CENTRE for LiveableCities SINGAPORE

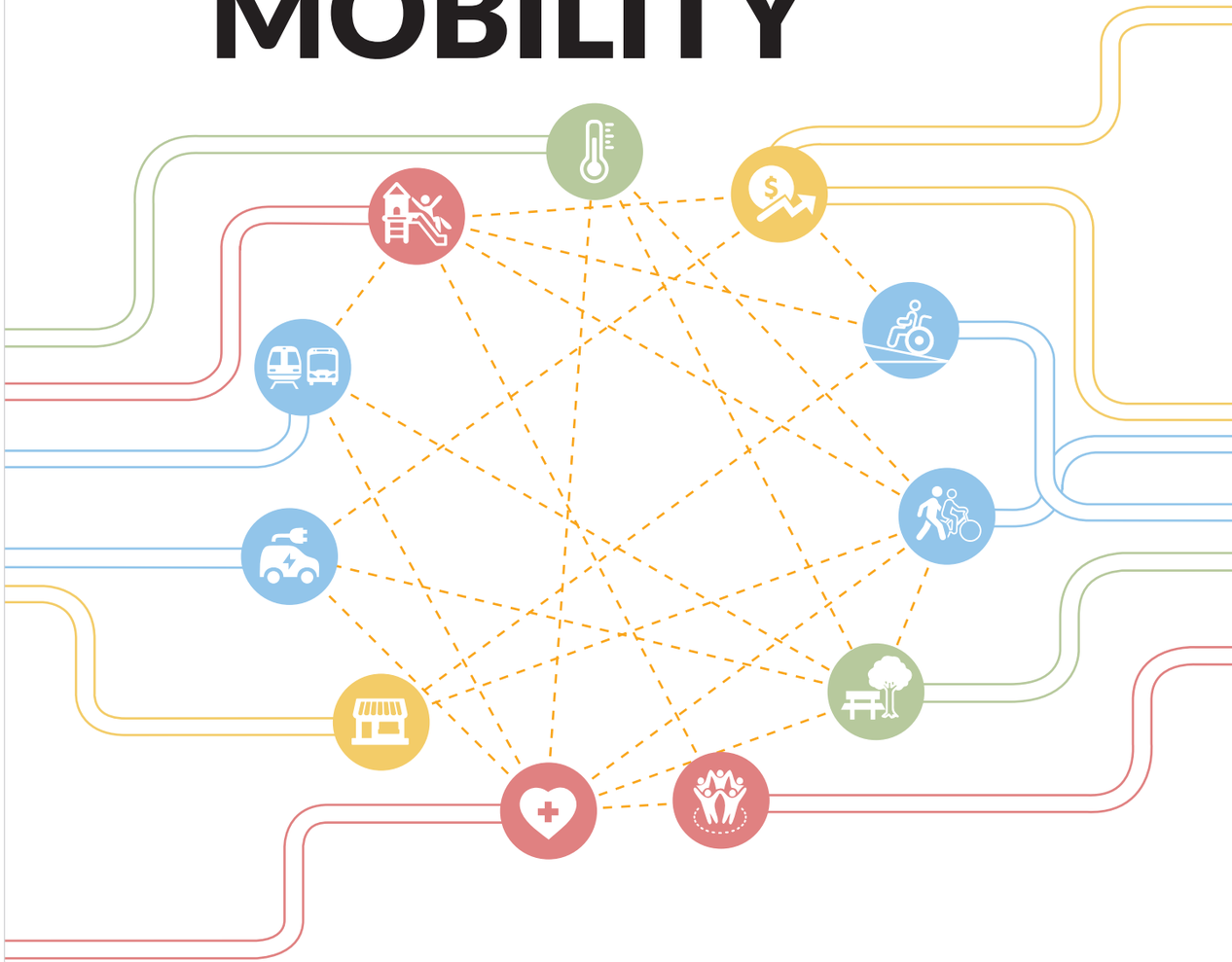
cenit Science for Transport
An Innovation Unit of CIMNE

A CROSS-DOMAIN APPROACH TO **SUSTAINABLE MOBILITY**

CREATING LIVEABLE CITIES

CREATING LIVEABLE CITIES

A CROSS-DOMAIN APPROACH TO **SUSTAINABLE MOBILITY**



Project Team

Writers	:	Harini Ravichandran, Zhiyi Teo
Research Supervisors	:	Limin Hee, Shawn Tan
Research Collaborators	:	Sergi Saurí Marchán, Francesc Gasparín Casajust, Samra Sarwar, Alex Mumbrú Camprubí, Mulia Andreas Pasaribu
Editor	:	Ada Davis
Design and Production	:	Redbean De Pte Ltd

CENTRE for LiveableCities SINGAPORE

CLC is a division of MND SINGAPORE

Set up in 2008 by the Ministry of National Development and the then Ministry of the Environment and Water Resources, the Centre for Liveable Cities (CLC) has as its mission "to distil, create and share knowledge on liveable and sustainable cities". The CLC's work spans four main areas—Research, Capability Development, Knowledge Platforms, and Advisory. Through these activities, the CLC hopes to provide urban leaders and practitioners with the knowledge and support needed to make our cities better. For more information, please visit www.clc.gov.sg.

For enquiries, please contact:
The Centre for Liveable Cities
T : +65 6645 9576
E : MND_CLC_Enquiries@mnd.gov.sg

ISBN 978-981-94-4008-5 (e-version)

CREATING LIVEABLE CITIES

A CROSS-DOMAIN APPROACH TO **SUSTAINABLE MOBILITY**

CONTENTS

FOREWORD

Hugh Lim
Executive Director,
Centre for Liveable Cities

Cities in the 21st century will see a transformation in how we move, as more people move into urban areas. At the same time, momentum to decarbonise will continue to grow, along with a greater expectation by urban residents to have access to nature, and opportunities to enhance their health and well-being. Sustainable mobility needs to be recognised as a key strategy for creating more liveable communities. With land transport responsible for over 70% of global transport emissions,[1] reimagining how we get around can drive profound changes in our cities.

The Liveability Framework developed by the Centre for Liveable Cities (CLC) serves as a useful reference for cities to examine the impact of sustainable mobility on the liveability outcomes of a competitive economy, sustainable environment and high quality of life. As a concept, sustainable mobility goes beyond reducing carbon emissions. It embodies a holistic approach to urban planning which, if done well, can foster economic vibrancy, create more equitable and inclusive cities, and bring about a higher quality of life for all.

We need to embrace a more systems-driven understanding of mobility strategies and their externalities. In this regard, applying a cross-domain approach and having a framework that can holistically evaluate the benefits and costs of sustainable mobility interventions can accelerate these transitions.

Sustainable mobility needs to be recognised as a key strategy for creating more liveable communities. With land transport responsible for over 70% of global transport emissions, reimagining how we get around can drive profound changes in our cities.

The CLC and Center for Innovation in Transport in Barcelona have jointly developed a cross-domain framework to help capture, quantify and communicate the holistic benefits of sustainable mobility projects. In doing so, we hope to facilitate integrated decision-making processes and provide a platform for stakeholder engagement. This e-publication presents our research findings and examines how cities such as Singapore, Vienna, Barcelona and London have taken a cross-domain approach in their mobility interventions. From enhancing public transportation and reclaiming roads for active mobility, to integrating green infrastructure and adopting data-backed solutions, these cities' experiences provide valuable insights for policymakers and urban planners who are charting pathways ahead.

As cities confront intertwined urban challenges and shifting mobility needs, this framework offers a timely and structured way to ask more informed questions, uncover unexpected impacts, and help balance competing priorities. We hope that the framework will serve as a practical reference for city leaders, planners and researchers seeking to drive mobility strategies that are not only sustainable, but meaningfully aligned with the kind of cities we aspire to build. I wish you an enjoyable read.

From enhancing public transportation and reclaiming roads for active mobility, to integrating green infrastructure and adopting data-backed solutions, these cities' experiences provide valuable insights for policymakers and urban planners who are charting pathways ahead.

FOREWORD

Sergi Saurí Marchán
Director,
Center for Innovation in Transport

When researchers from the Centre for Liveable Cities and Center for Innovation in Transport set out on this project, they aimed to answer a crucial question: how can we evaluate sustainable mobility initiatives in ways that better inform policy and investment decisions, and in turn, drive more decisive and lasting shifts in travel behaviour? This publication marks the culmination of that journey—but it is also only the beginning. The experiences of the cities featured illustrate the power of cross-domain thinking in action, and how such thinking can reveal benefits, trade-offs and opportunities to drive meaningful change. They show that when mobility is treated as a lever for wider urban transformation, cities can achieve outcomes that are greater than the sum of their parts.

The experiences of the cities featured illustrate the power of cross-domain thinking in action, and how such thinking can reveal benefits, trade-offs and opportunities to drive meaningful change.

At its core, this publication introduces a multi-criteria analysis framework that considers and quantifies intangible indicators, as well as a set of methodologies that can be used together to holistically assess sustainable mobility initiatives. While this approach is useful in evaluating complex urban mobility interventions, its real value lies in its translatability.

Despite the focus of this publication on sustainable mobility, the framework can in fact be applied in other urban planning and policy domains. Whether assessing green infrastructure implementation, or evaluating urban rejuvenation projects and climate resilience strategies, the ability of the framework to account for economic, social, environmental and health dimensions provides a robust approach for holistic planning and stakeholder engagement. As this framework is applied across diverse areas, it can also uncover new insights to help drive more integrated and effective urban development.

Our work underscores the importance of understanding local conditions to develop context-specific solutions. We must also value interdisciplinary collaborations and be deliberate in bringing together experts from various fields to tackle cross-domain issues through partnerships. We encourage you to explore applying this framework to an emerging challenge in your field, then test and adapt it towards solutioning.

As we face pressing global issues such as public health crises, climate change and social inequities, the need for evidence-based and holistic approaches to urban development has never been greater. The framework presented here represents a step forward to reshape not only how we move, but how we live, work and thrive in our cities. Let us move forth with curiosity, rigour and in partnership with one another.

As we face pressing global issues such as public health crises, climate change and social inequities, the need for evidence-based and holistic approaches to urban development has never been greater.

Photo courtesy of joyt / Adobe Stock

01

INTRODUCTION

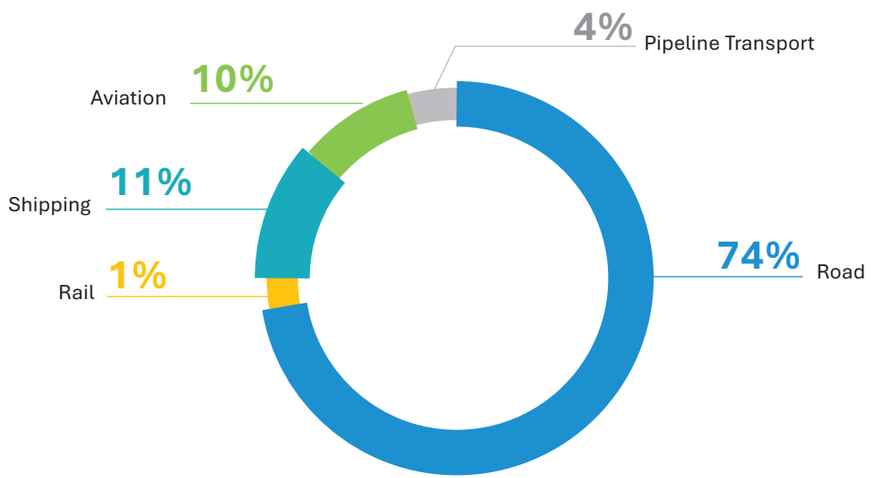
Sustainable urban mobility is key to tackling many of the challenges facing cities today—from climate change to health risks and social inequities. By shifting from car-centric planning to people-focused design, cities can cut emissions while boosting equity, well-being and economic vitality.

Cities today are confronted with increasingly complex challenges that are deeply interconnected, requiring more nuanced solutions than before. Issues such as climate change, public health crises, air pollution and ageing populations are not isolated; rather, they are part of a broader system and their impacts on one area reverberate across others.

In the face of these multifaceted challenges, the concept of sustainable urban mobility has emerged as a critical priority for cities worldwide. Sustainable transport solutions that minimise environmental impacts and enhance social equity have become a necessity for cities dedicated to ensuring long-term liveability and resilience.

According to the International Energy Agency (IEA), in 2022, the transport sector accounted for roughly 25% of global carbon dioxide (CO_2) emissions,[2] with land transport alone contributing approximately 75% of this total.[3] This highlights a pressing need for change in the way of thinking about urban mobility.

For decades, cities designed and prioritised land transport infrastructure around ensuring efficient traffic flow for motor vehicles, in turn influencing the allocation of space for public transport, cycling and walking. This approach has not only exacerbated environmental degradation but has also contributed to worsening quality of life in many urban environments.



Carbon emissions generated from the transport sector in 2022.[4]

Given the significant contribution of transport to global emissions, the transition to sustainable mobility must be a cornerstone of any urban climate action strategy. The urgency of this transition is clear.

Sustainable mobility is not just about cutting emissions—it encompasses a broader set of goals. These include promoting social inclusivity, improving public health, fostering economic vibrancy, and ensuring that mobility systems are resilient in the face of future challenges such as population growth and technological advancements.

What is Sustainable Mobility?

Sustainable mobility refers to transport systems that enable people to move efficiently, safely and inclusively while minimising negative impacts on the environment, public health and social equity. It calls for a shift away from car-centric planning towards people-centred design that supports more compact, connected and human-friendly urban environments.*

This reflects a broader rethinking of transport as a means to achieve better societal outcomes, where walking, cycling and public transport are not only viable, but attractive and safe choices for everyday trips. This means designing streets that are not just meant to accommodate private motorised vehicles, but also serve as public spaces for interaction, play and community life.

Many cities are embedding this broader view into their mobility strategies. For example, Singapore's Land Transport Master Plan, Barcelona's Urban Mobility Plans, London Mayor's Transport Strategy and Vienna's Urban Development Plan (STEP 2025) reflect a holistic approach to urban mobility planning, aiming to create efficient, sustainable and inclusive transport systems that cater to the diverse needs of urban populations while addressing environmental and societal challenges.

Despite this growing momentum, the path to sustainable mobility is not without its challenges. Many cities continue to face political, institutional and social barriers. Existing frameworks for planning and evaluation are often too narrow to capture its full range of benefits, or may not account for local context and evolving community needs. To accelerate change, cities need tools that can help them see the bigger picture—tools that reveal the links between mobility and liveability, make co-benefits visible and measurable, and support more integrated decision-making.

* The scope of this publication focuses primarily on the movement of people and examines how sustainable mobility can unlock cross-domain outcomes.

The Need for Integrated Urban Solutions

To achieve truly sustainable urban solutions, cities must move beyond conventional planning approaches to embrace more integrated strategies that consider not just transportation, but also other interrelated urban systems such as housing, energy and public health. Addressing transportation in isolation neglects the complex ways in which these systems interact with one another, often leading to ineffective or fragmented solutions. Instead, cities need cross-sectoral strategies that consider these interdependencies to create long-lasting and meaningful change. One strategy is to integrate land use and transport planning. By designing walkable and mixed-use neighbourhoods, cities can bring live, work and play opportunities closer to each other, enabling residents to access amenities on foot or by bicycle and reducing the need for car dependency. This can be further supported by repurposing roads into public spaces, prioritising pedestrian-friendly environments for enhanced safety, expanding cycling networks, and densifying public transport infrastructure.

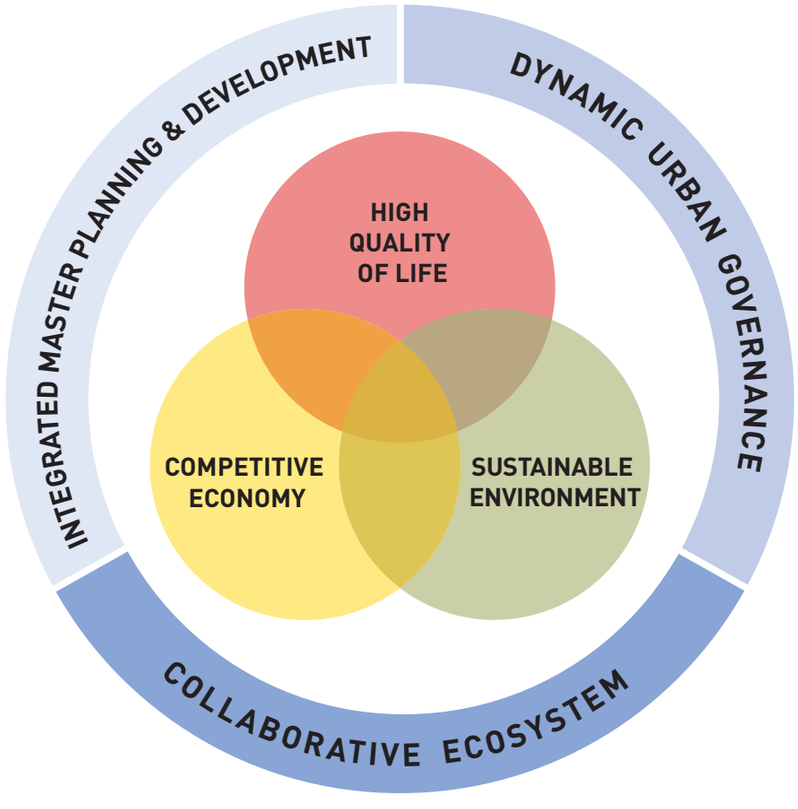
These approaches not only improve air quality, but can lead to additional benefits such as improved physical and mental well-being, and more vibrant public spaces. The strength of integrated solutions lies in their ability to address multiple challenges simultaneously. Expanding cycling networks or pedestrian-friendly streets, for instance, helps mitigate congestion while fostering healthier lifestyles. Such solutions make cities more inclusive, ensuring that all residents have access to safe, efficient and sustainable transport options.

To guide this process, the Liveability Framework (LF) developed by the Centre for Liveable Cities offers a holistic lens to look at liveability outcomes as well as the systems required to achieve these outcomes. The LF focuses on balancing three liveability outcomes—a high quality of life, a competitive economy and a sustainable environment—which are supported by integrated planning, dynamic urban governance and a collaborative ecosystem.

The intersection of the liveability outcomes provides a cross-domain lens for shaping urban interventions that prioritise the holistic well-being of a city. Active mobility modes and public transportation play a crucial role in reducing carbon emissions, which aligns with broader environmental objectives. These interventions not only improve residents' quality of life, they ensure accessibility for everyone, including those in disadvantaged communities, thus promoting social equity and fostering a sense of cohesion.

Well-designed mobility systems can invigorate local economies by increasing foot traffic and reducing commute times, which, in turn, boost productivity and economic vibrancy. Furthermore, the thoughtful integration of green spaces and public areas within mobility projects can enhance physical spaces and enrich community life.

By adopting this multi-dimensional approach, cities can design mobility systems that do far more than move people efficiently; they can shape environments that are equitable, resilient and adaptable to future challenges.



The Liveability Framework.
Image from Centre for Liveable Cities

Measuring the Wider Benefits of Sustainable Mobility

To better understand the wide-ranging benefits of sustainable mobility interventions, it is essential to first review existing transport planning frameworks. This allows cities to identify gaps and adopt new ways of thinking that fully reflect the broader benefits and values of integrated mobility solutions.

A key step in this process is expanding the frameworks used in urban planning. Engaging a diverse range of stakeholders—city planners, policymakers, citizens and the private sector—is essential for developing a better sense of what to place where, and how to connect the pieces, while understanding the benefits to different stakeholders. This will help shift the focus from transportation-centric spaces to those that foster the achievement of cross-domain outcomes.

Integrating data and insights from multiple disciplines can demonstrate how every decision-making layer plays a role in shaping urban spaces and how their actions are interconnected. This comprehensive approach allows for a rethinking of the way urban environments are evaluated, and builds a more holistic understanding of how they can be transformed to serve a wider range of societal goals.

The following chapters delve into the challenges that cities face in their transition towards sustainable mobility, and share key insights and best practices from selected city case studies. This publication also presents a framework that supports a cross-domain approach to sustainable mobility, and suggests potential applications for this approach across other domains.

Cities need new ways of thinking that fully reflect the broader benefits and values of integrated mobility solutions.

Photo courtesy of f11photo / Adobe Stock

Photo courtesy of Adobe Stock

02

BARRIERS TO SUSTAINABLE MOBILITY

Sustainable mobility is not just about adding new infrastructure—it is about reshaping systems, shifting mindsets and challenging decades of car-centric planning. Understanding the roadblocks that exist to building more sustainable urban mobility systems is the first step towards achieving them.

Cities around the world vary widely in their capacity to transition towards sustainable mobility. While some cities benefit from compact urban forms and well-established public transport systems, others face deeply embedded car-dependence which is reinforced by social norms—despite growing environmental pressures to make the transition. The path forward can also be blocked by interconnected hurdles such as coordinating between bureaucratic layers, behavioural resistance, a lack of holistic understanding about the benefits of sustainable mobility, and uncertainties over when and how to implement policies. These can be more pronounced in cities with established car-centric infrastructure and ingrained travel behaviours, demanding a fundamental rethinking of how cities move people and allocate space.

There are six clear barriers standing in the way of the transition towards sustainable mobility, which are presented over the following pages.

Some of the challenges can be more pronounced in cities with established car-centric infrastructure and ingrained travel behaviours.

Photo courtesy of Creativa Images / Adobe Stock

1 Complexities in Coordinating Multi-Level Governance

Urban mobility challenges span multiple domains—from transport and land use to environment and public health—requiring coordinated action across various government agencies. The inherently cross-domain nature of urban mobility issues demands integrated planning and implementation approaches, but breaking down administrative silos and fostering collaboration can be a challenge.

Coordination Across Governance Levels

Urban governance operates on different levels—local, regional and national—each with varying degrees of authority and responsibility. This multi-level structure requires systemic coordination and alignment across all levels to ensure that polices are integrated and implemented effectively. However, given that strategic priorities often vary both across and within the different layers of governance, cities may experience difficulties in translating solutions into actionable plans.

For example, Hong Kong's Mass Transit Railway Corporation encountered delays and cost issues when constructing two railway links that cut across dense neighbourhoods, largely due to the project's complex bureaucratic requirements.[5] The need to coordinate with at least 12 different government departments created substantial challenges, prompting recommendations for a single point of contact to streamline decision-making and improve coordination efficiency.[6] This highlights the cross-domain nature of urban mobility, and the importance of coordination within and across the levels of governance to deliver effective solutions.

Complexities in Resource Allocation

The complexity of multi-level governance also presents challenges in resource allocation decisions, where national funding frameworks can inadvertently limit the implementation of sustainable mobility policies at the regional or local level.

For instance, one study comprising insights from all governance levels in the Netherlands showed that while each city's mobility landscape is determined at the local level together with its stakeholders, funding for mobility initiatives is provided at the national level.[7] The study observed that funding typically went to developing road infrastructure to improve vehicular flow—a priority of the national government—resulting in limited funds being allocated for local initiatives that support sustainable mobility.[8] Differing priorities and targets across multiple levels of governance may therefore hinder the implementation of innovative and forward-thinking policies, thus influencing the success of cities' transitions towards sustainable mobility.

In Hong Kong, the Mass Transit Railway Corporation faced delays and cost issues due to complex bureaucratic requirements and coordination issues.
Photo courtesy of king Ho / Pexels

2 Barriers to Effective Stakeholder Engagement

Effective stakeholder engagement is key to developing mobility strategies that address end-user needs and support the transition to sustainable mobility. Stakeholder participation in policy formulation yields valuable insights for planning processes and initiatives implemented. Although cities are moving from top-down approaches towards more collaborative planning, barriers to effective stakeholder engagement remain. Identifying and addressing these challenges will help to ensure constructive engagement that results in the long-term success of policies and initiatives.

Balancing Stakeholder Participation

Cities face difficulties in balancing stakeholder participation, as over- or under-representation of different groups can lead to policy outcomes that do not align with overall strategic goals.[9] On the other hand, insufficient involvement from stakeholders can result in initiatives that fail to address the needs on the ground.

Having a participatory process was key to successful implementation of Superblock developments in Barcelona.
Photo courtesy of Ajuntament Barcelona (CC BY-NC-ND 2.0) / Flickr

For example, when the Superblock development in Poblenou, Barcelona, was first introduced, it was implemented in a piecemeal manner and lacked public participation during the planning process, resulting in community pushback.[10] The initiative received greater acceptance with subsequent Superblock developments, but only after efforts to increase stakeholder participation and co-creation were put in place to address concerns such as gentrification.[11] This shows that policymakers must balance the scope and depth of stakeholder participation to achieve both efficient implementation and community buy-in.

Information Gaps in Communication With Stakeholders

Clear communication about immediate and long-term benefits and costs of sustainable mobility can help to drive stakeholder buy-in. Often, there is an assumption that stakeholders have perfect information when making choices, enabling them to identify and choose the optimal option.[12] However, there may be gaps in public awareness about the true benefits and costs of interventions, which in turn impact the choices made by commuters and receptiveness of policies. Imperfect information, coupled with a lack of communication, may result in negative reactions and tensions on the ground when new initiatives are implemented.

For example, when London's congestion pricing scheme was introduced in 2003, public support was gained only through extensive stakeholder engagement and revisions to initial proposals. The initiative saw greater buy-in after 3 years, once measurable improvements were seen—traffic eased by 15% to 20%, congestion dropped by over 20% in central London, carbon emissions fell by 19% and minimal impacts were felt on peripheral traffic.[13] This example underscores the need for effective communication about the benefits of initiatives through public engagement, in order to achieve desired policy outcomes.

3 Limitations of Existing Assessment Tools

Evaluation is a key step in policy implementation—informing how cities allocate resources and funding, which projects scale, and how success is defined. Standardised transport evaluation practices, while well-established, tend to centre around travel efficiency and cost, struggling to capture the broader societal impacts of sustainable mobility projects. As cities pursue more holistic and long-term objectives around climate resilience, public health and social equity, a growing mismatch has emerged between what cities aim to achieve and what they are able to measure.[14]

Changing Priorities and Methodological Gaps

For decades, transport evaluation practices have focused on large-scale, capital-intensive infrastructure projects, shaping institutional capacity and methodological standards around these areas.[15] Widely used evaluation tools like cost-benefit analysis primarily focus on travel-time efficiency and movement of large volumes of people; as a result, they tend to prioritise time and cost efficiencies that align more closely with car-based travel—often undervaluing the benefits associated with walking, cycling and other sustainable mobility modes.[16]

Sustainable mobility projects are typically implemented on a smaller scale, with distributed interventions such as pedestrianisation schemes or cycling infrastructure that generate system-wide benefits beyond transport efficiency.[17,18] Current frameworks leave these interventions in a methodological gap, with new methods for capturing these broader impacts just beginning to emerge.[19] Many institutional frameworks also lack post-implementation evaluations, often due to resource constraints, which can limit understanding of actual project impacts and their alignment with initial expectations.[20]

Lack of Holistic Evaluation Processes

Standard assessments tend to treat non-mobility benefits as supplemental. Studies highlight disparities in how frequently such impacts are evaluated—health impacts tend to receive the most attention, followed by environmental impacts, while social benefits are rarely addressed.[21,22] Without standardised approaches for evaluating broader impacts, their consideration remains secondary rather than integral to evaluations.[23] This structural bias may limit cities' ability to understand trade-offs and make balanced investment decisions that reflect the full scope of intended outcomes from sustainable mobility.

Transport assessments that focus on vehicle capacity can perpetuate car-centric infrastructure, while overlooking liveability outcomes such as safety, comfort and vibrant public spaces.
Photo courtesy of Minesweeper (CC BY-SA 3.0) / Wikimedia Commons

4 Data Gaps in Mobility Planning

The ability of cities to monitor the impact of transportation strategies is crucial for ensuring their success. Measuring key indicators such as traffic flow, emissions levels, cycling rates and pedestrian activity can help cities understand what works and what needs adjustment. As transportation systems grow increasingly complex and interconnected, monitoring and data collection efforts must evolve accordingly. Residents' needs and behaviours also continue to change, making continuous monitoring essential for keeping mobility strategies responsive and enabling proactive, evidence-based planning.

Lack of Standardised Indicators and Challenges in Data Sharing

Sustainable mobility projects are often multi-modal, integrating active mobility and shared mobility with other transport modes to create synergistic benefits. However, with the lack of standardised indicators to monitor interconnected impacts, it is difficult to analyse how the different transportation modes compete with or complement one another.[24]

At the same time, monitoring holistic benefits requires tracking of non-mobility indicators, ideally with inputs from a range of stakeholders to capture the full breadth of project impacts.[25] Sometimes relevant data may already exist—collected by other government agencies or private sector organisations—but institutional barriers impede access and usage.[26,27] Privacy concerns and proprietary interests limit access to private sector data, while coordination gaps between government agencies may duplicate data collection efforts, and/or obscure potential synergies.

Cost and Resource Constraints

Monitoring efforts must also account for cost and resource constraints, which restrict the ability of cities to monitor key indicators. For most cities, monitoring of sustainable mobility projects still relies on resource-intensive data collection methods, such as manual surveys and household interviews. Advanced tools like sensors, GPS tracking and big data analytics, which could bridge this gap, are not always accessible to everyone.[28] Without closing this gap, cities may not be able to capture the full complexity and fast-changing dynamics of modern transport patterns.[29]

A bicycle traffic counter in Konstanz, Germany. Reliable data on active mobility remains uneven across many cities, creating gaps in how planning and investment decisions are made.

Photo courtesy of JoachimKohler-HB (CC BY-SA 4.0) / Wikimedia Commons

5 Infrastructural and System Limitations

The shift towards sustainable mobility requires both changes to physical infrastructure ('hardware') and reshaping commuting behaviour ('software'). While institutional, evaluative and behavioural challenges shape high-level policy decisions, many barriers are rooted in the everyday experience of navigating the city. Poorly integrated, outdated or exclusionary infrastructure can significantly weaken the impact of sustainable mobility interventions.

Infrastructure Limitations

In dense cities, the physical and structural limitations of ageing infrastructure pose significant challenges for sustainable mobility transitions. For instance, Japan's Shinkansen high-speed rail system is now confronting the pressures of ageing infrastructure amid growing passenger demand. Built decades ago to serve different urban conditions, the system's tunnels and viaducts require extensive maintenance and reinforcement, reflecting the broader dilemma that cities face—how to adapt ageing systems to meet the needs of expanding, evolving urban populations without major disruptions.[30]

Dense cities may also lack space for new infrastructure, requiring difficult trade-offs in prioritising road space for cycling, walking and buses. Retrofitting for active modes, bus priority or accessible infrastructure like ramps is complicated by physical constraints and competing uses such as parking, deliveries or ride-hailing zones. These trade-offs can be politically sensitive and socially contentious.[31]

System Friction and User Experience

Gaps in spatial coordination, unclear wayfinding, disconnected transfer points, and fragmented payment systems can deter users and diminish the appeal of multi-modal travel. These small frictions add up, creating psychological and logistical barriers to using sustainable mobility modes. Without deliberate design to improve legibility, ease transfers and prioritise user experience, sustainable mobility can remain technically available but practically out of reach.

6 Planning in Dynamic Environments

Sustainable mobility transitions unfold in highly variable and evolving urban environments. Cities differ not only in their starting points such as land use patterns, travel behaviours and infrastructure legacies, but also in how these factors interact with evolving urban needs, the political landscape and technological change. This may create uncertainty around how best to plan, implement and scale interventions.

The rapid rise of emerging mobility modes often outpaces planning and regulation, creating challenges in integrating them in urban environments not originally designed for their use.
Photo courtesy of Markus Spiske / Unsplash

Uncertainty Over When and How to Scale

Cities may need to carefully navigate the timing and scaling of sustainable mobility initiatives. While small pilots generate valuable insights, they may still face resistance for wider adoption. Implementation without phased rollouts or comprehensive public engagement can result in challenges that affect even well-designed plans.

In Tübingen, Germany, when the city proposed a new tram system to strengthen public transport and reduce car dependency to align with climate goals, the project was scaled quickly, without building broad-based consensus first. As a result, the plan was narrowly rejected in a public referendum, with concerns raised about costs, disruptions and lack of transparent engagement.[32] Such cases highlight that the success of ambitious interventions relies on strategic planning, trust and community alignment to deliver meaningful change. The timing of sustainable mobility interventions is also affected by political and public support. Policies like congestion pricing can be postponed or completely removed as a result of shifting goals, changing public sentiment or fiscal pressures influencing decisions.[33,34]

Lack of Readiness for Emerging Mobility Modes

The rise of emerging mobility modes, such as shared bicycles, personal mobility devices and e-scooters, offers opportunities to close service gaps, improve first- and last-mile connectivity, and reduce emissions, but also presents challenges, as planning and regulatory frameworks require time to adapt to new mobility systems. As a result, they may be deployed into environments not designed for their use, leading to operational inefficiencies, safety concerns and spatial conflicts with pedestrians, cyclists and public transport.[35,36] The effectiveness of emerging modes in enhancing accessibility, reducing car dependency and creating people-centric mobility systems depends on well-planned integration strategies.

OPINION

The Journey to Sustainable Mobility Requires All on Board

By Samuel Chng
Research Assistant Professor and Head, Urban Psychology Lab, Lee Kuan Yew Centre for Innovative Cities (at the Singapore University of Technology and Design)

Sharing of the 3P+ partnership to advocate for greater collaboration among stakeholders.
Photo courtesy of Jacky Ho

The shift towards sustainable mobility—whether through cycling, walking, electric vehicles or public transportation—offers benefits beyond reducing carbon emissions. Improved public health, reduced congestion, energy savings and enhanced social cohesion are among some of the under-recognised benefits. However, fully understanding these benefits requires the development of better measurement frameworks that make them more apparent. For instance, tools that can quantify the advantages of active mobility on health, and link these to reduced healthcare costs, or models that simulate how the electrification of mobility contributes to both cleaner air and reduced congestion, will help frame sustainable mobility as more than just an environmental issue.

To facilitate this, cities must focus on ensuring that their sustainable mobility initiatives and plans impact not only emissions but also areas like well-being, quality of life, productivity and the creation of new economic opportunities. When a comprehensive narrative demonstrates that sustainable mobility serves to benefit the people and planet while ensuring economic competitiveness, citizens, businesses and policymakers alike will be nudged towards making more sustainable mobility choices.

A 3P EFFORT IS NECESSARY

Making sustainable mobility a reality requires cooperation among the public, private and people (3P) sectors, each playing a distinct yet complementary role. In the public sector, governments must invest in infrastructure such as cycling lanes and public transportation networks, while simultaneously implementing policies that reduce car and fossil fuel dependency. This requires long-term planning and a strong will to implement policies that may not be popular but are necessary for the transition towards sustainable mobility.

When a comprehensive narrative demonstrates that sustainable mobility serves to benefit the people and planet while ensuring economic competitiveness, citizens, businesses and policymakers alike will be nudged towards making more sustainable mobility choices.

Private sector organisations can drive innovation through products and services such as the use of electric vehicles, bike- and ride-sharing systems, and autonomous vehicles. They can also promote the use of sustainable modes of transport among employees by offering public transport subsidies and facilitating remote work options that reduce the need for commutes.

The people sector plays a critical role in civic engagements to encourage buy-in for sustainable mobility. Advocacy groups championing causes that push for sustainable mobility can raise awareness and lend pressure for change. Grassroots champions can help normalise sustainable transportation modes to accelerate their uptake. Public participation and co-creation in planning and policymaking can ensure that introduced initiatives and changes meet community needs and are well-supported.

