



Demand Management to Facilitate Efficient Urban Transport



Research Report

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The International Transport Forum

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International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
contact@itf-oecd.org
www.itf-oecd.org

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For any inquiries, [contact the ITF Head of Research](#)

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At the ITF, Matthew Ireland and Nicholas Caros coordinated the Working Group and drafting of the report with substantial contributions from Working Group members, who are listed in Annex B. Mila Iglesias and Apostolos Skourtas provided administrative support for meetings, Olaf Merk and Elisabeth Windisch reviewed the report and Camille Larmanou managed the publication process.

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Executive summary

Main findings

By 2060, more than 70% of humanity is expected to live in urban areas. This represents a 54% increase in the urban population over the 35 years from 2025. The ITF estimates that if current trends continue, demand for urban travel is expected to increase by even more between 2025 and 2060 – 69% for vehicle-kilometres and 81% for passenger-kilometres travelled – reflecting rising incomes which affects trip frequencies, a preference for private vehicles, and the need to travel further as cities expand spatially to accommodate population growth. These trends are not evenly distributed across the world. Urban travel demand is expected to grow modestly in Europe, the United States, Canada, Australia, and New Zealand, and the higher income Asian countries such as China, Japan and South Korea. Meanwhile, rapid urbanisation and economic growth will lead to considerable travel demand increases elsewhere, particularly in sub-Saharan Africa and across Southeast Asia, closing the per capita travel demand gap between regions.

This presents a major challenge for urban areas, as private vehicle travel generally produces more negative externalities per passenger-kilometre than other types of travel. These negative externalities could include congestion-related delays impacting labour productivity, environmental impacts and road safety hazards.

Urban travel demand management, defined as the application of strategies and policies to increase the efficiency of transport systems through reducing or redistributing travel demand in space and time, can help residents pursue their desired activities while reducing negative externalities. Depending on the country, urban travel demand management may be shaped by national policy frameworks or administered principally by local governments.¹ The main types of urban demand management measures include better integrating land-use and transport planning, improving active and shared travel modes, and policies on urban vehicle access.

In many countries and cities, urban demand management has been an element of transport policy for decades, evolving considerably through experience and innovation. However, some national and sub-national governments use alternative approaches to address increasing transport demand. For governments interested in using urban demand management measures, a refreshed focus on this approach is needed for several reasons:

- For many cities, addressing the negative externalities of urban transport remains an important public policy challenge with strong public support and, in many cases, these externalities have grown more severe over time.
- Many policy interventions have proven effective when tailored to the local context, however lessons learned and best practices are not widely shared internationally, and holistic approaches to urban demand management remain rare.
- Technological and social trends such as the rapid rise of teleworking, uptake of electric vehicles, ongoing innovation in automated vehicle systems and aging populations are changing the context

¹ In the United States, urban demand management is regarded as a State or local issue. Localities are responsible for managing growth and demand based on their own short- and longer-term planning goals, in coordination with Metropolitan Planning Organizations. National government does not set urban demand management policy nor assign demand management mandates.

of urban travel, necessitating new approaches to urban demand management that account for evolving travel behaviour and mobility systems.

- In fast-growing urban areas in developing countries, urban demand management can help avoid lock-in to costly, inefficient and environmentally harmful travel patterns – equally for regions experiencing more moderate growth, urban demand management can help governments respond to calls from the public for improvements in urban affordability and quality of life.

This report outlines a new generation of urban demand management policy by distilling insights from international case studies and translating them into actionable policy options for governments interested in this approach, while recognising that some ITF member countries may choose alternative ways to address increasing travel demand. The report examines the effectiveness of both established and emerging urban demand management measures, including potential synergies and conflicts, and it highlights considerations that are essential to successful delivery and continued support, such as communication, funding, governance, and public acceptance. The needs of current and future urban transport users are also considered, including potential social, economic and technological changes, as well as resilience to unforeseen shocks.

The analysis focuses on passenger travel within urban areas and between urban centres and their periphery. It does not discuss freight transport, which is covered by several other recent ITF reports.

Recommendations

For governments and policymakers interested in urban demand management, the following actions are advisable. The report recognises that these actions may not be applicable across all countries or forms of government.

Adopt a vision-led planning approach that considers urban demand management

Transport authorities could move away from the “predict-and-provide” approach to transport planning, which focuses primarily on forecasting travel demand and investing in new infrastructure to accommodate future growth. This approach, which treats travel preferences and behaviour to be immutable, has taken travel demand growth as a given and led to a considerable expansion of road infrastructure and private vehicle travel in urban areas along with a consequential increase in negative externalities. Recognising the limitations of continuous infrastructure expansion, mounting fiscal pressures, and the transformative potential of emerging mobility technologies, authorities might instead adopt a proactive, vision-led “decide-and-provide” planning approach where urban demand management can be used to improve living standards by making more efficient use of existing infrastructure and mitigating negative externalities.

Take a systems approach to urban demand management implementation to improve outcomes and engender public support

A systems-level approach that considers complementarity between demand management measures, appropriate sequencing, and coordination across levels of government is more likely to succeed while avoiding unintended impacts that can undermine public support. Starting with smaller-scale, place-based interventions provides an opportunity to refine policy design and public messaging before gradually ramping up ambition over time. Horizontal coordination is needed to align policy priorities across relevant authorities and departments (e.g. land use and transport planning). Vertical coordination ensures that national governments provide funding, legislative and political support to regional and local authorities responsible for making change on the ground.

Consider and address the distributional impacts of urban demand management measures from the outset

The impacts of urban demand management measures on individuals vary across many dimensions, including but not limited to disability, age, sex, income, ethnicity and digital literacy. When designing and communicating interventions, authorities might account for the intersectionality of these dimensions across individuals, as well as the heterogeneous needs, preferences and capabilities of both current and future transport network users. Particular attention might be paid to the distribution of costs and benefits of changing travel behaviour on groups, and to mitigating any regressive impacts. Such an approach is likely to be more popular and have a greater chance of achieving the desired results.

Enhance appraisal, monitoring and evaluation frameworks

Current approaches often fall short in fully capturing social, distributional, spatial and long-term impacts for demand management interventions. To enhance appraisal, transport authorities could invest in multimodal and behavioural modelling to better understand how users respond to different interventions, as well as expand appraisal tools to cover non-monetised benefits, including resilience, health and urban regeneration, reflecting evolving policy priorities. Strong monitoring and evaluation (M&E) practices are essential for evidence-based urban demand management programmes. M&E helps to demonstrate that policies are justified and promote their expansion – or, if they prove ineffective, inform changes or policy rollbacks. Evaluation could include early planning, clear objectives, robust baseline data, integration with business case development, and independent assessment where feasible. Travel surveys and data from mobile devices can be used to analyse changes in travel patterns before, during, and after interventions are implemented. Different interventions may complement or conflict with one another; programme-level M&E can be useful to support the assessment of synergies and trade-offs. It can also help to shift the focus from narrow effects to broader societal outcomes across a portfolio of interventions.

Recognise that urban demand management can be cost-effective and provide long-term transport funding

Urban demand management can help governments use existing transport assets more efficiently and avoid the need to invest in costly expansions, instead focusing on opportunities with lower capital, operation and maintenance costs per person. Depending on a country's approach to transport funding allocation and scheme design, some interventions, such as pricing mechanisms, can generate substantial amounts of revenue to cover their associated costs and even support complementary investments (e.g. in public transport) that enhance their long-term viability and help build public support. Some of the revenue can also be recycled to address distributional impacts.

Link transport and land-use planning through future-orientated statutory and policy reforms

Compact, mixed-use development, accessibility-oriented planning, and transit-oriented development are intrinsic demand management tools that reduce the need for urban residents to travel long distances while helping to build the business case for investment in public transport, walking and cycling infrastructure. New mobility technologies will interact with land markets and developer expectations in uncertain ways. Authorities can plan for robustness through scenario-based integrated modelling and institutional redesign. Integrated land-use–transport scenarios (including plausibly high automated vehicle uptake, varying Mobility-as-a-Service deployments, and varying levels of remote work) can be used to stress-test the effectiveness of zoning changes, transit investments, and fiscal implications. Institutional arrangements such as land use policy performance monitoring units, with mandates to revisit zoning codes every 3–5 years using modelled scenario outcomes, would ensure that land use frameworks remain aligned with technological change and accessibility goals.

Improve access to walking, cycling and shared modes of transport

Public transport fare reform, including fare integration across modes and operators, fare capping, low-income concessionary fares, and open payment systems, can decrease cost barriers to adoption and encourage multimodal travel. However, service quality and coverage have a stronger impact on ridership than pricing, so setting fares too low could result in a risk of underfunding and is therefore likely to be counterproductive. Enhancing pedestrian and cycling infrastructure to make them viable end-to-end travel modes, as well as feeder modes for public transport, is also important and helps reduce negative mobility externalities.

Consider policies on vehicle access and pricing mechanisms when appropriate

The effectiveness of vehicle access regulations such as low-traffic neighbourhoods, priority travel lanes, low emissions zones, pricing mechanisms, incentives to avoid driving, and increased parking fees depends on the socioeconomic context, the availability of alternative modes, and desired outcomes. Policies that incorporate both vehicle access approaches and pricing can be more flexible in achieving objectives while mitigating negative impacts. Dynamic approaches, such as real-time responsive road pricing, are often more operationally efficient than static schemes. When paired with revenue recycling, they can help support complementary investments. Real-time responsive road pricing is also expected to play a pivotal role in funding future transport improvements as fuel tax revenue declines due to improved vehicle fuel efficiency and electric vehicle uptake. Any transition to road pricing benefits from the support of clear public communication and education.

Prioritise communication and public acceptance for any policy intervention

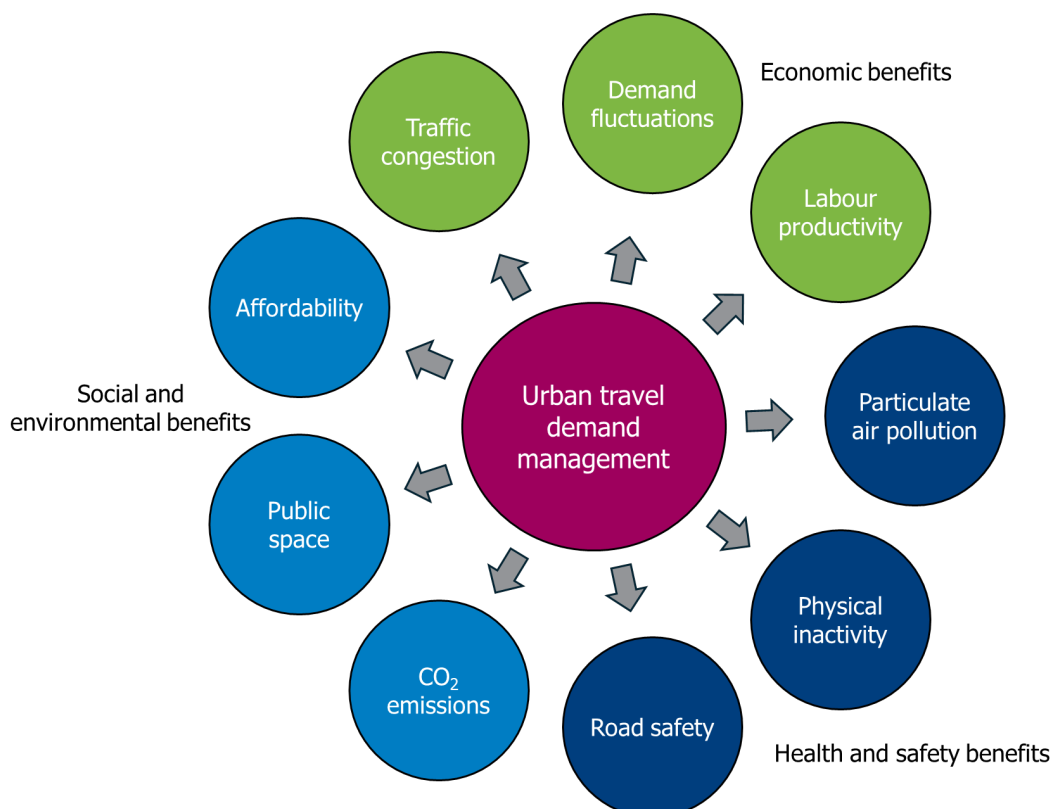
Public outreach and engagement could focus on what can be gained from urban demand management and proactively combat against misinformation. The use of innovative media channels can help to reach a larger share of the population and improve participation. Civil society and academia can often facilitate building support for urban demand management measures. Different communications strategies may be needed at different phases of planning and implementation to increase efficacy.

Introduction

Urban travel demand management (TDM) as a concept has been an element of transport policy for decades, although it has evolved considerably through experience and innovation (Meyer, 1999; Qin et al., 2022). Defined in this report as the application of strategies and policies to increase the efficiency of transport systems through reducing or redistributing travel demand in space and time, TDM can help residents pursue their desired activities while reducing negative externalities for society. Rather than focusing transport planning on the movement of vehicles, TDM shifts attention to the accessibility of services and societal functions for people, e.g. by ensuring that critical services are located closer to people, or provided virtually, and ensuring a diversity of transport options for a given trip or activity. The main types of TDM measures include better integrating land-use and transport planning, improving active and shared travel modes, and urban vehicle access policies.

TDM can contribute to a wide range of public policy goals, as shown in Figure 1: from reduced traffic congestion, addressing fluctuations in seasonal demand, and better traffic safety outcomes, to improved air quality, health benefits from physical activity, lower emissions, economic agglomeration benefits from improved accessibility, and an increase in public space for community and social uses. TDM can also help address social inequalities and make transport more affordable for low-income groups.

Figure 1. Public policy benefits of urban travel demand management



This report addresses the key challenges in urban demand management planning and implementation by drawing on lessons and best practices from a wide range of international case studies and translating them into actionable policy recommendations. It examines the effectiveness of both established and emerging

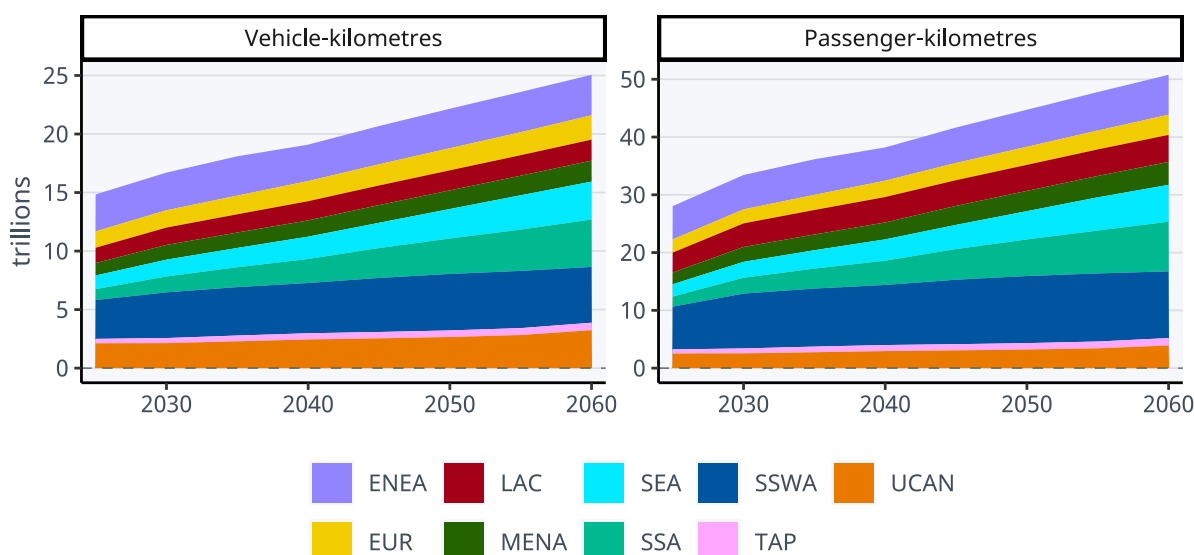
TDM measures and highlights essential considerations related to communication, funding, governance and public acceptance. The analysis aims to anticipate the needs of current and future urban transport users, including potential social, economic and technological changes, as well as resilience to unforeseen shocks.

The report's scope is limited to passenger travel within urban areas and between urban centres and their periphery. Several separate ITF reports focus on freight transport (ITF 2023a, ITF 2024a,b).

Rising demand will increase pressure on urban transport systems

The ITF estimates that rapid urbanisation of the global population will result in major changes to the volume and distribution of urban travel demand over the coming decades. Under a Business-as-Usual scenario, which assumes a continuation of current trends in travel demand management, the quantity of travel within urban areas is expected to increase by 69% from 15 to 25 trillion vehicle-kilometres (VKM) between 2025 and 2060, as shown in Figure 2. Similarly, travel in terms of passenger-kilometres (PKM) is expected to grow by 81%. Over that time, the urban population is forecasted to rise by only 54%, implying that the anticipated increase in travel is driven by travel behaviour changes as well as population growth.

Figure 2. Estimated urban passenger transport trajectories in a business-as-usual scenario



Note: This figure depicts 2025 ITF modelled estimates. ENEA: East and Northeast Asia. EUR: European Economic Area and surrounding countries, including accession states to the European Union. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. SEA: Southeast Asia. SSA: Sub-Saharan Africa. SSWA: South and Southwest Asia. TAP: Transition economies and other Asia-Pacific countries. UCAN: United States, Canada, Australia and New Zealand.

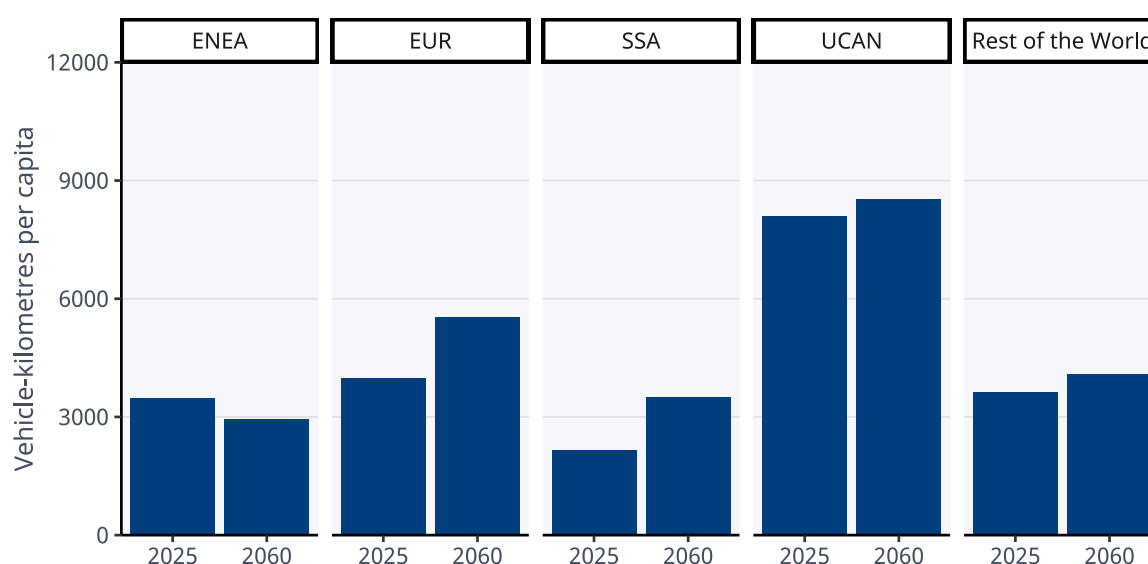
These trends are not evenly distributed across the world. Urbanisation and economic growth are expected to lead to considerable travel demand increases in sub-Saharan Africa (SSA) and across Southeast Asia (SEA). In contrast, urban travel demand is expected to remain relatively constant in Europe (EUR), the United States, Canada, Australia and New Zealand (UCAN), and the higher-income countries in East Asia and Northeast Asia (ENEA), such as China, Japan and South Korea. For more information about the ITF global transport forecasting methodology and scenario design, please refer to ITF (2023b).

To isolate the impact of changing travel behaviour, per capita travel demand in 2025 and 2060 was modelled, as shown in Figure 3 for selected regions. There are large differences across regions in 2025. In

VKM terms, urban travel demand per capita in the United States, Canada, Australia and New Zealand (UCAN), for example, is nearly four times higher than in sub-Saharan Africa (SSA), due to the widespread use of personal vehicles and relatively low population densities.

Comparing per capita demand between 2025 and 2060 suggests that a substantial portion of the rise in overall travel is a result of a closing of the gap between regions. Both UCAN (United States, Canada, Australia and New Zealand) and ENEA (East and Northeast Asia) are expected to see little or negative growth in per capita travel demand due to a plateauing of the urban population. Sub-Saharan Africa, however, is expected to see strong growth in per capita travel demand. This is a result of rising incomes, which affects trip frequencies and mode choice, and the need to travel further as cities expand spatially to accommodate rapid urbanisation. Europe also sees a significant rise in VKM per capita as rates of private vehicle travel increase due to rising incomes, especially in Eastern and Central Europe.

