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Next Generation Sustainable Transport Solutions in the Context of post-2015 Development Era

(Background Paper for Country Roundtable Dialogue of the Provisional Programme)

Final Draft

This background paper has been prepared by Mr. Madhav Pai and Ms. Tanushri Gupte for the Eighth Regional EST Forum in Asia. The views expressed herein are those of the authors only and do not necessarily reflect the views of the United Nations.

Next Generation Sustainable Transport Solutions in the Context of post-2015 Development Agenda

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Authors:
Madhav Pai
Tanushri Gupte

EMBARQ, World Resources Institute (WRI) Centre for Sustainable Transport

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1.0 Executive Summary

The paper starts by describing the post 2015 development era, recognising adoption of the sustainable development goal on cities and highlighting four aspects (road safety, accessibility, universal access and sound public transport) identified to make transport solutions more sustainable. The paper then describes next generation sustainable transport systems as six complimentary trends that demonstrate the potential of achieving sustainable transport goals. The six trends are as follows:

1. Complete Streets for Safe Universal Access
2. Sound Public Transport
3. Transit Oriented Development
4. Car Restriction & Other Pricing Approaches
5. Shared Mobility
6. Multimodal Connectivity

Finally the paper briefly recommends actions both at the international level and the national & sub-national levels to achieve the goals of sustainable transport.

2.0 Post 2015 Development Context

2.1 Context

The global dialogue on development is focussed around two major areas: Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). MDGs were adopted in United Nations Millennium Declaration, the outcome document of the Millennium Summit. These goals focussed on providing basic rights to each individual in the world and reducing poverty by half. There are eight MDGs, which focus on areas key for development such as poverty eradication, access to education, gender equality, improvement of health and environmental sustainability (CAFOD 2013). Most countries have had considerable success in achieving these goals over the past decade. Some targets have already been met before the 2015 deadline. For example, according to the UN report on the progress of the MDGs, there has been a reduction of 700 million people living in extreme poverty (UN 2014).

However, during the past fourteen years, areas of sustainability and environmental conservation have gained importance. MDGs, while focusing on sustainability, do not delve deep into the subject (Loewe 2012). The Rio+20 summit, held in Rio de Janeiro in 2012 emphasised on sustainable development (UN, Rio+20 Outcome Document 2012). This summit gave birth to the Sustainable Development Goals. While the SDGs maintained the same stand on poverty eradication as the MDGs, they also acknowledged the *"need to further mainstream sustainable development at all levels integrating economic, social and environmental aspects and recognizing their inter-linkages, so as to achieve sustainable development in all its dimensions"*.

The Rio+20 Outcome Document (The Future We Want) also set out to establish an Open Working Group (OWG) which, over the past two years, has discussed and come up with

Sustainable Development Goals. According to the 13th and last session of the OWG, there are a total of 17 SDGs which focus on areas ranging from poverty to access to justice for all (OWG 2014). They include the areas which MDGs focus on. All these goals, however, have been discussed in the broader framework of sustainable development. They are framed on the basic premise that people are at the centre of sustainable development. Post-2015 development agenda is the broad umbrella framework under which both MDGs and SDGs are housed.

One of these goals (number 11) focusses on making cities and human settlements inclusive, safe and sustainable. As of 2014, more people live in urban areas than in rural areas. 54% percent of the global population currently lives in cities. 66% of the total population of the world is expected to live in urban areas by the year 2050 (UN, World Urbanization Prospects: Highlights 2014). 'Cities', therefore, becomes a key area of consideration in the dialogue on sustainable development.

2.2 References to Sustainable Transport

SDG number 11 specifically mentions four aspects pertaining to sustainable transportation which are necessary for making cities inclusive, safe, sustainable and resilient. These are: safety, accessibility, sound public transportation and universal access. A sustainable transportation system is an important requirement of a safe and sustainable city. Such systems provide access to goods and services which enable equitable development (SLoCaT 2014). The Rio+20 Outcome document acknowledges that *"transportation and mobility are central to sustainable development"* (paragraph 132).

3.0 Next Generation Sustainable Transport

3.1 Current Trends & Future Action

Car-oriented development is still the prevalent paradigm of urban development in the developing world. There has been exponential growth of private cars in emerging economies especially the People's Republic of China and India. The road infrastructure in emerging cities have also been expanding rapidly (i.e. People's Republic of China plans to build 34,000 kilometres of new expressways and 500,000 kilometres of new roads from 2010 to 2015).

The text below further elaborates how the four aspects included in the SDG on cities are impacted by this prevalent paradigm.

Road Safety: Road safety is an urgent issue. Road traffic injuries are the eighth leading cause of death globally 1.24 million people died in road traffic accidents in 2010 alone. Cyclists, motorcyclists and pedestrians are the most vulnerable of all road users and account for half of all road accident deaths. While many countries have been able to reduce deaths caused by road traffic, many countries haven't. 80% of the deaths occurred in middle income countries.

