Global Roadmap of Action Toward Sustainable Mobility

PAPER 2 | Universal Urban Access

SUSTAINABLE mobility™ FOR ALL

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GLOBAL ROADMAP OF ACTION

Toward Sustainable Mobility

UNIVERSAL URBAN ACCESS

SUSTAINABLE mobility™ FOR ALL

WORLD BANK GROUP

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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LIST OF ACRONYMS

ADB	Asian Development Bank
AFD	Agence Française de Développement (French Development Agency)
AFDB	African Development Bank
ATAG	Air Transport Action Group
BMZ	German Federal Ministry for Economic Cooperation and Development
BRT	Bus Rapid Transit
C40	C40 Cities Climate Leadership Group
CAF	Development Bank of Latin America
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CAUPD	China Academy of Urban Planning Design
CIVITAS	City-Vitality-Sustainability
CSCP	China Sustainable Cities Program
CSTC	China Sustainable Transport Centre
DBS	Dock Less Bikeshare System
DNP	Departamento Nacional de Planeación (National Planning Department)
ESCAP	Economic and Social Commission for Asia and the Pacific
GIZ	German Development Agency (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GMR	Global Roadmap of Action
GOPR	Governor's Office for Planning and Research
GRA	Global Roadmap of Action
HOV	High Occupant Vehicles
ICAO	International Civil Aviation Organization
ICLEI	Local Governments for Sustainability (International Council for Local Environmental Initiatives)
IDB	Inter-American Development Bank
IRU	International Road Transport Union
ITDP	Institute for Transportation and Development Policy
ITE	Institute of Transportation Engineers
ITF	International Transport Forum
ITS	Intelligent Transport System
KfW	Kreditanstalt für Wiederaufbau (German state-owned development bank)
LOS	Loss of Service

Maas	Mobility-As-A-Service
NACTO	National Association of City Transportation Officials
NCLB	No Country Left Behind
NDCs	Nationally Determined Contributions
NPA	National Petroleum Authority
NUA	New Urban Agenda
PMZ	Parking Meter Zone
RTR	Rapid Transit to Resident Ratio
SDGs	Sustainable Development Goals
SETPs	Sistemas Estratégicos de Transporte Público (Strate¬gic Public Transport Systems)
SLoCat	Sustainable, Low Carbon Transport
STI	Sustainable Transport Indicator
STIMs	Integrated Mass Transit Systems
SUM4ALL	Sustainable Mobility for All
SUTP	Sustainable Urban Transport Project
TDM	Transport Demand Management
TfL	Transport for London
TOD	Transit Oriented Development
TUMI	Transformative Urban Mobility Initiative
UCLG	United Cities and Local Governments
UITP	Union Internationale des Transports Publics (International Association of Public Transport)
UN	United Nation
UNESCAP	The United Nations Economic and Social Commission for Asia and the Pacific
UN-HABTAT	United Nations Conference on Housing and Sustainable Urban Development
VTPI	Victoria Transport Policy Institute
WRI	World Resources Institute

FOREWORD

Sustainable Mobility for All (SuM4All) is an umbrella platform that brings together 55 public and private organizations and companies with a shared ambition to transform the future of mobility. Its unique value lies in bringing key influential actors to work together. It serves as the principal platform for international cooperation on sustainable mobility, a center of excellence, and a repository of policy, knowledge and resource on sustainable mobility. Its mission is to play a leading role in the ongoing transformation of the global mobility system, and support countries in their transition towards sustainable mobility.

Established in 2017, SuM4All's first task at hand was to find common ground on what countries wanted to achieve. We all agreed that transport was a key contributor to economic development and core to people's quality of life. We also agreed that the transport that we have is not the transport that we want—congestion in cities, segregation among rural and urban communities, carbon emissions, air and noise pollution, and traffic accidents that are symptomatic of a systemic problem with mobility. We set our ambition high for the mobility of the future: we need an equitable, efficient, safe and green mobility.

The consensus on what sustainable mobility meant set us on our next task to establish the imperative for action. The Global Mobility Report 2017 benchmarked countries' performances on mobility relative to four policy goals. The findings of that report were alarming: not a single country in the world—developed or developing—has achieved sustainable mobility.

With evidence at hand, SuM4All embarked on a major drive in 2018 to develop a comprehensive policy framework to assist decision makers in cities and countries as well as practitioners at development banks to identify gaps, necessary steps, and appropriate instruments to attain the Sustainable Development Goals, and improve the sustainability of their transport sector.

We are pleased to share the outcomes of these efforts that embody the collective knowledge of all its members and more than 180 experts, and feedback from more than 50 public decision makers and 25 large private corporations. The report builds on six papers, including this Universal Urban Access paper, whose content is made accessible and usable to all in a web-based tool for decision making.

Sustainable Mobility for All Steering Committee
(On behalf of our 55 Member organizations)
July 2019, Washington, D.C.

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EXECUTIVE SUMMARY

Central to universal access in urban areas, is that enabling access to opportunities goes beyond the idea of providing access to transport alone. It involves increasing population's access to opportunities, with a special emphasis on improving access for the most vulnerable populations and enhancing equity of access.

Several indicators aimed at measuring access rely heavily on the availability and accuracy of data, often lacking for cities in the developing world. Various global organizations use available knowledge to provide policy advice, technical support and financial help to governments that are willing to follow their lead. The challenge lies in applying that knowledge, redirect those investments, and learn from those best practices.

Challenges to universal urban access start with the mainstream approach in urban planning, which continues to give greater emphasis to low-density, sprawled urban areas and individual motorized traffic, while disregarding public transport, cycling and walking. Additionally, policy measures to manage demand are commonly discarded because of political challenges in implementation, despite their known positive effects in overall transport improvements.

This GRA universal urban access paper is unique in several respects, as it:

- Advocates for new approaches which promote, for instance, exclusive right-of-way for public transport, redesigned street space for walking and cycling, sharing individual transport modes and lower maximum speeds. These can be complemented by multimodality, sharing and digital services, such as mobility-as-a-service (Maas), intelligent transport systems (ITS) and digital parking management.
- Gives greater importance to accessibility rather than mobility by focusing on movement of people and goods rather than vehicles.
- Follows a hierarchy of modes where non-motorized, active travel is given greater priority than individual motorized traffic, and where integration of transport (i.e., ease of movement between modes) is enhanced, most visibly in the allocation of street space.
- Focuses on saving lives while making transport safer and cleaner rather than better performance of the transport system as a whole.
- Assesses travel times instead of average speeds when measuring performance.

The key findings of this paper are that countries in Europe have the best performance, while countries that have traditionally favored sprawling and low-density cities, such as the USA and Australia, have low performances. Most developing countries have low levels of the RTR[1] as well, although it is worth noting countries such as Ecuador or Chile, which have higher levels of rapid transit provision than some countries in the global North.

In terms of financing, the challenge lies in the allocation of funds into other interests, policies and investments, as well as hidden subsidies. Interestingly, the investments needed to achieve great improvements will be much smaller than the medium and long-term benefits that they will generate.

ENDNOTES

1 The rapid transit to resident ratio (RTR) indicator is a measure developed by the Institute for Transportation and Development Policy (ITDP) and provides a very good proxy for quality public transport provision.

1. INTRODUCTION TO URBAN ACCESS

BACKGROUND AND CONTEXT

This paper provides guidance for achieving Sustainable Development Goal 11.2, which states that by 2030 there should be *"access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons"* (UN, 2015). This paper describes key concepts related to urban access, identifies ways to incorporate this goal into planning activities, and provides practical guidance for improving urban access in a particular situation.

What

Accessibility (or just access) refers to people's ability to obtain or reach desired goods, services and activities. Sustainability balances economic, social and environmental goals such as economic productivity, social equity, public health and safety, resource conservation, and environmental protection. A sustainable transport system is therefore *efficient* (it minimizes the money, land, time, energy and environmental resources required to access services and activities) and *equitable* (it is fair and serves all users, including disadvantaged people) in additional to safe and green.

Why

The world is increasingly urbanized–68% of the world's population is projected to live in urban areas by 2050 (UN 2018). As a result, urban transport conditions significantly affect people's quality of life and opportunities. In modern industrial economies, economic and social opportunity depends on access to urban jobs and services. Improving urban access can provide large and diverse benefits, as summarized in Table 1.1.

Table 1.1: Efficient and Equitable Urban Access Benefits

Improve Access Options	Increased Use of Efficient Modes	Reduced Automobile Travel	More Compact Development
Better walking, bicycling, transit and telework	*More walking, bicycling, ride-sharing, transit, etc.*	*Reduced private vehicle ownership and travel*	*More compact and connected communities*
• Improved traveler convenience and comfort • More access to opportunities • Social equity (disadvantaged groups benefit) • Improved safety and security	• Mobility benefits to users • Increased fare revenue • Increased fitness and health • Increased security • Local economic development • User enjoyment	• Reduced traffic congestion • Road and parking cost savings • User savings and affordability • Increased safety • Energy conservation • Reduced noise and air pollution	• Public savings and revenues • Improved accessibility, particularly for non-drivers • More efficient public services • Open space preservation • More economic productivity

Note: Improving access options, shifting travel modes, and more compact development can provide many benefits

Source: Todd Litman (2013), "The New Transportation Planning Paradigm," ITE Journal (www.ite.org), Vo. 83, No. 6, pp. 20-28 (https://trid.trb.org/view/1256859).

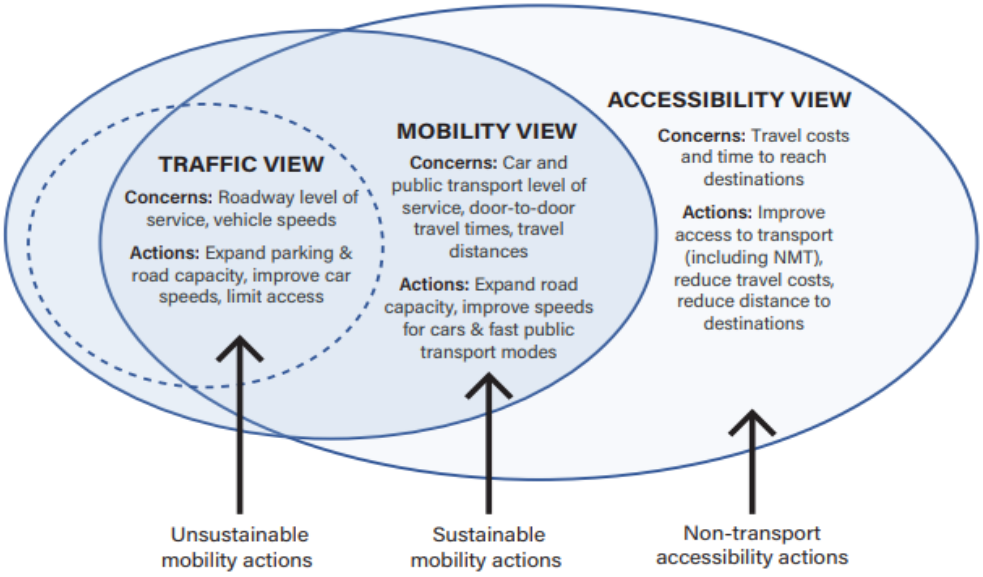
How

This report describes various strategies for improving urban transport efficient and equity. They include improvements to resource-efficient mobility options, mobility substitutes such as telecommunications and delivery services that reduce the need for physical travel, incentives for travelers to use the most efficient option for each trip, development policies that create more compact and connected communities, Transport Demand Management (TDM) programs, and technologies that facilitate efficient transport. The next section puts these policies into a broader context.

1.1. A new transport planning paradigm

This paper's analysis reflects a new planning paradigm which is changing the way we define transport problems and evaluate potential solutions (ADB 2009; Litman 2013). The new paradigm represents a progression from traffic-oriented to mobility-oriented and accessibility-oriented planning. *Traffic-oriented* planning evaluates transport performance based primarily on vehicle traffic conditions, and so assumes that the primary goal is to improve vehicle travel conditions. *Mobility-oriented* planning focuses on the movement of people and goods, and so recognizes the efficiencies that can result from automobile to more space-efficient vehicles such as public transit and rail. *Accessibility-oriented* planning recognizes that the ultimate goal of transport is to access services and activities, and recognizes a wide range of factors that can affect access including mobility, transport network connectivity, geographic proximity, affordability and even information (Levinson, Marshall and Axhausen 2017; Rode and Floater 2014; Venter 2016). Figure 1.1 illustrates these concepts. The new paradigm expands the range of solutions that can be applied to transport problems, which tends to increase efficiency and equity.

Figure 1.1: Traffic, mobility and accessibility



Source: Philipp Rode, Catarina Heeckt, Nuno da Cruz (2019), *National Transport Policy and Cities: Key Policy Interventions to Drive Compact and Connected Urban Growth*, Coalition for Urban Transitions (www.coalitionforurbantransitions.org); available at https://lsecities.net/wp-content/uploads/2019/04/CUT2019_transport_final.pdf

Note: A Traffic View focuses on vehicle travel conditions and favors roadway and parking improvements. *A Mobility View* focuses on personal travel and favors public transit in some conditions. An *Accessibility View* considers all factors that affect people's ability to reach desired services and activities including mobility, connectivity, geographic proximity, affordability, and user information.

Table 1.2: Transport problem perspectives

Perspectives	Traffic	Mobility	Accessibility
Users	– Do I have a vehicle and license? – Is it safe to drive? – Is the road paved? – Is it safe to drive here? – Is the road congested? – Can I find parking? – Can I afford fuel and parking?	– Is there transit service? – Are buses and trains crowded? – How far must I walk? – Will I be safe? – I can I navigate the system? – Can I afford the fare? – Is transit travel stigmatized?	– What services are nearby? – Can I afford to live here? – What are my commuting costs? – Can I get around without a car? – How safe is this area? – How much exercise will I get? – Can I use delivery services?
Businesses	– Are we located on a busy road? – How visible are we to traffic? – Are we on a busy road? – Do we have enough parking?	– How far is the transit station? – How many customers use transit? – How many workers can reach us by transit?	– How many customers are nearby? – How many workers are nearby? – Can staff video conference? – How attractive is this area?
Planners	– What is the road surface quality? – How congested is the road? – What is the accident rate? – How can non-drivers travel? – How can we manage traffic? – How much parking is needed?	– What is the demand for transit? – Can we create Transit Oriented Development (TOD)? – How can we shift travelers from driving to transit? – How safe is transit travel?	– What do people want to access? – How connected is the system? – How dense and mixed is the area? – How affordable is housing in TODs? – How safe is travel overall? – How can we manage transport?

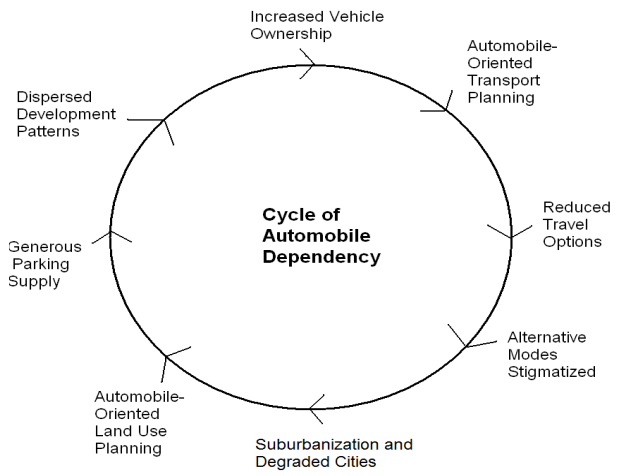
Note: Transport questions vary depending on perspective.
Source: Authors

These different perspectives present different questions to users, businesses and planners, as indicated in Table 1.2. For example, if a roadway is congested, traffic-oriented planning assumes that the problem is inadequate vehicle capacity and favors roadway expansion; mobility-oriented planning may support public transit service improvements, and targeted incentives to use those modes; accessibility-oriented planning considers active and public transport improvements and roadway expansion that privileges more efficient modes, mobility substitutes such as telework (using telecommunication for work and shopping) and delivery services, more compact and mixed development to reduce travel distances (for example, more neighborhood schools and more affordable housing in urban areas, more Transit Oriented Development, plus incentives for travelers to choose the most efficient mode for each trip).

Comprehensive analysis is important because planning decisions often involve trade-offs between different types of access. For example, increasing urban density tends to increase traffic and parking congestion but increases proximity, and increases public transit efficiency. Wider roads with higher design speeds improve vehicle access but create barriers to walking and bicycling. Increasing parking increases motorists' convenience but disperses development which reduces access by other modes. As a result, traffic-oriented planning can create a self-reinforcing cycle of more driving, fewer mobility options and more automobile-dependent development, as illustrated below (Figure 1.2.). Accessibility-oriented planning can help reverse these trends.

Table 1.3 compares the old and new paradigms.

Figure 1.2: Cycle of automobile dependency



Source: VTPI, Online TDM encyclopedia, Automobile Dependency, Available at https://www.vtpi.org/tdm/tdm100.htm

Note: Many common planning practices contributed to a cycle of automobile dependency and sprawl. These tend to reduce the supply of affordable housing in compact, mixed, walkable and transit-oriented communities.

The new paradigm is more comprehensive and multi-modal. It expands the range of impacts and solutions considered in transport planning. It considers emerging planning issues, such as parking costs, public fitness and health, and local economic development, as indicated in Table 1.4. For example, the new paradigm recognizes *universality*, the importance of serving all users' needs, wealthy and poor, young and old, strong and weak, men and women. Comprehensive analysis helps identify policies that achieve diverse goals and support global agreements such as those described in Annex 1 of this paper.

The new paradigm also considers a broad range of access improvement strategies, as indicated in Table 1.5.

The new paradigm recognizes the unique and important roles that active (walking and bicycling) and public transport (buses, trains and shared taxis for last mile connectivity) play in an efficient and equitable transport system. They are resource-efficient (they have minimal financial, space and energy requirements) and inclusive (they accommodate diverse users). It

Table 1.3: Changing transport planning paradigm

	Old Paradigm	New Paradigm
Definition of Transportation	*Mobility* (physical travel)	*Accessibility* (people's ability to reach services and activities).
Modes considered	Mainly automobile	Multi-modal: Walking, cycling, public transport, automobile, telework and delivery services.
Objectives	Congestion reduction; roadway cost savings; operating cost savings; reduced crash and emission rates per vehicle-km.	Congestion reduction; road and parking savings; consumer savings and affordability; accessibility for non-drivers; safety and security; energy conservation and emission reductions; public fitness and health; efficient land use (compact city with diversified land use).
Impacts considered	Travel speeds and delay, operating costs, crash and emission rates.	Various economic, social and environmental impacts, including indirect impacts.
Favored transport improvements	Roadway capacity expansion.	Improve transport options (walking, cycling, public transit, etc.). Transportation demand management. Smart Growth development policies.
Performance indicators	Vehicle traffic speeds, congestion delay, crash and emission rates.	Quality of accessibility for various groups. Multi-modal LOS. Various economic, social and environmental impacts.

Note: The old paradigm was mobility-oriented, the new paradigm is accessibility-oriented.
Source: Todd Litman (2013), "The New Transportation Planning Paradigm," ITE Journal (www.ite.org), Vo. 83, No. 6, pp. 20-28 (https://trid.trb.org/view/1256859)

Table 1.4: Emerging Transport Planning Issues

Old Issues	Emerging Issues
• Traffic congestion • Crash rates (e.g., per billion vehicle- or passenger-kms) • Vehicle travel costs • Government costs • Pollution emission rates (per vehicle-km)	• Parking congestion and costs • Affordability • Vision zero / road safety • Basic access (to school, jobs, stores, healthcare, etc.) • Economic and social opportunities • User comfort and convenience • Public fitness and health • Total per capita transport emissions • Community environmental quality (livability) • Local economic development

Note: The new paradigm recognizes emerging planning issues, and therefore the value of a more efficient and diverse transport system.
Source: Authors

Table 1.5: Access Improvement Strategies

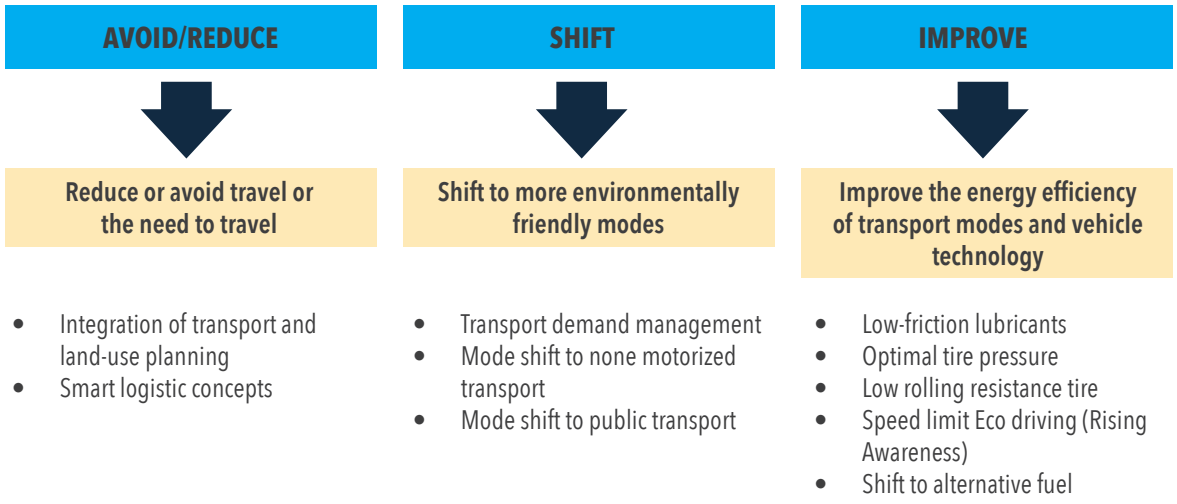
Accessibility Factors	Improvement Options
Mobility	Improve traffic speed, capacity and safety by paving roads and improving roadway design.
Mobility options	Improve walking, bicycling, public transport, rideshare, taxi, automobile and carsharing
Prioritization	Facility management and pricing favor higher-value trips and more efficient modes.
Mobility Substitutes	Improve telecommunications and delivery services that substitute for physical travel.
Network connectivity	Increase the density of paths and roads, and the connections between modes.
Proximity	Increase density and mix to reduce travel distances and improve walkability.
Affordability	Improve affordable access options (walking, cycling, public transport ridesharing and telework).
Convenience	Improve user information and payment systems.

Note: There are many possible ways to improve accessibility.
Sources: (a) Philipp Rode and Graham Floater (2014), Accessibility in Cities: Transport and Urban Form, NCE Cities – Paper #3, by the London School of Economics' LSE Cities program (www.lsecities.net), for the Global Commission on the Economy and Climate's New Climate Economy Cities Program (www.newclimateeconomy.net); at https://bit.ly/1vaXLJi.; (b) VTPI (2019) Online TDM Encyclopedia, Victoria Transport Policy Institute (www.vtpi.org/tdm)

also considers TDM incentives and Smart Growth policies that create more accessible and multimodal communities.

The old paradigm was reductionist; individual agencies were responsible for solving narrowly-defined problems, and so often implemented solutions that exacerbated other problems outside their scope. For example, transport agencies often devoted the majority of their resources to expanding urban roads and parking facilities to reduce congestion, although this degrades walking and bicycling conditions, undermines public transport, causes sprawl, and induces additional vehicle travel, and therefore increases traffic problems. More comprehensive analysis tends to support more multimodal planning and transporta-

Figure 1.3: Avoid-Shift-Improve



Source: Daniel Bongardt, Manfred Breithaupt and Felix Creutzig (2011), *Beyond the Fossil City: Towards low Carbon Transport and Green Growth,* Sustainable Transport Technical Document #6, Sustainable Urban Transport Program (www.sutp.org); at https://bit.ly/2wttbCQ.

Note: Avoid-Shift-Improve maximizes sustainable transport benefits by favoring strategies that reduce total motor vehicle travel and so provide more total benefits than simply improving vehicle design

tion demand management solutions that provide additional benefits, in addition to reducing congestion. Many organizations now apply *Avoid-Shift-Improve* priorities, which first favors strategies that reduce the need to travel or shift travel to more resource-efficient, modes because they provide more benefits than improving vehicle design, as indicated in Figure 1.3 and Table 1.6.

There are many obstacles to achieving universal urban access. Many current planning practices favor automobile-oriented transport planning and sprawled development patterns, to the detriment of walking, bicycling and public transport. For example, any countries subsidize vehicle fuel consumption; many jurisdictions limit development densities and require abundant parking; a major portion of transport funds are dedicated to highways and parking facilities and cannot be invested in other modes or TDM programs; and travel data and performance evaluation often undercount and overlook non-auto modes. More comprehensive and multimodal planning requires new data, analysis methods and agency responsibilities.

Many policy and planning reforms can increase urban transport efficiency and equity by improving efficient mobility options, providing incentives to use the most efficient option for each trip, plus development and roadway design changes. An integrated program of such strategies can significantly improve transport system efficiency and equity, providing large and diverse benefits, including benefits to motorists and communities.