BUILDING A STRONGER 3P+ PARTNERSHIP

The reality is that cooperation between the 3P sectors may be lacking, and this impedes progress in adopting sustainable mobility. This calls for a 3P+ partnership—where academia is the plus. While academia is independent from all 3Ps, it is a valuable ally, as its responsibility is (and its legitimacy rests upon) the production of rigorous research and testing of solutions which can help make sustainable mobility a reality. Researchers can develop the frameworks and tools needed to provide data that informs government policymaking and private sector strategies. Likewise, researchers can develop technological innovations to refine sustainable mobility solutions. Furthermore, they are able to offer evidence-based insights for nudging individuals towards adopting sustainable mobility habits.

This calls for a 3P+ partnership—where academia is the plus. While academia is independent from all 3Ps, it is a valuable ally, as its responsibility is (and its legitimacy rests upon) the production of rigorous research and testing of solutions which can help make sustainable mobility a reality.

Around the world, challenges confronting the achievement of sustainable mobility differ. Some cities have a greater-than-average acceptance of public transport and active mobility, but face resistance in the transition to electric mobility and other clean technologies. Other cities may face more fundamental challenges, such as expanding basic public transport infrastructure. Nevertheless, in both scenarios, success depends on partnerships across sectors and an ability to recognise that sustainable mobility needs to holistically benefit the people and planet while ensuring economic feasibility. As we strive for greener cities globally, we must recognise all the benefits of sustainable mobility, and not simply address the technical aspects of mobility alone. Hence, a coordinated 3P+ approach that involves the public, private and people sectors working with academia can only accelerate the transition to sustainable mobility.

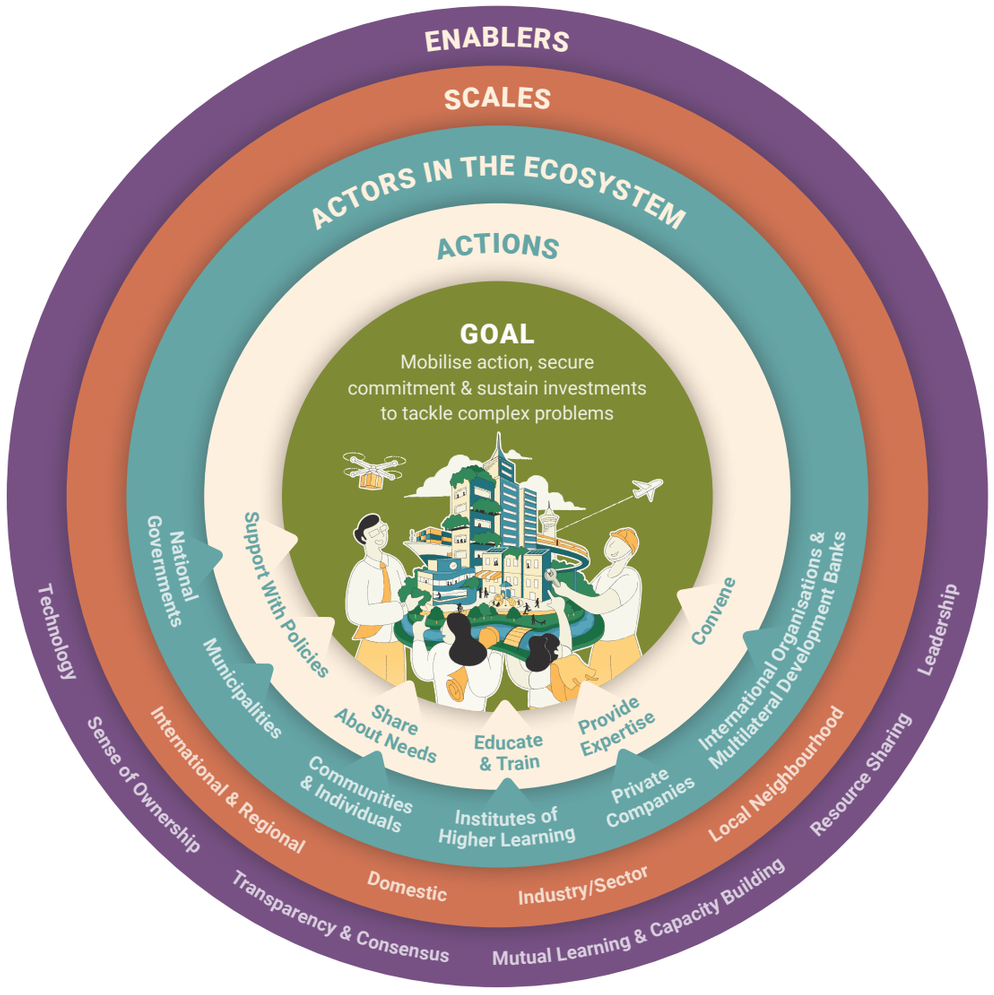
Charting the Path to Sustainable Mobility

Unpacking these challenges provides a foundation for understanding why a more integrated and adaptive approach is needed to achieve lasting progress, and offers opportunities for innovation, collaboration and transformation. By addressing these barriers head-on, cities can unlock new potential to create more liveable, resilient and equitable urban environments. Streamlining multi-level governance, for instance, can pave the way for more cohesive decision-making and resource allocation, ensuring that urban mobility projects are executed with efficiency and long-term vision.

Applying a systems approach to understand stakeholders and their roles can help break down engagement barriers, build trust and implement interventions that are tailored to local needs. This will, in turn, foster long-term success of the interventions. A deeper understanding of the stakeholder groups and local context will also enable policymakers to implement timely initiatives for the community.

Embracing holistic evaluation frameworks will allow cities to measure the full impact of mobility interventions—from understanding social and health outcomes better, to tracking progress towards environmental sustainability—and therefore provide clear justifications to prioritise and scale effective solutions. Data-driven approaches will support cities to make informed, evidence-based decisions that are responsive to changing local conditions. Finally, by adapting existing infrastructure to meet the needs of the current population, cities can enhance their day-to-day lived experience while encouraging shifts towards more sustainable travel behaviour.

Ultimately, with the right tools in place, cities can better adapt to these challenges to transform their transport systems into more sustainable ones that meet the evolving needs of residents.



A conceptual framework for applying a systems approach to capture the cross-sectoral and multi-scalar 'system' of urban partnerships.

Image from Centre for Liveable Cities

What Do Cities Need for a Smooth Transition to Sustainable Mobility?

COLLABORATIVE GOVERNANCE

To provide holistic solutions, cities should work towards:

- Fostering effective collaboration between local, regional and national authorities to build transport infrastructure that meets diverse community needs.
- Bridging gaps in governance to provide integrated solutions that support the transition to sustainable mobility.

EFFECTIVE STAKEHOLDER ENGAGEMENT

To build trust with stakeholders and facilitate buy-in, cities must:

- Establish stakeholder participation that is guided by a structured participation framework.
- Improve communication and raise awareness on both short- and long-term benefits of interventions.

EVOLVING MOBILITY ASSESSMENT TOOLS

To plan and implement integrated mobility solutions, cities need tools that can:

- Assess the broader impacts of mobility interventions.
- Allow planners to compare and weigh alternatives.
- Provide insights into solutions that maximise socio-economic and environmental benefits.

DATA-DRIVEN MOBILITY PLANNING

To develop future-ready transport systems, cities require:

- Integrated solutions for tracking key indicators and data sharing.
- Data-driven approaches to build trust, support shared goals and enable informed decision-making processes.

INFRASTRUCTURE TRANSFORMATION

To reimagine current infrastructure to improve the day-to-day lived experiences of residents, cities need:

- Holistic design approaches to reduce user friction while meeting diverse needs.
- Future-proofed and resilient infrastructure.

ADAPTIVE AND CONTEXT-SPECIFIC STRATEGIES

To navigate uncertainties during the transition to sustainable mobility, cities must gain:

- A nuanced understanding of local conditions to support context-specific planning.
- Flexible strategies that can adapt to local conditions.

Photo courtesy of kravka / Adobe Stock

03

A CROSS-DOMAIN APPROACH TO SUSTAINABLE MOBILITY

Sustainable mobility calls for a cross-domain approach that connects public health, the environment, economy and social equity. By embracing systems thinking, cities can uncover synergies, navigate trade-offs and measure broader impacts of sustainable mobility initiatives. This shift enables smarter decisions and stronger collaboration, aligning mobility with long-term liveability.

Many cities today recognise the need to design more inclusive, climate-resilient and people-centred mobility systems, but the tools used to evaluate these interventions often fall short. The benefits of sustainable mobility such as cleaner air, healthier lifestyles, safer streets and more vibrant communities are well recognised, but they are not always easily measured, compared or communicated.

Standard assessment methods tend to evaluate impacts within separate policy domains—transport agencies focus on speed and capacity; health departments track physical activity or disease burden; environmental regulators target emissions. This separation makes it difficult to understand how a single intervention, such as a reconfigured street or a car-lite neighbourhood, might generate multiple, overlapping benefits across different domains.

A cross-domain, evidence-based approach seeks to bridge the divides in typical planning and assessment approaches that treat urban systems in silo. It acknowledges the multiplier effect of interventions across different areas—for instance, a redesigned street can simultaneously reduce emissions, enhance community health, increase footfall to local businesses and strengthen social ties. By making interdependencies visible, this approach demonstrates shared value and supports a more adaptive, transparent and systems-oriented way of shaping mobility.

To help cities better articulate and assess these benefits, a research team from the Centre for Liveable Cities (CLC) and the Center for Innovation in Transport (CENIT) developed a cross-domain framework—one that draws on the Liveability Framework (LF) developed by the CLC, and combines systems thinking and practical experiences from cities, to make a stronger, evidence-based case for sustainable mobility.

A cross-domain lens encourages cities to view everyday mobility challenges in relation to wider needs such as safety, accessibility, and public space.
Photo courtesy of Tian Ying Lee

From Idea to Tool: The CLC-CENIT Research Process

Framing the Challenge

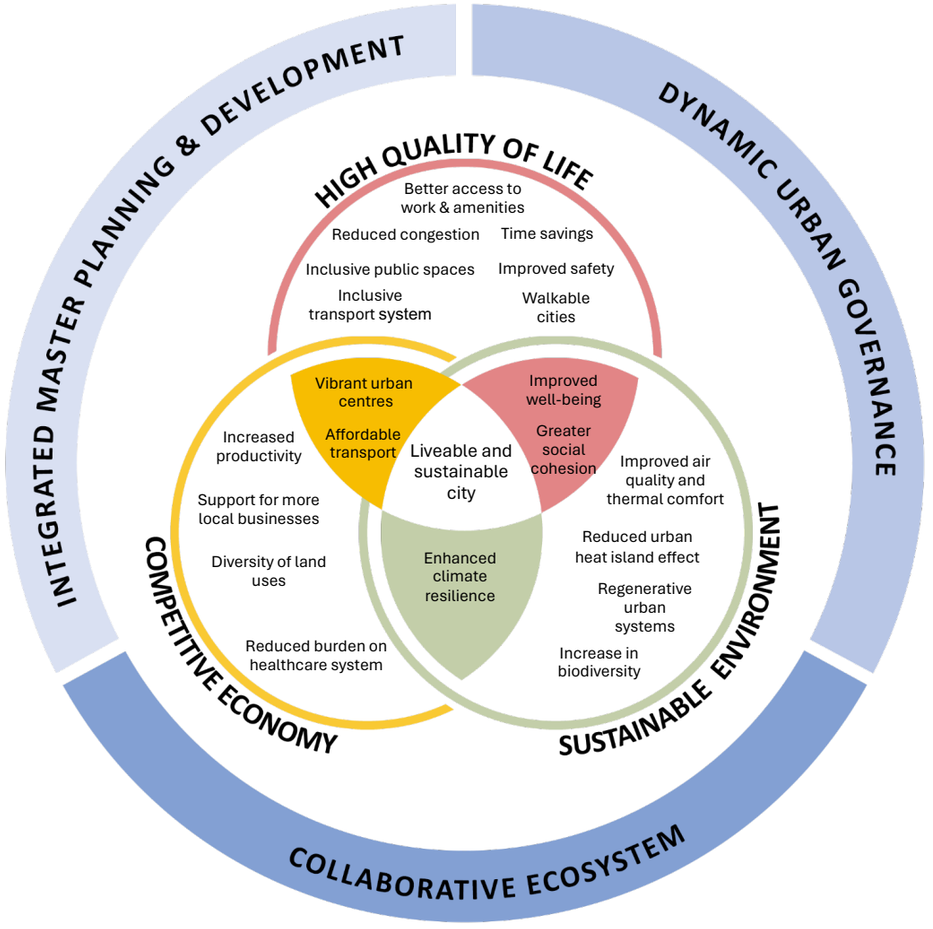
This project began with a straightforward but important question:

How can cities more effectively capture and communicate the full range of benefits delivered by sustainable mobility interventions—especially those that extend well beyond standard transport performance metrics?

Cities invest in cycling lanes, pedestrian-friendly streets or green corridors, but struggle to demonstrate how these interventions do more than just move people. They improve air quality, boost physical activity, make neighbourhoods more vibrant, attract footfall to local businesses and strengthen community ties. Yet these impacts often remain hidden or under-valued because they slip through the gaps of existing planning and evaluation frameworks.

Using the LF as a reference, the research team set out to understand what practical tools could help cities translate a systems perspective into real-world planning and decision-making. The team explored how cities could move from siloed evaluations towards a more integrated way of planning and assessing mobility solutions—one that reflects the complex systems thinking that the LF advocates.

To understand how cities are currently attempting to assess the cross-domain benefits of sustainable mobility and its broader impacts on health, environment, equity and liveability, the research team undertook a multi-stage process that combined a review of international frameworks and tools, as well as insights from practical case studies and diverse stakeholder perspectives. These approaches offer important lessons for cities looking to move beyond standard transport metrics.



The application of the LF to visualise the cross-domain benefits of sustainable mobility.
Image from Centre for Liveable Cities

Learning from Practice

To develop the framework, the team first examined how cities around the world are already attempting to capture the wider benefits of sustainable mobility. This began with a review of international planning frameworks and evaluation tools, which was complemented by insights from practical case studies. Together, these examples revealed how mobility initiatives can be assessed not only for their transport performance, but also for their broader, non-mobility impacts. In the United Kingdom (UK), for example, Transport for London's Healthy Streets Indicators have been used to evaluate street environments through a mix of user perceptions, health outcomes and active travel data. The tool measures indicators such as ease of crossing, shade, shelter and people's willingness to linger—translating liveability goals into tangible metrics.[37]

Other national-level frameworks have adopted composite indicators to benchmark performance across multiple domains. The European Commission's Sustainable Urban Mobility Indicators offer cities a structured set of metrics that link urban mobility with environmental quality, safety, affordability and quality of life—providing a common language for local policy appraisal under the Sustainable Urban Mobility Plan process.[38]

Before and after images of New York City's Union Square, where public spaces were introduced to enhance the economic vitality of the neighbourhood.
Photo courtesy of New York City Department of Transportation (CC BY-NC-ND 2.0) / Flickr

In New York City, the Measuring the Street framework marked a shift in how street redesigns were evaluated—moving beyond vehicle flow to include metrics like pedestrian volume, retail sales and safety outcomes. This helped demonstrate how many urban intervention projects delivered co-benefits across mobility, economy and public space use, influencing broader adoption of cross-domain evaluation in the United States and globally.[39]

Bikenomics offers a compelling example of how cost-benefit analysis (CBA) principles can be extended to capture the broader societal value of active mobility. Widely applied across European cities, this approach monetises not just infrastructure costs, but also the impacts on public health, emissions reduction and quality of life, providing a stronger economic case for investing in cycling infrastructure.[40]

In Utrecht, the Netherlands, Bikenomics played a pivotal role in justifying the reallocation of €30 million from a proposed car parking facility towards building the world's largest bicycle parking station, as it demonstrated that cycling costs were significantly lower than alternative transport modes. This has resulted in millions in government subsidy savings annually, and avoided substantial negative externalities associated with car travel[41]—illustrating how transport investments prioritising sustainability can deliver systemic benefits while supporting more fiscally responsible urban planning.

Copenhagen offers another instructive model. The city's long-running Bicycle Account serves as both a performance and satisfaction tracking tool. Published every two years, it combines hard data (e.g., cycling modal share, accident rates, network length) with resident surveys on perceived safety, comfort and infrastructure quality. This dual approach not only helps assess cycling progress, but also ensures that planning decisions are grounded in both technical performance and user experience.[42]

The Copenhagen cycle superhighway has helped to support and encourage modal shifts to cycling.
Photo courtesy of Lars Plougmann (CC BY-SA 2.0) / Flickr

Streetmeter, a prototype tool, offers a deliberately simple way to adjust and visualise basic street conditions around shared goals, fostering dialogue and collective learning rather than delivering ready-made solutions.[43] Community-led tools are also gaining traction. In cities like Sydney and London, StreetScore and PlaceScore collect residents' qualitative feedback on streetscape quality and use this to inform public realm interventions.[44,45] These platforms help surface outcomes often missed in standard evaluation models, such as sense of place, informal social interaction and perceived safety.

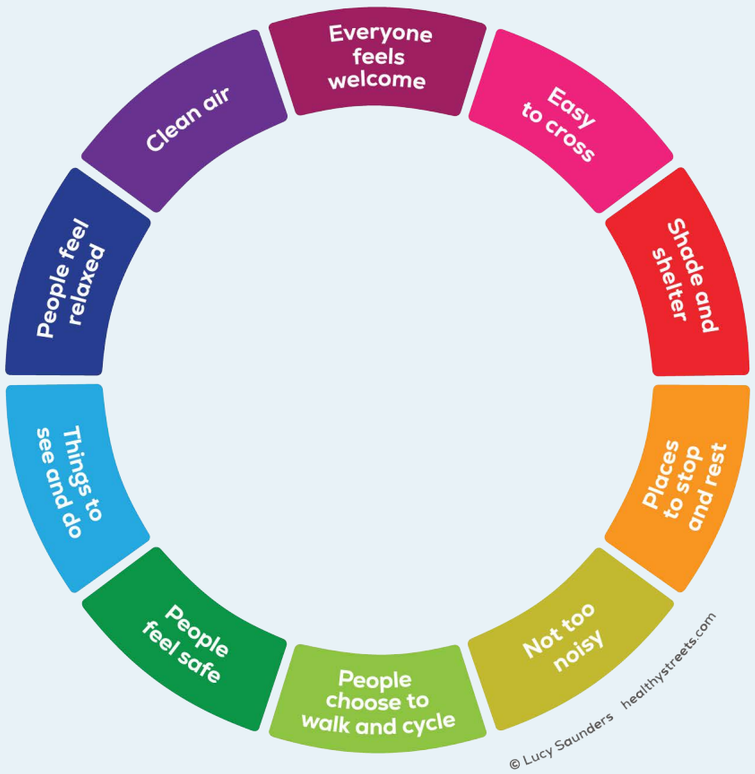
Taken together, these efforts reflect a growing global awareness that sustainable mobility must be assessed as part of an integrated urban system. They show how cities can capture the co-benefits of mobility, including improved health, climate resilience and social inclusion. At the same time, they highlight an opportunity to build on these efforts by developing a flexible yet structured methodology that can weave these diverse impacts into a unified decision-making tool.

OPINION

How Healthy Is Your Street?

By Lucy Saunders
Director,
Healthy Streets Ltd

While roads are seen primarily as corridors for moving cars, there is a growing understanding that the same is not true of streets, where people also need to walk, cycle and dwell. Spaces that are used by people must meet basic human needs such as being safe from injury, toxic air and harmful noise. This is not just for the protection of public health, but also because walking, cycling and dwelling in cities contributes to making them environmentally sustainable, socially vibrant and economically prosperous.



The 10 Healthy Streets Indicators describe important aspects of the human experience of being on streets that should be considered in the design and evaluation of a project.
Image courtesy of Healthy Streets

THE NEED FOR A COMPREHENSIVE FRAMEWORK

Until now, cities have not had the necessary framing and tools to systematically treat streets differently from roads. Every city has at least a few good examples of public spaces where attention has been paid to the needs of people, but few cities have put in place the means to ensure this is the default approach to all decisions about all streets.

The Healthy Streets Approach offers a comprehensive framework for making decisions on how streets are designed, managed and used. The premise of this approach is very simple—all streets, regardless of their position on the globe or their function in the transport network, must meet the needs of the human beings who inhabit them. The foundation of Healthy Streets is a set of 10 Indicators, each describing a basic human need (e.g., shade and shelter).

Of course, our basic needs change throughout our lives. For example, our need for places to stop and rest may be more urgent when we are very young or very old, pregnant or recovering from an injury. To ensure that everyone's needs are met, all 10 Indicators should be addressed for all streets.

ROLE IN INFORMING URBAN PLANNING AND POLICY

Practitioners in transport and urban planning know that they play an important role in creating liveable places and supporting people to live healthy lives. However, when they attempt to take a progressive approach for the spaces they design, they often face the institutional barrier of prioritising vehicle throughput. This barrier can be overcome by aligning professional disciplines, party politics and advocacy priorities to deliver a people-centred approach that everyone can accept.

The Healthy Streets Approach offers a comprehensive framework for making decisions on how streets are designed, managed and used. The premise of this approach is very simple—all streets, regardless of their position on the globe or their function in the transport network, must meet the needs of the human beings who inhabit them.

This is what the Healthy Streets Approach offers. It is adaptable, flexible to every situation and easily understandable by all. Globally, the number of people (practitioners, politicians and advocates) who have taken part in Healthy Streets training is increasing, providing a momentum that is leading to delivery at scale.

London's adoption of the Healthy Streets framework in the Mayor's Transport Strategy is a prime example of its successful application. The city's policy shifts towards walking, cycling and public transport are informed by the Healthy Streets Indicators, with a focus on creating safer and more enjoyable streets for all.

A major contributor to the success of this approach is that it is not just an ethos, a set of policies or a way of working. Rather, it offers a range of quantitative tools that can be used to apply Healthy Streets in many different fields. There is a tool for scoring the design of a new neighbourhood, a tool for scoring the layout of a street upgrade, a tool for strategically planning a city, and a tool for gathering the sentiments of the community. This means that all the different processes that shape our experience on streets are quantitatively assessed against the same set of standards—the 10 Healthy Streets Indicators.

Planners aim to provide safe crossing facilities, high quality cycle space, street trees and other landscaping, and wide footpaths. Healthy Streets provides the tools to quantify and demonstrate how all this can be done, even for narrow streets and on low budgets. This holds the potential to add a dollar value to the Healthy Streets score that can be placed alongside the hypothetical disbenefit of reducing the expedience of car movement, which has dominated decision-making for decades.

Planners aim to provide safe crossing facilities, high quality cycle space, street trees and other landscaping, and wide footpaths. Healthy Streets provides the tools to quantify and demonstrate how all this can be done, even for narrow streets and on low budgets.

INTEGRATING COMMUNITY INSIGHTS WITH DATA-DRIVEN SOLUTIONS

The newest Healthy Streets tool may be the most powerful one yet. It can be used by anyone, not just trained professionals. How Healthy Is My Street? is a web-based tool that can be opened on a smartphone and applied to any street in the world to score it both objectively against a set of simple metrics, and also subjectively to give a score of how one feels there. This enables a much wider range of users (the public, businesses, practitioners and politicians) to identify why some streets are not yet meeting their basic needs. This tool also indicates ways to make streets healthier by showing what street features could be incorporated to make the biggest impact in meeting users' needs.

Data collection within the framework combines qualitative and quantitative methods. Local stakeholders provide insights into how streets function, with surveys and street audits used to gather feedback on the experience of walking, cycling and socialising. Additional datasets that measure other elements such as air quality measurements, noise levels and traffic volume can be overlaid to create a more complete picture of street performance. The framework advocates for the use of multiple data sources to ensure a balanced assessment.

So, this is an exciting time. London has established itself as a city that has been successful at implementing the Healthy Streets Approach in its urban spaces through progressive policies. These policies include the rollout of 20-mile-per-hour (roughly 32-km-per-hour) speed limits, as well as restrictions on polluting vehicles, school streets and low traffic neighbourhoods, to mention just some of the city-wide initiatives implemented in the past 5 years. The Healthy Streets Approach is also gaining popularity around the globe and is being applied around the world in projects large and small—from Austria to Australia. The How Healthy Is My Street? app is spreading the conversation and action much further. In the first weeks since this tool was launched, 1,000 surveys were completed globally, showing the potential for this data to produce a Healthy Streets map of the world. As urban planners increasingly recognise the value of prioritising human health and well-being in urban design, the Healthy Streets Approach stands poised to transform our urban landscapes.

Local stakeholders provide insights into how streets function, with surveys and street audits used to gather feedback on the experience of walking, cycling and socialising.

Integrating Multi-Stakeholder Perspectives

Building on what the team had learnt from its review of current practices, a series of multi-stakeholder workshops and roundtables were convened to better understand cross-domain perspectives from more than 40 participants from the transport, health, urban planning, environment, economic development and community engagement sectors. Practitioners from cities such as Barcelona and Singapore shared concrete experiences of the institutional and technical barriers they faced, from reconciling competing departmental priorities to quantifying 'soft' outcomes like mental well-being, local economic vibrancy or community cohesion.

The sessions focused on exploring the future of mobility, and understanding the key challenges and opportunities in implementing sustainable mobility across diverse urban settings. Additionally, the participants identified socio-economic indicators to assess the comprehensive benefits of sustainable mobility, and explored how a structured framework could address existing gaps and facilitate the transition to sustainable urban mobility.

Through these discussions, participants stressed that cities need tools that are not only technically robust, but practical, flexible and credible in local decision-making contexts. They must be able to build on existing evaluation methods, rather than adding unnecessary layers of complexity. The workshops also reinforced the importance of co-benefits and trade-offs. When cities are able to show how a mobility project strengthens outcomes across domains such as mobility, health, the environment and economy, they can build stronger cases for investment, wider buy-in and better long-term stewardship.

Setting the Foundation for the Framework

Based on the insights from literature reviews and the workshop discussions, some common themes emerged:

- Planners need ways to reconcile competing priorities and bridge institutional silos.
- There is a persistent gap between what communities value, such as mental well-being, sense of safety and community life, and what is formally measured or funded.
- New tools must be practical and flexible, not simply add complexity or duplicate what CBA already does well.

Participants also emphasised that cities need tools that do more than measure impacts. They should:

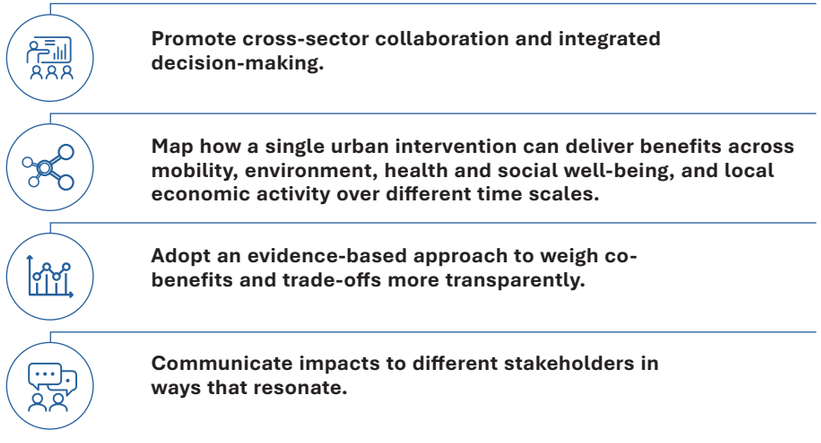
- Build a shared language between sectors and disciplines.
- Justify investments in more inclusive and distributed mobility solutions.
- Enable more strategic conversations with policymakers and the public.

These insights shaped the design of a structured cross-domain framework, underpinned by multi-criteria analysis. The idea is not to replace established methods like CBA, but to complement them, providing cities with a way to capture the broader, less tangible benefits of sustainable mobility initiatives. In practice, this means not only aligning across domains, but also balancing short-term operational needs with longer-term societal goals. Planning and evaluation cycles are often driven by what can be demonstrated quickly, yet many critical outcomes—such as shifts in community health, social cohesion or public trust—emerge only over time.

Cities need tools that support both immediate decision-making and ongoing learning from long-term projects, enabling them to be tracked, refined and evaluated progressively as their full impacts unfold. This is especially important in infrastructure planning, where design choices made today will shape outcomes for decades.

Together, these steps laid the groundwork for what follows: an introduction to the key principles behind the cross-domain approach, and how the approach can be adapted to support cities in making the case for more sustainable urban mobility solutions.

The result is an approach that aims to help cities:



OPINION

Creating a Common Language to Achieve Shared Goals

By Tan Wearn Haw
Director, Strategic Planning and Collaborations, Health Promotion Board

Nicole Cheah
Senior Manager, Strategic Planning and Collaborations, Health Promotion Board

The cycling track at Singapore's Play@Heights Park in Lorong 2 Toa Payoh is one of many features promoting recreational physical activity in the neighbourhood. The track is linked to surrounding blocks by sheltered walkways to improve resident accessibility.
Photo courtesy of Nicole Cheah

Our health and daily living environment are intertwined. The spaces where we live, work, play and commute are more than just backdrops to our daily routines—they actively shape our well-being. Urban infrastructure influences how we move through our environment, how we interact with our surroundings, and even who we meet. The compounded effects of these experiences have an outsized impact on our health in the long term. Measuring and monitoring the influence of the built environment on health outcomes would thus allow us to better understand how urban design can create health-promoting spaces for the community.

The built environment's impact on physical activity is significant.[46] Residents with greater access to public transport and active mobility modes are more likely to be physically active because of walking or cycling on a daily basis.[47] In 2023, 78.5% of Singapore residents achieved a sufficient level of total physical activity per week,* with commuting being the largest contributor to this.[48] This is unsurprising given that a daily average of 3.4 to 4 million trips were taken on Singapore's public transport system that year.[49]

Neighbourhoods with higher-quality pedestrian infrastructure and open spaces that incorporate better aesthetics, safety and maintenance are associated with higher levels of active mobility and recreational physical activity.[50] Pedestrian walkways and bicycle lanes help to reduce urban traffic congestion and air pollution as people choose active mobility options over vehicular transport.[51] This has a range of positive health effects, including a reduction of respiratory illnesses due to improved air quality.

Pedestrian walkways and bicycle lanes help to reduce urban traffic congestion and air pollution as people choose active mobility options over vehicular transport. This has a range of positive health effects, including a reduction of respiratory illnesses due to improved air quality.

Research in Europe and the UK has also tied the reduction of noise, particulate matter and traffic accidents that come from the shift to active transport to reduced healthcare expenses. For example, a net avoided cost of £6 billion within a 20-year period was forecasted for the UK National Health Service stemming from such a modal shift. In Sweden, Stockholm County's healthcare budget saw a net economic benefit of 8.7% from initial investments in sustainable mobility—including an annual savings of €900 per person from shifting from car- to bike-friendly transport infrastructure.[52]

Having a robust public transport system also enables social connections and community resilience. A National University of Singapore study on ageing in place found that well-connected mobility networks empower older adults to maintain active lifestyles and diverse social connections within and beyond their

* Sufficient total physical activity refers to doing at least 150 minutes of moderate-intensity physical activity, at least 75 minutes of vigorous-intensity physical activity, or an equivalent combination of moderate- and vigorous-intensity physical activity per week.

neighbourhoods. Singapore's comprehensive public transport system allows seniors to regularly access social spaces—from food courts and coffee shops to community centres. This is crucial for fostering 'ageing in networks', where older adults can maintain meaningful social ties across different locations, contributing to stronger community bonds and personal resilience in later life.[53]

These findings are consistent with studies in Hong Kong, where the built environment at the neighbourhood level has been shown to play a crucial role in promoting health outcomes for frail older adults—having metro stations closer to their homes significantly improved both service utilisation and quality of life for seniors. When public transport was easily accessible, older adults were more likely to use community services and maintain better health conditions.[54] With global life expectancy projected to increase by 4.6 years by 2050,[55] investing in sustainable mobility infrastructure as complementary to preventive health strategies will be crucial for alleviating increased burden on the healthcare system in the future.

MEASURING A 'HEALTHY' SYSTEM

The National Population Health Survey series, jointly conducted by the Ministry of Health (MOH) and Health Promotion Board, tracks and provides information on the health, risk factors and lifestyle practices of Singapore residents, as well as the prevalence of non-communicable and chronic diseases in Singapore.

At the same time, Healthier SG (HSG), a national initiative by the MOH, monitors the effects of preventive health efforts at a regional level within Singapore. The indicators monitored under HSG include both medium-term health outcomes such as physical activity levels, and long-term health outcomes such as prevalence of chronic diseases (e.g., diabetes, hypertension and hyperlipidaemia) and healthcare cost. Since lifestyle risk factors, especially physical activity and unhealthy diets, are major drivers of chronic diseases, some of these indicators could be applied as conceivable measures of the built environment's impact on population behaviour and health.

BRIDGING SECTORS THROUGH A COMMON LANGUAGE

The growing synergies between the urban planning and health sectors present an opportunity to improve liveability in cities. In Singapore, the Urban Redevelopment Authority's Draft Master Plan 2025 envisions a Happy Healthy City by integrating health-promoting elements into urban design, such as the provision of recreational spaces and enhanced access to active mobility networks.

Sungei Tampines, which is connected by a bridge to Pasir Ris Park. By 2026, 8 in 10 residents living in public housing will have access to a cycling network within minutes under the new Islandwide Cycling Network programme. In towns like Pasir Ris and Tampines, comprehensive cycling networks are already in place.

Photo courtesy of DreamyBeluga (CC BY-SA 4.0) / Wikimedia Commons

Achieving collective outcomes across sectors can be supported by creating a common language to unite existing efforts through the development of frameworks that encompass a range of cross-domain indicators. Efforts to do so are already underway in Singapore. For instance, the Healthy Precincts Framework by the MOH Office for Healthcare Transformation tracks the effects of socio-environmental determinants on residents' behaviour and health outcomes. The framework looks at domains such as the built environment, transport, access to healthy foods and environmental quality to provide a holistic picture that informs policy, programming and decision-making.

A similar approach was taken by the UK's Office for National Statistics, in the form of a Composite Health Index. The Index was intended to measure the stock of health across communities and provide granular insights using 56 indicators across three domains—healthy places (wider determinants of health), healthy lives (health-related behaviours) and healthy people (healthy outcomes). Although funding for the Index ceased in 2024, there are views that the Index should be revived as the state of health could impact the UK's future economic growth and gross domestic product potential.[56]

While the creation of such frameworks requires time, effort and expertise across sectors and disciplines, they are instrumental in establishing structures and processes that facilitate collaboration, data sharing and aggregation. This is an important foundation for complex multi- and cross-sectoral engagement, partnerships and mobilisation. For example, when tied to the implementation of a sustainable mobility project, pre- and post-implementation data collection across sectors can create robust datasets to yield conclusive evidence demonstrating multisectoral impacts on the well-being of the population—be it in pursuit of health, improved mobility or beyond.

Creating a common language through the development of frameworks is instrumental in establishing structures and processes that facilitate collaboration, data sharing and aggregation.

Note: The views and opinions expressed in this article are solely those of the authors and do not necessarily reflect the official policy or position of the Health Promotion Board.

Defining the Cross-Domain Approach

At its heart, the cross-domain approach is not just a technical toolkit—it is a way of rethinking how cities design, evaluate and communicate the value of mobility interventions in the context of wider urban systems. It builds on a simple recognition, that the movement of people is inseparable from the broader social, economic and environmental fabric of a city.