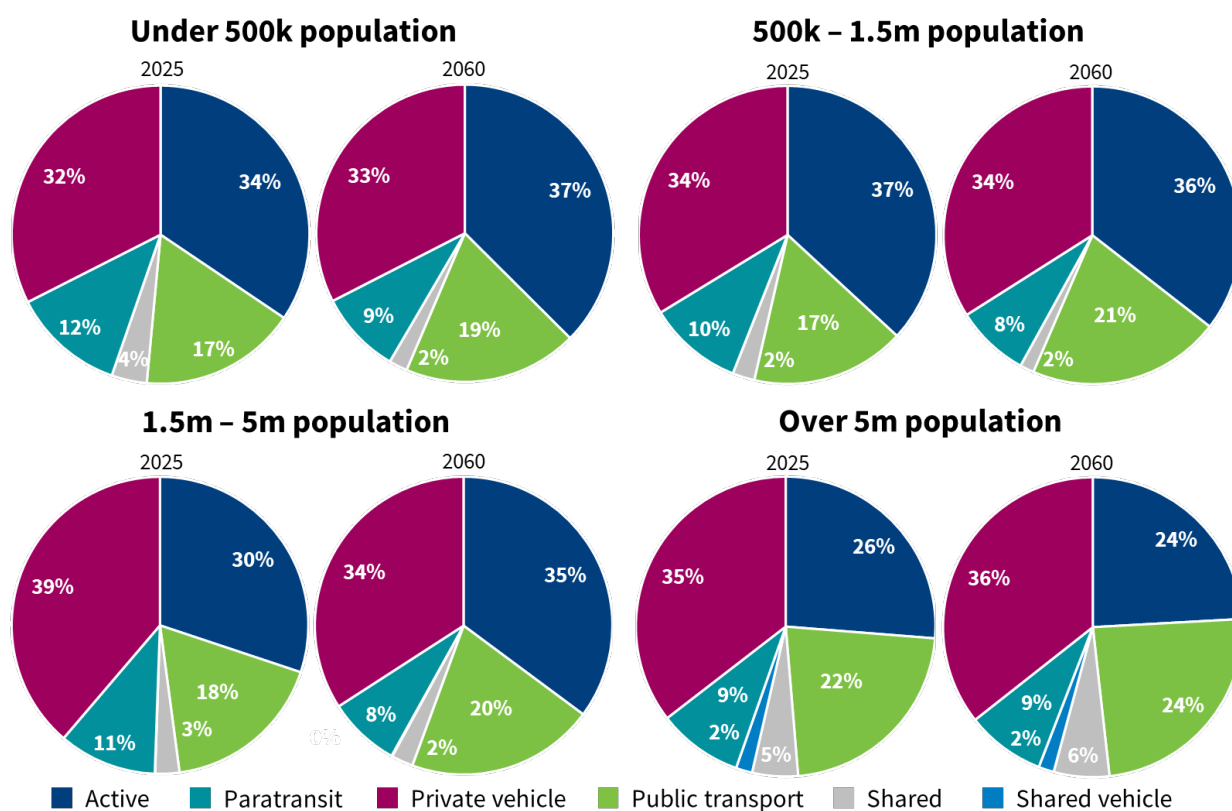
Figure 3. Estimated per capita urban passenger transport demand in a business-as-usual scenario



Note: This figure depicts 2025 ITF modelled estimates. ENEA: East and Northeast Asia. EUR: European Economic Area and surrounding countries, including accession states to the European Union. SSA: Sub-Saharan Africa. UCAN: United States, Canada, Australia and New Zealand.

Figure shows the anticipated modal share of trips in 2025 and 2060 for a range of city sizes in the business-as-usual scenario. Cities have different modal compositions depending on their size, density, socioeconomics and transport networks. Small cities tend to accommodate a greater share of active travel trips as distances are short, while larger cities are more likely to have robust public transport networks and suffer from road congestion, resulting in a lower trip mode share for private vehicles. In a business-as-usual scenario, on a global scale, modal share does not change significantly from 2025 to 2060.

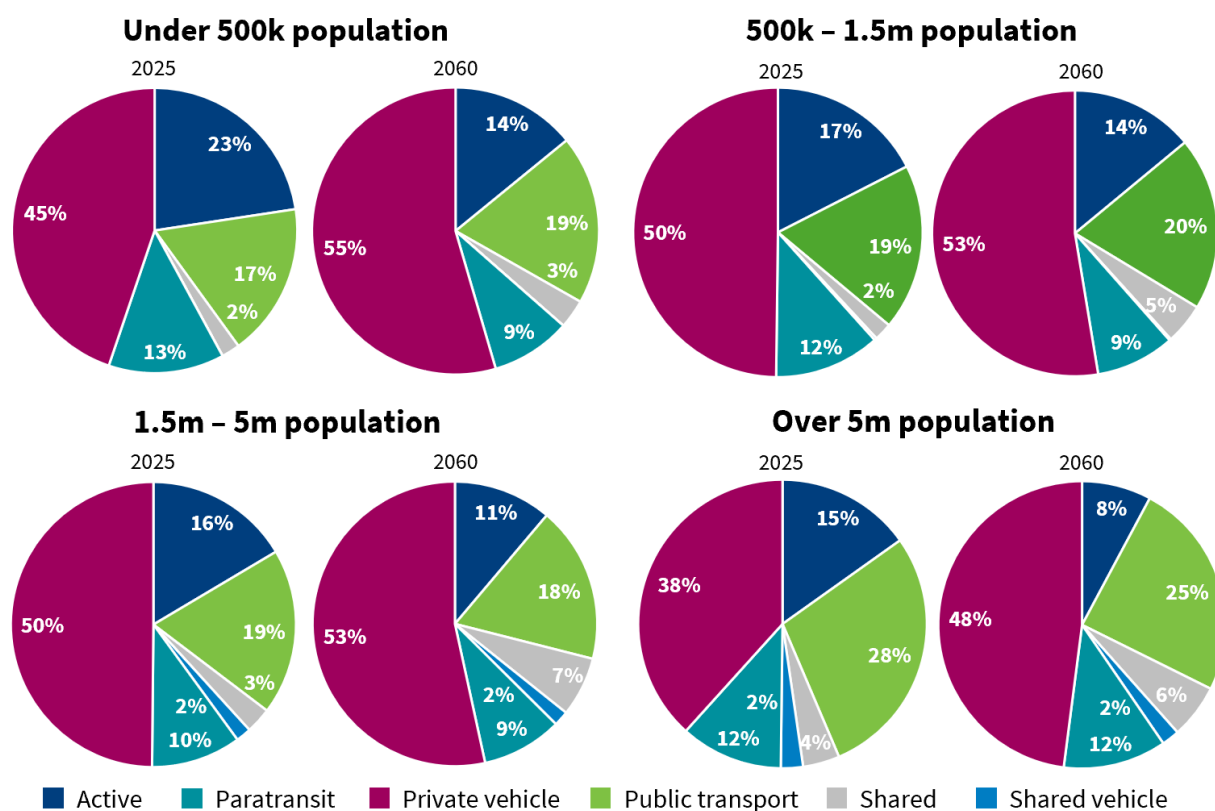
Figure 4. Modal share of urban passenger trips in the business-as-usual scenario



Note: This figure depicts 2025 ITF modelled estimates for all world regions combined.

However, the modal share of passenger-kilometres, shown in Figure , shows a more pronounced increase in private vehicle travel; as cities gain population and grow larger, private car trips become longer and longer. This is especially pronounced in the smallest and largest cities. Using current technology, this could present a challenge for urban areas, as private vehicle travel generally produces more negative externalities per passenger-kilometre than other modes of travel. These negative externalities include emissions, particulate air pollution, space consumption (both in motion and while parked), safety hazards, and congestion-related delays. Technological developments, such as uptake of electric and automated vehicles, might alter to some extent the nature of negative externalities.

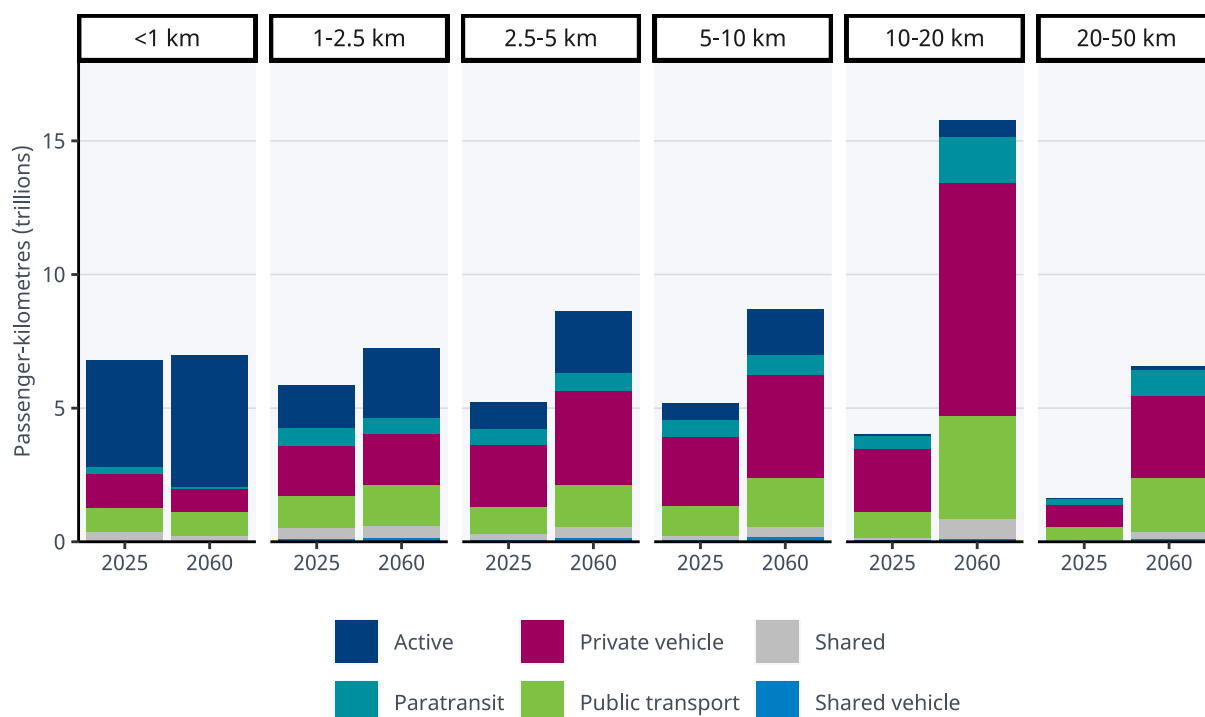
Figure 5. Modal share per urban passenger-kilometre in the business-as-usual scenario



Note: This figure depicts 2025 ITF modelled estimates for all world regions combined.

As noted previously, longer trip distances are another factor in the forecasted increase in overall urban travel demand. Figure shows that while the demand for trips between 0 and 2.5 km is expected to remain relatively constant, ITF forecasts expect a modest increase in trips from 2.5 km to 10 km, largely captured by active travel (cycling), public transport, and private vehicles. Trips longer than 10 km are expected to increase by a factor of four, however. This occurs because growing cities take up more space, requiring longer trips to access the city core from the periphery, and because greater car ownership enables people to pursue longer trips that they might have avoided otherwise.

Figure 6. Urban passenger travel by trip length, in 2025 and 2060, in the business-as-usual scenario



Note: This figure depicts 2025 ITF modelled estimates for all world regions combined.

The theory of travel behaviour change

Passenger transport, in most cases, is a derived demand, meaning that it arises from the desire to pursue an activity outside of the home, although occasionally people travel for the pleasure or status associated with travelling. Transport demand is shaped by individual choices about the sequence of activities, individual destinations, departure times, travel modes and routes for each leg of each trip. Those decisions are not always made explicitly, but are often embedded in routines. Decisions about where, when and how to travel are shaped by four categories of factors:

1. The geographic distribution of housing and activity centres within an urban area;
2. The characteristics and performance of the urban transport system, including cost, accessibility and reliability;
3. The nature of the activities (e.g., whether they involve the transport of goods or other people);
4. The individual beliefs, capacities and preferences of the traveller.

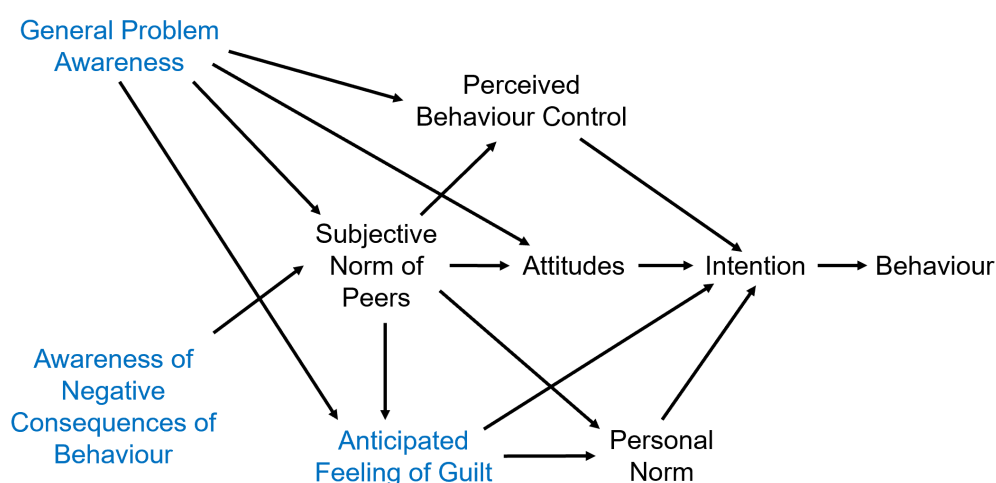
Travel demand can thus change with the volume or type of activities pursued, adjustments to land use and transport systems, or evolving traveller beliefs, capacities and preferences.

People have widely varied and complex portfolios of time, money and accessibility to modes, and hold different values, aims, preferences and prejudices, needs and wishes. Societal roles and restrictions on time and money may limit people's choices or prevent them from pursuing certain trips. As a result, even within the same city, both travel routines and spontaneous trips may vary considerably.

Transport planners and policy makers often seek to reduce this complexity by grouping people together based on single socio-demographic or socio-economic characteristics (e.g. age, sex, household type, household income, driving license status, level of education etc.). In part, this is the result of pragmatic considerations regarding the availability of official statistics. However, people's behaviour is not dictated by single attributes, but rather is shaped by complex combinations of characteristics along with individual values, attitudes and preferences (Markvica et al. 2020; Morton, Mattioli & Anable, 2021; Sonnberger & Graf 2021; Dangschat & Millonig 2023). Therefore, theories for how travel behaviour might change in response to policy interventions benefits from social science research and experience gained during broader participatory processes (Lyons 2004). To be effective, policy approaches must reflect an understanding of people's motivations, interests, general attitudes and aims, preferences, routines, as well as prejudices, aversions and dislikes (Luger-Bazinger & Hornung- Prähauser, 2021; Millonig 2021; Dangschat & Millonig 2023). Evidence suggests that shifting individual behaviour towards more socially beneficial decisions is not easy, particularly if travel choices are deeply rooted in routines and perceived peer values (Reckwitz 2002; Shove 2005, Shove, Watson and Pantzar, 2012).

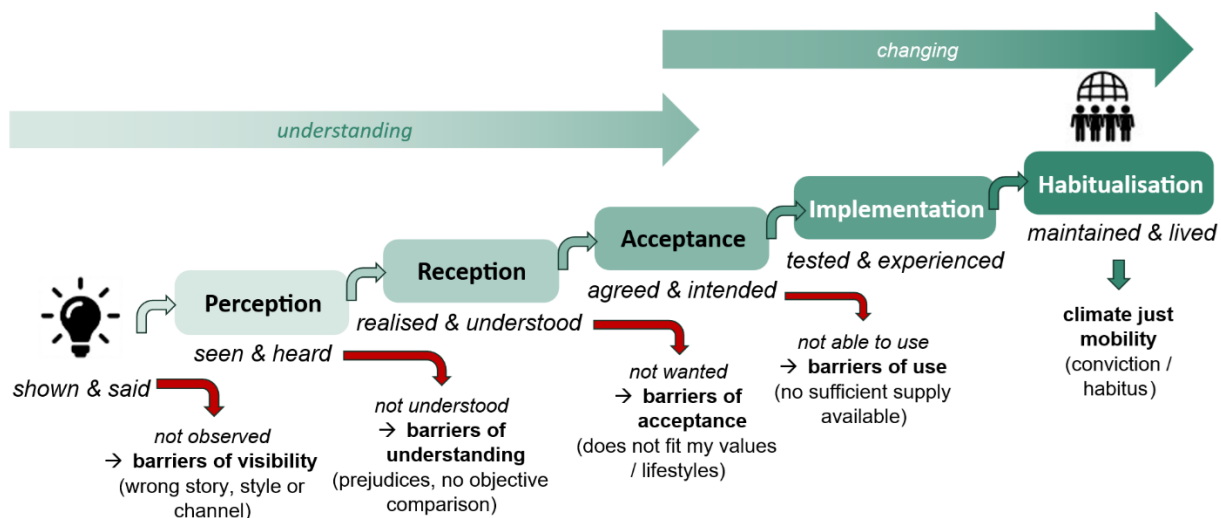
Figure 7 illustrates an empirically tested model of how individual mode-choice behaviour is determined via the integration of the Theory of Planned Behaviour, a rational choice model developed by Ajzen (1991) (in black), and the Normative Decision Model, a socio-psychological model developed by Schwarz & Howard (1981) (in blue) (Bamberg & Schmidt, 2003).

Figure 7. Determinants of individual mode-choice behaviour



Changing behaviour is rarely achieved all at once; it is a stepwise process that requires multiple nudges, continued engagement and openness to experimentation on the part of the traveller and political and planning institutions alike. Travel decisions are often deeply embedded in daily routines that are perceived as the best or even only solution for a given trip (Barr & Prillwitz, 2014), so alternatives must overcome a status quo bias. Figure illustrates the multi-step process of changing travel behaviour and the many barriers that must be overcome. Change must begin with making the policy intervention known and understood before it can be accepted, experienced and sustained in the long term. An incompatibility with the traveller's capabilities, values and preferences at any step can derail the process.

Figure 8. Step-by-step approach to influencing mobility behaviour



Source: Adapted with permission from the original author, Dr Alexandra Millonig, of the Centre for Mobility Change and the Austrian Institute of Technology. More information can be found at <https://changemobility.at/>.

The evolution of demand management policy and its shortcomings

For decades, policymakers and transport planners have sought to achieve policy objectives by affecting travel behaviour change. The theory of change that established TDM as a lever for policy makers is that people will make different travel choices if they are exposed to new information, given access to new travel alternatives, or if the social cost of making certain travel choices is better reflected in the user cost, provided that the behaviour change is consistent with their values, preferences and capabilities.

Typical TDM measures can be categorised along two main dimensions: whether they affect supply or demand, and whether they “push” or “pull” behaviour. Supply-side measures are those that seek to change the supply of transport services and infrastructure to influence choices, such as building new bicycle lanes, providing new shared modes or introducing new bus services. Demand-side measures are aimed at changing decisions around where and when to travel. Examples include mixed-use urban development and the promotion of teleworking that reduces the need or timing of travel. Along the other dimension, “pull” measures are those that encourage socially beneficial travel choices, while “push” measures try to discourage behaviour with substantial negative externalities. For example, improving the quality and availability of pedestrian infrastructure would be considered a “pull” measure, while congestion pricing would be considered a “push” measure.

The first generation of travel demand management focused primarily on forecasting demand and investing in infrastructure capacity to meet it. This model, known as “predict and provide”, treated travel preferences and behaviour as immutable and focused mainly on alleviating the congestion that arose from observed travel patterns (see Figure). The result was a considerable expansion of road infrastructure and significant growth in private vehicle travel in cities worldwide throughout the 20th century. The supply interventions were constrained and shaped by existing policy and planning frameworks oriented towards congestion management and accommodating private vehicle travel.

