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SUSTAINABLE URBAN MOBILITY TO ACHIEVE SUSTAINABILITY GOALS IN INDIA

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ABSTRACT

As per various definitions 'urban sustainability' can be achieved by building cities that could continue without running out of resources and are self-sustaining units with regards to energy, food, economy, mobility and such inevitable means. Such cities should also ensure better lifestyle by provision of good air quality, unpolluted water and good infrastructure. Sustainability at urban scale, also talks about four major aspects to focus on - namely economy, ecology, mobility and Infrastructure. Amongst these mobility or transportation plays a pivotal role as it affects the other three directly or indirectly. Many developed as well as developing countries have committed to invest billions of dollars in developing and maintaining sustainable transport systems. This is reflected in the global sustainable commitment as per Paris agreement. According to this, each country determines plans and regularly reports its own contribution in order to mitigate global warming. It is realized that in Indian scenario; provision of sustainable transport and good urban mobility will ensure health and well-being, access to quality education, good jobs and economic growth, sustainable cities and communities, climate action as well as boost in industry innovation and infrastructure. The aim of this paper is to explore the possibilities of sustainable urban mobility in Indian scenario and the ways in which it can help achieve the Global Sustainability Goals.

Keywords: Sustainable transport, urban mobility, sustainable goals, Paris agreement.

METHODOLOGY

The study examines the role or contribution of transportation in achieving the sustainable development goals. The paper explains 1) Paris Agreement and Sustainable development goals. 2) Ways in which transportation is linked to the global warming and Paris agreement and briefly talks about 3) Indian Scenario. The paper uses means of literature review and case studies to understand the impact of transportation and ways to solve the issues linked to transportation. Various cases studied show that transportation improves the standard of living of the people and also contributes in mitigating global warming.

Paris Agreement and Sustainable Development Goals (SDG)

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Paris Agreement is a legally binding global climate deal that was signed and agreed upon by 195 countries globally at the Paris climate conference held in December 2015. The agreement lays out a global action plan to mitigate climate change by keeping global average temperatures from rising above 1.5'C as compared to the pre-industrial years. The target is to achieve climate neutrality before the end of the century and use the Paris Agreement as an intermediate stepping stone towards achieving this goal. Before the Paris agreement, a comprehensive document titled- "Transforming Our Worlds: The 2030 Agenda for Sustainable Development" was formulated. On 25th September 2015, all the countries under the United Nations agreed on this agenda and pledged to the vision for the future of all humanity through international collaborations. The 17 goals and the 169 targets listed in the document are the most specific expression of that vision. There is no formal link between the Paris agreement and the SDG. However there is a mention of UNFCCC (United Nations Framework Convention on Climate Change) Paris climate summit in Goal13 that refers to "Take urgent action on climate change and its impacts." Not only Goal 13, also SDG 2, 7, 9, 11, 14 & 15 refer to the reduction of greenhouse gas emissions in various sectors like sustainable agriculture, affordable energy, sustainable industrialization, sustainable cities and ecosystem & forest protection. This paper attempts to establish that Sustainable Transportation is the key to achieve targets set in the Paris Agreement and in many ways have an impact on Sustainable Development Goals as well.

Transportation, Global Warming & Paris Agreement

Fuel combustion in motor vehicles is responsible for up to 75% of urban air pollution (Lefevre et.al, 2014). Quality of outdoor air is getting adversely affected due to increase in motorized vehicles and it is estimated that there will be a three-fold increase in the number of cars worldwide from 2000-2050. The Greenhouse gas emissions caused by transportation are expected to increase by 120% as per International Energy Agency. Rapid growth and urbanization worldwide has resulted into majority of population residing in the cities. There is rise in the number of personal motorized vehicles with the increase in affordability. Studies show that the average motorized vehicle produces approximately 1 lb of carbon-dioxide (CO2) per mile, while using bus results into production of 0.18lbs of CO2 at full capacity (Kirkpatrick, 2017). Modifications in choice of transportation alone can help mitigate global warming to a great extent by reducing the CO2 emissions to more than 50%. With advancement in technology and availability of sustainable bio fuels, one can find variety of solutions beyond walking and cycling. Considering the fact that transport is an opportunity for reducing the CO2 emissions, more than 75% of the plans announced in the COP21, have specific measures for mitigation action related to transportation (Lefevre et.al, 2014). These strategies include solutions like shifting from road to rail, using sustainable fuels, switching to electric vehicles, changes in planning policies, changes in land use patterns, improvement in vehicle efficiency and so on. Apart from releasing CO2 and other greenhouse gases, transportation is also responsible for noise pollution, traffic & congestion, wastage of space for parking and roads, longer trip time, accidents and so on reducing the quality of life to a great extent. The present day cities are designed for supporting the use of cars and if we fail to make changes in the transport and land use patterns now, we will end-up with a high emission infrastructure for years to come.