Drawing on lessons from the research process, including good practices emerging internationally, the framework rests on the following four key principles.

Recognising Multiple Domains, Not Single Outcomes

Often, cities design transport projects around one dominant goal, such as travel-time savings or congestion reduction. A cross-domain lens prompts planners to ask, what other outcomes might this project influence? For example, does a new walking or cycling route improve air quality, support local businesses, reduce noise pollution or make daily journeys safer for vulnerable groups?

This perspective also requires a shift in institutional mindset. Agencies can no longer treat their outcomes in isolation, but must begin to consider how their projects contribute to the priorities of others. Embracing this view opens the door to stronger inter-agency collaboration, shared ownership of results and more integrated urban solutions.

Embracing Systems Thinking

By looking at mobility projects through the interdependencies between domains, cities can better identify synergies and manage potential trade-offs. This means asking how an intervention in one area can create ripple effects in others, and ensuring these relationships are reflected in planning and evaluation.

Enabling More Nuanced Measurement

Many benefits, such as improved mental well-being, sense of safety and increased local footfall, can be difficult to quantify in purely monetary terms. The framework encourages the use of a mix of quantitative and qualitative indicators that are grounded in robust evidence, while building in flexibility to reflect local priorities and contexts.

Supporting Better Decision-Making, Not Just Better Data

This approach is ultimately about helping cities make choices that align with long-term liveability goals. Providing a clearer picture of how different impacts stack up—and who benefits from interventions—supports more transparent, balanced decision-making and strengthens the rationale for integrated investments.

Armenian Street in Singapore was permanently pedestrianised in 2019, introducing more public spaces for events and activities.
Photo courtesy of Choo Yut Shing (CC BY 2.0) / Flickr

CITY FEATURE

Singapore

A city achieving better liveability through integrated mobility solutions

Singapore's unique geographical constraints, characterised by limited land resources, necessitated an integrated approach to transport infrastructure and land-use planning from the outset. The city's urban mobility landscape has, over the decades, transformed significantly to a dynamic tapestry of interconnected transportation systems, where urban planning initiatives and technological innovations foster seamless, sustainable and inclusive mobility for its residents.

This integrated approach is reinforced at the policy level through national strategies like the Singapore Green Plan 2030, which sets ambitious environmental targets across the whole of government. Aligning with the goals of the Singapore Green Plan 2030 to enhance the provision of sustainable transportation modes, the Land Transport Master Plan 2040 (LTMP 2040) sets out the vision and strategies to create an accessible, sustainable and inclusive land transport system by encouraging commutes via Walk-Cycle-Ride (WCR). This is coupled with a focus on creating mobility solutions that deliver wider benefits: greener streets that improve environmental quality, public spaces that promote health and social connection, and infrastructure that supports economic vitality.

In practice, this means that transport projects are designed not just to enhance connectivity, but also shape the kind of places people want to live, work and play in. The North-South Corridor illustrates how this integrated approach is being put into action.

BOX STORY

North-South Corridor: Redefining Mobility through Multi-Stakeholder Collaboration and Co-creation with the Community

Singapore's transformation of the North–South Expressway (NSE) into the North–South Corridor (NSC) represents a significant shift from car-centric infrastructure to a more inclusive, people-centric and car-lite mobility corridor. Originally conceived as a traditional expressway, the NSE was reimagined as the NSC in 2016 to support Singapore's WCR goals and foster a more sustainable transport ecosystem.[57]

The 21.5-km NSC comprises a portion of the NSC Expressway (a viaduct and tunnel) and adjacent surface streets, with a focus on improving urban mobility, liveability and environmental sustainability.[58] It is a multi-modal transportation corridor that will enhance connectivity from the northern region to the city, serving towns such as Sembawang, Yishun, Ang Mo Kio, Toa Payoh, Novena and Rochor. With more traffic being channelled to NSC's 8.8-km viaduct and 12.3-km tunnel, surface streets along the corridor—which pass through diverse residential neighbourhoods, recreational spaces, industrial areas and historic districts—will be repurposed to give more priority to walking, cycling, public transport, community spaces and greenery.

This shift supports Singapore's vision to promote the use of public transportation and active mobility. By creating a multi-modal corridor, the NSC not only creates additional capacity to serve the new growth areas along the North–South axis, but also supports the development of community-centric spaces and enhances connectivity to existing green spaces along the route. The corridor will also establish new connections to adjacent places and transport modes to enhance walkability and encourage the use of public transport. These spaces will contribute to Singapore's liveability by fostering social cohesion and providing greater health benefits.

Artist's impression of the North–South Corridor.
Image courtesy of the Land Transport Authority

CO-CREATING THE NSC WITH THE COMMUNITY

Between July 2023 and January 2024, the Land Transport Authority (LTA) conducted a series of visioning workshops, inviting the public to share their perspectives on the NSC's surface street design in terms of the use, amenities and connection to places along the NSC. Participants expressed a desire for amenities that support walking and cycling, including shaded areas, greenery, spaces for rest and community activities, and closer connection with nature.

Additionally, the LTA announced that they will be working closely with the appointed design team on the NSC surface streets master plan to seek feedback from the community, other stakeholders and members of the public to co-design the master plan concepts along the NSC.

The surface streets along the NSC will have widened sidewalks, landscaped areas and rest spots to make walking and cycling more comfortable and enjoyable. The aim is to encourage active mobility while improving connectivity to adjacent neighbourhoods. By integrating public spaces, these surface streets will not only promote physical activity but also serve as gathering points for the community and enhance social cohesion.

Ultimately, these nodes and surface streets will transform the NSC into more than a mobility corridor, offering spaces that contribute to both building a sense of place and improving the social well-being of Singapore's residents.

Artist's impression showing more public spaces along the NSC.
Image courtesy of the Land Transport Authority

Artist's impression of dedicated spaces for WCR users along the NSC.
Image courtesy of the Land Transport Authority

Artist's impression of a node along the NSC; such nodes will become gateways to neighbourhoods and amenities.
Image courtesy of the Land Transport Authority

Lessons for Cross-Domain Planning

To move towards a more convenient, well-connected and inclusive transport system, the LTA is working towards enhancing the infrastructure for WCR transport modes, reimagining road design, encouraging active mobility and adopting cleaner-energy vehicles. Some of these plans include:

- Enhancing Singapore's public transport system by expanding the coverage of its rail network and complementing it with a public bus network that covers almost every part of Singapore.[59]
- Encouraging the use of active mobility by expanding cycling networks and implementing various initiatives to make the roads safer and more pedestrian-friendly, such as School Zones, Silver Zones, road repurposing and Friendly Streets.
- Catalysing the adoption of cleaner energy vehicles by providing incentives for adopting electric vehicles (EVs) and installing 60,000 EV charging points in public carparks and private premises, as well as electrifying half of the public bus and taxi fleet by 2030.

Singapore's mobility strategies offer several lessons for cities seeking to adopt a cross-domain lens to mobility by aligning transport with land use, health and community well-being outcomes. These lessons include:

EMBEDDING PEOPLE-CENTRIC MOBILITY INTO LONG-TERM PLANNING

The Land Transport Master Plan 2040 connects mobility targets to broader liveability and climate goals, ensuring that new transport infrastructure is designed to reduce reliance on private vehicles while improving air quality, promoting active lifestyles and integrating greenery into the streetscape. This reflects a broader understanding that transport planning also involves addressing broader urban challenges such as climate change, public health and social cohesion.

INSTITUTIONALISING PARTICIPATORY DESIGN PROCESSES

Singapore's mobility projects demonstrate a deliberate shift towards co-creation with communities. Visioning workshops for the NSC and project taskforces for Friendly Streets show that structured engagement can surface local knowledge, address residents' concerns early and build public ownership of the final outcome.

DESIGNING FOR DIVERSE NEEDS AND FUTURE DEMOGRAPHICS

Singapore's transport initiatives anticipate shifts in demographic patterns, such as an ageing population and changing commuting habits. Features like barrier-free design, covered walkways, and safe cycling infrastructure ensure that projects remain inclusive over the long term, catering to the needs of both current and future residents.

LEVERAGING DATA AND MODELLING

Singapore grounds its transport initiatives in data collection, analytics and modelling. From bus sensors to commuter hotspots, real-time feeds are continuously analysed to manage services and infrastructure effectively.

STRENGTHENING MULTI-STAKEHOLDER COLLABORATION

The delivery of complex projects like the NSC depends on coordination between government agencies and community partners. This governance model enables the integration of diverse priorities—from traffic flow to public realm design—into a single, coherent project.

While grounded in Singapore's unique geographic and governance context, these lessons reveal how a city can systematically embed cross-domain thinking into mobility planning from the outset.

CITY FEATURE

Vienna

A city embedding equity through holistic mobility planning

Vienna has long been recognised for its progressive approach to urban planning, where sustainable mobility is treated not just as a transport issue but as a driver of social equity, public health and environmental quality. Over decades, the city has refined its methods through pilot projects, data-led analysis and systematic learning, resulting in an integrated planning framework that balances people-centred design with ecological sustainability and economic vitality.

The Urban Mobility Plan, introduced in 2014 as part of Vienna's broader Urban Development Plan (STEP 2025),[60] sets out a clear vision for achieving a more equitable and sustainable transport system. At its core is the 80:20 mobility target: by 2025, 80% of all trips should be made by public transport, cycling or walking, reducing private car use from 28% to just 20%.[61,62] This target is backed by detailed measures to create a network that is fair, healthy, compact, eco-friendly, robust and efficient.

A defining feature of Vienna's mobility strategy is its early and systematic integration of gender mainstreaming—recognising that mobility patterns vary across groups and that public spaces must serve diverse needs of all users. Since the late 1990s, the city has applied its Manual for Gender Mainstreaming in Urban Planning and Urban Development, embedding principles of accessibility, safety, and inclusivity into street and mobility design. This has shaped a network of polycentric neighbourhoods, short walking distances, barrier-free access and environmentally friendly transport systems.

By embedding equity into mobility planning, Vienna has advanced cross-domain thinking—safer, more inclusive streets also improve environmental quality, public health and local economic vitality. These principles were tested at the district scale in the Mariahilf pilot project, which showed how gender-sensitive design can work as universal design, delivering benefits for the whole community.

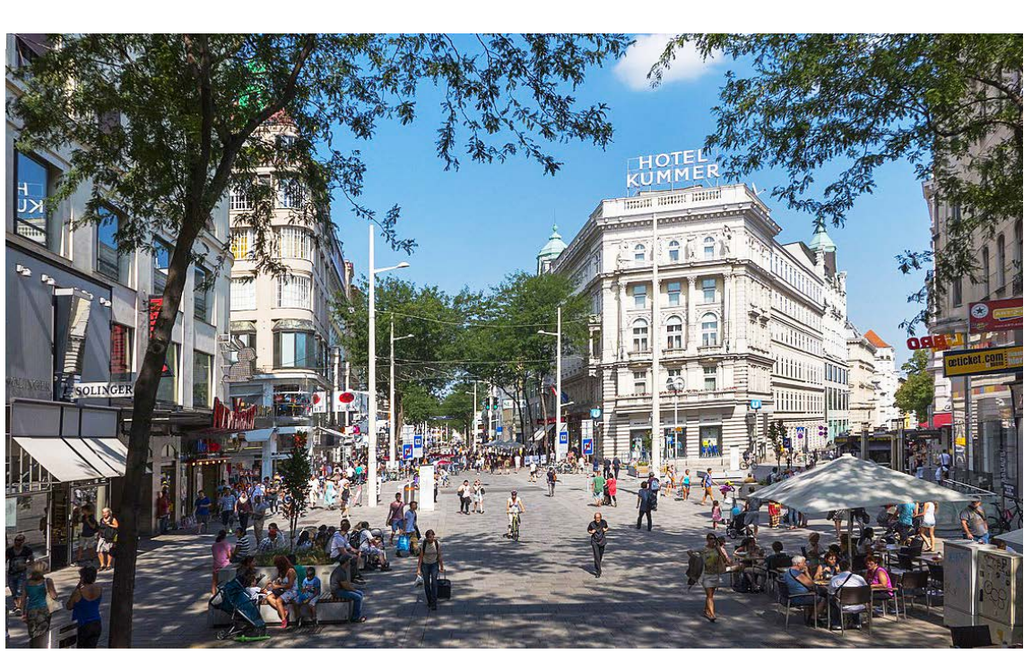
The Graben in central Vienna. This historic shopping street was transformed into a pedestrian zone, reflecting the city's shift towards sustainable mobility.

Photo courtesy of C.Stadler/Bwag (CC BY-SA 4.0) / Wikimedia Commons

BOX STORY

Mariahilf Pilot District: A Gender-Sensitive Transformation Supporting Sustainable Mobility

In the early 2000s, Vienna's 6th District, Mariahilf, was a dense urban area with high pedestrian volumes where many residents relied on public transport and walking for their daily needs. Yet the street environment often failed to meet the needs of those making the most trips on foot. Studies of daily mobility patterns revealed that women, along with older residents, children and caregivers, tended to make more frequent, shorter trips, often combining errands with caretaking responsibilities.



Mariahilfer Straße in 2015, redesigned as a pedestrian-priority shared space with wider pavements and improved public amenities.
Photo courtesy of Gugerell (CC0 1.0) / Wikimedia Commons

However, a quarter of the pavements were too narrow for wheelchairs or prams, half of all junctions were difficult to cross, and inadequate lighting created 'anxiety zones' that discouraged walking at night.[63,64] These conditions made daily tasks like shopping or accompanying children challenging—highlighting how pedestrian transport had become a 'blind spot' in traditional planning, and created structural disadvantages for those relying on walking and public transport.[65]

Recognising these barriers, the city selected Mariahilf as a pilot district for gender mainstreaming between 2002 and 2005. The project was led by Vienna's specialist gender mainstreaming unit, working in close cooperation with municipal departments, district officials and local stakeholders. Insights from community engagement and journey pattern studies directly shaped the interventions. Streets were made safer and more accessible through over 1,000 metres of widened pavements, 60 junction upgrades, barrier-free crossings, pedestrian lead times at traffic signals, strategically placed seating and improved lighting at 26 locations.[66]

While the measures addressed gender-sensitive mobility needs, they also delivered wider benefits. More accessible pavements and safer crossings supported families with young children, people with disabilities and the elderly. Better lighting and seating encouraged street use throughout the day, strengthening social interaction and local economic activity. In effect, gender-sensitive design functioned as universal design, improving the public realm for all users.

The pilot's impact extended beyond Mariahilf. Its documented results helped secure city-wide adoption of wider pavement standards, ramp installation guidelines and gender-sensitive evaluation methods. Just as importantly, it demonstrated how targeted, small-scale projects can serve as both design laboratories and testbeds—generating evidence, building political support and shaping long-term policy. Today, the lessons from Mariahilf continue to inform Vienna's integrated approach to mobility, where accessibility, safety, environmental quality and social equity are addressed together as interlinked priorities.

Lessons for Cross-Domain Planning

Vienna's success with gender mainstreaming has catalysed a broader transformation in how the city approaches urban planning. Today, this approach is deeply embedded in Vienna's political systems and planning frameworks, with mobility projects driven by an integrated vision of people-centric design, ecological sustainability, social equity and economic vitality. This holistic approach is evident in several key initiatives:

- Designing new districts that prioritise enhanced liveability right from the onset—seamlessly integrating principles of gender mainstreaming, social inclusion, economic vibrancy and sustainable mobility—for example in Aspern Seestadt.[67]
- Continued improvements to pedestrian infrastructure guided by district-level master plans for walking—including wider streets, cooled neighbourhoods and enhanced safety measures.[68]
- Expansion of sustainable mobility networks and increased integration—like upgrades to the U-Bahn and cycling networks, with new shared mobility options such as the WienMobil bike hubs and electric car sharing points.[69]

Vienna's approach to planning continues to be supported by key strategies such as:

DATA-DRIVEN PLANNING AND SOCIAL SPACE ANALYSIS

Vienna's comprehensive data collection system brings together inputs from across departments—from traffic flows to public space usage—to understand the interplay between mobility, space and society. Social space analysis, which combines qualitative and quantitative methods, is now central to planning, informing everything from pedestrianisation projects to macro-scale district designs. Post-implementation documentation of results also provides crucial evidence on the effectiveness of interventions, building support among stakeholders.

PILOT PROJECTS AND SMALL-SCALE BEGINNINGS

Vienna's pilots create opportunities to test interventions and multi-stakeholder collaboration at a manageable scale, while producing visible improvements for the community. Their high visibility allows political leaders to showcase tangible results, and careful documentation ensures successful approaches can be scaled up and embedded into citywide standards.

STRATEGIC LANGUAGE AND REBRANDING

Vienna's communication of urban mobility initiatives is focused on understanding and addressing stakeholder priorities, rather than leading with technical planning objectives. When promoting gender-sensitive or environmentally friendly transport initiatives, for instance, planners emphasised immediate community benefits like safer streets and better accessibility rather than technical metrics. Branding efforts, such as 'Fair Shared City' and 'Together on the Move', have helped broaden public support while still advancing goals like gender equity and sustainable mobility.

COOPERATIVE PLANNING AND BUILDING ALLIANCES

By bringing together district coordinators, municipal departments and community stakeholders early in the planning process, Vienna created effective channels for addressing local needs while advancing broader city objectives. Political support from advocates in key positions has been critical to embedding social and environmental considerations into mobility and public space projects. Combined with structured dialogue between districts and city administration, this helped frame initiatives as contributing to multiple policy goals—from electoral success to broader urban improvements.

Vienna's efforts in institutionalising integrated solutions and cross-domain planning through strategic scaling and smart alliances offers valuable lessons for cities worldwide. Its evolution from gender mainstreaming to comprehensive sustainable mobility planning demonstrates how cities can effectively embed social, economic, health and environmental considerations into urban planning—creating more liveable, sustainable and equitable cities for all.

Photo courtesy of Curro Palacios / Ajuntament de Barcelona

04

APPLYING A MULTI-CRITERIA ANALYSIS LENS

A multi-criteria analysis lens enables cities to incorporate both quantitative data and qualitative insights to provide a more holistic picture of the impacts of sustainable mobility initiatives. It also helps build consensus among stakeholders and supports decision-making that prioritises liveability and long-term resilience.

About the Framework

To capture the holistic benefits of sustainable mobility, the framework applies techniques using multi-criteria analysis (MCA), which itself encompasses methodologies such as the analytical hierarchy process and the multi-attribute utility theory. This approach allows for a broad understanding of urban mobility by considering a wide range of criteria, especially aspects that are difficult to quantify but are important to achieving liveability. The framework is designed to enable cities to benchmark against their own individual progress, foster collaboration and facilitate dialogue between stakeholders.

Adopting an MCA approach enables urban planners and policymakers to evaluate complex decisions by systematically comparing multiple policies against identified policy objectives.[70] In particular, the framework leverages MCA techniques such as pairwise comparison to establish clear policy objectives and incorporate multi-stakeholder inputs through a participatory approach. One of the framework's strengths is its ability to include qualitative metrics in addition to quantitative ones, providing a balanced assessment of initiatives and supporting decision-making processes.

An MCA approach allows cities to evaluate cross-domain impacts by combining quantitative data with qualitative insights, supporting balanced, people-centred decisions.

Photo courtesy of Caresse Audrey Chia

How to Approach the Framework—Adapt, Apply, Analyse

ADAPT

1. **Define the Core Problem:** Identify the main issue that the intervention seeks to address, and determine whether it is primarily mobility-related, or linked to wider challenges.
2. **Establish Objectives and Outcomes:** Map out what changes are desired in the short, medium and long term, and decide which pillars are most relevant.
3. **Identify Relevant Indicators and Metrics:** Across the four pillars, select indicators and metrics that capture both direct and indirect impacts of the intervention.
4. **Review Scoring Benchmarks and Threshold Values:** Examine the suggested benchmarks and threshold values to ensure that they are appropriate for the context of the project, and reflect local priorities and conditions.

   Benchmarks: Determined based on industry / national / international standards, mapped to a scoring scale from 1 to 5.

   Thresholds: Identified as the minimum expected standard for each metric (based on the 1 to 5 benchmark score).

APPLY

5. **Survey Stakeholders:** Survey stakeholders to define project priorities. With the findings, use a pairwise comparison calculator, assign weightages to pillars and sub-pillars.
6. **Explore Cross-Domain Links:** Identify additional domain outcomes that the project could influence. What are some cross-domain impacts from the intervention? Are there any gaps or opportunities?
7. **Collect and Score Data:** Gather data for selected metrics, score them against the benchmarks, and aggregate to determine pillar and overall scores.

ANALYSE

8. **Visualise Results:** Create a scoring summary table and spider diagram to visualise the impacts of the intervention.
9. **Interpret Scores:** Assess how outcomes align with the intervention's intent and cross-domain opportunities. Identify areas for improvements, trade-offs and gaps.
10. **Iterate and Scale:** Draw lessons for refining the intervention and similar interventions in the future, scaling impacts, or expanding its scope into other domains.

Framework Components and Methodology

The framework includes three core components:

A
An **Assessment Tool** to detail the hierarchical components for evaluation

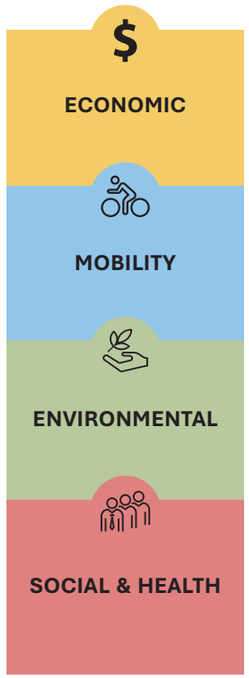
B
A **Reference Manual** that provides the list of metrics, including their definitions, rationale and benchmarks for measurement

C
A **Pairwise Comparison Tool** to survey stakeholders, which helps to determine local priorities and assign weightages

A. Assessment Tool

THE FOUR PILLARS

The framework is built around four core pillars—Economic, Mobility, Environment, and Social and Health. These pillars are at the heart of what makes a city liveable, aligning with the liveability outcomes defined in the Liveability Framework.



Mobility can enable local economic opportunity. Consideration should be made to how cross-domain interventions can support vibrant street life, boost footfall to neighbourhood businesses, enhance local job access and contribute to long-term area value. This pillar makes visible the local economic case for an intervention that might otherwise seem marginal through a purely transport lens.

At its foundation, the intervention should enhance how people and goods move through the city. This means improving accessibility, safety, travel efficiency, modal share and connectivity—with a strong emphasis on shifting towards more sustainable, active and shared modes of transport.

A cross-domain approach recognises the environmental footprint of mobility decisions. Projects should contribute to better air quality, reduced noise pollution, lower carbon emissions, and ideally, urban greening or biodiversity. This pillar ensures that transport solutions support the city's broader climate and ecological goals.

Beyond moving people, mobility shapes daily life. A cross-domain approach prioritises physical and mental health, inclusivity and community cohesion. For example, safe streets can encourage walking and cycling, in turn reducing chronic disease risk. Public spaces that are designed for people can foster informal social interaction and a sense of belonging.

Taken together, these four pillars help planners and policymakers see mobility as a lever for shaping healthier, greener and more resilient cities. They provide a lens through which to ask:

- Does this project strengthen liveability across all four pillars, or does it only deliver gains in one area while missing opportunities elsewhere?
- Can resources be pooled across domains to promote co-ownership of certain projects to deliver common outcomes?
- How can we track the performance of interventions and make suitable refinements over time so that projects continue to be relevant and respond to evolving needs?

Barcelona & Superblocks highlight how measuring outcomes beyond mobility can create more liveable and resilient streets.
Photo courtery of Cataleirxe (CC BY-SA 4.0) / Wikimedia

Sub-pillars representing potential desired outcomes from sustainable mobility initiatives across the four pillars.

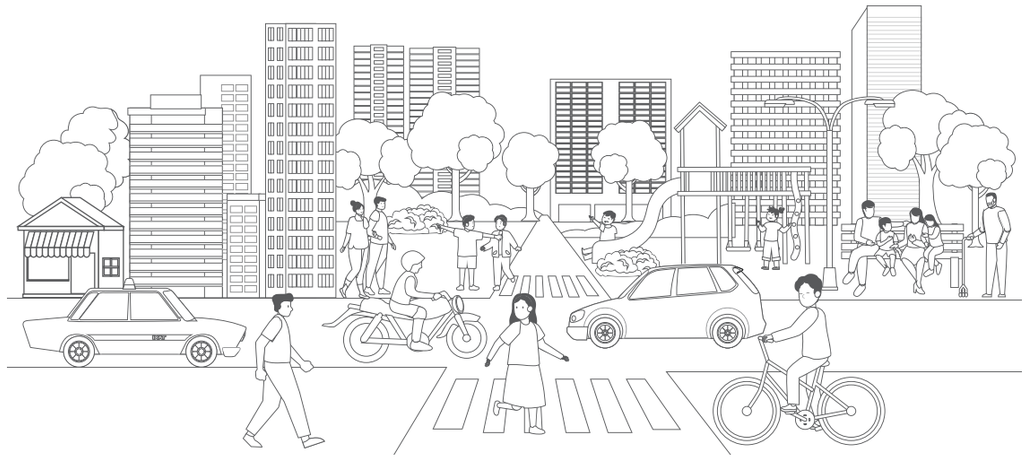
Pillar	ECONOMIC	MOBILITY	ENVIRONMENTAL	SOCIAL & HEALTH
Sub-Pillar	• Enhancing local economic vibrancy	• Promoting sustainable mobility shifts	• Reducing environmental externalities	• Promoting vibrant and socially active public spaces
Indicator	• Economic activity generated	• Walkability	• Urban heat island (UHI) effect	• Spaces that promote outdoor usage and active lifestyle
Metrics	• Number of new SMEs • Increase in revenue from retail activity	• Average width of sidewalk • Percentage of barrier- and obstacle-free pedestrian zones • Percentage of covered sidewalks	• UHI values • Percentage of total area covered by permeable surface area	• Average dwell time • Provision of sufficient public seating • Percentage of public space dedicated to play areas

Example of the hierarchy of criteria that defines the assessment tool.

Sub-Pillars, Indicators and Metrics: The pillars are further broken down into sub-pillars which map out the desired outcomes, and a set of indicators that represent the key aspects to be measured. Each indicator measured through specific metrics allows for more granular evaluation.

For example, under the Mobility pillar there could be a desired outcome of promoting a shift to sustainable mobility, which is assessed using indicators like walkability and tracked through metrics such as percentage of covered sidewalks and percentage of barrier- and obstacle-free pedestrian zones.

Indicators, Metrics, and Cross-Domain Outcomes



ECONOMIC | MOBILITY | ENVIRONMENTAL | SOCIAL & HEALTH

The indicators and metrics are distilled to support the cross-domain evaluation of sustainable mobility initiatives by mapping them across the pillars.

ECONOMIC

Indicator	Metric	Outcome Mapping
Economic activity generated	Number of events in the area that require purchase of an entry ticket	●
	Change in revenue generated by retail/commercial activity in the area	●
	Change in number of small and medium-sized enterprises (SMEs)	●
	Change in commercial space vacancy rates relative to city median	●
Property value	Average purchasing value of property in the area	● ●
Public transport (PT) affordability	Proportion of household income spent on public transport	● ● ●

MOBILITY

Indicator	Metric	Outcome Mapping
Walkability	Proportion of pedestrian zones that are barrier- and obstacle-free	● ● ●
	Proportion of pedestrian lanes over total road network	● ● ●
	Proportion of covered sidewalks (tree canopies or overhanging roofs)	● ● ●
	Average width of sidewalk	● ●
	Ease of crossing (presence of safe and direct crossing or pedestrian right-of-way)	● ●
Modal share of active mobility modes and shared transport	Active mobility modal share	● ● ● ●
	Shared transport modal share	● ●
Modal share of public transport	Public transport modal share	● ● ● ●
	Number of private motorised vehicles per 1,000 residents registered within the area	● ● ●
Provision of mobility hubs	Number of transport modes within a mobility hub	● ● ● ●
	Number of transport-related amenities and services within a transport hub	● ● ● ●
	Number of non-transport related amenities and services within a transport hub	● ● ● ●
Ease of intermodal integration	Average transfer time between modes	● ● ●
Bicycle priority	Proportion of bicycle lanes within the total road network	● ● ●
Bus priority	Proportion of bus priority lanes within the total road network	● ●
Efficiency of PT buses	Average speed of urban buses	●
Level of congestion	Average congestion hours on/near the area per day	● ● ● ●
Public charging points for electric vehicles (EVs)	Ratio of public charging points (PCPs) per EV	● ●
	Proportion of residential areas with access to EV recharging points within a radius of 700 m (15-min walk)	● ●

Urban public transport (UPT) accessibility/ level of service	Population living within a 500-m distance of a 5-minute headway to a UPT stop or station	● ●
	Average waiting time at UPT stops or stations	●
	Average walking distance to the closest UPT stop or station	●
Speed regulation	Average maximum vehicle speed allowed in the area	● ●
Parking regulation and policy	Area dedicated to parking spaces of private motorised vehicles	● ● ●
	Number of bicycle parking spots per resident	● ●

ENVIRONMENTAL

Indicator	Metric	Outcome Mapping
Urban heat island (UHI) effect	Total area covered by permeable surfaces	● ●
	UHI values	● ●
Green space	Total area covered by green space	● ●
Blue space	Total area covered by blue space	● ●
Air pollution	Annual average air quality index (combination of pollutants)	● ●
Noise pollution	Annual average level of noise per day	● ●
Share of renewable energy in transport	PT buses on clean energy	● ●
	Taxis on clean energy	● ●
	EVs in total vehicle fleet	●

SOCIAL & HEALTH

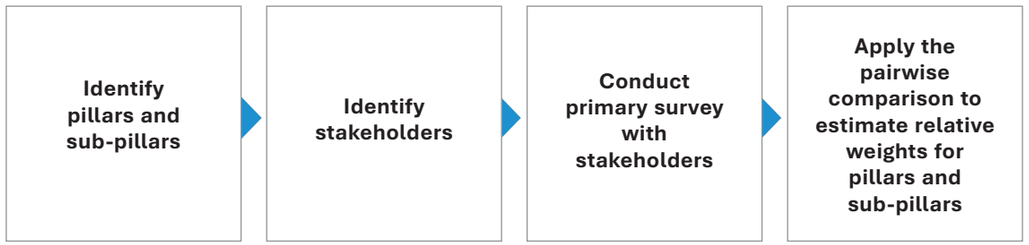
Indicator	Metric	Outcome Mapping
Spaces that promote outdoor usage and active lifestyle	Average dwell time in the area	●
	Provision of sufficient public seating infrastructure	● ●
	Proportion of public space dedicated to play areas	●
User profile mix	Diversity of genders and ages of users in the area	●
	Diversity of household incomes in the area	● ●
	Diversity of household types in the area	● ●
Accessibility to urban public space	Area of urban public space per resident within a radius of 700 m (15-min walk) of their residence	● ●
Placemaking/vibrancy of public spaces	Diversity of users observed in public spaces	●
	Diversity of uses in public spaces	● ●
	Average number of cultural, social and recreational events in public spaces per month	● ●
Community engagement/ participatory planning	Number of public consultations for feedback sessions	●
Public perception of sustainable mobility initiatives	Level of participation	●
Commuter satisfaction scores	Efficiency and comfort of public transport	● ●
Perceived safety of streets	Perceived safety of streets by pedestrians	● ●

B. Reference Manual

The reference manual sets out the definition and rationale behind each metric, with the corresponding scoring scales, and key points to consider in interpreting results. By highlighting trade-offs and contextual factors, the manual provides guidance to ensure consistent and meaningful application of the framework across diverse contexts. It is important to note that the list is not exhaustive, but rather intended to serve as a reference for key outcomes to be measured. The final list used for assessment should reflect the priorities and objectives set out for the respective initiatives. More details can be found in the **ANNEX**.

C. Pairwise Comparison Tool

Assigning Weightages: After determining the pillars, sub-pillars, indicators and metrics to be measured, weights for each component are derived through surveys and consultations with various stakeholders to reflect the priorities and objectives of initiatives in the local context. This methodology employs a pairwise comparison technique that assesses each criterion against all other criteria with a nine-point scale to determine the relative weights.[71]



Steps involved in determining weightages.

Weights are assigned to the pillars and sub-pillars. Stakeholders first compare the relative importance between pillars, followed by comparisons between the sub-pillars (i.e., outcomes) within each pillar. Scores from 1 to 9 are assigned during the comparison, with 1 indicating that both options are equally important and 9 representing that one option is absolutely more important than the other. These comparison scores are then calculated with the pairwise comparison technique and normalised to establish the weighted importance of both pillars and their corresponding sub-pillars.[72]

PILLARS		Which of the two pillars is more aligned with the goals of the project?	How much more important is it? (1-9)
A	B		
Economic	Environmental	B	7
	Social and Health	B	8
	Mobility	B	7

Example of pairwise comparison between pillars.

Benchmarking and Scoring of Metrics: Metrics in the assessment tool are scored on a scale from 1 to 5, with 1 being the least ideal and 5 being the most ideal. To develop a more straightforward scoring matrix, benchmarks for each metric should be established. Based on data collected during the pre- and post-implementation of the initiative, scores of each metric are assigned accordingly.

Overall Scoring and Results Interpretation: Scores are first aggregated within each pillar, before all four pillar scores are added up to provide an overall project score. The respective scores at both pre- and post-implementation of the initiative are then plotted onto a spider diagram to better visualise the impacts.

Since the framework uses an aggregated scoring approach, strong performance in some pillars may compensate for weaker results in others. This could result in poor performing yet critical metrics remaining unidentified during the interpretation of results.[73] Threshold scores for each metric—minimally, the key metrics that are used for evaluation—therefore need to be established based on the initiative's priorities or international benchmarks.[74] This enables the framework to not only measure outcomes but also set clear thresholds for success and signal opportunities for improvements.

Metric	Benchmark Score					Data	Data	Score	Score
						Pre	Post	Pre	Post
Percentage of barrier- and obstacle-free pedestrian zones (%)	1	2	3	4	5	60	82	2	3
	< 50	50–79	80–89	90–99	100				

Example of the benchmark score for a metric, and how each metric would be scored.

		PRE	POST	THRESHOLD
Pillars	Economic	15.0	14.1	11.0
	Mobility	16.0	19.8	22.3
	Environmental	11.6	18.2	16.0
	Social & Health	13.2	17.4	15.4
Total Scores		**55.8**	**69.5**	**64.7**

An example of the framework's application in scoring a hypothetical intervention. The results indicate measurable gains in the Mobility, and Social and Health pillars, while highlighting room for improvement in the Environment pillar which fell below threshold requirements.

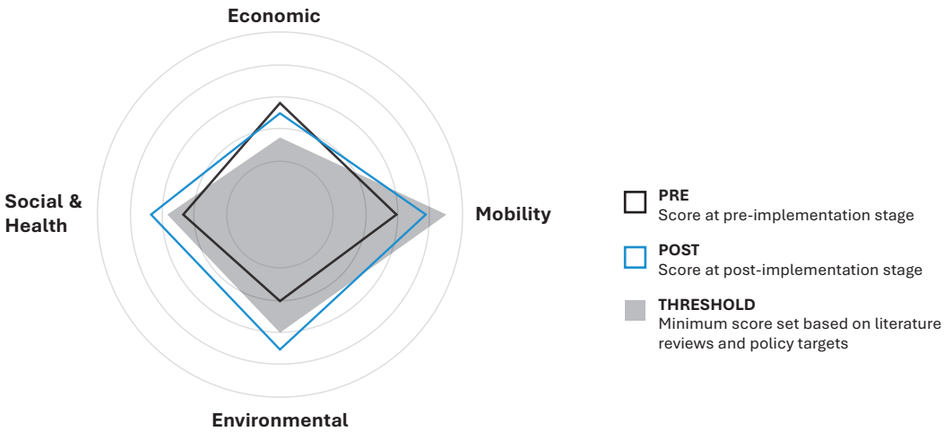


Illustration of aggregated pillar scores mapped onto a spider diagram for better visualisation of results.