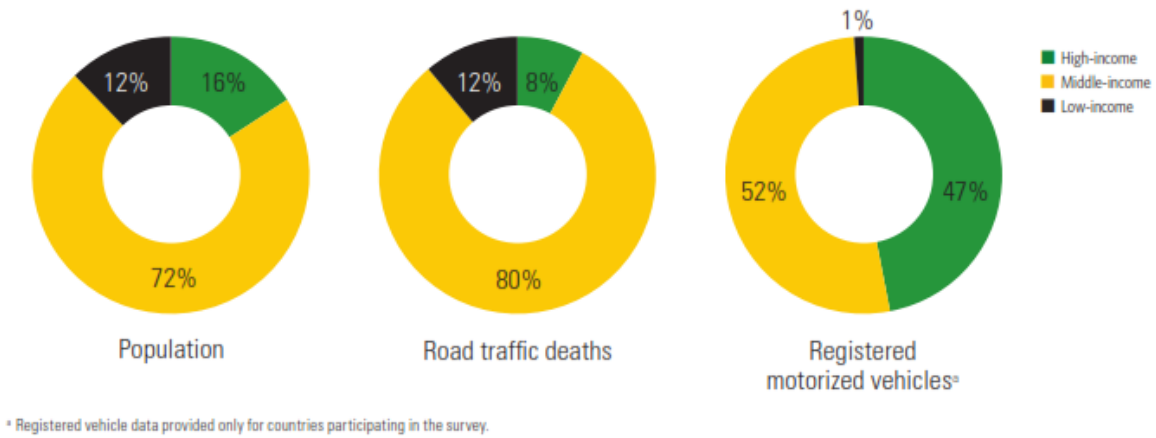

Figure 1: Population, road traffic deaths, and registered motorized vehicles, by country income status
Source: (WHO 2013)

If current trends of motorisation and vehicle kilometres travelled continue road traffic fatalities are estimated to grow to 5 million by 2050 (Heshuang Zeng 2014). They further recommend a two-pronged approach to address this challenge.

1. Strong laws and actions are required to reduce the risk per vehicle kilometre travelled.
2. A significant (approximately 20%) reduction in vehicle kilometres travelled through shifts to public transport and non-motorised transport.

Accessibility: Road congestion costs are rising, for example Asian economies lose 2-5 percent of Gross Domestic Product (GDP) each year due to long travel times and higher transport costs (Anjali Mahendra 2013). This significantly impacts individuals in low income households; they have very low accessibility to jobs, education, and health care and are either priced out or spend 3-4 hours every day in travel. Again if current trends on motorisation continue accessibility will further diminish. There is a call for cities to use new measure for their transport system. For cities to aspire to provide all citizens with access to jobs, education and health care within 30 minutes and to use this as a starting point for designing their systems.

Universal Access: Universal access refers to equitable access to urban goods and services for all irrespective of their race, income, gender, age, physical ability or social status. We are aging as a world. In 2006, almost 500 million people worldwide were 65 and older. By 2030, that total is projected to increase to 1 billion—1 in every 8 of the earth's inhabitants (Department of State 2007). Another un-emphasized is access to differently abled persons. Transport infrastructure, especially in lower and middle income countries, is highly inadequate to allow persons with disabilities to move about in a barrier free environment. United Nations estimates that 6%-10% of the population in developing countries has a disability (C.J. Venter 2003). Also, studies have shown disability rates are inversely proportional to economic status (due to the fact that the poor have limited access to health facilities) (Elwan 1999). Similarly, the Nirbhaya incident in New Delhi December 2012 brought sharp focus to the lack of safety for women. Studies such Mumbai (World Bank 2011), and Delhi (Jagori and UN Women 2010) have demonstrated that

women and girls face high level of sexual harassment on streets, public transport and during boarding and alighting.

Sound Public Transport: Sound public transport refers to reliable, fast and affordable services for all citizens within sufficient proximity. Public transport especially bus based in the last few decades has suffered a lot due to congestion. Being stuck in congestion reduces reliability, quality and increases cost. For example in Mumbai, speeds in evening peak hour have reduced for 20 kmph to 12 kmph over the last decade leading 30% increase in costs (BEST, 2010).

To achieve the ambitions on road safety, accessibility and universal access, sound public transport is key and hence has been included in the SDG on cities. The aspiration here initiated by (UITP 2012) is to double public transport market share globally by 2025.

3.2 Next Generation Sustainable Transport

As described earlier, current transportation development paradigms have generated negative environmental, social, and economic impacts, reflected in high road fatalities, poor accessibility, greater air pollution and chronic traffic congestion in large cities (UNEP 2011). These increasing challenges have started shifting policies and investment away from automobiles and highways and toward public transportation, walking, and cycling. There is a growing consensus among researchers, practitioners and development agencies that they need to be coupled with "avoid" measures (Holger Dalkmann 2012). Beyond the "push forces" of policies, the "pull forces" of economic development, technological innovation and social progress also open up new opportunities. This section describes the new paradigm of sustainable transport – multimodal and integrated, a paradigm that shifts from "moving cars" to "moving people", and a paradigm that will help achieve the vision set-up in SDG for cities.

a. Complete Streets for Safe, Universal Access

Most cities in low income countries have high walking and cycling mode shares. For example in the city of Mumbai 57% of all trips are walking or cycling (LSE 2011). However, roads in these countries are very bad for walking and cycling and far from the vision of safe, universal access.

