pedestrian lanes with public transport networks.
  - f. Well-designed table tops and crossing junction for pedestrians and cyclist.
- Bicycling Tourism – Promoting the bicycling tourism in special areas (such as core city area) and areas with high intensity of monuments/heritage.
- Alternative Transportation
  - a. Car sharing, car-pooling, bicycling, using public transport etc should be considered and made available especially for large campuses.
  - b. Venture into using water transportation systems.

## REFERENCES

1. B. D. C. & K. P. I. Pinna, "Energy used by transport systems in India: The role of the urban population, sources, alternative modes and

- quantitative analyses, "WIT Transactions on Ecology and The Environment", vol. Vol 190, pp. 661-675, 2014.
2. "Selected Socio- Economic Statistics," Ministry of Statistics and Programme Implementation, October 2011.
3. H. -R. Li, "Study on Green Transportation system of international metropolises," Elsevier, p. 762 – 771 , 2016.
4. C. Z. L. M. R.P Zhang, "Compact city and green transportation SYSTEM," 09.
5. "Green Transportation - An Eco Friendly Travel," Ministry of Environment, Forests and Climate Change, Government of India, New Delhi, 3 October- December 2017.
6. Centre for Science and Environment(CSE), ""Good news & bad news: Clearing the Air in Indian Cities", " CSE, New Delhi, 2013.
7. F. L. & E. Windish, "Triggering the Development of Electric Mobility: A Review of Public," Eur. Transp. Res. Rev., pp. 221-235, 2011.
8. Y. Y. & N. Yang, Study on Regional Low-carbon Society Construction in Japan, 2010.
9. I. B. E. Foundation, "Automobiles," IBEF, 2019
10. M. o. P. a. N. Gas, "National Policy on Biofuel," MPNG, India, 2018.