Figure 9. The first generation of demand management policy was focused on increasing the supply of infrastructure

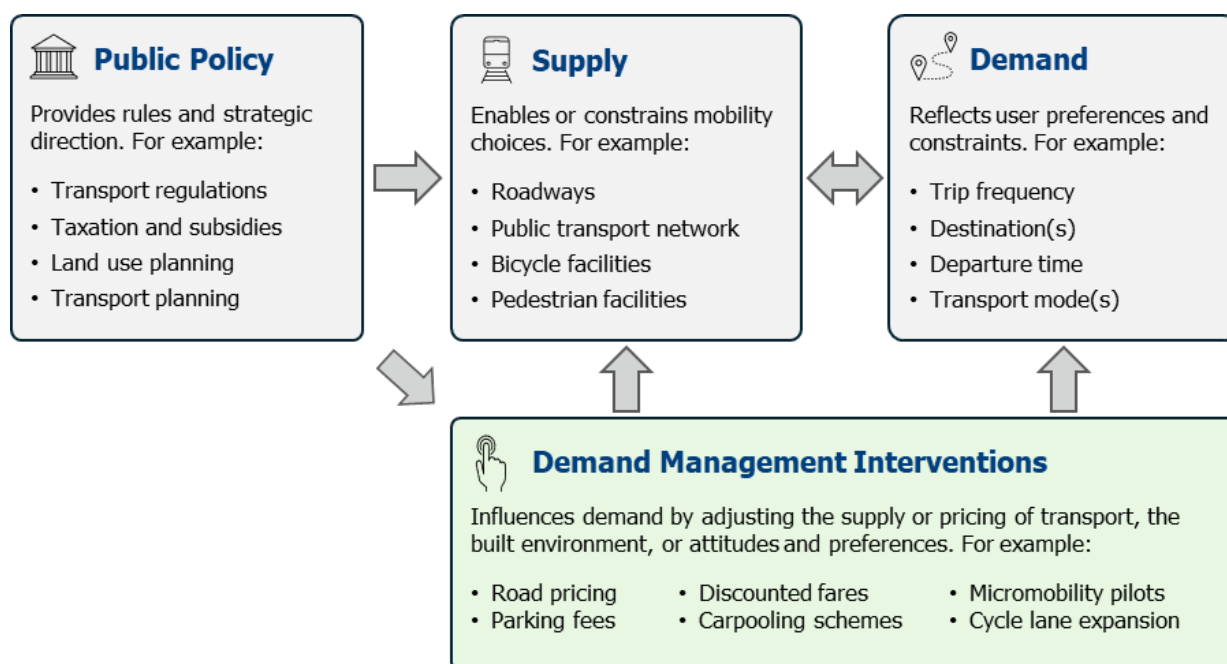


Subsequently, growing public pressure to mitigate the negative externalities of private vehicle transport in cities, as well as a rising awareness of the limitations of continuous infrastructure expansion, gave rise to a new generation of TDM. The overall approach began to move beyond simply alleviating congestion and accommodating forecasted demand growth through supply-side “pull” measures. Policies and planning were adapted to allow for both demand-side measures and “push” measures aimed at promoting more efficient use of existing transport infrastructure. Examples include the rise in bus-only and high-occupancy vehicle (HOV) lanes in the United States in the 1960s and 1970s, and road pricing schemes for congestion management in Asia, Europe and the United States beginning in the 1970s (Poole, 2020; Small and Gomez-Ibanez, 1998). State Departments of Transportation in the United States have applied a hybrid approach that pairs increased highway capacity with HOV lanes and road pricing (e.g., in California, Texas, Utah, and Virginia) (Poole, 2020; USDOT, 2025).

The second generation of TDM, depicted in Figure 10, has since expanded to include a wide range of interventions and implementations across the world, many of which are described in the subsequent sections of this report. The hierarchical “Avoid – Shift – Improve” (ASI) framework has become a popular guide to prioritising the TDM interventions that have the greatest potential for empowering people to make socially beneficial travel choices:

- **Avoid** the desire and need to travel long distances to access opportunities. Examples of “Avoid” interventions include mixed-used neighbourhood development and teleworking.
- **Shift** travel to modes and time periods with fewer social externalities if travel cannot be avoided. Examples of “Shift” interventions include dynamic parking pricing, promotion of carpooling, and expanding public transport services.
- **Improve** the performance of transport if shifting is not possible. Examples of “Improve” interventions include electrification of public transport services and better use of Intelligent Transport Systems (ITS) to manage traffic flows.

Figure 10. The second generation of demand management policy introduced interventions aimed at redistributing demand



Experience from these efforts has shown that while TDM interventions can make a positive difference at the margins, externalities from transport in urban areas remain a major public concern around the globe (Vecchio, Tiznado-Aitken and Mora-Vega, 2021; Ambrosino, 2023; Eurocities, 2025).

One of the primary shortcomings of the second generation of TDM is the reactive implementation of individual interventions to address pressing challenges, rather than a proactive strategy guided by an overarching vision. As a result, the benefits of new measures are quickly diminished by the “rebound effect”: when technological and infrastructural measures produce a reduction in travel time or mode shift, the time and road capacity gained are invested in longer and more trips, higher speed and bigger and heavier cars (Dunkerley et al., 2018).

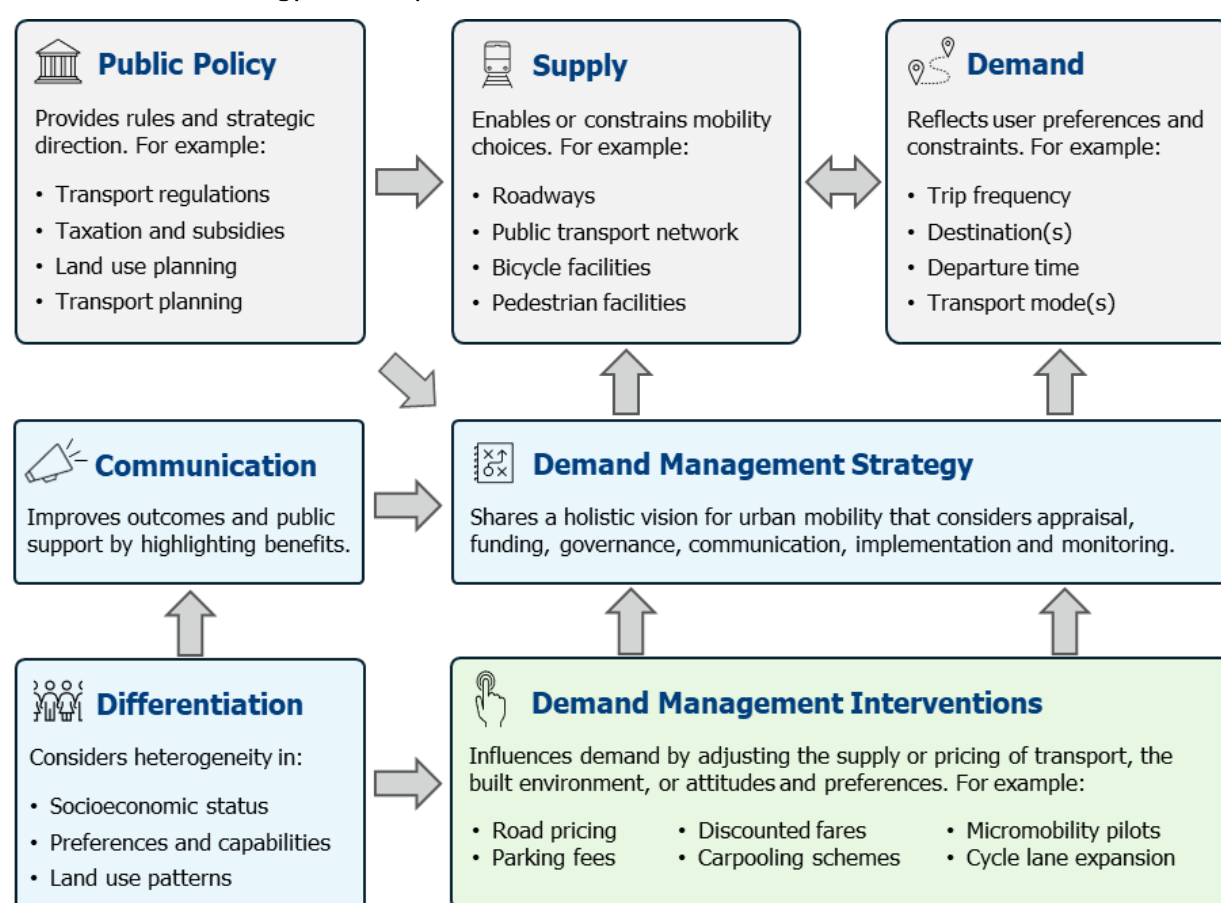
Another criticism is the lack of attention to differentiated needs, attitudes, and capabilities within the population when implementing TDM measures, which reduces their effectiveness and political acceptability. Individual differences in what is considered essential travel and what mobility alternatives are available mean that substantial shares of the population may be unwilling or unable to change their behaviour in response to the intervention (Kar, Le and Miller, 2021; Lindsey, Tikoudis, and Hassett, 2023).

Finally, recent discourses about transport, mobility and planning transitions have become the subject of intense debate and pressure campaigns from across the political spectrum. In many cases, positive narratives about TDM and enabling a greater diversity of urban mobility solutions have been drowned out by criticism and, in some cases, deliberate misinformation (Marquet et al., 2024). However, strategic communication campaigns that address the routines and preferences of travel behaviour and target the concerns of different audience groups by their social milieu or mobility style have proven effective in building support for TDM interventions (Gössling, 2025).

A new generation of urban demand management policy is needed

A new generation of TDM policy is needed to address the challenges facing urban areas, informed by lessons from earlier efforts and focused on strengthening effectiveness and public trust. As shown in Figure 11, under this approach individual measures should be integrated into a multi-year strategy grounded in a positive vision for urban mobility and a clear understanding of the implementation and communication challenges involved. Moreover, new strategies should account for heterogeneous needs, desires and capabilities when designing and communicating interventions, making behaviour change more likely and more durable.

Figure 11. A new generation of demand management policy should unite interventions into a strategy that emphasises communication and differentiation needs



As new mobility technologies enter the mainstream, urban travel patterns will continue to evolve, requiring policy makers to adapt to safeguard and enhance the quality of life in cities. Regulations and infrastructure for connected and automated vehicles, electric micromobility, artificial intelligence (AI)-enabled mobility platforms, and other emerging innovations should be designed around the needs of cities and their residents. A vision-led TDM strategy that is trusted by the public to deliver effective interventions with widespread benefits will be well positioned to shape these technology transitions in the future.

Section 2 of this report explores cross-cutting considerations for effective TDM implementation, including how interventions interact with one another, how they are sequenced over time, how they align with other urban systems, and distributional impacts. Sections 3–5 then examine key elements of a successful TDM strategy, including integration with land use policies and planning, ways to improve active and shared travel, and urban vehicle access policies. Each section considers key lessons for effective delivery, public acceptance and communications and looks towards the future to understand how implementation may benefit from, or adapt to, emerging technologies. Numerous case studies highlight best practices and lessons learned around the world.

Cross-cutting considerations for a holistic demand management strategy

This section of the report analyses the cross-cutting tensions that affect all demand management strategies and interventions. The five cross-cutting themes covered here span institutional and disciplinary boundaries:

- The need for cities, regions and central governments to coordinate policy measures;
- The need to consider the sequence of interventions and potential complementarity impacts between interventions when developing a demand management strategy;
- The need to secure continued long-term funding in a politically viable manner;
- The need to properly appraise, monitor and evaluate demand management strategies to ensure alignment with policy objectives, demonstrate benefits, and enable continuous learning; and
- The need to ensure that strategies adequately take into account the distributional impacts of measures on different users to aid public support.

A set of case studies provides transferable lessons across these themes. The diversity of examples demonstrates how a vision-led, systems approach to demand management policy can improve outcomes, accelerate implementation and engender durable support.

Multilevel coordination and governance

The effectiveness of TDM interventions depends on strong and coherent coordination between national, regional, and local governments. While institutional arrangements vary by country, national governments commonly establish the legal framework and long-term direction, and offer financing for nationally important assets. Regions translate these into place-based strategies, provide additional financing and planning for inter-urban and metropolitan assets, and set rules for regional rail and roads while coordinating land use and transport. Local authorities drive implementation: preparing and funding local transport networks, applying mobility-management tools, reallocating street space and leading public engagement.

In some contexts, international actors may reinforce these efforts. Official development assistance (ODA) supports mobility in developing and emerging economies, while multilateral banks and international organisations and initiatives provide financing, technical assistance and planning frameworks (e.g., national and city-level sustainable mobility plans). Effective demand management depends on clear role delineation, strong vertical coordination and aligned funding across all tiers (Veeneman & Mulley, 2018; Siedentop, Schmidt and Dunlop, 2022). Table 1 summarises the typical responsibilities of different levels of government and international actors.

Table 1. Typical urban travel demand management responsibilities by type of actor

Actor	Legal and regulatory	Strategy and planning	Funding	Implementation
National government ²	Sets the legal framework, division of responsibilities and tax rules. Adopts rules for specific modes and national transport networks.	Defines targets and issues national guidelines for demand management. Develops plans for nationally significant infrastructure.	Funds national research programmes and major infrastructure.	Evaluates and monitors programme implementation.
Regional government	Adopts rules for regional modes and networks (regional public transport, regional road systems).	Plans regional transport infrastructure and facilities, within and between urban areas.	Funds transport infrastructure and facilities, including urban transport services and assets.	Coordinates local transport and land use authorities.
Local government	Creates urban design guidelines and regulations.	Plans local urban transport infrastructure, demand management interventions and land use.	Provides local funds for urban transport infrastructure, facilities and services.	Implements and funds mobility management tools; delivers urban-level interventions. Leads public dialogue and participation.
Donors and development partners	—	Support partner countries to develop demand management strategies and equip cities with more efficient urban transport systems.	Provide development finance and assistance.	Provides technical assistance to support project implementation, capacity building and policy exchange.
International organisations and initiatives	—	Provide technical expertise and advice to strengthen demand management; help develop national and urban mobility plans.	Provide development finance and assistance.	Provide technical expertise for programme support, diagnostics and implementation assistance.

Coordination is often hampered by overlapping jurisdictions and diverging priorities. Urban areas often extend beyond administrative boundaries, making decisions on transport, housing, and other services a matter of inter-municipal collaboration. Meanwhile, national governments are often driven by a broader set of objectives, including international commitments and macroeconomic goals, while local governments must balance limited budgets, political pressures, and the immediate acceptability of interventions. These tensions create gaps and inconsistencies in policy design and delivery. Road use charging, for instance, often needs national enabling legislation but requires local authorities to carry the burden of implementation. Capacity constraints at the municipal level can further weaken effectiveness. A strong example of governance coordination and public consultation is set out in Box 1 with Ireland's approach to developing its new national demand management strategy.

² In the United States, urban demand management is regarded as a State or local issue. Localities are responsible for managing growth and demand based on their own short- and longer-term planning goals, in coordination with Metropolitan Planning Organizations. National government does not set urban demand management policy nor assign demand management mandates.

Box 1. Moving Together: Ireland's Collaborative Approach to Systems Change in Transport

Arising from a commitment in the Climate Action Plan 2023, Ireland has developed a new national transport demand management strategy – the first of its kind internationally. The strategy aims to improve the efficiency of Ireland's transport system and address the economic, environmental and societal impacts of car dependency and congestion. It takes a system wide approach to transforming transport, by placing a strong focus on collaboration with sectors that generate travel demand (e.g. education, public services, tourism and sport) and freight (e.g. business, retail, private deliveries). It encourages a bottom-up approach to local action, supported by enabling provisions at a national level, as well as a mechanism to monitor and evaluate implementation.

To develop the strategy, a cross-government steering group led by the Department of Transport was established, with input from more than 100 expert stakeholders. Online public consultations and focus groups were conducted throughout 2023 and 2024 to understand public sentiment and attitudes towards demand management measures. In total, more than 110 organisations were engaged and 154 submissions received through the public consultation process. The effort to collaborate so extensively was valued by the stakeholders involved and contributed to broad support for the strategy.

To make coordination work, governments must tackle three linked challenges:

1. **Jurisdictional fragmentation**, where governance structures are not aligned with transport networks and travel patterns;
2. **Regulatory overlaps and gaps**, leading to either duplication or paralysis in decision-making; and
3. **Uneven capacity and capability**, where smaller municipalities lack the resources or expertise to deliver complex interventions.

Addressing these challenges requires both legislative and non-legislative approaches. Legislative instruments can establish clarity and consistency by setting binding national or regional targets, or by introducing minimum service and accessibility standards. Non-legislative instruments are equally important mechanisms that build alignment without heavy regulation, including:

- **Inter-governmental agreements** and memoranda of understanding;
- **Joint planning frameworks and data-sharing platforms** to enable evidence-based decisions across boundaries;
- **Funding incentives**, such as conditional grants to align local action with central priorities while respecting autonomy.

Legal frameworks alone are insufficient if local capacity remains weak, however. Many municipalities require additional resources and institutional strengthening to implement programmes effectively. Developing regional or metropolitan authorities can bridge gaps across municipal boundaries, while cross-sectoral coordination, between the institutions overseeing transport, housing, energy and the environment, can help ensure that urban demand management is embedded in wider urban strategies. The two examples described in Box 2, illustrate how local–regional coordination and cross-sectoral coordination can affect the success of urban demand management schemes.

Box 2. Local-regional and cross-sectoral coordination in Belgium and Azerbaijan

Brussels' Good Move Mobility Plan

The Good Move Mobility plan (2020–2030) is the Brussels-Capital Region's main strategy to tackle urban mobility challenges. It aims to reduce car dependency, give more space back to people, and promote sustainable mobility while improving quality of life and supporting economic development. The plan introduces measures like directional changes, pedestrian zones, and bus lanes, intended to discourage unnecessary car use and encourage modal shift. It sets ambitious targets for 2030: a 24% reduction in car use, a 34% drop in traffic transit, and a fourfold increase in cycling, and the creation of 50 low-traffic neighbourhoods.

To reach these targets, the region uses Local Mobility Contracts to collaborate with municipalities. These contracts enable tailored interventions that reflect local needs while remaining aligned with regional objectives. Municipalities are expected to follow regional mobility regulations. If they don't comply, they can face consequences: fines, reduced funding, withdrawal of subsidies, legal actions, or even operational restrictions. However, the lack of hierarchical governance has led to uneven implementation. Some municipalities delayed deployment due to perceived shortcomings in the consultation process, particularly in lower socio-economic areas, where residents felt excluded from decision-making.

The Good Move Mobility Plan exemplifies a comprehensive urban demand management strategy that balances top-down regulation with local flexibility. At the same time, it has faced criticism due to local resistance and political friction. The plan exposed tensions between regional ambitions and municipal autonomy. Politically, it remains controversial, with parties divided over its future - making mobility policy a sensitive issue in regional governance and coalition negotiations.

Azerbaijan's Transport Coordination Council

Azerbaijan strengthened cross-government coordination in urban transport through the establishment of the Transport Coordination Council, created by Presidential Decree in 2023 and formalised through a Statute approved later that year. The council provides a high-level institutional platform to align transport policy, infrastructure investment, urban mobility planning, and road safety measures across national and local authorities. Chaired by the Minister of Digital Development and Transport, it supports an integrated and strategic approach to managing mobility challenges in Baku and across the country.

The council brings together a broad range of institutions involved in transport and urban development, including the Cabinet of Ministers, the Ministry of Internal Affairs, the Ministry of Ecology and Natural Resources, the Baku City Executive Power, the State Committee for Urban Planning and Architecture, the Azerbaijan Land Transport Agency, the Azerbaijan Railways, and Baku Metro, among others. By convening operators, regulators, and planning authorities within a single decision-making framework, the council enables coordinated responses to congestion, public transport integration, and urban accessibility challenges. A central objective has been to support a long-term shift from private car use toward more efficient and sustainable transport modes.

This coordinated governance structure has informed a range of integrated investment and operational decisions. Measures approved under the framework include expansion of the bus fleet, metro network extensions, and modernization of rail services, alongside efforts to improve interchange quality and first- and last-mile connectivity. Rather than planning each mode independently, the council promotes a network-based approach that considers how bus, metro, rail, micromobility, and pedestrian infrastructure function together as part of a unified urban mobility system.

Complementarity and sequencing considerations

Demand management measures rarely act in isolation from one another; they might complement one another or produce unintended consequences. Taking advantage of complementarity requires a unifying strategy for demand management and understanding the relationships between measures.

There are many examples of single-instrument interventions with unintended consequences that diminish their impact. For example, Milan's Ecopass was introduced as a measure to tackle pollution, but the impact of the charge tapered out within a week of introduction, despite some positive results in the reduction of particulate emissions on a yearly base (Percoco, 2013). This was attributed to the limited cordon area (8 km²) and exemptions for motorbikes, which saw an increase in use after the charge was introduced. While the fleet was gradually replaced with cleaner vehicles, the number of vehicles circulating in the Ecopass area remained constant. The Ecopass was later replaced by a dual congestion and pollution charge, which had a more substantive impact on air quality (Mattioli, Boffi and Colleoni, 2012; Marchetti & Antonelli, 2024).