By revealing the achievements, opportunities and shortfalls of an intervention across all four pillars, the framework provides cities with a clear basis for targeted improvements and guiding subsequent planning efforts.

Using the Framework to Broaden Impact: A CBA + MCA Approach

CBA remains a widely used tool for assessing large-scale and capital-intensive infrastructure projects, particularly where monetisation of tangible impacts is central to decision-making. However, a CBA may not be suitable to assess smaller scale projects that support the transition to sustainable mobility as it may not capture outcomes that are not easily quantified in financial terms, such as perceived safety, mental well-being or social cohesion.

To address this, the framework recommends using both a CBA and MCA during evaluation to capture both tangible and intangible benefits of sustainable mobility initiatives. The application of both approaches helps cities assess smaller-scale, people-centred interventions that may fall outside typical investment thresholds, while also capturing intangible or distributed benefits that matter for liveability. Combining both analyses in parallel can thus provide decision makers with a holistic understanding of the initiative and policy impacts, as well as the ability to weigh trade-offs between different pillars, supporting more informed decision-making.

COST-BENEFIT ANALYSIS	Provides a clear and rational evaluation to examine quantifiable aspects such as lifecycle cost calculations, time savings, and monetised specific environmental and health benefits.
MULTI-CRITERIA ANALYSIS	Surfaces qualitative outcomes such as user satisfaction, transport network integration, land-use mix and footfall to local businesses. It complements a CBA by providing insights into intangible benefits that are difficult to monetise.

To ensure the two tools work together effectively, cities should identify early on which metrics are evaluated under each method. For instance, if a project's environmental benefits are already monetised through a CBA, an MCA can focus on other intangible dimensions such as perceived improvements in local quality of life or access equity. By clearly mapping indicators across both methods, cities can avoid duplication and ensure each tool contributes uniquely to a shared understanding of impact.

PILLAR	CBA Normally monetised	CBA or MCA May be measured under either, depending on: (a) scale of the project (b) cost & resources	MCA Unlikely or unable to be monetised
	Most Monetisable ——— Least Monetisable		
ECONOMIC	Property value Economic activity generated due to sustainable mobility	Public transport affordability	
MOBILITY	Level of congestion Speed regulation	Modal share of active / micromobility modes (walk-ride modes) Modal share of public transport Provision of mobility hubs Percentage of priority lanes in the total network (%) Efficiency of PT buses	Ease of intermodal integration (transport hubs) Bicycle priority Walkability Public charging points for EVs Urban public transport accessibility/ level of service Parking regulation and policy
ENVIRONMENTAL	Share of renewable energy in transport Air pollution	Noise pollution Green space Urban heat island effect	Blue space Accessibility to essential amenities
SOCIAL & HEALTH	Health economic benefits	Accessibility to urban public space Perceived safety of streets	User profile mix Placemaking/vibrancy of public spaces Spaces that promote outdoor usage and active lifestyle Community engagement/ participatory planning Public perception of sustainable mobility initiatives Commuter satisfaction scores

Example of defining metrics under a CBA and/or an MCA

New York's High Line shows how public realm improvements can also drive gentrification pressures.
Photo courtesy of David Berkowitz / Wikimedia Commmon

Balancing Trade-offs and Unintended Consequences

Beyond measuring benefits, the framework also helps cities surface trade-offs and unintended consequences, especially when indicators are interpreted in relation to one another. For example, a rise in retail footfall or public realm quality might signal economic revitalisation, but when viewed alongside housing affordability or social diversity indicators, it could also reveal early signs of gentrification or displacement risk. Similarly, improved safety and air quality within a project boundary may mask spillover effects, such as traffic congestion or pollution shifted to adjacent areas.

Planners using the tool are encouraged to examine how indicators interact across domains to identify early signs of potential trade-offs or unintended consequences that may not be visible within a single domain. In doing so, the framework acts as an early warning system, helping cities identify potential tensions between goals and take corrective action before negative impacts are locked in.

The framework can be used to identify early signs of potential trade-offs or unintended consequences that may not be visible within a single domain.

Photo courtesy of Tian Ying Lee

How Cities Can Use the Framework

Based on literature reviews and city case studies, the framework is envisioned to be used at both pre- and post-implementation stages to assess the benefits of an initiative and identify gaps for improvement. During the implementation stage, the framework can also track progress, providing a basis for mid-course adjustments where needed and grounding decisions in observed outcomes.

Importantly, the framework is not a fixed or prescriptive tool. It is best understood as a living structure—one that provides a shared reference point for inter-agency dialogue, while remaining open to refinement. As cities apply the framework in different contexts, it can evolve. New indicators may be added, scoring methods adjusted, or pillar weights recalibrated based on emerging priorities. In this sense, the framework functions both as a catalyst for cross-sector dialogue and a mechanism to capture evolving practice, offering cities the flexibility to adapt it over time, while still benefiting from a structured approach to evaluation.

An example of how the framework can be integrated into existing planning and assessment workflows is illustrated on the next page. This mapping reflects its potential role in supporting real-time decision-making, programme iteration and long-term institutional learning.

Example of how the framework can be integrated into existing assessment workflows

A. PLANNING

The framework serves as a reference in determining relevant indicators and data needed under the four pillars for tracking progress.

It also facilitates the identification of key stakeholders, fostering collaboration among public, private and people sectors from the beginning.

A1: Characterising the sustainable mobility initiative (e.g., precinct-level interventions).

A2: Data Requirements & Stakeholder Mapping: Collate sustainable mobility data and reference costs, simulated or proxy data and identify relevant stakeholders.

A3: Stakeholder Engagement & Ground Sensing: Seek stakeholder buy-in for project, establish weightages/priorities of pillars.

B. PRE-IMPLEMENTATION (EX-ANTE)

The framework is applied to measure a business-as-usual scenario and estimate potential impacts. The resulting projections provide preliminary evidence to support the value of the initiative.

These estimates enable stakeholders to visualise the project's potential outcomes, facilitating more informed decision-making and resource allocation.

B1: Conduct the MCA using base data and reference costs.

B2: Results Interpretation: Analyse MCA results through pillars identified by framework.

B3: Stakeholder Engagement: Engage relevant stakeholders using the results from the ex-ante evaluation, and track pre-project implementation data.

B4: Secure Initial Funding: Use the results from the ex-ante evaluation and the stakeholder support to secure initial grants.

D. IMPLEMENTATION

The framework is applied to track project progress systematically, ensuring that interventions remain aligned with the original objectives.

This ongoing assessment helps in making timely adjustments if needed, keeping the project on course.

C: Implementation of Sustainable Mobility Initiative: Work in close engagement with relevant stakeholders to minimise any inconvenience and track data regularly.

D. POST-IMPLEMENTATION (EX-POST)

The framework is applied once more to measure the actual impact of the project, comparing outcomes against initial projections.

Results obtained can provide a foundation for supporting similar initiatives in the future and offer valuable content for public engagement and stakeholder communications.

D1: Data collection of post-implementation results.

D2: Conduct the MCA using collected data.

D3: Results Interpretation: Analyse MCA results through pillars identified by framework. Visualise results through spider diagram.

- Could be used to obtain support for additional funding or scaling up pilots.
- Could be used by agency/ division as support or basis for similar initiative.
- Could be used to foster understanding through selected public-facing metrics.

Neighbourhood Scale Tools for Citywide Impact

The framework is suited for evaluating small-scale, area-based interventions at a neighbourhood scale* such as low-traffic neighbourhoods, superblocks or active mobility corridors. These projects often operate below the radar of traditional CBAs, yet have the potential to deliver wide-ranging co-benefits for health, environment, local economy and social inclusion.

At the neighbourhood scale, it is often easier to define the project scope, intended outcomes and spatial boundaries of impact, making it more feasible to observe and interpret changes over time. Compared to large-scale infrastructure projects, where spillover effects may be harder to measure or determine cause and effect, small-scale interventions may provide a clearer testing ground for linking specific design interventions with measurable outcomes. This makes them particularly relevant for applying and testing the framework, refining indicators and building institutional support in a cross-domain approach.

By providing a structured way to assess these outcomes at the neighbourhood level, the framework helps cities make the case for investing in interventions that enhance liveability at this scale. At the same time, the framework encourages planners to situate small-scale initiatives within the city's broader urban mobility goals, such as reducing private car dependency, supporting active travel, or meeting climate and equity targets. In this way, the tool not only captures localised impacts but also helps evaluate how these initiatives contribute to larger strategic objectives.

A street in Paris prioritising pedestrians and cyclists over cars illustrates how small-scale, neighbourhood-level interventions can reclaim space for people and contribute to wider citywide mobility and climate goals.

Photo courtesy of Tian Ying Lee

* Neighbourhood scale refers to the everyday, human-scale environments where public life unfolds—typically within a 5- to 15-minute walking distance. These are places where people can access most of their daily needs and are small enough to be experienced on foot, yet large enough to influence how people interact, move and connect in daily life. It is at this scale that interventions can most directly shape people's behaviour, sense of safety and quality of life.

PROJECT TYPE	GOALS	USE OF THE FRAMEWORK
Car-lite Zones (e.g., Low-Traffic Neighbourhoods or Superblocks)	Reduce through-traffic, improve walkability, create safer streets, reclaim streets for people, increase local vibrancy	Evaluate co-benefits like air quality, physical activity, use of public space Track trade-offs and synergies across pillars
School / Silver Zones	Improve accessibility or safety, encourage walking or cycling to school	Assess safety, accessibility, noise levels, social perception around schools
Green Corridors / Active Mobility Routes (e.g., Road Repurposing Projects)	Connect open spaces, promote active transport	Link mobility improvements with social cohesion, environmental resilience, equitable access
Public Space Revitalisation	Enhance public life, reduce heat stress, create inclusive space	Measure impacts on mental well-being, social cohesion, microclimate

Examples of neighbourhood scale interventions suited to the cross-domain framework.

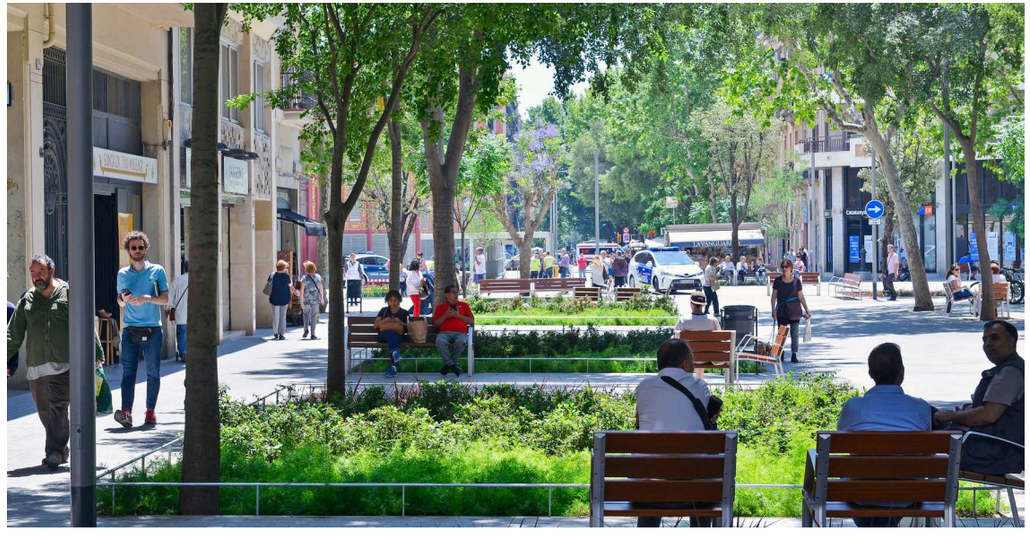
Cities can apply the framework in a modular way by focusing on targeted projects, while using the aggregated insights to inform citywide strategies, replicate successful models and guide long-term investment planning. This multi-functionality reinforces the idea that local change is most powerful when embedded in a coherent systemwide vision.

CITY CASE STUDIES

Cities are increasingly recognising the need to prioritise active mobility, public transit and other low-emission modes of travel to address climate change, improve public health and foster social equity. The following case studies are from cities that illustrate diverse and context-specific approaches to transforming urban mobility.

These case studies explore how cities around the world are experimenting with various mobility strategies—ranging from expanding public transportation networks and reclaiming streets for pedestrians and cyclists, to integrating green infrastructure and implementing data-driven mobility solutions. These examples highlight the importance of local context in shaping effective solutions while also demonstrating that certain principles—such as equity, accessibility and environmental sustainability—remain universal.

By studying how these cities navigate their unique circumstances, we gain valuable insights into the flexible, adaptive and forward-looking approaches required to create more liveable urban environments for the future. This diversity of strategies reinforces the idea that while the goals of sustainable mobility are shared, the paths to achieving them must be as varied as the cities themselves.



Pacified street within the Sant Antoni Superblock, where calmer traffic conditions have created safer, more inclusive spaces for residents.
Photo courtesy of Òscar Giralt / Ajuntament de Barcelona

CITY FEATURE

Barcelona, Spain

A city reclaiming streets for a sustainable future

Barcelona is widely recognised as one of Europe's leading cities for sustainable urban mobility. Its compact urban form and well-established grid system create a strong foundation for walkability and active travel. Over 80% of trips within the city are made by sustainable modes, including walking, cycling and public transport. The city's extensive public transport network, featuring metro lines, trams, buses and bike-sharing systems such as Bicing, ensures good multimodal connectivity for residents.

However, Barcelona's high level of car ownership within a limited amount of space has created unique challenges. Despite strong uptake of public transport and active mobility, the city has historically recorded some of the continent's highest rates of vehicle ownership per square kilometre—contributing to congestion, air pollution and noise.[75] In response, Barcelona has prioritised strategies to reduce car dependency and reclaim its streets for people.

Over the past two decades, Barcelona's mobility plans have focused on shifting away from car-centric planning towards people-centred streets, with the overarching goal of cutting carbon emissions and enhancing liveability. Under its Urban Mobility Plan (PMU) 2024 and Climate Emergency Declaration, Barcelona committed to a structural shift to reduce car dependency, reclaim public space and address environmental injustice as part of an integrated approach to climate and health. The collective interventions under the PMU, which include the expansion of both low-emission zones and the Superblocks model, demonstrate the value of aligning mobility policy with broader sustainability and resilience goals.

OVERVIEW (AS OF 2024)

AREA[76]

Barcelona (City)
100 km²

Barcelona Metropolitan Area (AMB)
636 km²

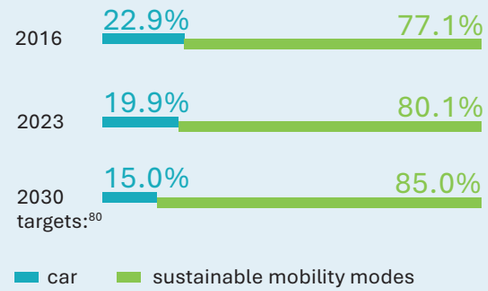
POPULATION[77,78]

City
1.7 million

AMB
3.4 million

BARCELONA AT A GLANCE

MODAL SHARE[79]



URBAN DENSITY[81]
City
16,637.5 residents/km²

VEHICLE DENSITY[82]
5,844 vehicles/km²

AVERAGE GREEN SPACE[83]
7 m²/resident

TARGETS FOR THE FUTURE

PMU 2025–2030[84]

The proposal for the next PMU uses journey pattern analysis for the first time, alongside enhanced data monitoring, to accelerate sustainable mobility adoption and the continued development of safe, equitable transport systems and public spaces—furthering Barcelona's environmental and mobility goals while enhancing urban liveability.

MAIN GOALS AND TARGETS

- Reduce private car use
- Improve air quality
- Expand liveable public space
- Cut urban inequalities

Sources: Ajuntament de Barcelona,[79,80,82,83,84] Àrea Metropolitana de Barcelona,[76,77] Instituto de Estadística de Cataluña[78,81] (see endnotes for citations in full).

BOX STORY

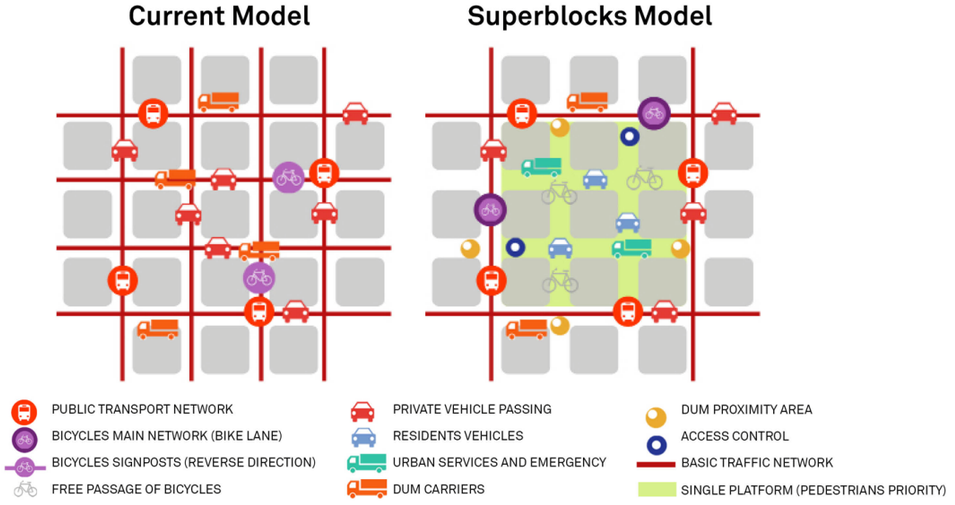
Superblocks: Catalysing Urban Transformation through a Multi-stakeholder and Data-Driven Approach

BACKGROUND

As one of Europe's densest cities, Barcelona has long grappled with a complex urban paradox— while its compact urban fabric supports high levels of walking and vibrant street life, it has also suffered from heavy car dependence and the environmental and health burdens that come with it. By the 2000s, Barcelona had one of the highest vehicle densities in Europe at approximately 6,000 vehicles per km^2 in some districts.[85] The consequences were far-reaching—persistent air and noise pollution, overcrowded streets, and a chronic shortage of accessible green and public spaces.

Air quality data consistently showed that levels of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) frequently exceeded European Union (EU) and World Health Organization (WHO) limits. A landmark health impact assessment in 2017 linked air pollution in Barcelona to approximately 1,200 premature deaths annually in the metropolitan area.[86] Meanwhile, motorised traffic was the single greatest contributor to urban noise pollution, with over 60% of residents exposed to levels above WHO guidelines.[87]

Compounding these environmental challenges was a critical lack of green and social spaces. Barcelona's average provision of public green space was about 7 m^2 per resident,[88] well below the WHO's minimum recommendation of 9–10 m^2 per resident, with much of this limited public space dominated by moving and parked vehicles. This not only limited opportunities for recreation, social interaction and physical activity, and posed significant road safety risks for the city's most vulnerable residents, but also amplified anthropogenic heat generation. Temperatures in the city centre could also be up to 8°C higher than surrounding areas, driven by the urban heat island effect,[89] further compounding health risks during increasingly frequent heatwaves.



Road space within the Superblocks is reclaimed to prioritise pedestrians and active mobility modes, and to introduce more public spaces for the community.
Image courtesy of Ajuntament de Barcelona

THE VISION FOR A CROSS-DOMAIN SOLUTION

Barcelona recognised that these intertwined challenges could not be tackled through isolated or large-scale infrastructure projects alone. The Superblocks (Superilles) programme emerged as a structural, cross-domain solution designed to deliver overlapping gains for air quality, noise reduction, safety, community well-being and climate resilience.[90]

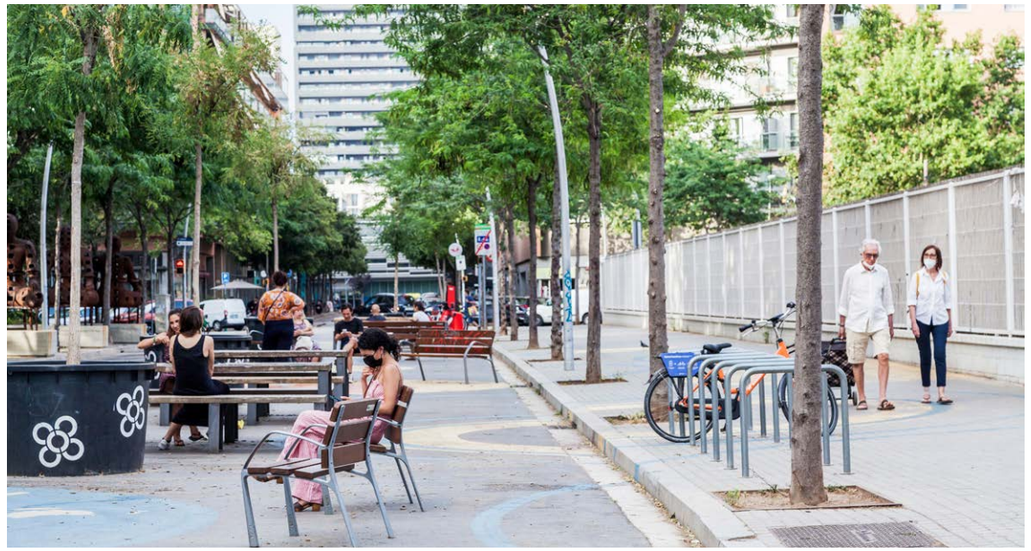
A Superblock consists of a group of typically nine city blocks (3×3) aggregated into a larger unit. Within each Superblock, through-traffic is restricted by design, with only local access permitted for residents, deliveries and emergency services. Motorised vehicles must enter and exit in the same direction, effectively eliminating shortcutting traffic and calming vehicle speeds to around 10–20 km/h within the Superblock interior.[91] Major through-traffic is redirected to the perimeter arterial roads, which are designed to absorb the redistributed flows.

This design reclaims up to 70% of former road space for pedestrians, cyclists, urban greenery, play areas and community use.[92] The model leans heavily on tactical urbanism interventions, such as paint, planters, bollards and movable street furniture, to deliver low-cost, adaptable and visible changes that transform streetscapes without large capital expenditure.

At its core, the Superblocks programme aims to:

- **Reduce air pollution:** By limiting through-traffic and prioritising walking, cycling and public transport, Superblocks lower local emissions and help the city comply with EU and WHO air quality thresholds.
- **Cut noise pollution:** Fewer vehicles and lower speeds within residential streets significantly reduce ambient noise, offering measurable health benefits for residents.
- **Expand accessible public space:** Reclaiming streets for people and greenery increases the area available for play, recreation and social life—vital elements in a city with limited green space.
- **Promote public health and well-being:** By creating more walkable, bike-friendly neighbourhoods, Superblocks encourage active mobility, reduce chronic disease risk and strengthen local social ties.[93]
- **Improve road safety:** Traffic calming, low speeds, and local-only vehicle circulation create safer streets for pedestrians, cyclists, children and the elderly.[94]

Children playing in the Poblenou Superblock.
Photo courtesy of Curro Palacios / Ajuntament de Barcelona



Reclaiming streets for play, recreation and social life—vital elements in a city with limited green space.
Photo courtesy of Curro Palacios / Ajuntament de Barcelona

EARLY ROLLOUT: LEARNING FROM THE FIRST THREE SUPERBLOCKS

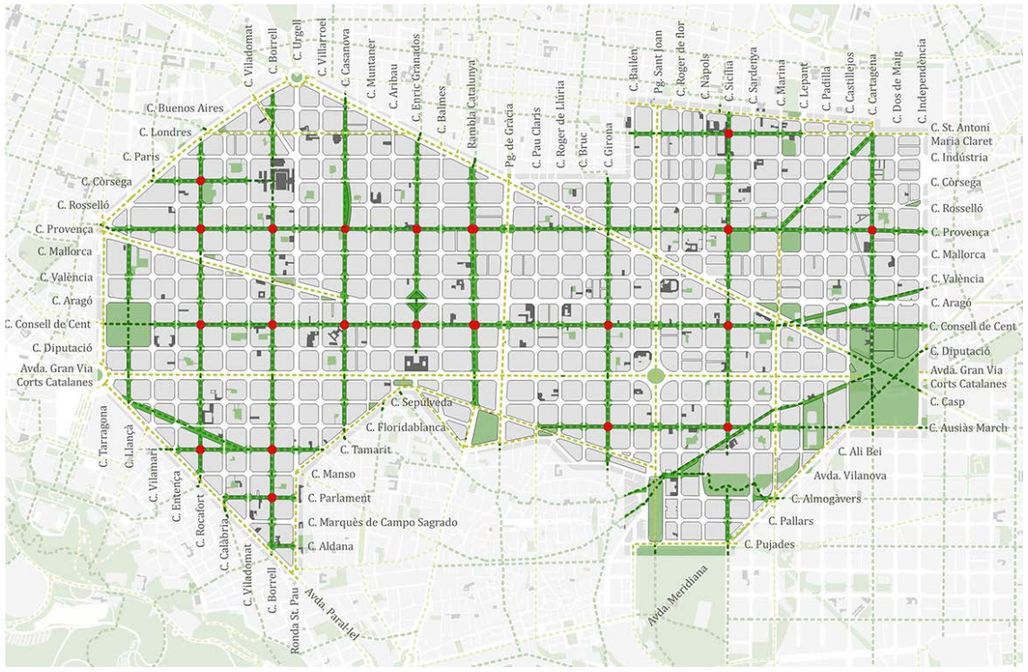
Between 2016 and 2019, Barcelona launched its first three Superblocks under the city's 'Omplim de vida els carrers' ('Let's Fill the Streets with Life') campaign in the diverse neighbourhoods of Poblenou, Sant Antoni and Horta.

The implementation of the first Superblock in the Poblenou neighbourhood faced considerable resistance from local residents. This was largely due to its ad hoc rollout, limited opportunities for community input, and concerns that improved liveability would drive up rents and property prices, leading to potential gentrification and displacement of long-term residents.

Learning from this, the City Council revised its approach in later phases. Citizen consultation and participation became core elements of Superblock planning and design, ensuring that local voices shaped each intervention. These early challenges highlighted the need for strong local governance, iterative design and meaningful citizen participation to ensure legitimacy and long-term support, which in turn helped build trust and acceptance. As a result, Superblocks in the neighbourhoods of Sant Antoni and Horta were much better received.

ADAPTING THE MODEL: GREEN AXES IN EIXAMPLE

Building on lessons from the first pilots, Barcelona adapted the Superblocks concept for the dense Eixample district—one of the city's most traffic-congested and pollution-burdened areas. Detailed studies of the area's street network, mobility flows and social fabric informed a more flexible strategy. Rather than pacifying two out of every three streets as originally envisioned, the Eixample plan prioritises reclaiming one in three streets from through-traffic to create a network of pedestrian-friendly green corridors and new urban squares.[95]



Planned network of Superblocks and Green Axes in Eixample district.
Image courtesy of Ajuntament de Barcelona

More people are using the pacified area of the Sant Antoni Superblock.
Photo courtesy of Òscar Giralt / Ajuntament de Barcelona

The Green Axes plan aims to rebalance Eixample's car-dominated grid by expanding tree cover, improving sustainable drainage, and transforming intersections into gardens and public spaces, aligning with Barcelona's vision of a 'city of proximity'—where everyday needs are accessible within short walking distances, and streets become places for social life, not just traffic. This multi-scalar, cross-domain design shows how traffic calming is integrated with green infrastructure, climate resilience and biodiversity goals.

According to the city's estimates, the Eixample Green Axes programme will create 21 new green corridors and 21 urban squares, adding nearly 0.4 km^2 of new pedestrian areas and greenery to the district.[96] By 2023, four major streets had already been transformed, and the concept has inspired a broader shift towards integrating Superblocks with complementary urban initiatives such as safer school streets, new cycling lanes, major avenue redesigns and new public parks.

Together, these expansions demonstrate that the Superblocks model is not a static blueprint but a flexible, evolving toolkit that can be adapted to local context, governance realities and lessons learnt on the ground.

Understanding the Cross-Domain Impacts of Superblocks

Barcelona's Superblocks demonstrate how a structural reorganisation of the street grid can generate transformative co-benefits far beyond transport alone and redefine how urban space can contribute to public health, environmental resilience and social equity.

Children's play area in the Poblenou Superblock.
Photo courtesy of Curro Palacios / Ajuntament de Barcelona

The performance of Barcelona's Superblocks is viewed through the framework as a demonstration of how a neighbourhood-scale mobility intervention can generate benefits that extend well beyond traffic flow.*

The weightages across the four pillars were derived retrospectively by applying the pairwise comparison to support the application of the framework on the Superblocks at Poblenou and Sant Antoni. A structured survey was administered to stakeholders from the public, private and people sectors to capture their priorities. In parallel, indicative weightages for citizen perspectives were inferred from findings in published studies (e.g., perception surveys and participatory evaluations). These weightages were not used in the original planning of the Superblocks, but serve to demonstrate how the framework can reflect local priorities in future applications.

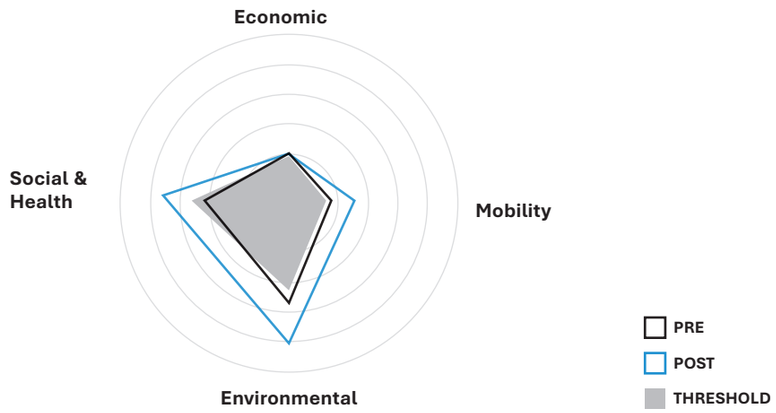
Pillar	Weightage	Rationale for Weighting
ECONOMIC	8.2%	Weighted lowest due to the fact that the Superblocks were not primarily focused on increasing economic activities in the neighbourhood.
MOBILITY	20.0%	Motorised traffic was seen as a huge contributor to Barcelona's environmental and public space challenges. Reducing car dependency and reorganising street space were essential structural interventions to address wider goals around liveability, safety and equity.
ENVIRONMENTAL	35.9%	Assigned the highest weighting due to strong stakeholder concern over air pollution, noise and climate risks; reflects the priority placed on environmental justice and sustainability goals.
SOCIAL & HEALTH	35.9%	Given equal emphasis as the environment pillar, recognising the role of Superblocks in improving well-being, safety, social cohesion and public health outcomes.

* Because the framework is designed to capture interlinked outcomes, we draw on a mix of data and insights from our own tests as well as published research, including health impact studies, urban monitoring and recent analyses to build a more complete picture.

Barcelona's Superblocks highlight how mobility interventions can deliver overlapping gains across health, environment, and social equity.
Photo courtesy of Òscar Giralt / Ajuntament de Barcelona

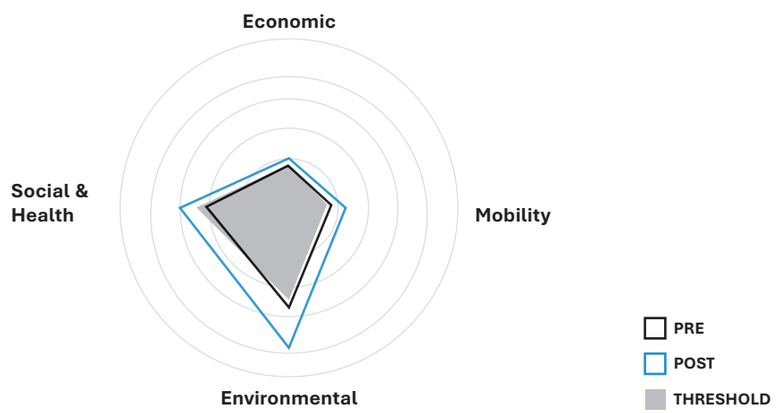
Cyclist in the Poblenou Superblock.
Photo courtesy of Clara Soler Chopo / Ajuntament de Barcelona

SANT ANTONI		PRE	POST	THRESHOLD
Pillars	Economic	5.3	5.3	4.9
	Mobility	5.1	7.4	4.2
	Environmental	12.1	17.3	10.8
	Social & Health	10.0	15.2	12.1
Total Scores		**32.5**	**45.2**	**32.0**



Results for the Sant Antoni Superblock, assessed through the framework.

POBLENOU		PRE	POST	THRESHOLD
Pillars	Economic	4.9	5.7	4.9
	Mobility	5.0	6.8	4.2
	Environmental	11.2	17.0	10.8
	Social & Health	9.5	13.3	12.1
Total Scores		30.6	42.8	32.0



Results for the Poblenou Superblock, assessed through the framework.

Superblocks: Cross-Domain Impacts at a Glance

ECONOMIC

While not a primary objective of the Superblocks programme, some economic benefits have emerged at the neighbourhood level. Improved street environments and reclaimed public space have supported local foot traffic and retail vitality in Sant Antoni and Poblenou.

However, economic gains were relatively modest compared to other impact areas, likely reflecting the fact that the intervention was not explicitly designed to boost local commerce. At the same time, enhanced liveability has raised concerns over rising rents and the risk of displacement, highlighting the importance of coupling urban design with housing and equity safeguards.[97]

MOBILITY

An evaluation of the Sant Antoni Superblock between 2018 and 2023 revealed that car traffic fell by around 20% in the neighbourhood, freeing up streets for walking and cycling.[98] These changes have led to a measurable increase in active travel, with more residents feeling safer and choosing to walk or cycle for short trips, especially in areas where improvements in street design were accompanied by green space enhancements and traffic calming. This has enabled safer, slower and more continuous movement within neighbourhoods, particularly for children, older adults and other vulnerable groups.[99]

However, while mobility conditions inside Superblocks have improved, displaced traffic on boundary roads remains a challenge and raises concerns about congestion and air quality outside the intervention zone.[100]

ENVIRONMENTAL

Air pollution impacts varied across Superblocks. In Sant Antoni, NO_2 levels fell by 25% and PM_{10} by 17%, alongside reductions in noise. In Poblenou, while measured changes were limited, residents perceived a noticeable reduction in pollution, particularly noise. As of 2020, air quality improved significantly in areas where the Superblocks were implemented and noise exposure fell as streets were calmed and traffic volumes dropped.[101] These gains have helped narrow exposure inequalities, particularly in areas historically burdened by pollution, bringing the scores for the environmental pillar up to the threshold level but leaving room for improvements.

However, recent air pollution modelling suggests that these gains may not be uniform across the city. Studies cautioned that reductions in NO_2 concentrations within Superblocks may be offset by increases in surrounding areas due to traffic re-routing.[102] This highlights the importance of planning and scaling Superblocks alongside broader demand reduction measures, such as congestion charging or prioritisation of active mobility modes, to ensure system-wide environmental gains. Urban heat continues to remain a challenge due to Barcelona's dense fabric, underscoring the need to further expand urban greenery infrastructure.