Globally there has been a big movement to create more amenable human-scale connections for pedestrians, these projects pay attention to sidewalks, active ground floor and biking infrastructure between the buildings and their surrounding area; some projects even tear down original highways, and replace them with easily accessible public parks or boulevards

The concept of pedestrian zones or car-free zones which designated certain urban streets or districts for pedestrian only was originated in Lijnbaan, Rotterdam, the Netherlands in 1953 and became popular in Europe in 1960s and 1970s. Today, this idea has been adopted by over 370 cities in all five continents, but still nearly two thirds of pedestrian zones were located in Europe

In the United States, the complete street movement which calls for designing, operating and maintaining streets for users of all ages and modes has become increasingly popular these years. This concept is to respond to popular highway construction in the States that causes inaccessibility of non-car modes and social exclusiveness of vulnerable groups. Complete street also bring benefits such as reduced air pollution, enhanced pedestrian safety and increased

urban vitality (Stefanie Seskin 2012). As of July 2013, more 495 regional and local jurisdictions, 27 states have adopted policies or have made written commitment for complete streets, while in 2005 only about 30 jurisdictions installed this policy (NCSC 2014). With the increasing application of complete street policies, the biking environment in cities in the United States has been improved. The number of biking trips in the United States grew by 64% from 1996 to 2006. Change is even more significant in cities like Chicago, Portland, Minneapolis, and San Francisco (R. B. John Pucher 2011).

Preserving or promoting non-motorized travel through better street design has also received attention in emerging economies like the People's Republic of China. In 2012, the People's Republic of China's Ministry of Housing and Urban-Rural Development announced that the non-motorized share of travel in Chinese cities should be no less than 45 percent by 2015. Guangdong, as a pioneering city, has launched a "greenway" demonstrate project which involves biking and walking corridors paired with landscaping. By 2011, the city had built greenways with a total length of 1,060 kilometers, connecting attractions and many subway stations in the city.

Strong evidence shows that good pedestrian and bike environment will not only increase surrounding property values and a shift to more sustainable transportation modes, but also improve public health. Human-friendly urban environments invite people to bike and walk more, improving the public health. For example, New York City's life expectancy has risen 6.2 years since the 1990s while the increase in the United States overall was only 2.5 years (Gehl 2013).

All these positive economic and social feedbacks create a virtuous cycle for urban design for access. The benefits of human-and-transit-oriented urban design include better quality of life, increase in property value, and positive health impact, and these benefits have become more and more recognized, motivating individuals, business and the governments to invest and support more on these types of projects so as to create better and more liveable cities. And will also help achieve the ambitious goals of universal access set in the urban SDG.

b. <u>Sound Public Transport</u>

Most cities in low income countries have high public transport mode shares. Unfortunately this is on poor quality buses stuck in congestion. Cities need to provide reliable, good quality, public transport within acceptable distance to all its citizens. This is achievable by developing a network which is combination of ordinary bus services and prioritised public transport.

Ordinary bus services need to be planned well. Use of information technology for automatic vehicle location and automatic fare collection has made high quality data necessary for good planning easily available. Clear metrics on fare, frequency and reliability can now be put in place using this data and good bus services can be delivered though out the city. Providing services throughout the city will require subsidies especially if fares have to be affordable. Parking and pricing revenues can be used to pay for subsidies. Only planned subsidies should be provided.

Prioritised public transport can be provided through bus rapid transit or metro rail services. The scaling up of bus rapid transit systems from Latin America to the world has been a strong trend and an excellent choice for prioritised public transport. BRT is a public transport concept that allows high-capacity buses to operate at a rapid speed with some priorities through an integrated system including dedicated lanes, stations, and technologies and advanced branding. The initial concept of BRT was implemented in Lima, Peru in 1972 in the form of busway. In 1974, Curitiba implemented the full BRT system with at-level boarding, prepayment, articulated buses and other priorities. However, it was not until the success of Transmilenio, a high-capacity BRT system in Bogotá, Colombia (2000), did BRT start growing exponentially (FIGURE 2). More recently, Beijing (2004) and Guangzhou BRT in the People's Republic of China (2010) and Ahmedabad's BRT in India (2009) demonstrated that this innovation can be replicated and succeed in various contexts. As of July 2013, BRT systems were in operation in 158 cities around the world, comprising 288 corridors, a total length of 4,077 kilometres, and serving close to 237.1 million passengers every day (BRTCoE et al. 2013).

