CPC_006_Sustainable Mobility

A CP Contribution to Develop an Actionable Definition of Sustainable Mobility

Developed by the CP Editor and CPTSC

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Executive Summary

Statement of Need

A standard definition to support an actionable Sustainable Mobility plan is essential for intra-city and cross-city knowledge sharing as cities seek to navigate the transformation of the transportation sector taking place (from an auto-centric system to a techno-centric one), the impacts of widespread changing mobility preferences, and the need to reduce the adverse effects of vehicular traffic (congestion, air pollution, noise, and impacts on land use and streetscapes) on citizens' well-being and quality of life. Cities that successfully navigate the transition from an auto-centric society to a techno-centric society, where urban public spaces are reclaimed to make them accessible and environmentally friendly, will adopt a normative approach to achieving sustainability for their transportation systems. A livable district is a sustainable community that enjoys high levels of social equity, benefits from a healthy environment, and sustains a strong economy with returns through public and private sector investment and the creation of businesses and jobs. Sustainable Mobility is a key element of that equation.

Relationship to City Protocol.

Following the City Protocol Development Theme of **City Transformation**, specifically improving livability/quality of life, this document develops the action domain #5, mobility, in the Livable Districts and Cities document (CPC_004_Livable_Districts_and_Cities.pdf) by providing a common definition and understanding of how Cities can make their aspirations for sustainable mobility actionable.

This document seeks to advance this by establishing a comprehensive definition of Sustainable Mobility that is actionable using City Protocol tools and resources (Indicators and Action Domains for Livability). Sustainable Mobility can be made actionable by identifying the environmental, social, economic and well-being benefits associated with the decrease in motorized vehicle dominance in cities and by prioritizing walking, bicycling, and public transportation, combined with appropriate metropolitan public transportation systems. Strategies that also address modal shift, land use policies to promote mix-of-uses, and proximity of functions/services and activities within the city should decrease urban traffic levels. This decrease impacts

on:

- environmental health since it reduces air pollution, with its adverse effects on climate, human health and built domain conservation; diminishes noise and vibration; conserves energy (*i.e.*, urban metabolism becomes more efficient and the city more self-sufficient), and improves the livability of the public realm; and on
- social equity since it promotes an egalitarian approach to urban mobility. In addition, districts and cities become more livable since reclaimed spaces become functional and structural attractors for living and community development; and finally on
- economic activity, and overall improved urban economic efficiency and resiliency, due to the well documented increase of local commerce related to pedestrianization initiatives, from calmed, complete or slow streets to superblocks and full walkable districts.

This document ties into at least two **Protocol Elements**: The **Problem Statement** (advancing sustainable mobility despite the entrenched auto-centric interests that continue to drive pubic policy in many places) and **Definition** (developing a definition of Sustainable Mobility that encourages collaboration across disciplines and among cities).

Approach

This document examines the topic of Sustainable Mobility and provides a comprehensive, detailed definition of what it means to achieve sustainability from a transportation perspective.

Target Users

The target users of the Sustainable Mobility document are the following: city officials; urban planners; transportation planners and policymakers; community organizers and advocates; transit managers.

Table of Contents

1. INTRODUCTION: A FRAMEWORK FOR BUILDING A SUSTAINABLE & EQUITABLE TRANSPORT SYSTEM 1

1.1 AN AUTO-CENTRIC CENTURY GIVES WAY TO A NEW PARADIGM 1

1.2 URBAN LIVABILITY & SUSTAINABLE MOBILITY 2

1.3 SUSTAINABLE MOBILITY MADE ACTIONABLE 3

2. THE THREE COMPONENTS OF A SUSTAINABLE MOBILITY SYSTEM 5

2.1 A SUSTAINABLE MOBILITY SYSTEM IS GREEN. 5

2.1.1 LESS RELIANT ON FOSSIL FUELS AND DESIGNED TO MANAGE TRAFFIC EFFICIENTLY. 5

2.1.2 DESIGNED FOR INFORMED DECISION MAKING WITH SENSORS-ACTUATORS AND DATA-DRIVEN TRAFFIC MANAGEMENT TOOLS. 7

2.1.3 PROVIDES MEANINGFUL MODAL CHOICES AND USES DYNAMIC TOLL & USER FEE PRICING POLICIES TO ENCOURAGE MODAL SHIFT AWAY FROM SINGLE OCCUPANCY VEHICULAR TRAVEL. 8