SOCIAL & HEALTH

The Superblocks have delivered wide-ranging health and social gains by shifting streets from mere transit corridors to spaces for gathering, play and connection. In Sant Antoni and Poblenou, residents reported longer dwelling times and more diverse public space use, especially among families, children and older adults.[103] In Poblenou, for instance, families and office workers repurposed new spaces for play and informal gatherings. Where co-creation processes were embedded, residents described stronger social ties and a deeper sense of community ownership.[104]

Qualitative evaluations highlighted that residents not only moved through these streets, but lingered, interacted and reclaimed them for daily life. These changes were accompanied by improved perceptions of safety, vibrancy and accessibility, particularly among vulnerable groups.[105] However, some groups, particularly youth, felt less represented in redesigned spaces, highlighting the need for inclusive placemaking. Early resistance also underscored concerns over gentrification, prompting later projects to adopt stronger community participation frameworks.

A citywide health impact assessment found that full implementation could prevent 667 premature deaths annually, primarily through reductions in air pollution, traffic noise and heat exposure, alongside increased physical activity and access to green space. This translates to an average life expectancy gain of nearly 200 days and €1.7 billion in annual savings.[106]

CITY FEATURE

London, United Kingdom

A city rethinking local streets for health, equity, and climate

London is often recognised as a leader in urban transport innovation. Its world-famous Tube, dense bus network and growing cycleway grid have helped make sustainable modes the backbone of daily travel. On paper, the city's goals are ambitious: by 2041, 80% of all trips should be made on foot, by bike or on public transport—a dramatic shift from the car-dependent patterns that took hold in the mid-20th century.[107]

Yet London remains one of the most congested cities in Europe. According to the INRIX 2023 Global Traffic Scorecard, drivers in London lost an average of 156 hours to congestion in 2022— more than any other UK city and near the top globally.[108] This traffic saturation comes with stubborn side-effects—transport is London's largest source of carbon emissions, motor vehicles are the biggest contributor to illegal nitrogen dioxide levels, and neighbourhood-level pollution disproportionately affects low-income communities.

These challenges are compounded by an 'inactivity crisis' that is estimated to cost the National Health Service over £0.9 billion every year.[109] By 2014, Transport for London (TfL) data showed that many short trips that could be walked or cycled were still made by car, particularly in Outer London.[110] Road danger, lack of protected infrastructure, and hostile street environments were key barriers to more active travel, particularly for women, children and older people.[111]

While policies like the congestion charge zone (introduced in 2003) helped manage traffic in the central area, local streets, which make up 80% of London's road network, remained vulnerable to rising 'rat-running'—where drivers use residential streets to bypass congested main roads.[112] Studies showed that up to a third of motor traffic in some boroughs was through-traffic, bringing noise, air pollution and road danger to streets never designed for heavy flows.[113]

Addressing these challenges required a clear, people-centred framework for rethinking what streets should do. London's Healthy Streets Approach, embedded in the Mayor's Transport Strategy (MTS), provides this link by connecting citywide goals with local action to make streets healthier, safer and more inviting for everyone.

LONDON AT A GLANCE

AREA[114]

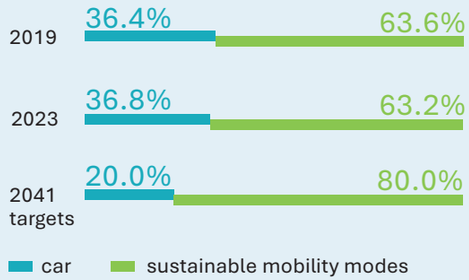
Greater London
1,572 km²

POPULATION[115]

Greater London
8.9 million

BY THE NUMBERS

(TRIP-BASED) MODAL SHARE[116]



URBAN DENSITY[117]

5,690 people per km²

PRIVATE CAR OWNERSHIP[118] (AS OF 2023)

Outer London:
66% of households

Inner London:
37% of households

ULTRA LOW EMISSION ZONE COVERAGE

100% of Greater London as of 2023

TARGETS FOR THE FUTURE

MAYOR'S TRANSPORT STRATEGY (MTS)

Sets out a plan for how the city will shift towards sustainable mobility, with an emphasis on walking, cycling, and other forms of active mobility.

MAIN GOALS AND TARGETS

- Improve air quality and enhance public health
- Reduce car dependency
- Transition to zero-emission bus fleet by 2034

Sources: Transport for London (TfL),[116,118] Greater London Authority[114,115,117] (see endnotes for citations in full)

The Healthy Streets Approach recognises that streets are not just routes for traffic, but vital public spaces that shape the health, well-being and resilience of communities.[119] It addresses the growing need for a human-centred model of urban mobility that incorporates health, well-being and liveability into urban planning, and advocates for urban environments that prioritise people.

By encouraging walking, cycling and social interaction while reducing the dominance of cars, the approach helps London move towards its goals of healthier streets and more sustainable transport systems that enhance quality of life for all Londoners. Drawing on evidence from public health, urban design and transport planning, the framework sets out ten indicators—from clean air and easy crossings to safer streets and more places to rest—that define what makes a street truly supportive of walking, cycling and everyday social life.[120,121]

The indicators are adaptable and can be applied across different street contexts, from bustling urban centres to quiet residential streets. They provide a comprehensive means of evaluating streets in ways that go beyond simple traffic counts—looking at how inclusive, equitable and healthy an environment is for all users.

The MTS commits London to embedding these Healthy Streets indicators into all aspects of local transport and land use planning. Initiatives such as the Ultra Low Emission Zone (ULEZ), bus priority corridors, expanded cycle networks and Low Traffic Neighbourhoods (LTNs) all aim to deliver on this vision—shifting trips away from cars and towards more active, low-carbon modes while making streets more inclusive and attractive for all Londoners.

At the neighbourhood scale, LTNs are a practical example of how the Healthy Streets Approach is put into practice. By calming traffic, they create safer, quieter spaces that encourage walking and cycling, reduce exposure to pollution, and enable people to spend more time in the public realm.

BOX STORY

Low Traffic Neighbourhoods: Reclaiming Local Streets

BACKGROUND

In London's journey towards becoming a healthier, climate-ready city, Low Traffic Neighbourhoods (LTNs) emerged as a practical tool to reclaim residential streets for people. They build on decades of growing recognition that the city's residential streets had become dominated by cars in ways that undermined local health, safety and liveability—despite falling car ownership in many neighbourhoods.

At their core, LTNs aim to reduce through-traffic on residential streets by installing planters, bollards, or camera-enforced modal filters to stop through-traffic, while keeping streets fully accessible to residents, deliveries and emergency services. In doing so, LTNs create quieter, safer and more liveable streets for local residents, including those who walk or cycle as part of daily life.

Modal filters on a road in Kingston upon Thames, one of the boroughs with LTNs.
Photo courtesy of Jack Fifield (CC BY-2.0) / Wikimedia Commons

THE ORIGINS OF LOW TRAFFIC NEIGHBOURHOODS

The roots of LTNs lie in London's early experiments with local street interventions that would complement its bigger structural measures, such as the Ultra Low Emission Zone (ULEZ) and expanding cycle networks. Early programmes like the Mini-Holland pilots launched in 2014 in boroughs like Waltham Forest, Kingston and Enfield were inspired by Dutch design and served as early examples of LTN-style schemes. They combined filtered streets, safe crossings and protected cycle lanes to create neighbourhoods that facilitated walking and cycling. These early trials showed measurable gains—higher active travel rates, better air quality, fewer collisions and stronger community ties—but they also highlighted the need for careful consultation and design before implementation.[122,123]

When COVID-19 hit in 2020, the city faced a new imperative—keeping people moving safely while public transport capacity was reduced. The UK government's Emergency Active Travel Fund provided boroughs with resources to implement tactical interventions quickly, including LTNs.[124] More than 100 LTNs appeared across London in less than a year—an unprecedented test of the Healthy Streets Approach in action at the neighbourhood scale. But they also revealed challenges around rapid rollouts, perceived fairness and how to manage displaced traffic on boundary roads—challenges that continue to shape how London refines its approach today.

EARLY PILOTS: LEARNING FROM WALTHAM FOREST AND EALING

LTNs have been rolled out in recent years in many areas across London, including Camden, Croydon, Ealing, Hounslow, Lambeth, Newham and Waltham Forest. However, while LTNs are an integral part of London's move towards sustainable transport, they have been met with mixed responses owing to a number of factors, such as concerns about increased traffic on surrounding roads, emergency services delays and their impact on local businesses.

Waltham Forest, one of three boroughs awarded "Mini-Holland" funding in 2014, pioneered a more structural, area-based approach to calming local streets. Inspired by Dutch filtered-permeability design, the borough combined LTNs with segregated cycle routes, pocket parks and pedestrian improvements under the banner "Enjoy Waltham Forest". Early resistance gave way to broad local support as residents experienced quieter streets, cleaner air and safer spaces for walking and cycling. By 2020, the borough had recorded significant rises in active travel and improvements in air quality and road safety—evidence that reclaiming local streets could deliver cross-domain gains when supported by

Crowds outside Ealing Council House protesting the LTN scheme in 2021.
Photo courtesy of Roger Green (CC BY-SA 4.0) / Wikimedia Commons

In contrast, Ealing's experience during the pandemic era highlights the risks of rolling out multiple LTNs at speed without robust engagement. Ealing used emergency powers in 2020 to install nine LTNs to encourage walking and cycling. But concerns about increased traffic on boundary roads, emergency service access and impacts on local businesses triggered strong resident pushback. Mass protests and a local referendum led to the removal of most schemes within a year—showing that even well-intentioned LTNs can struggle without clear communication, trusted local champions and measures to manage spillover effects.[127]

The mixed experiences of Waltham Forest and Ealing highlight the need for effective communication with careful phasing and implementation, underpinned by strong governance. In the years since these early rollouts, several London boroughs have taken these lessons to heart by refining community consultation processes, investing in better monitoring of traffic displacement, and combining LTNs with wider improvements such as boundary road crossings, new cycle routes or public realm upgrades.

At their best, today's LTNs demonstrate how small, tactical changes to local streets can deliver co-benefits that go far beyond traffic flow, strengthening London's Healthy Streets Approach and showing how neighbourhood design, public health and social equity can work hand in hand.

Understanding the Cross-Domain Impacts of LTNs

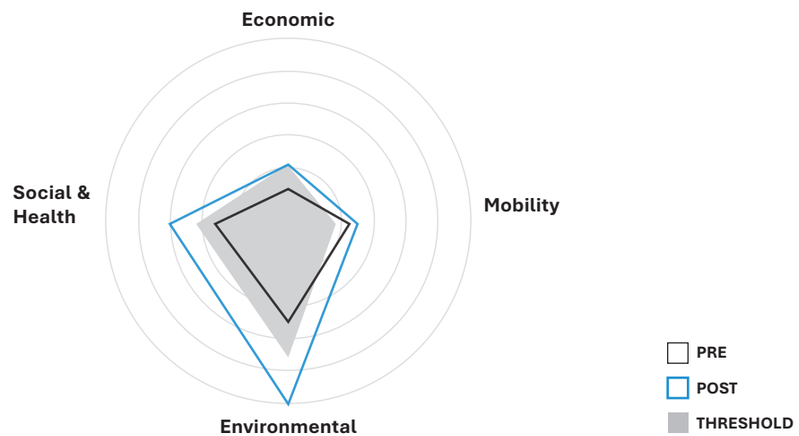
The significance of LTNs extends far beyond localised traffic management—they represent how modest and tactical interventions to calm traffic on residential streets can deliver benefits that cut across transport, health, environment and community well-being, at the scale of the local street. This section applies the cross-domain framework to evaluate LTNs across four key pillars. Indicative weightages were derived retrospectively using the pairwise comparison, to reflect both the intent and impact of the LTNs, enabling a reasoned allocation of pillar weightings to support post-hoc comparison and interpretation.*

Pillar	Weightage	Rationale for Weighting
ECONOMIC	8.0%	Economic uplift was not a primary goal of LTNs and has not been consistently measured. While some areas reported increased footfall, economic impacts were place-specific.
MOBILITY	20.0%	Improving access through reduced traffic, improved cycling, and safer walking routes was central to the LTN model and a core metric in TfL's Healthy Streets indicators.
ENVIRONMENTAL	36.0%	Environmental improvements such as reduced air and noise pollution were seen as valuable co-benefits, though they were not always evenly experienced (e.g., due to boundary effects).
SOCIAL & HEALTH	36.0%	Health, safety and inclusion were dominant framing elements across policy, evaluation and communications—from increased walking to reduced injuries and stronger communities.

* The indicative weightings for London's LTNs were derived retrospectively using a triangulated approach. This drew on: (i) strategic framing in policy documents such as the Mayor's Transport Strategy and TfL's Healthy Streets Approach; (ii) recurring themes in evaluation studies (e.g. *BMJ, Journal of Transport & Health*, borough-level reports); and (iii) emphasis areas in public monitoring and communications.

Street improvements in Walthamstow Village under the Mini-Holland trial.
Image courtesy of UK Government, Open Government Licence v3.0

LONDON		PRE	POST	THRESHOLD
Pillars	Economic	3.2	5.3	5.4
	Mobility	6.0	6.5	4.6
	Environmental	8.8	15.4	12.1
	Social & Health	7.0	11.6	9.2
	Total Scores	25.0	38.8	31.3



Results for London's LTNs assessed through the framework.

LTNs: Cross-Domain Impacts at a Glance

ECONOMIC

While robust citywide data remains limited as economic impacts of LTNs have not been studied extensively, the potential economic benefits of increasing walking and cycling are recognised. Conditional on the receptiveness of LTNs, property values in the surrounding areas and footfall traffic at local establishments are expected to increase.

Survey results from LTNs in Birmingham, Bournemouth, Ipswich and Salford showed a moderate economic uptick, with 14% to 17% of respondents visiting local dining places and shops more frequently after implementation.[128] Despite tangible economic benefits, there is awareness that public improvements need to safeguard against gentrification, potential decline in footfall if the scheme is not well-received, and rising rents that could price out local businesses.[129]

MOBILITY

According to London-wide studies, the median number of vehicles on the roads have decreased from 1,200 per day to 650 in LTNs, with minimal impacts on peripheral traffic.[130,131] In addition, residents living inside LTNs have shown behavioural shifts towards active modes.

A longitudinal study from 2017 to 2021—taking into account the effects of the COVID-19 pandemic on travel patterns—to study the impacts of the "mini-Hollands" boroughs found that people walk or cycle more often, with average walking and cycling time increasing by up to 66 minutes and over 20 minutes, respectively, compared to control areas.[132] Many short car trips have been replaced by local journeys on foot or by bike, supporting London's Healthy Streets targets. These modal shifts further translate into environmental benefits—like improved air quality—as well as safer and healthier streets for residents.

ENVIRONMENTAL

Air pollution levels, particularly nitrogen dioxide (NO2), have dropped inside many LTNs. Those in the borough of Islington saw an average decline of NO2 by 8.9% and 5.7% at the periphery and within the boundaries when compared to control groups.[133] However, there are boroughs that experienced mixed effects—with the peripheries of the LTNs experiencing no change or even increasing levels of NO_2,[134] underscoring the need to balance potential trade-offs in air quality on boundary roads if broader network management is not in place

SOCIAL & HEALTH

A recent analysis found that road injuries in London fell by around 35% and 2% in the LTNs and at its boundaries, respectively, demonstrating that removing through-traffic makes streets safer for people walking and cycling.[135]

A survey commissioned by the Department for Transport in London found that over 40% of residents residing within LTNs in the Birmingham, Bournemouth, Ipswich and Salford boroughs experienced an increase in road safety, improved air quality, as well as reduced traffic noise and traffic congestion.[136] The cleaner air, lower noise levels, and additional space for play and social life contribute to everyday health gains. Among respondents, 31% agreed that the LTNs helped foster a sense of community in the neighbourhood, while 29% felt LTNs improved social ties.[137]

OVERALL IMPACTS

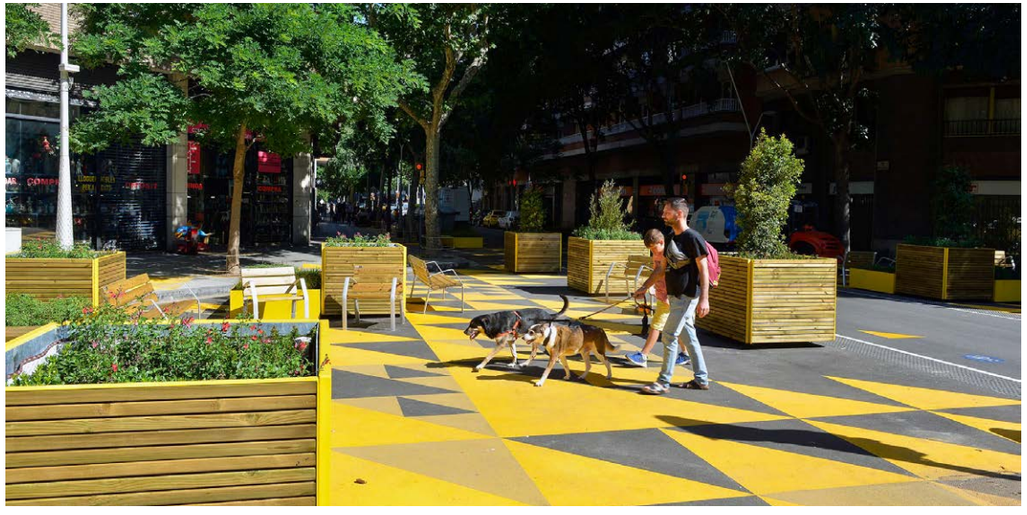
Despite the LTNs in London showing promising impacts across the four pillars, the extent to which the benefits are experienced are largely borough dependent. For instance, survey findings from Birmingham, Bournemouth, Salford and Ipswich revealed that while the first three areas demonstrated positive outcomes from LTNs, Ipswich, in contrast, showed significantly lower benefits.[138] The variation in outcomes suggests that understanding potential gaps in LTN implementation and enhancing public engagement could lead to more uniform benefits experienced across all London neighbourhoods.

LESSONS LEARNT:

Bridging the Gaps with a Cross-Domain Lens

Barcelona's Superblocks and London's LTNs both highlight why cities must look beyond standard tools like CBA to truly capture the value—and trade-offs—of reclaiming streets for people. While CBA remains a vital tool for assessing financial viability and economic returns, it can overlook critical co-benefits and ripple effects across pillars.

Evidence from Barcelona and London shows that neighbourhood-scale interventions generate far-reaching gains that do not always fit within conventional economic models. Barcelona's Superblocks have delivered significant improvements in air quality, noise reduction and local safety, while London's LTNs have helped cut road injuries by around 17% and boosted walking and cycling. Yet both cases also reveal potential side effects—from displaced traffic on boundary roads to rising property values that risk indirect displacement if not properly managed.



Barcelona's Superblocks highlight how mobility interventions can deliver overlapping gains across health, environment and social equity.
Photo courtesy of Òscar Giralt / Ajuntament de Barcelona

Pairing CBA with a robust MCA or cross-domain lens provides a fuller picture of what changes as a result of sustainable mobility interventions, and for whom. This approach makes it easier to:

- Surface co-benefits that are real but not easily monetised, such as better respiratory health, quieter streets, safer spaces for children or stronger community ties.
- Detect trade-offs like traffic displacement, boundary road impacts or gentrification pressures.
- Reinterpret 'negative' signals such as slower vehicle speeds or longer journey times which may register as costs in standard models, but actually indicate safer, more people-friendly streets.

A cross-domain lens helps planners focus on questions like:

- Are apparent losses actually trade-offs that unlock wider community gains?
- Do benefits reach those who need them most—especially vulnerable or historically under-served groups?
- Are mobility changes reinforcing broader climate, health and equity goals, not just financial returns?

Barcelona's Green Axes reclaim road space for public squares and urban greenery.
Photo courtesy of Laura Guerrero / Ajuntament de Barcelona

Putting the Cross-Domain Lens into Practice

Cities can use simple cross-domain checks to complement standard CBA by pairing each metric with wider social, environmental and equity indicators:

CBA METRIC	COMPLEMENTARY CROSS-DOMAIN METRICS	KEY QUESTIONS
Travel time savings	Average vehicle speed; pedestrian activity levels	Are slower speeds creating safer, more inviting streets?
Vehicle throughput	Mode share for walking and cycling; local air/noise levels	Does reduced car flow support health and sustainability?
Property value uplift	Social diversity index; affordability measures	Is revitalisation pricing out long-term residents?
Operating cost savings	Local retail footfall; small business revenue	Are savings strengthening local economies and social vibrancy?
Revenue from retail or small businesses	Noise levels; increased footfall	Is increased footfall creating a greater nuisance for residents?
Accident rates	Perceived safety; physical activity trends	Are fewer collisions encouraging active travel for all ages?
Infrastructure cost per user	Public space per capita; green space gains	Do costs unlock climate resilience and liveability benefits?
Noise nuisance cost	Residents exposed to noise above WHO limits	Who benefits from reduced noise and who might be left out?

The Barcelona and London cases show how this mindset works in practice:

- In Barcelona's Poblenou Superblock, slower traffic speeds initially appeared as a 'loss' in conventional models—yet they dramatically improved pedestrian safety and reduced noise exposure.[139]
- In London's Waltham Forest, residents living within LTNs increased weekly walking time by up to 66 minutes and cycling by over 20 minutes compared to control areas, helping tackle the city's inactivity crisis while also cutting road injuries.[140]
- Both cities also show that without strong governance and social safeguards, new public realm improvements can drive up local rents, displacing those who stand to benefit most from healthier, greener streets.[141]

When combined with good governance, robust community engagement and a commitment to equitable distribution of benefits, a cross-domain lens helps cities capture what really matters—healthier, safer and more resilient urban streets for everyone.

Photo courtesy of Teo Zhiyi

05

CONCLUSION

Measurement in urban planning has long prioritised easily quantifiable variables such as cost, travel times and emissions. But truly sustainable, people-centered cities demand metrics that reflect lived experience, social connection and community well-being. Expanding what is measured is key to reshaping what is valued.

Measuring and tracking outcomes that enhance liveability is key to demonstrating the wider value of urban interventions.
Photo courtesy of Tian Ying Lee

Why Measurement Matters

As cities reimagine their transport systems for a more sustainable future, it is not only the *interventions* that must evolve—so too must the *ways that we measure their impact*. What we measure, and how, signals what we value. Especially in dense urban environments where trade-offs are inevitable, the true value of a mobility intervention lies in its ability to support liveability, resilience and equity goals.

The experiences of Barcelona and London show that these wider benefits are not abstract—they are measurable and transformative. They offer a proof of concept—that new ways of measuring can capture broader value and guide more integrated, people-centred interventions.

This shift is already underway. From comprehensive frameworks that embed well-being and climate goals into project evaluation, to grassroots approaches that capture lived experience and local economic benefits, cities are beginning to redefine what counts as value in mobility. By adopting a cross-domain lens, co-benefits can be embedded up front as core design criteria. Measurement, in this sense, becomes more than a technical exercise—it is a tool to steer change, align institutions and build public trust.

By expanding how we define and measure success, cities can unlock new ways of designing and delivering mobility—ones that prioritise people, places and the shared promise of a more liveable urban future.

OPINION

Start with the street

Dan Hill
Director,
Melbourne School of Design,
University of Melbourne

Watch any old film of a city street a hundred years ago, and you discover a rich, diverse and fluid set of interactions and relationships unfolding, weaving across and within the street. Instantly, we understand that the street was, for centuries, a truly public space, full of possibility and promise, capable of adapting and flexing in real time, where ideas and cultures collided. We see children playing, people chatting, other animals, trees, commerce and exchange, theatre and music, cooking and eating, intrigue, excitement, solitude, attraction, reflection, experimentation, logistics, maintenance, idleness, invention, energy … the practices of everyday life. Decades later, the dynamic of the street was captured in Jane Jacobs's famous phrase, reflecting on the improvised and emergent choreography outside her window: 'the ballet of the street'.

That all changed, in decisions made quickly and carelessly during the 1930s, driven by the new technology of the motor car. City planners ignored the architect Cedric Price's artful dictum from 1965: 'Technology is the answer. But what was the question?' Rather than asking how particular cities should best move around—and thus what they are about, for whom, why, and who decides?—streets became mere corralled avenues for motor traffic, as if the city's primary role was to 'induce demand' for the automobile industry. The loss of *true* value was immense, though rarely considered next to the blunt metrics of car sales, vehicle miles travelled and commute times.

Now that we are nearing the end of that cycle of domination by the motor car, that most 20th century of technologies, we can ask these questions again, for the 21st century. How should a city best move around? How might a *particular place* move around? How to recapture the dynamic of street as public space, but by moving forward rather than reversing into the ghostly cul-de-sacs of the near past?

ERRANDS AND EPIPHANIES

A few key principles may help. Focus on the street first. Use its sense of possibility to reframe mobility technologies. Finally, address the complex questions that emerge around the outcomes of shared value and values.

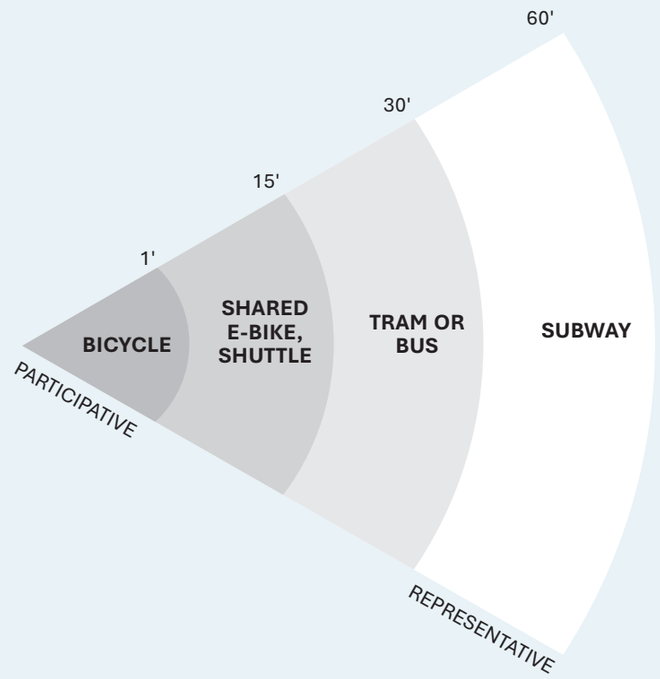
The street is typically a city's largest public space, and certainly its most meaningful, generative and enriching. We must balance its utilitarian functions—milk being delivered to a coffee shop at 5 a.m.; street-cleaning robots sweeping up glass; security guards cycling home; stormwater seeping into bioswales; trees quietly acting as health workers—with its wider cultural and civic purposes. For streets are places where the city plays out, where value is generated, and values are revealed. As the writer Rebecca Solnit suggests, *"The magic of the street is the mingling of the errand and the epiphany"*.[142] Within that complexity are multiple kinds of value, contained in those 'errands', the jobs that make the city spin, and 'epiphanies', the highly qualitative and intimate reasons why people value city life.

The street is typically a city's largest public space, and certainly its most meaningful, generative and enriching. We must balance its utilitarian functions—milk being delivered to a coffee shop at 5 a.m.; street-cleaning robots sweeping up glass; security guards cycling home; stormwater seeping into bioswales; trees quietly acting as health workers—with its wider cultural and civic purposes.

While working at Vinnova, the Swedish Government's innovation agency, we created a 'mission'[143] to retrofit all the streets in the country such that they are 'healthy, sustainable, and full of life', aware that, as the street tangles all systems together, this would mean, in turn, rethinking essentially everything about how cities work. Focusing on the street can connect up our positions and dispositions: we can use the street to forge a joined-up, care-based and upstream approach, allowing us to invest in health-producing—meaning 'health' in a broad sense, for people, place, nature—rather than health-diminishing environments.

The project's 'theory of change' balanced tactical urbanism techniques with strategic design, drawing together all levels of government across multiple agencies, disciplines and functions

with large companies like Volvo Cars and startups like Voi, universities, community groups and citizens.[144] As it was applied across a series of differing streets in almost a dozen cities over two years, its key move was to let the citizens of the street retrofit their own street: *the street designs the street*. After all, these people, whether 8-year-olds or 80-year-olds, are the true experts in their own streets. They possess a quite different form of knowledge—grounded, implicit, ambiguous, alive, relational, embodied—as compared to that of the traffic planner's, which is typically abstracted, distanced, atomistic, explicit, transactional. The work of psychiatrist and neuroscientist Iain McGilchrist suggests that these are two knowledge systems at play, which might benefit from a careful mutual interlocking. Foregrounding citizen expertise is a reversal of the typical power balance, of course, requiring quite different public capabilities and sensibilities—designers, planners and bureaucrats support citizens in a co-creative relationship, but it is citizens that actually own the street, and its questions. They are the street.



Place layers organising mobility and governance cultures across scale and time, in '1-15-30-60-Minute Cities'.
Image courtesy of Dan Hill[145]

We called this citizen-led retrofit programme 'The One Minute City'. The city right outside your front door—your street and surrounds—is something you might have an intimate, participative relationship with, far more than with a '15-Minute City'[146] which, for all its many clear virtues, is largely orchestrated by representative municipal teams on your behalf.[147]

To organise these gradients of governance modes, we devised the concept of 'place layers',[148] adapting the place layers concepts of British architect Frank Duffy and American writer Stewart Brand and laying it over urban space, to suggest an arrangement of these different cultures of decision-making for different scales, conditions and technologies. Place layers allowed us to explore what might be truly owned, designed, maintained and managed locally, via participative cultures and systems at the 1–15-Minute City scale, and what requires representative forms of governance, capital, management and infrastructure at the wider scales: say, the 60-Minute City of subways and watersheds.

Giving citizens an appropriately free hand with the designer's pen, and guided by an imperative to address shared systemic challenges, our work showed that people overwhelmingly chose to remove many cars from streets in favour of making more convivial social spaces and healthier green places that are supported by lightweight, affordable and shareable mobility. Citizen approval rating for redesigns hovered around 75% in favour, with only 3% strongly against, and the activity on the retrofitted streets increased by 400% post-design implementation.[149]

Giving citizens an appropriately free hand with the designer's pen, and guided by an imperative to address shared systemic challenges, our work showed that people overwhelmingly chose to remove many cars from streets in favour of making more convivial social spaces and healthier green places that are supported by lightweight, affordable and shareable mobility.

TECHNOLOGY IS THE QUESTION

So, the presence of vehicles *can* be broadly shaped *by* the street, reversing the dynamic of the last century in which *vehicles* shaped the street. But 'starting with the street' does not mean ignoring technology. Rather, we must pay *greater* attention to particular mobility technologies—whether large cargo bikes or large language models—that can help achieve these shared outcomes. After all, technologies tend to change the city more than any architect or urban planner has done. So, we need a new capability here too, with a sensibility for both mobility technologies and the street, in symbiosis.

Palla moped, Shanghai street, late September 2024.
Photo courtesy of Dan Hill

The new possibilities in small electric and human-powered vehicles—bikes, e-bikes, shared city bikes, e-scooters, trolleys, three-wheeler and four-wheeler micro-cars, Kei-class vans, occasional pockets of electric cars and buses—allow us to recapture the essence of the street as a fluid and adaptive space tuned to both errand and epiphany. These vehicles are generally cheap, lightweight, interchangeable and accessible. They exemplify the qualities of the '£100 technologies' that economist E.F. Schumacher wrote about in his *Small is Beautiful* (1973),[150] with its key principles of *"energy-efficient, environmentally sustainable, and locally autonomous … a technology with a human face"*. Such adaptive and convivial vehicles bring human faces back into the street. How do we design with them?

THE NEW VALUE, AND VALUES, OF THE STREET

In all this new diversity, we might spy a new 'value model' for streets around the corner. We sketched out such a model in the Swedish work, realising we needed a clear statement to capture a richer set of outcomes, framed around the shared goals implied in 'every street is healthy, sustainable and full-of-life'.

We unpacked those high-level mission outcomes to a series of sub-goals—health and well-being, biodiversity, environment, maintenance, physical activity, property, commerce, learning and social fabric—which might be supported by numerous research-backed elements, such as an increase in neighbourhood tree canopy and diversity leading to better overall health, mediated by lower obesity and respiratory illnesses, better social cohesion, reduced urban heat island effect, etc., or greener streets boost children's immune systems and learning abilities, or a decrease in road traffic noise and corresponding increase in birdsong leading to an increase in mental health, recovery from illness, and life satisfaction, and so on.

We collated hundreds of research articles, supporting around 50 data points, yet barely scratched the surface. Still, such research is rarely brought to bear, creatively and coherently, around shared spaces like streets. But as cities look to transform streets back into more diverse public places—and forward into more *biodiverse* spaces—integrating this research might help shift the ways we understand value, and the values that underpin it, and how we articulate places, design for places.

This subtle shift to outcome-oriented approaches led to the development of a prototype urban design tool called Streetmeter.[151] At this stage, it is no more than a deliberately simple interface that might enable urban designers—whether professional planners or citizen amateurs—to adjust basic street conditions such that they might be tuned around shared outcomes. As with any meaningful prototype, it is not yet the answer—but it is a good question. (We've built a similar digital twin here in Australia, deploying 'proximity-based city' principles for the better planning of housing and neighbourhoods.)

Integrating this research might help shift the ways we understand value, and the values that underpin it, and how we articulate places, design for places.

Prototypes like Streetmeter, or our twin, can usefully weave data into drawings, but they are really tools to support discussion rather than spit out technical plans, because we must be careful with metrics. Obsessing over the quantification of complex urban environments tends towards a functionalist view of cities—and thus to functionalist approaches to planning and governing cities, framing them with the logics of efficiency, control or scientism. Cities are not *about* efficiency. If they are about anything, it is culture, conviviality, community—perspectives largely beyond quantification. Some of the best aspects of city life are distinctly inefficient. Use quant for quant things, but don't overreach. After all, the meaning of a tree is more than the sum of its ecosystem services. We must place great store in context, critique and translation, noting that, as McGilchrist writes, *"things as they exist in practice in the real world ... are likely to be intrinsically resistant to precision and clarification"* and that we must inflect our representations with *"tactful recognition of the limits to human understanding"*.[152] Like dough, data is of little value unless it is worked into something more meaningful.

So, we must also *practise* with different languages, and more embodied forms of understanding, in order to transform our bureaucracies' 'dynamic capabilities'.[153] As opposed to designing and managing streets with crass 20th century metrics—leading to trade-offs akin to *the number of deaths per year versus reduction in travel time*—we might start with questions like: *Can children safely walk to good schools nearby, along clean, green, and enriching streets? Or not?* We have endless amounts of research about why this would be a good outcome to strive for. The research is *done*. We just have to deliver on it, reorienting our silos and structures around the gaps in between them, cultivating practises for more meaningful and participative everyday outcomes.

Cities are not *about* efficiency. If they are about anything, it is culture, conviviality, community—perspectives largely beyond quantification. Some of the best aspects of city life are distinctly inefficient.

When working on the UK government's mission-oriented industrial strategy at University College London, we hosted workshops about mobility and transport, bringing together academics, policymakers and industry. In one session, the conversation was meandering along 'business-as-usual' lines—reducing congestion, saving the auto industry, mitigating accidents via vehicle design, roll-outs of charging points, 'intelligent' [sic] transportation systems. It was subconsciously following unspoken assumptions about efficiency logics, an induced demand for outdated ideas.