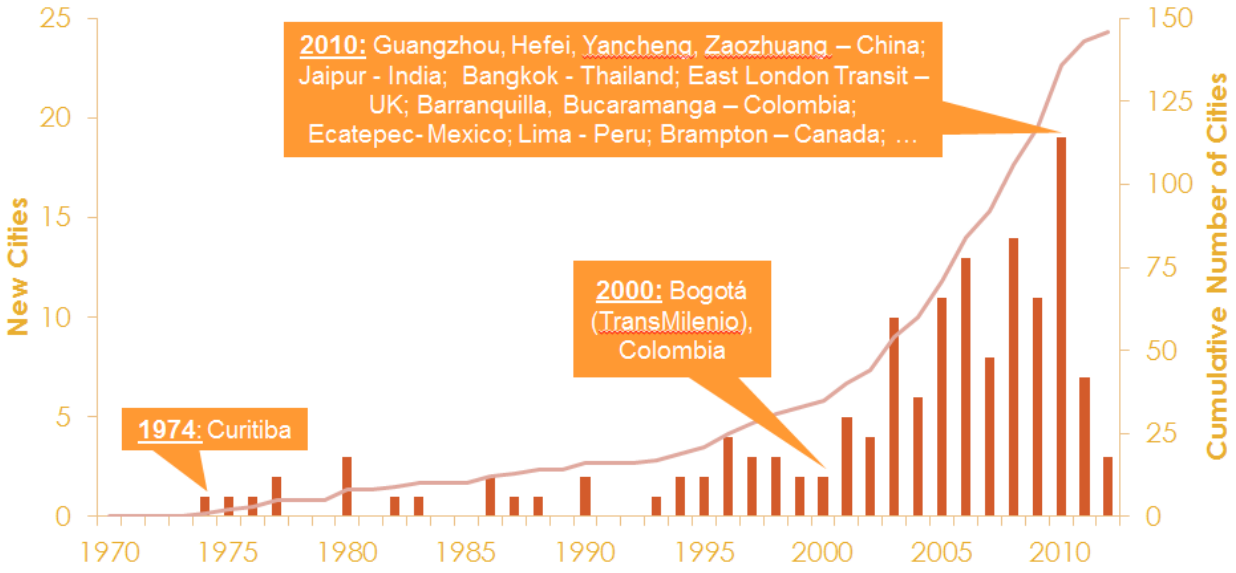

Figure 2: Growth of BRT Systems and Busways in the World
Source: BRTCoE et al. 2013

Of the 158 BRT systems, 128 were built after 2000 and most of them are in developing nations. In addition, there are 23 cities with BRT expansion plans and 82 cities have BRT planned or under construction. BRT is now included in the portfolio of public transportation options for cities by international organizations like the World Bank, the International Energy Agency, and UN-HABITAT. Cities can use BRT to rapidly scale up their prioritised public transport.

In addition to BRT, national governments in the People's Republic of China and India show strong support for metro rail construction. Metro rail systems have been as an important provider of urban mobility in many cities, since the first metro rail system was launched in

London in 1863. As of December 2012, metro systems were in operation in more than 180 cities around the world, with total length of close to 10,500 kilometres, serving nearly 112 million passengers every day (WMD 2013). In the People's Republic of China, metro rail systems are expanding at an unprecedented pace. With the opening of new 70-kilometer metro in December 2012, Beijing became the city with the largest metro system in the world with a 442km network, followed closely by Shanghai where the metro network is 423km (Economist 2013). The country plans to construct 2,500 kilometers of metro lines (six times the length of London's Metro) between 2010 and 2015, costing US$600 billion (Xin Dingding 2012). Currently, more than 30 cities in the People's Republic of China have metro railways under construction or in planning. In India, a similar policy of metro expansion is being considered, with metro systems being proposed for 53 cities of more than a million inhabitants.