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Indian Transportation Scenario

Cities play a vital role in generating economic growth and prosperity (Padam et.al, n.d.). According to the World Bank, India along with China and few other nations will lead the world's urban population surge by 2050. As per current statistics the top four cities with largest urban agglomeration in India are Mumbai, New Delhi, Chennai and Kolkata. These four cities have witnessed a rapid growth since independence. Cities are considered as "engines of economic growth" and more than 60% of the Gross Domestic Product (GDP) comes from the urban areas which is likely to increase to 75% by 2030 (Agarwal et.al, 2014). Recognizing this potential to contribute to India's economic growth, Government of India has shortlisted 100 cities for becoming the next generation 'Smart Cities". One of the biggest hurdles, in achieving the aim of Smart City, is the transportation. In cities like Mumbai, problems like congestion, poor air quality, noise etc, will become uncontrollable in the near future, if immediate action is not taken. Statistics show that urbanization and increase in buying capacity has lead to rapid motorization. According to the Ministry of Road Transport and Highways the total number of registered vehicles increased from 0.3 million in 1951 to 142 million in 2011. Steep growth in number of vehicles has resulted in congestion as the road space is not enough. This has resulted in decrease in the travel speed and increase in the travel time even for short distances. If the issue is not addressed in due time, it will result into car speed being as low as cycling or even walking (Agarwal et.al, 2014). Another major issue is the uncontrolled air pollution that has a direct impact on the health and well-being of people. Inadequate street lights, lack of safety, absence of bicycle parking, badly designed footpaths, unhygienic conditions, lack of shelters etc, discourage people from walking and cycling. In the above mentioned four cities with high urban population, there exist a large number of urban poor who use the public transport as a means of commute besides walking and cycling. The issues faced by them include long travel time, insufficient frequency, unavailability of seats, poor condition of buses etc, and many a time absence of public transport forces them to travel long distances by walking or cycling, exposing them to severe effects of air pollution. The key issue with the mobility planning is that it does not give sufficient importance to the alternate and sustainable means of transportation. The provision of budget, strategies for transport, land use planning etc, all need to be in place so as to promote sustainable means of transport instead of investing in constructing roads and flyovers & parking facilities for cars and private buses. Transportation is a backbone of all possible activities in the urban areas, may it be socializing, shopping or economic activities of trading, supply of raw materials and finished goods; without transport, city comes to a standstill. Not only this, transport plays a vital role in education and reduction of poverty by connecting people to schools, colleges as well as work places (Estache, 2007). According to a report prepared by TARA (Technology and Action for Rural Advancement) the cities and human settlements can be made inclusive, safe, resilient and sustainable (focus of SDG 11) by providing access to safe, affordable, accessible and sustainable transport systems for all. Special attention can be given to the road safety, improving public transport keeping in mind inclusive design aspects. Growing population also triggers urban sprawl, making situation worse. As the cities grow, the distances increase, resulting

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into reduction of non-motorized transport (NMT) usage. The urban planning and design that promotes sprawl acquiring the fringe areas is becoming the norm in big cities. Development of ring-roads around the city results into development of housing and other activities around them. Within few years these areas become densely populated and to manage the traffic another ring-road is developed. The cycle repeats resulting into long travel distances. A classic example of this phenomenon is Bangaluru. Ideal distances for promoting bicycle use are 4-6 km; while for walking distance should not be more than 1.2 km (Joshi, 2015). The average travel distances in cities have increased up to 9-12 km (iihs.co.in. 2018). Besides urban sprawl and long travel distances, certain restrictions also discourage people from using NMT & sustainable transport. For instance, in Delhi, the e-rickshaws are banned due to lack of regulations and guidelines for them. Not only that, the e-rickshaws were termed as "hazard to other traffic" (Firstpost, 2014). Another example is the restriction levied on pedal rickshaws (cycle rickshaw) to increase the traffic speed. Kolkata does not permit the pedal rickshaw on more than 170 main roads. This restriction has not only discouraged a sustainable mode of transport, but also affected the livelihoods of pedal rickshaw drivers. This indicates that along with provision of suitable infrastructure, incorporation of certain aspects in the urban planning policy will have to be done to promote sustainable transport.