The concept of Mobility Management provides an illustrative example of how complementarity can be incorporated into demand management strategies. The European Platform on Mobility Management (EPOMM) defines it as a strategy for avoiding the pitfalls of single-instrument interventions (EPOMM, 2018). At its core are “soft” measures such as information and communication, organising services, and coordination among different partners that can enhance the effectiveness of “hard” measures (e.g., new tram lines, new roads and new bike lanes). Soft measures do not necessarily require large financial investments and may have a high benefit–cost ratio. Mobility management strategies are timed to help ensure that individual measures help subsequent measures to succeed:

- **Long-term interventions:** Focus on systemic change through strategic instruments such as sustainable urban mobility plans (SUMPs) and national urban mobility plans (NUMPs), urban transport funding frameworks, intermodality policies and tax measures. These tools set the foundation for integrated, sustainable mobility systems.
- **Medium-term interventions:** Aim to influence behaviour and operations via mobility advisory services, mobility centres and tailored plans for organisations such as companies, hospitals, schools and shopping centres. Measures include parking management, urban tolls (including positive/reversed tolls), funding schemes and training programmes for various audiences, including students.
- **Short-term interventions:** Target immediate behaviour change through public campaigns, individualised marketing, personalised user support and behavioural nudges to encourage sustainable travel choices.

Singapore and Tokyo have both used complementary measures in different short- and long-term contexts, but with a consistent framework to achieve their objectives successfully. Singapore's experience with complementary demand management measures started in 1995, with the establishment of the Land Transport Authority (LTA). The LTA has been described as a pioneer in integrated demand management, as it was able to capture multiple planning functions under the umbrella of its authority (Barter and Dotson, 2011). It uses a variety of complementary measures across the A-S-I framework:

- **Avoid:** The vehicle quota system restricts the number of vehicles registered in Singapore (Mo, Kwon and Park, 2014). This was combined with the introduction of the Electronic Road Pricing (ERP) scheme as a more comprehensive measure to reduce congestion across the country.

- **Shift:** Promoting public transport systems and improving walkability to stations made it easier for people to avoid the vehicle quota and road pricing charges by using public transport. This effort was further expanded in the Land Transport Master Plan 2040, in which the LTA committed to introducing multimodal transit hubs across the country (Land Transport Authority, 2019).
- **Improve:** Modernisation of the fleet, releasing more buses with air conditioning, access to arrival and departure times of buses in real time, and introduction of a distance-based fare system cemented public transport as an affordable and convenient mode (Goh, 1996; Land Transport Authority, 2008; Land Transport Authority, 2021).

Collectively, these measures had a significant impact; the ERP scheme caused as many as 20% of trips to shift from private cars to buses during its hours of operation (Agarwal and Koo, 2005). The synergies also extended to funding: revenue generated from auctioning vehicle permits was used to improve public transport service even further (Koh, 2004).

Tokyo leveraged complementarity to manage demand during the 2020 Olympic and Paralympic Games, introducing many different measures under an A-S-I strategy:

- **Avoid:** Firms were encouraged to allow teleworking and stagger shift timings as part of the “Smooth Biz” initiative to reduce peak demand on rail.
- **Shift:** These included new travel routing apps for better decision making during the games, increased capacity of public transport, and toll discounts for late-night travel (Tokyo Metropolitan Government, 2022).
- **Improve:** During the games, Tokyo established a 24-hour traffic monitoring centre to adjust the number of lanes and toll gates on expressways depending on traffic conditions.

Traffic volumes dropped following the introduction of the Smooth Biz initiative. Lane closures, junction restrictions and a reduction in toll gates were credited with reducing delays by 27% on weekdays and by 9% on Saturdays, Sundays and holidays (Xing, Toriumi and Oguchi, 2025). Essentially, an intervention on each pillar reinforced interventions in others, creating a robust system of integrated demand management.

While every urban area and country is different, the common theme between Tokyo and Singapore is that effective complementarity requires intentional design of mutually reinforcing interventions. This approach offers a pathway for governments to target transport policies holistically, instead of resorting to piecemeal measures as and when the need arises.

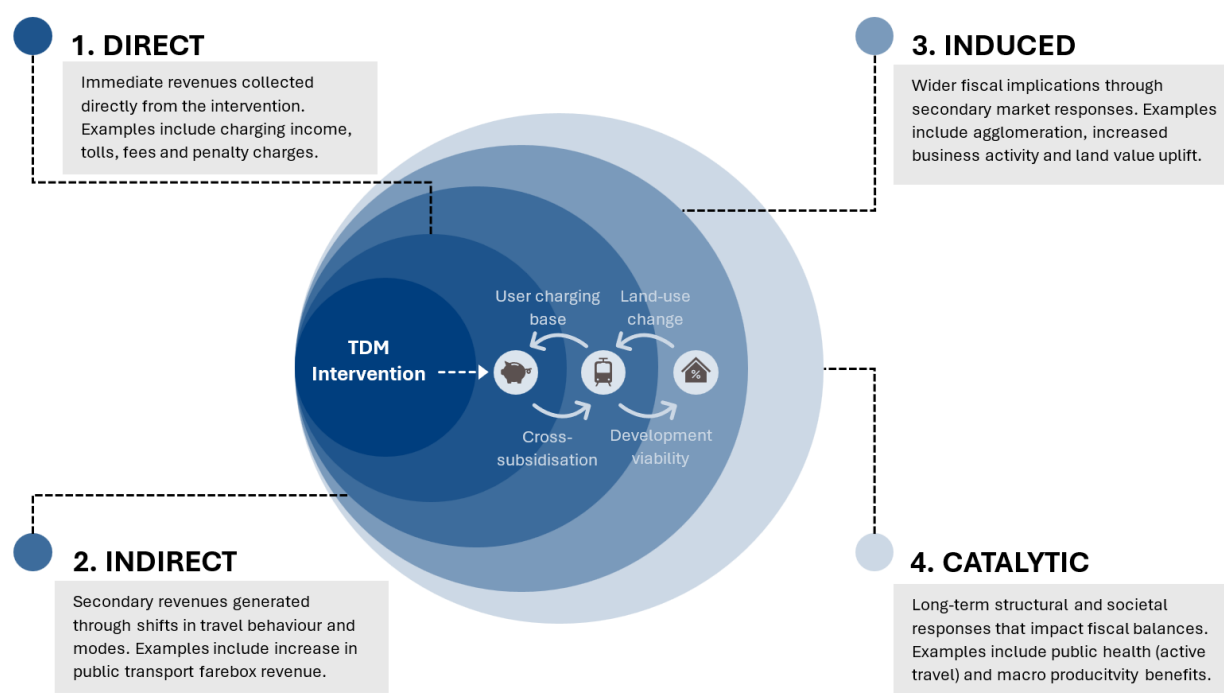
Principles for continued long-term funding

Well-designed demand management interventions can be a cost-effective solution for transport authorities to improve service provision when faced with affordability constraints (Kodransky, 2018). When budgets are constrained, it can be cheaper to manage demand to use assets more efficiently, rather than invest in expensive and inefficient forms of travel. Demand management improves cost efficiency through lower capital, operation and maintenance costs, reducing inefficient trips in congested urban areas where the marginal external costs imposed are high and targeting multiple co-benefits through a single intervention (USDOT, 2004; Victoria Transport Policy Institute, 2017; EPOMM, 2025).

In addition to improving the cost efficiency of the existing transport system, TDM can create self-sustaining funding mechanisms that support its long-term financial viability. Figure 12 presents the relationships between demand management and transport funding:

- **Direct funding:** Funding certainty is greatest and payback quickest from direct channels, such as road pricing fees, that are collected by the scheme and used to support operational expenses. At a sufficient scale, direct revenue can achieve cost recovery. For example, London's congestion charge is estimated to have recovered implementation costs within three years (TfL, 2004a; 2005; 2006; Evans, 2007; ESMAP, 2011).
- **Indirect funding:** Shifts in travel behaviour away from private vehicle use can lead to increased public revenue from other modes, such as public transport fares (Eliason, 2009).
- **Induced and catalytic funding:** These channels capture TDM's wider impact on non-transport markets. These impacts occur when reduced congestion and improved connectivity lead to enhanced economic interactions and productivity-induced tax revenues (DfT, 2025; Victoria Transport Policy Institute, 2017). Exogenous factors may obscure direct causal chains at this level, making the link back to demand management less clear.

Figure 12. A taxonomy of continued funding for urban transport demand management



Source: Adapted from ITF (2024); Victoria Transport Policy Institute, (2017); Department for Transport, (2025).

In the United States, fares and other earned income contribute around half of local and regional public transport funding, of which almost all is used to fund operations (TCRP, 2009). Income-earning demand management may increase revenues but is unlikely to be sufficient to finance new capital transit improvements outright. For example, although London's congestion charge generated a net surplus of GBP 235 million in 2023/24, a central government capital grant was still required to fund large capital

infrastructure enhancements (TfL, 2024; 2025a). Instead, revenue is typically used to cross-subsidise complementary demand management measures.

Cross-subsidisation may support demand management schemes that do not have dedicated funding, such as maintenance for active travel infrastructure or public transport fare subsidies (Yanocha, 2021). For example, Azerbaijan established a national public transport fund that allocates a portion of fuel excise taxes and revenues from future urban road tolling schemes towards public transport operations (Republic of Azerbaijan, 2025). In other instances, demand management may generate a stable revenue stream to use as collateral for project financing (UK Parliament, 2009; Booz & Co, 2012; PCAC, 2024). Under this mechanism, upfront investment costs can be financed over the project life cycle and underwritten through long-term revenues. Box 3 sets out Nottingham's Workplace Parking Levy as a recent example where a GBP 1 billion investment in the transport system was facilitated by the levy's stable funding stream (Nottingham City Council, 2022).

Box 3. The Nottingham Workplace Parking Levy, congestion and public transport

In April 2012, a new workplace parking levy was implemented in Nottingham, UK. The first of its kind in Europe, this scheme sought to apply a surcharge for employers with 11 or more off-street parking spaces. The annual fee is indexed to inflation; in 2025/26 the fee is GBP 570 per spot (Nottingham City Council, 2025). The intervention has the dual goal of reducing congestion and generating income to improve public transport in the city. In 2024 prices, setup costs totalled GBP 3.7 million (Leach, 2023).

The intervention had the effect of reducing eligible parking spaces by 25% from 2010 to 2015 as employers responded to the financial incentive to minimise parking (Dale et al., 2017). Despite congestion increasing due to broader trends, it has grown more slowly in Nottingham than in comparative areas. The levy has been credited with reducing congestion growth by 47% (Nottingham City Council, 2022). Empirical studies have also found that a 1% reduction in liable parking places is associated with a 0.55% decrease in delay per vehicle mile travelled (Dale et al., 2017).

In its first decade of operation, the programme generated GBP 9–10 million per year in revenue. Annual operating costs average GBP 0.5 million, or 5% of typical revenues (WWF Scotland, 2016; Leach, 2023). The income stream has been credited with facilitating more than GBP 1 billion in investments to build 17 km of new public transport lines and upgrade the city's tram system, bus network and rail station (Nottingham City Council, 2022). Because the scheme targets employers, revenue generation is stable over time, and fee collection is easily managed (Leach, 2023).

Funding challenges

Despite the potential for TDM to have a high degree of self-sufficiency, practical implementation challenges remain. Pricing instruments are politically contentious to implement and tend to face strong public opposition (Sherriff, 2014). Overcoming this opposition may lead to compromises and lower charges that are suboptimal for both demand management and revenue objectives. In London, for example, the congestion charge was introduced at GBP 5 per day, instead of the estimated socially optimal charge of GBP 7.20 (Prud'homme & Bocarejo, 2005). Distributional considerations, discussed further below, may also lead to exemptions and discounts for certain user groups that can erode revenue potential in some cases.

Demand management schemes with a dual mandate of revenue generation and demand suppression may lead to conflicting outcomes where greater compliance and traffic reduction will result in lower charging

revenue. This inherent conflict can result in both more volatile and lower-than-expected revenue generation for transport authorities (London Assembly, 2004). Balancing these two objectives requires good data and monitoring to understand travel behaviour, such as users' willingness to pay and price elasticity of demand, alongside clarity over the social costs of private vehicle use (USDOT, 2008; Bull, Mauchan and Wilson, 2017).

Volatility can also occur during exogenous shocks to travel behaviour. During the COVID-19 pandemic, public transport ridership and private vehicle usage fell across many countries in response to social distancing and imposed restrictions (Buehler, 2025; O'Garra & Fouquet, 2022). While shocks that reduce car travel can deliver positive outcomes for demand management objectives, they can have large consequences for public revenue. For example, while demand management objectives were partially achieved, annual revenues fell more than 50% in Milan's Area C between 2019 and 2020, remaining roughly 24% below the pre-pandemic level by 2022 (Marchetti & Antonelli, 2024).

To maintain necessary revenue, public authorities should adapt to changing conditions. In the wake of the COVID-19 pandemic, temporary measures were introduced to expand the coverage and scope of the London Congestion Charge (Greater London Authority, 2020). With some measures made permanent in 2021, this led to a 39% real terms increase in net revenue, on average, between 2020/21 and 2023/24 (TfL, 2021a,b; 2024). Demand management revenue may also be subject to economic shocks, as overall transport demand is sensitive to economic downturns (Krüger, 2012). Studies have found that rail demand is more sensitive to economic factors than road traffic demand, suggesting greater revenue resilience for private vehicle price interventions (Krüger, 2012).

Considerations for stable and efficient revenue

Policy design for pricing schemes involves many decisions that affect the stability and efficiency of revenue, as well as public acceptance. Table 2 summarises considerations to inform these decisions, with specific examples of successful implementation.

Table 2. Summary of considerations for stable and efficient revenue generation

Design principle	Design and delivery levers
Administrative efficiency	- Minimise enforcement costs through automated delivery (e.g., Singapore's Electronic Road Pricing) (Theseira, 2021). - Retain revenues for cross-subsidisation of demand management schemes run by the same administration. - Harness economies of scale and density to spread fixed costs across a wider revenue base. - Adopt a clear legislative mandate and process for collecting income to provide stability (ITF, 2024).
Revenue predictability	- Design the scheme and revenue target to maximise compliance and collection rates. - Ensure the tariff-setting mechanism is transparent, stable and indexed to inflation to maintain purchasing power (e.g., Nottingham Workplace Parking Levy) (Nottingham City Council, 2022). - Implement a robust appraisal, monitoring and evaluation framework to observe travel trends and pre-empt risks before they materialise. - Target multiple funding mechanisms through a diverse TDM portfolio to spread revenue risk (ITF, 2024c).
Public and political acceptability	- Foster long-term and apolitical support for TDM schemes to enhance certainty and stability for the revenue base. - Mitigate regressive distributional impacts through scheme design to overcome implementation barriers. - When appropriate, limit concessions to vulnerable groups to maintain a broad revenue base.

Appraisal, monitoring and evaluation

Delivering demand management interventions effectively requires robust appraisal, monitoring and evaluation frameworks. This section briefly describes good practices and highlights considerations specific to TDM interventions.

Appraisal of demand management interventions

Appraisal should ideally begin with a strategic assessment to ensure that proposed interventions align with broader policy goals at national, regional, and local levels. This includes:

- Assessing the strategic context and understanding the strategic fit of the intervention (e.g. alignment with national, regional and local objectives and other existing policies);
- Identifying the problem to be addressed; and
- Establishing whether there is a need for transport intervention.

The responsible authority should then prepare a longlist of options and carry out an initial appraisal using one of two common methods:

- **Cost-benefit analysis (CBA):** Quantifies the net social value of interventions by comparing user benefits (e.g. travel time savings, improved safety, reduced emissions) to investment and operating costs. It captures direct user benefits and indirect economic impacts, such as productivity and spatial reallocation of economic activity.
- **Multi-criteria decision analysis (MCDA):** Used when outcomes are not easily monetised (e.g. accessibility). MCDA allows comparison of multiple objectives, supporting transparent trade-off decisions during longlisting and shortlisting of options.

A typical transport CBA considers the following impacts:

- User benefits calculated as the change in consumer surplus based on the change in generalised travel costs (including time, money and discomfort);
- Other monetisable benefits, such as wider economic impacts, reliability and crowding;
- Externalities, such as emissions, noise and road crashes (where economic quantification is sufficiently robust);
- Revenues, operating and investment costs, including fare or toll income, maintenance requirements and costs to the taxpayer.

Bus and rail enhancements are typically appraised using standard transport CBA methods (e.g. similar to those used for major road and rail projects), with a focus on changes in generalised cost and travel time savings, congestion relief, and wider economic impacts. Active travel schemes require tailored tools, as typically used in MCDA. For example, in the UK, the Active Mode Appraisal Toolkit (DfT, 2022), captures benefits such as:

- Physical and mental health improvements;
- Environmental outcomes (e.g. air quality, other emissions); and
- Decongestion benefits (especially where modal shift reduces car use).

The World Health Organization’s HEAT tool (WHO, 2021) is also widely used to quantify the health and economic value of reduced mortality from walking and cycling, based on physical activity levels and epidemiological evidence. HEAT provides adaptable inputs for different countries and supports cost-effectiveness and benefit estimation even where travel time savings are minimal.

CBAs are often informed by sophisticated transport models that assess forecast changes in travel demand, behavioural responses, and network performance to generate key outputs such as time savings, mode shift estimates and congestion impacts. Transport modelling plays a vital role in supporting urban demand management interventions by offering a structured approach to explore plausible futures under different scenarios. For example, the “digital twin” transport model of Baku has been used to evaluate and compare the benefits of alternative designs for more than 20 different transport projects, including future metro expansions (Ahmedov, 2026).

Rather than being used to forecast and justify infrastructure expansion, as in the traditional “predict and provide” approach, modelling is increasingly deployed in TDM within a “vision and validate” framework. This shift allows policy makers to start with a desired outcome, such as net zero emissions or equitable access, and use modelling to test whether proposed interventions align with those goals. Modelling should ultimately be transparent and proportionate, and be used to support rather than dictate policy.

Monitoring and evaluation of demand management interventions

Strong monitoring and evaluation (M&E) practices are essential to deploy evidence-based demand management interventions, supporting learning, accountability and improved decision-making. M&E helps to demonstrate that policies are justified and promote their expansion – or, if they prove ineffective, inform changes or policy rollbacks.

Key types of evaluation for demand management schemes include:

1. **Process evaluation:** Examines how interventions were delivered, especially useful for pilots and novel approaches (e.g. stakeholder interviews, project document reviews).
2. **Impact evaluation:** Uses counterfactual or theory-based methods to determine causal effects (e.g. difference-in-differences, matched comparison groups, before/after studies).
3. **Value for money evaluation:** Compares realised outcomes with appraisal forecasts to assess cost-effectiveness (e.g. cost–benefit comparison, economic efficiency metrics).

Good evaluation practice should include early planning, clear objectives, robust baseline data, integration with business case development, and independent evaluation where feasible. Data collection and analysis can be a relatively inexpensive tool to understand travel behaviour and trends over time. National Travel Surveys and emerging data sources such as mobile phone records can be used to analyse changes in travel patterns before, during and after interventions are implemented. Box 5 describes how Active Travel England learned from M&E over time to adjust its approach to demand management.

In addition, programme-level M&E can be useful for assessing synergies and trade-offs between interventions. It can also help to shift the focus from narrow effects to broader social outcomes across a portfolio of interventions. Examples of outcome-based metrics for programme-level M&E include economic productivity (increase in gross value added per capita) and road safety (reduction in casualties per unit of investment).

Box 4. Monitoring and evaluation with Active Travel England

In 2012, the UK government conducted a literature review of demand management M&E programmes, finding impressive benefit-cost ratios (ranging from 1.3 to 12.7) for active travel schemes in the country due to relatively low infrastructure costs and large health benefits (DfT, 2015). These findings informed the allocation of GBP 6.6 billion to Active Travel England from 2016 to 2025 to deliver an infrastructure and behaviour change programme with a mandate to reduce emissions, improve air quality and improve physical activity. Active Travel England was set up at the national level to deliver the programme, while local authorities are responsible for implementing interventions.

However, as the earlier monitoring and evaluation results became less relevant over time, new results to inform intervention design were missing. From 2016 to 2021, local authorities were not required to monitor or evaluate scheme costs less than GBP 2 million (more than double the average grant size), resulting in a limited understanding of the impacts of funding. Active Travel England suspected funding had been spent on low value-for-money infrastructure, which undermined the case for future funding, created uncertainty, and increased the need for M&E (House of Commons, 2023).

Following this, Active Travel England updated its M&E practices to:

- Advise appraisal for schemes over GBP 750 000;
- Standardise the evaluation framework;
- Provide guidance and evaluation tools to reduce the administrative burden and increase the likelihood of evaluation;
- Support local capacity through a Capability Fund and public engagement;
- Conduct large-scale programme-level process and impact evaluations.