2.1.4 PLACES FUNDING EMPHASIS ON NON-VEHICULAR MODES (TRANSIT, CYCLING, WALKING). 10

2.1.5 SYNERGISTIC WITH LAND USE & PLANNING POLICIES THAT ENCOURAGE DENSITY, MANUFACTURING AND PROFESSIONAL/COMPANY ACTIVITIES AND HELP RESOLVE THE "LAST MILE" CONUNDRUM. 11

2.2 A SUSTAINABLE MOBILITY SYSTEM IS AGILE & RESILIENT. 13

2.2.1 RESPONSIVE TO CHANGING DEMOGRAPHICS AND MOBILITY PREFERENCES. 13

2.2.2 A WELL MAINTAINED TRANSPORTATION SYSTEM. 14

2.2.3 ABLE TO KEEP PACE W/INNOVATION VIA OPEN PLATFORMS. 15

2.3 A SUSTAINABLE MOBILITY SYSTEM IS EGALITARIAN. 15

2.3.1 ACCESSIBLE/CONVENIENT. 15

2.3.2 AFFORDABLE. 16

2.3.2 EQUITABLE. 17

3. CONCLUDING REMARKS 17

4. COPYRIGHT STATEMENT 18

1. Introduction: A Framework For Building a Sustainable & Equitable Transport System

1.1 An Auto-Centric Century Gives Way to A New Paradigm

When the ground breaking Ford Model T first appeared in late 1908, it marked the beginning of what would quickly become a global auto-centric society. Advances in technology and manufacturing mass production techniques, combined with relatively plentiful and low-cost fuel, meant that automobiles were available to people across many income strata in every corner of the globe with a market economy. A post-World War 2 suburban diaspora in many developed nations marked the beginning of decades of urban struggle and decline, as those with means moved out and demanded public investment in highway systems that responded to their needs. What followed was an era of transportation planning that placed disproportionate emphasis on funding and building a network of highways, tunnels and bridges.

Over time the focus on vehicular mobility at the expense of other modes began to degrade quality of life in ways that were increasingly unacceptable to many people. The tendency of citizens in the early twentieth century to accept a transportation planning paradigm that too often leveled neighborhoods, disregarded historic legibility markers, and separated communities from one another and from natural resources like waterfronts and rivers, gave way to an era of citizen activism that rejected the notion that modernity required the diminution of their quality of life.

Good transportation planning in the 21st Century should go hand-by-hand with appropriate urbanization and land use policies to respond to demographic changes and mobility preferences. Approaches to improving mobility should be rooted in the broad consensus (among transportation planners, decision makers and citizens) that contemporary transportation systems ought to respond to our desire to build, live and work in communities that offer a high quality of life, *i.e.*, are livable.

Two terms – “sustainable” and “equitable” – are often used to describe the foundational principles for what a high quality of life transportation system would

follow. Those terms are frequently used, but they share the burden of having had multiple definitions and interpretations applied to them, so much so that the full force and specific meaning of sustainability and equity often get lost.

1.2 Urban Livability & Sustainable Mobility

The City Protocol Society ("CPS") has developed and proposed a systems-based approach to considering the question of city transformation in the 21st Century, and taking action to begin that work. The CPS has published a number of guides for cities seeking to transform into more efficient and sustainable environments. *See, e.g.*, CPA-I_001-v2_City_Anatomy.pdf; CPC_004_Livable_Districts_and_Cities.pdf. City Protocol's organizing framework for cities is embodied in the City Anatomy, an analogy to the human anatomy and its dynamic physiology. It offers a common language describing the city ecosystem as three key system elements: a set of physical structures (*Structure*); the living entities that make up a city's society (*Society*); and the flow of interactions between them (*Interactions*). In so doing, City Anatomy helps understanding and mapping interconnections between city systems.

Given human nature, old paradigms have separated city functions and services into silos, effectively disabling cities from taking advantage of an integrative approach to governance and service delivery. Cities that cannot break out of the old paradigm of silos cannot easily transition to the opportunities offered by a 21st century technology platform that works best as an integrated "internet of things" (IoT). In this context, City Protocol aims at looking at the IoT from an "internet of cities" point of view by proposing a common language and understanding for these complex and diverse urban settlements.

The proposed anatomy of urban habitat, while acultural (valid for any culture or geography), generic (modular in approach but specific in application), and scalable (valid for any size of urban settlement), provides the organization of content (taxonomy) within the city information architecture. Thus, it is supported by an Anatomy Ontology (cao.owl; CPA-PR _003_Anatomy_Ontology) to provide meanings and relationships for the flow of interactions and also by Anatomy Indicators to facilitate a consistent assessment of performance. With these three foundational protocols, informed decision making can be made from a holistic and

dynamic point of view by interrelating city systems that impact livability (*e.g.*, mobility, urbanization and land use, metabolism, etc.), as described in the City Protocol Livable Districts and Cities document.