Sustainable Transport & Impact on Sustainable Development Goals

Figure 1: SDGs (http://www.un.org/sustainabledevelopment/sustainable-development-goals/)

Transportation plays a pivotal role in urban sustainable development as it affects the economy, ecology and infrastructure. On closer inspection and study of transportation sector, one realizes that it provides various opportunities for shared value, promotes multi-stake holder partnerships and collaborations, triggers growth of businesses and has an impact on all the 17 Sustainable Development Goals. These impacts are enlisted below-

SDG1: [No Poverty]

A primary requirement of every individual is to be able to commute to work. The facility that an individual uses to commute must be comfortable and affordable. This is a very important aspect for the rural areas as well as urban poor. There are various examples all across the globe that talk about collaborations and services that promote mobility through sustainable solutions. For instance Renault, a French car manufacturing company offers garage service to the vulnerable population facilitating their transport to work place and enabling them to use and maintain their vehicles optimally (Unglobalcompact.org, 2016).

SDG2: [Zero Hunger]

Transportation does not have a direct impact on SDG 2, however innovation in technology for vehicles used in farming as well as transporting the food products can result into less wastage of food while maintaining the carbon footprint low.

SDG3: [Good Health and Well-being]

Transportation plays a major role in ensuring the good health and well being of people by increasing road safety and minimizing accidents. Also provision of emergency services, like 108 ambulance service in Gujarat, helps to provide urgent medical aid. Provision of better infrastructure for cycling and walking can help people stay fit. The futuristic self

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driven cars or the autonomous breaking system being developed by Jaguar Land Rover that enables to gauge the risk of collision and attempts to prevent it. This kind of a vision is in line with the 2030 agenda of reduction of deaths and injuries by accidents.

SDG4: [Quality of Education]

Apart from providing enough mobility to the students to reach schools and colleges, Vehicles can be transformed as learning centres. Large vehicles like buses can be re-designed to be mobile schools or libraries that can spread knowledge from one place to another. Large companies can enter into a partnership to provide vocational training schools across countries for eg Volvo.

SDG5: [Gender Equality]

Both men and women use every possible means of transport available. However, in many instances, it has been realized that there is a need of designing safe transport for women so as to reduce any unpleasant and life threatening incidences whilst they are travelling. Transport facilities like bus stations, railway stations etc; can also provide adequate facilities and safety measures for both male and female travellers. Various categories of transport should offer equal job opportunities and create a balance at the work place. One such example is the company called Transnet that, in collaboration with a global car manufacturing company, worked towards empowering the women entrepreneurs in engineering sector by training them and enhancing their technical skills. Lufthansa also encourages women pilots by organizing a series of outreach programs and also offer programs that help women balance work and family.

SDG6: [Clean Water and Sanitation]

Many companies have put policies in place that help them to reduce the consumption of water for cleaning cars and parts by implementing water-saving technologies at work place. Many of these also attempt the rain water harvesting to maintain the natural water cycle intact (Unglobalcompact.org, 2016). Companies like Mercedes-Benz are supporting research into improving water quality (Daimler, n.d).

SDG7: [Affordable and Clean Energy]

With the advancement in the technology and availability of alternative options to conventional fuel, the manufacturers have re-designed vehicles to improve performance. Companies also invest in research of more sustainable biofuels, which help to achieve desired speed of the vehicles to make them viable in market. Not only that, companies also encourage use of electric cars by provision of charging points across cities like Daimler and RWE did in Berlin by launching 100+ EVs (electric vehicles) and 500 Charging Points(Green Car Congress, 2008).

SDG8: [Work Opportunities and Economy]

Transport sector is a large industry employing thousands of people. In emerging markets the transport industry engages directly 6% to 9% of the work force (Unglobalcompact.org. 2016). This gives not only employment to the people but also exposes them to various training sessions and equips them with skills to enhance their job opportunities. In many cases collaborations between different departments is also seen to achieve economic gain though transport. One such example is the Konkan railway corporation that collaborated with the tourism department to boost the tourism industry in the state. To achieve this strategic marketing was needed. Training the rickshaw and taxi drivers to give proper information to the tourists contributed to improving the experience of tourists as well as income of the taxi and rickshaw owners.