Many new technologies and services complement those measures. For example, integrated navigation systems and payment apps, parking management systems, car- and bike-sharing, ride-hailing and self-driving vehicles, Maas and ITS support and are supported by more efficient and diverse transport planning. In addition, these emerging technologies and services can create new problems, such as privacy concerns, universality, and rebound effects (for example, if ride-hailing and self-driving cars stimulate more driving, which exacerbates traffic problems) and so require efficient management to ensure that they support sustainable transport goals (Polis Traffic Effi-

Table 1.6: Comparing strategies

Planning Objective	Reduce	Shift	Improve
Strategies	*More compact development, efficient pricing, and telework*	*Improve and encouragement walking, bicycling, and public transit*	*More efficient and alternative fuel vehicles, roadway improvements.*
User convenience and comfort	✓	✓	✓
Congestion reduction	✓	✓	
Road and parking charges	✓	✓	
Consumer savings and affordability	✓	✓	✓
Reduced traffic accidents	✓	✓	
Improved mobility for non-drivers		✓	
Energy conservation	✓	✓	✓
Pollution reduction	✓	✓	✓
Physical fitness and health	✓	✓	
Supports land use objectives	✓	✓	

Note: Compact development provides various internal (to residents) and external (to other people) benefits and costs.

Sources: (a) Reid Ewing and Shima Hamidi (2014), Measuring Urban Sprawl and Validating Sprawl Measures, Metropolitan Research Center at the University of Utah for the National Cancer Institute, the Brookings Institution and Smart Growth America (www.smartgrowthamerica.org); at https://bit.ly/2I6StdG.;(b) Todd Litman (2014), Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute (www.vtpi.org), LSE Cities (www.lsecities.net), for the Global Commission on the Economy and Climate (www.newclimateeconomy.net); at http://bit.ly/1EvGtIN.

ciency & Mobility Working Group & Hoadley, 2017).

Implementing the new paradigm requires capacity building and global information sharing among policymakers. Some important new ideas, such as Bus Rapid Transit (BRT) and pedestrianized streets, that first developed in the Global South and are now being implemented throughout the world, and many new technologies, such as integrated public transit navigation and payment systems, are being implemented in Asia more quickly than in other regions. More global capacity building can help understand and address key sustainable mobility goals described in this document, including social equity, economic opportunity, economic development, improved public fitness and health, and environmental protection.

1.2. Analysis scope

This paper primarily considers local personal access but recognizes the importance of efficient commercial transport *(called logistics)*, and longer-distance personal travel. Efficient commercial transport support economic productivity, business activity, employment and tax revenue. Individuals sometimes need bulk transport, for example, for large purchases or moving to a new home. Commercial travel tends to have high travel time values, including labor, equipment and vehicle expenses, and sometimes large costs for unexpected delays. In addition, heavy freight vehicles tend to impose large external costs including traffic congestion, road wear, parking requirements, accident risk, noise and air pollution emissions. For these reasons, improving commercial transport can provide large potential savings and benefits.

Although this report is primarily concerned with *intra-region* (within region) mobility and accessibility, many concepts also affect *inter-regional* (between region) transport. Improving urban mobility facilitates interregional travel by improving access to bus and train stations, ports and airports, and local logistics, and by reducing through traffic congestion delays. For example, travel to airports is often less reliable, more stressful, and takes longer than air travel itself, and long-haul freight deliveries are often delayed by congestion in the cities they pass through, so improving urban mobility and access improves interregional travel efficiency. In addition, rail terminals, ports and airports often become major activity centers themselves, with administration, logistical, maintenance, manufacturing and storage facilities and services. As a result, overall logistical efficiency and disadvantaged groups' economic opportunity require efficient local access for passengers, workers and goods distribution.

1.3. Understanding and responding to criticisms

Sustainable transport policy reforms often face criticisms, much of which is inaccurate or exaggerated. It is important that proponents understand and respond to such claims.

For example, critics argue that these strategies harm travelers by forcing them out of cars, but surveys indicate that many people actually want to drive less and rely on sustainable modes, provided they are convenient, comfortable and affordable. Multimodal planning responds to these demands.

Critics also argue that pricing reforms harm poor people. Although a given tax or fee represents a greater portion of household budgets for lower- than higher-income motorist, since vehicle ownership and fuel consumption increase with income, vehicle fees and fuel taxes are less regressive than most other funding source, and they benefit the poor overall if revenues are invested in affordable modes, or if pricing reduces bus delays, crash risk or pollution emissions. Similarly, critics argue that pricing reforms and vehicle restrictions harm businesses and reduce economic productivity. Although some fees burden some businesses, many businesses benefit from reduced congestion which increases their productivity and improves customer and employee. Businesses also benefit from reduced parking requirements that reduce their costs, from multimodal planning that improves access for their customers and employees, and from vehicle and fuel savings that leave households with more money to spend on locally produced goods and services. In fact, countries with higher fuel taxes such as Norway and Japan, and cities with higher road and parking fees such as London and Singapore, tend to be more economically successful and resilient than automobile-dependent regions with higher transport costs.

Sustainable transport advocates must respond to inaccurate and exaggerated criticisms and communicate the many benefits provided by more efficient and diverse transport system. We can use this to build a broad political coalition. For example, transport agencies, businesses, public health professionals, environmental organizations, and anybody who requires or prefers alternatives to driving has good reasons to support these policy reforms.

1.4. Principles of efficient and equitable urban access

To be efficient and equitable, a transport system must be diverse to serve diverse demands, and efficient to minimize the resources – time, money, land and energy – needed to access services and activities. To be equitable it must also be fair in its distribution of costs and benefits, and ensure that everybody, including disadvantaged groups, can access basis services and activities. To achieve these goals an urban transport system should reflect the following principles (International Transport Forum, 2016; Viegas, Martinez, Crist, & Masterson, 2016):

- Planning should be comprehensive, integrated multimodal, and *accessibility-based*.
- Access options should be diverse to serve diverse demands, including the needs of disadvantaged groups. Planning should respond to consumer demands (called *consumer sovereignty*). For example, if demand for a travel mode increases, responsive planning improves that mode.
- Investments should reflect least-cost principles, allowing selection of the most cost-effective solutions.

- Users should have incentives to choose the most efficient option for each trip. Higher value trips and more efficient modes should have priority in transport investments, facility management and pricing.
- Transportation fuel taxes, road and parking fees, and vehicle fees and taxes should at least reflect short-term marginal costs and recover long-term total costs, unless underpricing is specifically justified.
- Planning should include community engagement and comprehensive performance evaluation.

These principles help identify optimal urban design targets described below (Litman 2017; Rode and Floater 2014).

1.4.1. Development Density and Mix

What

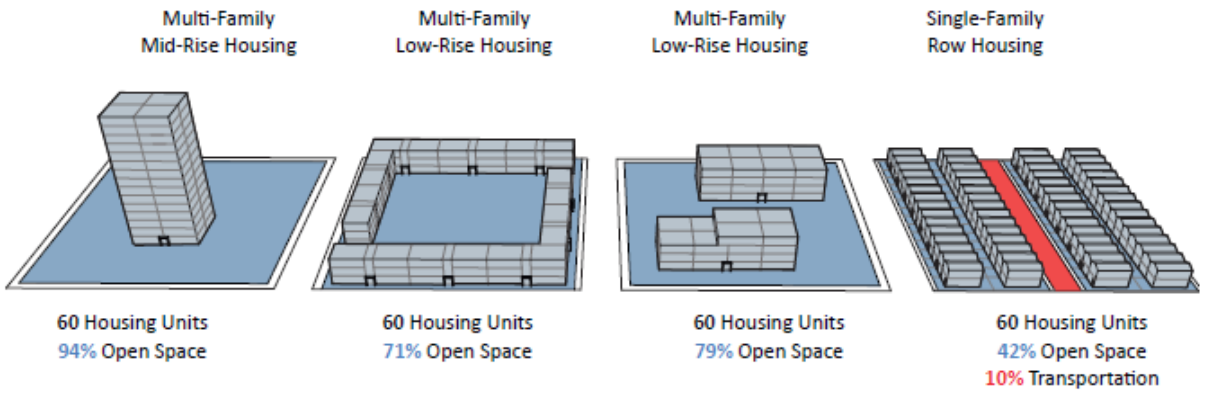
Density refers to the number of people and jobs located in an area. *Mix* refers to the combination of land uses (residential, commercial, recreational, etc.) in an area. These can be measured in various ways, such as people, jobs or housing units per acre, hectare, square-kilometer or -mile; net (residential land only) or gross (total land area); and for a particular district, neighborhood, municipality or region. Urban densities typically range from about 20 to 200 residents per hectare, with higher rates in central districts.

Mix can also refer to diverse housing types that respond to diverse housing needs, including physical abilities (some housing units should accommodate wheelchairs and other impairments), incomes, household size and type (including large and multi-generation families), ages and special needs (such as home workspaces and gardens). Figure 1.4 illustrates various housing types. These are categorized as detached (single-family) or attached (multi-family); and low-rise (2-4 story), mid-rise (4-8 story), and high-rise (more than 8 story).

Why

Increasing densities and mix reduces travel distances and improves walking, bicycling and transit access (Currie and De Gruyter 2018). This reduces vehicle travel and increases sustainable travel as illustrated in Figures 1.5 and 1.6. Increased density also reduces per capita land consumption, which preserves open space (farmlands and habitat). Diverse housing types serve diverse demands, affordable urban housing increases economic opportunity and inclusivity for disadvantaged groups. Table 1.7 summarizes compact development benefits and costs.

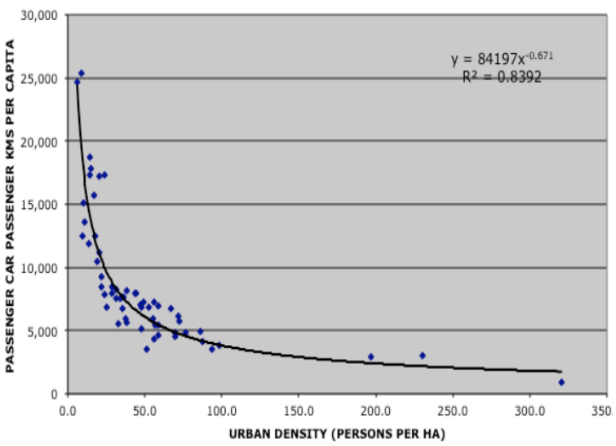
Figure 1.4: Types of residential density



Source: Ann Forsyth, et al. (2016), *Revitalizing Places: Improving Housing and Neighborhoods from Block to Metropolis,* Harvard University Graduate School of Design (http://research.gsd.harvard.edu); at http://bit.ly/2fszLii.

Note: Urban housing types including detached (1-3 story), and low-rise (2-4 story), mid-rise (4-8 story), and high-rise (more than 8 story).

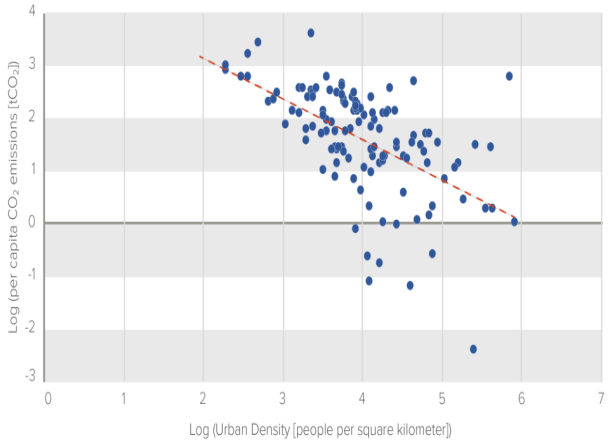
Figure 1.5: Car travel versus density for 58 world cities



Source: Peter Newman and Jeffrey Kenworthy (2011), 'Peak Car Use': Understanding the Demise of Automobile Dependence," *Journal of World Transport Policy and Practice*, Vol. 17.2, pp. 31-42; at www.eco-logica.co.uk/pdf/wtpp17.2.pdf.

Note: Higher densities tend to reduce motor vehicle travel.

Figure 1.6: Urban densities versus carbon emissions



Source: Philipp Rode, et al. (2017), *Integrating National Policies to Deliver Compact, Connected Cities: An Overview of Transport and Housing,* New Climate Economy (https://newclimateeconomy.report); at https://bit.ly/2vonQeQ.

Note : As density increases carbon emissions tend to decline.

Table 1.7: Compact Development Benefits and Costs

	Internal (To Residents)	External (To Other People)
Benefits	– Increased accessibility, which reduces travel time and money costs, and increases affordability. – Improved mobility options, which gives non-drivers more independent mobility and reduces chauffeuring burdens. – More efficient and affordable housing options. – Increased economic resilience. – Increased traffic safety, fitness and health.	– More efficient public transit services – Open space preservation (farm and natural lands). – Reduced public infrastructure and service costs. – Reduced total congestion. – Reduced traffic crash rates. – Reduced disability and healthcare costs. – Increased economic productivity and development. – Reduced fuel consumption and pollution emissions.
Costs	– High-rise increases construction costs. – Infill increases unit land prices (dollars per hectare). – Less private greenspace (lawns and gardens) and privacy. – Increased exposure to some pollutants.	– Better planning requirements for compact cities and diverse land use – Increases in some infrastructure costs such as curbs and sidewalk. – More local traffic and parking congestion.

Note: Compact development provides various internal (to residents) and external (to other people) benefits and costs.

Sources: (a) Reid Ewing and Shima Hamidi (2014), Measuring Urban Sprawl and Validating Sprawl Measures, Metropolitan Research Center at the University of Utah for the National Cancer Institute, the Brookings Institution and Smart Growth America (www.smartgrowthamerica.org); at https://bit.ly/2I6StdG.; (b) Todd Litman (2014), Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl, Victoria Transport Policy Institute (www.vtpi.org), LSE Cities (www.lsecities.net), for the Global Commission on the Economy and Climate (www.newclimateeconomy.net); at http://bit.ly/1EvGtIN.

Targets

People most walking trips are less than a kilometer, so most urban housing should be located in compact walkable neighborhoods within a kilometer of commonly used services such as schools, shops and parks (ITDP 2016). Efficient bus service typical requires 40, and rapid transit service at least 80, residents or workers per hectare within a kilometer of stations (World Bank 2018). In unconstrained cities (those that can expand into low-value land) most homes can be low- or medium-rise (1-8 stories), but geographically constrained cities generally require some high-rise housing. For recreation and happiness sake, 15-25% of urban land should be devoted to public greenspace, parks and trails (Larson, Jennings and Cloutier 2016). To maximize urban access, most new development should occur within or adjacent to existing cities, with major activity centers (large office buildings, college campuses, cultural and recreational facilities) located in central areas or near rapid transit stations.

How

Smart Growth and Transit Oriented Development (TOD) are general terms for development policies that create compact, mixed, and multimodal neighborhoods (Forsyth, et al. 2016; World Bank 2018). Planning should support appropriate densities, land uses, building types, and vehicle parking supply. Development policies should favor urban infill over expansion, with growth concentrated in central areas and near rapid transit stations. Any urban expansion should occur along designated corridors with adequate transit services and utility lines and create complete and walkable neighborhoods with most homes located within a kilometer of commonly-used services (Angel 2011; Rode, et al. 2017).

1.4.2. Vehicle Ownership and Use

What

This refers to the number of motor vehicles owned, vehicle kilometers, and mode share (portion of total trips made by a mode) in an area. Optimal levels are the amounts travellers would choose if they had diverse access options and all costs (roads, parking, congestion, crash risk, and pollution) were internalized (Boarnet 2013). Optimization is important because transport planning often involves trade-offs between auto travel and other access options; for example, vehicle travel reductions reduce traffic impacts

Table 1.8: Motor vehicle costs

	Internal (Vehicle User)	External (To Other People)
Variable (Operation)	– Fuel – Road and parking user fees – Wear and tear – Vehicle occupant crash risk	– Road and parking facility costs not paid directly by users – Traffic congestion – Barrier effect (delay motor traffic causes to active transport) – Crash risk imposed on other road users – Fossil fuel production external costs – Noise and air pollution emissions
Fixed (Ownership)	– Depreciation – Insurance – Registration fees – Scheduled maintenance – Residential parking paid by users	– Sprawled development patterns – Road and parking facility habitat and hydrologic impacts

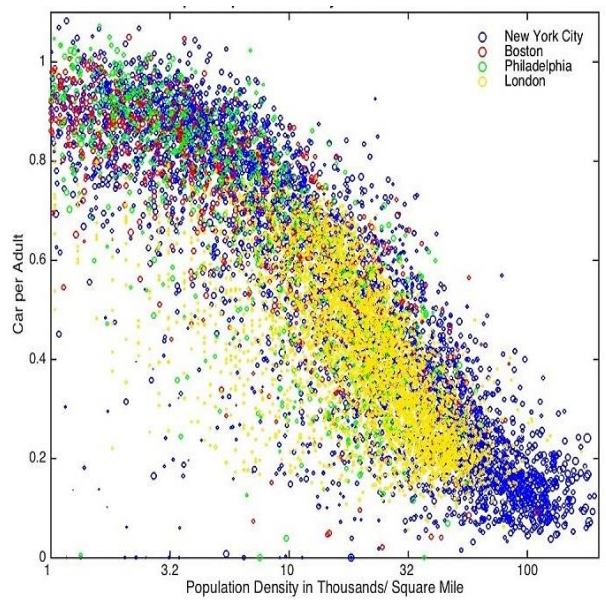
Note: Motor vehicle travel imposes many costs, including direct user costs and external costs imposed on others.
Sources: (a) Todd Litman (2009), *Transportation Cost and Benefit Analysis*, VTPI (www.vtpi.org/tca).; (b) NZTA (2010-2017), *Economic Evaluation Manual,* Volumes 1 and 2, New Zealand Transport Agency (www.nzta.govt.nz); at https://bit.ly/2KC3k17 and https://bit.ly/2P0wpEd.; (c) Ricardo-AEA (2014), *Update of the Handbook on External Costs of Transport Final Report*, European Commission (http://ec.europa.eu); at https://bit.ly/2c4e0b1.

that improve walking, bicycling and transit conditions, and by reducing parking supply, allow more compact and accessible development.

Why

Motor vehicle ownership and use imposes various costs, summarized in Table 1.8. Many of these, including congestion, facility costs, barrier effect, crash and pollution damages, tend to increase with density. In urban areas, total external costs are generally higher than motorists' out-of-pocket expenses, so for each dollar a motorist spends on driving their vehicle imposes more than a dollar worth of costs on governments and other people. This is economically inefficient and unfair; it increases external costs and cross subsidies from people who drive less than average to people who drive more than average and degrades walking and bicycling conditions. Since motor vehicle travel tends to increase with income, this is regressive.

Figure 1.7: Car ownership versus density in selected cities



Source: Greater Greater Washington, 2018

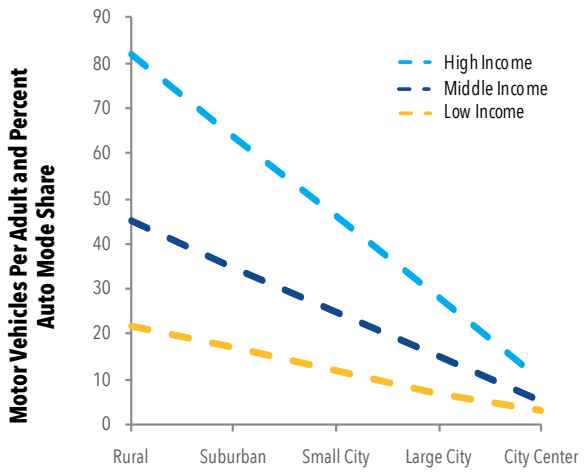
Note: In affluent cities such as New York, Boston, Philadelphia and London, automobile ownership tends to decline as density increases. This show how land use factors can affect travel activity, and therefore transport costs such as vehicle expenses, road and parking infrastructure costs, crash risk and pollution emissions.

Targets

Vehicle ownership and use tend to decline in cities with multimodal transport planning and efficient pricing (Buehler, et al. 2016; CARB 2014; Small 2017). This suggests that optimal vehicle ownership and use are significantly lower than what currently occurs in many cities. Even in affluent cities, per capita vehicle ownership tends to decline with density, as illustrated in Figures 1.7 and 1.8.

Many jurisdictions have emission reduction or vehicle travel reduction targets. For example, the State of California has targets to reduce greenhouse gas emissions to 40% below 1990 levels by 2030, and reduce total vehicle travel at least 15% by 2050 compared to expected levels (GOPR 2018). Similarly, Washington State House Bill 2815 that passed in 2008 set targets for reducing per capita vehicle travel by 18% by 2020, 30% by 2035 and 50% by 2050.

Figure 1.8: Optimal Automobile Mode Share



Source: World Conference on Transport Research, 2016

Note: As city size, density and poverty increase, vehicle ownership and use should decline. Optimal levels are less than 0.2 vehicles per capita and less than 20% auto mode shares in affluent city central areas, and less than 0.1 vehicle per capita and less than 10% auto mode shares in lower-income city centers. Various demand management strategies can be used to favour more space-efficient and affordable modes over private automobiles.

This indicates that in affluent rural areas, it may be appropriate for most adults to own a motor vehicle and use it for most trips, but as city size, density and poverty increase, they should decline, with less than 0.2 vehicles per capita and less than 20% auto mode shares in affluent central areas, and less than 0.1 vehicle per capita and less than 10% auto mode shares in lower-income city centers, as indicated below.

How

Efforts to reduce motor vehicle ownership and use are generally called Transportation Demand Management (TDM) or Vehicle Travel Reduction. These include multimodal planning, efficient transport management and pricing, Smart Growth development policies that that create more accessible and multimodal communities, and targeted TDM programs (Small 2017; TfL 2018; VTPI 2018).

1.4.3. Vehicle Fuel Conservation

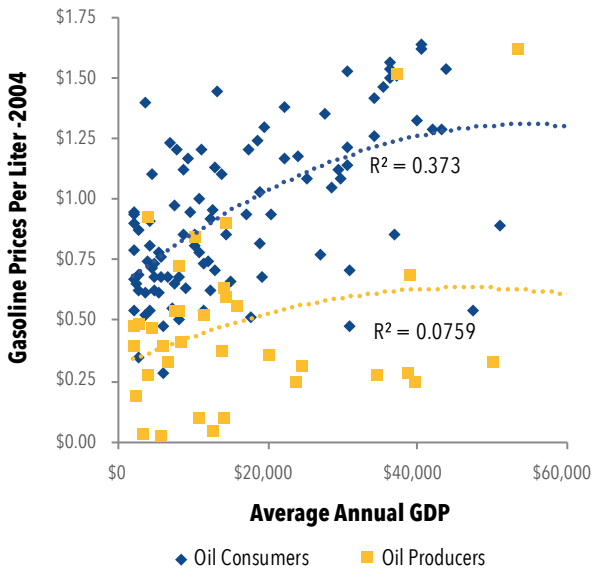
What

Vehicle fuel conservation reduces motor vehicle fossil fuel consumption and emissions.

Why

There are many reasons to reduce fossil fuel consumption and emissions. Fossil fuel production and consumption impose significant economic, social and environmental costs. Motor vehicle fuel a major source of local pollution and global pollution; in most cities it is the largest single source of climate change emissions. Petroleum production pollutes air and water and disturbs habitat and farmlands. Some countries bear significant petroleum subsidy costs (Davis 2013). Many regions depend on imported fuel which reduces local economic development and makes them vulnerable to price shocks and political manipulation (Nawaz, Shahzada and Alvi 2018; Plante2011). Figure 1.9 illustrates this: economic productivity tends to increase with fuel prices, particularly for petroleum importing countries, while petroleum-producing countries with low fuel prices, such as Iran, Venezuela and Nigeria, have poor economic performance, sometimes called the resource curse.

Figure 1.9: Economic productivity versus fuel prices



Source: Gerhard Metschies (2005), *International Fuel Prices*, German Agency for Technical Cooperation (www.international-fuelprices.com).

Note: Economic productivity tends to increase with fuel prices, indicating that fuel conservation supports economic development, particularly in petroleum importing regions.

Targets

Many jurisdictions have targets to reduce fossil fuel consumption by 20-50% in order to reduce local and global emissions, and to reduce petroleum import costs and risks (GOPR 2018; Nawaz, Shahzada and Alvi 2018).

How

Vehicle fuel can be conserved by reducing total motor vehicle travel through multimodal transport planning, TDM strategies, Smart Growth development policies, and efficient transport pricing (particularly fuel taxes), and with clean vehicle programs that encourage use of fuel-efficient vehicles and renewable fuels.