Successful cities in the 21st Century will be those that can navigate the often turbulent waters of chance with a consistent knowledge base of their own city reality and context, informed by the experience of other cities via collaboration. Those cities will find proven ways to embrace needed city transformation and leverage technology wherever needed to develop, sustain and improve the quality of life for their inhabitants.

Quality of life relates specifically to livability. A livable district or city is a sustainable community that enjoys (among other things) high levels of social equity, a healthy environment, and a strong economy. Each of these factors relate to the existence of a Sustainable Mobility platform.

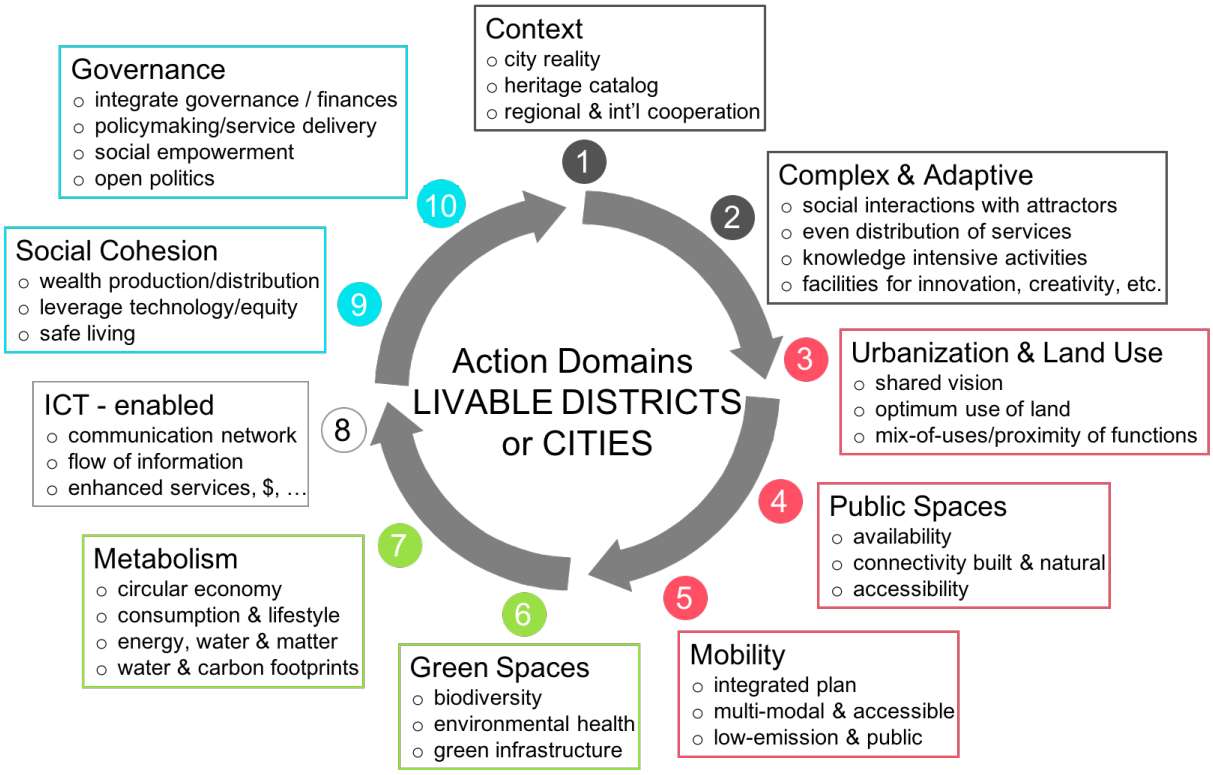
This article is meant to provide both a definition and a working framework for how to think about, and act upon, the goal of Sustainable Mobility. It is structured to have global applicability, regardless of culture, city or district geography, size or governance. If we have a common language and common understanding of the elements that comprise Sustainable Mobility, it will foster the kind of collaboration and action that is urgently required.

This article addresses the issue of Sustainable Mobility in three ways: first, it proposes a comprehensive and evergreen definition of the term; second, it links each definition to specific indicators that will enable cities to measure status quo performance and progress; and third, it ties each of the definitional components to one or more Action Domains set forth in the City Protocol Livable Districts and Cities document.