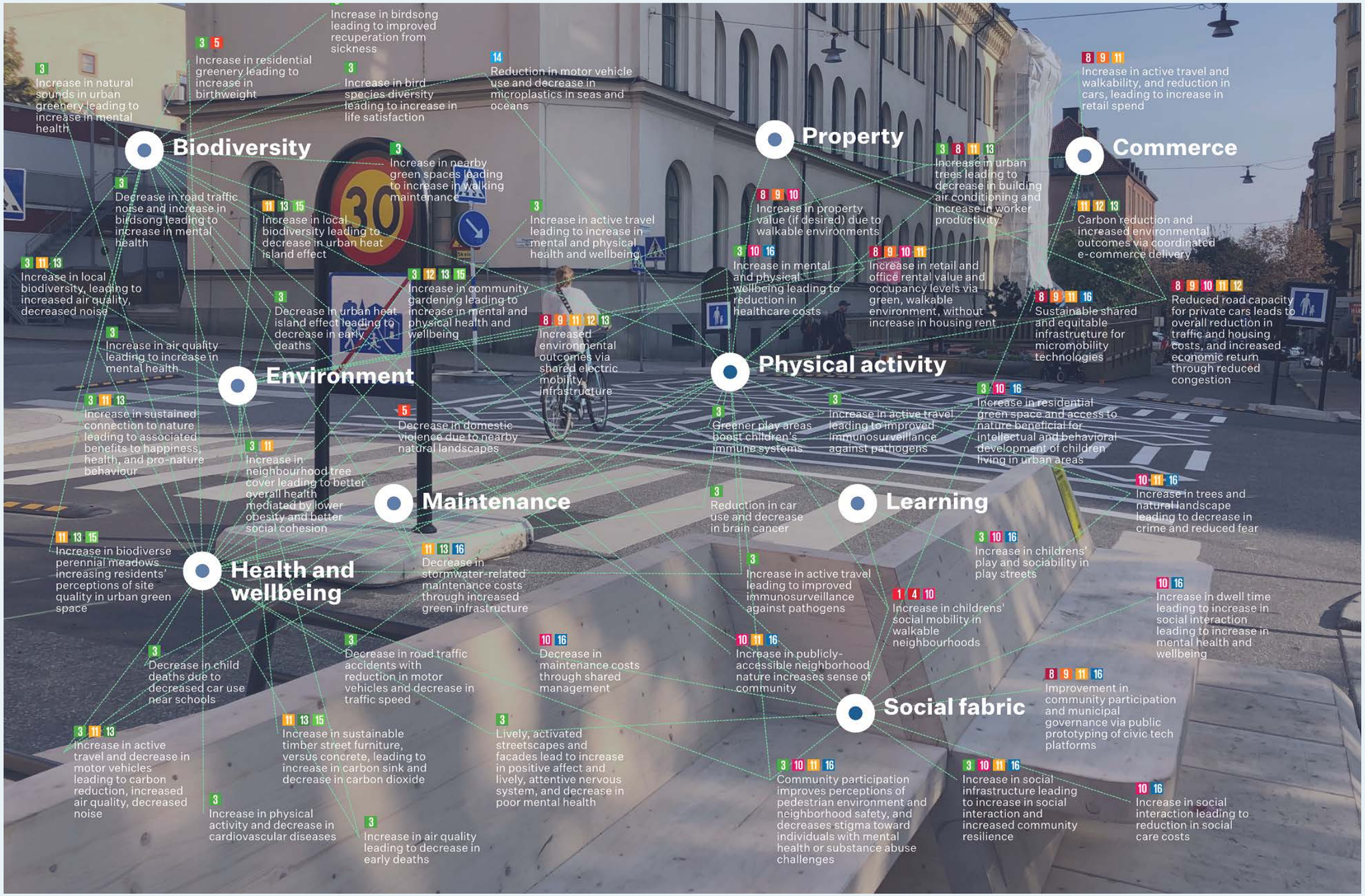
Fortunately, our group included a 'wildcard', the artist and musician Brian Eno, who hit pause on the discussion with a very polite, but firm, suggestion, along the lines of: *"Instead of all that, perhaps we could imagine a place in which everyone and everything moved around a little less, and a little more slowly ..."*

In this careful sentence, and its artful, almost deliberately naive framing, lie some clues to 21st- century mobility. It subtly reverses the dynamic of imported tech-driven innovation, and asks us to engage with places, to explore their quite different values. What richly complex variables are implied in that simple question? What might it unlock? What would it mean *here*, in the context of Asian cities? What possible futures might emerge from open, lightweight and adaptive mobility technologies, subtly flavoured with particular folk memories, with 'human faces'? What 'ballet of the street' is this? And with these streets, and their values in mind, how might we get there?

Instead of all that, perhaps we could imagine a place in which everyone and everything moved around a little less, and a little more slowly ...

Later, working with Eno again on the Swedish street project, I asked him to write some design principles for streets.[154] The first in his endlessly intriguing set is perhaps one of the most generative: *Think like a gardener, not an architect: design beginnings, not endings*.

In that simple allusion to gardens—the opposite of untended hardscape— we find further clues as to planning versus adaptation, culture and nature, participation, care, reimagining what a street is for, its value and its values as well as mode and method. Design beginnings not endings—and begin in the street.



A sketch of the value model from Vinnova's mission-oriented approach mapping how retrofitting streets generates overlapping outcomes across multiple types of value, aligned with the United Nations Sustainable Development Goals.

Image courtesy of Dan Hill[155]

Making the Framework Work

The framework is intended as a guide to help cities think beyond the immediate scope of a project and explore how mobility interventions can be viewed through a broader, integrated lens. Not every mobility intervention may be able to address multiple domains from the outset, particularly when resources, mandates or site conditions limit what can be achieved. Instead, the framework encourages planners to use current mobility interventions as a starting point, and to consider what broader issues the neighbourhood may be facing, and how an intervention could be adapted or expanded across domains to address them over time.

For example, reclaiming roads for public spaces may begin with a focus on prioritising pedestrians and introducing more green spaces to the neighbourhood. By applying the framework, planners can take a step back to consider the wider context and identify area-specific needs or other domain issues, such as heat exposure, lack of resting spaces for seniors, insufficient play opportunities for children, or limited community gathering areas. Thereafter, they can explore how future phases could incorporate shaded walkways, rest areas, play spaces or community event spaces to strengthen the intervention's overall impact and evolve into more holistic solutions.

Rather than functioning as a rigid scoring tool or a compliance checklist, the framework is meant to serve as a stepping stone to connect these 'dots' and form a bigger picture of how mobility interventions can shape liveable, inclusive neighbourhoods. Where possible, it is also recommended that the indicators be integrated into existing planning and evaluation frameworks, including but not limited to cost-benefit analyses, ensuring they complement rather than duplicate them, while prompting cities to track and value benefits that may otherwise go unmeasured.

While the framework offers a structured approach to evaluating sustainable mobility interventions, its effective use depends on how well it is tested and adapted to the realities of local governance, data ecosystems and planning practices. Through continued refinement, it can help build a stronger shared understanding of what works and why. There are several key considerations that cities should bear in mind when applying the framework.

Managing traffic is often the first step, but broader planning can extend benefits to safety, access and liveability.

Photo courtesy of Caresse Audrey Chia

Reducing Bias through Structure

One of the strengths of the framework is its ability to incorporate multiple voices—from policy makers to local citizens—through a participatory approach where weightages are assigned to the respective pillars and indicators. However, the approach, while valuable for incorporating stakeholder perspectives, introduces subjectivity, as stakeholders may have diverse and sometimes conflicting priorities.

To address this, the framework applies a systematic approach. Standardised indicator and metric definitions, as well as clear measurement scales, are established at the outset. Thereafter, engaging stakeholders in structured discussions or workshops helps establish a consensus on the relative importance of each criterion. This foundation ensures that stakeholders have a shared understanding of the criteria when they perform the pairwise comparisons step outlined in the framework, reducing bias in the weightage assignment process.

Building Data Capacity Over Time

As the framework adopts an evidence-based approach backed by data, its reliance on data availability may present challenges for cities with less developed data collection infrastructure, as incomplete or unreliable data can hinder accurate assessments and limit the ability to track progress.

To address this, cities with constraints could approach this progressively, starting with simpler and more basic data collection methods to gradually build capacity. Leveraging open-source platforms and crowdsourcing efforts could help develop more robust databases. Partnerships with stakeholders—including regional agencies, international organisations and institutes of higher learning—can further support cities in strengthening their data collection infrastructure.

Balancing Comprehensiveness with Practicality

While the framework provides a comprehensive list of metrics for evaluation, it recognises that not all indicators can be practically measured in every context. To ensure meaningful analysis, it is recommended to measure at least three or four metrics under each pillar. This approach aims to ensure the cross-domain evaluation of interventions, and to also account for practical constraints in data collection and measurement capabilities.

Recognising Complexity

In complex urban systems, it can be difficult to draw a correlation between a single intervention and a specific outcome. Changes in air quality, business footfall or social cohesion could be attributed to multiple overlapping factors, not just the mobility project under review.

The framework does not claim to resolve attribution challenges. Instead, it provides a structured way to observe patterns, explore correlations and encourage conversations across domains. Cities should approach results as a means to support dialogue, helping stakeholders build a shared understanding of benefits and trade-offs.

Supporting Collaboration and Institutionalisation

For the framework to be meaningful in practice, it must be embedded in how cities plan and make decisions. Many of the impacts it seeks to measure lie outside the remit of any single agency. This makes joint ownership and coordination across departments such as transport, planning, environment, health and community development essential. Achieving this kind of collaboration requires a shift in institutional mindset. Agencies need to move beyond meeting their own key performance indicators and instead recognise how their work contributes to—and benefits from—the priorities of others. By understanding these interdependencies and shared values, agencies can align efforts towards more cohesive, people-centred mobility strategies.

Cities are encouraged to use the framework as a facilitation tool to align priorities early in the planning process, surface potential trade-offs, and build consensus through inter-agency working groups or cross-departmental workshops during project scoping to identify shared outcomes.

Beyond collaboration, the framework has greater value when it is tied to formal decision-making and evaluation processes—such as funding justifications, performance tracking or grant reporting. Even if used initially as an internal or exploratory tool, it can help shift the conversation around what constitutes value in sustainable mobility and who that value is meant to serve. By approaching implementation with collaboration and a willingness to iterate, cities can use the framework as a stepping stone towards more integrated, evidence-based governance.

Applications to Other Domains

Beyond its focus on sustainable urban mobility, the framework is designed as a catalyst for broader urban transformation. Urban challenges rarely exist in isolation, and neither should their solutions. The framework encourages cities to look beyond a single intervention and see how it can spark improvements across interconnected systems—economic vitality, environmental quality, social well-being and public health.

The framework's pillars and indicators are adaptable across domains, offering a common structure to evaluate initiatives ranging from environmental restoration to public space revitalisation and infrastructure upgrades.

Applying the framework in these ways allows cities to:

- See beyond sectoral boundaries by uncovering how interventions in one domain create benefits or trade-offs in others.
- Guide investments towards co-benefits by comparing outcomes across different types of projects, not just within one sector.
- Strengthen accountability and trust by making the full range of impacts visible to decision-makers and communities.

In this sense, the framework is not only a tool for mobility, but a catalyst for more integrated urban governance. Each project, whether in transport, housing, environment or public space, becomes an opportunity to connect interventions to the broader systems they influence—and to build a more liveable, inclusive and resilient city.

Cheonggyecheon River restoration project
Image courtesy of Francisco Anzola / Wikimedia Commons

Live music on Cheonggye Stream, near Dongdaemun market.
Image courtesy of Schellack / Wikimedia Commons

ANNEX:
REFERENCE MANUAL

A Framework for Evaluating Sustainable Mobility

As urban populations grow, cities will continue to transition towards sustainable mobility solutions that integrate walking, cycling, public transport and shared mobility systems. These efforts align with global sustainability targets such as the United Nations Sustainable Development Goals and the Paris Agreement on Climate Change. By shifting towards sustainable mobility, cities contribute to global emissions reduction while improving local air quality, urban liveability and public health.

The cross-domain framework, developed by leveraging multi-criteria analysis techniques, provides a structured methodology for cities to assess and evaluate their mobility policies and interventions. It considers multiple dimensions across four pillars, and includes a set of recommended indicators and metrics which have been distilled to support cities in making data-driven decisions and cross-domain evaluations of sustainable mobility initiatives.

This reference manual contains a list of recommended indicators, the metrics they comprise, and benchmarks for each metric. The list is non-exhaustive and serves as a reference for key outcomes to be measured. The scoring benchmarks are derived from a mix of local, regional and international standards, and should be assessed to ensure they are appropriate for your project's context and local conditions.

ECONOMIC

1 Economic activity generated

Sustainable mobility enhances urban economies by driving investment, increasing property values and supporting local businesses. Projects such as transit-oriented developments (TODs)—which integrate high-density, mixed-use development with efficient public transport—encourage walkability and reduce car dependency. This attracts businesses, boosts foot traffic and stimulates demand for commercial spaces, helping to create a vibrant local economy.

A. Number of events in the area that require purchase of an entry ticket

This metric measures the annual number of cultural, leisure and other events in areas influenced by sustainable mobility initiatives (e.g., around TOD nodes, business districts, pedestrianised districts, cycling corridors). Concerts, exhibitions and sporting events, for example, act as local economic multipliers, generating revenue through ticket sales, hospitality services and retail activity.

Areas with better accessibility to public transport and sustainable mobility modes make more attractive locations for events, as ease of access can increase attendance and reduce reliance on private cars.

In residential areas (e.g., superblocks, low traffic neighbourhoods), this is better reflected by the number of community and cultural events such as street markets, local festivals and temporary activations.

This metric should be interpreted alongside potential negative impacts such as rising local property values, noise or overtourism.

SCORING:

Non-residential Areas

1. <20
2. 20–40
3. 41–80
4. 81–100
5. >100

Residential Areas:

1. <5
2. 5–10
3. 11–20
4. 21–30
5. >30

This metric should be interpreted alongside transport accessibility measures to ensure events are inclusive and do not generate car-dependent travel. A high number of events reflects strong cultural and economic vitality, but must be balanced with equity and environmental goals.

SOURCES:

Future Place Leadership, *Tallinn High Street: Case Studies* (Future Place Leadership AB, 2017), https://futureplaceleadership.com/wp-content/uploads/2017/05/Tallinn-High-Street-Case-studies-Future-Place-Leadership.pdf.

Rachel Aldred and Megan Sharkey, *Healthy Streets: A Business View* (University of Westminster, commissioned by Transport for London, 2017), https://tfl.gov.uk/cdn/static/cms/documents/healthy-streets-a-business-view.pdf.

Transport for London, *Small Change, Big Impact: A Practical Guide to Changing London's Public Spaces* (Transport for London, 2017), http://content.tfl.gov.uk/small-change-big-impact.pdf.

B. Change in revenue generated by retail/commercial activity in the area

Improved accessibility and walkability enhance customer footfall, with studies showing that people arriving on foot, by bicycle or by public transport often spend more per month in local shops than those travelling by car. Rising commercial revenues signal that sustainable mobility contributes to economic vitality, supporting both businesses and street vibrancy.

This metric should be interpreted alongside footfall data to ensure that revenue increases are not driven solely by price inflation.

SCORING:

1. No change
2. 1–5% increase
3. >5–10% increase
4. >10–15% increase
5. >15% increase

SOURCES:

New York City Department of Transportation, *The Economic Benefits of Sustainable Streets* (New York: Department of Transportation, 2013), http://www.nyc.gov/html/dot/downloads/pdf/dot-economic-benefits-of-sustainable-streets.pdf.

Rachel Aldred and Megan Sharkey, *Healthy Streets: A Business View* (University of Westminster, commissioned by Transport for London, 2017), https://tfl.gov.uk/cdn/static/cms/documents/healthy-streets-a-business-view.pdf.

C. Change in number of small and medium-sized enterprises (SMEs)

Measuring the growth of SMEs highlights whether sustainable mobility supports diverse local businesses, or whether smaller operators are displaced by large brands.

Rapid growth may signal vibrancy, but it can also mask higher business turnover if older businesses are being displaced.

SCORING:

1. >10% decrease
2. 0–10% decrease
3. >0–5% increase
4. >5–10% increase
5. >10% increase

SOURCE:

Rachel Aldred and Megan Sharkey, *Healthy Streets: A Business View* (University of Westminster, commissioned by Transport for London, 2017), https://tfl.gov.uk/cdn/static/cms/documents/healthy-streets-a-business-view.pdf.

D. Change in commercial space vacancy rates relative to city median

A decline in vacant commercial spaces, relative to the city median, suggests increased demand for business locations near transport hubs, signalling commercial vibrancy and a positive response to sustainable mobility investments.

Vacancy rates should be interpreted in relation to overall retail trends to avoid attributing unrelated market dynamics to mobility projects. Very low vacancy can also indicate affordability challenges for small businesses.

SCORING:

1. >5% increase
2. 0–5% increase
3. >0–5% decrease
4. >5–10% decrease
5. >10% decrease

SOURCE:

Savills, “Spotlight: European Office Development”, 11 June 2024, https://en.savills.fr/research_articles/256178/362952-0.

2 Property value

This indicator measures the financial worth of real estate in a given area, reflecting factors such as demand, location desirability, infrastructure quality and economic conditions.

Property values serve as a key economic indicator as they influence investment decisions, housing affordability and urban development patterns. Higher property values often signal strong economic activity, desirable amenities and well-planned infrastructure, while rapid increases may indicate potential affordability challenges and gentrification risks. Monitoring property values helps policymakers balance economic growth with housing accessibility and equitable urban development.

A. Average purchasing value of property in the area

This metric provides insight into real estate market trends and affordability within a specific location. A rising average purchasing value may indicate increased demand, improved infrastructure or economic growth, while extremely high values can lead to affordability issues and social displacement.

Because this metric is benchmarked to the city median, it adjusts dynamically to local market conditions. A higher score does not necessarily mean a better outcome, but signals a relatively more stable housing market.

To understand whether this reflects healthy growth or affordability risks, results should be read together with complementary indicators such as price-to-income ratios or housing cost overburden rates. When interpreted in a cross-domain lens, property value trends can reveal important trade-offs between economic vitality and social equity, and should inform policies that integrate housing, mobility and urban development strategies.

SCORING:

1. >20% above median (signals strong economic growth, but could be a sign of a growing housing bubble) **or** below median (extremely weak demand; signals significant apparent economic decline)
2. >10–20% above median (unbalanced demand and vitality; potential gentrification and exclusion risk) **or** below median (signals disinvestment or weak demand; may suggest economic decline)
3. >7–10% above median (signals higher demand; growing risk of affordability) **or** below median (signals weaker demand)
4. 3–7% above median (signals strong desirability; may risk affordability pressures) **or** below median (slightly below market but relatively stable)
5. 0-3% above **or** below median (healthy, stable market aligned with wider city trends)

SOURCES:

Eurostat, “Housing price statistics–house price index”, 2025, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing_price_statistics_-_house_price_index.

OECD, “OECD Affordable Housing Database”, n.d., https://www.oecd.org/en/data/datasets/oecd-affordable-housing-database.html.

3 Public transport (PT) affordability

Public transport affordability is a key factor in ensuring equitable access to mobility for all socio-economic groups. An affordable transport system enables greater economic participation, social inclusion and improved quality of life. High transport costs relative to household income can disproportionately burden lower-income groups, limiting their mobility options. Sustainable transport policies should aim to keep public transport costs reasonable while maintaining financial sustainability for operators.

A. Proportion of household income spent on public transport

A lower percentage for this metric indicates greater affordability and accessibility, while a higher percentage indicates a higher cost burden.

This metric should be interpreted alongside modal share and vehicle ownership data to give a fuller picture of household transport costs. While a lower percentage may reflect stronger affordability and high PT coverage, it can also occur where PT usage is limited due to poor service or high-income households spending a lower % of household income on PT.

SCORING:

1. >4% (high-cost burden)
2. >3–4%
3. >2–3%
4. 1–2%
5. <1% (high affordability)

SOURCES:

European Environment Agency, “Are We Moving in the Right Direction? Indicators on transport and environmental integration in the EU: TERM 2000”, 19 April 2016, https://www.eea.europa.eu/publications/ENVISSUENo12/page023.html.

International Association of Public Transport, “Keeping It Fare: How to Make Public Transport Fares Affordable”, May 2025, https://cms.uitp.org/wp/wp-content/uploads/2025/05/20250505_Fare-Affordability_Policy-Brief_WEB.pdf.

International Association of Public Transport (UITP) and Walk21 Foundation, *Urban Mobility Indicators for Walking and Public Transport* (UITP, Walk21 Foundation and VBK, published on behalf of the Urban Agenda for the EU, 2019), https://ec.europa.eu/futurium/en/system/files/ged/convenient-access-to-public-transport.pdf.

MOBILITY

1 Walkability

This indicator reflects how well the urban environment supports walking as a safe, convenient, and attractive mode of travel. It encompasses factors such as accessibility, connectivity, safety, comfort and the quality of the public realm. A higher score indicates that streets are continuous and barrier-free, crossings are safe, sidewalks are wide and shaded, and destinations are easily accessible.

A walkable environment not only encourages people to choose walking over short car trips but also supports healthier lifestyles, reduces emissions, and enhances the vibrancy of neighbourhoods. Well-designed pedestrian infrastructure ensures that people of all ages and abilities can move easily and independently, while also contributing to economic vitality through increased footfall for local businesses.

A. Proportion of pedestrian zones that are barrier- and obstacle-free

Barriers and obstacles such as parked vehicles, street vendors, construction, poorly maintained sidewalks and steep road gradients impede walking. Having a higher percentage of pedestrian zones that are barrier- and obstacle-free ensures that they are safe and accessible to all.

SCORING:

1. <50%
2. 50–70%
3. >70–85%
4. >85–95%
5. >95%

SOURCES:

Daniel Rhoads, Albert Solé-Ribalta and Javier Borge-Holthoefer, “The Inclusive 15-minute city: Walkability analysis with sidewalk networks,” *Cities* 139 (2023): 104278, https://doi.org/10.1016/j.compenvurbsys.2022.101.

Gloria Serra-Coch et al., “Graphical approach to assess urban quality: Mapping walkability based on the TOD-standard”, *Cities* 76 (2018): 58–71, https://doi.org/10.1016/j.cities.2018.01.007.

Institute for Transportation and Development Policy (ITDP), *TOD Standard* (New York: ITDP, 2017), https://itdp.org/wp-content/uploads/2017/06/TOD_Standard_EN.pdf.

B. Proportion of pedestrian lanes over total road network

The proportion of pedestrian lanes over the total road network within the area reflects how much a city prioritises walkability by ensuring safe, accessible and continuous pedestrian pathways. A higher percentage reflects better connectivity and ease of movement, reducing reliance on cars and promoting healthier, more sustainable urban mobility.

SCORING:

1. <60%
2. 60–70%
3. >70–80%
4. >80–90%
5. >90%

SOURCES:

A. Bartzokas-Tsiompras and Y.N. Photis. “Global indicators for pedestrian streets by city”, *Mendeley Data*, 14 January 2021, https://data.mendeley.com/datasets/fs9xxhh5yh/2.

Institute for Transportation and Development Policy (ITDP), *Pedestrians First*: Tools for a Walkable City (New York: ITDP, 2018), https://itdp.org/wp-content/uploads/2024/09/pedestrians_FINAL.pdf.

C. Proportion of covered sidewalks (tree canopies or overhanging roofs)

Covered sidewalks improve accessibility and inclusivity while enhancing pedestrian comfort and safety. While beneficial to all, a higher percentage of sidewalks that are covered is particularly helpful for older adults, children and people with disabilities, who may be more sensitive to environmental conditions. Covered sidewalks also contribute to environmental sustainability, with tree-lined streets improving air quality, reducing stormwater runoff and supporting urban biodiversity.

SCORING:

1. <10%
2. 10–20%
3. >20–30%
4. >30–40%
5. >40%

SOURCES:

Institute for Transportation and Development Policy (ITDP), TOD Standard (New York: ITDP, 2017), https://itdp.org/wp-content/uploads/2017/06/TOD_Standard_EN.pdf.

Scott E. Maco and E. Gregory McPherson, “Assessing canopy cover over streets and sidewalks in street tree populations.” Journal of Arboriculture 28.6 (2002): 270–276, https://auf.isa-arbor.com/content/isa/28/6/270.full.pdf.

Voronoi, “Ranked: Urban Tree Cover of European Capital Cities”, 20 July 2024, https://www.voronoiapp.com/climate/Ranked-Urban-Tree-Cover-of-European-Capital-Cities-1770.

D. Average width of sidewalk

Sidewalk width is a key determinant of pedestrian comfort, safety, and accessibility. Wider sidewalks minimise crowding, allowing people to walk side by side and accommodating those using mobility aids or strollers. Adequate width supports universal design by ensuring inclusive access for people of all ages and abilities.

Wider sidewalks also provide space for street furniture, greenery, and other amenities, improving the overall quality of the public realm. Providing adequate sidewalk width contributes to local economic vitality by supporting higher footfall and encouraging street-level activity.

SCORING:

1. <1.5 m
3. 1.5–3 m
5. >3 m

SOURCES:

Institute for Transportation and Development Policy, *Street Design*: Components and Guidelines, (ITDP, 2014), http://itdp.in/wp-content/uploads/2014/12/03-Design-components-and-Guidelines-140915.pdf.

E. Ease of crossing (presence of safe and direct crossing or pedestrian right-of-way)

Accessibility is a crucial factor in assessing ease of crossing. Existence of features such as curb ramps and tactile paving for visually impaired individuals ensures that everyone has a safe experience navigating through the urban environment. Well-marked, frequent and accessible crossings can also avert conflicts between pedestrians and vehicles.

SCORING:

1. No pedestrian right-of-way (no marked pedestrian crossings or designated crossing points exist)
2. Poor pedestrian crossing condition (some informal crossing points, like curb cuts or faded markings, exist; no pedestrian signals or traffic-calming measures are in place)
3. Limited pedestrian right-of-way (marked pedestrian crossings exist but are infrequent; traffic signals do not include pedestrian phases)
4. Moderate pedestrian priority (well-marked and signalised pedestrian crossings are present at major intersections; crosswalks have countdown timers; some traffic calming features exist)
5. High pedestrian priority (clearly marked crosswalks; dedicated pedestrian signals and prominent traffic-calming measures are in place)

SOURCES:

Christopher Kost et al., *Streets for walking & cycling: Designing for safety, accessibility, and comfort in African cities* (UN-Habitat and Institute for Transportation & Development Policy, July 2018), http://unhabitat.org/sites/default/files/2020/06/streets-for-walking-and-cycling.pdf.

Presto, “Give Cycling a Push: Implementation Fact Sheet”, n.d., https://www.rupprecht-consult.eu/fileadmin/migratedRupprechtAssets/Documents/10_PRESTO_Infrastructure_Fact_Sheet_on_Right-of-Way_Intersections.pdf.

2 Modal share of active mobility modes and shared transport

This indicator measures the proportion of urban trips made using active mobility modes, including walking, cycling, and micromobility (e.g. e-scooters, e-bikes), as well as shared transport options such as ride-hailing and car-sharing, as alternatives to private vehicle ownership.

Cities with a high share of walk-cycle-ride modes typically experience lower congestion, better air quality and improved public health outcomes due to increased physical activity and enhanced liveability. Additionally, shared mobility solutions contribute to more efficient land use, reducing the need for extensive parking infrastructure and complementing public transport networks.

This indicator helps cities evaluate the success of policies promoting non-motorised and shared transport options, such as dedicated cycling lanes, pedestrian-friendly infrastructure and micromobility integration with public transport.

A. Active mobility modal share

A higher percentage of active mobility trips (walking, cycling, micromobility) indicates that pedestrian and cycling infrastructure are well-integrated into urban planning, and that policies supporting sustainable transport are effective.

It important to interpret each mode distinctly, as they reflect different policy outcomes. Walking levels often reflect urban density and accessibility, while cycling and micromobility uptake are more directly tied to infrastructure, safety, and regulatory support. Micromobility adoption is still emerging, but where it scales successfully, it demonstrates strong policy support, infrastructure integration, and public acceptance.

SCORING:

Walking:

1: < 10%

2: 10–20%

3: >20–30%

4: >30–40%

5: > 40%

Cycling:

1: < 1%

2: 1–10%

3: >10–20%

4: >20–30%

5: > 30%

Micromobility:

1: < 1%

3: 1–3%

5: >3–5%

SOURCES:

Enrico Pisoni, Panayotis Christidis and Elena Navajas Cawood, “Active mobility versus motorized transport? User choices and benefits for the society”, *Science of The Total Environment* 806.2 (2022): 150627, https://doi.org/10.1016/j.scitotenv.2021.150627.

Ministère Chargé De L’Enseignement Supérieur Et De La Recherche and Horizon Europe, “Increasing walking and cycling: to reap health benefits, emission reductions and integrate active mobility and micro-mobility devices, with smart technologies and infrastructure”, 2025, https://www.horizon-europe.gouv.fr/increasing-walking-and-cycling-reap-health-benefits-emission-reductions-and-integrate-active-40536.

https://www.weforum.org/stories/2022/08/bicycle-mobility-transport-ranked-world/

https://www.economist.com/graphic-detail/2025/02/07/what-can-the-worlds-most-walkable-cities-teach-other-places

https://www.weforum.org/stories/2022/07/micromobility-will-make-our-cities-clean-and-quiet-how-can-it-be-widely-used/

B. Shared transport modal share

As an alternative to private vehicle ownership, shared transport (ride-hailing services or car-share) reduces urban congestion, lowers vehicle ownership rates and optimises the use of available transport resources, particularly when integrated with public transport, making cities less dependent on private cars.

The metric should be interpreted alongside private car and active mobility modal share to provide a fuller picture.

SCORING:

1. <2%
2. 2–5%
3. >5–10%
4. >10–20%
5. >20%

SOURCES:

Charlotte Brannigan et al., *The state of shared and zero-emission mobility in Europe: Final Technical Report* (Ricardo Energy & Environment, published for Clean Cities Campaign, June 2023), http://cleancitiescampaign.org/wp-content/uploads/2023/06/CCC-Thank-you-for-Sharing-Technical-Report.pdf.

International Association of Public Transport, “Shared vehicles,” 2025, https://www.uitp.org/topics/shared-vehicles/.

3 Modal share of public transport

The modal share of public transport is the proportion of total trips taken using public transport modes such as buses, trains and trams.

A higher share of public transport usage signals an efficient, accessible and well-integrated urban transit system, which reduces reliance on private motorised vehicles. Cities that prioritise public transport benefit from lower congestion, reduced emissions, improved air quality and enhanced mobility equity for all residents.

A. Public transport modal share

An increase in public transport modal share (buses, metros, trains, trams) often reflects effective policies such as investment in transit infrastructure, fare subsidies, last-mile connectivity improvements and integration with active mobility modes.

Conversely, a low public transport share may indicate inadequate service coverage, affordability concerns or insufficient infrastructure, leading to continued dependence on private vehicles.

SCORING:

1. <20%
2. 20–40%
3. >40–50%
4. >50–60%
5. >60%

SOURCE:

European Commission, *Report on the Quality of Life in European Cities, 2023* (Luxembourg: Publications Office of the European Union, 2023), https://ec.europa.eu/regional_policy/sources/reports/qol2023/2023_quality_life_european_cities_en.pdf.

B. Number of private motorised vehicles per 1,000 residents registered within the area

A higher number of private vehicles per capita suggests greater reliance on personal cars, often due to limited public transport options or poor service quality. A lower number can reflect a shift towards sustainable transport alternatives and reduced congestion.

SCORING:

1. >600
2. >400–600
3. >200–400
4. 100–200
5. <100

This metric should be interpreted alongside modal share of PT and active mobility because in some areas, a lower number may also signal transport poverty.

SOURCES:

Eurostat, “Statistics Explained: Passenger cars in the EU,” 2025, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU.

Eurostat, “Statistics Explained: Stock of vehicles at regional level,” 2025, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Stock_of_vehicles_at_regional_level#Stock_of_passenger_cars_at_regional_level.

Fernando Perez Diez, Magin Campos Cacheda and Julià Cabrerizo Sinca, “Stage of historical evolution of private vehicle ownership in the City of Barcelona”, *Transportation Research Procedia* 18 (2016): 140–147, https://doi.org/10.1016/j.trpro.2016.12.020.

4 Provision of mobility hubs

A mobility hub is a designated location that integrates multiple transport modes and essential services, enabling seamless transfers and improving accessibility. These hubs are designed to enhance multimodal connectivity, reduce reliance on private vehicles and support sustainable urban mobility by combining public transport, active travel infrastructure and shared mobility services.

This indicator helps cities assess the availability, functionality and inclusivity of mobility hubs, ensuring that they support seamless mobility, reduce last-mile connectivity gaps and contribute to a car-lite urban environment.

Well-designed mobility hubs facilitate efficient, convenient and equitable transport choices, encouraging greater adoption of public transport, walking, cycling and shared mobility options while contributing to increased efficiency and connectivity in the wider transport network. In addition to transport integration, the presence of mixed-use amenities and services within or near the hub further enhances its utility.

A. Number of transport modes within a mobility hub

The presence of multiple transport modes within a hub enhances accessibility and travel flexibility, allowing users to shift easily between different mobility options. Hubs that integrate public transport with walking, cycling, micromobility and shared mobility services provide a stronger alternative to private car use.

SCORING:

1. 1 mode
2. 2 modes
3. 3-4 modes
4. 5 modes
5. >= 6 modes

SOURCE:

International Association of Public Transport, “Mobility hubs: Steering the shift towards integrated sustainable mobility”, April 2023, https://cms.uitp.org/wp/wp-content/uploads/2023/06/Policy-Brief-Mobility-hubs-web.pdf.

B . Number of transport-related amenities and services within a transport hub

The presence of supporting transport and amenities and services (e.g., charging infrastructure, parking facilities for bicycles, end of trip facilities, lockers) enhances the attractiveness, convenience and functionality of sustainable mobility modes and encourages their use. A higher score indicates a comprehensive hub offering diverse amenities, creating a vibrant, functional space.

SCORING:

1. 0 amenities
2. 1–2 amenities
3. 3–4 amenities
4. 5–6 amenities
5. ≥7 amenities

SOURCES:

Alta Planning + Design and Portland Bureau of Transportation (PBOT), *Mobility Hub Typology Study* (Alta Planning + Design and PBOT, 2020), https://altago.com/wp-content/uploads/PBOT-Mobility-Hub-Typology_June2020.pdf.

International Association of Public Transport, "Mobility hubs: Steering the shift towards integrated sustainable mobility", April 2023, https://cms.uitp.org/wp/wp-content/uploads/2023/06/Policy-Brief-Mobility-hubs-web.pdf.

C. Number of non-transport related amenities and services within a transport hub

Integration of non-transport amenities and services (e.g., supermarkets, convenience stores, day care centres, clinics, gyms, libraries, F&B options) ensures that essential daily needs can be met within a short distance of where people live, work or travel. By integrating them within the transport hub, the hubs function not only as points of interchange but also as mixed-use urban anchors that enhance convenience, reduce the need for long journeys, and strengthen local economic and social life.