1.4.4. Efficient Roadway Management

What

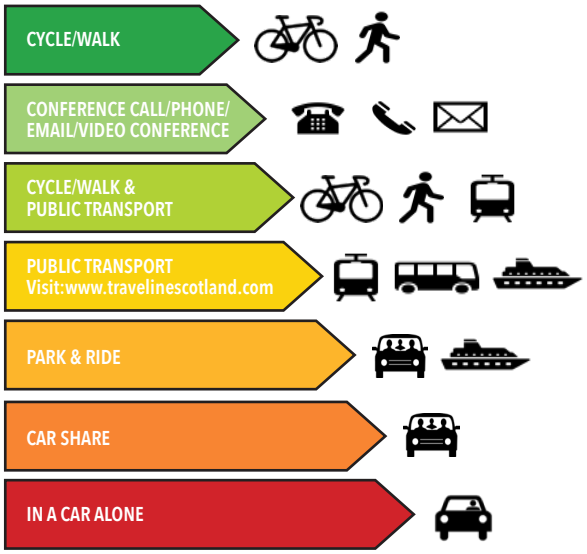
Roadway management includes various policies and programs to increase system efficiency (see Figure 1.10). This uses regulations, space allocation and pricing to favor higher value travel and space-efficient modes, reflecting a sustainable transport hierarchy.

Why

Public roads are a valuable public asset. Public rights-of-way typically represent 10-25% of urban land, and urban streets provide mobility, accommodate utility lines, are the primary public realm where people interact, and are the face of a city. Efficient management and prioritization can increase transport system efficiency and equity and reduce problems such as traffic congestion and accidents.

Prioritization tends to benefit commercial travel, including freight and service vehicles, buses and business travel, because they have high travel time values and support economic activity. Heavy vehicles (trucks and buses) impose large congestion, road wear, accident and pollution costs, so efficient freight transport can reduce externalities. Favoring High Occupant Vehicles (HOVs) increases travelers' incentive to use these modes, which increases system efficiency and benefits disadvantaged groups. As a result, transport prioritization and management increase system efficiency and equity, providing many benefits.

Figure 1.10: Sustainable Transport Hierarchy



Source: Authors

Targets

All cities need sufficient road space, including a network of arterials that can efficiently accommodate bus routes and heavy trucks. These should reflect *complete streets* design principles which ensure that urban roads are designed and management to accommodate diverse uses and users. This generally means sufficient sidewalks and crosswalks, bike- and bus-lanes where justified, and traffic calming and speed control.

How

In rapidly developing cities, roadway management may include development of sufficient arterial roads designed based on *complete streets* principles to accommodate diverse modes including walking, bicycling, public transport, automobiles and heavy trucks (ITDP 2011; NACTO 2016). Urban streets should be managed to favor more sustainable modes, with wide sidewalks and crosswalks, bike- and bus-lanes, low design speeds, and traffic calming (ITE 2019).

Prioritization can include dedicated bus, HOV or truck lanes, or priced lanes on urban roadways and parking facilities. Better logistics and technologies can coordinate deliveries and consolidate loads, optimize routing, reduce delays and improve customs clearances. Shifting freight from truck to rail or marine can reduce costs. Improved bus and truck design can reduce road damage, fuel consumption, noise and air emissions. Public policies can support these efficiency gains through better planning, infrastructure, pricing and incentives (Caltrans 2016; CIVITAS 2015; World Bank and IRU 2017).

1.4.5. Efficient Parking Management

What

Parking supply refers to the number of spaces available in an area. Parking management refers to various policies and programs that result in more efficient use of parking resources.

Why

Parking policies significantly affect transport and development patterns. Urban parking is expensive; many vehicles are worth less than the parking spaces they occupy (Scharnhorst 2018). Many cities have more parking than is efficient and fair because they underprice municipal parking and require developers to provide abundant off-street parking. This increases motor vehicle ownership and use, development costs and sprawl, and forces people who don't own vehicles to subsidize parking for those that do, which is inefficient, and unfair, and because vehicle ownership and use tend to increase with income, this tends to be regressive (Belmore 2019; The Economist 2017). The challenge is to have rates that do not hamper economic activities (e.g. shopping) while at the same time discouraging travelling, notably during peak time.

Targets

All cities should efficiently manage on- and off-street municipal parking. Cities should reduce or eliminate minimum parking requirements, allowing developers to determine the number of parking spaces to provide based on market demand, and support parking management strategies.

How

Table 1.9 summarizes various parking management strategies and their typical parking demand reductions.

1.4.6. Efficient Transport Pricing

What

Efficient transport pricing means that fuel, roads, parking, and vehicle fees are priced to recover long-run

Table 1.9: Parking management strategies

Strategy	Description	Typical Reduction	Traffic Reduction
Walking and cycling improvements	Improve walking and cycling conditions to expand the range of destinations serviced by a parking facility. Provide bike parking.	5-15%	✓
Reduced and more accurate requirements	Adjust parking standards to more accurately reflect demand in a particular situation. Establish parking supply maximums.	10-30%	
Efficient pricing	Charge motorists directly and efficiently for using parking. Unbundle (rent parking separately from building space) and cash out (give non-drivers the cash equivalent of parking subsidies offered motorists) free parking.	10-30%	✓
Shared parking	Parking spaces serve multiple users and destinations.	10-30%	
Regulations	Regulate parking to favor higher value uses and increase efficiency.	10-30%	
Increase capacity of existing facilities	Increase parking supply by using otherwise wasted space, smaller stalls, car stackers and valet parking.	5-15%	
Improve Information and Marketing	Provide convenient and accurate information on parking availability and price, using maps, signs, brochures and the Internet.	5-15%	✓
Improve enforcement	Insure that regulation enforcement is efficient, considerate and fair.	Varies	
Improve facilities	Improve parking facility design and operations.	Varies	

Note: This table summarizes various parking management strategies. It indicates the typical reduction in the amount of parking required at a destination, and whether a strategy also reduces vehicle traffic and associated problems.

Sources: a) GIZ (2012), Sustainable Parking Management, Transfer Project (http://transferproject.org); at https://bit.ly/2AdQdzV.; b) Ríos Flores, et al. (2014), "Practical Guidebook: Parking and Travel Demand Management Policies in Latin America," Inter-American Development Bank, (www.iadb.org); at http://publications.iadb.org/handle/11319/3577?locale-attribute=en.

costs and at a minimum reflect marginal costs. For example, efficient road and parking pricing recovers the costs of these facilities, with rates that increase with congestion and vehicle size. This gives travelers an incentive to change time, mode, route, and vehicle type to reduce congestion and road wear, and allows higher value trips to outbid lower value trips, which increases economic efficiency. This also increases equitable, since it reduces subsidies from non-drivers to motorists, and since vehicle travel increases with income, tends to be progressive.

Why

A basic economic principle is that efficiency and equity tend to increase if *prices* (what users pay for a good) reflect the marginal cost of producing that good. This prevents society from spending two dollars to produce a good that consumers only value at one and reflect the principle that consumers should generally "get what they pay for and pay for what they get." Transport systems often violate this principle, reducing efficiency and fairness. Vehicle fuel is often subsidized, roads and parking are often unpriced, and many costs are external (Shoup 2005; SUTP 2018). This underpricing increase vehicle travel beyond what is economically efficient, which exacerbates traffic problems and tends to be regressive because poor households gain smaller benefits and bear larger external costs. Efficient pricing is particularly important in urban areas where facility, congestion, crash risk and pollution costs are high. More efficient pricing can provide many benefits and help achieve many planning goals. For example, efficient road pricing reduces traffic congestion, accident risk and pollution emissions, and efficient parking pricing reduces the number of parking spaces needed, allowing more compact and affordable development.

Targets

All jurisdictions should implement programs to reduce subsidies and apply efficient transport pricing. Transportation prices should at least reflect short-term marginal costs and recover total long-term costs, so for example, road user fees should repay total roadway costs, with higher rates under congested conditions. This follows the 'if you benefit you pay' principle. For instance, expressways should be tolled because they benefit users and that those who do not pay can be denied access to the road. However, in the case of local or neighborhood streets this is not necessarily possible.

How

Table 1.10 summarizes the appropriate pricing of various transport costs.

Table 1.10: Appropriate pricing of various transport costs

Cost	Pricing Method	How to Calculate
Fuel production	Fuel tax.	External costs of producing, importing and consuming fuel, including GHG emissions. General taxes are applied to fuel.
Congestion	Time and location-based vehicle fees or road tolls.	Prices are higher under congested conditions. Price to reduce traffic volume to optimum flow.
Roadway costs	Road tolls or weight-distance fees.	Cost allocation applied to all roadway costs, including local streets and sidewalks, traffic services, rent and taxes on roadway land.
Parking	Charge users directly for parking using time and location-based fees.	Fees set to recover parking facility costs and maintain 85% maximum occupancy during peak periods.
Crash risk	Time- and location-based fees, or distance-based fees.	Current insurance premiums prorated by annual mileage, increased to account for uncompensated accident costs.
Pollution Emissions	Time and location-based fees (if possible) or distance-based fee.	A vehicle's emission rate (such as grams per mile) times regional pollution unit costs (such as cents per gram).

Note: This table describes the appropriate way to price various transport costs.
Source: Authors

1.4.7. Inclusivity

What

Inclusivity refers to a community's ability to accommodate diverse groups, including physically, economically and socially disadvantaged people, rural-to-urban migrants, foreign migrants, and refugees, plus artistic, religious and cultural activities. This improves urban access for population groups that particularly benefit. A political movement that supports inclusivity is sometimes called *the right to the city* (Lefebvre 1968).

Why

In modern industrial economies, economic opportunity largely depends on workers' access to urban jobs and services, and therefore affordable urban transport and housing options (Ewing, et al. 2016). Inclusivity helps achieve social equity goals (it helps disadvantaged people), supports local economic development by increasing labor supply, and can help prevent social and health problems that can result from concentrated poverty and alienation. It also tends to create more artistic, creative and attractive cities (Florida, Mellander and King 2015).

Targets

Inclusivity targets vary depending on specific conditions and planning goals. All cities should collect information on disadvantaged groups' transport and housing demands, and respond to those needs with appropriate facilities, services and programs (Di Ciommo 2018).

How

Inclusivity requires developing diverse housing types to accommodate diverse needs, including housing for people who are poor, have large families, or have special cultural practices. In some cases, it can involve providing land and materials that allow disadvantaged groups to build their own communities. It can also include building spaces particular activities such as artists' studios and workshops, small businesses (called *economic incubators)*, and meeting spaces suitable for religious and social activities. Inclusivity may also require special services to support and integrate disadvantaged groups, such as language and skills training, plus social and recreational activities.

Attractive and economically successful cities tend to have high land costs which result in unaffordable housing. In response, they use various strategies to increase housing affordability including development reforms, subsidies, price controls, and various incentives to encourage affordable infill (Angel 2011; King, et al. 2017) – see Table 1.11. Because a cheap house is not truly affordable if located in an inaccessible area with high transport costs, it is important to locate affordable housing in areas with good urban access (Forsyth, et al. 2016)

Inclusivity planning can be challenging. Urban land tends to be expensive, and higher density development increases construction costs, so market-priced urban housing is often unaffordable to poor households, and public spaces are often crowded and vulnerable to conflict. The urban poor often live in informal settlements, where they lack basic property rights and services; special programs may be needed to integrate them. Planning such programs should include

Table 1.11: Inclusive Transport and Housing

Transport	Housing
Improve active mode (walking and bicycling) conditions (including links to compact city and diverse land use).	Encourage more affordable infill housing development.
Universal design (accommodating people with mobility. impairments and other special needs)	Housing subsidies.
Affordable public transport, including informal services.	Improving informal settlements.
	Programs to support and integrate immigrants.

Source: Authors

stakeholder consultations to identify and address concerns and potential problems.

1.4.8. Optimal Urban Design Summary

This section identified various urban design factors, targets and implementation strategies, summarized in the following Table.

Cites vary in conditions and needs. For this analysis cities can be divided into three categories:

1. **Unconstrained cities** are surrounded by abundant lower-value lands. They should expand along designated development corridors and maintain at least 30 residents per hectare densities. A significant portion of new housing may consist of small-lot single-family houses, plus some larger lots to accommodate residents who have space-intensive hobbies such as large-scale gardening or owning large pets. Private automobiles may be common, but their use should be discouraged under urban-peak conditions.
2. **Semi-constrained** cities have a limited ability to expand. Their development should include a combination of infill and expansion. A significant portion of new housing should consist of attached housing (townhouses and low-rise apartments) and mid-rise multi-family. Private automobile ownership should be discouraged, and their use restricted under urban-peak conditions.
3. **Constrained cities** cannot significantly expand, so most growth should be infill, consisting of mid- and high-rise apartments. Strong policies are needed to maximize livability in dense neighborhoods including well-designed streets, adequate parks and trails, building designs that maximize fresh air and privacy, and restrictions on vehicle ownership and use, particularly those with internal combustion engines.

Table 1.12 summarizes various growth and design factors for optimal urban access.

Table 1.12: Optimal Urban Design

Factor	Unconstrained	Semi-constrained	Constrained
Growth pattern	Expand as needed	Limited expansion	Minimal expansion
Gross density (residents/ha)	20-60	40-80	80 +
Net (parcel) density (residents/ ha)	40-120	80-160	160 +
Housing types	Mostly low-rise	Approximately equal portions low-, mid- and high-rise	Mostly mid- and high-rise
Vehicle ownership (per 1,000 res.)	300-400	200-300	< 200
Private auto mode share	20-50%	10-20%	Less than 10%
Intersection density per sq. km.	40+	60+	80+
Portion of land in road ROW	10-15%	15-20%	15-20%
Roadway design	All urban streets safely accommodate walking and bicycling.		
Recreational facilities	Most households are located within a ten-minute walk of local parks and recreational facilities, and 15-25% of urban land is devoted to public open space.		
Examples	Most African and American cities	Most European and Asian cities	Singapore, Hong Kong, Malé

Note: This table summarizes urban design features optimized for urban access and other planning goals.

Source: Todd Litman (2017), "Determining Optimal Urban Expansion, Population and Vehicle Density, and Housing Types for Rapidly Growing Cities," Transportation Research Procedia, for the 2015 World Conference on Transport Research; at www.vtpi.org/WCTR_OC.pdf

2. STATE OF PLAY

2.1. Measuring urban access

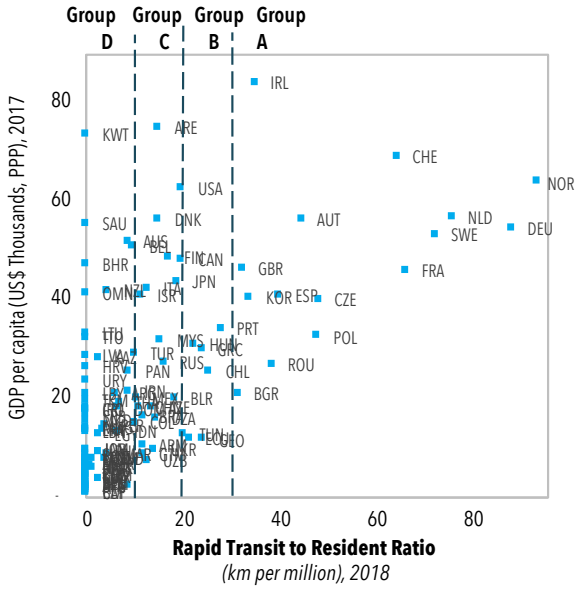
As previously discussed, many factors can affect urban access including mobility, connectivity, proximity and affordability (Venter 2016). New data sources and mapping systems can be used to measure urban access. It is often measured based on the time required to reach desired services and activities. Some systems are more comprehensive, accounting for pedestrian, bicycle and automobile travel speeds, sometimes considering the effects of traffic congestion, and some account for money as well as time costs *(called generalized costs)*. For equity analysis, this should be measured for different groups, for example, by income, physical ability and location. The United Nations Sustainable Development Goal 11.2 (indicator 11.2.1: *proportion of population that has convenient access to public transport, by sex, age and persons with disabilities)* supports this analysis.

SUM4All's Global Mobility Report 2017 noted that there is no internationally agreed methodology for measuring SDG 11.2 and that few cities and countries measure 11.2.1: (i.e. percentage of the population within 500m of a public transport stop). The Report identified a set of proxy indicators that are easier to measure (especially in developing countries / cities) and frequently reported by public transport undertakings in both developing and developed countries / cities. This can be used to gauge people's satisfaction with the service offer and when coupled with SDG 11.2.1 data it will help provide a city with a clearer picture of how accessible their city is through public transport.

One existing indicator that measures the availability of rapid transit in different cities and countries is the Rapid Transit to Resident Ratio (RTR). While this indicator is not a direct measure of urban access, it can be considered as a proxy for measuring availability of quality public transport. The Figures below show the distribution of the RTR for the countries in the world that have cities with over 500,000 inhabitants, showing that there are many developed countries that have sizeable rapid transit networks, however, many other countries, developed or developing, still lag behind.

In Figure 2.1, data on the Rapid Transit to Resident Ratio is plotted against GDP per capita and used to compare countries on Universal Urban Access. Countries are divided into four groups (A to D) based on distance to best performance.

Figure 2.1: Scatterplot of Rapid Transit to Resident Ratio vis-à-vis GDP per capita by country



Source: ITDP raw data analyzed by the World Bank

Group D represents countries that, compared with their peers, have made the least progress; Group C represents those that have made less progress; Group B represents those that have made more progress; and Group A represents countries that have made most progress. It may be noted that each country group includes countries from most or all regions.

Figure 2.2 shows the distribution of Rapid Transit per Resident (RTR) ratio in developed and developing countries, and in six regions of the world for developing countries only. The line in the box shows the median of the variable. The width of the box on either side of the median shows the "spread" of one quartile of the observations. The "Whiskers" show where the more spread out observations lie (two quartiles). Individual dots show observations which are outlying extreme values beyond the quartiles. For example, the median for developing countries in Europe and Central Asia is about 12. The values within one quartile range from about 0 to 12 (the Box) and the broader values range from about 0 to 38 (the Whiskers). There exists an extreme outlier at 48.

Developed countries were found to have a higher median RTR ratio than developing countries. There were also clear differences between regions in the median of the RTR ratio and in the variability (spread) of the data among countries within a region. Ranked by median, the regions, from lowest to highest, would be: Sub-Saharan Africa, South Asia, Middle East & North Africa, Latin America & Caribbean, East Asia & Pacific and Europe & Central Asia.

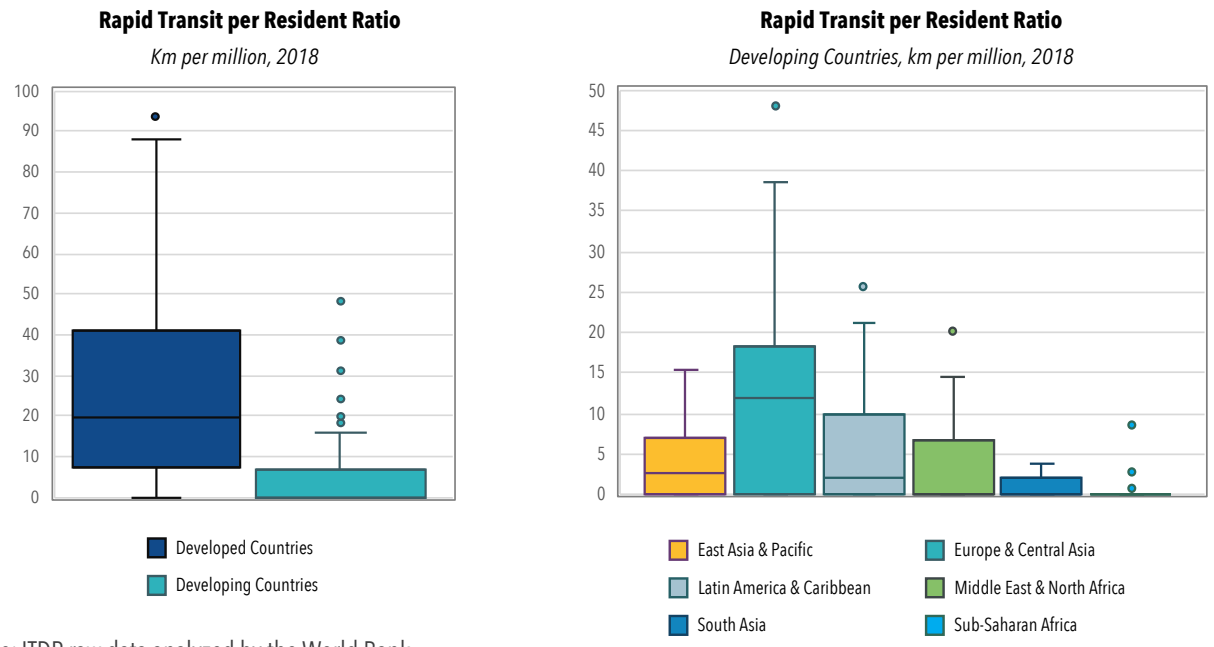
2.2. Accessibility Tools

Tools are increasingly used in developed countries, and soon in some developing countries (ITF 2017). However, currently most access mapping systems overlook key factors. Most only measure travel time, ignoring financial costs, although for many lower-income travelers, money costs are a major burden and constrain on travel. Few systems account for travel comfort, such as transit vehicle crowding, or station amenities such as seats, and few cities have detailed information on walking and bicycling conditions. Below are examples.

Accessibility in Practice [2]

This State Smart Transportation Initiative report offers practical guidance on implementing accessibility-based planning. It outlines concepts, data needs

Figure 2.2: Rapid Transit per Resident Ratio by regions



Source: ITDP raw data analyzed by the World Bank

and availability, analysis tools, and other considerations in measuring accessibility, and describes examples of such analyses.

Conveyal Analysis for Public Transport[3]

Conveyal Analysis helps you evaluate changes to public transport systems using accessibility indicators. These indicators quantify the access to opportunities experienced by transit riders, such as the proportion of the regional job market reachable within 45 minutes of total walking and transit time.

Inaccessibility Index for Social Equity Analysis[4]

Ciommo (2018) developed an *inaccessibility index* which indicates the number of desirable activities (such as jobs, healthcare and shopping) that a particular demographic group cannot reach. The results are used to evaluate the social equity impacts of strategic planning decisions in Barcelona, Spain, such as city center vehicle restrictions, parking policy changes, public transit service improvements, and park-and-ride services. The results indicate that the inaccessibility index analysis provides a practical way to consider equity impacts in planning decisions.

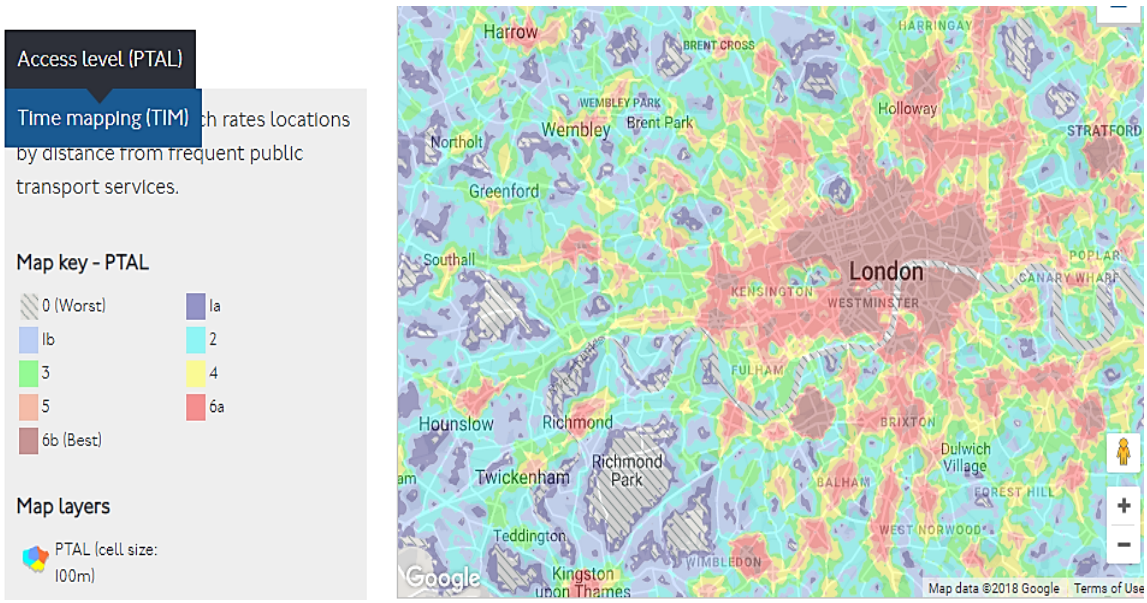
London's WebCAT Mapping System[5]

London Transport's WebCAT mapping system shows the areas that can be reached by transit within a given travel time (Figure 2.3). It is used by individuals and governments for strategic planning. The figure below illustrates typical output.

Public Transit Accessibility Levels[6]

Public Transit Accessibility Levels (PTALS) is a standardized method for measuring a location's public transport network accessibility, considering average walk speeds, distances to transit stops and transit service frequencies. This can help community planning and investment decisions. Each area is graded from 0 (very poor access) to 6b (excellent access). Shah and Adhvaryu (2016) applied this method using GIS mapping in Ahmedabad, India. This demonstrates

Figure 2.3: London's WebCAT Mapping



Note: London Transport's WebCAT mapping system shows the areas that can be reached by transit within a given travel time.