1.3 Sustainable Mobility Made Actionable

The City Anatomy Livable Districts and Cities document examines human needs that livable districts and cities must respond to, reviews challenges to the development of livable districts, and proposes guidelines to transform such areas. The guidelines are organized around ten domains (*see* Figure below) where action is required to attain and sustain livable districts or cities. These domains (context, complex & adaptive (eco)system, urbanization & land use, public &

common spaces, mobility, green spaces & biodiversity, metabolism, ICT – enabled, social cohesion, and governance) are consistent with those elements proposed by urban ecology experts to measure sustainability in cities, and fit comfortably into the City Anatomy construct.



In this context of livable districts or cities, Sustainable Mobility should (among other things) be compatible with:

- a healthy environment with reduced air pollution (*i.e.*, minimum adverse effects on climate, human health and conservation of built domain), damped noise and vibration, efficient urban metabolism (*i.e.*, energy conservation) and aesthetics of the public space (*i.e.*, visual comfort with green spaces and minimal presence of private vehicles in the public space). This requires the prioritization of walking, bicycling and public modes of transportation;
- high levels of social equity by promoting egalitarianism and diminishing community severance. This is facilitated by prioritizing walking, bicycling and public transportation and converting reclaimed car-intensive public spaces into vibrant functional and structural spaces attractive for living, proximity commerce and community development;

- a strong economy due to the well documented increase of competitiveness of local commerce caused by pedestrianization initiatives, which can range from calmed or complete or slow streets to superblocks and full walkable precincts. A healthier environment, attractive and greener neighborhoods and reduced street casualties also impact on the desire of people to settle there, encouraging the private sector to invest and improving the overall economic health of cities.

Finally, city boundaries are porous and urban mobility is affected by commuters who move in/out with cars due to a lack of reliable and convenient metropolitan public transportation systems. Urbanization and land use policies aiming at promoting mix-of-uses, proximity of functions/services and the reintroduction of clean industrial activities within the city are another set of key elements for Sustainable Mobility.

2. The Three Components of a Sustainable Mobility System

Sustainability in the context of mobility is a term that encompasses the range of attributes - environmental impacts, urbanization and land use, prioritization of transportation modes, accessibility, affordability, resilience – characterizing a system that responds to transportation needs, personal preferences, changing paradigms and technologies, and legal requirements. The above considerations lead to the identification of the main three components for a Sustainable Mobility system: green, agile and resilient, and egalitarian

2.1 A Sustainable Mobility System is Green.

Green means

2.1.1 Less reliant on fossil fuels and designed to manage traffic efficiently.

Sustainable Mobility promotes the use of new energy vehicles and energy storage systems that support such vehicles. It also promotes transit, cycling and walking as low (or lower) carbon impact modes.

Sustainable Mobility also means reducing traffic (and associated traffic congestion) by addressing the built domain, the design (scope, range and interconnectivity) of the mobility network, and urban functions. It requires a

built domain that responds to a multi-modal, more transit/cycling/walking oriented spatial environment by, for example, implementing pedestrianization initiatives ranging from calmed or complete or slow streets to superblocks and full walkable precincts, and promoting mix-of-uses.

Put differently, Sustainable Mobility depends in large part upon urban design and planning decisions that enable, sustain or promote mobility through alternatives to the privately owned vehicle.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators: 3.1.A.2.1* (*PM2.5 concentration)*; *3.1.A.2.2 (GHG emissions); 3.1.A.2.3 (PM10) concentration)*; *3.1.B.2.1 (noise pollution); 3.1.B.2.2 (NO2 concentration)*; 3.2.A.1.8 (% parking places off the road); *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.20 (vehicle ownership); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.2.B.1.3 (interconnectivity between modes); 3.2.B.1.5 (# of species of urban trees); *3.2.B.2.15 (number of 2-wheeled motorized vehicles per capita*); *3.2.B.2.16 (km of cycling lanes per 100K population)*; *3.2.B.2.18 (annual number of trees* planted per 100k population); 3.3.A.1.2 (neighborhood homogeneity/proximity to services); 3.3.A.1.4 (accessibility of public space); 3.3.A.1.5 (# street trees / km urban road); 3.3.A.1.6 (surface of pedestrian priority streets); 3.3.A.1.7 (density housing); 3.3.A.1.8 (size of mixed use development in a city); 3.3.B.1.1 (building compactness); 4.1.A.1.2 (office space density); 4.1.A.1.3 (proximity to convenience shopping); 4.1.A.1.5 (% of population with alternative public transport choices); 4.1.A.1.6 (avg. daily traffic jams/hr); 4.1.B.1.6 (city food markets per 100k population).