SCORING:

1. 0–1 amenities
2. 2–3 amenities
3. 4–6 amenities
4. 7–9 amenities
5. ≥10 amenities

SOURCES:

Alta Planning + Design and Portland Bureau of Transportation (PBOT), *Mobility Hub Typology Study* (Alta Planning + Design and PBOT, 2020), https://altago.com/wp-content/uploads/PBOT-Mobility-Hub-Typology_June2020.pdf.

International Association of Public Transport, "Mobility hubs: Steering the shift towards integrated sustainable mobility", April 2023, https://cms.uitp.org/wp/wp-content/uploads/2023/06/Policy-Brief-Mobility-hubs-web.pdf .

5 Ease of intermodal integration

This indicator evaluates how seamlessly passengers can navigate between modes—whether transfers are fast, intuitive and user-friendly, or plagued by delays, confusion and inconvenience for users.

Seamless and efficient transfers, from reduced journey friction and clear wayfinding (e.g., good signage, digital support, infrastructure improvements), are critical for multimodal transport adoption and can determine whether users choose or abandon public, active and shared transport.

A. Average transfer time between modes

The ease of transfers between modes reflects how efficiently different transport modes are connected at transport hubs. Shorter average transfer times indicate greater ease and a well-designed and efficient transfer experience.

This metric should be considered together with qualitative aspects such as legibility of wayfinding signage, barrier-free access, integrated ticketing options and perceived safety. Cities may also adapt thresholds based on network design, recognising that the quality of the transfer experience often matters as much as speed.

SCORING:

1. >15 min
2. >10–15 min
3. >5–10 min
4. 3–5 min
5. <3 min

SOURCES:

Ankita Sil et al., "Exploring satisfaction for transfers at intermodal interchanges: A comparison of Germany and India", Journal of Public Transportation 24 (2022): 100005, The Association Between Ridehailing and Public Transit Use in the United States," *Transport Policy* 116 (2022): 1–9, https://doi.org/10.1016/j.jpubtr.2022.100005.

Biao Yin and Fabien Leurent, "Estimation of Transfer Time from Multimodal Transit Services in the Paris Region," *Future Transportation* 2.4 (2022): 886–901, https://doi.org/10.3390/futuretransp2040049.

6 Bicycle priority

Bicycle priority assesses the extent to which a city prioritises cycling as a transport mode, as well as the provision of dedicated infrastructure to ensure safe, connected and accessible cycling routes. A strong cycling network also promotes healthier commuting habits, thereby reducing rates of sedentary lifestyle-related diseases.

A. Proportion of bicycle lanes within the total road network

A higher percentage of bicycle lanes over the total road network within the area indicates greater coverage of dedicated cycling lanes and shared paths for active mobility, reflecting improved connectivity and accessibility, as well as a stronger commitment to bicycle priority.

SCORING:

1. <40%
2. 40–50%
3. >50–60%
4. >60–70%
5. >70%

SOURCES:

Simone Weikl and Patricia Mayer, "Data-driven quality assessment of cycling networks", *Frontiers in Future Transportation 4* (2023): 1127742, https://doi.org/10.3389/ffutr.2023.1127742.

7 Bus priority

Bus priority assesses the level of priority placed for buses, trams and high-occupancy vehicles. A higher bus priority can result in enhanced travel time reliability, making public transport more attractive and thereby increasing ridership while ensuring efficient and sustainable mobility. It can also reduce congestion, improve air quality, create quieter streets that are pedestrian-friendly, increase accessibility for all residents and support local economic activity.

A. Proportion of bus priority lanes within the total road network

Bus priority lanes reduce delays caused by mixed traffic, improve travel time consistency, and increase the overall capacity of the transit system. Higher coverage of bus priority lanes reflects a city's commitment to efficient and reliable public transportation. By ensuring faster and more predictable bus services, these lanes also enhance urban mobility, reduce congestion and lower emissions.

SCORING:

1. <5%
2. 5–10%
3. >10–15%
4. >15–20%
5. >20%

SOURCES:

Marija Burinskienė, Modesta Gusarovienė and Kristina Gabrulevičiūtė-Skebienė, "The Impact of Public Transport Lanes on the Operating Speed of Buses," published in conjunction with the 9th International Conference 'Environmental Engineering (2014), https://www.researchgate.net/publication/269224712_The_Impact_of_Public_Transport_Lanes_on_the_Operating_Speed_of_Buses.

Thomas Schönhofer and Klaus Bogenberger, *A Comprehensive Review on Managed Lanes in Europe* (Technical University of Munich, 2021), https://mediatum.ub.tum.de/doc/1640100/d9y0se39q840q2o97meagntj3.pd.

8 Efficiency of PT buses

Efficient public buses are essential for reducing congestion, improving air quality and enhancing accessibility, all of which contribute to a more liveable city. When buses operate with minimal delays, frequent service and optimised routes, they encourage greater ridership, reducing dependence on private cars and lowering overall emissions. A well-functioning bus network also ensures affordability and accessibility for all residents, particularly those who rely on public transport for daily commutes.

A. Average speed of urban buses

Higher average speeds of buses in urban areas usually reflect reduced congestion, effective traffic management and the presence of bus priority measures, making buses more competitive with private cars. Faster and more reliable services shorten travel times, improve passenger satisfaction and encourage greater public transport use.

Benchmarks for this metric should be adjusted for routes that operate mainly in designated low-speed zones such as school areas or silver zones.

SCORING:

1. <15 km/hour
2. 15–20 km/hour
3. >20–25 km/hour
4. >25–30 km/hour
5. >30 km/hour

SOURCES:

Global BRT Data, “Systems Indicators: Operating Speed”, 2025, https://brtdata.org/indicators/systems/operating_speed.

Transports Metropolitans de Barcelona, “Transport Figures,” TMB, 1 January 2025, https://www.tmb.cat/en/get-to-know-tmb/corporate-information/transport-figures.

9 Level of congestion

The level of congestion indicates the extent of traffic delays and road network inefficiencies in an urban area, typically expressed as average travel delay per kilometre, congestion index or percentage of time lost in traffic. It reflects how efficiently vehicles move through the city and how much congestion impacts commuting times, fuel consumption and overall mobility.

Managing congestion is essential for creating a liveable city, as excessive traffic leads to longer commutes, higher emissions and reduced air quality, negatively impacting public health and urban sustainability. High congestion levels decrease productivity, increase stress levels and discourage active mobility by making streets less pedestrian- and cyclist-friendly.

A. Average congestion hours on/near the area per day

Higher congestion hours can indicate persistent bottlenecks, inefficient traffic flow and excessive demand on road infrastructure, leading to longer commutes, increased fuel consumption and higher emissions. Lower congestion hours can indicate better traffic management and enhanced urban accessibility due to efficient public transit and active mobility options.

Since lower congestion hours can also reflect traffic displacement to nearby roads, results should be checked both inside and outside the project boundary, and read alongside indicators like modal share and air quality.

SCORING:

1. >4 hours
2. >3–4 hours
3. >2–3 hours
4. 1–2 hours
5. <1 hours

SOURCE:

Panayotis Christidis and Juan Nicolás Ibáñez Rivas, *Measuring Road Congestion* (Luxembourg: Publications Office of the European Union, 2012), https://publications.jrc.ec.europa.eu/repository/bitstream/JRC69961/congestion%20report%20final.pdf.

10 Public charging points for electric vehicles (EVs)

This indicator looks at the availability and accessibility of EV charging infrastructure within a city, which is typically expressed as the number of charging stations per capita, per square kilometre, or per registered EV.

A well-distributed and easily accessible charging network ensures that EV users can recharge conveniently, reducing range concerns and supporting the widespread adoption of electric mobility. Expanding public EV charging infrastructure is essential for reducing reliance on fossil fuels, lowering emissions and promoting cleaner urban transport, all of which enhance air quality and public health.

A. Ratio of public charging points (PCPs) per EV

A higher ratio of PCPs per EV indicates better accessibility, reduced waiting times and greater convenience, supporting the widespread adoption of EVs. Well-balanced charging infrastructure prevents charging bottlenecks, encourages EV ownership for those without private chargers and promotes smoother integration of electric mobility into the urban transport network.

SCORING:

1. <2.5%
2. 2.5–5%
3. >5–10%
4. >10–20%
5. >20%

SOURCE:

Dale Hall and Nic Lutsey, *Charging infrastructure in cities: Metrics for evaluating future needs*, Working Paper 2020-17 (Washington D.C.: International Council on Clean Transportation, 2020), https://theicct.org/wp-content/uploads/2021/06/EV-charging-metrics-aug2020.pdf.

B. Proportion of residential areas with access to EV recharging points within a radius of 700 m (15-min walk)

A higher percentage of residential areas with access to EV recharging points indicates a well-distributed charging network, ensuring that EV owners can conveniently recharge their vehicles without long detours or extended wait times. Expanding access to EV chargers supports sustainable mobility, encourages the transition to cleaner transportation and reduces range anxiety, ultimately contributing to lower urban emissions and improved air quality.

SCORING:

1. <25%
2. 25–40%
3. >40–60%
4. >60–75%
5. >75%

SOURCES:

Giacomo Falchetta and Michel Noussan, “Electric vehicle charging network in Europe: An accessibility and deployment trends analysis,” *Transport Research Part D* 94 (2021): 102813, https://doi.org/10.1016/j.trd.2021.1028.

Rick Wolbertus et al., “Charging infrastructure roll-out strategies for large scale introduction of electric vehicles in urban areas: An agent-based simulation study,” *Transportation Research Part A* (2021): 262–285, https://doi.org/10.1016/j.tra.2021.04.010.

11 Urban public transport (UPT) accessibility/level of service

This indicator measures how easily and efficiently residents can reach and use public transportation services. They are typically assessed through factors like proximity to transit stops, service frequency, reliability and overall network coverage.

A higher score indicates that public transport is well-integrated, widely available and convenient, reducing reliance on private vehicles and improving urban mobility.

Well-designed public transport networks enhance social equity by providing affordable and reliable mobility options, making jobs, education and essential services more accessible. Where data is available, methods such as Public Transport Accessibility Levels (PTALs), used by cities like London, can be used to score this. Otherwise, a scoring based on walking distance, frequency and/or network coverage, like the ones below, can provide a practical proxy.

A. Population living within a 500-m distance of a 5-minute headway to a UPT stop or station

Measuring the amount of people near UPT stops or stations is crucial for ensuring equitable access to jobs, education and essential services, particularly for low-income and car-free households. A higher percentage indicates that more people can conveniently reach reliable and frequent transit services, reducing dependence on private vehicles and promoting sustainable urban mobility.

SCORING:

1. <80%
2. 80–85%
3. >85–90%
4. >90–95%
5. >95%

SOURCE:

European Commission, *How many people can you reach by public transport, bicycle or on foot in European Cities? Measuring urban accessibility for low-carbon modes* (Luxenbourg: Publications Office of the European Union, 2020), https://ec.europa.eu/regional_policy/information-sources/maps/low-carbon-urban-accessibility_en.

B. Average waiting time at UPT stops or stations

Shorter waiting times indicate frequent and well-coordinated services, making public transport a more attractive alternative to private vehicles. Excessive waiting times, on the other hand, discourage use, increase travel uncertainty and reduce accessibility, particularly for time-sensitive commuters. By optimising schedules, reducing delays and improving real-time information systems, cities can enhance transit reliability to directly impact passenger experience and overall ridership.

SCORING:

1. >15 min
2. >12–15 min
3. >8–12 min
4. 5–8 min
5. <5 min

SOURCE:

International Association of Public Transport (UITP) and Walk21 Foundation, *Urban Mobility Indicators for Walking and Public Transport* (UITP, Walk21 Foundation and VBK, published on behalf of the Urban Agenda for the EU, 2019), https://ec.europa.eu/futurium/en/system/files/ged/convenient-access-to-public-transport.pdf.

Moovit, *Moovit Global Public Transport Report 2024*, https://moovitapp.com/report#waiting-time.

C. Average walking distance to the closest UPT stop or station

A shorter walking distance to a UPT stop or station ensures greater convenience and encourages ridership. Excessively long walking distances, on the other hand, create barriers to accessibility, particularly for elderly individuals, people with disabilities, and those carrying goods or traveling with children.

SCORING:

1. >700 m
2. >600–700 m
3. >500–600 m
4. 400–500 m
5. < 400 m

SOURCES:

Dennis van Soest, Miles R. Tight and Christopher D. F. Rogers, “Exploring the distances people walk to access public transport”, Transport Reviews 40 (2020): 160–182, https://doi.org/10.1080/01441647.2019.1575491.

Juan Carlos García-Palomares, Javier Gutiérrez and Osvaldo Daniel Cardozo, “Walking accessibility to public transport: An analysis based on microdata and GIS”, Environment and Planning B: Urban Analytics and City Science 40.6 (2013): 1087–1102, https://doi.org/10.1068/b39008.

12 Speed regulation

Speed regulation refers to the policies, infrastructure and enforcement measures that control vehicle speeds in urban areas to improve road safety, pedestrian accessibility and overall traffic flow.

Effective speed regulation is essential for creating a liveable city, as lower, well-enforced speed limits reduce traffic fatalities, enhance pedestrian and cyclist safety, and promote walkable environments. Slower vehicle speeds improve street vibrancy and encourage active mobility.

Speed regulation also reduces noise pollution, lowers emissions and improves the overall quality of public spaces.

A. Average maximum vehicle speed allowed in the area

Lower speed limits, especially in pedestrian-heavy zones, reduce the risk and severity of accidents, making streets safer for walkers, cyclists and public transport users. Well-calibrated speed limits also contribute to quieter, more pleasant urban environments, supporting local businesses and public space usage.

Interpretation of this metric should reflect street function and context. A 30 km/hour environment is best practice in residential, school or commercial areas, while higher limits may be acceptable only on arterial roads with limited pedestrian or cycling activity. Results should be read together with road safety and active mobility indicators to assess whether limits support broader liveability goals.

SCORING:

1. >30 km/hour
3. 15–30 km/hour
5. <15 km/hour

SOURCE:

Institute for Transportation and Development Policy (ITDP), *TOD Standard* (New York: ITDP, 2017), https://itdp.org/wp-content/uploads/2017/06/TOD_Standard_EN.pdf.

13 Parking regulation and policy

This indicator looks at the rules and strategies governing parking within urban areas, including parking fees, zoning laws, permits and enforcement. It is aimed at managing parking demand and encouraging alternative transportation options.

This indicator is crucial for promoting sustainable mobility. Effective parking policies help decrease car dependency, free up public space for other uses and support more efficient land use, contributing to a more sustainable and equitable urban environment.

A. Area dedicated to parking spaces of private motorised vehicles

With this metric, a high percentage could indicate over-provision of parking relative to the overall area, with space used for vehicle storage taking away from public and green spaces. This may be a sign of inefficient land use and potentially contributes to congestion and reduced walkability as well. Reducing this percentage could free up space for sustainable urban development that prioritises space for people over cars, and promote alternative transport options.

SCORING:

1. >40%
2. >30–40%
3. >20–30%
4. 10–20%
5. <10%

SOURCE:

Institute for Transportation and Development Policy (ITDP), *TOD Standard* (New York: ITDP, 2017), https://itdp.org/wp-content/uploads/2017/06/TOD_Standard_EN.pdf.

B. Number of bicycle parking spots per resident

This metric measures the availability of designated spaces for bicycle parking relative to the population size. A higher ratio indicates a city's commitment to supporting cycling as a sustainable mode of transport, encouraging more people to cycle by providing convenient and secure parking options. It also reflects the city's infrastructure readiness for cyclists and to promote active transportation.

SCORING:

1. < 0.05
2. 0.05–0.2
3. >0.2–0.5
4. >0.5–1
5. >1

SOURCES:

European Cyclists' Federation (ECF), "Two bicycle parking spaces per apartment set to become new European norm," 15 December 2023, https://www.ecf.com/en/news/two-bicycle-parking-spaces-per-apartment-set-to-become-new-european-norm/

European Union, "Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast)", *Official Journal of the European Union* L 1275 (2024), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401275.

ENVIRONMENTAL

1 Urban heat island (UHI) effect

This indicator looks at the difference in temperature between urban areas and their surrounding rural or natural environments. The UHI effect occurs when cities, with their dense buildings, concrete and asphalt, absorb and retain more heat than non-urban areas, leading to higher temperatures in comparison.

The UHI effect is a critical environmental concern as it contributes to increased energy consumption (due to higher cooling demands), worsens air quality and exacerbates health issues like heat stress. Addressing the UHI effect can improve urban liveability by promoting cooler, more sustainable cities. Mitigating this effect through strategies like increasing green spaces and using reflective materials can reduce energy costs, lower pollution and create healthier environments for residents.

A. Total area covered by permeable surfaces

Higher coverage of permeable surfaces such as grass and gravel, or permeable pavements that allow water to pass through, promotes better water infiltration, reduces surface runoff and mitigates the UHI effect through evaporative cooling. Permeable surfaces help manage stormwater, reduce flooding risks and cool the environment.

SCORING:

1. <80%
2. 80–85%
3. >85–90%
4. >90–95%
5. >95%

SOURCES:

Andrea Ferrari et al., “The use of permeable and reflective pavements as a potential strategy for urban heat island mitigation”, *Urban Climate* 31 (2020): 100534, https://doi.org/10.1016/j.uclim.2019.100534.

European Environment Agency, “Imperviousness and imperviousness change in Europe”, 20 November 2024, https://www.eea.europa.eu/en/analysis/indicators/imperviousness-and-imperviousness-change-in-europe?activeAccordion=546a7c35-9188-4d23-94ee-005d97c26f2b.

B. UHI values

Higher UHI values (i.e., larger temperature differences between urban areas and their surrounding rural or natural environments) indicate stronger heat retention in cities, leading to increased cooling demands, higher energy consumption and greater risks of heat-related health issues.

Monitoring UHI values helps in assessing the severity of the UHI effect and informs urban planning strategies, such as increasing vegetation, implementing reflective materials and improving building design to mitigate excessive heat buildup.

SCORING:

1. >2°C
2. 1.67–2°C
3. 1.34–1.66°C
4. 1–1.33°C
5. <1 °C

SOURCE:

Dirk Lauwaet et al., “High resolution modelling of the urban heat island of 100 European cities”, *Urban Climate* 54 (2024): 101850, https://doi.org/10.1016/j.uclim.2024.101850.

2 Green space

This indicator focuses on the presence, distribution and accessibility of parks, forests and other vegetated areas within a city, assessing their role in enhancing the environment and social well-being.

A. Total area covered by green space

Adequate provision of green space supports biodiversity, mitigates the UHI effect, improves air quality, and provides residents with opportunities for recreation and physical activity. Access to greenery also enhances mental well-being and strengthens social cohesion by offering inclusive public spaces.

This metric should be assessed alongside the distribution of green space, ensuring that all residents live within a reasonable walking distance of a park or garden. This links directly to health outcomes and environmental resilience.

SCORING:

1. <15%
2. 15–20%
3. >20–30%
4. >30–50%
5. >50%

SOURCES:

Evelise Pereira Barboza et al., “Green space and mortality in European cities: A health impact assessment study,” *Lancet Planet Health* 5 (2021): e718–e730, http://ecodes.org/images/que-hacemos/01.Cambio_Climatico/Incidencia_politicas/Clean_Cities_Campaign/Pereira_et_al_2021_Green_space_and_mortality_TLPlanet_Oct2021.pdf.

3 Blue space

This indicator looks at the presence, distribution and accessibility of water bodies such as rivers, lakes, ponds, wetlands and coastal areas within a city, assessing their contribution to environmental and social well-being.

Blue spaces play a crucial role in climate regulation, biodiversity support and water management, while also providing recreational, aesthetic and mental health benefits. Well-integrated blue spaces enhance urban resilience by mitigating flooding, cooling surrounding areas and improving overall environmental quality.

A. Total area covered by blue space

The extent to which blue spaces cover the total area reflects a city's commitment to preserving natural water resources and promoting sustainable water management. Higher coverage of blue spaces enhances ecological diversity, mitigates extreme temperature and contributes to healthier cities with stronger urban resilience.

As with green space, distribution and accessibility matter as much as overall coverage. Blue spaces can provide significant climate adaptation benefits, but care should be taken to ensure equitable access and balance ecological protection with recreational use.

SCORING:

1. <4%
2. 4–8%
3. >8–12%
4. >12–16%
5. >16%

SOURCE:

Clemens Deilmann et al., "A multifactorial GIS-based analytical method to determine the quality of urban green space and water bodies", *Urbani Izziv* 26, supplement (2015), https://www.researchgate.net/publication/306308729_A_Multifactorial_GIS-Based_Analytical_Method_to_Determine_the_Quality_of_Urban_Green_Space_and_Water_Bodies.

4 Air pollution

The indicator measures the concentration of harmful pollutants in the air, assessing the overall air quality and its impact on public health, the environment and urban liveability.

Air pollution is a major environmental and public health concern, contributing to respiratory diseases, cardiovascular issues and reduced life expectancy. Monitoring air pollution levels helps cities implement effective policies to reduce emissions, promote sustainable transportation and improve overall urban air quality for a healthier population.

A. Annual average air quality index (combination of pollutants)

This metric assesses the annual average air quality index (AQI), which aggregates multiple pollutants (e.g., NO_2, $PM_{2.5}$, PM_{10}, SO_3, ozone) into a single measure of air quality.

A higher AQI indicates worse pollution levels, affecting public health and quality of life. Monitoring this metric provides a comprehensive assessment of air pollution and helps guide policy decisions to improve urban air quality.

SOURCE:

European Environment Agency, "European Air Quality Index", https://airindex.eea.europa.eu/AQI/index.html.

World Health Organization (WHO), *WHO global air quality guidelines: Particulate Matter ($PM_{2.5}$ and PM_{10}), Ozone, Nitrogen Dioxide, Sulfur Dioxide and Carbon Monoxide* (Geneva: WHO, 2021), https://iris.who.int/bitstream/handle/10665/345329/9789240034228-eng.pdf.

SCORING:

1. Very or extremely poor ($PM_{2.5}$: ≥ 91; PM_{10}: ≥ 196; O_2: ≥ 161; NO_2: ≥ 101; SO_2: ≥ 191)
2. Poor ($PM_{2.5}$: 51- 90; PM_{10}: 121 - 195; O_2: 121 - 160; NO`: 61- 100; SO_2: 126 - 190)
3. Moderate ($PM_{2.5}$: 16- 50; PM_{10}: 46 - 120; O_2: 101 - 120; NO_2: 26 - 60; SO_2: 41 - 125)
4. Fair ($PM_{2.5}$: 6 - 15; PM_{10}: 16 - 45; O_2: 61 - 100; NO_2: 11 - 25; SO_2: 21 - 40)
5. Good ($PM_{2.5}$: 0 - 5; PM_{10}: 0 - 15; O_2: 0 - 60; NO_2: 0 - 10; SO_2: 0 - 20)

* Measured in $\mu g/m^3$

5 Noise pollution

Excessive noise exposure contributes to stress, sleep disturbances, cardiovascular diseases, and reduced well-being. Monitoring noise pollution helps cities implement mitigation measures such as traffic calming, sound barriers and urban planning strategies to create healthier and more liveable environments.

A. Annual average level of noise per day

By measuring the annual average day-evening-night-weighted noise level (Lden) that residents are exposed to over 24 hours, which is expressed in decibels (dB), cities can account for long-term noise exposure, with more weight given to evening and nighttime levels when noise can be more disruptive.

High Lden values indicate significant noise pollution, affecting residents' health and comfort. Tracking this metric helps guide noise reduction policies, zoning regulations and infrastructure planning to minimise harmful noise exposure in urban areas.

SCORING:

1. > 55 dB Lden
3. 50–55 dB Lden
5. < 50 dB Lden

SOURCE:

International Energy Agency, "Global EV Outlook 2024: Outlook for electric mobility", n.d., https://www.iea.org/reports/global-ev-outlook-2024/outlook-for-electric-mobility.

6 Share of renewable energy in transport

The share of renewable energy in transport looks at the extent to which a city's transportation system relies on clean, renewable energy sources, reducing dependence on fossil fuels and lowering emissions from mobility.

Transitioning to renewable energy in transport is crucial for reducing greenhouse gas emissions, improving air quality and promoting sustainability. A higher share of clean energy in public and private transport decreases urban pollution, enhances energy efficiency and supports climate resilience. By tracking the adoption of renewable energy-powered buses, taxis and private vehicles, cities can evaluate the effectiveness of their sustainable mobility policies and infrastructure investments, supporting cleaner urban air, public health improvement, greenhouse gas reduction and climate targets.

A. PT buses on clean energy

This metric measures the percentage of public bus fleet vehicles powered by clean energy—including those that are battery-electric (BEVs), plug-in hybrid (PHEVs), hydrogen fuel cell (FCEVs), and others that utilise low- or zero-emission technologies—out of the total number of buses operated by public or contracted transit agencies in a city.

High proportions of PT buses on clean energy in a fleet suggest significant progress in the transition to clean-energy bases, contingent upon the decarbonisation of the local energy grid.

SCORING:

1. <10%
2. 10–20%
3. >20–30%
4. >30–50%
5. >50%

SOURCE:

International Energy Agency, "Global EV Outlook 2024: Outlook for electric mobility", n.d., https://www.iea.org/reports/global-ev-outlook-2024/outlook-for-electric-mobility.

B. Taxis on clean energy

This metric measures the percentage of registered taxis powered by clean energy—including BEVs, PHEVs and FCEVs—relative to the total number of taxis in a city and reflects the extent of the fleet transition. Smaller proportions could indicate cities in the early stages of transition, while larger shares could reflect major fleet transitions and strong policy backing for clean energy vehicles.

SCORING:

1. <5%
2. 5–20%
3. >20–35%
4. >35–50%
5. >50%

SOURCES:

International Energy Agency, "Global EV Outlook 2024: Outlook for electric mobility", n.d., https://www.iea.org/reports/global-ev-outlook-2024/outlook-for-electric-mobility.

Robin Whitlock, "UK Government to help more black cab drivers go green with further funding support," *Renewable Energy Magazine*, 21 February 2024, https://www.renewableenergymagazine.com/electric_hybrid_vehicles/uk-government-to-help-more-black-cab-20240221.

C. EVs in total vehicle fleet

This metric measures the percentage of EVs in the total registered vehicle fleet of a city or metropolitan area overall—including BEVs, PHEVs and FCEVs—and reflects the degree of electrification in private, commercial and institutional road transport.

A higher proportion of EVs suggests the mainstreaming of electric mobility, beyond public or professional fleets, and highlights policy effectiveness and market readiness, as well as shifts in consumer behaviour.

SCORING:

1. <5%
2. 5–10%
3. >10–20%
4. >20–30%
5. >30%

SOURCES:

International Council on Clean Transportation (ICCT), *Market Spotlight—European Market Monitor, Cars and Vans: May 2025* (ICCT, 2025), https://theicct.org/wp-content/uploads/2025/06/ID-409---high-EU-cars-May-Market-Spotlight-A4-70167-v4.pdf.

International Energy Agency, "Global EV Outlook 2024: Outlook for electric mobility", n.d., https://www.iea.org/reports/global-ev-outlook-2024/outlook-for-electric-mobility.

SOCIAL AND HEALTH

1 Spaces that promote outdoor usage and active lifestyle

This indicator measures the effectiveness of public spaces in promoting outdoor usage and active lifestyles through infrastructure provision.

Spending time outdoors can result in improved well-being and increased physical activity. How long people spend outdoors can be dependent on the attractiveness of public spaces, due to the key role they play in serving as vital hubs for community engagement, recreation and physical activities. When well-designed and integrated into neighbourhoods, public spaces can encourage more time spent outdoors, thereby enhancing health, community vibrancy and social cohesion.

A. Average dwell time in the area

This metric measures how long people dwell or stay in a public space on average, to assess a space's attractiveness, level of comfort, and ability to support social interaction and active lifestyles.

A higher dwell time suggests that the space is engaging, well designed and provides amenities that encourage people to linger, fostering community connections and promoting outdoor activity.

SCORING:

1. <2 min
2. 2–10 min
3. >10–20 min
4. >20–30 min
5. >30 min

SOURCES:

Vikas Mehta, *A Toolkit for Performance Measures of Public Space* (published in conjunction with the 43rd ISOCARP Congress, 2007), https://www.isocarp.net/Data/case_studies/983.pdf.

UN-Habitat, *Healthier Cities and Communities Through Public Spaces: A guidance paper.* (Nairobi: UN-Habitat, 2025), https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf.

B. Provision of sufficient public seating infrastructure

This metric measures the provision of and distance between public seating infrastructure. Regular seating, provided at shorter intervals, enhances accessibility by supporting the needs of diverse populations, including older adults and people with disabilities. This makes spaces more inclusive and encourages time spent outdoors.

SCORING:

1. >300 m of spacing
3. 150–300 m of spacing
5. 50–<150 m of spacing

SOURCE:

UN-Habitat, *Healthier Cities and Communities Through Public Spaces: A guidance paper.* (Nairobi: UN-Habitat, 2025), https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf.

United Nations, *Accessibility for the Disabled: A Design Manual for a Barrier-Free Environment* (prepared by the Ministry of Social Affairs National Committee for the Disabled, United Nations Economic and Social Commission for Western Asia, and SOLIDERE, 2003), https://www.un.org/esa/socdev/enable/designm/index.html.

C. Proportion of public space dedicated to play areas

This metric measures the percentage of public space dedicated to recreation in the form of play areas for different demographic groups—such as chess tables, table tennis tables and children's playgrounds.

Public spaces with a higher proportion of play areas that cater to diverse demographics enhance their attractiveness and encourage greater use.

SCORING:

1. <2%
2. 2–5%
3. >5–8%
4. >8–10%
5. >10%

SOURCE:

UN-Habitat, *Healthier Cities and Communities Through Public Spaces: A guidance paper.* (Nairobi: UN-Habitat, 2025), https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf.

2 User profile mix

This indicator reflects the demographic diversity of people living in or using an area, considering factors such as age, gender, household structure and income levels—as calculated using the Shannon Diversity Index (H'), which can be applied to quantify both the range of groups present and the balance among them. This helps to assess how inclusive and socially balanced a neighbourhood or public space is.

A diverse user profile indicates an inclusive and well-integrated urban environment where people of different backgrounds, ages and economic situations can coexist and thrive. High diversity fosters social cohesion, reduces segregation, and enhances the vibrancy and resilience of a community. By ensuring a balanced mix of users, cities can create spaces that cater to varied needs, promote equity and encourage a rich social and economic environment.

A. Diversity of genders and ages of users in the area

This metric assesses how balanced and varied the mix of age groups and genders is within a given space. It is calculated in terms of H', with a higher score indicating a more inclusive and representative user mix, suggesting that the space is accessible and welcoming to a wide spectrum of residents.

While the index provides a useful composite measure, cities should also monitor specific group participation (e.g., women, children, persons with disabilities) to ensure vulnerable users are adequately represented. Results should be interpreted alongside qualitative user feedback and accessibility audits.

SCORING:

1. 0–0.3 H'
2. >0.3–0.75 H'
3. >0.75–1.1 H'
4. >1.1–1.4 H'
5. >1.4–1.6 H'

SOURCES:

Richard Wright, Mark Ellis and Gemma Catney, "The age of diversity: The neighbourhood demographic structure of ethnic groups in England and Wales, 2001–2021, *Transactions of the Institute of British Geographers* Early View (2025): e70014, https://doi.org/10.1111/tran.70014.

Steven R. Holloway, Richard Wright and Mark Ellis, "The racially fragmented city? Neighbourhood racial segregation and diversity jointly considered", *The Professional Geographer* 64 (2012): 63–82, https://www.tandfonline.com/doi/epdf/10.1080/00330124.2011.585080.

B. Diversity of household incomes in the area

This metric measures the economic diversity of residents, reflecting whether an area includes a mix of low-, middle- and high-income households. It is calculated in terms of H', with a higher score indicating economic inclusivity, which reduces the risks of segregation and fosters a more integrated and socially cohesive environment. Ensuring a mix of income levels supports local businesses, prevents economic displacement and promotes equity in access to services, opportunities and public amenities.

SCORING:

1. 0–0.3 H'
2. >0.3–0.75 H'
3. >0.75–1.1 H'
4. >1.1–1.4 H'
5. >1.4–1.6 H'

SOURCES:

Richard Wright, Mark Ellis and Gemma Catney, "The age of diversity: The neighbourhood demographic structure of ethnic groups in England and Wales, 2001–2021, *Transactions of the Institute of British Geographers* Early View (2025): e70014, https://doi.org/10.1111/tran.70014.

Steven R. Holloway, Richard Wright and Mark Ellis, "The racially fragmented city? Neighbourhood racial segregation and diversity jointly considered", *The Professional Geographer* 64 (2012): 63–82, https://www.tandfonline.com/doi/epdf/10.1080/00330124.2011.585080.

C. Diversity of household types in the area

This metric measures the diversity of household structures, such as single-person households, families with children, multi-generational households and shared living arrangements. It is calculated in terms of H', with a higher score suggesting a well-balanced community that accommodates various lifestyles and needs. Promoting a mix of household types contributes to neighbourhood resilience, social stability and a richer local economy by ensuring services and infrastructure are designed to serve different population segments effectively.

SCORING:

1. 0–0.3 H'
2. >0.3–0.75 H'
3. >0.75–1.1 H'
4. >1.1–1.4 H'
5. >1.4–1.6 H'

SOURCES:

Richard Wright, Mark Ellis and Gemma Catney, "The age of diversity: The neighbourhood demographic structure of ethnic groups in England and Wales, 2001–2021, *Transactions of the Institute of British Geographers* Early View (2025): e70014, https://doi.org/10.1111/tran.70014.

Steven R. Holloway, Richard Wright and Mark Ellis, "The racially fragmented city? Neighbourhood racial segregation and diversity jointly considered", *The Professional Geographer* 64 (2012): 63–82, https://www.tandfonline.com/doi/epdf/10.1080/00330124.2011.585080.

3 Accessibility to urban public space

This indicator assesses the availability of, and ease of access to, public spaces such as parks, gardens, plazas and recreational areas. This ensures that residents can engage in social, cultural and leisure activities within close proximity to their neighbourhoods.

Access to well-distributed public spaces enhances social interaction, mental and physical well-being, and overall urban liveability. Equitable access to these spaces promotes inclusivity, reduces social disparities and supports environmental sustainability by providing green infrastructure that mitigates the UHI effect and improves air quality.

A. Area of urban public space per resident within a radius of 700 m (15-min walk) of their residence

A higher value of public space (e.g., parks, gardens, outdoor spaces, play areas) per capita indicates better spatial distribution of, and more equitable access to, urban public spaces. Such spaces strengthen social cohesion, enhance environmental benefits and support sustainable urban development by encouraging active lifestyles, fostering community connections and improving mental health.

SCORING:

1. <1 m^2 of urban public space/capita
2. 1–4 m^2 of urban public space/capita
3. >4–7 m^2 of urban public space/capita
4. >7–10 m^2 of urban public space/capita
5. >10 m^2 of urban public space/capita

SOURCES:

Alexander Ståhle and CEO Spacescape, *Developing Public Space and Land Values in Cities and Neighbourhoods*, UN-Habitat Discussion Paper, 23 July 2018, https://unhabitat.org/sites/default/files/download-manager-files/Discussion%20Paper%20-%20Developing%20Public%20Space%20and%20Land%20Values%20in%20Cities%20and%20Neighbourhoods.pdf.