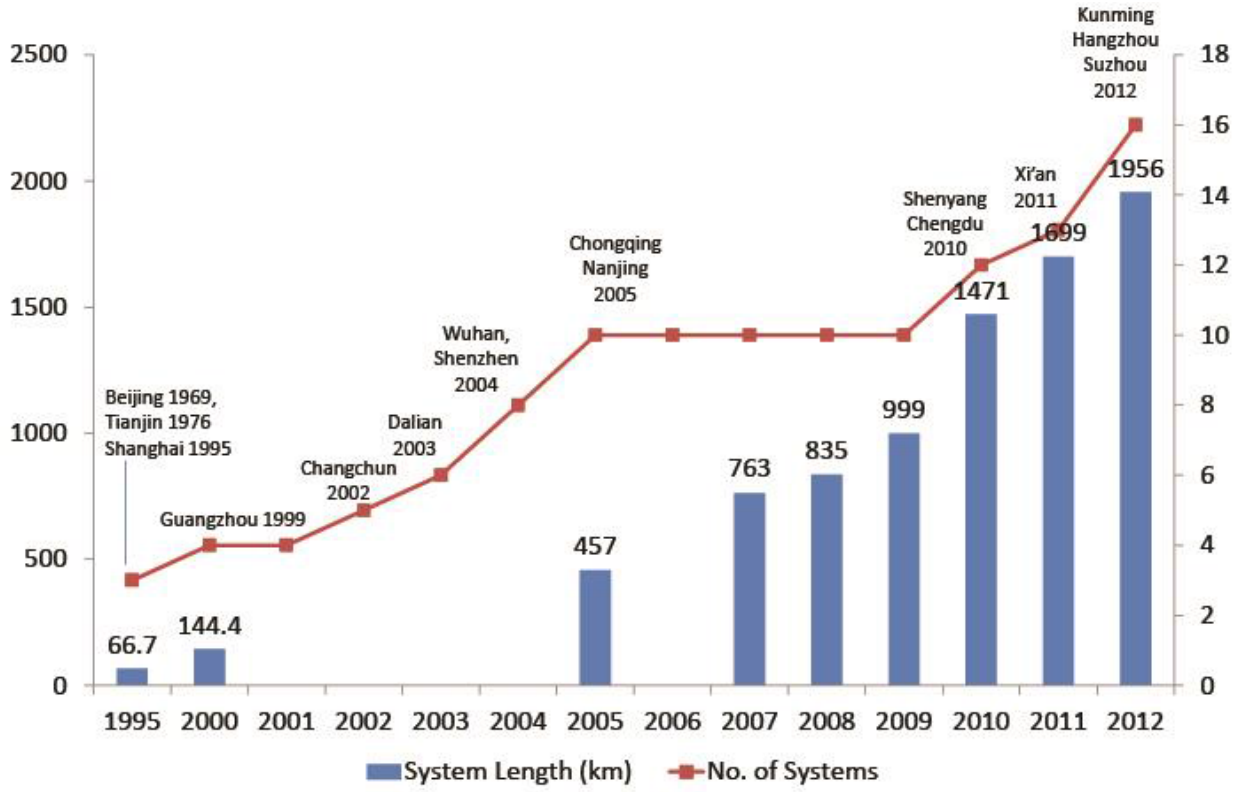

Figure 3: Growth of Rail Metro Systems in the People's Republic of China
Sources: Wikipedia, 2013; Wang 2005; P.R. China Statistics Year Book 2008-2012.

The growth in transit investment is consistent with an emerging global shift of transportation funding toward sustainable urban transportation. Before 1970s, most countries dedicated national transport funding only to support highways for cars. But starting from late 1970s and 1980s, more developed and emerging economies—including the United States, Germany, France, Brazil, Mexico, and others—have established national public transportation funding programs to support sustainable urban transportation development. Internationally, a potential game-changer commitment was announced at the United Nations Conference on Sustainable Development (Rio+20) in June 2012 where eight of the largest multilateral development banks

committed to investing US$175 billion in sustainable transportation systems over the coming decade. The shift of funding by national governments and international credit agencies may leverage large amounts of funding from the private sector and catalyse big changes in mass transit in the next decades.

c. Transit Oriented Development

Transit-oriented development (TOD) refers to compact, mixed-use development near transit facilities and high-quality walking environments (Robert Cervero 2004). TOD is not a recent phenomenon. Early examples can be found in the railway expansion in the United Kingdom, Japan, and the United States in the late 1900s and early 20th century. During the highway expansion in the United States from 1950s to 1980s, TOD caught the attention of Nordic cities like Copenhagen and Stockholm, as these European cities wanted to maintain the quality of life by controlling vehicular traffic within the limited urban space they had. Recently, reflection on the unsustainable nature of automobile-oriented development has again brought TOD to the attention of urban planners as part of the "New Urbanism Movement." The past three decades have seen a surge in research on TOD, an increase in the recognition of TOD principles from planning agencies, and a growing number of TOD projects. According to the prediction from the Centre for Transit-oriented Development (2011), the share of regional households near transit systems will significantly increase in American cities like Los Angeles, New York, Chicago, San Francisco, Philadelphia, and Pittsburgh in the next decade.

Although successful implementation of TOD projects requires institutional coordination and policy endorsement, there are a number of world-recognized TOD best practices today. These TOD projects include Copenhagen's new Finger Plan, Curitiba's BRT and urban development, the joint development of the Rosslyn–Ballston Corridor in Arlington, Virginia, and the Hong Kong Rail + Property development, among others.

Best practices develop valuable and practical TOD knowledge from which other cities can learn, and the accumulative knowledge has been summarized into sustainable neighbourhood guidelines for new urban development. In the United States, "LEED for Neighbourhood Development" integrates the principles of smart growth, urbanism and green building into a system for sustainable neighbourhood design, while BREEAM Communities in the United Kingdom also provides an assessment method of integrating sustainable urban design into master planning.

Recent TOD projects embrace a boarder set of principles beyond the traditional physical focus of the old 3Ds: "Density, Diversity, and Design." These projects not only include zoning policies that allow for a dense and mixed-use development pattern, they also address walking and biking connectivity through better street design, and create financing mechanisms, such as recapturing increases in land value around stations to fund rail expansion. The performance outcome of TOD projects has been increasingly designed to measure their success, including less driving, higher mode share of sustainable transport modes, increases in land value, and increases in community competiveness and vitality.

TOD has become a key design principle widely referred to in the People's Republic of China and, to a lesser extent, in India in the urban design proposals. However, the exploration is more on research than practice, as the challenges on cross-institution coordination still remain and enabling policies or incentives are still needed in both countries. A 2012 sustainable transport directive by the State Councils in the People's Republic of China suggests using land-value capture to support transit development, which opens the door to better combine transportation and land development through financing mechanism (Xinhua News 2013a). Some metro projects in Shenzhen, the People's Republic of China are now applying the Hong Kong Rail + Property model, which integrates urban railway expansion with the land development around the new stations. Although the implementation of TOD projects needs further institutional coordination and capacity building, a change of urban development paradigm in emerging economies like the People's Republic of China might be foreseeable in the near future.

d. Car Restrictions & Pricing Approaches

Car restrictions are growing in different parts of the world as a response to congestion and air pollution caused by the increase of motorized vehicles and limited road space. Authorities introduce these types of measures when it is not possible to provide enough infrastructure to efficiently cope with the increase in car use or when there is urgent need to improve air quality. In the industrialized economies, car restrictions and pricing approaches have become increasingly visible, ranging from fuel taxes, road pricing, parking to low-emission zones.