Actions Described in Livable Districts Document:

Action Domains 2 (Complex and Adaptive), 3 (Urbanization & Land Use), 4 (Public and Common Spaces), 6 (Green Spaces), 7 Metabolism and 10 (Governance)

1. Promote diversity of human functions by balancing living with other activities available or accessible nearby.
2. Plan to update mobility infrastructure to increase spatial & functional street

continuity.

3. Optimize the use of land with urban planning initiatives and regulations that prioritize high density urban housing; absolute compactness; proximity of services.
4. Adopt strategic city planning that ensures mix-of-uses and connectivity, including a reasonable number and total surface area of livable public spaces with a good balance between built and open space.
5. Facilitate connectivity between well-distributed built public spaces and natural spaces.
6. Develop an integrated urban mobility plan that reduces the need for private motorized transport and converts many spaces dedicated to vehicular use into public spaces.
7. Adapt public transportation to the urban morphology to increase its use and interconnectivity, and reduce time of travel between all district functions.
8. Reduce the impact of transport on environmental, public and economic health.
9. Consider aesthetic quality in designing green infrastructure.
10. Promote responsible consumption and lifestyles that are more aligned with a culture of conservation and that ensure equitable access to resources for all residents over time.
11. Implement and manage a competitive resource-efficient economy (circular economy).
12. Promote diversity of urban functions by balancing living with other activities available or accessible nearby. This may require updating mobility infrastructures to increase spatial and functional street continuity; ensuring that the multi-purpose built or reclaimed public spaces described in the action plan act as structural attractors and favor the development of activities that promote at a small scale the type of interactions that we aim for at the neighborhood/district scale.

2.1.2 Designed for informed decision making with sensors-actuators and data-driven traffic management tools.

Sustainable Mobility promotes the use of data gathered by sensors and geo-referenced individual information to support widespread dissemination of real

time information that advises residents of current conditions and historic (retrospective real time) conditions to make informed mobility decisions, and informs government agencies to improve planning and decision making.

Measuring status quo & performance:

Anatomy Indicators/ *ISO Indicators*: 3.2.A.1.1 (number of 3G/4G connections per 100k population); 3.2.A.1.2 (public space Wi-Fi coverage); 3.2.A.1.3 (fiber optic coverage); *3.2.A.2.1 (# of internet connections per 100K population)*; *3.2.A.2.2 (# of cell phone connections per 100K population)*; 4.4.A.1.1 (open sensors platform); 4.4.A.1.2 (city app availability); 4.4.A.1.3-6 (type of indicators informed by open datasets); 4.4.B.1.1 (publicly available apps using open data); 4.4.B.1.2 (usage of apps and tools by non-public sector parties); 4.4.B.1.3 (quality of the datasets).

Actions Described in Livable Districts Document:

Action Domains 5 (Mobility) and 8 (ICT-enabled).

1. Develop an integrated urban mobility plan that reduces the need for private motorized transport and converts most of open spaces into public spaces.
2. Adapt public transportation to the urban morphology to increase its use and interconnectivity, and reduce time of travel between all district functions.
3. Reduce the impact of transport on environmental, public and economic health.
4. Implement and manage a diversified communications infrastructure to assure multiplatform, multi-modal and multi-object connectivity.
5. Ensure transparent and efficient flow of information emanating from any content and format obtained from sensors, data analytics, apps, etc.

2.1.3 Provides meaningful modal choices and uses dynamic toll & user fee pricing policies to encourage modal shift away from single occupancy vehicular travel.

Sustainable Mobility has to consider mobility infrastructures and transportation systems across city boundaries and the flows of people within the metropolitan and regional areas. Thus, it should provide people with modal choices that are reasonably equivalent in terms of affordability, convenience and reliability, and be supported by a funding system that

encourages modal shift by using technology-based systems to establish fair and transparent pricing regimes designed to price highway use to reflect impacts on congestion, capacity, and air quality.

Promoting the return of businesses by incentives, land use policies and proper refurbishing of a district's infrastructure is also an alternative to reduce inner/outer city traffic.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *3.1.A.2.1* (*PM2.5 concentration)*; *3.1.A.2.2 (GHG emissions); 3.1.A.2.3 (PM10 concentration)*; *3.1.B.2.1 (noise pollution)*; *3.1.B.2.2 (NO2 concentration)*; 3.2.A.1.5 (low emission private vehicles); 3.2.A.1.6 (low emission public vehicles); 3.2.A.1.7 (# of electric vehicle charging stations); *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.2.B.1.3 (interconnectivity between modes); *3.2.B.2.15 (number of 2-wheeled motorized vehicles per capita); 3.2.B.2.16 (km of cycling lanes per 100K population)*; 4.1.A.1.5 (% of population with alternative public transport choices); 4.2.A.1.6 (# of new companies per 100k population per year); 5.1.A.1.6 (% of SMEs); 5.1.A.1.7 (average # of workers per company).