Source: WebCAT Mapping system. Figure available from "https://tfl.gov.uk/info-for/urban-planning-and-construction/planning-with-web-cat/webcat"

that such tools can function in developing as well as developed countries.

Revision[7]

This regional mapping, analysis and visualization program integrates a range of public and private data and performance indicators for sustainable community evaluation.

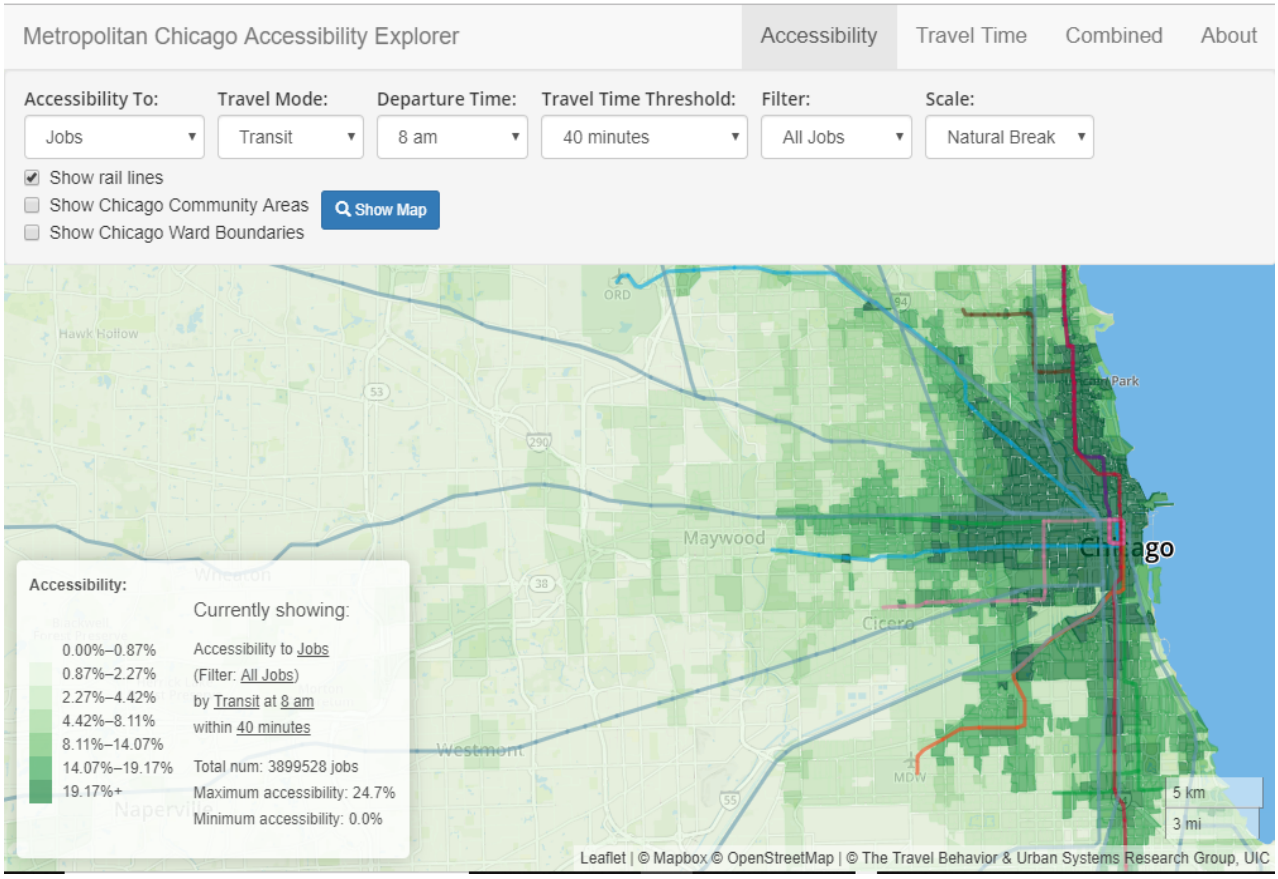
Smart Location Mapping[8]

This program provides interactive maps and data for measuring location efficiency, including the effects of the built environment on per capita vehicle travel, and methods for measuring transit access to jobs and workers.

Urban Accessibility Explorer[9]

Chicago's *Accessibility Explorer* is an easy-to-use mapping system that measures the number of activities, including various types of jobs, schools, parks, stores and libraries, that regional residents can reach within a given travel time, by a particular mode. The results are displayed on maps (see Figure 2.4) which can be adjusted by scale and area. This tool can help policy makers, planners and residents evaluate how transport and land use decisions affect accessibility.

Figure 2.4: Chicago's Urban Accessibility Explorer



Note: The Urban Accessibility Explorer shows the number of activities (in this case, jobs) that can be reached within a given travel time (40 minutes) by a particular mode (public transit) in the Chicago region.

Source: Urban Accessibility. Online tool available from http://urbanaccessibility.com/

Transportation for Everyone Rating System[10]

Table 2.1 summarizes the Transportation for Everyone rating system, which evaluates mobility and accessibility options, and helps identify gaps and improvement options. It recognizes diverse factors that affect accessibility. This can be used by households when choosing where to live, businesses making location decisions, and communities making planning decisions.

A higher rating is particularly important for people whose ability to drive is constrained, including youths, people with disabilities or low incomes, and people who are frequently impaired or distracted, plus drivers who want to avoid chauffeuring household mem-

Table 2.1: Transportation for everyone ratings

Accessibility Factors	Rating (1-10)
1. All-weather (paved) roads, and reliable motor vehicle fuel supplies.	
2. Compact, mixed urban development, which creates Transit-Oriented Development (if located around transit stations) or Urban Villages (if pedestrian oriented), where most common services (shops, restaurants, schools, parks, transit stops, etc.) can be reached within a 5-10-minute walk or bicycle ride of most homes and worksites.	
3. Good walking and cycling conditions, including adequate sidewalks, crosswalks, paths, bike lanes, bike parking, and vehicle traffic speed control.	
4. High quality public transit services, with good coverage, frequency, comfort, safety and affordability for both local and interregional (between city) services.	
5. Good connectivity, including dense walking and road networks, and intermodal connections such as walking and cycling access, and taxi services at transit stations.	
6. Convenient and affordable carsharing and bike sharing, taxi and ride-hailing services.	
7. Universal design (the ability of transportation systems to accommodate people with diverse needs and abilities, including those with disabilities and heavy loads).	
8. Good telework options, such as on-line shopping, banking and municipal services, and efficient delivery services ((mail, courier and local shops).	
9. Convenient user information concerning transportation options.	
10. Social marketing that promotes non-automobile modes and enhances their status.	
Sum	

Note: Each factor can be rated from 0 (worst) to 10 (best).

Source: Todd Litman (2017), "Determining Optimal Urban Expansion, Population and Vehicle Density, and Housing Types for Rapidly Growing Cities," Transportation Research Procedia, for the 2015 World Conference on Transport Research; at www.vtpi.org/WCTR_OC.pdf

Transportation for Everyone Score

70–100 **Multimodal** – A car is unnecessary for most daily travel. Many households are car-free.

50–69 **Mixed** – Non-auto travel is possible but sometimes difficult. Most households have at least one car.

0–*49* **Automobile Dependent** – It is difficult to live without a car. Most households have one car per driver.

Table 2.2: Urban access analysis data needs

Geographic	Demographic	Economic	Transport Activity	Transport Conditions
• City size • Residential density • Employment density • Development mix • Transport network	• Age and gender • Wealth • Population growth rate	• Transport expenditures • Employment and productivity • Government	• Transit trips • Active transport • Mode shares • Vehicle ownership • Motor vehicle use	• Transit quality • Walking and cycling conditions • Traffic congestion • Crash casualty rates

Note: Urban access analysis requires various types of data.

Source: Authors

bers with such constraints, or who may value having non-automobile options for current or future use.

Accessibility analysis requires various types of data, as summarized in Table 2.2. For optimal analysis this information must be geocoded at a fine-grain scale and disaggregated by demographic factors. Much of this information is already collected through census, travel surveys and infrastructure planning programs, but many need augmentations for more comprehensive and multimodal planning. For example, most jurisdictions will need additional facility and traffic data for pedestrian and bicycle level-of-service analysis.

New data sources and analysis methods can help overcome obstacles to urban accessibility analysis in developing countries.[11]

ENDNOTES

2 www.ssti.us/2017/07/accessiblity-in-practice

3 https://www.conveyal.com/analysis

4 https://bit.ly/2QJoj4Q

5 https://bit.ly/2j3u5Og

6 http://bit.ly/2raLR8b

7 http://revision.lewis.ucla.edu/?mc_cid=6d7654de44&mc_eid=b8e4b2304e

8 www.epa.gov/smartgrowth/smart-location-mapping

9 http://urbanaccessibility.com

10 www.vtpi.org/choice

11 The following documents describe transport survey and modelling in such regions.

Judy Baker, et al. (2005), *Urban Poverty and Transport: The Case of Mumbai Policy*, Research Working Paper 3693, World Bank (www.worldbank.org); at http://ideas.repec.org/p/wbk/wbrwps/3693.html.

Eric J. Gonzales, et al. (2009), *Multimodal Transport Modeling for Nairobi, Kenya: Insights and Recommendations with an Evidence-Based Model,* Paper UCB-ITS-VWP-2009-5, UC Berkeley Center for Future Urban Transport (https://escholarship.org/uc/item/6dv195p7).

Jacob Koch, Luis Antonio Lindau and Carlos David Nassi (2013), *Transportation in the Favelas of Rio de Janeiro*, Lincoln Institute (www.lincolninst.edu); at https://bit.ly/2DCeCQZ.

Debora Salon and Sumila Gulyani (2010), "Mobility, Poverty and Gender: Travel Choices of Slum Residents in Nairobi, Kenya," *Transport Reviews,* Vol. 30/5, pp. 641-657 (www.tandfonline.com/doi/abs/10.1080/01441640903298998).

Sumeeta Srinivasan (2011), "Linking Travel Behavior and Location in Chengdu, China: Geographically Weighted Approach," Transportation Research Record 2193, Transportation Research Board (www.trb.org), pp. 85-95; summary at http://trb.metapress.com/content/1786181773g62543.

Sumeeta Srinivasan and Peter Rogers (2005), "Travel Behavior of Low-Income Residents: Studying Two Contrasting Locations in the City of Chennai, India," *Journal of Transport Geography*, Vol. 13, pp. 265-274; summary at www.sciencedirect.com/science/article/pii/S0966692304000535.

C. Venter, V. Vokolkova and J. Michalek (2007), "Gender, Residential Location, And Household Travel: Empirical Findings From Low-Income Urban Settlements In Durban, South Africa," *Transport Reviews,* Vol. 27, No. 6, pp. 653-677; summary at http://144.171.11.39/view.aspx?id=843271.

3. LEGAL AND REGULATORY AGREEMENTS

3.1. Review of Existing Commitments

Many international agreements and commitments relate to sustainable development, sustainable transportation and transportation pollution emissions. These support efforts to improve urban access and create more efficient and equitable transport systems. This section describes examples.

3.1.1. Instruments

In 2017, the United Nations Conference on Housing and Sustainable Urban Development (UN-Habitat) developed the *New Urban Agenda* (NUA), endorsed by the UN General Assembly through resolution 66/207. The NUA provides a vision, principles, and tested practices for better and more sustainable cities worldwide. Its successful implementation is a critical step towards the realization to the 2030 Agenda for Sustainable Development, including the achievement of Goal, making cities and human settlements inclusive, safe, resilient and sustainable.

The addresses various aspects of urbanization in an integrated and coordinated manner, emphasizing the participation of global, regional, national, subnational, and local actors. On transport, it calls for action on accessible passengers and freight mobility in urban areas, more inclusive public spaces, and access for persons with disabilities. It also encourages development and expansion of new financing instruments for infrastructure. Overall, the NUA is a commitment towards (i) ensuring coherence between goals and sectoral policies, including mobility policies; (ii) the integration of urban and territorial planning; (iii) adopting, implementing, and enforcing safety policies and measures including pedestrians, bicyclists, and motorcyclists; and (iv) strengthening the coordination between transport, urban, and territorial planning departments.

The 2016 *Paris Agreement* provides a strong commitment to action towards sustainable urbanization through the Nationally Determined Contributions (NDCs). Although the Paris Agreement focuses on green mobility, an analysis by UN-Habitat showed that the majority of NDCs (113 of 164) have strong to moderate urban content, particularly in regions of Africa and Asia, clearly recognizing the association between urbanization and climate change. The transport sector is most referred to when it comes to urban climate action, including improved roads, efficient and reliable public transport, mass transit systems, and railway lines.[12]

The *Ashgabat Statement,* endorsed by the participants of the United Nations Global Sustainable Transport Conference in 2016, addresses several areas within transport in pursuit of the Sustainable Development Goals. On urban accessibility, the Ashgabat Statement emphasizes that public transport services and infrastructure contributes to the vitality of cities and are critical to enabling the mobility of people and goods, in particular considering the needs of vulnerable groups (women, children, youth, persons with disabilities, people living with HIV/AIDS, older persons, indigenous peoples, refugees and internally displaced persons and migrants).

The International Association of Public Transport (UITP) 2014 *Declaration on Climate Leadership* committed to doubling public transport market share worldwide by 2025. This Declaration puts public transport systems at the forefront, emphasizing planning for long-term improvements in public transport systems and the need for a modal shift to low carbon public transport within cities. It also calls for cities to "design public policies that limit urban sprawl and allow integrated public transport systems to expand in parallel with urban development", and to "support the

development and use of technological innovations in the public transport sector that lay the foundations for the sustainable smart city."

Similar principles for urban mobility are laid out in the *Regional Action Programme* for sustainable transport connectivity in Asia and the Pacific, phase I (2017-2021), by the United Nations Economic Commission for Asia and the Pacific (UNESCAP). While urban transport is one of the many areas addressed by this document, this action program indicates that countries and cities of the region must "initiate and implement innovative policies and frameworks to assess, plan, develop, improve and maintain sustainable urban transport systems and services." It proposes guides, frameworks and studies as the specific outputs of this action plan.

The role of civil aviation in the provision of interurban transport has been addressed by instruments adopted by the International Civil Aviation Organization (ICAO). ICAO particularly addressed the least connected countries, such as landlocked developing countries and small island developing states, in the Council Resolution on Aviation Contribution towards the United Nations 2030 Agenda for Sustainable Development, which was adopted unanimously by ICAO 39th Assembly in 2016. This resolution focuses on the implementation of assistance programmes aimed at enhancing the air transport systems of these countries.[13] Another resolution from ICAO focusing on least connected countries is the Council Resolution on No Country Left Behind (NCLB) Initiative in 2016.

In addition, non-state initiatives such as the Marrakech partnership, Mobilize Your City, TUMI, UITP initiative to double share of public transport also complement the action of national governments in improving conditions for transport.

3.1.2. Implementation Challenges

By means of the NUA, the international community has covered significant ground in addressing the need for an integrated approach towards urbanization challenges. Despite significant progress, universal access remains the global goal for sustainable mobility with the smallest number of dedicated international instruments. At the global level, there is a need to build upon the existing know-how, such as the NUA, to continue to support developing countries and cities in the pursue of more sustainable cities.

With a focus on cities rather than countries, the international community must also continue to embrace local governments. Policy recommendations can be more implementable if they address urban mobility needs at the local level, after considering specific needs and challenges, and prioritizing the actions offering greatest impact. Finally, a comprehensive but simple tracking framework would be beneficial for use at different levels of government (including cities), allowing to measure progress and understanding the needs for adjustments in the path towards sustainable mobility.

ENDNOTES

12 UN-Habitat. (2017) Sustainable Urbanization in the Paris Agreement.

13 United Nations Economic and Social Commission for Asia and the Pacific, Ministerial Conference on Transport, December 2016. *Ministerial Declaration on Sustainable Transport Connectivity in Asia and the Pacific*. (E/ESCAP/MCT(3)/11. Moscow. Retrieved from www.unescap.org/sites/default/files/pre-ods/MCT3_11E.pdf

4. CATALOGUE OF MEASURES

This paper divides them into these four toolboxes:

1. **Regulatory and Institutional** – includes reforms to governance, laws, regulations, funding and planning practices that improve urban access.
2. **Economics and finance** – includes reforms to transport prices to encourage efficiency and equity.
3. **Engineering and Technology** – impacting physical and technological infrastructure and operations.
4. **Communications** – These involve an integrated set of marketing strategies that encourage travel activity changes in a situation or group, such as commuters, freight transport or special event attendees.

These strategies and programs can be implemented at various scales. Some require national or state/provincial action. Others are implemented at a regional or municipal scale, some at a district or neighborhood scale, and others at a site such as a campus or building. Many of these strategies are synergistic, that is, they are more effective and efficient if implemented together, so they should generally be planned as an integrated program that includes a complementary set of positive and negative incentives. Every city, district and site are unique, and so requires a unique set of access improvement strategies and programs. The following section describes factors that should be considered when selecting the combination to apply in a particular situation.

4.1. Evaluation criteria

Every city and urban district are unique and so requires a unique set of sustainable transport policies and programs. This section discusses various factors that should be considered when selecting and designing these strategies.

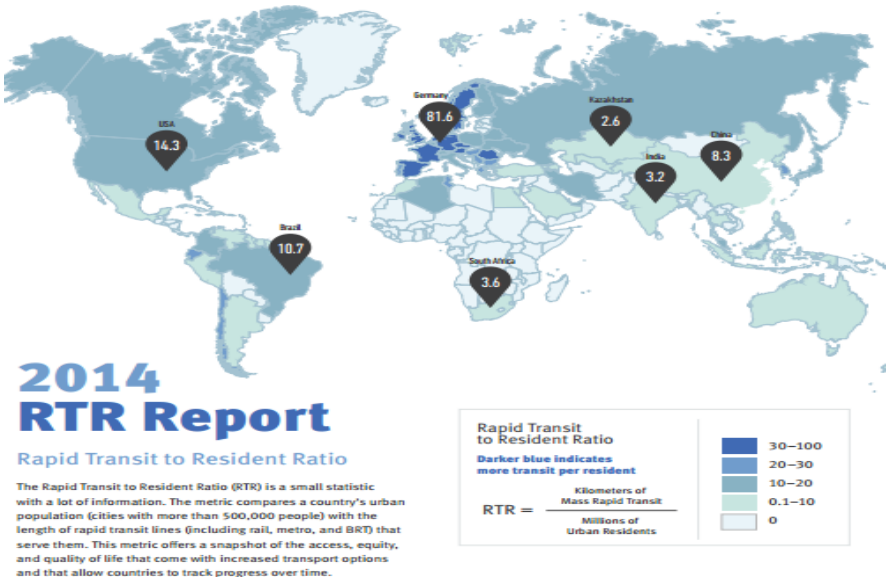
Public transit service quality

The quality of transit services significantly affects urban access. Scheduled buses and shared taxis operating in mixed traffic provide basic and affordable mobility for non-drivers. Higher quality transit can attract discretionary passengers who would otherwise drive, reducing traffic problems and provide a catalyst for Transit Oriented Development (TOD). This directly benefits transit users and reducing vehicle traffic provides community benefits.

Rapid transit refers to high quality bus and urban rail systems that typically include frequent and relatively fast service, rapid boarding and attractive stations. The Institute for Transportation and Development Policy's *Rapid Transit to Resident Ratio* (RTR) is a good indicator of transit service quality. It compares a country's urban population with their rapid transit supply. Countries and cities can be divided into the following four groups based on their RTR rating (Figure 4.2).

- **Group D** have the lowest RTR, meaning that they have severe deficiencies in rapid transit access. To improve urban access and reduce traffic problems they must establish an urban transport planning and funding capacity to begin rapid transit networks, improve basic bus services, develop active transport, and support TOD.
- **Group C** have low RTR ratings. To improve urban access and reduce traffic problems they should improve their urban transport planning and funding capacity so they can significantly expand and improve their rapid transit systems, improve station access, and support TOD. They should also

Figure 4.2: Rapid transit to resident ratio (RTR) map



Source: 2014 RTR Report

implement TDM incentives and programs.

- **Group B** moderate RTR ratings. They should expand and improve their rapid transit systems, improve station access, and support TOD. They should also implement TDM incentives and programs.
- **Group A** have the highest RTR ratings. They should focus on improving rapid transit design, universality and affordability, transit station access, and integrated transport and land use planning. To achieve equity goals, TODs should include housing that accommodates disadvantaged groups. They should also implement TDM incentives and programs to encourage travelers to drive less and rely more on resource-efficient modes.

Urban region size and density

Smaller city residents can reach more destinations by active transport, but larger and more dispersed cities require more motorized transport, including higher speed transit and automobile travel. Larger cities tend to have more intense traffic congestion which justifies more efficient road and parking pricing and pay-as-you-drive vehicle insurance and registration fees. Many large urban regions have fragmented planning and transit services, and so require governance, planning and funding reforms to improve region-wide coordination of transport systems and land use development policies.

Growth rates

Rapidly growing cities can justify more infrastructure investments, such as rapid transit network expansions, to accommodate future needs. Strategic transport planning and policy reforms are particularly important in rapidly-growing cities to prevent automobile-dependent transport systems and sprawled development patterns.

Geographic constraints

Unconstrained cities that are surrounded by abundant, lower-value land can expand, allowing more dispersed development patterns, such as higher rates of single-family housing, although for efficiency and equity, their urban-fringe developments should create walkable, compact and mixed-use communities that encourage active transport and provide independent

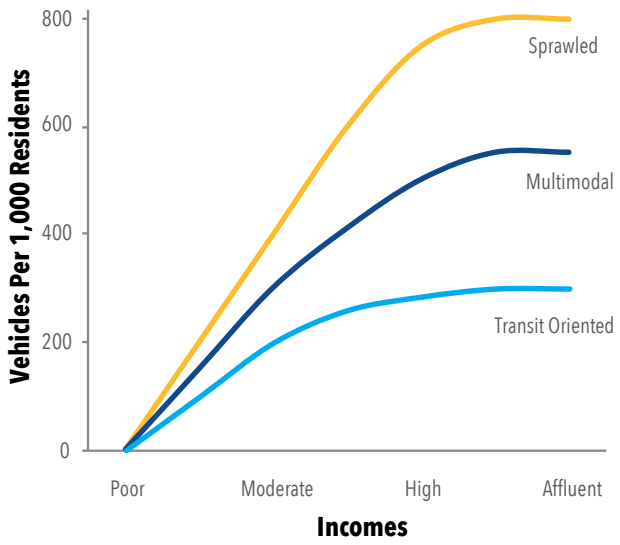
mobility to non-drivers. Cities that are constrained by shorelines, mountains or high-value open space (habitat, parks or farms) must grow upward rather than outward, and so require stronger policies to limit automobile ownership and use and create dense but very livable communities.

Automobile ownership and use

Automobile ownership and use tend to increase with income, particularly as households increase from low to moderate incomes, but vehicle use eventually saturates, and this point of saturation depends on urban transport and land use policies (see Figure 4.1).

All cities should strive to limit vehicle ownership and use to optimal levels, although their goals and strategies will vary depending on conditions. For example, many lower-income cities should improve and expand urban roadways to increase vehicle travel efficiency and safety, these roads should incorporate complete streets principles, so they are designed and managed to favor diverse uses and users in order to favor sustainable modes for efficiency and equity sake. Lower-income countries must improve walking and bicycling conditions, and affordable public transit services, for example, by formalizing shared taxi services and developing BRT networks.

Figure 4.1: Vehicle ownership by income and location



Source: Authors

Note: Private motor vehicle ownership and use tend to increase with income but eventually saturate. This level depends on transport and land use factors. Many affluent but transit-oriented urban neighborhoods have low levels of vehicle ownership, resulting in more efficient and equitable transport systems for everybody.

Promoting active transport and improving public transport quality

Many affluent cities already have high rates of vehicle ownership and use and so require high quality public transit services, including BRT and rail transit, efficient pricing to discourage vehicle travel, particularly to major activity centers, and TDM programs that encourage travelers to use the most efficient option for each trip. Parking management helps reducing parking facility costs, reduce parking demand, and reduce sprawled development. Many affluent cities can significantly improve walking and bicycling conditions.

Active transport (walking and bicycling)

Walking (including variants such as wheelchair, scooter and handcart use) is the most basic form of transport. Virtually everybody uses pedestrian facilities (sidewalks, crosswalks and paths), and most trips include walking links, for example, to transit stations and parked cars. Under some conditions, bicycling similar roles and can significantly increase mobility, increasing by an order of magnitude the area that can be accessed within a given time period. Walking and bicycling are affordable and healthy, require relatively inexpensive infrastructure, and produce minimal pollution. As a result, an efficient and equitable transport system requires good walking and bicycling conditions. Virtually all cities need high quality walking and bicycling conditions, including poorer cities where many people rely on these modes for basic access, transit-oriented cities where walking and bicycling provide local mobility and access to stations, and affluent and sprawled cities were active transport is important to achieve health objectives.