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SDG9: [Industry, Innovation and Infrastructure]

A lot of infrastructure in terms of roads, rails, flyover, airports, etc; is created every year to aid transportation. Integrating strategies to mitigate environmental and social impact of this infrastructure through collaborations will result into better solutions. Strategies can be designed to control fuel and water consumption during construction, recycle waste produced and not divert it to the landfills, to employ local masons and give business to the local community and much more. The construction of facilities like railway stations and airports can be done to meet the green building standards to create a more sustainable infrastructure for transport.

SDG10: [Promote Equality]

One of the primary needs is to create infrastructure and facilities that are universally accessible and provide equal opportunity to all. Transportation provides mobility options that enable differently able people, people with low affordability, women, children & elderly to travel with ease and comfort.

SDG11: [Sustainable Cities and Communities]

In the absence of proper transport, a vibrant city can come to pause. Sustainable cities need a land-use plan that not only supports, but also promotes sustainable transport. If cities are the powerhouses of economy, transport is the fuel for these cities to reap economic growth and benefit. Projects like Metro, Tram, Bus rapid transport etc, can act like life line of the city, providing the commuters a safe and fast means of transport.

SDG12: [Responsible Consumption and Production]

Transport can promote a responsible consumption of fuels by using various strategies like fuel efficient vehicles, car pooling, ride sharing, and public transport use and so on. A lot can be done by streamlining the manufacturing process towards achieving responsible consumption of resources. A good example is the Bajaj V5 bike which is made from a dismantled war ship that used to be aircraft carrier during Indo-Pakistan war in 1971(Wankar, 2016). There are other examples of companies taking up responsibilities in sustainable manufacturing as well as recycling its waste. Many examples show inclination of companies to promote sustainable trade through providing 'Fairtrade' food and beverages to their guests for eg; Virgin train switched to Fairtrade drinks on all trains and also introduced sustainable menu options (The Independent, 2006).

SDG13: [Climate Action]

Transport contributes to 24% of global carbon dioxide emissions from fossil fuel combustions. Various strategies to reduce the CO2 emission will help and contribute towards mitigating climate change. Transport industry can integrate the climate related risks and issues into investment analysis and decision making (Unglobalcompact.org.2016). It can also help use and promote sustainable strategies by collaborating with various organizations that are partners in 'Caring for Climate'. All the different sustainable solutions mentioned in this paper can be enlisted under SDG13.

SDG14: [Life below Water]

Shipping takes care of 90% of the world cargo, which makes it very important to maintain environmental standards on shipping and ship-breaking (http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade).

Innovation in design and technology is done so as to minimize the fuel waste from being released into the oceans. The ports must follow the standards of efficiency and sustainability to reduce the risk of pollution in the seas and oceans. There are various companies like Damen

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Shipyards, Swire group, Thordon Bearings, etc, that are working towards innovative engineering solutions to reduce oil and grease discharge from the ship into the water, promoting cleaner oceans.

SDG15: [Life on Land]

Transportation planning can play a key role in protecting, restoring and promoting sustainable use of land and curtail loss of biodiversity. Companies like Yamaha are contributing towards maintaining wildlife diversity as well as preserving the environment at its test course in Japan (https://global.yamaha-motor.com/about/csr/the_environment/conservation-biodiversity/index.html). Even Jaguar land rover is following similar strategy for all its sites.

SDG16: [Peace, Justice and Strong Institutions]

Transport may not directly impact the SDG16, but can surely contribute to it by curbing crimes related to transport, human trafficking, illegal transport of goods and weapons and so on to ensure fair trade as well as peace.

SDG17: [Partnerships for the Goals]

Various collaborations and partnerships are being explored to provide transport industry perspectives to Government, policy makers, legislators as well as regulators on the sustainable development impact of legislative regulatory and tax frameworks that include recommendations for enhancement (Unglobalcompact.org. 2016). Enormous range of partnership and initiatives are demonstrating significant leadership as well as commitment to the sustainable development goals.