Actions Described in Livable Districts Document:

Action Domains 3 (Urbanization and Land Use), 5 (Mobility), 7 (Metabolism) and 10 (Governance)

1. Reduce the impact of transport on environmental, public and economic health.
2. Move towards a more competitive resource-efficient economy (*i.e.*, circular economy).
3. Promote responsible consumption and lifestyles that are more aligned with a culture of conservation that ensure an equitable access to resources for all residents over time.
4. Engage in community conversation.

2.1.4 Places funding emphasis on non-vehicular modes (transit, cycling, walking).

Sustainable Mobility increases the allocation of transportation funding to improve non-vehicular modes. It adopts approaches like congestion pricing, and dedicates the "delta" between a base price and a congestion premium price to transit. It also adopts a carbon impact fee on non-residential parking over certain thresholds and dedicates that revenue to cycling, complete streets and mobility hubs. Instead of investing in new private vehicle mobility infrastructures priorities should be established to calm streets, make them more complete or fully walkable, and greener (promoting biodiversity)..

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *3.2.A.1.8 (% of parking places off the road)*; 3.2.B.1.3 (interconnectivity between modes); *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.2.B.1.3 (interconnectivity between modes); 3.2.B.1.5 (# of species of urban trees); *3.2.B.2.15 (number of 2-wheeled motorized vehicles per capita); 3.2.B.2.16 (km of cycling lanes per 100K population)*; *3.2.B.2.18 (annual number of trees* planted per 100k population); 3.3.A.1.4 (accessibility of public space); 3.3.A.1.5 (# street trees / km urban road); 3.3.A.1.6 (surface of pedestrian priority streets); 4.1.A.1.5 (% of population with alternative public transport choices); 4.1.A.1.6 (avg. daily traffic jams/hr).

Actions Described in Livable Districts Document:

Action Domains 4 (Public and Common Spaces), 5 (Mobility), 6 (Green Spaces), 7 (Metabolism) and 10 (Governance)

1. City planning to ensure a reasonable number and total surface area of livable public spaces with a good balance between built and open space.
2. Develop an integrated urban mobility plan that reduces the need for private motorized transport and converts most of open spaces into public spaces.
3. Adapt public transportation to the urban morphology to increase its use and reduce time of travel between all district functions.
4. Promote environmental health to protect and regenerate all species in the city habitat.

5. Increase biodiversity and quality in the nature infrastructure and promote productive agricultural land and forestry.
6. Develop a plan to maintain all physical factors in the city habitat (soil, moisture, etc.).
7. Consider aesthetic quality in designing green infrastructure.
8. Promote responsible consumption and lifestyle.
9. Integrate policymaking with service delivery.

2.1.5 Synergistic with land use & planning policies that encourage density of residential and business uses, and helps resolve the "last mile" conundrum.

Sustainable Mobility fosters approaches to land use planning that respond to a new emphasis on a more multi-modal, transit centric transportation system. This begins with traditional "transit oriented development," expands to include Mobility Hubs that are designed to offer meaningful mobility choices and real-time information, and ends-up by calming streets and adopting pedestrianization in urban transformation.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.2.B.1.3 (interconnectivity between modes); *3.2.B.2.16 (km of cycling lanes per 100K population)*; 3.3.A.1.2 (neighborhood homogeneity/proximity to services); 3.3.A.1.4 (accessibility of public space); 3.3.A.1.7 (density housing); 3.3.A.1.8 (size of mixed use development in a city); 4.1.A.1.2 (office space density); 4.1.A.1.3 (proximity to convenience shopping); 4.1.A.1.5 (% of population with alternative public transport choices)*;4.1.B.2.6 (% of commuters using a transport mode other than personal vehicle)*; 4.2.A.1.6 (# of new companies per 100k population per year); 5.1.A.1.6 (% of SMEs); 5.1.A.1.7 (average # of workers per company).

Actions Described in Livable Districts Document:

Action Domains 3 (Urbanization & Land Use), 5 (Mobility), 7 (Metabolism) and 10 (Governance)

1. Optimize the use of land with urban planning initiatives and regulations that

prioritize l high-density urban housing; absolute compactness; proximity of services.
2. Facilitate connectivity between well-distributed built public spaces and also natural spaces.
3. Move towards a more competitive resource-efficient economy (*i.e.*, circular economy).
4. Integrate policymaking with service delivery.