Enhancing appraisal, monitoring and evaluation practices

Even well-established appraisal and M&E practices often fall short in fully capturing social, distributional, spatial and long-term impacts. For example, appraisal often focuses on aggregate impact, overlooking how interventions affect different places and user groups. Certain populations, such as low-income commuters, people with no alternative to car use, or those with mobility constraints, may face disproportionate costs. Emerging policy goals such as resilience and health are also rarely fully captured. Recommendations for enhancing these practices include strengthening analytical tools, incorporating distributional insights, and building institutional capacity:

- Invest in multimodal and behavioural modelling to better understand how users respond to different interventions.
- Better incorporate spatial and distributional impacts to capture effects on income, sex, age, geography and disability, ensuring no groups are unfairly burdened.
- Expand appraisal tools to cover non-monetised benefits, including resilience, health and urban regeneration, reflecting evolving policy priorities.
- Build subnational capability, improve collaboration across governance levels, and provide resources to conduct robust analysis, monitor outcomes and adapt policies over time.

- Share case studies and evaluation findings internationally to strengthen the evidence base, refine assumptions and improve appraisal methods.

Public acceptability through fairness

The long-term success of demand management measures depends on building and maintaining public support, including by addressing concerns about the fairness of interventions across stakeholder groups. Transport systems impact regions, companies, institutions and people differently (Martens 2016, Sheller 2018). They also tend to be capital-intensive, making it difficult to address any problems with fairness in the short term through large-scale infrastructure and service investments. Demand management policies offer an opportunity to improve mobility and access for all to transport relatively quickly. They can also negatively affect fairness, however, if not designed to expand economic opportunity for all.

Issues with fairness can manifest in various forms, including disparities in income, health, education and access to transport. Transport can deepen those socioeconomic disparities in several ways (ITF, 2023b):

Demand management measures could aim to ensure that resources, opportunities and responsibilities are shared fairly (Dangschat, 2025). In practice, this means that the costs and benefits of changing travel behaviour are spread across social groups and not pushed onto certain people, to avoid diminishing the acceptability of demand management measures. This section sets out a framework for how to consider distributional impacts in demand management policy design across a range of different intervention types, thereby increasing the feasibility of implementation.

“Push” measures can be effective, but may burden low-income groups

In general, “push” measures such as fuel taxes, congestion charges and parking pricing place a disproportionate burden on low-income households, especially those without feasible travel alternatives that allow them to avoid the imposed fees. The effect is disproportionate because the fees make up a larger share of their income, and they are more likely to have to forgo important trips when the cost of travel rises (Richman et al., 2024). However, the reduction of private vehicle traffic as a result of these measures has a positive impact in other dimensions, as the health and social benefits are more prominent for pregnant women, children and older adults (Watkins, Antonelli, and Bergeling, 2024).

Different “push” measures have different impacts. Parking levies disproportionately affect poorer households without access to feasible alternatives to driving (Institute for Transport Studies, 2012). Low emission zones have a similar outcome, as low-income households may not be able to afford the upfront cost of a new, lower-emitting vehicle, and are therefore more likely to have to pay the toll or adjust their travel patterns (Shi, 2024). Flat fuel taxes disproportionately affect rural residents, who typically travel longer distances; low-income households are particularly affected (Pyddoke et al, 2021).

To mitigate these impacts, policy makers could allocate some or all of the revenue from pricing schemes to dedicated measures to expand and improve alternatives to driving, especially in low-income or poorly connected areas. Box 6 describes how the distributional impacts of the London Congestion Charge were alleviated by investing revenues in improving bus services.

Households that are adversely affected by pricing measures and cannot access alternative modes could be supported through the general taxation and social security system if governments consider additional mitigation measures warranted (ITF, 2018). Studies and pilots suggest mobility credits or monthly trip allowances can protect low-income drivers from congestion fees if credits are well targeted, though most

evidence so far comes from models and small trials, rather than large real-world rollouts (Cohen-Blankshtain, Bar-Gera & Shiftan, 2020; Li & Robusté, 2021).

Box 5. The distributional effects of the London Congestion Charge

The London Congestion Charge, as a flat fee, regressively impacts low-income households because they spend a larger share of their income on fees or forgo trips into the charging zone. This is concerning because if low-income car users live in an area that is underserved by public transport, then they stand to lose employment and educational opportunities. Women and older people are also disproportionately affected; one study found twice as many women as men said they would not be able to afford the charge (Hosford et al, 2021). As a result, some women made fewer trips after the introduction of the charge, particularly to visit relatives or friends, thereby reducing their social capital (TfL, 2004; Munford, 2017).

To address the negative effects of the congestion charge on lower-income households, London is bound by law to invest the proceeds from the charge in improving public transport (London Assembly, 2002). In the first year of operation, 62% of the revenue raised was invested in the bus system, which saw a 38% increase in patronage after the introduction of the charge (London Assembly, 2005, TfL, 2004). Santos and Bhakar (2006) found that motorists who shifted to buses also benefited from a reduction in congestion-related delays for buses. When the Ultra Low Emission Zone was introduced in 2019, London provided a vehicle scrappage scheme for low-income and disabled drivers to offset the cost of purchasing a compliant vehicle (TfL, 2025b).

Research has also shown that the charge led to a reduction in air pollution that disproportionately benefited the most deprived areas of London, which had higher levels of pollution to begin with (Tonne et al., 2008).

“Pull” measures require careful targeting to ensure benefits are widely shared

“Pull” measures generally improve accessibility or reduce costs for shared and active modes. As a result, their impact is highly dependent on the populations that they serve. If these measures are chosen, careful targeting is needed to ensure that the benefits of these largely public investments are widely shared.

Shared and active infrastructure expansion can be a powerful tool for reducing spatial disparities. The Grand Paris Express project will build 42 metro stations within or near designated disadvantaged areas, many of which have inadequate public transport connections. One such commune, for example, is expected to see an 11-fold increase in the number of jobs accessible by public transport within 45 minutes (Société des Grands Projets, n.d.). Similarly, the OECD has recommended well-targeted cycling infrastructure as a low-cost and effective way to improve accessibility for low-income neighbourhoods in Accra, Ghana (Anderson et al., 2025).

However, poor targeting of TDM measures, or unintended consequences, have sometimes exacerbated disparities in access to non-motorised transport. Cycle lane improvements are sometimes concentrated in high-income areas while the lowest-income areas are often neglected (Mora, Truffello and Oyarzún, 2021; Lemon et al, 2023; World Bank, 2025; Betts & Potoglou, 2025). Evidence suggests that if fairness is not a core objective, operators of new mobility services such as Mobility-as-a-Service (MaaS) may choose to offer their products exclusively in high-income areas in cities (Ho & Tirachini, 2024).

One challenge with place-based service improvements is that access to high-quality public transport and active travel infrastructure makes neighbourhoods more desirable, especially when such access is scarce. As a result, property becomes more expensive, and over time, these services end up primarily serving more

affluent communities. This effect has been notably observed in Barcelona (Anguelovski & Connolly 2024). In the UK, studies have found that government subsidies for public transport largely benefit higher-income groups, who travel more and tend to live in areas that are well served by subsidised public transport (Stacey & Shaddock, 2015). Expanding the availability of affordable housing near new transport investments and reducing the scarcity of high-quality service can both help mitigate the effect of transport-induced gentrification (Freemark et al., 2025).

Digital mobility platforms may also have unequal impacts due to their barriers to access. MaaS, for example, typically requires access to a mobile device and familiarity with digital applications (Crozet & Coldefy, 2021). The elderly, people with certain disabilities, and those with low educational attainment are often at risk of being excluded from MaaS offerings because of their digital-first approach (Bradley et al., 2021). Multichannel methods for booking and payment, such as dedicated phone lines and in-person kiosks, can alleviate barriers to adoption.

Enhancing public acceptability through fairness

A four-phase framework is set out below to enhance the public acceptability of TDM interventions by integrating fairness considerations into policy design.

1. Engagement:

- Identify core stakeholders and the most impacted households, including through engagement with civil society, activist groups and residents' associations.
- Engage at the design stage with a focus on broad participation. To achieve successful delivery, policy must consider processes of information and participation for all (Rode, 2023; Rode et al., 2025).

2. Sequencing:

- Identify measures to facilitate broad societal benefits before implementing interventions, such as improvements to public transport infrastructure and services, last-mile connectivity, inclusive payment and booking channels, and targeted exemptions or grants if warranted.
- Consider phasing, with pilots to gauge public concerns, grace periods and compliance windows.

3. Revenue recycling:

- Partially or fully recycle revenue towards complementary interventions to yield benefits for all.
- Consider compensation measures like scrappage schemes for low-income or disabled drivers to defray the upfront cost of purchasing a new vehicle.

4. Appraisal, monitoring and evaluation:

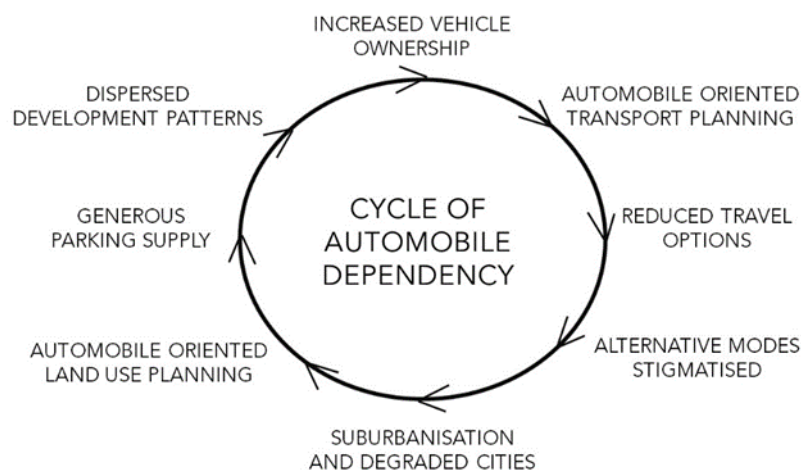
- Design appraisal and data collection methods to enable a robust evaluation of the distributional impacts of both benefits and harms. Set intervention thresholds.
- Monitor the scheme for fairness and make improvements if intervention thresholds are reached.

Land use and transport

Individual mobility has grown consistently since the end of the Second World War driven by the expansion of private car travel. Consequently, land use planning over the same period was largely oriented towards accommodating car traffic. Existing roads and new streets were widened, often by drastically reducing the public space available for pedestrians and cyclists (Tira et al. 2024). That process was also combined with the development of low-density residential areas that increased dependence on the automobile for daily movements (Newman & Kenworthy, 1999).

Automobile dependency is the result of a self-reinforcing cycle of increased automobile ownership, reduced travel options and low-density land use patterns, as illustrated in Figure 14. Automobile dependency persists because land use patterns, transport investments, pricing and social norms continuously feed back into one another. A systems approach to demand management looks at land use and transport not as separate policy areas, but as interacting parts of a reinforcing system. This section explores the essential role of land use planning in a systems approach to urban demand management.

Figure 13. The cycle of automobile dependency.



Source: Adapted from Litman (2025).

How to better integrate land-use and transport planning

Land use planning approaches to stimulate multimodality start by making opportunities and activities easier to access with a variety of transport modes. Several intersecting land use planning philosophies have become well known around the world for reducing the need to travel long distances. There are many examples of these concepts being put into practice in the past two decades, but minimal discussion of the governance structures and implementation plans that contributed to their success. Each of the concepts is introduced briefly below, followed by case studies that explore the practical policy and governance considerations in the next section.

Compact, mixed-use development or “urban villages”

Compact, mixed-use development (sometimes referred to as “urban villages”) is a land use planning approach that weaves residential, commercial and civic functions into a walkable, higher-density urban fabric. By maximising proximity between homes, jobs, services and amenities, this approach aims to make many daily activities accessible by walking, cycling or short public transport trips, reducing car dependency. These developments are often centred around public green spaces or pedestrianised areas (ITF, 2022; ITF 2024f).

Successful implementation requires municipal governance frameworks that align zoning codes, building standards, urban design policies and fiscal instruments such as inclusionary zoning and density bonuses. Compact development also benefits proactive coordination between land-use and transport planning, particularly in metropolitan regions where municipal boundaries and responsibilities are fragmented. Projects with participatory design phases and ongoing communication tend to reduce resistance rooted in fears of change or loss of neighbourhood character, especially in suburban contexts where such transformations are less established (Wälty and Silberberger, 2025).

Although compact development shares objectives with transit-oriented planning and accessibility-oriented models, its emphasis is primarily on urban form and density as foundational drivers of reduced travel demand, rather than on public transport integration or access targets.

Transit-oriented development (TOD)

Transit-oriented development is an approach that explicitly links high-capacity public transport investment with mixed-use, higher-density urban development around transit nodes. Orienting density increases around high-capacity public transport is both effective as a demand management tool and generally popular. The densification contributes less to local traffic congestion if convenient public transport is located nearby, and investments in public transport have better cost–benefit ratios when the stations are surrounded by greater density (ITF, 2022).

Effective governance for TOD also hinges on multilevel coordination between local governments, transit operators and regional planning authorities to ensure that investments in transport infrastructure are matched with land use changes that provide walkable access to stations and generate sufficient ridership. Dedicated transport and land use coordination authorities can help to align development, as seen in Vancouver, Canada (Huerta Melchor & Lembcke, 2020). Implementation challenges can include managing affordable housing around transit hubs and harmonising parking and street design policies.

Accessibility-oriented planning (the “x-minute city”)

Accessibility-oriented planning, often operationalised as the “x-minute city” concept (e.g. the 15-minute city), reframes urban planning around accessibility outcomes rather than density or proximity to public transport. Its central tenet is that daily needs should be reachable by walking, cycling, or public transport within a defined travel time threshold, thus making car trips unnecessary for routine activities. The types of daily needs that are included in the framework vary, but typically include work, recreation, healthcare, education and groceries at a minimum (ITF, 2022).

Realising this vision requires a holistic governance approach that transcends siloed agencies and levels of government, integrating transport planning with land use policy, economic development and social services planning. Implementation of accessibility-oriented planning challenges traditional sectoral planning by prioritising people’s ability to reach what they value rather than simply moving vehicles

efficiently. Literature shows that implementation is uneven globally and still early in many contexts, with most cities still planning rather than executing comprehensive strategies (Teixeira et al., 2024). In contrast to TOD, which is anchored to transit infrastructure, and compact mixed-use strategies, which emphasise density and functional mix, the x-minute city is explicitly performance-driven: it uses travel-time thresholds to define success and sets clear benchmarks for policy evaluation.

Governance of integrated land use and transport reforms

Land use reform concepts for managing urban travel demand are well established, but enacting them in practice requires overcoming a range of policy design, governance, and implementation challenges. The case studies below highlight different approaches and how they addressed these challenges.

The Copenhagen Finger Plan

In 1947, Danish urban planners introduced the “Fingerplanen” or “Finger Plan” to manage the post-war urban expansion of Copenhagen, combining urban growth and density with green space preservation (Cervero, 1998). As illustrated in Figure 15, the topography of the plan resembles a hand, with the city centre as the palm and five urban development corridors radiating outwards along rail lines. Rail stations along the “fingers” are explicitly designated for dense mixed-use development. Green spaces between the development corridors constrain urban sprawl and provide convenient access to green spaces and recreation for all residents.

Figure 14. Copenhagen’s Finger Plan for urban growth



Source: Egnsplankontoret (1947).

The plan has evolved to meet the needs of the city and its residents. The urban fingers have grown longer and wider, but the principle of transit-oriented development has remained consistent. One of the most important changes was the implementation in 1989 of the principle of locating passenger-intensive urban functions (e.g., office buildings, educational institutions) near train stations. Although not perfectly implemented, this principle has been an important part of the planning mindset in the region (Sørensen and Torfing, 2019).

There has been debate concerning the balance between the benefits of a cohesive central plan and the independence of municipalities to adjust the plan for their communities and to attract businesses and workplaces. There has also been a persistent debate on the merits of constraining urbanisation within the palm and fingers. Many municipalities outside or straddling these areas find that the plan inhibits their capacity for economic and population growth.

Nationwide upzoning in New Zealand

Upzoning is an urban planning approach in which restrictive land use regulations (e.g. building height limits) are relaxed to enable higher-density development and induce market-led housing supply. Attempts to introduce such policies have typically been politically fraught, attracting strong NIMBY (not-in-my backyard) opposition. New Zealand, a country with relatively low-density cities, high car dependency, and one of the most unaffordable housing markets in the world, recently introducing two policies that have been met with international acclaim (Burn-Murdoch, 2023; Cox, 2023; West & Garlick, 2023).

The first, the National Policy Statement on Urban Development 2020, requires local authorities in major cities to raise building height limits within walkable catchments of urban centres and along rapid transit corridors, as well as abolish minimum car parking requirements. The second, the Medium Density Residential Standards 2021, require these local authorities to allow three homes of up to three storeys on any section by right. These two policies are exceptional for two reasons. First, they are a rare example of a central government directing zoning interventions at the national scale, overriding local planning control and circumventing NIMBYism. Second, despite their politically unpalatable nature, they were introduced with support from both the main political parties in New Zealand (West & Garlick, 2023).

It took more than a decade to prepare the ground for reform, however. The process was both top-down and bottom-up, informed by the influence of expert international urban economists (Edward Glaeser and Alain Bertaud in particular). Inside government, a bipartisan discourse focused on “competitive urban land markets” formed, while outside government, academics and civil society organisations formed a coalition advocating for relaxing land use regulations to address housing unaffordability amongst other objectives. Finally, small-scale pilots were conducted in the years preceding the reforms to test international policy ideas domestically (West, 2024). The result in the years since implementation has been a marked increase in urban density and transit-orientated development, particularly in major cities such as Auckland.

Implementing high-density transit zones in California

Efforts to enact TOD-oriented land use reforms in California were partially motivated by the need to address a severe statewide housing shortage in urban areas. Despite considerable investments in expanding and improving public transport, many urban stations remained surrounded by low-density land uses, including single-family homes. In 2025, the state legislature passed a bill, SB 79, with widespread zoning increases aimed at alleviating the housing shortage while managing urban transport demand and providing a boost to public transport ridership.

The law pre-empts local zoning restrictions and sets a minimum density for land near high-quality public transport service. It applies different minimum zoning thresholds depending on the speed and frequency of the transit line and the proximity of the land to the station. The bill also allows public transport authorities to initiate mixed-use development projects on their own property, and it provides streamlined approvals for mixed-use development projects in the upzoned areas if they meet certain criteria (Freemark, Lo and Su, 2025).

In Los Angeles alone, this new law is expected to permit the construction of an additional 1.5 million new homes near public transport (Vredevoogd, 2025). Though it passed by a narrow margin, the bill's proponents argue that the connection between densification and public transport is essential, as it helps to mitigate traffic congestion and provides much-needed fare revenue for the public transport system (Flemming, 2025). Moreover, by applying transparent statewide rules for densification, the bill spreads the burden of alleviating the housing shortage across many communities simultaneously. There are concerns, however, that these automatic zoning changes may increase opposition to public transport expansion in the future (Christopher, 2025).

Accessibility-based planning to manage rapid urbanisation in Accra, Ghana

Like many African cities, Accra has undergone a major geographic expansion in recent decades; the built-up area increased by 400% in just 35 years (Anderson et al., 2024a). Much of this expansion around the periphery of the urban area has been residential, while essential services and commercial activities remain concentrated in the city centre. As a result, more than a quarter of Accra's residents cannot easily access any essential services (markets, primary schools and healthcare facilities) within a 30-minute walk.

To resolve these issues, the regional transport authority partnered with the OECD and ITF to map accessibility gaps across the city for a range of destination types and transport modes (Anderson et al., 2025). The study then evaluated the potential of transport improvements (bus rapid transit and minibus network expansions) with coordinated land use reforms (the development of markets and healthcare facilities near key public transport hubs) to improve accessibility. The analysis found these changes would increase the number of residents with access to markets within 30 minutes by 18%, and to healthcare facilities by 15%. The regional transport authority is now using this evidence to build support across the government for a new urban development plan based on providing access to opportunities for all (Anderson et al., 2025).

Financing urban rail through land value capture in Japan and Hong Kong

While California only recently expanded opportunities for joint development of land owned by public transport agencies, Japan and Hong Kong have leveraged joint development to fund urban rail transport for decades (ITF, 2024d). A variety of legal mechanisms allow private and public rail operators and municipal governments to capture the increased land value that is derived from investments in passenger rail networks – an approach known as “land value capture”. As a result, Japanese private rail operators generated nearly 70% of their revenue from non-transport sources as of 2020 (Minami, 2023).