Cases around the world

'Efficient urban mobility' is the one which allows people to travel across the city, helps them to connect to their workspace, industry and ideas and hence providing a strong platform for economic growth of the city. Different cities across world have their own distinguishing features of mobility and are making a bold move to improve quality of life. These cities have a better balance across the three important factors of sustainability namely Social (People), Environmental (Planet) and Economic (Profit). Arcadis commissioned the Centre for Economic and Business Research (Cebr) to see how cities are performing across these three parameters. Cebr assessed the quality and sustainability of mobility systems in 100 cities around the world using 23 indicators. Figure 2 shows the top 15 cities ranked by quality of sustainable mobility in 2017. Out of these 100 cities 3 cities namely Hong Kong (1st rank), New York (23rd rank) and Zurich (2nd rank) are being studied to understand what strategies are being used to achieve GHG reduction through transportation sector. These examples are chosen based on the strategies that can be used in the Indian context based on the learning from them.

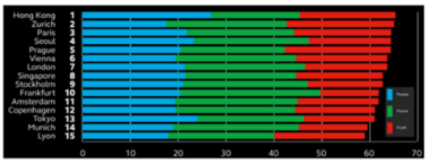

Figure 2: Cities ranked by quality of sustainable mobility in 2017 (Source: 2017 Arcadis Sustainable Cities Mobility Index)

Hong Kong

Despite massive and densely-concentrated population, Hong Kong is the world's top city for sustainable transport, according to the 2017 Sustainable Cities Mobility Index (Anon, 2017). Hong Kong's public transport system is widely recognized as one of the most sophisticated and efficient one. According to Hong Kong Government's Travel Characteristics Survey, around 90% of daily passengers of Hong Kong uses public transport for commuting,

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making it most dominant mode of transportation. As per the Hong Kong government fact sheet, since 2007, Rail which includes MTR, East Rail, West Rail, Light Rail, and Airport Express has become the biggest passenger carrier making it a backbone of public transport of Hong Kong. On the other hand, private transport takes up only 10% of passenger trips. Not only this but Hong Kong's modern metro system allows riders to use 3G internet in all tunnels and stations enhancing the digital capabilities of their metro and bus networks.

Figure 3: Image showing environmental comparison of Hong Kong with London and New York (Source: 2017 Arcadis Sustainable Cities Mobility Index)

However, Hong Kong's situation was not always the same. According to the survey, published by Research Institution Future Spaces Foundation in 2016, Hong Kong's transport system was poor as compared to New York and London. Despite the excellent rating for its public transport network, Hong Kong had a poor bike and foot network, as well as bad air quality that discouraged people from walking. As Hong Kong is an important industrial port, high container traffic every day resulted in high levels of harmful gases including NO2, SO2 and PM2.5 (Sun, 2016). It was also observed that city lacks in biking share scheme and promotion when compared with the other two. Within a year Hong Kong improved its bicycle network and also provided information regarding cycling routes and easy to rent bicycles on its official government website. It is also important to know that all Hong Kong was at the bottom of the list as compared to other Asian cities on the affordability of public transport parameter. Introducing various schemes and concessions like cheaper tickets for children and elderly as well as for travelling in non-traffic hours has resulted in more people opting for public transport.

New York

After US withdrew from the Paris climate accord, 17 Governors and 125 cities including New York city, Los Angeles, Pittsburgh committed itself to the Paris targets. New York has already reserved billions of dollars to make their buildings more energy efficient, promoting electrical vehicle to reduce emission, plant thousands of trees and increase the use of solar panels. With growing real estate prices in New York, people are forced to move in the outskirts of the city which in turn increases the reliability on private transport. By improving and expanding public transport systems, city can achieve great reduction in GHG emissions deduction from transportation sector. Hence as a first step to accelerate greenhouse gas (GHG) reductions and put city on a path to deep de carbonization New York Mayor Bill de Blasio planned certain set of actions. It was observed that there can be great reduction in the emissions in transportation sector just by improving and expanding the public transport system. By implementing the identified prioritized set of actions across energy, transportation, building, and waste sectors by 2020, NYC will enable faster reductions of GHG over the following 30 years. The potential for GHG reduction of all the quantified actions in the report is 10 million metric tons of CO2or the equivalent of taking more than 2 million