Specific Target Actions for Cities to Consider Under These Proposed Actions:

1. Accessibility to affordable, reliable, convenient public transportation.
   * Availability of a functional multi-modal transportation system.
   * Proximity of citizens to public transportation networks.
   * Accessibility to all regardless of physical impediments or age.
   * Development of Mobility Hubs that offer “last mile” multi-modal connectivity.
2. Availability of human powered modes of transport (cycling, walking).
   * Proximity of bike rental & parking spots.
   * Separated cycling lanes that provide maximum safety for cyclists & pedestrians.
3. Prioritization of low-emission vehicle with recharging or tax-related benefits.
4. Assessment and regulation of micro-transit alternatives.
5. Exploration & implementation of Bus Rapid Transit.
6. Provide ICT services to efficiently manage and enhance all actions supporting the performance of economy, services and urban metabolism.
7. Ensure a high level of interaction among people.
8. Support end-use access to ICT and mobility apps, especially those aimed at vulnerable populations.
9. Follow the cyclic methodology depicted below to achieve Sustainable Mobility.

2.2 A Sustainable Mobility System is Agile & Resilient.

Agile & Resilient means –

2.2.1 Responsive to changing demographics and mobility preferences.

This means, among other things, providing people with public transportation and private sector micro transit options that are coordinated in order to ensure maximum customer convenience and affordability. Such coordination will require an agile and fair regulatory framework that responds to new and emerging business models and paradigms, and that treats all modes as connected parts of a mobility ecosystem (as opposed to a balkanized system where public and private sector systems remain disconnected from one another).

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.2.B.1.3 (interconnectivity between modes); 3.3.A.1.2 (neighborhood homogeneity/proximity to services); 3.3.A.1.4 (accessibility of public space); 3.3.A.1.6 (surface of pedestrian priority streets); 3.3.A.1.7 (density housing); 3.3.A.1.8 (size of mixed use development in a city); 3.3.B.1.1 (building compactness); 4.1.A.1.2 (office space density); 4.1.A.1.3 (proximity to convenience shopping); 4.1.A.1.5 (% of population with alternative public transport choices); *4.1.B.2.6 (% of commuters using a transport mode other*

than personal vehicle); 4.2.A.1.6 (# of new companies per 100k population per year); 5.1.A.1.6 (% of SMEs); 5.1.A.1.7 (average # of workers per company).

Actions Described in Livable Districts Document:

Action Domains 1 (Context), 7 (Metabolism), 9 (Social Cohesion), & 10 (Governance)

1. Work towards ensuring that the built domain facilitates safe living environments with access to land, shelter and services to cover basic human needs.
2. Move towards a more competitive resource-efficient economy (*i.e.*, circular economy).
3. Involve citizens in identifying opportunities for change.
4. Coordinate within a cross-discipline approach, enhancing collaboration and reducing risk of failed or ineffective communications that are critical to success.
5. Integrate policy making with service delivery.

2.2.2 A well maintained transportation system.

This means a system that is maintained through (1) an intelligent, instrumented asset management system, and (2) an appropriately funded routine and programmed maintenance protocol. This last point is critically important. The “secret sauce” of many successful independent public authorities and Public Private Partnerships is the requirement (under trust agreements or contracts) that an ample maintenance fund be reserved and available for use in routine and programmed maintenance.

Measuring status quo & performance:

Anatomy Indicators: 3.2.A.1.3 (fiber optic coverage); 4.4.A.1.1 (open sensors platform); 4.4.B.1.3 (quality of the datasets).

Actions Described in Livable Districts Document:

Action Domains 2 (Complex and Adaptive) and 8 (ICT Enabled)

1. Update mobility infrastructures to increase spatial and functional street

continuity.

2.2.3 Able to keep pace w/innovation via open platforms.

Sustainable Mobility requires that the public sector establish procurement processes that put an end to "hardware and software lock" – the frequent outcome of traditional "low bid" procurement processes. A Sustainable system is one that is agile and relatively low cost. This requires solutions that are more software based (rather than hardware based), and it requires solutions that are not so customized that they place the public sector at the mercy of one vendor.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: 3.2.A.1.1 (number of 3G/4G connections per 100k population); 3.2.A.1.2 (public space Wi-Fi coverage); 3.2.A.1.3 (fiber optic coverage); *3.2.A.2.1 (# internet connections per 100k population); 3.2.A.2.2 (# cell phone connections per 100k population)*; 4.4.A.1.1 (open sensors platform); 4.4.A.1.2 (city app availability); 4.4.B.1.1 (publicly available apps using open data); 4.4.B.1.2 (# of apps used by private citizens monthly).