Various methods can be used to evaluate walking and bicycling conditions, Level of Service (LOS) and other rating systems (Dowling, et al. 2008). These measure

the extent of sidewalks, crosswalks, bike lanes, and paths, and roadway traffic volumes, speeds and vehicle mix, and sometimes factors such as topography and climate (Semler, et al. 2016).

Inclusivity needs

Cities and districts with more disadvantaged groups, such as people with mobility impairments or low incomes, should implement strategies that improve affordable and inclusive transport and housing options.

Political feasibility and support

Urban access strategies should be selected based on their political feasibility and support. Some strategies may be politically infeasible or may require effort and time to build support. More aggressive programs may become more acceptable over time as transport problems increase and people become more familiar with these changes.

Institutional capacity

Implementation often requires institutional reforms and practitioner training to support more comprehensive and multimodal planning. For example, transit service improvements may require more integrated planning, new funding sources, and planners familiar with rapid transit and TOD implementation. The aim here will be to ensure that compact and more diverse development can happen.

Time scale

Some strategies can be implemented quickly and have immediate impacts. Others require more time to develop and provide benefits.

Table 4.1 below summarizes how density and wealth can affect access improvement priorities. Poorer-denser areas rely more on active transport, poorer-dispersed areas rely more on basic public transit,

Table 4.1: Access improvement strategies by geographic and economic factors

		Wealth	
		Poorer	**Richer**
Density	**Lower** *(dispersed)*	– Public transport improvements – Bicycle improvements – Street paving – Complete streets policies – Shared taxis services – Traffic safety programs – Plan complete communities	– Complete streets policies – Smart Growth policies – HOV lanes – Bus service improvements – Regional rail – Campus transport management – Clean vehicle incentives
	Higher *(compact)*	– Bus Rapid Transit – Walking and bicycling improvements – Integrated Corridor Management – Street paving and arterial design – Affordable infill housing – Complete streets policies Universal design – Parking pricing and management – Neighborhood vehicle restrictions	– Urban rail transit – Integrated Corridor Management – Complete streets policies – Smart Growth policies – Commute trip reduction programs – Efficient road and parking pricing – Parking management – Neighborhood vehicle restrictions

Note: Optimal vehicle control strategies will vary depending on local geographic and economic factors.

Source: Authors

wealthy-compact areas require more vehicle travel reduction strategies and incentives to use space-efficient modes, and wealthy-dispersed areas rely more on clean vehicles. These factors apply at both local and regional scales, so a city may have different priorities in different neighborhoods.

Additional factors to consider when selecting urban access improvement strategies are outlined in the list of policy reforms outlined below.

4.2. Toolboxes

This section describes and evaluates various sustainable urban access policy measures.

4.2.1. Regulatory and Institutional Toolbox

Policy measures include reforms to governance, laws, regulations, funding and planning practices that create more compact and connected cities, improve resource-efficient travel options, and give travelers incentives to use the most efficient option for each trip.

Examples of these policy measures include:

1. Reform governance to allow more integrated planning among different sectors, jurisdictions and agencies. Support more coordination between transport and land use, passenger and freight transport, plus intra- and interregional planning.
2. Establish NUMPs (National Urban Mobility Plans) and SUMPs (Sustainable Urban Mobility Plans)
3. Establish a Vision Zero policy, with a traffic safety implementation plan.
4. Establish sustainable transport goals and performance targets related to active transport (amount that people walk and bike), shift to public transport, reduced fuel consumption and pollution emissions, traffic casualty rates, consumer costs and affordability, impervious surface area, and other impacts. Change transport planning goals, *from maximizing traffic flow to minimizing vehicle travel*.
5. Establish transport-related data collection, performance evaluation and accessibility mapping programs.
6. Integrate transportation and land use planning to support Transit Oriented Development (TOD). Reform development policies and zoning codes to support more compact, mixed and connected development, and establish growth management policies that limit urban expansion.
7. Apply reduced and more flexible parking requirements, and other policies that support parking management.
8. Reform investment practices to reflect least-cost planning principles.
9. Establish new funding options for sustainable modes and TDM programs, including land value capture.
10. Formalization and regularize informal mobility services such as shared taxis and private buses.
11. Implement Smart Growth policies. Encourage location-efficient and transit-oriented development. Produce maps which show the accessibility of different locations and encourage households and businesses to choose accessible and multimodal locations.
12. Support sustainable transport capacity building (training and information resources) by transport agencies and professional organizations (planners and engineers).
13. Reform regulations to allow and support innovative mobility services such as demand-responsive, TNCs (Transportation Networking Company for last mile connectivity to high capacity modes), carsharing and bike sharing, and linking these with public transit.
14. Develop regulations and incentives that encourage more efficient or alternative fuel vehicles, require emission inspections, or encourage scrapping older vehicles.
15. Establish complete streets policies to ensure that all roads accommodate diverse users and uses.

Table 4.2 evaluates these policy measures according to their impacts, implementation speed and costs. These assessments are very general and may vary significantly depending on conditions and perspective. Some strategies, such as land use development policy reforms and cleaner vehicle purchase incentives, may be quick to implement but take years or decades to achieve their full impacts and benefits. Similarly, some

Table 4.2: Regulatory and Institutional policy measures and their impacts

Policy Measure	Impacts and benefits	Implementation speed	Implementation costs
Governance reforms for more integrated planning	Varies (a)	Medium (b)	Medium
Establish NUMPs and SUMPs	Varies	Medium	Low
Establish sustainable transport goals and performance targets	Varies	Medium	Low
Establish transport-related data collection, evaluation and mapping programs	Varies	Medium	Low
More integrate transport and land use planning	Varies	Medium	Low
Parking reforms and improved management	Large	Medium	Low
Apply least-cost planning	Varies	Medium	Low
Establish sustainable transport funding	Varies	Medium	Low to high
Formalize shared taxis and private buses	Medium	Quick	Low
Smart Growth policies	Varies	Medium	Medium
Support sustainable transport capacity building	Varies	Medium	Low
Allow and support innovative mobility services	Medium	Medium	Low
Encourage efficient or alternative fuel vehicles	Medium	Medium	Low if regulations, high if subsidies
Establish complete streets policies	Medium	Medium	Low

Note: This table provides general assessments of various sustainable transport policy reforms. Actual impacts and costs can vary depending on conditions and perspectives. (a) Planning reforms do not affect travel directly but can result in large impacts and benefits. (b) Can be implemented quickly but may take years or decades to achieve their full impacts and benefits.

Source: Authors

policy measures may have low implementation costs to governments but impose additional costs and savings to consumers and businesses.

4.2.2. Economics and Finance Toolbox

These policy measures change transport prices to encourage efficiency and equity. They are proven to be effective at achieving transport planning goals and some also generate revenue that can be used to support sustainable transport programs. For example, Commute Trip Reduction programs are two to five times more effective at reducing automobile commuting is commuter parking is efficiently priced or cashed out (people who don't drive receive the cash equivalent of the parking subsidies offered to motorists).

Motorists generally prefer "free" roads and parking, but these facilities are never really free, the choice is really between paying directly or indirectly. Paying directly through user fees is more efficient and equitable, since it reduces vehicle travel and therefore external costs such as congestion, accident risk and pollution emissions, and reduces subsidies from people who drive less than average to those who drive more, if roads and parking facilities are funded through general taxes or rents. Described differently, charging directly for roads and parking facilities gives consumers a new opportunity to save money by reducing their use, for example, with efficient pricing a commuter who shifts from driving to another mode would save hundreds of dollars annually in reduced road and parking costs. Since lower-income households tend to own fewer vehicles and drive less than those with

higher incomes, this tends to be progressive with respect to income.

These strategies include:

1. Eliminating fuel subsidies. Many countries subsidize vehicle fuels or charge less than international market prices or production costs. Reducing these subsidies increases efficiency and equity (GIZ 2018).
2. Cost-based fuel taxes. At least recover all roadway costs, and possibly charge for external cost through an escalating carbon tax. Apply general sales taxes to vehicle fuel.
3. Efficient road pricing. This includes road tolls or vehicle-travel fees, to pay roadway costs, with rates that increase under urban-peak conditions to reduce traffic congestion.
4. Efficient parking pricing. This means that fees recover costs (revenues repay all costs, including the equivalent of rents on land devoted to parking facilities), with higher rates at times and locations with higher demand to reduce parking congestion problems. Apply efficient pricing to municipal parking and encourage private property owners to charge for parking. Require landlords to unbundle parking (rent parking separately from building space, so tenants are not forced to pay for spaces they do not need). Cash out free parking (people who don't drive receive cash benefits equal to parking subsidies provided to motorists). Charge daily rather than monthly or annual parking fees, so motorists have incentives to use alternative modes part-time.
5. Pay-as-you-drive pricing. This means that vehicle insurance and registration fees are based directly on the amount a vehicle is driven, so a $400 annual fee becomes 4¢ per vehicle-kilometer and a 1,200 annual fee becomes 12¢ per vehicle-kilometer. This gives motorists a significant new incentive to reduce their vehicle travel, but is not a new fee at all, just a different way to pay existing fees.
6. Affordable public transport fares. Structure fees so they are affordable, and attractive in order to reduce costs to lower-income transit-dependent passengers, and to make transit travel more attractive to discretionary travelers who would otherwise drive.
7. Integrated payment systems. Develop convenient, integrated payment systems for road, parking and transit fares.
8. Efficient and clean vehicle incentives. Charge

Table 4.3: Economics and Finance policy measures and their characteristics

Policy measures	Impacts and benefits	Implementation speed	Implementation costs
Eliminating fuel subsidies	Very large	Quick	Provides savings
Cost-based fuel taxes	Very large	Quick	Provides revenue
Efficient road pricing	Very large	Medium	Provides revenue
Efficient parking pricing	Very large	Quick	Provides revenue
Pay-as-you-drive pricing	Very large	Medium	Very low
Affordable public transport fares	Medium	Quick	Medium-high
Integrated payment systems	Medium-low	Medium	Low
Efficient and clean vehicle incentives	Mixed benefits and costs	Medium[a]	High if subsidies

Note: This table provides general assessments of various economic reforms. Actual impacts and costs can vary depending on conditions and perspectives. It should be noted that technologies such as GPS in cell phones and cars can make it easier to implement these strategies, for instance allowing an individual to pay a toll via the phone for using any road in the city. (a) Can be implemented quickly but may take years or decades to achieve its full impacts and benefits.

Source: Authors

higher taxes on the purchase of higher-pollution vehicles and fuel and offer discounts and rebates on cleaner vehicles and fuels.

Table 4.3 evaluates these policy measures.

4.2.3. Engineering and Technology Toolbox

These involve physical and technological infrastructure that improves urban access. They include:

1. **Roadway improvements.** Pave currently unpaved urban streets and improve design to increase traffic efficiency and safety.
2. **Complete streets and streetscaping.** Apply complete streets principles and streetscaping to ensure that public roads accommodate diverse users and uses, including active and public transport modes, plus sitting, vending, eating and playing on sidewalks, and accommodation of nearby residents and businesses.
3. **Road space reallocation.** Reallocate road space based on a sustainable transportation hierarchy, which favors active and public transport over automobile traffic, commercial over private traffic, and movement over vehicle parking, and short- over long-term parking. This typically results in wider sidewalks, bike- and bus-lanes where justified by demand, and more efficient parking management.
4. **Efficient curb management.** Manage curbs to favor higher value uses including bus stops, passenger and freight loading, and taxi stands.
5. **Public transit improvements.** Improve public transport services with a special emphasis on equitable access (including the implementation of mass transit solutions). Improve service coverage, frequency, speed, comfort, reliability, and amenities (such as on-board Wi-Fi services, and attractive waiting areas). Implement bus lanes and other bus priority measures.
6. **Transit Oriented Development (TOD).** Support compact and mixed development around transit stations. Improve transit station access with pedestrian and bicycle improvements, and mobility services such as taxis and ride hailing, bike- and carsharing, and other amenities.
7. **Active transport improvements.** Improve walking and bicycling facilities including sidewalks, crosswalks, paths, and bike parking (with recharging for electric bikes). Ensure that all pedestrian facilities reflect universal design (they accommodate people with disabilities, luggage, carts, and other special needs).
8. **Active and public transport integration.** Enhance physical integration between public transport cycling and walking with safe, direct access to stops and stations
9. **Urban navigation and payment technologies.** Develop integrated navigation and transport payment apps. Establish open-source data standards and requirements or incentives for all transport service provides to use them.
10. **Accessibility evaluation and mapping.** Develop tools for measuring the accessibility of different locations and evaluate how various transport and land use changes will affect accessibility for various groups and activities. Give special attention to access for disadvantaged groups.

Table 4.4 lists engineering and technology policy measures.

4.2.4. Communications Toolbox

As defined above, these are measures related stakeholder engagement and enhancing understanding of how to improve conditions of urban transport in their countries or cities. These measures are generally low-cost, as they are often centered around communication campaigns and require little infrastructure investment. Related TDM policy measure are also highlighted in this toolbox.

Although these measures are not costly and not unpopular, often they are not implemented or implemented incorrectly, either because government officials perceive community engagement as an unnecessary and time-consuming stage in a project or because awareness strategies are based on excessively complicated messages and goals, propose far-fetched changes or lack adequate audience research (Pardo, 2018). The Table below presents a summary of measures identified in the discussions within the working group.

Table 4.4: Engineering and technology policy measures and their characteristics

Policy Measure	Impacts and benefits	Implementation speed	Implementation costs
Roadway improvements	Medium	Medium [a]	High
Complete streets and streetscaping	High	Medium	Medium
Road space reallocation	Medium	Medium	Medium
Efficient curb management	Quick	Medium	Low
Public transit improvements	Medium-large	Quick-slow	Medium-high
Transit Oriented Development (TOD)	Large	Medium-slow	Medium-high
Active transport improvements	Large	Quick-medium	Low-medium
Active and public transport integration	Low	Quick-medium	Low
Navigation and payment technologies	Varies	Quick-medium	Low
Accessibility evaluation and mapping	Varies	Quick-medium	Low

Note: This table provides general assessments of various economic reforms. Actual impacts and costs can vary depending on conditions and perspectives. It should be noted that technologies such as GPS in cell phones and cars can make it easier to implement these strategies, for instance allowing an individual to pay a toll via the phone for using any road in the city. (a) Can be implemented quickly but may take years or decades to achieve its full impacts and benefits.

Source: Authors

Key categories of communication measures, including transport demand management, identified by the Working Group are the following:

1. **Transportation management associations (TMAs).** TMAs are public-private agencies that provide parking and transportation management services in a particular area, such as a commercial district, medical center or campus. They typically coordinate parking management activities, promote active and public transport travel, provide rideshare matching, guaranteed rides home (special trips for a ridesharing or public transit commuters who occasionally need to return home) and other support services.
2. **Improve intermodal connections.** Improve local access to transport hubs including bus and train stations, ports and airports.
3. **Transit station area planning program.** This is a targeted planning process to improve pedestrian and bicycle access and encourage TOD around a transit station.
4. **Commute trip reduction and campus transport management programs.** These programs encourage commuters and visitors at a worksite or district to use resource-efficient modes. These programs are often financed through parking facility cost savings or required for development (GOPR 2018).
5. **Freight transport management.** These programs encourage more efficient commercial and freight transport, including improved routing, consolidated loads, shifts from truck to rail and marine modes, cleaner and safer vehicles, and other logistical improvements.
6. **Tourist and special event transport management.** These programs encourage tourists and people attending special events to use resource-efficient transport options.
7. **Mobility management marketing.** These programs use various marketing methods to encourage travelers to use resource-efficient modes. These can include community-wide and targeted marketing.
8. **Traffic safety and speed management.** These

Table 4.5: Communication policy measures and their characteristics

Policy Measure	Impacts and benefits	Implementation speed	Implementation costs
Transportation management associations	Medium	Quick	Low
Intermodal connections to transport hubs	Large	Medium	Moderate
Transit station area planning program	Large	Medium	Low
Commute and campus transport management	Large	Quick	Low
Freight transport management.	Large	Medium	Low
Tourist and special event transport management	Medium	Quick	Low
Mobility management marketing	Medium	Quick-medium	Low
Traffic safety and speed management	Medium	Quick	Low
Stakeholder engagement	Medium	Quick	Low

Note: This table provides general assessments of various communication and TDM programs. Actual impacts and costs can vary depending on conditions and perspectives.

Source: Authors

programs encourage traffic safety and more appropriate traffic speeds.

9. **Stakeholder engagement.** These programs allow and encourage stakeholders (affected people) to become involved in transport policy, planning and marketing. This can include various types of outreach, surveys, presentations and workshops to share information and obtain feedback.

A full list of the policy measures that were assessed in the process is presented in Table 4.5.

4.3. Synergies and trade-offs

Many of these policy measures are synergist: they are more effective and efficient as implemented as an integrated program if implemented individually. For example, public transit improvements (engineering measures) will cause greater vehicle travel reductions, and therefore greater benefits (reduced congestion, road and parking facility costs, crash risk and pollution emissions), if they are implemented with transportation demand management (TDM) incentives such as efficient road and parking pricing (economic measures), pedestrian and bicycle improvements to facilitate access to transit services (engineering measure), improved user information and payment systems and development policy reforms that create transit-oriented development around transit stations (regulatory/institutional measures).

Similarly, the incentives for consumers to purchase cleaner vehicles (economic measure) are more effective if implemented with requirements to scrap older vehicles and regulations that favor low-emission vehicles in traffic, such as only allowing electric vehicles to drive in some neighborhoods (regulatory / institutional).

Integrated programs are also important because some strategies are more effective than others at achieving various goals: Universal Access, Green, Gender, Safety and Efficiency. For example, improving vehicle fuels are most effective at reducing emissions, while public transport improvements are most effective at increasing urban transport system efficiency and achieving social equity objectives such as gender equity. These synergies are identified succinctly in Table 4.6.

Table 4.6: Urban access mobility measures and synergies with others

Toolbox	Measures	Synergies				
		Rural	Green	Efficiency	Safe	Gender
Engineering and Technology	Improve transit with a special emphasis on equitable access		x	x	x	x
	Improve active transport conditions		x		x	x
	Repurpose existing road space			x	x	x
	Improve access to transit stations		x	x		
	Traffic calming and traffic speed management				x	x
	Freight transport management		x	x		
Regulatory and Institutional	Comprehensive and multimodal planning		x	x	x	x
	Implement a Vision Zero policy			x	x	x
	Improve local connections to transport hubs	x	x	x	x	x
	Regulation allowing emerging mobility services		x	x		
	Regulations on efficiency and age of vehicles in the market		x	x	x	
	High quality design standards				x	x
Regulatory and Institutional	Mixed land use regulations		x			x
	Formalization/regularization of public transport operations			x	x	
	Improved mobility institutional setups		x	x	x	x
	Implement SUMPs and NUMPs		x	x	x	x
	Enforce improved parking regulations		x	x		
	Encourage more compact, multimodal development.		x	x		
	Create an explicit policy for freight in urban areas		x	x		
Economics and Finance	Affordable public transport fares			x		x
	Increase fuel taxes and eliminate fuel subsidies		x	x		
	Incentives for cleaner vehicles and efficiency in occupancy		x		x	
	Integration of fares across public transport modes			x		x
	Charging real costs for personal motorized vehicle use		x	x		
	Additional transport system funding		x	x		

Toolbox	Measures	Synergies				
		Rural	Green	Efficiency	Safe	Gender
Communications	Stakeholder engagement			x	X	x
	Participatory approach to policy-making				x	X
	Implement awareness and behavior change (ABC) strategies				x	X
	Engage private sector in promoting sustainable mobility			x		
	Promoting stakeholder engagement for sustainable transport		x	x	x	x

Note: This table indicates how potential urban access improvement strategies identified in this paper support goals in other sections of this report.

Source: Authors

5. THE COUNTRY EXPERIENCES

There are many examples of sustainable urban mobility programs in cities around the world. The most successful programs tend to involve integrated programs that include policy and planning reforms which lead to an integrated program of improvements to resource-efficient and inclusive travel modes, incentives for travelers to use the most efficient option for each trip, more compact and connected urban development, and technological innovations that facilitate positive change. Below are a few examples of these programs.

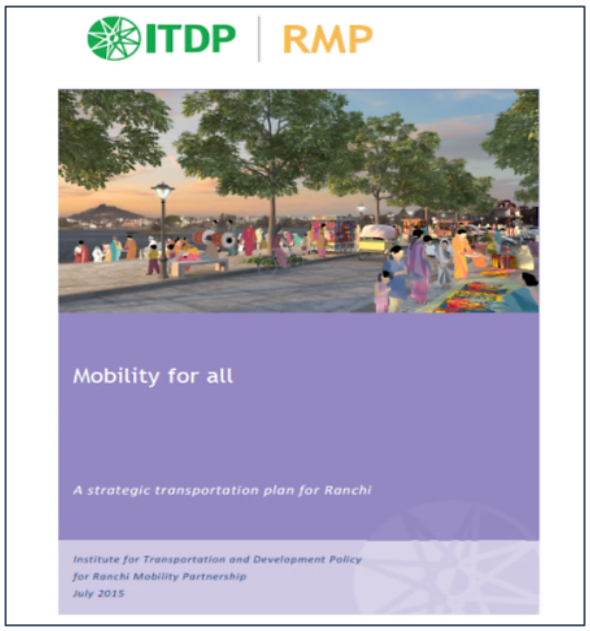
5.1. Ranchi, India strategic transport planning

Strategic transport plans are key to assembling the combination of policies and projects for more sustainable urban transport. A good example is the strategic transport plan created for Ranchi, India, the capital of Jharkhand. Ranchi and the other cities of Jharkhand are growing rapidly. The use of personal motor vehicles is expanding rapidly in Ranchi, leading to traffic congestion and crash risk. Ranchi current lacks a formalized public transport system; most people rely on walking and paratransit for their day-to-day travel. Until recently, the city's solution to traffic problems consisted primarily of road widening and flyovers. To develop more efficient and equitable transport a diverse coalition of civil organizations established the Ranchi Mobility Partnership (RMP) which obtained a grant to lead a comprehensive, multi-stakeholder strategic planning process which produced the report (Figure 5.1), *Mobility for All: A Strategic Transportation Plan for Ranchi*.

The process began by developing the *Ranchi Mobility Charter* which outlines the coalition's position on mobility issues. It established the principles that should guide transport planning:

- Equity: The needs of all people (including the differently able), regardless of the modes of transport they use, should be the primary criteria in the design of transport systems.
- Sustainability: The transport system should consume as few resources as possible; yet provide

Figure 5.1: Ranchi strategic transportation plan



Source: ITDP (2015), Mobility For All A Strategic Transportation Plan For Ranchi, Institute for Transportation and Development Policy (www.itdp.org) for Ranchi Mobility Partnership; at https://bit.ly/2MJACzK.

Note: The Ranchi Mobility Partnership obtained a grant to fund the development of a comprehensive, multi-stakeholder strategic planning process for more equitable, affordable, safe, accessible, and sustainable transport in their city.

attractive, comfortable, and convenient service. The resources in this context include urban space, clean air, fossil fuels

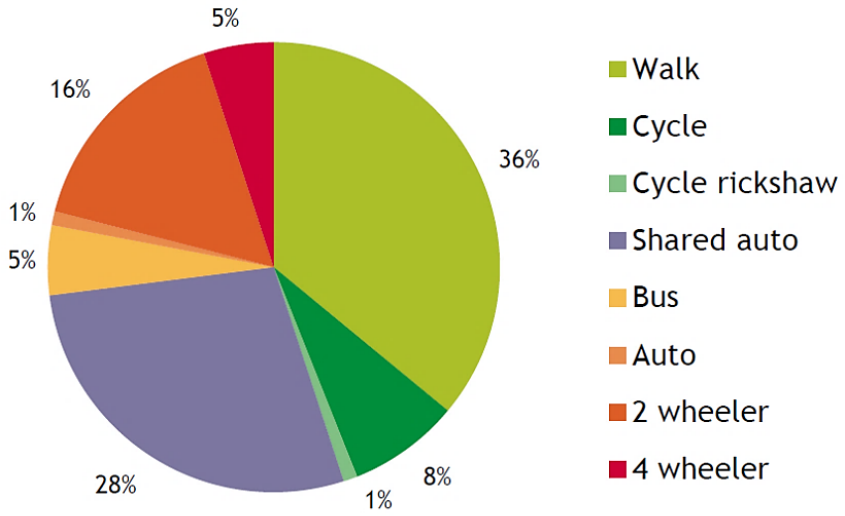
- Livability: Urban landscapes should provide ample public spaces for uses like casual recreation, relaxation, social gathering, and managed street-side vending.