The primary mechanism for land value capture in both places is the joint development of land near new public transport hubs. Municipal governments and rail operators collaborate on an integrated land use and transport plan for expanding rail transport and rezoning the area adjacent to future stations. In Japan, one or both of the entities may also acquire land adjacent to the station sites (World Bank, 2017). Then both parties act as shareholders for mixed-use property development in the rezoned area, often in partnership with private real estate developers. Each partner receives a share of the profit from the

development projects, and the municipal government benefits from the increase in land tax. This income helps to finance future expansions and subsidise the operation of passenger rail service (ITF, 2024d).

Other forms of land value capture for public transport funding have been implemented in Australia, France, Ireland and the UK (ITF, 2024d). They often involve one-off taxes, developer fees or business surcharges that apply to businesses and developments within a catchment area of the public transport expansion. The primary challenge is limited municipal administrative capacity to oversee development projects and implement new fees. Determining the appropriate level of fees and the cost-sharing split for development projects can also be a challenge. If fees are too low, the public may perceive the scheme as a giveaway to developers and property owners. Conversely, if they are set too high, there can be considerable resistance from local business owners (OECD, 2022).

Implications of emerging technologies for land use policy

Emerging technologies may upend traditional travel behaviour and spatial economics in cities, with potentially profound implications for land use patterns unless policy deliberately shapes that transition. Policy makers should ensure that plans and policies remain focused on quality of life rather than accommodating these new technologies until their externalities can be fully evaluated.

Automated vehicles (AVs) and other vehicle automation technologies lower the direct cost and perceived inconvenience of long trips (including for non-drivers), which may reduce the appeal of compact, mixed-use urban centres. Some combination of road user charging and regulatory limits on empty repositioning and passengerless trips are likely to be necessary to avoid AV-enabled urban sprawl (ITF, 2023c). Local authorities may require AV operators to internalise the societal cost of empty repositioning trips through dispatch fees or peak-hour surcharges, and condition operating permits on compliance with maximum empty-vehicle ratios and data-reporting obligations. As AV operations scale up, managing curbside stopping space and charging locations will also become an important complementary tool to prevent additional circulating traffic and support broader TDM objectives.

Land use reforms that provide density incentives for shared and active travel accessibility would also provide a strong signal to boost multimodality in an era of widespread AV adoption. For example, jurisdictions can adopt multimodal accessibility thresholds as a condition for rezoning or development approval, whereby projects must maintain or improve accessibility to key services via walking, cycling and high-capacity transit. This approach has the benefit of bringing the incentives of property developers into alignment with support for demand management initiatives.

New mobility technologies will interact with land markets and developer expectations in uncertain ways. Governments can plan for robustness through scenario-based integrated modelling and institutional redesign. Traditional transport models that treat mode shares and land use as exogenous may be misleading under rapid technological change. Integrated land use–transport scenarios (including plausibly high AV uptake, varying Mobility-as-a-Service deployments, and varying levels of remote work) can be used to stress-test zoning changes, transit investments, and fiscal implications – including changes to the tax base, parking revenue, and road maintenance cost allocation. Institutional arrangements such as land use policy performance monitoring units, with mandates to revisit zoning codes every 3–5 years using modelled scenario outcomes, would ensure that land use frameworks remain aligned with technological change and accessibility goals. This technical approach treats zoning not as static regulation, but as an adaptive system responding to measurable shifts in accessibility and land use patterns.

Improving active and shared travel modes

Encouraging the use of active and shared travel modes is a cornerstone of urban demand management strategies, offering access to opportunities at a relatively low social cost per user. While the impact of traditional measures such as infrastructure investments and fare subsidies is well established, cities are increasingly experimenting with new approaches to make these modes more attractive and efficient. This section reviews evidence on the effectiveness of these emerging interventions through a series of case studies, with a particular focus on technological innovations and educational programmes. Additional case studies can be found in Annex A.

New approaches to public transport pricing

Public transport fare and ticketing reform can decrease cost barriers to public transport adoption and encourage multimodal travel (ITF, 2024e). While public transport fares are typically subsidised with public funds, the costs of daily use can place a significant burden on low-income riders. Complex fare structures and passes, as well as payment systems that pose challenges for those who are uncomfortable with digital or mobile technology, also add a psychological barrier that can deter public transport adoption.

The ITF makes several recommendations for equitable and efficient public transport fares that encourage uptake, including fare integration across modes and operators, fare capping, low-income concessionary fares, and open payment systems (ITF, 2024e). These fare policies and technologies are likely to provide a moderate ridership increase without a major impact on revenues. Simply reducing fare levels can also boost ridership, but setting fares too low creates a risk of underfunding and service cutbacks if there is no additional funding to compensate for the reduced fare revenue. Furthermore, evidence indicates service quality and coverage have a stronger impact on ridership than pricing (ITF, 2024c).

Germany's Deutschlandticket and Austria's KlimaTicket both represent a novel approach to fare policy: a fixed-price ticket valid at the national level. By simplifying and capping fares, they improve access to public transport nationwide. Their approaches are different, but both can be considered success stories in improving ridership, and both have been met with considerable approval by the public and users. They have also reintroduced public transport into the social and political debate, which has had a positive effect on transport, the economy and society. The success of such a ticket offer ultimately depends on the provision of a satisfactory transport service, however (Follmer & Treutlein, 2023). In Germany, the popularity of the ticket scheme has led to overcrowding on regional trains during peak hours and on popular tourism routes (Follmer, 2025).

Deutschlandticket (Germany)

In 2023, the German Parliament introduced the Deutschlandticket, priced at EUR 49 per month. This new type of ticket enables holders to use public transport nationwide, including buses, trams, metros and regional trains, regardless of operator, zone or fare. The Deutschlandticket is funded in equal parts by the federal government and the federal states, with each contributing a budget of EUR 1.5 billion per year. The long-term legislative framework and budgetary commitment for the Deutschlandticket service are now being drafted (Gesetz zur Regionalisierung des öffentlichen Personennahverkehrs, 2025).

Numerous research projects have investigated the effects of this unique transport policy measure. Results show increased public transport usage and a decrease in car usage in the near term (Lutz and Rollin, 2025):

12–16% of the journeys with the Deutschlandticket were shifted from cars (Koch, Amberg, Krämer, Wilger and Bongaerts, 2025). Many transport companies and associations reported record passenger volumes and rising subscription sales figures due to the Deutschlandticket (MVG, 2025; RMV, 2025; DESTATIS, 2025). Moreover, the Deutschlandticket has contributed to a decrease in CO₂ emissions and has a substantial welfare economic benefit (Amberg & Koch, 2024; Krämer, 2024).

The Deutschlandticket is very popular across a range of political orientations and even among those who do not use public transport (DZSF, 2025). Preliminary survey evidence finds that about 87% of respondents approved of the initiative as of summer 2024, with 34% of respondents perceiving the Deutschlandticket as useful (Lutz and Rollin, 2025; DZSF, 2024). Those who live in large cities were most likely to perceive the personal benefits of the Deutschlandticket.

The Deutschlandticket has had a clear impact on mobility behaviour. More than half of survey respondents who purchased a Deutschlandticket use public transport more often, and 42% use their car less frequently. The analysis shows that the longer people have owned a Deutschlandticket, the more likely they are to increase public transport use. Moreover, almost 29% of current Deutschlandticket holders who have access to a private car have expressed a willingness to relinquish their car in the medium to long term, with a further 35% indicating a possible willingness to do so. However, almost 45% of ticket holders use their car just as frequently as they did before. This suggests that for many people, the Deutschlandticket has reduced their public transport cost, but is not sufficient to make public transport an attractive alternative to private vehicle use.

KlimaTicket Ö (Austria)

Austria's KlimaTicket Ö, like the Deutschlandticket, covers all scheduled public transport services (including all fast trains) nationwide. The general KlimaTicket Ö costs EUR 1 179 per year (or EUR 3.23 per day), with reduced fares for children, seniors, families and soldiers. Regional KlimaTickets are also available, with cost and fare design varying by region. The KlimaTicket Ö is designed to support Austria's national climate commitments by promoting public transport as a climate-friendly alternative to private vehicles for longer trips (Koch, Amberg, Krämer, Wilger and Bongaerts, 2025).

Unlike the Deutschlandticket, which can be purchased from various entities, including local and regional public transport operators, the KlimaTicket Ö is distributed by the federal government through a national platform (Federal Ministry Innovation, Mobility and Infrastructure, 2025). The legal basis for its long-term funding is the KlimaTicket Act (Bundesgesetz über die Einführung des Klimatickets, 2025). The nationwide and regional KlimaTickets are financed by revenue from ticket sales and predetermined subsidies from the federal budget (Federal Ministry Innovation, Mobility and Infrastructure, 2025).

As in Germany, the KlimaTicket is a popular measure among the public. Within the first two years, 15% of adults had purchased a national or regional KlimaTicket; nearly all (98%) of users expressed satisfaction with the service; 65% would recommend the ticket to others; and about 80% had renewed their annual pass (Follmer & Treutlein, 2023).

The KlimaTicket initiative has also induced a change in mobility behaviour (Follmer & Treutlein, 2023). In a survey, 20% of public transport users said that if the KlimaTicket were not available, they would have travelled by car. In 2022, about 25 million journeys were made using public transport services covered by the ticket. It is estimated that this resulted in 3 million fewer car journeys and thus avoided about 65,000 tonnes of carbon dioxide equivalent (CO₂e) emissions.

National Fares Strategy (Ireland)

In 2023, Ireland’s National Transport Authority (NTA) published a new National Fares Strategy (NFS) for commuters and interurban journeys on Public Service Obligation services to further the affordability and fairness goals put forth in the 2022 National Sustainable Mobility Policy (National Transport Authority, 2023; Government of Ireland, 2022).

A key concern was the lack of uniformity in pricing; passengers travelling similar distances could be charged significantly different fares depending on their route or destination. In many cases, fares were calculated based on the corridor or service provider, not the distance travelled. This approach disproportionately affected individuals who were required to take indirect or multi-leg journeys. The NFS introduced a new consistent fare calculation for all journeys covered under the strategy: a fixed “boarding charge” and an incremental distance-based fare that increases based on the straight-line distance from origin to destination, in 10-kilometre increments. The NTA also provides subsidies to enable free public transport for children under the age of 9, and substantial discounts for young adults and students (Ireland Department of Transport, 2025).

The NFS is similar to the German and Austrian case studies in that it represents a national effort to encourage public transport adoption by simplifying and standardising fare structures. However, it is implemented through a consistent national fare strategy and pricing structure, rather than an unlimited public transport subscription. Future evaluations of the impact of the NFS will allow comparison of its effectiveness relative to other public transport fare policy schemes.

New and emerging mobility services

In addition to improving traditional urban transport modes, emerging technology also enables new mobility platforms and services that are aligned with demand management goals. Two case studies provide insights for the governance of innovative mobility solutions.

National Policy Statement on Shared Mobility and the Provision of Hubs (Ireland)

Shared mobility hubs can expand a city’s mobility options by providing easy access to a range of smaller shared vehicles, such as bikes, e-bikes, e-scooters and electric vehicles. Ireland’s 2025 National Policy Statement on Shared Mobility and the Provision of Hubs explains how shared mobility schemes “can also help to reduce car ownership by offering a cost-effective alternative to owning a personal vehicle, alleviating the financial burden of car maintenance, insurance, and fuel” (Ireland Department of Transport, 2025a). Sharing schemes also benefit individuals who cannot afford to buy a car or e-bike, providing them with affordable and accessible transportation options that can enhance their mobility and quality of life.

Acknowledging the potential of shared mobility across multiple policy objectives, Ireland is working hard to expand the availability of related services. For example, the bike sharing schemes in the cities of Cork, Limerick, Galway and Waterford are being expanded to include larger fleets with more provision of e-bikes as well as increased geographical coverage.

Ireland is also developing a new Mobility Hub Pilot Programme to test how mobility hub networks might be designed and operated on a long-term basis in a diverse range of urban locations. The hubs will include shared e-bikes, e-scooters and (in some locations) e-cargo bikes and electric vehicles. Furthermore, a Mobility Hub brand will be developed to increase visibility, user awareness and usage. While the business

case for the programme is still in development, it is intended that approximately 300 hubs will be rolled out across five urban locations from 2027.

The new Policy Statement, the pilot programme and the impending expansion of shared micromobility schemes across the country collectively reflect the growing ambition for shared mobility as a key player in the transport landscape of Ireland.

Hamburg as a testbed for innovative mobility solutions (Germany)

In 2016, the City of Hamburg and the car manufacturer Volkswagen established a partnership, making the city the first testbed for Volkswagen's mobility innovations, including a battery-electric car-sharing platform (WeShare), electrified public buses, and a ride-pooling platform (MOIA) featuring connected and automated vehicles. Indeed, over the period to 2030, the City of Hamburg intends to purchase 10,000 connected and automated cars and mini-buses. For user convenience, these emerging mobility services will be integrated into the payment and ticketing system of the local public transport authority. The goal of this testbed scheme is to provide convenient and affordable alternatives to private car ownership (including during off-peak periods and at the periphery of the city) through a mixture of shared mobility platforms, active travel and efficient public transport.

Enhancing active travel infrastructure

The case studies above demonstrate how economic incentives such as fare policy can encourage behavioural change; however, they rely on the availability of high-quality and convenient alternatives to private car use. The next two case studies highlight national strategies to enhance cycling and pedestrian infrastructure to make them viable end-to-end travel modes as well as feeder modes for public transport.

Cycle Superhighways (Denmark)

In 2009, the Capital Region of Denmark and the municipalities around Copenhagen launched the Cycle Superhighway Collaboration. The goal was to provide better cycling infrastructure, making cycling as attractive as cars and public transport so more people would commute by these modes. Cycle Superhighways required the same infrastructure standards across municipal borders and aimed to provide direct cycling routes with few intersections and a high level of comfort. The program consisted largely of upgrades to existing routes to make the cycling infrastructure more cohesive over long distances.

The first cycle superhighway was launched in 2012, and 16 had been built by 2025. An evaluation carried out in 2025 found that total bicycle traffic on these routes had increased by 87% since they were upgraded. Immediately after a route was upgraded to a superhighway, bicycle traffic increased by 52% on average, with a 6% increase in traffic per year thereafter. The average trip length on a cycle superhighway is 12 kilometres, and 20% of cyclists use an e-bicycle. In terms of mode shift, 14% of new cyclists previously travelled by car, and 64% of users who had access to a car said they always commute by bike.

The Cycle Superhighway network has been one of the most socioeconomically beneficial infrastructure projects in Denmark to date. The total capital and operating cost of the 850 km network is estimated to be EUR 326 million by 2045. The full network is estimated to have a 23% socioeconomic return on investment, with much of that due to the additional health benefits associated with cycling. For commuters on the Cycle Superhighways, exercise is the main motivation for cycling to work. Surveys found that 89% of users are happier when they commute by bike, and 71% of users feel less stressed.

Greenways, active travel and the National Cycle Network (Ireland)

Ireland's National Sustainable Mobility Policy sets out a strategic framework to 2030 for active travel and public transport mode shift to help Ireland meet its climate obligations. Under the policy, nationwide pedestrian enhancement plans and cycle network plans have been developed to guide investment in new active travel infrastructure as well as in the retrofitting of existing infrastructure, with the aim of expanding walking and cycling options across the country, including greenways.

The National Cycle Network (NCN) comprises 85 corridors across the country, totalling 3 500 km and passing within 5 km of 80% of the population. The national government has committed to delivering 990 km of the NCN by 2030 in addition to other active travel and greenway projects. The NCN provides common standards for cycling infrastructure across the country and establishes a rigorous monitoring and evaluation programme to understand the outcomes (Ireland Department of Transport, 2023). Funding for new active travel facilities adjacent to the National Roads network, as well as off-road greenways, complements the NCN by expanding mixed-use trails and pedestrian infrastructure in urban and recreational areas.

Communications and awareness campaigns

In addition to public transport fares, infrastructure and technology, authorities have recognised the importance of communication and coordination platforms to improve awareness and uptake of shared and active mobility modes. An umbrella term for this is “mobility management” (see also Section 2), a strategy to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behaviour. At the core of mobility management are measures such as information and communication, organising services and coordinating activities of different partners, which do not necessarily require large financial investments and may have a high benefit-cost ratio.

Mobility management helps to promote other demand management interventions and make them more effective by providing information to groups of potential users. This principle can be tailored to different contexts, including schools, municipalities, tourism or companies. Corporate mobility management is a particular focus, as commuting travel contributes heavily to urban congestion and other externalities. Case studies from Germany and Ireland illustrate the potential of this approach.

Corporate mobility management (Germany)

The German government has been funding the implementation of comprehensive corporate mobility management concepts since 2018 (Mobil Gewinn, 2025). The focus is on technical and organisational measures to avoid and reduce unnecessary commutes and business trips, and to shift commuters to environmentally friendly modes of transport. Examples of successful interventions include inter-company car sharing programs, building networks of bicycle pathways and parking on corporate campuses, the purchase of electric vehicles for company fleets, and incentives to make public transport more affordable for employees.

Since its initiation, numerous innovative projects for corporate mobility management have been successfully implemented. Participating companies have found they had positive effects on employee health and job satisfaction and made companies and commercial locations more attractive to workers. Furthermore, evaluations reveal an emission reduction potential of about 320 kg of CO₂ per employee per year (Mobil Gewinn, 2025).

Forfait Mobilités Durables (France)

Introduced in 2019, the Forfait Mobilités Durables (“Sustainable Mobility Flat Fee”) allows French employers to cover the commuting costs of employees who use active and shared modes, including carpooling, cycling, public transport and electric car-sharing platforms. The initiative is optional, but employers receive EUR 600 per employee per year in tax deductions if they opt in.

As of 2025, about 25% of French private companies had implemented the program, and the vast majority of beneficiaries expressed satisfaction (Caline, Pease and Le Guezennec, 2025). However, 43% of surveyed employees whose employer had opted in indicated that the financial benefit alone would not prompt them to make a behaviour change. Persistent preferences for private cars, the increased travel time associated with active and shared modes, and road safety concerns were listed among the primary obstacles.

Urban vehicle access policies

Access measures, consisting of both access policies and pricing mechanisms, fall generally under the category of “push” strategies that aim to internalise the social costs of car travel or reallocate public space towards other modes and higher occupancy vehicles (Toan et al., 2023). In response to growing urban challenges such as traffic congestion, air pollution, and inefficient land use, cities are increasingly implementing access measures for private vehicles as part of broader strategies to manage travel demand, optimising the use of existing infrastructure without requiring overly costly expansions, and promote sustainable mobility. These measures—such as low emission zones, congestion charges, and regulating traffic areas—are designed to regulate when, where, and which vehicles can enter specific urban zones. Access policies keep certain vehicle trips out of designated areas, while pricing mechanisms use financial signals to discourage the use of scarce capacity and encourage alternatives (Holguín-Veras et al., 2020). They seek to accomplish these goals by reducing congestion and emissions, shifting travel demand towards active and shared transport modes (Wang et al., 2022).

While the implementation of such measures around the globe has demonstrated some success in managing travel demand, whether access measures alone can effectively achieve long-term TDM goals is still under discussion (Batur & Koç, 2017). There can also be strong initial public opposition to individual access measures, creating political barriers to implementation. For this reason, it is widely recognised that access measures should be combined into a broader TDM strategy with both push and pull measures for greater effect and continued public support (Toan et al., 2023).

The following sections present the most important access policies and pricing measures, focusing on lessons learnt from real-world applications regarding their function, advantages and disadvantages, applicability, impacts, and challenges. While some access measures have been in place for decades, their geographic distribution is typically concentrated in a few cities or countries and lessons from implementation are not widely shared. Moreover, even well-known measures are beginning to leverage emerging technologies and policy designs for improved effectiveness and public acceptance.

Access policy measures

Low-traffic neighbourhoods and traffic calming

Low-traffic neighbourhoods (LTNs, sometimes also called low-traffic zones, or LTZs) and traffic calming are primarily implemented to limit driving and improve conditions for active travel, with the aim of enhancing safety and quality of life. LTNs, which include pedestrian-only zones, impose through-traffic restrictions, whereas traffic calming does not regulate access but instead reduces driving speeds and convenience, thereby discouraging traffic flow.

LTNs

The intent of LTNs is to enhance quality of life and reduce congestion by restricting access to motorised vehicles, allowing only those trips considered essential for the functioning and daily life of the area, such as deliveries, emergency services, or resident access. In many cases, they involve both reallocation of public space to prioritise active and shared travel, as well as access restrictions for the remaining road space. LTNs are area-based interventions, primarily implemented in residential areas and historical city centres, that use modal filters to partially or fully restrict motor vehicle through-traffic (Aldred et al., 2021;

Yang et al., 2022; Xiao et al., 2023; Thomas & Aldred, 2024). These filters include physical measures (e.g., bollards, planters) and smart access control system such as camera-enforced gates with license plate recognition, which can impose temporary or permanent restrictions. Increasingly being implemented in the United Kingdom, LTNs aim to encourage the use of active modes, such as walking and cycling, while discouraging car use, combining “carrot” and “stick” approaches. Unlike low emissions zones (LEZs), LTNs do not involve direct financial disincentives; instead, they rely on practical measures that reduce the convenience of driving within designated areas (Thomas & Aldred, 2024).