Actions Described in Livable Districts Document:

Action Domain 8 (ICT Enabled)

1. Implement and manage a diversified communications infrastructure to assure multiplatform, multi-modal and multi-object connectivity.
2. Ensure transparent and efficient flow of information emanating from any content and format obtained from sensors, data analytics, apps, etc.
3. Provide ICT services to efficiently manage and enhance delivery of city services.
4. Support end-user access to ICT and apps, especially of vulnerable populations.

2.3 A Sustainable Mobility System is Egalitarian.

Egalitarian means –

2.3.1 Accessible/Convenient.

This means, among other things: (i) **enabling** people to have access to some form of public transportation (bus, trolley, subway) within a half mile of their

place of work and their primary residence; (ii) **providing** transit services on schedules that respond to customer needs, overlaying a traditional fixed route system with a more agile and responsive approach to determining origins and destinations based upon data-driven analytics; and (iii) **deploying** an effective network of public transportation where approximately one third of occupancy uses interchanging nodes and hubs that assure proper accessibility and service coverage time-wise and neighborhood-wise.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *3.2.A.2.19 (km of light passenger rail per 100k population); 3.2.A.2.21 (km of high capacity rail per 100k population)*; 3.3.A.1.2 (neighborhood homogeneity/proximity to services); 3.3.A.1.4 (accessibility of public space); 3.3.A.1.6 (surface of pedestrian priority streets); 3.3.A.1.7 (density housing); 3.3.A.1.8 (size of mixed use development in a city); 3.3.B.1.1 (building compactness); 4.1.A.1.2 (office space density); 4.1.A.1.3 (proximity to convenience shopping); 4.1.A.1.5 (% of population with alternative public transport choices); *4.1.B.2.6 (% of commuters using a transport mode other than personal vehicle)*; 4.2.A.1.6 (# of new companies per 100k population per year); 5.1.A.1.6 (% of SMEs); 5.1.A.1.7 (average # of workers per company).

Actions Described in Livable Districts Document:

Action Domain 5 (Mobility) and 7 (Metabolism)

2.3.2 Affordable.

An affordable transportation system is one that provides services at a fair cost to customers, that neither prices low income people out nor pushes higher income people to alternative unregulated micro transit alternatives.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *4.1.B.2.6 (% of commuters using a transport mode other than personal vehicle*); 4.2.A.1.2 (% of employed population); *4.2.A.2.1 (% of population in poverty)*.

Actions Described in Livable Districts Document:

Action Domain 9: Social Cohesion

1. Work towards ensuring that the built domain facilitates safe living environments with access to land, shelter and services to cover basic human needs.
2. Leverage technology to improve and sustain social equity.
3. Ensure affordable housing and health care with access to services and public facilities.

2.3.2 Equitable.

An equitable transportation system is based on funding equity, where all modes receive a fair allocation of funding resources, and where generally equal opportunities for affordable mobility are available to residents across neighborhoods and districts.

Measuring status quo & performance:

Anatomy Indicators/*ISO Indicators*: *4.1.B.2.6 (% of commuters using a transport mode other than personal vehicle)*; 4.2.A.1.2 (% of employed population); *4.2.A.2.1 (% of population in poverty)*.

Actions Described in Livable Districts Document: See Actions described above.

3. Concluding Remarks

The proposed definition of Sustainable Mobility can be considered as an integrated set of components that interact with one another. For example, it includes and encompasses

(i) Service delivery components: mobility systems that provide safe, affordable, convenient travel from origin to destination; **(ii) Quality of Life/Impact components**: mobility systems that (a) do not degrade air quality; (b) support and facilitate land use consistent with environmental and economic imperatives; (c) reduce congestion and delay and therefore are mindful of the “cost of time”; (d) provide the largest number of people with the highest level of service without diminishing the quality of life or negative impacts to any single individual or group (employing pareto optimality); and (e) support existing jobs and jobs growth; and **(iii) Cost Components**: affordability; resilience.

4. Copyright Statement

Co-chairs: Technical Steering Committee

Author: J. Aloisi

Contributions: R. Rallo, F. Giralt, and chairs, co-chairs and contributors of the CPAs City Anatomy, Anatomy Indicators and Anatomy Ontology.