RMP's Charter stresses that transport planning should focus on the movement of people, not vehicles, a goal clearly expressed in the National Urban Transport Policy (NUTP), which was a major change from previous studies that emphasized vehicle traffic movements. As a result, the plan included these infrastructure initiatives:

- Improve, expand, and manage a high-quality, bus-based public transport system.
- Develop design guidelines for complete streets that take into account all street users, especially pedestrians, cyclists, and various stationary activities.
- Construct complete streets that allocate street space equitably among all users.
- Develop an effective parking management framework.
- Develop compact, pedestrian friendly neighborhoods around public transport.

The planning process used comprehensive and multi-modal analysis, including a comprehensive travel survey that included all demographic groups, as illustrated in Figure 5.2. It also investigated specific concerns and problems, such as special risks that women, transit service quality, vehicle parking problems, and air pollution. The plan includes detailed administrative and funding proposals, a five-year implementation plan, and analysis of resulting economic, social and environmental impacts. This provides a foundation for rational decision-making that helps achieve diverse planning objectives and serves diverse system users.

Figure 5.2: Ranchi mode share data



Source: ITDP (2015), *Mobility For All A Strategic Transportation Plan For Ranchi*, Institute for Transportation and Development Policy (www.itdp.org) for Ranchi Mobility Partnership; at https://bit.ly/2MJACzK.

Note: The strategic planning process included comprehensive travel surveys: A household survey of 7,100 individuals in various demographic groups; On-road, interview-based surveys; Traffic counts at various strategic locations; Surveys of public transport users; Mapping of existing street and transit services; Government data on the vehicle population, traffic accidents, and ambient air quality.

5.2. Successful affluent city vehicle travel reductions

By improving resource-efficient travel options (walking, bicycling and public transit services), implementing TDM programs, and encouraging more compact, infill development many attractive, economically successful and affluent cities have successfully reduced vehicle travel, particularly to major commercial centers and campuses.

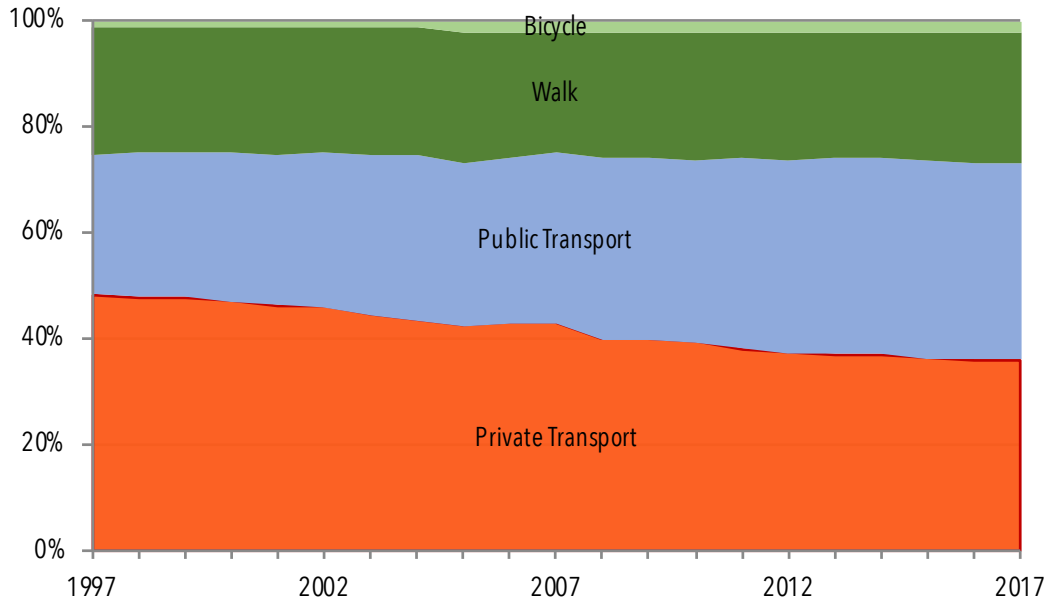
London, Great Britain

Between 1997 and 2017, London's total private car mode share declined from 48% to 36% of total trips, while public transport share increased from 26% to 37% (Figure 5.3). London's strategic transport strategy, based on detailed analysis, aspires to increase walking, cycling and public transport to 80% of trips by 2041 through a combination of 'Healthy Streets' pedestrian and bicycling improvements, bus and rail service improvements, parking restrictions, car-free areas, road pricing, transit-oriented development, and TDM programs (TfL 2018).

German, Austrian and Swiss Cities (Buehler, et al. 2016)

The report, *Reducing Car Dependence in the Heart of Europe* (Buehler, et al. 2016), finds that the largest cities in Germany, Austria, and Switzerland – Munich, Berlin, Hamburg, Vienna, and Zurich – have significantly reduced automobile travel over the past 25 years, despite high motorization rates, through an integrated program of policies that favor walking, bicycling and public transport over automobile travel in roadway design, pricing and land use policies. Each city is unique. The German cities have done the most to promote cycling, Zurich and Vienna offer more public transport service at lower fares. All five cities have implemented similar policies to promote walking, foster compact development, and discourage car use. Of the car-restrictive policies, parking management has been by far the most important. The five case study cities demonstrate that it is possible to reduce car dependence even in affluent societies with high levels

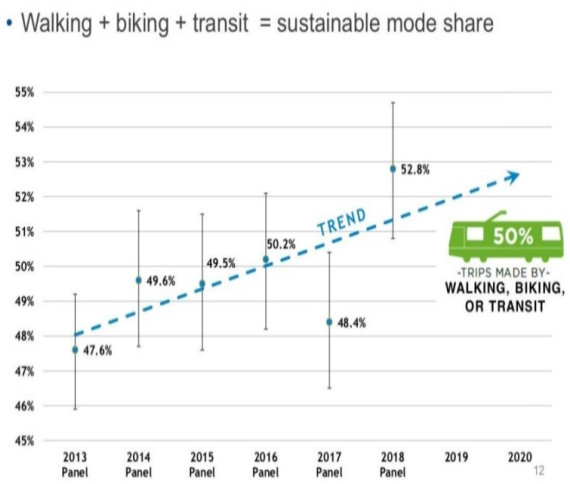
Figure 5.3: Changes in Travel in London, 2001-2017



Source: Travel in London Report. Available from https://bit.ly/2PmWYFf

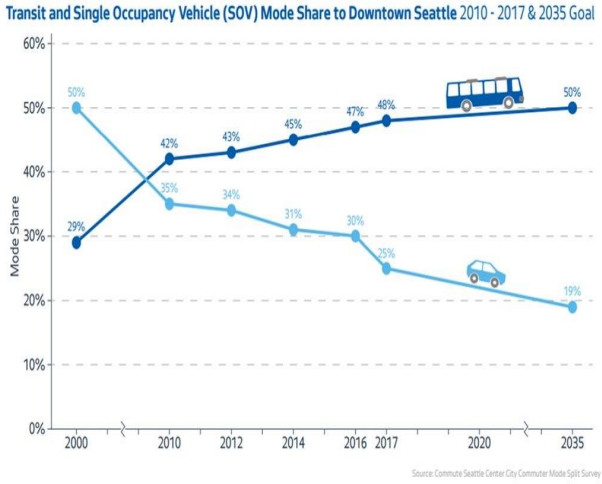
Note: During the last two decades London significantly reduced car mode share and increased public transport share.

Figure 5.4: Vancouver, Canada sustainable mode share, 2013-2018



Source: 2017-transportation-panel-survey. Available from https://bit.ly/2V2lIZC

Figure 5.5: Downtown Seattle mode share, 2000-2017



Source: 2017 Commuter mode split survey report. Available from https://www.seattlebusinessmag.com/seattle-using-public-transit-more-ever

of car ownership and high expectations for quality of travel.

Vancouver, Canada

Between 2013 and 2018, city-wide sustainable mode share (walking, bicycling and public transit) increased from 48% to 53% in Vancouver, Canada (Figure 5.4).

Seattle, USA

Between 2000 and 2017, downtown single-occupant automobile mode shares declined from 50% down to 25%, and public transit mode share increased from 29% up to 48%, in Seattle, USA (Figure 5.5). This was accomplished through a combination of numerous public transit service improvements and a regional commute trip reduction policy that encourages use of sustainable commute modes (Small 2017).

5.3. Bus rapid transit

High quality public transit, with fast and frequent service, and stations that are well integrated into the urban fabric, tend to provide large benefits to users and communities including efficient urban mobility, reduced traffic congestion, road and parking cost savings, consumer savings, increased safety, energy conservation and emissions reductions. As a result, many make large investments in rail transit systems. However, many cities cannot afford to build enough rail transit to serve their needs; they cannot afford to expand rail lines to new areas or to expand the capacity of existing routes to serve demands.

BRT is a high capacity bus system that provides many benefits of rail at a lower cost. BRT operates offers frequent service operating on a separate right-of-way, with attractive stations that support transit-oriented development, creating compact, mixed, walkable communities where residents can meet their access needs with fewer cars, less driving and more on walking, bicycling and public transit. BRT started in Curitiba, Brazil in 1974 and has since spread around the world. Like rail, BRT helps encourage efficient urban access. BRT is particularly appropriate in rapidly-developing cities that cannot afford rail but want to encourage compact, multimodal development.

Figure 5.6: Metrobús routes

Source: Mexico city bus rapid transit model. Available from https://www.wbur.org/bostonomix/2019/04/29/mexico-city-bus-rapid-transit-model

Note: In just twelve years Mexico City developed the seven-route Metrobús BRT system which carries nearly two million daily passengers.This and other examples demonstrate that BRT is a relatively fast and affordable way for cities to significantly improve public transit, making it competitive with automobile travel.

Mexico City Metrobús

"How BRT Eased Mexico City's Grueling Commutes[14]"

Mexico City's Metrobús BRT system started in 2006 and has expanded to seven lines that cross the city and connect with other forms of transit (Figure 5.6). It offers frequent and fast service. Ticketing is by prepaid proximity smartcard. A single trip costs 6 Pesos (about € 0.27 or US$ 0.38). Service is free for those over 70 years old, or disabled, as well as for children under 5 accompanied by an adult. On a typical weekday it carries an estimated 1.8 million passengers, about a third of the city's subway ridership.

5.4. Colombia and strategic transport policy

In 2002 the Colombian government developed a National Urban Transport Policy (Rodríguez Porcel, Bernal González, & Beltrán Real, 2018). This requires cities with more than 600,000 inhabitants to implement integrated massive transport systems (SITM for its name in Spanish), while cities with less than 600,000 and more than 250,000 should implement SETPs – Strategic Public Transport Systems – (DNP, 2015).

This national urban transport policy was inspired by the success of the TransMilenio BRT system in Bogotá, which inspired the development of BRT systems in other cities. Before TransMilenio, Bogotá's public transport was entirely provided by private companies, which operated mostly informally, without regulated payment methods, frequencies or stops (Alcaldía Mayor de Bogotá, 2003). Although fares were set by the city government and routes were assigned to each company, there was little regulation for the operation of buses and bus drivers were paid by passenger carried, thus, creating a perverse incentive for competing with other drivers within the same route, picking-up and dropping passengers anywhere on the route and driving carelessly. This resulted in a high level of traffic crashes, poor service levels and, in general, higher levels of risk (Vergel-Tovar, Hidalgo, & Sharpin, 2018). This was particularly harmful to lower-income people – and especially women – who depended most on public transport and mostly live in the economic strata peripheral areas of the city.

Furthermore, as private companies operated based on revenue, peripheral and poor areas of the city often lacked public transport options, while 'strategic' areas had an oversupply of routes (DNP, 2002). This situation – informal systems resulting in poor access and affecting particularly those with lower incomes in the periphery – was the same for every city in the country and is still the situation in many of them.

After the implementation of TransMilenio, new regulation was developed to allow and promote the implementation of mass transit systems based on buses. Following the national guidance, six more BRT systems have been developed in Colombia (DNP, 2015).

Additionally, medium-size cities have gained access to international credit for developing their own SETPs, such as credits from the IDB (Rodríguez Porcel et al., 2018).

The Colombian national government has produced a series of decrees and laws aiming at regulating the provision of public transport in urban areas. These started with Law 105 of 1993, defining basic dispositions, such as operation permits, and came together in a policy document which defined the National Urban Transport Policy (Rodríguez Porcel et al., 2018). This document defined the main problems and externalities associated with the provision of public transport in Colombian cities, among these were deficient institutional capacity, inadequate regulation, oversupply, inequitable and unsustainable infrastructure, congestion and road danger (DNP, 2002).

Furthermore, the document defined the national policy and strategy for improving public transport in cities, which was based on strengthening cities institutionally in terms of planning, managing, regulating and controlling transport. The strategy defined responsibilities for both the national level and local level, differentiating the latter between cities with populations over 600,000 inhabitants and cities smaller than that. For the large cities, the actions were focused on implementing SITMs (DNP, 2002).

A few years later, the Ministry of Transport published a decree focused on orienting transport solutions for cities with less than 600,00 inhabitants, and established the SETPs (Ministerio de Transporte, 2009). The first goal of these systems was defined as *"Improve coverage, accessibility and connectivity between different sectors of the city […] ensuring the entirety of the strategic system is accessible for the population"*. As of 2017, eight cities had started the process of design and implementation of SETPs (DNP, 2017).

Nevertheless, while the implementation of SITMs and, specifically, the expansion of BRT has been rather successful, medium-size cities have had more difficulties when developing SETPs. Issues such as the competition from motorcycles serving as public transport (known as *mototaxismo*) and difficulties when reorganizing existing informal transport systems have led to operational problems and lower demand than expected (DNP, 2015). Still, several cities, such as Armenia and Pasto, have operating SETPs and have improved public spaces and implemented cycle infrastructure as part of the general infrastructure investment associated with SETPs (Rodríguez Porcel et al., 2018). Moreover, there is an increasing number of medium-size cities which are implementing or structuring their own SETPs, aiming to provide more efficient, accessible and sustainable urban public transport for their inhabitants.

Finally, it is worth mentioning that both the city-scale implementation of SITMs and SETPs and the nation-wide urban public transport policy have been complemented by a broader sustainable transport policy aiming at promoting walking and cycling. In the case of TransMilenio in Bogotá, the system has a number of cycle-parking facilities in stations and portals (terminals) free of charge, which allow users to access the system by bicycle. At national level, several policies have been issued aimed at integrating the National Urban Transport policy with non-motorized transport. Notably, the Sectoral Action Plan for Transport and the 'Cycle-infrastructure guide for Colombian cities' are examples of these focus on multimodality.

5.5. Active transport planning in Asia

There is a pressing need to overhaul the existing pedestrian guidelines or develop appropriate guidelines for Asian cities. The available guidelines are often ambiguous or inequitable and rarely enforced in cities. Traffic experts still evaluate urban transport system performance based primarily on vehicle traffic speed, rather than overall accessibility for all users. This overlooks the important roles that walking and bicycling play in an efficient and equitable urban transport system. The ADB report, *Walkability and Pedestrian Facilities in Asian Cities: State and Issues*, (Leather, et al 2011), the Republic of Korea's new commitments to active transport (Shin, et al. 2013), programs to revitalize walking and bicycling in Chinese cities, and pedestrian-oriented planning in various cities are examples of new support for active transport throughout Asia (Efroymson (2012). The ADB report concludes:

"These actions need the support of key stakeholders, identified to be the national government, city government, civil society, development agencies, and the private sector. The city government is identified as the key stakeholder group for pedestrian facility development and implementation. The national government's substantial role is in the development of policies catering to pedestrians or building the capacity of city governments' efforts to develop their own policies.

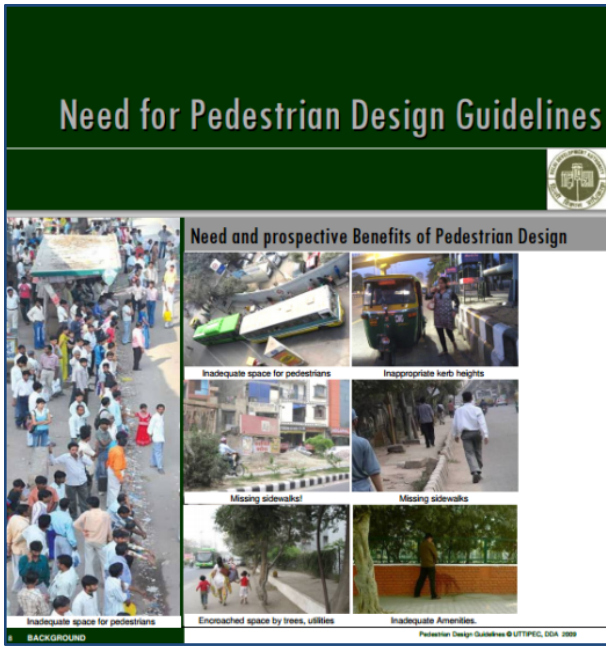
Although walking is the most common travel mode in most Asian cities, it often receives little consideration in conventional transport planning. Sustainable transport planning recognizes the important roles that walking plays in an efficient and equitable transport system and so tends to provide far more support for this mode. New planning resources help make this possible.

China's Ministry of Housing and Urban-Rural Development has produced the *Guideline for Urban Pedestrian and Bicycle Transportation System Planning and Design,* the first national- level technical policy document of its kind in the field[15]. The Guidelines were developed by China Academy of Urban Planning and Design (CAUPD) and China Sustainable Transportation Center (CSTC), supported by the Energy Foundation China Sustainable Cities Program (CSCP).

Civic groups in India are working to improve walking and cycling conditions (CSE 2009), and some government agencies including the National Transport Policy Development Committee and the Delhi Development Authority, which published the *Pedestrian Design Guidelines: Don't Drive…Walk* (Figure 5.7), are institutionalizing more pedestrian-oriented urban transportation planning.

Clean Air Asia (CAA 2012) conducted a walkability study in six Indian cities, including three big cities (Chennai, Pune and Bhubaneshwar), and three smaller

Figure 5.7: Delhi Pedestrian Design Guidelines



Source: Delhi Development Authority, 2010

Note: Multimodal street design guidelines help institutionalize new concepts and practices, such as this document for improving the accommodation of pedestrians in Indian cities.

but growing cities (Surat, Rajkot and Indore). The project's objective is to improve the state of walking and pedestrian facilities in Indian cities by policy, strategic documents, regulations and project development. Based on the study findings it developed specific recommendations for improving walking conditions and identified various stakeholders who should play a role in developing policies and projects to improve walkability in Indian cities.

Bicycle Facility Impacts on Cycling Activity and Risk (NACTO 2017)

A study by NACTO, *Equitable Bike Share Means Building Better Places for People to Ride* evaluated the relationships between bicycle facility development, cycling activity and bicycle crash rates. It found that:

- When cities expand protected bike networks, more people bicycle. Studies of North American cities indicate that such facilities increase bike ridership on those streets by 21% to 171%.

- Cycling becomes safer as cities build better bike lane networks. In five of the seven U.S. cities NACTO surveyed, the absolute number of bicyclists killed or severely injured declined from 2007 to 2014 despite increased cycling. Even in cities where bicycle casualties increased the increases where smaller than the increase in bicycling activity.
- Gains in bike safety are especially important for low-income riders and riders of color. 49% of the people who bike to work earn less than $25,000 per year, and Black and Hispanic bicyclists have a fatality rate 30% and 23% higher than white bicyclists, respectively. Building extensive protected bike lane networks benefits those who are most at risk.
- Approximately 60% of people surveyed are "interested but concerned" about biking and would bike with higher-comfort facilities. Of those, 80% would be willing to ride on streets with a separated or protected bike lane. Recent national research suggests that that people of color are more likely than white Americans to say that adding protected bike lanes would make them ride more.
- Bike share systems should be matched with protected bike lane networks to encourage ridership and increase safety. People on bike share bikes make up a disproportionate number of the riders on protected lanes, and stations adjacent to bike lanes are busier than ones that are not. For bike sharing to be successful, people need to feel comfortable riding.
- The risk of a bicyclist being struck by a motorist declines as the number of people biking increases. Appropriately scaled bike share systems can dramatically increase the total number of people on bikes in a city and help build political momentum for bike lanes.
- Mandatory adult helmet laws reduce bike ridership and don't increase safety. Such laws have reduced bike ridership in Sydney, and hampered bike share ridership efforts in Melbourne and Seattle and tend to be disproportionately enforced against disadvantaged people, further discouraging them from riding.

Nonmotorized Transportation Pilot Program Evaluation (FHWA 2014)

The U.S. Federal Highway Administration produced a comprehensive evaluation of its Nonmotorized Transportation Pilot Program that assessed the program's costs, travel impacts, and benefits based on travel survey data. The program invested about $100 per capita in pedestrian and cycling improvements in four typical communities (Columbia, Missouri; Marin County, Calif.; Minneapolis area, Minnesota; and Sheboygan County, Wisconsin), which caused walking trips to increase 23% and cycling trips to increase 48%, mostly for utilitarian purposes, plus increased recreational and exercise activity. Studies also found evidence of slower driving speeds and safer conditions for pedestrians and bicyclists. It estimated health and environmental benefits, including quantities of fuel savings and emission reductions.

5.5.1. Dock less bikeshare systems in China

China is the birthplace of Dock less Bikeshare Systems (DBS), which have expanded rapidly across cities all over the world. In China, approximately 70 companies operate in dozens of cities, providing inexpensive travel alternatives to the traditional station-based bikeshare systems. The increased popularity of DBS has led to greater accessibility, reduced private vehicle use and has solved several problems related with the traditional shared bike model: mainly problems finding a docking point near the desired destination (Shaokun, Wei, & Han, 2017; Zhao, 2018). DBS can also increase coverage for massive transport systems, thereby having an even greater impact on accessibility. Nevertheless, DBS pose several challenges, mostly taking into account that, although the systems operate with private funding, they require public infrastructure to function (ITDP, 2018b). This issue has prompted several problems, such as oversupply, invasion of pedestrian spaces and bicycle misuse (Shaokun et al., 2017). As a result, government authorities, both at national and local level, as well as private operators, such as Mobike (ITDP, 2018a), have highlighted the need for clear regulation.

As a response to this demand, the Ministry of Transport, along with nine other national-level departments in China, issued a guideline on DBS regulation. This guideline establishes some requirements to be ful-

filled at national level, such as requiring a real name registration or prohibiting children under 12 to access the different systems (State Council, 2017), and gives local authorities the mandate to address other issues, such as parking.

Following this guideline, a number of cities have drafted regulations aiming at reducing the negative impacts of DBS, while profiting from the greater accessibility and sustainable transport opportunities they provide (Shaokun et al., 2017). Among them, the case that has received greater attention is that of Tianjin and its *Internet Rental Bike Management Interim Measures* (ITDP, 2018c).

Although there are still some challenges, and many cities have yet to regulate bicycle parking provision, cycle infrastructure and public space use for DBS, this is a good example of how a national-level regulation can spark actions improving urban access and promote non-motorized transport modes.

5.5.2. Improving Urban Freight Logistics

Transportation demand management programs often focus on some type of personal travel such as commuting, but a few focus on increasing freight system efficiency. This is particularly important in dense commercial areas where deliveries are important to the economy and contribute significantly to traffic congestion, parking problems and pollution. Freight transport management can be challenging because it involves several stakeholders, including policy makers, planners, shippers and their customers. It therefore requires an integrated program coordinated by a transportation management association or city logistics coordinator that includes experts who understand freight transport needs (CIVITAS 2015 – Figure 5.8). Clean Air Asia's *Green Freight Website* (www.greenfreightandlogistics.org) provides information on policies, programs, technologies and logistics suitable for developing countries.

5.5.3. New technologies

Some Asian countries are world leaders in developing and operating state-of-art transportation systems, including sophisticated traffic management and user information, payment technologies, and traffic control systems. Technology implementation is particularly high in Singapore, Japan and the Republic of Korea (see Figure 5.9). New technologies, including improved logistics, vehicles and terminals, are also important for improving freight transport sustainability.

Integrated technological implementation requires coordinated planning between public agencies, private companies and users. Government leadership ensures that services are efficiently integrated, for example, between different mobility service providers and modes, and incorporate features such as payment and problem reporting. This integration increases user convenience and system efficiency, which supports use of more efficient transport modes such bikesharing, ridesharing and public transit.

Telecommunications technologies are also improving public transit services in cities around the world (Klopp 2016). Users need convenient information about transit systems but in many developing country cities where many people rely on informal public transit, these services are not mapped. If people can't even see their routes as routes and their system as a system, it is difficult to plan improvements. However, cellphone use is rapidly expanding in Africa which provides a huge opportunity to collect critical data. For example, in Nairobi, almost every adult has a phone, increasingly smartphones. Data can be collected in two ways. First, mobile phone geo-location data can be analyzed to see how the city moves. This was used to optimize bus routes in Abidjan.