In the industrialized economies, car restrictions and pricing approaches have become increasingly visible, ranging from fuel taxes, road pricing, parking to low-emission zones. This section is focused on three vehicle demand management solutions that have emerged and received popularity in Europe and the United States over the past decade, i.e. new parking management, low emission zones, and congestion pricing. These new approaches internalize different negative environmental and/or social externalities of car usage to improve the health and quality of life of everyone in cities.

In some emerging economies, rapid motorization means that cities face even more grim challenges of air pollution and congestion. As a response, more and more Latin American such as Mexico City and Chinese cities like Beijing and Shanghai are taking car ownership and/or utilization restriction. Car travel restrictions based on the last number of the license plate is one type of restriction which has gained popularity recently in the developing world. This restriction is often applied in congested urban zones or streets to reduce the traffic volume. Another type of vehicle restriction that has received wider implementation recently in Asia is the vehicle quota system. A vehicle quota system (VQS) caps the number of new vehicle registrations to control the growth of vehicle population at a sustainable rate. It was firstly implemented in Singapore in 1990, where the quota is decided based on the principle of keeping the number of cars at levels supportable by road infrastructure development and distributed by auction.

Recently four Chinese cities - Shanghai (1994), Beijing (2011), Guiyang (2011), and Guangzhou (2012) - have adopted vehicle quota systems mostly to cap the over-rapid private vehicle growth. Shanghai is the earliest Chinese city applied VQS. Like Singapore, it sells the vehicle

license plates to the highest bidders by auction. The early implementation of this policy makes Shanghai successfully control the vehicle ownership half the Beijing level throughout the years and create large amounts of revenues for public transportation. Different from Shanghai, other Chinese cities did not adopt this policy until the traffic congestion had already been long entrenched in cities. Guangzhou, the newest member of VQS cities, implements a combined strategy distributing the license plates half by lottery and half by auction.

A key driver for car restrictions in developing cities is to show results in a short time. In many places, restricting car use is the result of mayoral decision in response to serious congestion or air pollution. These cities are keen to adopt simple regulatory approaches which could yield change quickly, at the price of skipping important extensive public consultation or background studies. That is mostly the case in Latin America where car use is still much less than 30% as well as the case in most Chinese cities (OMU 2010).

However, pricing approaches have also emerged sporadically in emerging economies too, In the People's Republic of China, other than Shanghai which implements the vehicle quota auction, cities such as Guangzhou and Beijing have introduced on-street parking management and are interested in implementing multi-objective parking management (ADB 2011). In Latin America, the city of Santiago have established three Parking Meter Districts (PMD), and one PMD, Uptown District, uses part of its parking revenue to promote public transit. The ongoing challenges of air pollution and congestion and the continuous improvement of governance will likely drive more developing cities to apply the pricing approaches now seen in the developed world.

The trend in car restrictions shows that there is an increasing variety of policies that are targeted at curbing different externalities of vehicle ownership and usage. These policies not only relieve congestion and improve air quality in cities, but also increase the pedestrian traffic and retail sale in the car restricted areas, resulting in the boost of vitality and liveability of urban centres. As policymakers become more aware of the negative environmental and social impacts related to automobiles and of the best practices of different car restrictions, more comprehensive vehicle restriction systems will likely be implemented in more cities, especially urban areas with large populations but limited road space.

e. <u>Shared Mobility</u>

In these systems, vehicles can be accessed by multiple users through subscription or pay as you go services. These services occupy a space apart from public transportation, walking, and private vehicles and fill niche roles in urban mobility systems. Shared mobility systems include car sharing, bike sharing, instant ridesharing and taxis. Recently, through the incorporation of advanced information technologies and penetration of smart phones, shared mobility systems have seen exponential growth in terms of system size, membership and variety worldwide. Shared mobility systems increase mobility options in cities, altogether contributing to the reduction of private vehicle usage.

The most recent example of a successful shared mobility scheme is Uber. It is a ridesharing service which uses a smartphone application to connect passengers with taxi drivers. The

service originated in San Francisco in 2009. It is currently available in 45 countries and more than 200 cities (Uber 2014). It uses the principles of congestion pricing to calculate fares.

Shared mobility services in the form of van-pooling, carpooling or auto-rickshaw sharing has long existed in developing countries. Operational, financial and regulatory challenges make these services low quality in these countries. Absence of official driving and criminal records often proves to be a major hindrance to introduce high quality shared mobility services. Other regulatory challenges, such as an unconducive environment for entrepreneurs, imposition of various taxes on such services, and lack of public policy on shared mobility prove to be problematic. Financial challenges include lack of availability of capital. Also, poor transportation infrastructure (lack of parking for shared vehicles) and congestion hinder the quality of these services (Lane 2014).