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cars off the road by 2030.This is the first Paris Agreement-compliant plan from any city in the world (The official website of the City of New York, 2017). To achieve the 1.5oC plan certain targets were set under different heads like recycling, waste, building, energy, transportation and carbon neutrality. Under transportation New York plans to increase the number of active cyclist through annual development of at least 50 new miles of bike network including 10 miles of protected bike lanes. It also targets to increase 20% new car registrations under electric vehicle (EV) by 2025. Certain commitments were given by city heads like Council Transportation committee chair Ydanis Rodriguez, to promote greener transport in New Yorkers like,

• Installation of public electric vehicle charging stations,

• Expanding bike and car share programs,

• Creating dozens miles in bike lanes,

• Closing down streets to vehicular traffic with summer streets and car free day.

According to many officials in New York like, transportation commissioner, chair of council's Environmental protection committee, director at Environmental defence fund, 'transportation plays a very important role in achieving Paris agreement goal. By encouraging sustainable transit systems and making smart choices about transportation one can make real difference in combating global climate change.'

Zurich

In many ways Zürich demonstrates how urban sustainability achievements are possible through well-designed public transport. Zurich is amongst top worldwide ranking cities which provide good urban quality of life, sustainable public transport, low-cost transport infrastructure, and limited car use even in the midst of high affluence. Following are some of the findings because of which Zurich is able to achieve this.

• There is only a single body (Zürcher Verkehrsverbund) which coordinates between 262 transport lines and 44 operators and has the power to make decisions over budgets, pricing and financing. This makes the system work efficiently.

• In Zurich it is important to connect all the residential areas with zonal buses with higher frequency of departures. Also it is essential to provide expanded network of transport over day and night which allows people to travel at their own convenience. Providing affordable transport with integrated public transport travel passes and promoting the use of public transport system by using wide range of media including direct marketing.

• People are encouraged to use Light electric rail as they are space efficient, uses clean and renewable energy, inexpensive surface-based infrastructure, provides safety hence making it a most sustainable motorized transport. Which further helps in preservation of urban spaces for other multiple uses?

• There is a strict parking policy which provides only 1 parking space per 1200 sq.mt area. These decisions have helped the city in improving quality of urban life due to excellent public transport systems. It also resulted in creating very attractive urban spaces according to Mercer's 2003 survey.

• Europe's highest per capita use of public transport making more people commute by public transport instead of private vehicles. 74% of inbound commuting was by train.

• High quality public transport at lower costs with smaller infrastructure.

• Low and stable levels of car ownership (370 cars/1,000 persons) and

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car use (28% of all journeys), despite very high levels of income

• About one-quarter of Zürich's land area is in forests (Thomas, 2012)

Hence, we can say that the Zürich's approach to sustainable transportation is both highly successful and widely relevant as it not only provides sustainable public transport but also provides quality life to its citizens by restricting pollution in town.

CONCLUSION

Transportation accounts for a high percent of global human-caused emissions of greenhouse gases. Hence in this sector cities can develop efficient public transit systems by providing well connected public transport network across the city which reduces reliability on private vehicles, affordable public transport to popularize its use, more bike lanes or creating more pedestrian friendly areas to promote sustainable means of transport. Along with this regulating the use of private cars and trucks to avoid additional emissions, promoting the use of electric vehicle to reduce the dependency on fossil oils, as well as building energy performance initiatives and sustainable transportation options can help reduce the CO2 levels in major cities. The cases studied, can be summarized by saying "An effective transport system is one which can simultaneously address and improve its functioning for all stakeholders, while facilitating economic opportunity without compromising environmental concerns" (Batten et.al, 2017). Today the biggest mobility challenges faced by Indian cities and their policy makers for the sustainable growth are rapid urbanization, aging infrastructure, population growth and climate change. But it is also true that cities have a great opportunity to improve their citizens "quality of life" and "experience". By having a clear vision and willingness to make bold decision in advancing and diversifying their urban transport systems focusing on the relevant priorities, and making proper financial investments, cities can create a better future for their citizens. As said by John Batten, Global Cities Director at Arcadis: – "we see that investing in improved and sustainable mobility will give cities enhanced productivity, attractiveness and overall quality of life." This paper also shows that transport has a direct or indirect impact on all the SDGs and hence countries should focus on improving their transport systems so as to fulfil requirements of SDGs as well as achieve the commitment made in the Paris Agreement.

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