Evidence indicates that LTNs tend to decrease car use and car ownership among residents in implementation areas and may increase walking and cycling and decrease traffic speeds; this, in turn, reduces road injuries and improves air quality (Aldred et al., 2021; Xiao et al., 2023; Thomas & Aldred, 2024). However, there are several concerns about this strategy. First, traffic and air pollution may migrate to surrounding areas or alternative routes (Yang et al., 2022; Thomas & Aldred, 2024). Second, although evidence on travel-time impacts is limited, there are concerns about longer trips due to the removal of through-traffic (Thomas & Aldred, 2024), as well as about the strategy’s effectiveness in increasing walking and cycling, especially in areas with low car ownership rates (Xiao et al., 2023). Finally, the implementation of LTNs is often considered challenging due to limited public acceptability (Yang et al., 2022).

Traffic calming

Traffic calming, meanwhile, uses both physical and regulatory measures to reduce traffic speeds and make roads safer for all users (Ambros et al., 2023). Physical measures comprise of, among others, speed bumps, speed humps, speed tables, chicanes, road narrowing or curb extensions, and roundabouts, while non-physical measures include appropriate road signing and marking (Abdulmawjoud et al., 2021; Zargiannaki et al., 2024). The basic idea is that lower speed limits and road signs alone are insufficient to achieve compliance, but engineering measures make it more difficult to drive in excess of legal limits (Distefano & Leonardi, 2022; Zargiannaki et al., 2024). Widely applied in Western Europe since the 1960s and later adopted in Australia (1980s) and North America (1990s), traffic calming also discourages through-traffic on local streets, diverting it to more appropriate routes (Ambros et al., 2023).

Traffic calming measures have been shown to reduce average vehicle speeds and, in some settings, decrease traffic volumes, though effects vary by site (Damsere-Derry et al., 2020; Sołowczuk, 2021). They have also been associated with increases in the use of public transport in a simulation-based study (Zargiannaki et al., 2024). However, they are often subject to extensive criticism, as speed reduction can lead to travel delays (which are crucial in emergency response) and congestion at certain locations. Some vehicles also abruptly decelerate and then accelerate at intervention locations, leading to passenger discomfort, accelerated vehicle and pavement wear, increased fuel consumption, noise pollution, and higher overall costs (Damsere-Derry et al., 2020; Abdulmawjoud et al., 2021; Sołowczuk, 2021; Distefano & Leonardi, 2022). These speed fluctuations may also pose road safety risks if measures are poorly designed or overused.

Overall, it is important to design traffic calming measures carefully to ensure speed uniformity and mitigate severe speed fluctuations (Sołowczuk, 2021; Distefano & Leonardi, 2022) so that its goals are achieved without incurring negative effects. Moreover, this strategy should be adapted to modern needs and contexts, as insights from early applications may no longer be applicable (Ambros et al., 2023).

A notable example of a large-scale, modern approach to traffic calming is the Brussels-Capital Region (see also Box 2 in Section 2), which implemented a region-wide 30 km/h speed limit, with specific exceptions for main roads. The aim is to improve road safety, reduce noise and emissions, and enhance overall quality of life. By applying the speed limit uniformly across a broad area and combining it with sufficient enforcement and communication, the Brussels model also helps reduce abrupt speed changes and

supports more consistent driving behaviour, addressing one of the key challenges of traditional traffic calming interventions. Notably, the introduction of the general speed limit has been accompanied by ongoing infrastructure improvements, such as redesigned intersections, safer pedestrian crossings, and traffic-calming layouts, to reinforce the new speed regime and ensure its long-term effectiveness.

Reallocation of street space

Reallocation of street space towards shared and active modes or other public uses can be an effective tool for altering travel behaviour (Urban Brussels, 2024). These measures involve reallocating space that was formerly dedicated to general travel lanes or on-street parking to pedestrian, cyclist or public transport lanes, or in some cases to social or public uses. The reallocation of on-street parking encourages mode shift and allows more people to benefit from public space.

Space reallocation gained considerable attention during the COVID-19 pandemic, as the need to safely accommodate a rise in pedestrians and cyclists was addressed with temporary space reallocation measures (e.g. POLIS, 2020a,b). Many of the changes eventually became permanent due to their popularity among local communities. There are notable examples from across Europe:

- Brussels installed 40 km of pop-up cycle lanes during the pandemic, many of which were made permanent (POLIS, 2022).
- Paris added 52 km of temporary bike lanes, now part of a broader plan to remove half of the city's on-street parking for non-car uses (City of Paris, 2024).
- Milan reconfigured 35 km of streets to favour walking and cycling, kickstarting a lasting shift in street design (POLIS, 2020a).
- Berlin created temporary bike lanes and pedestrian spaces, many of which were formalized post-pandemic (POLIS, 2020b).

Street space can be reallocated on a regular or dynamic basis, changing throughout the day. Examples include parking-to-transit lanes or multi-use lanes that serve as unloading zones and parking at night, then converted to transit lanes during the peak hours of the day. Barcelona is an example of a city that implemented multi-use lanes, with digital signage indicating current lane usage and supporting night-time deliveries using quieter vehicles (CIVITAS, 2011). In Belgium, streets near schools are closed to vehicle traffic during drop-off and pick-up times to improve safety and encourage active travel for school trips (City of Brussels, n.d.).

Priority travel lanes

Restricted travel lanes are a hybrid form of access control, combining location-based and vehicle or permit-based criteria. They are often referred to by the use permitted: bus lanes, cycle lanes, high-occupancy vehicle (HOV) lanes, and so on. Lane restrictions may also change throughout the day, using variable signs, signals or markings, allowing the road space to adapt in response to changing conditions. The primary goals of lane restrictions are to improve traffic flow by reducing congestion, increase safety by separating vulnerable road users from general traffic, and improve the reliability of public transport. For example, Baku, Azerbaijan introduced 114 kilometres of new bus lanes over four years in an effort to increase the reliability and frequency of bus transport (Ministry of Digital Development and Transport, 2026).

HOV lanes

HOV lanes exclusively permit vehicles carrying a predetermined minimum number of occupants (Boysen et al., 2021). Initially introduced in the United States in 1969, the concept has since been widely applied across the globe, with variations in terms of directionality (concurrent flow, contraflow, or reversible), operating times (peak-hour or all-day), and the minimum number of occupants required (two, three, etc.) (Cohen et al., 2022). They are meant to incentivise the use of public transportation and carpooling and thus increase passenger throughput relative to regular lanes (Cohen et al., 2022; Gitelman & Doveh, 2023).

HOV lanes have indeed yielded benefits, increasing average vehicle occupancy, reducing travel times, promoting carpooling and the use of public transportation, and ultimately reducing traffic congestion (Zhong et al., 2020; Gitelman & Doveh, 2023). Those benefits have led to a generally positive public perception of HOV lanes (Cohen et al., 2022). However, there has also been extensive criticism. First, safety concerns have been raised, as HOV lanes are associated with higher crash rates, particularly near interchanges, mainly due to speed differences (Himes et al., 2022; Gitelman & Doveh, 2023). Second, HOV lanes are often underutilised, which may lead to additional congestion on the regular lanes (Cohen et al., 2022). A third concern is induced demand – meaning that the lower congestion on these lanes may generate additional travel demand (Boysen et al., 2021).

Real-world HOV lane applications verify their effectiveness in improving mobility and promoting carpooling (Gitelman & Doveh, 2023; Cohen et al., 2022). However, the level of this contribution depends on the underlying occupancy requirements (for example, findings from Israel suggest that lanes requiring only two occupants saw significantly higher adoption rates compared mandating three or more occupants). The ability to complete roundtrips also makes carpooling more attractive. Other factors determining effectiveness include enforcement and the availability of alternative travel modes. As a result, their impact on improved travel times varies (Naseri et al., 2024). Distortions may also emerge, such as the peculiar case of individuals paid to sit in cars solely to meet occupancy requirements (Cohen et al., 2022), or visibly underutilised lanes (Rivadeneira et al., 2024). For enhanced safety, careful design is necessary to separate HOV from regular lanes – for instance, by installing physical barriers (Fu et al., 2023). Construction should therefore proceed only when the underlying benefits outweigh all direct and indirect costs (Naseri et al., 2024).

HOT Lanes

High-occupancy toll (HOT) lanes, first implemented in the United States in 1995, are a variation on HOV lanes that allow drivers of single-occupancy vehicles to pay a fee to access an uncongested “express” lane on an otherwise congested roadway (ITF, 2023). Access to the HOT lane is provided free or at a discount for vehicles with multiple occupants, public transport and emergency vehicles. HOT lanes are most common in the United States and Canada. Their primary objectives are to ensure uncongested free-flow conditions on the managed lanes, while also maximising the total throughput of all lanes (Lou et al., 2011; Gardner et al., 2013). HOT lanes might help to reduce harmful impacts to the environment associated with congestion, especially by encouraging the use of multi-passenger vehicles or mass transit systems. In practice, many former HOV lanes have been converted into HOT lanes to make greater use of their capacity (Jin et al., 2020).

Revenues from HOT lanes can be used to offset the cost of building and maintaining the express lanes, or to fund other transport improvements. In several US cities, toll revenues have been used to fund new express bus and park-and-ride services, many of which travel along the HOT express lanes for improved reliability (Supernak et al., 2001; Newmark, 2014).

Overall, HOT lanes are considered beneficial in TDM, especially when they result from the conversion of existing HOV lanes (Zhong et al., 2020). However, when new HOT lanes are built to expand the capacity of an existing roadway, they are likely to induce new demand for driving by reducing congestion on the

general-purpose lanes. Evidence from California suggests that introducing a new HOT lane results in approximately the same increase in VKT relative to the status quo as introducing a general-purpose lane (California Department of Transportation, 2020). There is also the risk of increased congestion on regular lanes of the same route, as well as on alternative free routes, due to the presence of managed lanes that require payment for access (DeCorla-Souza et al., 2022; Schönhofer et al., 2024).

Appropriate pricing is crucial (Guensler et al., 2020). For example, excessively low tolls may incentivise single drivers to take more convenient trips on less congested lanes (Schönhofer et al., 2024). To address this issue, toll prices can be adjusted dynamically which also enhances pricing efficiency (Ma et al., 2024; Gardner et al., 2013). Deciding the optimal charge rates can be challenging because of limited knowledge of potential users' willingness to pay, particularly in regions where the concept is unfamiliar (Jin et al., 2020; Ma et al., 2024).

Public opposition to HOT lanes is often lower than HOV lanes, as drivers retain flexibility in their travel choices (Abulibdeh & Zaidan, 2018). However, there can be public opposition to the conversion of general-purpose lanes into HOT lanes, as users are generally reluctant to accept the introduction of new tolls (DeCorla-Souza, 2022).

Low emission zones

Low emission zones (LEZs) are geographically designated areas where vehicle access is regulated or conditioned based on compliance with certain pollutant emission standards (Broster & Terzano, 2025). The levels of permissible pollutants, operating hours and regulatory stringency may vary (Margaryan, 2021). LEZs can also be integrated with other TDM measures, such as congestion pricing (Mehdizadeh & Shariat-Mohaymany, 2021). The primary objective of LEZs is to reduce emissions within the designated areas, rather than controlling congestion (Morton et al., 2021; Rizki et al., 2022). This measure is often introduced initially as a restriction on heavy-duty vehicles such as trucks and buses; in some cases, it is later expanded to private vehicles as well (Morton et al., 2021).

A range of names are used to refer to different variants of LEZs. Clean air zones (CAZs) are similar in function to LEZs but may vary in strictness. Ultra low emission zones (ULEZs) – a term originating in London – are LEZs with tighter emission standards. Zero emission zones (ZEEs) allow only zero carbon-emission vehicles. Partial ZEEs, usually focused on freight vehicles, have been enacted, proposed or piloted in cities such as Amsterdam and Oslo, but full ZEEs applying to all vehicles have not been implemented on a permanent basis to date (WRI, 2024).

There are multiple LEZ implementations across Europe, with characteristic examples including, but not limited to, London, Milan and Berlin, where progressive restrictions based on Euro emission classes have been applied (Börjesson et al., 2021; Margaryan, 2021; Broster & Terzano, 2025). The London LEZ, which was first introduced in 2008, applied primarily to heavy vehicles such as trucks, buses and coaches, while lighter vehicles were only targeted later under the ULEZ. In Spain, Madrid established a relatively small zone, while Barcelona implemented a citywide LEZ (Peters et al., 2021; Rodriguez-Rey et al., 2022).

LEZs have been shown to improve local air quality and mitigate health problems related to air pollution (Börjesson et al., 2021; Broster & Terzano, 2025). This positive impact may be even greater for certain age groups and specific diseases (Margaryan, 2021). However, the reduction in air pollution attributable to the introduction of LEZs has not always been found statistically significant (Broster & Terzano, 2025), and even when significant benefits exist, they may not be immediately evident (Rizki et al., 2022). In addition, the social benefits do not always outweigh the measures' implementation and maintenance costs, due to factors such as the relatively low contribution of light vehicles to air pollutants (Börjesson et al., 2021).

Moreover, a crucial drawback of LEZs is their low public acceptability, with two primary factors driving these attitudes: drivers' perception of restricted freedom and, when revenues are collected from this measure, distrust in how they will be managed by the government (Mehdizadeh & Shariat-Mohaymany, 2021; Morton et al., 2021). Furthermore, resistance to LEZs is particularly present among lower-income groups, who often lack the financial means to upgrade their vehicles – an issue clearly visible in Brussels, where protests have highlighted the tension between environmental goals and social issues (Lyons, 2025).

LEZs have also been found to contribute to accelerate rates of local fleet renewal, encouraging the replacement of older vehicles with newer and cleaner technologies (Peters et al., 2021; Broster & Terzano, 2025). However, certain requirements should be met for fleet renewal to be effective: strong enforcement and stringent vehicle technology thresholds (Börjesson et al., 2021; Peters et al., 2021; Rodriguez-Rey et al., 2022). In this sense, zero emission zones are expected to contribute to a greater extent than low emission zones to fleet modernization.

Another consideration is that while LEZs can bring benefits to the areas where they are established, they may lead to increased emissions on alternative routes that take on the additional traffic burden (Rodriguez-Rey et al., 2022). This would partially offset network-level gains. Moreover, as discussed in Section 2, from a societal perspective, such measures can be regressive, since the purchase cost for newer-technology cars is more easily covered by relatively wealthier households, thus leading to social inequalities with respect to the application of the zones and their impacts (Börjesson et al., 2021).

Number plate restrictions

Plate restrictions limits vehicle entry on certain roads (or areas) based on the last digit of the license plate (Alshetty et al., 2021). In its most common form, cars with license plates ending in an odd number are allowed to drive only on odd-numbered dates, while those with even-numbered plates can drive on even-numbered dates. However, variations also exist; for example, certain plate numbers may be banned on specific weekdays (Farda & Balijepalli, 2018).

Number plate restriction policies have been widely applied worldwide, with examples in Mexico, China, India, the Philippines, Brazil, Colombia, Greece and Chile, among others (Gu et al., 2017; Farda & Balijepalli, 2018; Alshetty et al., 2021). Probably the most prominent application of the measure was during the 2008 Olympic Games in Beijing (Liu et al., 2018). The measure was so successful in mitigating traffic and improving air quality that it was later established as a permanent measure in Beijing during peak periods (Alshetty et al., 2021).

Plate restrictions have been found to be very effective in the short run, reducing congestion, travel times and emissions while increasing average speeds (Alshetty et al., 2021; Farda & Balijepalli, 2018). However, the benefits appear to fade in the long run, as many drivers adapt by purchasing a second car with a plate number complementing that of the first in terms of the restrictions (Gu et al., 2017; Mohan et al., 2017; Farda & Balijepalli, 2018). In addition, travellers typically shift travel days rather than reducing overall travel (Gu et al., 2017). Indeed, congestion may worsen during unrestricted days due to latent demand built up during the restrictions (Yudhistira et al., 2025).

Although the application of this measure is straightforward, field observations reveal that it cannot be successfully implemented and executed without public engagement (Alshetty et al., 2021). Enforcement over long periods is difficult and costly (Farda & Balijepalli, 2018; Yudhistira et al., 2025). Potential non-compliance resulting from these challenges, along with exemptions to the restrictions, can lead a substantial number of motorists to bypass restrictions and drive as usual (Mohan et al., 2017; Jain et al., 2021).

Overall, it is widely accepted that number plate restriction schemes are effective short-term policies but fail to deliver long-term benefits. Therefore, they are considered most useful when implemented during special short-term events (Farda & Balijepalli, 2018). Consequently, the impact of such measures may be mixed, and the decision to implement them should depend on the specific objectives at the time.

Pricing mechanisms

Road pricing

Road pricing is a TDM strategy based on the idea that users of transportation resources, such as road infrastructure, should pay for that use to internalise the external costs they impose (Chen et al., 2018). Interest in road pricing has increased due to the growing severity and impact of traffic congestion, especially in large urban areas, and it has been implemented in several cities (Anas, 2020). Singapore introduced the first urban road pricing scheme in 1975 and replaced it with Electronic Road Pricing in 1998. Several other cities worldwide have followed suit, notably London, where a congestion charge was implemented in 2003 (Chen et al., 2021).

There are various ways road pricing is implemented, ranging from cordon systems, where drivers pay to access a designated area (usually central business districts), to tolls on major roads (Anas, 2020). Charges or passes can be purchased on the spot or online, while monitoring and enforcement can be carried out through gates/gantries, video cameras, license-plate recognition, or radio frequency identification technology (Cipriani et al., 2019; Green et al., 2020; Aung et al., 2021).

In terms of pricing policies, two types can generally be distinguished: fixed/static and variable. The former imposes a fixed toll, while the latter varies, typically by time of day (predictive or anticipatory pricing) or in real time, in response to observed congestion (dynamic pricing) (Aung et al., 2021; International Transport Forum, 2021).

Major real-world examples of road pricing include Singapore, London, Stockholm, and Milan. In Singapore, an electronic pricing system uses cordons and toll points with real-time dynamic charges (Cipriani et al., 2019). In London, there is a Congestion Charge Zone with a flat daily fee (Crocì, 2016). Milan applies a cordon charge (Area C) around its centre with a flat per-day entry fee, while Stockholm employs a time-dependent, congestion tax for accessing the zone with a daily cap (Crocì, 2016).

Studies have shown that road pricing is among the most effective TDM strategies, capable of reducing congestion, increasing average speeds, and lowering emissions by enhancing the overall efficiency of the transportation network (Chen et al., 2018; Baghestani et al., 2020; Aung et al., 2021). Peak-hour pricing can reallocate demand away from peak periods and congested locations, for instance, by discouraging non-commuting trips (Chen et al., 2021). Average welfare effects are generally positive, but may also be uneven, as not all travellers benefit (He et al., 2021).

Pricing measures also often face low public acceptability, leading to political hesitation (Chen et al., 2021; Hall, 2021). For example, voters in Edinburgh (2005) and Manchester (2008) rejected congestion charging proposals (Marazi et al., 2022), and Beijing and Shanghai did not implement road pricing, largely due to acceptability concerns (Li et al., 2019). These concerns stem from regressivity (charges weigh more heavily on lower-income drivers) and from limited adaptability among highly car-dependent users (Chen et al., 2021; Hall, 2021).

The choice between fixed and variable road pricing schemes is primarily a debate between acceptability and efficiency (Baghestani et al., 2020; Baranzini et al., 2021). As different travellers face different demand

curves, a socially efficient equilibrium cannot be achieved with a fixed charge or toll; instead, there is a need for a variable pricing system that reflects these differences (Crocì, 2016). On the other hand, the simple and predictable nature of fixed pricing makes it much more publicly acceptable, and thus more politically feasible (Baranzini et al., 2021). For fixed pricing schemes, the economic costs of road pricing can be more easily predicted and incorporated into the household budget, while simple pricing schemes, such as peak-hour pricing, tend to have the highest levels of acceptability (Milenković et al., 2019).

There is substantial real-world evidence supporting the preference for simpler pricing schemes. For example, in Manchester and Edinburgh, the proposed schemes were downvoted partially due to their complexity, while in Milan, the current simpler system that replaced a more complex previous one has gained higher acceptance (Gu et al., 2018; Selmourne et al., 2020). The application of electronic road pricing in Singapore indicates that when simpler schemes are implemented, travellers are also able to organically adapt to them, which can facilitate a transition towards more complex schemes in the future.