A study conducted by ITDP found that several factors can help achieve success. These are, differential treatment for different kinds of services, developing the service to complement public transport, regulatory support from the government, and innovations in the sector (Lewenstein 2014). Shared mobility services have the potential to provide both point to point and last mile connectivity. If widely implemented, they can also help to provide access to opportunities to low income populations. These services must be viewed in conjunction with other sustainable transport and technological solutions.

f. Multimodal Connectivity

An integrated multimodal system provides more mobility choices for people and more sustainable travel patterns for cities. Multimodal connectivity entails the provision of three elements:

1. Integrated infrastructure (different modes connected to each other both physically as well as operationally);
2. Multimodal information systems that provide reliable and accurate personalized information to travellers about the various modes, routes, schedules, and fares; and
3. Integrated payment solutions such as smart cards that allow seamless payment across different modes.

Currently, several cities in the world are leading the way by providing integrated infrastructure, multimodal information systems, and integrated payment solutions to promote multimodal connectivity

Integrated multimodal Infrastructure has been steadily improving, especially with high-speed railway expansion in Europe, the People's Republic of China and the United States. In the 1990s and early 2000s, new world class regional multimodal transportation hubs were built or renovated in Lille, Berlin, Madrid, London and other European cities. In the People's Republic of China, where high-speed railway is on the march, the nation plans to build 100 multimodal transportation hubs in the 12th Five Year Plan with US$5 to 8 million subsidies for each. A similar example can be found in San Francisco with the multi-modal transit hub "Transit Bay

Center" which is under construction now has received worldwide attention. At the local level, public transit agencies are continuously addressing and improving the interchange between modes, as shown in London, Los Angeles, Zurich, Guangzhou, and other cities.

Info-structure – Information and communication technology application: The real revolution in multimodal integration is the improved connectivity of transportation information in operational controls and user communications. Recently, providers of information technology and communications solutions are very active in the space of "smart mobility." Global companies like IBM, Siemens, Panasonic, Nokia, and CISCO have reorganized themselves to cater to the needs of information systems in transportation and "smart cities." Applications like advanced traffic controls, traffic information (routing/congestion), real-time information in stations, and advanced dispatch and control of transit systems are now common in many cities, helping transit agencies be more responsive to the real traffic conditions and make full use of different public transport service.

The advancement of "info-structure" at stations allows users to better access public transportation information, shifting travel behavior toward more public transit and more multimodal trips. One example is the increase in ridership that has resulted from real-time information displayed in stations. A study in London in early 1990s showed that 65 percent of passengers felt they waited for a shorter period of time when the Countdown information system was present (Schweiger 2003). A more recent study of Chicago's bus system, controlled for all other factors, confirmed a positive correlation between the provision of real-time information and ridership increases (Lei Tang 2012).

On the other hand, mobile-based communication applications have also become more available worldwide. For example, Google transit launched its online transit services in 2005 in partnership with transit agency of Portland, Oregon. Currently more than 250 cities in 67 countries worldwide are part of this initiative (Google 2013). Google and other similar applications make access to real transit information much more convenient, which might help users to choose the most convenient and effective modes according to the real traffic conditions. A key change in this area is the integration of user information that was previously dispersed throughout many government agencies or transit operators. With the gradual release of open data (location-based crowd-sourcing) and standardized transportation information (such as GTFS and GTFS real-time) provided by transit agencies, applications like Google tripper planner and open trip planner aggregating data for different modes such as bike-sharing become able to better inform users who are making multimodal trips.

Mobile apps providing transportation information to the public also appear in emerging economies like the People's Republic of China and India. For example, in PR China, the mobile app "shake and ride" includes public transit routes based on a user's location in 14 cities. In India, the m-Indicator app provides different transit options according to trip origin and destination information. New information and innovative solutions based on communication technologies will be an increasingly important way in improving the quality of service in public transport. The key here will be to ensure open data standards are adopted for all new technology systems implemented.

Integrated Payment Systems: Another important area fundamental to improving the user experience in transfers is advanced fare collection. Fare collection systems are evolving from single applications (i.e., a fare for one given type of transit service, like metro or BRT systems) to multimodal services. Today, fare collection systems using advanced contactless smart cards are available in more than 250 cities (Wikipedia 2013). The notable smart cards include Octopus (Hong Kong Special Administrative Region of China), EZ Link PTE (Singapore), Oyster (London), OV Chipkaart (The Netherlands), Clipper (San Francisco Bay Area), and Suica (Japan), serve millions of passengers every day.

Multimodal connectivity is driven by both policy and the market. Businesses have been seeking for opportunities in new integrated transport systems by providing better service in operation and information communications. Government decision-makers invest in increasing connectivity so that cities can attract more public transit users and reduce the cost of building and maintaining road infrastructure for private vehicles. The consumer response to infrastructure, info-structure, and integrated payment for multimodal mobility systems is very favorable. This positive response is built on—and supports—the five trends discussed in this report: car restrictions, transit, urban design for access, generational change, and shared systems.

Generational change and the rapid introduction of technology are showing shifts in individuals' tastes and aspirations, inclusive of more urban lifestyles. There are emerging policies for car restrictions and for increased public and non-motorized transportation supply. The creation of multimodal mobility platforms is no longer a futuristic vision, but a reality in the most advanced cities, and the ambition of a few cities in emerging economies.