A second source of useful data through social media, as in Nairobi's popular ma3route transport app, which mapped the city's informal minibus (matatu) system. Other cities are now replicating this process with their unmapped transit systems including Kampala, Maputo, Accra, Lusaka, Amman, Cairo, and Managua. This process must be dynamic and responsive. Stops can change location and are sometimes not marked or named. Routes may not have names or numbers and may not be fixed, so you have to take many trips to learn the most common one. Fares are often not set and fluctuate based on factors like rain. In addition, most common data format for transit (the general transit feed specification) was developed for formal systems, so it needs to be modified to take into account some of these factors. This experience in Nairobi shows

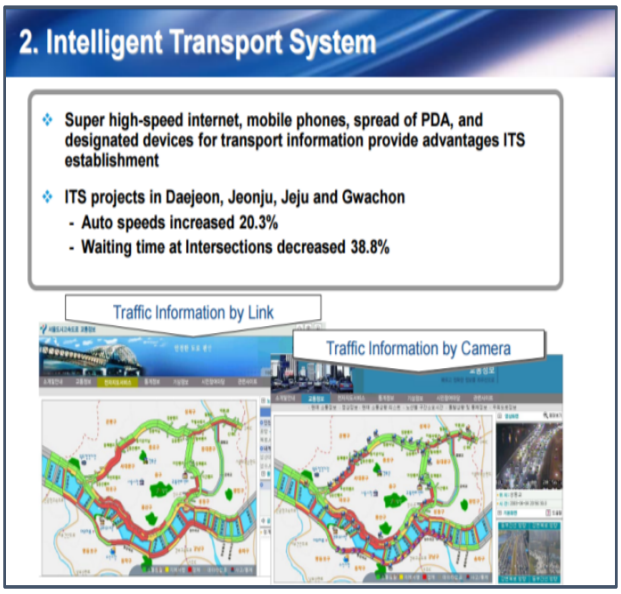
Figure 5.8: Freight transport management measures

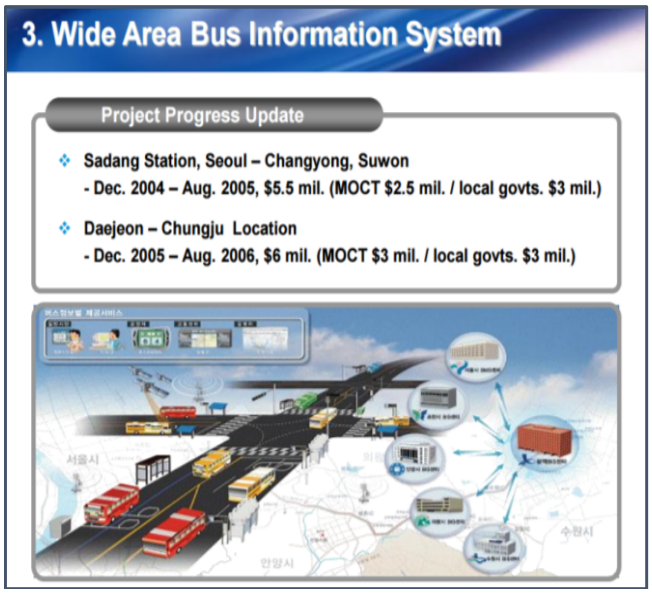
CATEGORY	MEASURES	NATURE OF THE PROBLEM					INVESTMENT	IMPLEMENTATION TIME
		Congestion	Inadequate Infrastructure	Pollution	Noise	Safety		
Stakeholders' engagement	Freight Quality Partnerships	×	×				low	medium
	Freight advisory boards & forums	×	×				low	medium
	Designation of a City Logistics Manager	×	×				low	medium
Regulatory measures	Time access restrictions	×			×	×	low	short
	Parking regulation	×				×	low	short
	Environmental restrictions			×	×		low	short
	Size/Load access restrictions				×	×	low	short
	Freight--traffic flow management	×			×	×	low	short
Market--based measures	Pricing (road pricing, congestion charging/ park pricing)	×			×		high/moderate	medium/short
	Taxation and tax allowances	×		×	×		high	medium
	Tradable permits and mobility credits			×	×		moderate	medium
	Incentives and subsidies			×	×		high	medium
Land use planning & Infrastructure	Adapting on--street loading zones	×	×			×	low	short
	Using building code regulations for off-street delivery areas		×				low	medium
	Nearby delivery areas	×	×			×	high	medium
	Upgrading central off--street loading areas		×			×	high	short
	Integrating logistics plan into land use planning	×	×	×	×	×	moderate	long
	Collect points	×	×				low	short
	Urban Consolidation Centers	×	×			×	high	medium
New technologies	Dynamic routing	×				×	high	medium
	Real--time information systems	×					high	medium
	Traffic control	×				×	high	medium
Eco-logistics awareness raising	Anti--idling			×			moderate	short
	Eco--driving			×	×		moderate	medium
	Modal--shift	×		×	×		low	medium
	Staggered work hours	×					low	medium
	Recognition and certification programmes			×	×		low	medium

Source: CIVITAS 2015. Clean Air Asia's Green Freight Website: www.greenfreightandlogistics.org

Note: Freight transport management can include various strategies which help solve various solutions. An integrated program can reduce costs to shippers and communities.

Figure 5.9: Korean technological implementation plans





Source: Authors

Note: To maximize impacts and benefits, technological innovation often requires strategic planning and coordination.

that creating quality data for informal transit systems is challenging but possible, and that there is demand for this information from citizens and planners.

Safetipin App for Bogotá[16]

In Bogotá, the risk of gender-based violence such as sexual harassment affects the use of public spaces by women and girls. With the safetipin app, the challenge will be addressed by providing aid in the collection of geo-referenced data on seven variables that influence the perception of personal safety for women and girls. The collected data from the safetipin app, that shows where women feel unsafe, will be used to design and implement interventions in mass public transport and public spaces. This project sets its focus primarily on women and girls in the City of Bogotá. Yet, in the end, all citizens will benefit from a safer environment in public spaces.

5.6. Eliminating fuel subsidies in Ghana

Fuel prices are one of the most important mechanisms to internalize social costs generated by excessive use of private vehicles. They can also represent an important source of revenue for governments, both at local and at national level, and can act as disincentives for using private modes, therefore reducing congestion and improving travel times and accessibility for urban dwellers. However, implementing fuel taxes can be highly unpopular and politically costly. Consequently, they can be better implemented when international fuel prices are falling, as was the case for Ghana in 2014 (Kojima, 2016).

Ghana fuel prices are set by the National Petroleum Authority (NPA) (GIZ, 2014). In November 2014, Ghana increased the gasoline, diesel, kerosene and LPG levy to 17.5% of ex-depot price. This eliminated the government expenditure on petroleum subsidies (Kojima, 2016). Ghana fuel prices increased from very low to approximately the international average (GIZ 2018)

5.7. Urban parking policy reforms

Many cities are reforming their parking policies, including reduced and more accurate parking requirements for new developments, more efficient pricing

and management of municipal parking, and support for more efficient management of private parking. This reduces parking facility costs, encourages vehicle travel reductions, particularly in dense urban centers, and supports more compact development.

Pasadena, California[17] (Nelson/Nygaard 2006)

Pasadena, a rapidly growing suburb of Los Angeles, California. During the 1950-70s Old Pasadena's downtown had become run down, with many derelict and abandoned buildings and few customers, in part due to the limited amount of parking available to customers. The city proposed pricing on-street parking as a way to increase turnover and make parking available to customers. Many local merchants originally opposed the idea. As a compromise, city officials agreed to dedicate all revenues to public improvements that make the downtown more attractive. A Parking Meter Zone (PMZ) was established within which parking was priced and revenues were invested. Because downtown parking had previously been unpriced, the city didn't lose anything from the general fund by dedicating the revenue to improvements in that area. In fact, the city gained additional revenue from overtime fines. A PMZ advisory board consisting of business and property owners recommended parking policies and set spending priorities for the meter revenues. Investments included new street furniture and trees, more police patrols, better street lighting, more street and sidewalk cleaning, pedestrian facility improvements and marketing (including production of area maps showing local attractions and parking facilities. To highlight these benefits to motorists, each parking meter has a small sticker which reads, "Your Meter Money Will Make A Difference: Signage, Lighting, Benches, Paving".

This created a "virtuous cycle" in which parking revenue funded community improvements that attracted more visitors which increased the parking revenue, allowing further improvements. This resulted in extensive new development and businesses. Parking is no longer a problem for customers, who can almost always find a convenient space. Local sales tax revenues increased faster than in other shopping districts and nearby malls with cheaper or free customer parking. This indicates that charging market rate parking with revenues dedicated to local improvements can be an effective way to support urban redevelopment.

UK Parking Management

The United Kingdom has a long tradition of implementing innovative urban transport solutions that come to be regarded as best practices, from the construction of the London Underground in 1863 – the first subway system in the world – to the paradigmatic London Congestion charge. One of such policies, which has received far less attention is the cap on parking in UK cities, based on a national directive.

The Planning Policy Guidance 13 – Transport (DCLG, 2001) sets the standards for local authorities to follow when regulating parking for non-residential uses. Among such standards, the guideline recommends not to require from developers more spaces than they are wishing to provide and promoting sustainable transport choices through parking measures. Furthermore, the document sets the maximum parking standards for non-residential uses throughout England, effectively setting a cap on parking requirements by local authorities. Maximums for residential uses were also set by Planning Policy Guidance 3 – Housing at 1.5 off street spaces per dwelling on average (Guo & Ren, 2013).

These parking standards have driven major cities to adopt their own maximums. For instance, London adopted them as part of the London Plan in 2004 and set parking caps for both resident and non-residential uses (Guo & Ren, 2013). These standards are set to be stricter with the New London Plan, scheduled to be released in 2019. According to the draft, every new development in opportunity areas located in Inner London, as well as areas with high levels of public transport accessibility, should be completely car-free (Mayor of London, 2017).

ENDNOTES

14 https://www.wbur.org/bostonomix/2019/04/29/mexico-city-bus-rapid-transit-model

15 https://bit.ly/2GGws5P

16 www.transformative-mobility.org/campaigns/safetipin-app-for-bogot%C3%A1

17 https://bit.ly/2J2VgER

6. ROADMAP OF ACTION

This section provides additional recommendations for selecting the most appropriate set of urban access improvement policies in a particular type of city or urban district. As previously described, many of these strategies are synergistic: they are most effective if implemented as an integrated program that includes a combination of mobility improvements, incentives, development policy reforms and TDM programs.

6.1. Evaluating strategies

Table 6.1 below identifies recommendations when selecting these sustainable urban access strategies.

Table 6.1: Selection considerations

Policy Measures	Recommendations When Selecting Policy Measures
Regulatory and Institution Toolbox	
Reform for more integrated planning.	All jurisdictions should look for ways to better integrate planning.
Establish NUMPs and SUMPs	All countries should establish NMPS and all cities or regional governments should establish SUMPs to provide strategic policy and planning guidance.
Sustainable transport goals and targets	All jurisdictions should establish sustainable transport goals and targets.
Establish a Vision Zero policy, with plans for implementing necessary safety strategies.	Jurisdictions that want to significantly reduce traffic risks should establish Vision Zero policies.
Local access to transport hubs	Jurisdictions that have bus and train stations, ports or airports.
Establish transport-related data collection, evaluation and mapping programs	All jurisdictions should incorporate transport-related data collection into census, mapping, travel survey and planning programs.
Integrate transportation and land use planning	All municipal governments should strive to integrate transport and land use planning, particularly in rapidly-growing areas.
Reduce parking requirements and support efficient parking management.	Most cities should reduce parking requirements and support parking management to increase efficiency, equity and more compact development.
Reform investment practices to reflect least-cost planning principles.	Governments that want to maximize cost efficiency and support multimodal planning should apply least-cost planning principles.
Change transport planning goals to minimizing vehicle travel.	Governments that want to encourage sustainable transport should shift planning goals to minimizing vehicle travel.
Formalize informal mobility services such as shared taxis and private buses.	If a major portion of transport is provided by informal mobility services, governments should formalize and improve such services.
Establish new funding sources for sustainable modes and TDM programs.	Jurisdictions that currently lack funding for sustainable modes and TDM programs should develop funding sources for them.

Encourage location-efficient development.	Jurisdictions that experience sprawl and associated costs.
Encourage or require sustainable transport capacity	Unless sustainable transport planning capacity is well established, jurisdictions should encourage or require its development.
Reform regulations to allow and support innovative mobility services.	Most jurisdictions should evaluate the ability of current regulations to support innovative mobility services and reform them as needed.
Develop regulations or incentives that encourage cleaner vehicles.	Jurisdictions that want to reduce energy consumption and pollution emissions, or reduce problems associated with older vehicles.
Economics and Finance Toolbox	
Eliminating fuel subsidies.	Any country that subsidizes fuels should eliminate them
Cost-based fuel taxes.	Countries that charge less than international market prices for fuel, or fail to recover roadway costs, should predictably and gradually increase fuel taxes.
Efficient road pricing.	Any city that experiences significant traffic congestion should consider efficient road pricing.
Efficient parking pricing.	All cities should charge efficient prices for use of municipal parking facilities and encourage or require private property owners to do so, including unbundling and cashing out parking.
Pay-as-you-drive pricing.	National and provincial/state governments that are responsible for insurance pricing regulations, or that collect vehicle registration fees or taxes, should consider converting them to distance-based pricing.
Affordable public transport fares.	Jurisdictions where transit fares are high relative to incomes should consider policies to reduce all transit fares or provide targeted discounts.
Engineering and Technology Toolbox	
Roadway improvements	Many growing, developing country cities should pave streets and expand some roadways into property-designed arterials suitable for bus routes, freight trucks and emergency vehicles.
Complete streets and streetscaping	All cities should establish complete streets policies and develop urban roadway design resources,
Road space reallocation	All cities should consider road space reallocation based on a sustainable transport hierarchy. This is particularly important in congested cities that currently lack adequate sidewalks, bike- and bus lanes.
Efficient curb management	All cities should begin the process of developing efficient curb management as part of complete streets and parking management programs.
Public transit improvements	This is most important in developing country cities with poor public transit services, but virtually all cities can improve transit services in some ways.
Transit Oriented Development (TOD)	TOD planning should be incorporated into any major public transit development program, in both developed and developing country cities.
Active transport improvements	This is most important in developing country cities with poor walking and bicycling conditions, but virtually all cities can improve active transport.
Active and public transport integration	This is most important in cities that are developing high quality public transit networks and TOD but can be useful in most cities.

Urban navigation and payment technologies	All cities should develop integrated navigation and service payment systems.
Accessibility evaluation and mapping	All cities should implement accessibility evaluation and mapping programs.
Communication Toolbox	
Transportation management associations (TMAs)	TMAs should be developed in large and congested districts such as downtowns, medical districts or campuses.
Transit station area planning program	All transit stations should have area plans to guide development and transport that maximizes accessibility.
Commute trip reduction (CTR) and campus transport management programs	All larger cities should encourage or mandate CTR and campus transport management, particularly in congested areas and for large employers.
Freight transport management.	All jurisdictions should have freight transport management programs.
Tourist and special event transport management	All large cities or resorts should have tourist and special event transport management programs.
Mobility management marketing	Large cities and automobile-dependent cities should implement mobility management marketing as part of regional TDM and transit encouragement.
Traffic safety and speed management	All jurisdictions should have traffic safety and speed management programs.
Stakeholder engagement	All planning activities should have stakeholder engagement components.

Note: This table describes the types of jurisdictions or cities where each urban access strategy is most appropriate. Most strategize are appropriate in must city types, although they can vary widely in their objectives and design.

Source: Authors

7. CONCLUSIONS AND RECOMMENDATIONS

We are in the middle of the great urbanization: more than half of humanity now lives in urban areas and this is projected to increase to grow to 68% by 2050. As a result, urban conditions will significantly affect our quality of life, economic and social opportunities, and the global environment. Policy makers, practitioners (planners, engineers and policy analysts), and the general public need practical guidance for improving urban transport.

A new transport planning paradigm helps provides this guidance. The new paradigm is accessibility-based; it recognizes that the ultimate goal of most transport activity is to access services and activities, and many factors affect urban accessibility including mobility, connectivity, proximity, affordability and user information. The new paradigm expands the range of impacts and options considered in transport planning, resulting in better solutions.

Improving urban access can provide many benefits, including some that tend to be undervalued in conventional planning. It increases system efficiency, reduces traffic problems, and helps ensure that all residents, including economically, physically and socially disadvantaged groups, can access economic and social opportunities.

This report identified basic principles for optimizing urban access, urban design factors that affect accessibility, suitable targets and implementation strategies. It also identifies various accessibility improvement strategies, described factors to consider when selecting the best strategies to implement in a particular situation.

Most cities are implementing some sustainable transport reforms, but few are implementing all of the reforms that are justified. For example, many cities are expanding their rapid transit services, and some are improving walking and bicycling conditions, these are not always coordinated, making it difficult to access many destinations without a car. A few cities are implementing parking pricing reforms, but fewer are applying efficient road pricing to reduce traffic congestion. Some cities are implementing Smart Growth development policies, but even they often impose excessive parking requirements or restrict affordable infill. This paper describes some examples, and there is much more literature describing best practices for improving urban access which is readily available in websites and knowledge centers from Sum4All members such as GIZ, World Bank, Walk21, UITP, ITDP and other professional organizations and development agencies.

New technologies and data sets support sustainable urban transport. They help planners understand travel demands and transport problems and allow users to easily navigate the transport system and pay for services. These innovations are already improving transport convenience and efficiency in many cities, and they can become even better if governments provide guidance and standards for information compatibility and integration. Sustainable urban transport planning requires appropriate performance indicators and data sets, in order to better evaluate problems, track progress toward goals, and for research purposes. Better data availability and monitoring is crucial in order to understand the impacts of transport policy changes as described in this paper's annex. For research purposes, transport data should be consistent with other data sets, such as land use, economic and health, so it is possible to determine their interactions. For example, to evaluate transport and land use factors affect public health we need data on travel activity (how much people walk, bicycle, drive and use public tran-

sit) should be collected using the same geographic units as land use data (population and employment density, road and parking supply, and the quality of walking and bicycling facilities), and health outcomes (per capita traffic casualty rates, physical fitness, birth defects, illness and longevity).

Sustainable urban access planning is an emerging and dynamic discipline and provides a foundation for the Global Roadmap for Action toward Sustainable Mobility.

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ANNEX A. URBAN ACCESS PERFORMANCE EVALUATION

Strategic planning requires appropriate performance indicators that can be used to identify problems, evaluate potential solutions, track progress and perform research. This requires developing appropriate indicators that reflect sustainability goals (ESCAP 2019; Gudmundsson & Regmi, 2017; STI 2008).

There are three major indicator types: inputs (such as per capita public transit service or active transport funding), outputs (such as changes in vehicle ownership and use, and mode share) and outcomes (such as per capita energy consumption, pollution emissions and accident deaths). It is usually best to include some of each: *inputs* indicate how well policies and organizations support sustainable transportation strategies, *output* indicate whether programs are effective, and *outcomes* indicate whether strategies are ultimately successful at achieving goals.

Table A1 is an example of a comprehensive set of sustainable transport indicators based on various economic, social and environmental goals, objectives that help achieve those goals, and performance indicators that can measure progress toward or away from those objectives. This defines the data that should be collected for problem identification, evaluation and research purposes. A strategic data collection program can improve data quality and availability and ensure that all jurisdictions and organizations use consistent definitions and collection methods to allow performance tracking, comparisons and research analysis between different times and locations (STI 2008).

Some types of analysis require additional indicators that reflect specific needs or conditions. For example, jurisdictions in environmentally-sensitive areas may want more detailed indicators of transportation pollution and habitat displacement. Health organizations may want more detailed information on fitness, health and safety impacts. Social planners may want more detailed information on disadvantaged populations' transport costs, independent mobility, and economic opportunity, and how these vary by neighborhood. Transit agencies and Transit-Oriented Development planners should apply the BRT Standard and the TOD Standard (ITDP, 2013, 2017). Active transport planners need data for walking and bicycling Level of Service indicators (Dowling, et al. 2008). Emerging issues may require new indicators such as the ICLEI EcoMobility Alliance's EcoMobility SHIFT planning system.

New data collection methods can help transportation performance evaluation (Baum & Howe, 2018). Digital remote sensing, geographic information systems, automated traffic counting, and new travel survey methods can collect more diverse and consistent data. For example, a government can establish transportation service information and payment system standards, so users need only one app to use public transit, taxi, ride hailing, car- and bike-sharing, as well as paying parking and road tolls. Similarly, governments can require fuel vendors to provide detailed fuel sales data, and mobile telecommunications service providers to provide mobile telephone movement data (which can be used to measure travel activity) to transportation agencies for free or at cost.

Inputs		Outputs		Outcomes
(infrastructure, service and funding levels, such as per capita transit service)	→	(Changes in per capita vehicle ownership and use, and travel activity)	→	(Changes in travel time, fuel consumption, pollution emissions, accidents, etc.)

Table B-1: Sustainable Transport Performance Indicators

Sustainability Goals	Objectives	Performance Indicators
I. Economic		
Economic productivity	Transport system efficiency. Transport system integration. Maximize accessibility. Efficient pricing and incentives.	• Per capita GDP • Portion of budgets devoted to transport. • Per capita congestion delay. • Efficient pricing (road, parking, insurance, fuel, etc.). • Efficient prioritization of facilities
Economic development	Economic and business development	• Access to education and employment opportunities. • Support for local industries.
Energy efficiency	Minimize energy costs, particularly petroleum imports.	• Per capita transport energy consumption • Per capita use of imported fuels.
Affordability	All residents can afford access to basic (essential) services and activities.	• Availability and quality of affordable modes (walking, cycling, ridesharing and public transport). • Portion of low-income households that spend more than 20% of budgets on transport.
Efficient transport operations	Efficient operations and asset management maximizes cost efficiency.	• Performance audit results. • Service delivery unit costs compared with peers. • Service quality.
II. Social		
Equity / fairness	Transport system accommodates all users, including those with disabilities, low incomes, and other constraints.	• Transport system diversity. • Portion of destinations accessible by people with disabilities and low incomes.
Safety, security and health	Minimize risk of crashes and assaults and support physical fitness.	• Per capita traffic casualty (injury and death) rates. • Traveler assault (crime) rates. • Human exposure to harmful pollutants. • Portion of travel by walking and cycling.
Community development	Helps create inclusive and attractive communities.	• Land use mix. • Walkability and bikability • Quality of road and street environments.
Cultural heritage preservation	Respect and protect cultural heritage. Support cultural activities.	• Preservation of cultural resources and traditions. • Responsiveness to traditional communities.
III. Environmental		
Climate stability	Reduce global warming emissions Mitigate climate change impacts	• Per capita emissions of greenhouse gases (CO2, CFCs, CH4, etc.).

Prevent air pollution	Reduce air pollution emissions Reduce harmful pollutant exposure	• Per capita emissions (PM, VOCs, NOx, CO, etc.). • Air quality standards and management plans.
Minimize noise	Minimize traffic noise exposure	• Traffic noise levels
Protect water quality & hydrologic functions	Minimize water pollution. Minimize impervious surface area.	• Per capita fuel consumption. • Management of used oil, leaks and stormwater. • Per capita impervious surface area.
Open space and biodiversity protection	Minimize transport facility land use. Encourage compact development. Preserve high quality habitat.	• Per capita land devoted to transport facilities. • Support for smart growth development. • Policies to protect high value farmlands and habitat.
IV. Good Governance and Planning		
Integrated, comprehensive and inclusive planning	Clearly defined planning process. Integrated and comprehensive analysis. Strong citizen engagement. Lease-cost planning.	• Clearly defined goals, objectives and indicators. • Availability of planning information and documents. • Portion of population engaged in planning decisions. • Range of objectives, impacts and options considered. • Efficient and equitable funding allocation

Note: This table summarizes sustainability goals, objectives and performance indicators.

Source: STI (2008), *Sustainable Transportation Indicators: A Recommended Program to Define a Standard Set of Indicators for Sustainable Transportation Planning,* Sustainable Transportation Indicators Subcommittee (ADD40 [1]), TRB (www.trb.org); at www.vtpi.org/sustain/sti.pdf.

High quality data has the following attributes:

- *Comprehensiveness*. An adequate range of statistics should be collected to allow various types of analysis. This should be disaggregated in various ways, including by geographic area (particularly by urban region), mode and vehicle type and demographic group.
- *Consistency*. The range of statistics, their definitions and collection methodologies should be suitably consistent between different jurisdictions, modes and time periods. For research purposes, transport data should be consistent with other data sets, such as land use, economic and health, so it is possible to determine their interactions.
- *Accuracy*. The methods used to collect statistics are suitably accurate.
- *Transparency*. The methods used to collect statistics must be accessible for review.
- *Frequency*. Data should be collected regularly, which may be quarterly, annually, or ever several years, depending on type.
- *Availability*. Statistics should be readily available to users. As much as possible, data sets should be available free on the Internet in spreadsheet or database format.