Hyunji Lee, "Quantifying public spaces for better quality of urban assets," *World Bank Blogs*, 24 October 2018, https://blogs.worldbank.org/en/sustainablecities/quantifying-public-spaces-better-quality-urban-assets#:~:text=To%20measure%20dynamic%20characteristics%20of,lacks%20empirical%20background%20or%20references.

World Health Organization (WHO), "Health indicators of sustainable cities in the context of the Rio+20 UN Conference on Sustainable Development", 17–18 May 2012, https://www.who.int/docs/default-source/environment-climate-change-and-health/sustainable-development-indicator-cities.pdf?sfvrsn=c005156b_2.

4 Placemaking/vibrancy of public spaces

This indicator assesses the quality, inclusivity and dynamic nature of public spaces by evaluating how diverse groups of people use them, the variety of activities they support, and how they reflect local identity and culture.

Vibrant public spaces enhance community interaction, social cohesion and urban liveability by being welcoming, functional and culturally meaningful. A well-designed public space fosters inclusivity by: attracting people of different ages, genders and abilities; offering diverse activities; hosting a variety of events that activate the space; and incorporating local materials and plants that strengthen cultural identity.

A. Diversity of users observed in public spaces

This metric measures the effectiveness of place-making by evaluating social mixing or the diversity of users, in terms of age, gender, ability and culture, in public spaces. This can be done through direct observation, surveys or other forms of urban data collection and analysis.

When spaces attract people across different user groups, and support a variety of activities, they demonstrate their effectiveness in meeting broader community needs. A high diversity of users within a public space can indicate that the space is inclusive, diverse and accessible, thereby promoting coexistence and active interaction between different user groups.

SCORING:

1. Very low (dominance of a single group in terms of age, gender or culture, with minimal interaction between groups)
2. Low (presence of some diversity of groups, but strong segregation or lack of interaction between them)
3. Medium (moderate diversity of groups with some interaction, but visible social barriers)
4. High (high diversity in age, gender and culture, with meaningful interactions between groups)
5. Very high (space is inclusive and diverse, where people of different ages, genders and cultures coexist and interact actively)

SOURCES:

Jackie De Burka, “Designing for diversity: How inclusive urban spaces shape societies”, *Constructive Voices*, 18 November 2024, https://constructive-voices.com/designing-for-diversity-how-inclusive-urban-spaces-shape-societies/.

Linda R. Tropp and Liora Morhayim, *Designing, Implementing, and Evaluating the Impact of Social Mixing Programmes: A Toolkit for IOM and Its Partners* (Vienna: International Organization for Migration, 2022), https://publications.iom.int/system/files/pdf/pub2022-194-r-designing-implementing-and-evaluating-the-impact-of-social-mixing-programmes.pdf.

Monika Maria Cysek-Pawlak, “Mixed use and diversity as a New Urbanism principle guiding the renewal of post-industrial districts: Case studies of the Paris Rive Gauche and the New Centre of Lodz”, *Urban Development Issues* 57: 53–62, https://www.researchgate.net/publication/325584704_Mixed_use_and_diversity_as_a_New_Urbanism_principle_guiding_the_renewal_of_post-industrial_districts.

B. Diversity of uses in public spaces

This metric evaluates the multifunctionality and dynamism of a given public space by counting the range of activities and uses they support. A greater diversity of uses, such as active frontages (shops, cafés), temporary pop-up installations, and community events, reflects the degree of vibrancy and adaptability of the space. Spaces with a higher variety of uses are more inclusive, engaging and resilient. This attracts varied users throughout the day, promotes local economic activity and fosters social interaction.

SCORING:

1. No variety in public space use
2. 1–2 uses of public space
3. 3–5 uses of public space
4. 6–7 uses of public space
5. ≥8 uses of public space

SOURCE:

UN-Habitat, *Healthier Cities and Communities Through Public Spaces: A guidance paper*. (Nairobi: UN-Habitat, 2025), https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf.

C. Average number of cultural, social and recreational events in public spaces per month

This metric measures how actively public spaces are used for cultural, social and recreational activities, through the total number of events conducted per month. Such activities contribute to community engagement and urban vibrancy.

A higher number of such events indicates that public spaces are well-utilised, which fosters social interaction, local economic activity and a sense of belonging. Events like car-free days also promote sustainable mobility and environmental awareness, reinforcing the role of public spaces as dynamic, inclusive and people-centred areas.

SCORING:

1. 0–2 events
2. 3–8 events
3. 9–12 events
4. 13–18 events
5. ≥19 events

SOURCE:

Greg Richards, “Events and urban space: a challenging relationship”, *International Journal of Tourism Cities* 10.3 (2024): 1067–1081, www.emerald.com/insight/content/doi/10.1108/ijtc-12-2023-0270/full/pdf?title=events-and-urban-space-a-challenging-relationship.

5 Community engagement/participatory planning

This indicator assesses the engagement of the local community in the formulation of policies that promote sustainable mobility initiatives.

Communities and local residents understand the specific needs and challenges of their area. Early engagement of these stakeholders can increase the likelihood of buy-in, leading to the success of initiatives. It also ensures that the diverse voices of the community are represented, which can foster greater trust between the public and government.

A. Number of public consultations for feedback sessions

This metric is a quantitative measure of the number of sessions conducted to gather public feedback for mobility related projects. The quantity is measured per project. At the same time, having quality consultation sessions can result in more detailed discussion and feedback, and improved transparency in the planning process.

SCORING:

1. <2 consultations
2. 2 consultations
3. 3 consultations
4. 4 consultations
5. ≥5 consultations

SOURCES:

United Nations Human Settlements Programme (UN-Habitat), *Inclusive and Sustainable Urban Development Planning: A Guide for Municipalities*, Volume 3 (Nairobi: UN-Habitat, 2007), https://unhabitat.org/sites/default/files/download-manager-files/Inclusive%20and%20Sustainable%20Urban%20Development%20Planning%20A%20guide%20for%20Municipalities%20%2C%20Volume%203.pdf.

World Bank, *Stakeholder Engagement Plan: Tonga Climate Resilience Transport Project* (World Bank, 2018), https://documents1.worldbank.org/curated/en/488641537171658332/pdf/TCRTP-Stakeholder-Engagement-Plan-final.pdf.

6 Public perception of sustainable mobility initiatives

This indicator measures the extent of public involvement and support for sustainable mobility initiatives. Public perception is critical for building legitimacy, ensuring long-term behavioural change and strengthening the adoption of new mobility policies. A higher score reflects deeper levels of citizen engagement and empowerment in shaping mobility decisions.

A. Level of participation

This metric is measured in terms of the level of engagement by the city to encourage public participation in the policy formulation process. It considers not only whether citizens are informed or consulted, but also the degree to which their views influence outcomes.

Higher levels of participation indicate more collaborative and transparent governance, where residents play an active role in shaping sustainable mobility initiatives.

SCORING:

1. Providing the public with information
2. Consulting the public on issues (providing feedback based on acknowledged concerns)
3. Getting involved with public discussions to understand concerns while proposing solutions
4. Collaborating with the public to make a decision together, including shared development of alternatives and identification of preferred solutions
5. Empowering the public with decision-making authority

SOURCE:

International Association for Public Participation (IAP2), “IAP2 Spectrum of Public Participation”, 2024, https://cdn.ymaws.com/www.iap2.org/resource/resmgr/pillars/iap2_spectrum_2024.pdf.

7 Commuter satisfaction scores

Commuter satisfaction scores provide a qualitative measurement of commuters' experience with the PT system and services, beyond technical performance.

Measuring commuter satisfaction through surveys provides insights into factors that directly shape commuter well-being and influence whether people continue using, or shift towards, more sustainable modes of travel.

A. Efficiency and comfort of public transport

The metric assesses key aspects of transport systems such as speed, comfort, safety, overall reliability and quality of transport journeys. The higher the score, the more satisfied a commuter is with their overall commuting experience.

Commuter satisfaction is typically assessed through recurring passenger surveys, structured focus groups, digital feedback tools or apps. In many cities, these datasets are complemented by regular customer service performance reports and longitudinal benchmark surveys, which allow changes in satisfaction to be tracked over time and across different commuter segments.

SCORING:

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neutral
4. Satisfied
5. Very satisfied

SOURCES:

Observatori de la Mobilitat de Catalunya, "Customer Satisfaction Index (CSI) of TMB bus service", 2023, https://ce.atm.cat/en/web/observatori/w/eqp-bus-tmb?filterCategoryIds=undefined&operationType=AND.

Transport for London, *Customer service and operational performance report: Quarter 4* (Transport for London, 2023/2024), https://content.tfl.gov.uk/customer-service-and-operational-performance-report-quarter-4-2023-24-acc.pdf.

8 Perceived safety of streets

This indicator measures individuals' perceived safety of streets, which shapes the success of sustainable mobility initiatives by influencing both travel behaviour and societal outcomes. Safe streets can catalyse community interaction and economic activity by encouraging commuters to choose active mobility and public transport modes.

A. Perceived safety of streets by pedestrians

This metric assesses the perceived safety of streets by pedestrians. A higher score indicates that streets in their neighbourhood or precinct are perceived to be safer.

Perceptions of safety may be measured through resident or commuter surveys, using Likert-scale questions (e.g., "How safe do you feel walking in your neighbourhood?"). These could also be integrated into city quality-of-life surveys, transport user satisfaction studies, or stand-alone perception audits. This metric should be cross-checked with objective safety indicators such as accident rates, lighting and/or traffic speeds, for a fuller picture.

SCORING:

1. Pedestrians do not feel safe at all
2. Pedestrians feel safe to a small extent
3. Pedestrians feel safe to a moderate extent
4. Pedestrians feel safe to a large extent
5. Pedestrians feel very safe

SOURCES:

Eleonora Papadimitriou et al., "Road Safety Attitudes and Perceptions of Pedestrians in Europe," *Procedia – Social and Behavioral Sciences* 48 (2012): 2490–2500, https://discovery.ucl.ac.uk/id/eprint/10011936/1/Road_Safety_Attitudes_and_Perceptions_of_Pedestrians_in_Europe_2012.pdf.

European Commission, *Report on the Quality of Life in European Cities*, 2023 (Luxembourg: Publications Office of the European Union, 2023), https://ec.europa.eu/regional_policy/information-sources/maps/quality-of-life_en.

ENDNOTES

1 IEA, "Transport", https://www.iea.org/energy-system/transport#tracking.

2 IEA, “Greenhouse Gas Emissions from Energy Data Explorer”, 2 August 2024, https://www.iea.org/data-and-statistics/data-tools/greenhouse-gas-emissions-from-energy-data-explorer.

3 IEA, “Global CO2 emissions from transport by sub-sector in the Net Zero Scenario 2000–2030”, 22 September 2022, https://www.iea.org/energy-system/transport#tracking

4 Ibid

5 Ian Scott and Ting Gong, “Coordinating government silos: challenges and opportunities”, *Global Public Policy and Governance* 1 (2021): 20–38, https://doi.org/10.1007/s43508-021-00004-z.

6 Ibid.

7 Xu Liu, Marc Dijk and Carlo Colombo, “Improving multilevel policy mixes for sustainable urban mobility transition”, *Environmental Innovation and Societal Transitions* 50 (2024): 100808, https://doi.org/10.1016/j.eist.2023.100808.

8 Ibid.

9 L.B.A. van der Linde, P.A. Witte and T.J.M. Spit, “Quiet acceptance vs. the ‘polder model’: stakeholder involvement in strategic urban mobility plans”, *European Planning Studies* 29.3 (2021): 425–445, https://doi.org/10.1080/09654313.2020.1735310.

10 Christos Zografos et al., “The everyday politics of urban transformational adaptation: Struggles for authority and the Barcelona superblock project”, *Cities* 99 (2020): 102613, https://doi.org/10.1016/j.cities.2020.102613.

11 Mark Nieuwenhuijsen et al., “The Superblock model: A review of an innovative urban model for sustainability, liveability, health and well-being”, *Environmental Research* 251.1 (2024): 118550, https://doi.org/10.1016/j.envres.2024.118550.

12 David Banister, “The sustainable mobility paradigm”, *Transport Policy* 15.2 (2008): 73-80, https://doi.org/10.1016/j.tranpol.2007.10.005.

13 Ibid.

14 International Transport Forum, *Broadening Transport Appraisal: Summary and Conclusions*, ITF Roundtable Reports, No. 188 (Paris: OECD Publishing, 2022).

15 ITF, *Broadening Transport Appraisal: Summary and Conclusions*.

16 Madison Bland, Matthew I. Burke and Kelly Bertolaccini, “Taking steps toward healthy & sustainable transport investment: A systematic review of economic evaluations in the academic literature on large-scale active transport infrastructure”, *International Journal of Sustainable Transportation*, 18.3 (2024): 201–220, https://doi.org/10.1080/15568318.2023.2296952.

17 Ibid.

18 Hanna Hüging, Kain Glensor and Oliver Lah, “Need for a holistic assessment of urban mobility measures—Review of existing methods and design of a simplified approach”, *Transportation Research Procedia* 4 (2014): 3–13, https://doi.org/10.1016/j.trpro.2014.11.001.

19 Bland, Burke and Bertolaccini, “Taking steps toward healthy & sustainable transport investment”.

20 Gerard de Jong, Silvia Vignetti and Chiara Pancotti, “Ex-post evaluation of major infrastructure projects”, *Transportation Research Procedia* 42 (2020): 75–84, https://doi.org/10.1016/j.trpro.2019.12.008.

21 Bland, Burke and Bertolaccini, “Taking steps toward healthy & sustainable transport investment”.

22 Ashish Kumar Krivastava, Iva Ashish Srivastava and Paritosh Singh Rana, “Advancing sustainable urban mobility by exploring trends and reimagining cost-benefit analysis for active travel”, *Transport Policy* 167 (2025): 91–100, https://doi.org/10.1016/j.tranpol.2025.03.014.

23 Bland, Burke and Bertolaccini, “Taking steps toward healthy & sustainable transport investment”.

24 Thérèse Steenberghen et al., *Support study on data collection and analysis of active modes use and infrastructure in Europe, Final Report* (Luxembourg: Publications Office of the European Union, 2017), https://op.europa.eu/en/publication-detail/-/publication/c02a2c8c-ffed-11e6-8a35-01aa75ed71a1.

25 Gulce Kirdar, “A Design Proposal of Integrated Smart Mobility Application for Travel Behavior Change towards Sustainable Mobility”, *Civil Engineering and Architecture* 8.5 (2020): 1095–1106, https://doi.org/10.13189/CEA.2020.080536.

26 Steenberghen et al., *Support study on data collection and analysis of active modes use and infrastructure in Europe*.

27 International Transport Forum, *Measuring New Mobility: Definitions, Indicators, Data Collection,* ITF Policy Papers, No. 114 (Paris: OECD Publishing, 2023).

28 International Transport Forum, *Big Data for Travel Demand Modelling: Summary and Conclusions*, ITF Roundtable Reports, No. 186 (Paris: OECD Publishing, 2021).

29 Steenberghen et al., *Support study on data collection and analysis of active modes use and infrastructure in Europe*.

30 Michiyo Ishida and Calvin Yang, “Japan’s Shinkansen high-speed rail faces surging passenger demand, ageing infrastructure”, *Channel NewsAsia*, 15 May 2025, https://www.channelnewsasia.com/east-asia/japan-shinkansen-high-speed-rail-train-ageing-infrastructure-passenger-demand-5131881#:~:text=East%20Asia-,Japan%E2%80%99s%20Shinkansen%20high%2Dspeed%20rail%20faces%20surging%20passenger%20demand%2C%20ageing,tunnels%20have%20to%20be%20reinforced.

31 International Transport Forum, *Reversing Car Dependency: Summary and Conclusions*, ITF Roundtable Reports, No. 181 (Paris: OECD Publishing, 2021).

32 Mareike Andert and Melanie Nagel, “Failed mobility transition in an ideal setting and implications for building a green city”, *npj Climate Action* 3 (2024): 114, https://doi.org/10.1038/s44168-024-00189-z.

33 Michelle Kaske, “New York City congestion pricing takes effect after years of delays”, *The Business Times*, 5 January 2025, https://www.businesstimes.com.sg/international/new-york-city-congestion-pricing-takes-effect-after-years-delays.

34 Nadia Gyane and Hannah Brown, “Cambridge congestion charge: Has it really run out of road?”, *BBC*, 29 September 2023, https://www.bbc.com/news/uk-england-cambridgeshire-66961894.

35 Riccardo Boin et al., “Infrastructure technologies: Challenges and solutions for smart mobility in urban areas”, McKinsey & Company, March 2023, https://www.mckinsey.com/~/media/mckinsey/industries/travel%20logistics%20and%20infrastructure/our%20insights/infrastructure%20technologies%20challenges%20and%20solutions%20for%20smart%20mobility%20in%20urban%20areas/infrastructure-technologies-challenges-and-solutions-for-smart-mobility-in-urban-areas.pdf.

36 International Transport Forum, Safer Micromobility, *ITF Policy Papers*, No. 129 (Paris: OECD Publishing, 2024).

37 Transport for London, “Healthy Streets”, https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/healthy-streets#on-this-page-1

38 Euro Cities, “Sustainable Urban Mobility Indicators (SUMI)”, https://eurocities.eu/projects/sustainable-urban-mobility-indicators/

39 New York City Department of Transportation, *Measuring the Street: New Metrics for 21st Century Streets* (New York: NYC DOT, October 2012), https://www.nyc.gov/html/dot/downloads/pdf/2012-10-measuring-the-street.pdf.

40 Matteo Jarre et al., *Bikenomics: Making the case for cycling investment in your city* (CIVITAS Handshake, 2022), https://handshakecycling.eu/bikenomics.

41 Chris Bruntlett, “Rethinking Transport Infrastructure Investment Through the Lens of Bikenomics,” *Österreichische Zeitschrift für Verkehrswissenschaft* (Austrian Journal for Transportation Science) 01 (2025), republished by Dutch Cycling Embassy, 15 June 2025, https://dutchcycling.nl/knowledge/best-practices/bikenomics-austrian-journal/.

42 Office for Cycle Superhighways, *Cycle Superhighway Bicycle Account 2019* (Denmark: Office for Cycle Superhighways, 2020), https://cyclingsolutions.info/wp-content/uploads//2020/12/Cycle-Superhighway-Bicycle-Account-2020.pdf.

43 Streetmeter, accessible at https://streetmeter.net/about-streetmeter.

44 MIT Media Lab, "Project StreetScore", n.d., https://www.media.mit.edu/projects/streetscore/overview/.

45 PlaceScore, *PlaceScore*, accessible at https://placescore.org/.

46 Yiyu Wang et al., "The Impact of the Built Environment and Social Environment on Physical Activity: A Scoping Review”, *International Journal of Environmental Research and Public Health* 20 (2023): 6189, https://doi.org/10.3390/ijerph20126189.

47 Ibid.

48 Ministry of Health, “National Population Health Survey”, 2023, https://www.moh.gov.sg/resources-statistics/reports/national-population-health-survey-2023.

49 Land Transport Authority, "Public Transport Ridership”, 2024 lta.gov.sg/content/dam/ltagov/who_we_are/statistics_and_publications/statistics/pdf/PT_Ridership_Monthly_2019-2023.pdf.

50 Wang et al., “The Impact of the Built Environment and Social Environment on Physical Activity”.

51 Ibid.

52 Sarah Michel, Nicola Banwell and Nicolas Senn, “Mobility Infrastructures and Health: Scoping Review of studies in Europe”, *Public Health Review* 45 (2024):1606862, doi: 10.3389/phrs.2024.1606862.

53 Siyao Gao et al., “More Than Aging in Place: ‘Aging in Networks’; in Singapore”, *Annals of the American Association of Geographers*, 114 (2024) :9, 2132-2152, doi: 10.1080/24694452.2024.2370922.

54 Shuangzhou Chen et al., “A Path Analysis of the Effect of Neighborhood Built Environment on Public Health of Older Adults: A Hong Kong Study”, *Frontiers in Public Health* 10 (2022) :861836, doi: 10.3389/fpubh.2022.861836.

55 Institute for Health Metrics and Evaluation (IHME). *Global Burden of Disease 2021: Findings from the GBD 2021 Study* (Seattle: IHME, 2024).

56 Jonathan Pearson-Stuttard and Sally C Davies, “The Health Index: a framework to guide health-driven prosperity”, *The Lancet 405* (2025): 777, https://doi.org/10.1016/S0140-6736(25)00010-8.

57 Land Transport Authority, "North-South Corridor", 18 August 2025, https://www.lta.gov.sg/content/ltagov/en/upcoming_projects/road_commuter_facilities/north_south_corridor.html.

58 Ministry of Transport, "MOT's Addendum to the President's Address", 21 January 2016, https://www.mot.gov.sg/news/Details/MOT-s-Addendum-to-the-Presidents-Address.

59 Land Transport Authority, “Getting Around”, 21 January 2021, https://www.lta.gov.sg/content/ltagov/en/getting_around.html#public_transport.

60 City of Vienna, “STEP 2025 Urban Development Plan Vienna”, 2014, https://www.digital.wienbibliothek.at/wbrup/download/pdf/4897824.

61 Stadt Wien, Smart City, “STEP 2025—Urban Development Plan”, https://smartcity.wien.gv.at/en/urban-development-plan-2025/.

62 City of Vienna, “STEP 2025 Urban Development Plan Vienna”.

63 Elisabeth Irschik and Eva Kail, "Vienna: Progress Towards a Fair Shared City", in *Fair Shared Cities: The Impact of Gender Planning in Europe*, ed. Inés Sánchez de Madariaga and Marion Roberts (London: Routledge, 2013), https://www.taylorfrancis.com/chapters/edit/10.4324/9781315581835-15/vienna-progress-towards-fair-shared-city-elisabeth-irschik-eva-kail?context=ubx&refId=a0784b4c-7a6e-495c-919b-f19e5acc7e0d.

64 City of Vienna, *STEP 2025: Urban Mobility Plan Vienna* (Vienna: Vienna City Administration, Municipal Department, 2015), https://sumps-up.eu/fileadmin/templates/sumps-up/lib/sumps-up_registry/_utility/tools/push_resource_file.php?uid=b69c20ab.

65 Irschik and Kail, "Vienna: Progress Towards a Fair Shared City".

66 Ibid.

67 City of Vienna, *aspern Seestadt Master Plan Revisited: Status of Planning 2017* (Vienna: Wien 3420 aspern Development AG and Municipal Department, 2018), https://www.aspern-seestadt.at/jart/prj3/aspern/data/downloads/aspern_masterplan_2017_EN_2019-08-30_1208911.pdf.

68 Stadt Wien, "Vienna Climate Guide - Monitoring", n.d., https://www.wien.gv.at/spezial/klimafahrplan-monitoring-en/climate-protection/mobility/.

69 Stadt Wien, "Vienna Climate Guide - Monitoring".

70 Marco Dean, "Chapter Six—Multi-criteria analysis", Advances in Transport Policy and Planning 6 (2020): 165–224, https://doi.org/10.1016/bs.atpp.2020.07.001.

71 Marco Dean, "A Practical Guide to Multi-Criteria Analysis", Technical Report, 26 January 2022, DOI: 10.13140/RG.2.2.15007.02722.

72 Ibid.

73 Ibid.

74 Ibid.

75 Jon Henley, Stephen Burgen and Lisa O’Carroll, “Bollards and ‘superblocks’: how Europe’s cities are turning on the car”, *The Guardian*, 18 December 2023, https://www.theguardian.com/cities/2023/dec/18/bollards-and-superblocks-how-europes-cities-are-turning-on-the-car.

76 Àrea Metropolitana de Barcelona, “The metropolitan area”, n.d., https://www.amb.cat/en/web/area-metropolitana.

77 Ibid.

78 Instituto de Estadística de Cataluña, “Densidad de población. Municipios con más de 20.000 habitantes” 2024, https://www.idescat.cat/indicadors/?id=aec&n=15228&lang=es.

79 Ajuntament de Barcelona, “Dades bàsiques mobilitat”, 2023, https://dades.ajuntament.barcelona.cat/dades-basiques-de-mobilitat/.

80 Ajuntament de Barcelona, “2030 Agenda”, 16 January 2025, https://ajuntament.barcelona.cat/agenda2030/en/mesbarcelona/actualidad-mes-barcelona/el-nou-pmu-2025-2030-estableix-lobjectiu-darribar-al-85-de-desplacaments-en-modes-sostenibles-i-reduir-lus-del-vehicle-privat-1477245

81 Instituto de Estadística de Cataluña, “Densidad de población. Municipios con más de 20.000 habitantes”, 2024, https://www.idescat.cat/indicadors/?id=aec&n=15228&lang=es.

82 Jordi Garriga Mas, “Air pollution in the city”, *Barcelona Metròpolis* 123 (Barcelona: Ajuntament de Barcelona, 2022), https://www.barcelona.cat/metropolis/en/contents/air-pollution-the-city https://doi.org/10.1016/j.healthplace.2024.103406.

83 Ajuntament de Barcelona, “Let’s Fill Streets With Life: Establishing Superblocks in Barcelona”, 20 May 2016, Commission for Ecology, Urban Planning and Mobility, en_gb_MESURA GOVERN SUPERILLES.pdf.

84 Ajuntament de Barcelona, “2030 Agenda”.

85 Francesc Magrinyà, Josep Mercadé-Aloy and Borja Ruiz-Apilánez, “Merging Green and Active Transportation Infrastructure Towards an Equitable Accessibility to Green Areas: Barcelona Green Axes”, *Land* 12.4 (2023): 919, https://doi.org/10.3390/land12040919.

86 Natalie Mueller et al., “Changing the urban design of cities for health: The superblock model”, *Environment International* 134 (2020): 105132, https://doi.org/10.1016/j.envint.2019.105132.

87 Ibid.

88 Ajuntament de Barcelona, “Let’s Fill Streets With Life”.

89 M. Carmen Moreno-Garcia, “Intensity and form of the urban heat island in Barcelona”, *International Journal of Climatology* 14: 705–710, https://doi.org/10.1002/joc.3370140609.

90 Ibid.

91 Mark Niewenhuijsen et al., “The Superblock model: A review of an innovative urban model for sustainability, liveability, health and well-being”, *Environmental Research* 251.1 (2024): 118550, https://doi.org/10.1016/j.envres.2024.118550.

92 Mueller et al., “Changing the urban design of cities for health”.

93 Ibid.

94 Niewenhuijsen et al., “The Superblock model”.

95 Magrinyà, Mercadé-Aloy and Ruiz-Apilánez, “Merging Green and Active Transportation Infrastructure towards an Equitable Accessibility to Green Areas”.

96 Ibid.

97 Niewenhuijsen et al., “The Superblock model”.

98 Patrick Diekelmann, ed., *Final Project Publication: Final Results from TuneOurBlock and ULL Activities,* Version 1.0 (Berlin: Deutsches Institut für Urbanistik, 2024), https://www.tuneourblock.eu/wp-content/uploads/2024/10/TuneOurBlock_Final-project-publication_Final-results-from-TuneOurBlock-and-ULL-activities_June2024.pdf.

99 Niewenhuijsen et al., “The Superblock model”.

100 Natalie Mueller et al., “Changing the urban design of cities for health”.

101 Niewenhuijsen et al., “The Superblock model”.

102 Daniel Rodriguez-Rey et al., “To what extent the traffic restriction policies applied in Barcelona city can improve its air quality?”, *Science of The Total Environment* 807.2 (2022): 150743, https://doi.org/10.1016/j.scitotenv.2021.150743.

103 Niewenhuijsen et al., “The Superblock model”.

104 Patrick Diekelmann, ed., *Final Project Publication: Final Results from TuneOurBlock and ULL Activities*.

105 Niewenhuijsen et al., “The Superblock model”.

106 Natalie Mueller et al., “Changing the urban design of cities for health”.

107 Transport for London, “The Mayor’s Transport Strategy”, https://tfl.gov.uk/corporate/about-tfl/the-mayors-transport-strategy.

108 BBC, “London roads still the most congested in Europe”, *BBC*, 6 January 2025, https://www.bbc.com/news/articles/c785pv31y7vo.

109 Gov.UK, “Physical activity: applying All Our Health”, 10 March 2022, https://www.gov.uk/government/publications/physical-activity-applying-all-our-health/physical-activity-applying-all-our-health.

110 Jacob Evans, “Twice as many car trips in outer London—report”, *BBC*, 6 June 2023, https://www.bbc.com/news/articles/cnd9y2w8183o.

111 Transport for London, *A fairer transport network: How we’re making travel in London more accessible, safe and inclusive Issue 2*, February 2024, https://content.tfl.gov.uk/equity-in-motion-summary.pdf

112 Carlton Reid, " 'Rat-running' increases on residential UK streets as experts blame satnav apps", *The Guardian*, 25 September 2020, https://www.theguardian.com/world/2020/sep/25/rat-running-residential-uk-streets-satnav-apps.

113 Transport for London, "Road Task Force—Technical Note 20: What are the main health impacts of roads in London?", n.d., https://www.theguardian.com/world/2020/sep/25/rat-running-residential-uk-streets-satnav-apps.

114 Greater London Authority, “Land Area and Population Density, Ward and Borough”, https://data.london.gov.uk/dataset/land-area-and-population-density-ward-and-borough/.

115 Greater London Authority, “London’s Population”, https://data.london.gov.uk/dataset/londons-population/?__cf_chl_tk=G3t9eLjhnF.LzBXX3Rl3N66kwuVLxNdsDs4swNdzbJQ-1752481846-1.0.1.1-ltfPKqWdmGKBMMCp8tzVF6RYZslyecVHAkpdFboVJ9s

116 Transport for London, Travel in London 2024—Consolidated estimates of total travel and mode shares, 2024, https://content.tfl.gov.uk/travel-in-london-2024-consolidated-estimates-of-total-travel-and-mode-shares-acc.pdf.

117 Greater London Authority, “London’s Population”.

118 Transport for London, *Travel in London 2024—Focus report: Car ownership trends*, 2024, https://tfl.gov.uk/cdn/static/cms/documents/travel-in-london-2024-car-ownership-trends-acc.pdf.

119 Healthy Streets, “What is Healthy Streets”, 2024, https://www.healthystreets.com/what-is-healthy-streets

120 Ibid.

121 Greater London Authority, “Healthy Streets”, 2025, https://www.london.gov.uk/programmes-strategies/health-and-wellbeing/transport-and-health/healthy-streets.

122 Transport for London, “Low Traffic Neighbourhoods: what, why and where?”, https://madeby.tfl.gov.uk/2020/12/15/low-traffic-neighbourhoods/.

123 Greater London Authority, “Transforming cycling in outer boroughs: Mini-Hollands programme”, 2025, https://www.london.gov.uk/programmes-strategies/transport/cycling-and-walking/transforming-cycling-outer-boroughs-mini-hollands-programme.

124 Gov.UK, “Active Travel Fund: local transport authority allocations”, 29 May 2020, https://www.gov.uk/government/publications/emergency-active-travel-fund-local-transport-authority-allocations.

125 Rachel Aldred, Anna Goodman and James Woodcock, “Impacts of active travel interventions on travel behaviour and health: Results from a five-year longitudinal travel survey in Outer London”, *Journal of Transport & Health* 35 (2024): 101771, https://doi.org/10.1016/j.jth.2024.101771.

126 London Borough of Waltham Forest, “South Leytonstone Low Traffic Neighbourhood (LTN)’’, 2025, https://www.walthamforest.gov.uk/parking-roads-and-travel/active-and-sustainable-transport-schemes/current-schemes/south-leytonstone-low-traffic-neighbourhood-ltn.

127 Tom Edwards, “Low Traffic Neighbourhoods: Anger, Hate and the Politics of the Planter”, *BBC*, 17 September 2020, https://www.bbc.com/news/uk-england-london-54180647.

128 Tracy Logan et al., *Low Traffic Neighbourhoods Residents’ Survey* (London: Department of Transportation, 2021), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004948/low-traffic-neighbourhoods-residents-survey.pdf.

129 Department for Transport, *Low Traffic Neighbourhood Review* (London: UK Government, 2024), https://www.gov.uk/government/publications/low-traffic-neighbourhood-review.

130 Transport for London, “The impacts of Low Traffic Neighbourhoods in London. A summary of evidence.”

131 Asa Thomas and Rachel Aldred, *Changes in motor traffic inside London’s LTNs and on boundary roads* (London: Active Travel Academy, University of Westminster, 2023), https://www.wearepossible.org/s/Changes-in-motor-traffic-inside-Londons-LTNs-and-on-boundary-roads-3.pdf.

132 Rachel Aldred, Anna Goodman and James Woodcock, “Impacts of active travel interventions on travel behaviour and health: Results from a five-year longitudinal travel survey in Outer London”, *Journal of Transport & Health* 35 (2024): 101771, https://doi.org/10.1016/j.jth.2024.101771.

133 Xiuleng Yang et al., “Evaluation of low traffic neighbourhood (LTN) impacts on NO2 and traffic”, *Transportation Research Part D: Transport and Environment* 113 (2022): 103536, https://doi.org/10.1016/j.trd.2022.103536.

134 Department for Transport, *Low Traffic Neighbourhood Review*.

135 Jamie Furlong et al., “Low Traffic Neighbourhoods in London reduce road traffic injuries: a controlled before-and-after analysis (2012–2024)”, *Injury Prevention* 2025: 1–7, https://doi.org/10.1136/ip-2024-045571.

136 Tracy Logan et al., *Low Traffic Neighbourhoods Residents' Survey*.

137 Ibid.

138 Ibid.

139 Natalie Mueller et al., "Changing the urban design of cities for health".

140 Rachel Aldred, Anna Goodman and James Woodcock, "Impacts of active travel interventions on travel behaviour and health.

141 Niewenhuijsen et al., "The Superblock model".

142 Rebecca Solnit, *Wanderlust: A History of Walking* (London: Penguin Books, 2021).

143 Mariana Mazzucato, *Mission economy: a moonshot guide to changing capitalism* (New York: Harper Business, 2021).

144 Dan Hill, *Designing Missions: Mission-oriented innovation in Sweden (*Sweden: Vinnova, 2022).

145 Dan Hill and Anja Melander, "Strategic Design for Public Purpose: Enriched and Expanded Practices for Human-Technology Interaction", in *Human-Technology Interaction*, eds. Elena Malakhatka and Mikael Wiberg (Cham: Springer, 2025).

146 Carlos Moreno, The 15-Minute City: A Solution to Saving Our Time and Our Planet (Hoboken: Wiley, 2024).

147 Dan Hill et al., (2024) "Cities beyond proximity", *Philosophical Transactions of the Royal Society A* 382.2285 (2024), https://doi.org/10.48550/arXiv.2411.12335.

148 Ibid.

149 Hill, *Designing Missions: Mission-oriented innovation in Sweden*.

150 E.F. Schumacher, *Small Is Beautiful: A Study of Economics As If People Mattered* (London: Blond & Briggs; New York: Harper Collins, 1973).

151 Streetmeter, accessible at https://streetmeter.net/about-streetmeter.

152 Iain McGilchrist, *The Master and His Emissary: The Divided Brain and the Making of the Western World* (New Haven: Yale University Press, 2019).

153 Rainer Kattel et al., *Dynamic Capabilities for Transformative Change in City Governments* (UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2025-03), 2025), https://www.ucl.ac.uk/bartlett/sites/bartlett/files/dynamic_capabilities_for_transformative_change_in_city_governments.pdf.

154 Hill, Designing Missions: *Mission-oriented innovation in Sweden*.

155 Hill, Designing Missions: *Mission-oriented innovation in Sweden*.

Photo courtesy of Caresse Audrey Chia