3.3 Low Carbon Transport

The 6 complimentary trend agenda described and proposed earlier as vision to achieve the accessibility, safety and universal access goals set out in the urban SDG for sustainable transport also serve the climate change mitigation goals. These trends align perfectly with the avoid shift improve framework (Holger Dalkmann, 2012) adopted by the Sustainable low carbon transport partnership in Bellagio, 2012.

The dominant growth model currently pursued by many of the world's major countries characterised by conventional motorisation is a key driver for urban sprawl. The area of urbanised land is estimated to triple between 2000 and 2030. Avoiding sprawling and additional square kilometres for accommodating urban populations is the biggest climate change mitigation opportunity. And pursuing the next generation sustainable transport agenda will be a big driver for capturing this opportunity and further makes the case of sustainable transport also being low carbon transport.

3.4 Resilient Transport

Cities are now more vulnerable to extreme weather events. The large concentrations of population, infrastructure and material goods exaggerate the vulnerability. The way cities adapt to the growth in intensity or frequency of any unexpected climate event will be an important challenge for the future.

As cities begin to implement sustainable transport systems, following principles should be additionally adhered to increase resilience and reduce vulnerability of the transport networks

1. Use of permeable materials in roads.
2. Creation of some redundant transport routes
3. Gradual replacement of road materials and railways with more permeable materials and materials more suitable for heat
4. Protection, adaptation or movement of particularly vulnerable transport infrastructures (tunnels, bridges, metro entrances etc.). (ONERC, 2010)

4.0 International Agenda

The goal on making cities and human settlements inclusive, safe and sustainable is a great achievement of the advocacy work of the international community of sustainable transport and sustainable development.

Internationally, another game-changer effort of this community is the commitment announced at the United Nations Conference on Sustainable Development (Rio+20) in June 2012 where eight of the largest multilateral development banks committed to investing US$175 billion in sustainable transportation systems over the coming decade.

However the ADB reports that in Asia alone, the transport sector needs an enormous investment of about $2.5 trillion over the 2010-2020 period (ADB, 2012a; Rio+20 Joint Statement, 2012) and the US$175 billion is only a small fraction of what is needed.

The international community needs to the following three things to achieve the vision for sustainable transport set out in the urban SDG

1. **Stronger Advocacy:** The largest investments are continuing to be directed at large capacity road projects aimed at improving vehicle flows. Extensive advocacy efforts are required targeted both at local decisions makers, local civil society group and construction businesses to reverse this trend.

2. **Quantification of Co-Benefits:** The social and economic returns from investing in sustainable transport are enormous. The co-benefits story needs to be measured and communicated better. Also, the message that low carbon transport and transport for sustainable development are the same needs to be constructed with simple and clear numerical assessments.

3. **Climate Finance:** To support national and local governments to prepare themselves to access climate finance for sustainable transport projects.

5.0 National & Sub-National Agenda

As mentioned earlier starting from late 1970s and 1980s, more developed and emerging economies—including the United States, Germany, Brazil, Mexico, the People's Republic of China, India and others—have established national public transportation funding policies and programs to support sustainable urban transportation development. These national policies and programs should be modified to drive sustainable transport agenda building of the six complimentary trends. Many countries have already made these advances. Also, clear metrics should be put in place to ensure all trends are advancing in complimentary manner and cities are implementing the tougher car restriction and pricing programs.

National governments also have a great opportunity to access climate finance as mentioned earlier. Transport climate finance is often accessed at the national level and filtered down to the regional and local jurisdictions where funds are dispersed. Further, data on transport outcomes is often collected by local authorities and bundled up to higher administrative levels to measure broader impacts. To ensure that resources and accountability transcend national and local levels, coordination between levels of government is essential. The process is a challenge for several reasons: cities are often not involved in national climate change dialogues or policies; the political, economic, and emissions boundary of a city are difficult to reconcile; and city governments have varying levels of autonomy (Benoit Lefevre 2014). But ensuring coordination between national and local authorities crucially aligns plans and expectations. This can be done in a variety of ways – Mexico has passed a climate law that helps to encourage coordinated efforts at national and local levels. The Indonesian government took a step in this direction in 2011, when they reorganized government institutions and published "Guidelines for Implementing Greenhouse Gas Emissions Reduction Action Plan" in an effort to guide actions from the central and local governments to support NAMA development (Xander van Tilburg 2012).

Further through a review of national transit investment programs from 13 countries, EMBARQ identified a framework for effective implementation of national policies and funding programs. The most critical principles for effective implementation fall under three primary "pillars":

1. Define project rationale – Proposed systems should result from a clear definition of need and comparison of alternative strategies. It should also be appropriately scaled to solve the problem at hand, with costs and benefits compared. The technical evaluation process should be transparent and free of political influence.

2. Ensure deliverability – Adequate capacity to implement the project should be created. Technical support should be made available to from the national government or other institutions with mass transit expertise. As far as possible proposed project should not have significant outstanding risks that could threaten its successful implementation.

3. Facilitate local buy-in – Local governments should lead project planning and development of these sustainable transport systems. This will require adequate advocacy efforts to increase understanding of local decision makers. Positioning these systems as development agenda and not climate agenda becomes important at this

scale. Advances in co-benefits assessment will greatly assist overcome this last stumbling block.

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