Some major international organizations currently provide transportation-related data:

- SuM4All's Data Portal (http://datatopics.worldbank.org/sum4all) is collecting standardized data related Universal Access, Efficiency, Safety and Green Transportation for each country.
- The Observatory for Urban Mobility (http://omu.caf.com) is collecting data on 50 indicators for 29 Latin American cities (www.datos-transporte.org).
- The BRT Standard (http://brtstandard.org) and TOD standard (http://todstandard.org) .
- The "Mobility in Cities" database (previously the "Millennium Cities Database" provides detailed information on more than 60 major cities around

the world (www.uitp.org/MCD).

- The EU Transport Scorecard (http://ec.europa.eu/transport/facts-fundings/scoreboard) provides information for comparing and evaluating transport system performance for each country.
- The Federal Highway Administration's, *Highway Statistics Annual Report* provide detailed information on U.S. roadway facilities and activities (www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.cfm).

However, these data sets have problems that limit their utility for urban transportation performance evaluation. Some key data are not comparable between jurisdictions or over time. For example, European and North America data sets differ not only in their units (Metric versus Empirical), but also in how vehicle types are defined, and which costs and pollution data are collected. Much of the data is collected at the national or state level and unavailable at geographic scales suitable for urban planning. To maximize their utility jurisdictions should collect the same data, using consistent definitions, and meet minimum data quality standards, so results can be compared between jurisdictions and over time.

Below are factors to consider when selecting urban access performance indicators.

- For *equity analysis*, indicators should be disaggregated by demographic and geographic factors such as income class, age, gender, physical ability and location. Equity analysis should give special attention to *basic access,* which refers to people ability to reach essential services and activities such as education, employment, affordable stores and healthcare.
- *Equity analysis* can also include the quality of travel options for non-drivers (walking, bicycling and public transport) compared with the quality of driving conditions, and the portion of public expenditures on transportation facilities and services (including government-mandated parking facilities provided by businesses) devoted to different modes, and therefore the degree that non-drivers received a fair share of infrastructure investments.
- Analysis should evaluate *user convenience,* including the ease of obtaining information for navigating the transport system, and for paying for mobility services, particularly by disadvantaged groups.
- Analysis should measure transport costs and *affordability* (cost burdens on lower-income households). Census data, travel survey and consumer expenditure survey data can be used to calculate household expenditures on local transportation (vehicle ownership, vehicle operation, public transportation fares and taxi fares), identify when these costs unaffordable (defined as more than 15% of household expenditures devoted to transportation, or more than 45% of household expenditures devoted to housing and transportation combined.[18]
- Analysis should measure *safety and health impacts,* including per capita traffic casualty rates (injuries and deaths), average daily minutes devoted to active transport, and portion of the population that achieves physical activity targets of at least 22 daily minutes devoted to moderate physical activity.
- Analysis should measure *environmental impacts* including per capita fossil fuel consumption and pollution emissions, portion of residents exposed to excessive noise and air pollution, and per capita impervious surface area (buildings, roads and parking facilities).
- Analysis should include *freight and logistical efficiency*. The GRA "Transport Efficiency" report identifies freight transport efficiency indicators such as the World Bank's *Logistics Performance Index* (LPI) which rates freight transport from 0 (least efficient) to 5 (most efficient). Other commercial transport indicators can include the quality of freight transport planning and management, shipping speed and prices, and indicators of freight vehicle external impacts such as crash casualties, energy consumption and pollution emissions per tonne-kilometer.
- Analysis should evaluate the *quality of planning*, including the degree that transportation planning is comprehensive and multimodal, including whether it considers emerging planning issues, and invests in non-auto modes and TDM solutions when they are most cost effective overall, the degree that planning is integrated between different

agencies and jurisdictions, including transport and land use planning to create more accessible and multimodal community, such as transit-oriented development, and whether planning is transparent and includes public engagement.

- Analysis should evaluate and report the quality, consistency and availability of data required for transport planning and performance evaluation.

ENDNOTES

18 Housing and Transportation Affordability Index (https://htaindex.cnt.org/).

ANNEX B.
USEFUL GUIDES TO IMPROVE URBAN ACCESS

Numerous guides can be used to help improve urban access. Box 1 below lists some information sources that can help identify and evaluate these.

Box: C1

ACCESS - Eurocities for a New Mobility Culture (www.access-eurocities.org) promotes a new mobility culture.

Association for Commuter Transportation (www.actweb.org) supports TDM programs.

Despacio and ITDP (2013), Practical Guidebook: Parking and Travel Demand Management Policies in Latin America, InterAmerican Development Bank; at https://bit.ly/1NIpZEo.

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Marc Schlossberg, et al. (2013), *Rethinking Streets: An Evidence-Based Guide to 25 Complete Street Transformations,* University of Oregon's Sustainable Cities Initiative; at www.rethinkingstreets.com.

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SGN (2002 and 2004), *Getting to Smart Growth: 100 Policies for Implementation, and Getting to Smart*

Growth II: 100 More Policies for Implementation, Smart Growth Network (www.smartgrowth.org).

SSTI (2018), *Modernizing Mitigation: A Demand-Centered Approach,* State Smart Transportation Initiative and the Mayors Innovation Project; at (https://bit.ly/2TCxtBD).

Sustainable Transportation: A Sourcebook for Policy-Makers in Developing Countries (www.sutp.org), by the Sustainable Urban Transport Project – Asia (www.sutp-asia.org) and GIZ (www.gtz.de).

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ANNEX C. LIST OF POLICY MEASURES

The list of policy measures identified in this paper to achieve universal urban access has been consoli¬dated and harmonized with the policy measures to achieve all other policy goals toward sustainable mobility. The Global Roadmap of Action toward Sus¬tainable Mobility provides the consolidated list of measures.

The consolidated policy measures that have an impact on universal urban access are shown in the Table below.

Table C.1: Policy Measures with Description (by toolbox and thematic area, with an impact on universal urban access)

Policy Measure	Policy Measure Description
Toolbox: Regulatory and Institutional	
Thematic Area: Plans and Strategies	
Develop an Integrated National Transport Plan	Develop and implement an integrated national transport plan to cover the four policy goals, all modes of transport, and passenger and freight traffic.
Set Targets across Policy Goals	Set clear targets to be achieved in the long term and in the interim for the four policy goals, aligned with an integrated sustainable mobility plan.
Develop Mobility Plans at the Sub-National Level	Develop a sustainable urban mobility plan and implement strategies at the sub-national level that are consistent with the integrated national sustainable transport plan.
Adopt TOD Principles in Land Use Planning	Adopt integrated land use planning that supports transit-oriented development (TOD), mixed land use and compact city planning, reforming development policies and zoning codes, limiting urban expansion, and incorporating rail network development in urban planning.
Embed the Safe System Approach into Transport Planning	Embed the safe system approach to road safety in all aspects of national and sub-national transport planning
Provide Policy Certainty to Businesses and Investors	Ensure a stable regulatory and policy framework, setting a timeline sustainable mobility targets, to increase the confidence for businesses and financial investors to make long-term decisions.
Thematic Area: Institutional Design, Cooperation, and Coordination	
Coordinate Planning across Government Agencies	Coordinate across agencies to ensure integrated planning and shared responsibility for results across levels of government, jurisdictions, and agencies, including but not limited to the coordination of road safety responsibilities and the coordination of response to extreme weather events.

Policy Measure	Policy Measure Description
Define Roles and Accountabilities across Agencies	Define government roles, responsibilities and accountabilities in the transport sector across the four policy goals, modes of transport, national and sub-national government levels, and passenger and freight transport.
Establish a Metropolitan Transport Governance	Establish a governance structure and an institutional framework for transport at the metropolitan level.
Establish Joint Gender Programs Across Agencies	Establish joint programs with ministries and agencies responsible for gender to include transport in their work program.
Thematic Area: Regulations for Transport Services	
Adopt a Coherent Competition Policy	Adopt a coherent competition policy for passenger and freight transport based on the principles that competitive markets are central to efficiency, and acknowledge that market failures in the transport sector require regulation.
Regulate Freight Delivery Hours in Urban Areas	Introduce regulations about the hours and areas in which freight delivery in urban areas is allowed to reduce congestion and noise pollution, mindful of the important role of freight delivery for economic activity.
Review Legal Framework for Women's Security in Transport	Review the national framework for security and safety in public spaces used to access transport, and for in-vehicle protection from harassment.
Allow and Regulate Vehicle Sharing and TNCs	Reform regulations to allow and support vehicle sharing programs (cars, bicycles, scooters), transportation networking companies (TNCs), and demand-responsive transport solutions, with a focus on last mile connectivity to high capacity modes, and support vehicle-sharing community networks such as car-sharing fleets within companies and administrations.
Review transport regulations periodically	Promote the periodic review of the regulations to allow the fast-moving mobility solutions to evolve towards a sustainable and inclusive transport system
Thematic Area: Regulations for Vehicles and Vehicle Use	
Ensure Legal Certainty Regarding Driver Permits	Adopt standards and compliance regimes for the provision and withholding of driver licenses and permits, including compliance regimes designed to prevent and reduce fatal and serious injury risk.
Define and Enforce Speed Limits	Define and enforce speed limits according to modal mix, road function, and protective qualities of roads.
Define Low Emission Zones in Cities	Define low emission zones (LEZ) in cities, i.e., areas where the most polluting vehicles are regulated through access restrictions, which could be based on vehicle emission standards or vehicle age, and enlarge them progressively.
Limit the Number of Parking Spaces in New Developments	Replace parking minimum requirements with caps (maximum limits) and other policies that support parking management.
Establish Electric Vehicle Manufacturing Mandates	Establish mandates for manufacturing electric vehicles and gradually increase their supply.
Limit the Number of New License Plates for Cars	Implement restrictions on vehicle ownership by limiting the number of new license plates issued.

Policy Measure	Policy Measure Description
Limit the Import of Second-Hand Vehicles	Limit the import of second-hand fossil fuel motor vehicles beyond a maximum age, including 2- and 3-wheelers.
Establish More Stringent Fuel Economy Standards	Establish stricter fuel economy standards and CO2 emission standards for new motor vehicles, as well as stricter fuel specifications, for example, the use of low-sulphur petroleum products.
Set Fuel Quality Requirements and Blending Mandates	Determine fuel quality requirements, for example, the use of low-sulphur petroleum products, and blending mandates to support alternative fuels.
Thematic Area: Regulations for Data Collection, Share and Use	
Establish Data Protection Regulations	Establish personal and travel data protection regulations, with processes that handle personal data with the appropriate safeguards and ensure that data are not made available to the public without explicit informed consent.
Require Service Providers to Report Standardized Data	Establish standardized data reporting requirements for all transport service providers, including transportation network companies (TNC), public transport operators, and bike- or car-share companies.
Develop Data Repositories and Data Collection Guidelines	Develop centralized data repositories and establish data collection guidelines at the national and metropolitan levels, and facilitate data access to different stakeholders (academics, private sector, etc.) while stablishing a legislative framework defining the context and purpose of its use.
Require Use of Data to Support Decision Making	Require using operational data to support decision making and regulatory oversight.
Thematic Area: Procurement and Contracts	
Prepare Public Procurement Rules and Procedures	Prepare procurement rules and procedures, standard contract documents for infrastructure construction and maintenance, supported by an e-procurement platform, and harmonize those at a regional or international level to foster economies of scale.
Procure Contractors on a Competitive Basis	Procure contractors on a competitive basis, using packaging of batches of projects to attract multiple capable contractors.
Integrate Gender in Public Procurement and PPPs	Integrate gender in bidding documents for standard public procurement and public-private partnerships (PPPs) by requesting bidders to demonstrate gender experience, by setting gender-specific targets for women's employment and entrepreneurship, for example, quotas for contracts to be awarded to women-owned and managed businesses.
Establish a Pool of Technical and Financial Experts	Establish a pool of independent experts capable to undertake technical and financial audits of projects.
Thematic Area: Capacity Building and Human Resource Development	
Identify and Empower Sustainable Mobility Champions	Identify and Empower Country Champions to Help Move Forward the Sustainable Mobility Agenda, for example, ministers and mayors.
Build Capacity Across Levels of Government	Build national and local capacity across levels of government, jurisdictions, organization, and modes, including providing training and information resources.
Provide Training for Workforce in Leadership Positions	Provide training for the current and future transport workforce in leadership positions, enabling well-trained staff to drive change toward sustainable mobility.

Policy Measure	Policy Measure Description
Facilitate Capacity Building at the International Level	Facilitate sector specific capacity building at the international level.
Train more Women on Skills Needed in Transport	Create incentives for training more women with the skills needed in transport, for example, operating heavy duty vehicles.
Build Capacity on Gender-Inclusive Accessibility Planning	Build capacity on accessibility planning that includes gender impacts, for example, consider access to centers of interest for women and gendered information on access to jobs and education.
Train Security and Transport Staff in Gender Aspects	Train security and transport stakeholders in gendered aspects of transport, especially security.
Create Mentoring Programs and Professional Networks	Create programs to promote role models, mentoring and networks of transport professionals, including programs targeted to women.
Toolbox: Engineering and Technology	
Thematic Area: Technical Standards	
Establish Technical Standards for Transport Infrastructure	Establish high technical standards for transport infrastructure design, for example, performing climate vulnerability screening, protecting roads against water penetration, and using local materials and resources when feasible.
Recruit Qualified Firms for Project Design and Feasibility	Recruit qualified consulting firms for preparing feasibility reports and engineering designs, and supervising civil works.
Ensure Safe Roads Design with Lower Design Speeds	Plan and design safe roads and roadsides for lower speeds, including features that calm traffic, and considering the increasing use of bicycles and pedestrian flows in urban areas.
Ensure Integration of Public Transport and Bicycles	Ensure physical integration between public transport and bicycles, for example, providing bicycle parking and allowing bicycles in public transport (with limitations because of vehicle size or passenger density).
Improve Intermodal Connections in Transport Hubs	Improve local access to transport hubs including bus and train stations, ports and airports.
Set Design Standards for Sidewalks and Bicycle Paths	Set high quality design standards for sidewalks and bicycle paths, for example, safe and convenient pedestrian crossing and adequate street lighting, ensuring accessibility to persons with disabilities and considering gender sensitive aspects (for example, dropped kerbs at crossings, size of refuge islands, and timing of traffic signals).
Ensure Transport Project Design Includes Gender Aspects	Include considerations for women and for people with disabilities in transport infrastructure project design and planning.
Set and Implement Climate Change Adaptation Standards	Set climate change adaptation and resilience standards and practices, and integrate them into project design across transport infrastructure, including roads, airports, and seaports.
Set Low-Noise Engineering and Traffic Management Practices	Set traffic management practices to reduce noise pollution, for example, speed limitations, speed humps, traffic lights coordination and roundabouts, and low-noise road engineering and maintenance practices, for example low-noise pavement and noise barriers.

Policy Measure	Policy Measure Description
Thematic Area: Asset Construction	
Build Rail and Maritime Transport Infrastructure	Build infrastructure for energy- and space-efficient modes such as rail and waterborne transport, including high-speed rail for corridors with sufficient demand.
Expand Public Transport Infrastructure	Expand the public transport network adjusted to demand requirements, with an emphasis on equitable access and considering the most appropriate modes in each context, including bus, rail, demand-responsive service, cable-propelled transport and ferry transport.
Prevent the Construction of Urban Expressways	Prevent the development of new urban expressways to avoid the segregation of neighborhoods and to avoid additional car travel.
Develop Infrastructure for Road Transport Electrification	Develop infrastructure for road transport electrification, such as charging stations, electric road systems, including electricity and hydrogen power for trucks, cars, buses, etc.
Improve First and Last Mile Access Infrastructure	Evaluate and improve first and last mile access to major transport services in urban and rural areas.
Expand the Network of Bicycle Lanes	Build quality and safe infrastructure for cycling, with a focus on protected bicycle lanes.
Repurpose Road Space to Allow Access for All Modes	Repurpose existing road space with complete street designs accommodating diverse users and uses, with access for all modes, particularly pedestrians and cyclists and their access to public transport stations.
Ensure an Optimal Level of Vehicle Availability and Use	Ensure an optimal level of vehicle availability and use, for example, adapt bus or train capacity to activity and load factor, invest in buses and rolling stock to reduce public transport crowding.
Thematic Area: Design and Deployment of Transport Services	
Improve the Quality and Safety of Public Transport	Improve the quality and safety standards of public and private as well as formal and informal public transport operations, such as service frequency, reliability, cleanliness, and safe driving practices, and implement bus lanes and other bus priority measures.
Provide Effective Car and Bicycle Sharing Systems	Provide effective shared car and bicycle-sharing systems as an alternative to vehicle ownership.
Ensure Access to Transport Services in Underserved Areas	Ensure complete transport services by extending services to underserved areas and populations.
Prioritize Pedestrians and Cyclists in Traffic Management	Adopt traffic management strategies that prioritize pedestrians and cyclists.
Implement ITS Solutions for Providing Transport Information	Implement online platforms and other ITS solutions for providing information on traffic, routes, and transport mode options for both passengers and freight transport
Conduct Accessibility Evaluation and Mapping	Develop tools for measuring the accessibility of different locations and evaluation how various transport and land use changes will affect accessibility for various groups and activities, with a special attention to access for disadvantaged groups.

Policy Measure	Policy Measure Description
Implement Mobility as a Service Packages	Implement government-coordinated mobility as a service (MaaS) packages combining different services and platforms for transport users to review travel options, changing the focus from providing a specific service on one mode of transport to mobility solutions that are consumed as a service.
Introduce Pedestrian and Bicycle Means of Delivery	Introduce pedestrian and bicycle-friendly means of delivery.
Integrate New Mobility Solutions to Existing Transport	Support the complementarity of new shared solutions such as car-sharing, electric vehicles rentals and autonomous vehicles with existing public transport networks, for instance by supporting new solutions to direct traffic to public transport stations or as a replacement after operating hours.
Thematic Area: Design and Deployment of Programs	
Deploy Road Safety Cameras	Deploy road safety cameras to monitor the condition on the road and enforce traffic violations.
Ensure Adequate Post-Crash Intervention	Ensure adequate post-crash intervention through efficient emergency notification, fast transport of qualified medical personnel, correct diagnosis at the scene, stabilization of the patient, prompt transport to point of treatment, quality emergency room and trauma care, and extensive rehabilitation services.
Support Data Sharing Programs and Platforms	Establish a framework and promote data sharing programs and platforms across different sectors to exchange data relevant for transport policy, such as data collaboratives models including the public and private sector.
Provide Incentives to Increase Car Occupancy	Provide incentives to increase private vehicle occupancy, for example, high occupancy vehicle (HOV) lanes.
Provide Sustainable Alternatives for Commuting Trips	Encourage initiatives that provide sustainable mobility options for employees, such as employer-sponsored transport programs, carpooling schemes, and public transport commuter benefits.
Implement Telecommuting Policies	Implement policies that allow flexible work schedules and telecommuting, i.e., working from home schemes, to avoid non-essential trips.
Develop Vehicle Rental Platforms for Different Types of Use	Provide effective shared car and bicycle-sharing systems as an alternative to vehicle ownership. Promote the use of vehicles adapted to daily needs (i.e. small BEV for daily trips) and offer alternatives renting solutions for exceptional journeys (i.e range-extender or large BEV holidays).
Thematic Area: Asset Management	
Develop Asset Management Standards and Plans	Develop asset management standards and plans to preserve, maintain, and manage transport infrastructure and their systems over their life cycle.
Set Up Audits for Construction Design and Safety	Set up independent audits of asset management industries and of construction design and safety to ensure the quality of assets.
Thematic Area: Safeguards	
Ensure Project-Induced Resettlement is Conducted Fairly	Ensure that project-induced displacements are economically justified and handled with fair and dignified treatment of those affected, ensuring that safeguards are in place.

Policy Measure	Policy Measure Description
Toolbox: Economics and Finance	
Thematic Area: Project or Program Cycle	
Use a Robust Framework for Project Prioritization	Use a robust investment evaluation framework to prioritize the allocation of public infrastructure funding to infrastructure projects and associated services.
Establish Performance Monitoring and Evaluation Schemes	Establish performance and result monitoring and evaluation schemes to inform the regular adjustment for projects, policies and programs, for example, the evaluation of road safety interventions and their institutional delivery.
Conduct Impact Evaluation Studies	Conduct impact evaluation studies to improve the evidence base available to policymakers, considering the impact of transport infrastructure projects on economic growth and employment, and considering differentiated impacts on women.
Thematic Area: Allocation of Public Funds	
Require Projects to Meet Cost-Effectiveness Thresholds	Require transport projects to meet an economic viability threshold based on a cost-benefit analysis and estimate the economic internal rate of return (EIRR), reflecting least-cost planning principles
Thematic Area: Fiscal and Financial Measures	
Enable Municipal Revenue through Tax and Bonds	Enable city-level revenue generation, such as taxation and bonds, for transport projects to be funded locally, especially in medium and large cities.
Apply Innovative Solutions Financing for Asset Creation	Apply sustainable and innovative financing schemes for asset creation, including new financing mechanisms, new fund management techniques, and new institutional arrangements.
Set User Fees to Support Transport Infrastructure Funding	Adopt transport user fees to help fund transport infrastructure and allow for return on investment, for example, toll roads.
Mobilize Public and Private Capital for Transport Finance	Mobilize public and private capital for transport finance, using PPPs to improve sector efficiency when appropriate, and help bridge the transport infrastructure gap.
Use Land Value Capture Schemes	Use land value capture schemes to increase funding for urban transport systems, capturing the increase in property value around new transport infrastructure development.
Thematic Area: Pricing for Efficiency and Inclusion	
Implement Fuel Taxes and Phase Out Fuel Subsidies	Implement and increase fuel taxes while phasing out fossil fuel subsidies to offset the social cost of greenhouse gas emissions and air pollution.
Use Congestion Charging or Pay-as-You-Drive Schemes	Use congestion charging or pay-as-you-drive schemes to charge for the congestion costs imposed by personal motorized vehicle use, with rates that increase under urban-peak conditions to reduce traffic congestions.
Implement or Increase Vehicle Registration Fees	Implement or increase vehicle registration fees to support road maintenance funding, reducing the incentives for purchasing a vehicle.
Apply Market-Based Parking Pricing	Apply market-based pricing schemes to on-street and off-street parking, such as variable pricing based on demand.

Policy Measure	Policy Measure Description
Provide Financial Incentives to Reduce Environmental Impact	Provide financial incentives, for example subsidies, tax credits, or low tax rates to reduce the environmental impact of transport, including financial incentives for cleaner vehicles, cleaner fuels, old vehicle abatements, and the circular economy.
Make Public Transport Fares Affordable for the Poor	Make public transport fares affordable for the poor using means testes approaches to ensure cost-recovering mechanisms.
Ensure Integrated Fare Payment across All Modes	Develop integrated fare payment systems across all modes of public transport, parking and road charges.
Thematic Area: Innovation Policy and Enhancement	
Support R&D to Reduce Environmental Impacts	Support systematic research and development for technologies that reduce the environmental damage from transport through joint industry and government research, for example, research to optimize the life cycle of batteries for vehicle electrification, alternative fuels (sustainable biofuels, biogas, synthetic fuels, hydrogen) and intelligent transport systems (ITS).
Toolbox: Communication	
Thematic Area: Consultation and Public Engagement	
Consult with Stakeholders during the Full Project Cycle	Consult extensively with stakeholders during project formulation and establish a framework for continuous consultation during project implementation.
Use Participatory Planning Methods	Use participatory planning methods, including creation of a website, to help communities propose interventions.
Promote Public Discussion on New Mobility Solutions	Promote public discussion with civil society about new mobility solutions to generate new ideas, innovations and tools.
Ensure Neutrality on Technology related communication	Ensure neutrality and transparency on technology related communication, taking into account the whole life-cycle of technologies when making technology decisions, using for instance LCA (Life Cycle Analysis) methodologies.
Thematic Area: Promotion Campaigns and Public Awareness	
Implement Awareness and Behavior Change Strategies	Implement awareness and behavior change (ABC) strategies to help shift attitudes towards sustainable modes, for example, public transport, walking and cycling, complementing other engineering, legal or economic measures.
Implement Anti-Harassment Campaigns in Public Transport	Implement anti-harassment awareness campaigns in public transport spaces.
Raise Road Safety Awareness	Ensure sustained communication of road safety as a core business for government and society, emphasize the shared responsibility for the delivery of road safety interventions, and raise awareness about the dangers of speeding.
Make Information Publicly Available on Projects and Policies	Make information accessible to increase the public support to transport policies and projects.
Foster a Security Culture in Public Transport	Foster a security culture to improve efficiency and attractiveness of public transport, based on the psychological elements that make passengers feel secure while using buses, trains, and other modes of public transport.

Policy Measure	Policy Measure Description
Thematic Area: Knowledge Management and Dissemination of Best Practices	
Share Knowledge on Successes and Best Practices	Share successes and best practices with other agencies at the local, national and international level, based on a well-designed knowledge transfer framework.
Inform Users about New Sustainable Solutions	Promote physical and online information centers aiming to reinforce the demand for sustainable mobility products, and facilitate the understanding of new technologies.