When it comes to variable and dynamic pricing, their theoretical superiority in terms of efficiency does not come without a cost. For instance, there are significant difficulties in estimating and applying fully differentiated tolls in the real world due to imperfect information (Crocì, 2016). Moreover, estimating the total social costs for every case, with respect to its spatiotemporal characteristics, is practically infeasible (Anas, 2020). However, the lack of dynamic adjustment in pricing may result in further inefficiency due to habitual or rebound traffic (Crocì, 2016).

As far as road pricing revenues are concerned, typical uses include investments in the underlying road infrastructure, improvements to public transportation, and deductions from transport-related or other taxes, as a means of returning monetary surpluses generated by travel demand management and supporting sustainable urban transportation (Anas, 2020; Hall, 2021; He et al., 2021; Genser & Kouvelas, 2022). In London, for example, revenues have typically been directed towards public transportation, particularly strengthening the urban bus network, while in Stockholm, road construction has been the primary focus (Baghestani et al., 2020; Green et al., 2020).

Incentive-based measures

Pricing mechanisms to encourage changes in travel behaviour do not always involve charges; they can also provide financial rewards for socially beneficial choices, such as not driving or making their journeys outside peak hours. Some initiatives use nudging or gamification to influence commuter choices without mandates or penalties. However, despite measurable benefits, the most prominent examples have failed to garner long-term public support due to the public costs involved and perceptions of unfairness.

There have been several pilot projects and temporary initiatives in Europe to pay travellers to avoid driving on congested roadways in peak hours. The Netherlands have experience with the so-called “Spitsmijden” to identify peak hour commuters on busy motorways and pay them not to drive. In Rotterdam, the offer of EUR 3 in cash or EUR 3.50 on a public transport card per avoided trip was reported to have removed 4 000 car journeys per day and reduced traffic by 5–10% during peak hours (Golla, 2017) at a cost of several million euros per year. Nine different incentive programs across the country from 2017 to 2019 were found to help avoid 1 to 1.5 trips per week per participant, with a participation rate of 18% among invited commuters. To receive the reward, participants would travel outside of peak hours (33%), take an alternative route (20%), shift to cycling or public transport (15%) or telework (14%) (Rijkswaterstaat, n.d.).

More recently, in Lille, the 2023–2025 Ecobonus programme paid drivers EUR 2 per trip to avoid two busy motorways during peak periods, with a monthly cap of EUR 80 per person (Barbureau, 2025). The programme is estimated to have avoided over 500 000 trips in two years, with participants choosing to

telework (43%), shift their commute time (34%), or opt for public transport (10%) instead of driving during peak hours. The difficulty of identifying new participants willing to shift their behaviour and a lack of sustainable funding sources were cited as factors in the early cancellation of the program in 2025.

Distance-based road user charges

Road user charges are an effective mechanism for recovering and internalising the variable costs of road use, including road wear, congestion delays and air pollution (ITF, 2023). The effect of these charges is that the social cost of driving is better reflected in the fees paid by the driver, making them more likely to choose a travel mode, route or schedule that minimises their impact on others. Aligning road user charges to the true social cost of driving a specific vehicle on a particular route at a certain time of day can be technically and politically challenging, therefore existing schemes often involve a compromise between economic efficiency and feasibility of implementation.

Historically, fuel taxes have provided a relatively simple cost recovery mechanism that is roughly proportional to distance travelled and penalises less fuel-efficient vehicles (ITF, 2023). However, fuel taxes cannot differentiate by impact on congestion, as the tax level is the same regardless of when or where the fuel is consumed. Moreover, the ongoing electrification of vehicle fleets worldwide will reduce fuel tax revenues and creates an impetus to transition towards an equitable and economically efficient road user tax with benefits for travel demand management. Given that electric vehicles have relatively low direct operating costs, people may choose to drive more often and for longer distances. Automation, by removing the burden of driving, has the potential to transform how people use travel time by making it more productive, relaxing or accessible, and thus could also contribute to a rise in motorised travel rates due to increased convenience and ease of use. As a result, road pricing measures may need to be designed in such a way to address the potential urban congestion impacts of these technologies (ITF, 2025).

Distance-based road user charging schemes have become more popular in recent years. Possible schemes range from simple, flat-rate charges calculated from an odometer reading, to more complex spatially and temporally differentiated charges requiring dedicated electronic devices. Simple distance-based charges for certain types of vehicles have been implemented in Iceland, New Zealand and the United States (ITF, 2023). These are typically applied only to vehicles that contribute little or are exempt from fuel taxes, such as hybrid and electric vehicles, or diesel-powered vehicles in the case of New Zealand. In January 2026, Iceland became the first jurisdiction to apply distance-based charging to all vehicles and New Zealand has announced a flat distance-based charge for all light vehicles that is planned to take effect from 2027 (Tómas, 2025; Newroad Consulting, 2026). Temporally or spatially differentiated charging programmes have not been implemented to date, with the exception of the Danish kilometre-based toll for trucks introduced in 2025 which incorporates higher charges in the same system for access to the low emission zones of Copenhagen, Frederiksberg, Odense, Aarhus and Aalborg (KmToll, 2025). The New Zealand government plans to go further, progressing legislative changes to allow the bundling of other road charges like tolls and time of used based pricing into a single, easy payment system for all road users (New Zealand Government, 2025).

Studies have shown that strategic implementation and public communication can help to improve public perception of distance-based road pricing. A 2022 survey in the UK found that “the ability of a distance-based charge to reward those who drive less, yielding environmental benefits” and “the need to ensure those who cause the highest external costs pay for them” were among the most convincing arguments for distance-based road pricing (Campaign for Better Transport, 2022). Regarding policy design, respondents were largely agnostic regarding the choice of technology (i.e., odometer readings vs. dedicated GPS devices), and they strongly supported public transport improvements in conjunction with distance-based

road pricing to alleviate fairness concerns. Proost (2022) argued that a gradual implementation of variable distance-based road pricing in several phases is more likely to garner public support, as the public will become more familiar with the technology and the policy impacts over time. Like New Zealand, other jurisdictions should consider implementing a flat distance-based charge for electric vehicles, then expanding the charge to all vehicles, and finally introducing a variable pricing scheme based on vehicle characteristics and impact on congestion.

Parking management

Parking management attempts to influence travel behaviour by adjusting the availability and pricing of private vehicle parking in urban areas. Schemes can encourage drivers to adjust their choice of travel mode, parking destination and time of arrival (Zong et al., 2024). There are several approaches:

- **Parking pricing** can deter long-term occupancy of public space and commuting into urban areas by private car. From an economic perspective, parking pricing integrates the parking social cost into the cost of driving, thereby reducing the number of trips (Petiot, 2004). Raising prices is often used as an initial measure to limit demand for on-street parking, which can then be allocated to more productive uses.
- **Dynamic parking pricing**, wherein fees rise during times of high demand, discourages driving during peak hours while ensuring that some parking is available when needed. This measure can reduce the incidence of double parking and excessive circulation of vehicles when searching for available parking.
- **Time-based restrictions** regulate parking use and price according to a predetermined schedule, allowing infrastructure to serve different functions throughout the day.
- **Size-based parking restrictions** discourage the use of large and heavy personal vehicles due to their growing and outsize impact on infrastructure degradation, air quality, public space consumption and traffic safety. These typically take the form of differentiated parking fees for large or heavy vehicles, limits on access to standard-sized spaces, or fines for non-compliance.
- **Permit-based restrictions** regulate access to parking in designated zones by requiring residential or commercial permits. This approach discourages commuting by private vehicle while prioritising local needs.

Parking pricing is an effective TDM strategy in the long term (Gonzalez et al., 2023). When integrated into a broader parking management scheme, such as reservation systems, it can mitigate search times and road congestion, thus reducing emissions and accidents (Macea et al., 2023). Its primary drawback is negative public perception and potential opposition, as it introduces a charge for using road space that was previously free (Kulakova & Reshetova, 2016). On the other hand, it is still considered a softer charging scheme than road pricing, and therefore more acceptable (Petiot, 2004). Paris, for example, has recently voted to eliminate car parking on hundreds of city streets and to triple the parking fees for larger personal vehicles (Chrisafis, 2024; O’Sullivan, 2025). However, it is widely accepted in the academic literature that parking pricing policies are more effective when combined with road pricing (Petiot, 2004; Gonzalez et al., 2023). In this sense, the two policies may inherently share common support or opposition.

Real-life applications of this policy can be found all over the world, providing ample evidence of its applicability. For instance, evidence from Rome indicates a successful decrease in on-street occupancy rates and a rise in parking turnover, while overall private car use was unaffected. Higher parking fares in Dublin and Stockholm have led to reductions in parking duration and total demand (Gonzalez et al., 2023).

The introduction of parking pricing schemes has improved parking turnover in Nanning, China, although parking demand during peak hours appears to remain unchanged. Evidence from Sydney reveals that optimal parking pricing is superior to both low-price and no-price schemes (Munir et al., 2021). Parking charges based on vehicle technology have been introduced recently in Spain, in an effort to promote the use of lower-emission cars which are primarily owned by higher-income households (Gonzalez et al., 2023).

Non-compliance, which can create additional negative effects, such as illegal parking on private properties, is a key challenge (Kulakova & Reshetova, 2016). Parking pricing policies should be accompanied by added-value measures, such as reservation systems, for which an increased willingness from drivers to accept paying the corresponding fares has been reported (Macea et al., 2023). In addition, pricing should be carefully determined, ideally in a dynamic manner, since over- or underpriced parking may lead to suboptimal outcomes (Zong et al., 2024). Finally, secondary effects need careful consideration prior to deploying a parking pricing policy, as increased parking turnover may create the perception of greater availability, consequently increasing demand and thus congestion (Petiot, 2004).

Comparative analysis

Restriction measures are generally more straightforward to implement, but often less efficient than pricing mechanisms, and they may require greater ongoing enforcement. On the other hand, pricing policies are typically more efficient, adjustable and scalable, but they face stronger political opposition and lower public acceptability. This trade-off highlights the importance of hybrid measures for effective demand management. Policies that incorporate both access restrictions and pricing can be more flexible in achieving objectives while mitigating negative impacts. In this context, real-world examples, such as converting HOV lanes into HOT lanes, indicate that hybrid approaches can be both more successful and more socially acceptable.

Moreover, dynamic approaches, such as real-time responsive pricing, are often more operationally efficient than static schemes and can help manage performance while generating revenue for complementary investments when paired with appropriate revenue recycling. Since these approaches are data-intensive and sensitive to real-time information, they require leveraging technological advancements and thorough coordination. In this sense, dynamic demand management still has room for improvement and is expected to play a pivotal role in the future. However, any transition should be smooth and supported by clear public communication and education, as well as gradual increases in scheme complexity.

Table 3 and Table 4 summarise the primary objectives, advantages and disadvantages of the policies analysed in this section.

Table 3. Comparative analysis of access restriction policies

Strategy	Objective	Primary advantages	Primary disadvantages
Low traffic neighbourhoods (LTNs) and traffic calming	Reduce through-traffic and improve safety	Effectively reduces speeds and through-traffic	Traffic displacement to boundary roads
		Improves road safety and air quality	Primarily indirect effect on travel demand
		Prioritises local residents and services	Requires effective communication and enforcement
			Limited scalability
Reallocation of street space	Create space for non-car modes and public uses	Improves road safety and air quality	Displacement of traffic to surrounding streets
		Often quite popular among residents	Limited impact on overall demand
		Simple to implement and enforce, allowing for testing of new ideas	Requires clear communication, especially if temporary or dynamic implementation
		Can be applied temporarily or dynamically	Resistance from car users
		Dynamic reallocation accommodates multiple uses without requiring additional space	
		Creates new space for public activities	
Priority travel lanes	Increase average vehicle occupancy	Encourages carpooling	Requires consistent enforcement
		Improves public transport reliability	May worsen congestion in other lanes
		Improves safety for cyclists and pedestrians	HOV interchanges may create safety issues
			Risk of underutilisation
			Less congestion may induce new demand
Low emissions zones (LEZs)	Reduce pollutant emissions	Improves air quality	Moderate travel demand benefits
		Indirectly reduces street noise	Fairness concerns for low-income drivers
		Accelerates adoption of cleaner vehicles	Managing exemptions can be complex
		Can be enforced through smart technology	Traffic displacement to alternative routes
		Access conditions can be adjusted over time	Requires clear signage and communications
			May require coordination across regions
			Likely to encounter public resistance
Number plate restrictions	Shift traffic to non-car modes	Quick to implement	Drivers often adapt (e.g. second cars)
		Very effective in the short run	Non-compliance and evasion
		Low implementation costs	Demand shifts to unrestricted days
		Simple to communicate	Fairness concerns

Table 4. Comparative analysis of pricing policies

Strategy	Primary objective	Primary advantages	Primary disadvantages
Road pricing	Shift traffic to alternative modes, routes or times	Effective in reducing traffic congestion, especially variable or dynamic pricing	Trade-offs involved in setting prices and exemptions
		Improves air quality	Strong public opposition
		Efficient and scalable	Fairness concerns
		Generates substantial revenues that can be allocated to other TDM initiatives	Requires investment in roadside infrastructure
			Traffic displacement to alternative routes
Incentive-based measures	Shift traffic to alternative modes, routes or times	Reduced congestion during peak periods	Requires sustained funding over time
		Strong public acceptance	Limited long-term impact
		Can be modified to suit local conditions	Difficult to recruit and track participants
Distance-based road user charges	Funding and shift traffic to less polluting vehicles or non-car modes	Helps to offset losses from gas tax revenue	Complex to implement
		Can be differentiated by vehicle type, time and location	Has not been tested for all vehicles in any jurisdiction yet
		May be used to address congestion caused by automated vehicles in the future	Differentiation by time and location requires collecting detailed data
		Easily adjusted over time	
Hybrid pricing-restriction methods	Increase average vehicle occupancy and manage congestion	Generates revenue that can be allocated to other TDM initiatives	Weaker incentive for carpooling compared with HOV-only lanes
		Encourages carpooling	Similar safety concerns to HOV lanes
		Better in traffic management than HOV lanes through pricing	Traffic displacement to general lanes
		More efficient and popular than HOV lanes	
Parking management	Encourage non-car commuting and reduce congestion	Shown to be effective in the long run	Strong public opposition
		Permit systems can differentiate between residents, businesses and commuters	Most effective when combined with complementary policies
		Straightforward to implement and enforce	Parking pressure may shift to nearby areas
		Dynamic pricing helps to ensure availability	Permit systems require enforcement and administration
		More publicly acceptable than road pricing	

Annex A. Additional case studies for improving active and shared travel modes

Micromobility and active mobility infrastructure (Azerbaijan)

Azerbaijan is increasingly positioning active mobility and micromobility as part of its broader urban mobility and public space strategy, particularly in the capital city of Baku. Alongside investments in pedestrian infrastructure, the city has expanded dedicated micromobility infrastructure and introduced measures to reduce car access in central areas. This combination of infrastructure expansion, regulatory standards, and public space redesign is intended as a tool for improving urban accessibility, reducing car dependence, and enhancing the quality of life in Baku.

The City of Baku built 15 new kilometres of micromobility lanes in 2025, bringing the total to 60 km across the city; new plans aim to expand the network to 100 km. Supporting infrastructure has also been scaled up, including 872 scooter parking spaces and 623 bicycle parking spaces (Baku State University, 2026). Shared micromobility services have grown rapidly: approximately 4 900 scooters and 2 200 bicycles are now available for rent. In 2025, around 405 000 users used these services, generating 3.74 million trips and covering a total distance of 10.6 million km. Micromobility now accounts for 12% of all trips made by private urban transport modes (including cars, taxis, and micromobility vehicles) that begin or end in the city centre (Ministry of Digital Development and Transport, 2026).

At the same time, Azerbaijan has adopted new state standards establishing general requirements for sidewalks and pedestrian paths, signalling a more systematic approach to walkability and street design. In central Baku, several streets and public spaces have been pedestrianized or redesigned to prioritize walking and micromobility. Vehicle access has been restricted around Khagani Garden, the historic Icherisheher district, and Aziz Aliyev Street, where dedicated pedestrian and micromobility zones have been introduced (Ministry of Digital Development and Transport, 2026).

Reallocation of street space in Baku (Azerbaijan)

Since 2024, Azerbaijan has accelerated efforts to rebalance the use of public space in central Baku by restricting vehicle access in key urban areas and prioritising pedestrian movement, public transport access, and urban quality of life. Rather than relying solely on permanent pedestrianisation, the city has implemented a range of interventions, combining timed access restrictions, controlled vehicle entry systems, repurposing of parking space, and integration of pedestrian, public transport and micromobility infrastructure. These incremental but coordinated measures reflect a broader policy shift toward reducing car dependency in the city centre while improving safety, accessibility, and the visitor experience.

A major focus of the programme has been the pedestrianisation of high-footfall areas during peak periods. Around Khagani Park, weekend vehicle restrictions were introduced on several central streets to create temporary pedestrian-priority zones. The initiative responded to growing pedestrian volumes in the area and aimed to provide safer and more attractive public space for residents and visitors. Access management measures, including resident-only access enforced by license plate recognition systems, were introduced to limit through traffic.

A second intervention targeted the area surrounding the “28 May” metro station, one of the city’s busiest multimodal transport hubs. Private car access and parking in front of the station were restricted, and existing parking areas were repurposed into managed passenger pick-up and drop-off zones as shown in

Figure 15. The changes were intended to improve station accessibility, reduce congestion, and prioritise the efficient circulation of public transport users and pedestrians around a busy urban transport node.

Figure 15. Access to the 28 May Railway Station in Baku, before and after pedestrianisation.



Further measures were implemented around Icherisheher (Old City) and Aziz Aliyev Street, where vehicle access restrictions expanded the city's pedestrian network and strengthened connections between existing walking areas, micromobility corridors, and the seafront. Tourist coach access was reorganised through designated pick-up and drop-off areas outside the historic core, while exemptions to access restrictions remained for residents, employees working in the area, and service vehicles. The intervention sought to reduce noise, emissions, and traffic pressure within the heritage district while improving conditions for walking and public activity.

Collectively, these measures illustrate how transport authorities can use targeted operational interventions to reclaim central urban space for people while maintaining necessary access for residents, services, and tourism.

Automated and connected public transport (Germany)

Technologies for connected and automated driving have undergone rapid development in recent decades within the automotive, metro and railway sectors, with an increasing number of these technologies being tested in pilot projects (Mitteregger, Mathias et al., 2022; Federal Ministry for Transport, Innovation and Technology, 2016). Government research on intelligent transport systems in Germany suggests that networking and automation of public transport could provide benefits for passengers and transport.

The German government conducted a comprehensive study to analyse the prospects of implementing tram automation. It found that it could provide significant operational and economic benefits for passengers, transport companies and the economy (Mitusch, Kay et al., 2023). Simulations suggest that substantial reductions in travel time and energy consumption are possible for trams. Depending on the scenario, the economic evaluation shows that the benefits arising from enhanced operational efficiency (e.g. improved timetable stability and reduced journey times) may exceed the initial investment costs. Depending on the scenario, the extrapolated benefits for all German cities with trams could range from EUR 6 billion to 12.8 billion, with the extrapolated costs ranging from EUR 2.3 billion to 4.3 billion.

The study demonstrates that the successive implementation of driver assistance systems or simplified automation technologies can already enhance the quality of operations. Corresponding investments can be progressively integrated into highly automated systems with a broad spectrum of capabilities, which can also be utilised to support drivers in critical situations. The study provides a roadmap that shows paths to automated driving of trams and recommendations for action in three areas. First, industry associations and transport companies are advised to make targeted contributions to the relevant committees in the area of standardisation at an early stage. Second, legislators, safety authorities and transport companies should reach an agreement on a suitable legal and institutional framework for the approval of automation technologies. Finally, model and pilot projects for automation and networking of trams should receive increased financial support (European Transport Safety Council, 2017; European Commission, 2016).

Co-operative Intelligent Transport Systems (Germany)

Two German research and pilot projects have explored the potential of Co-operative Intelligent Transport Systems (C-ITS) to improve the speed and capacity of public transport systems, making such services more attractive to users.

Over the past decade, Frankfurt am Main has explored communication-based train control (CBTC) as a method of increasing the capacity of the urban rail network. The project Digital Train Control aims to equip light rail vehicles and various sections of the metro and tram lines with the requisite technology for uninterrupted communication between vehicles and track-side components to share more accurate train position and speed data (VGF, 2025). The project found that CBTC provides an enhancement in track capacity, and could enable partial to fully automated train operation, permitting smaller distances and therefore headways between vehicles.

Furthermore, the city aims to establish enhanced networking between vehicles and the infrastructure. The objective of the VERONIKA project was to integrate C-ITS to enhance the registration and prioritisation of public transport vehicles at traffic lights, reducing delays for the passengers of trams and buses operating in mixed traffic. Implementation in the tram sector was found to have the potential to generate considerable benefits in terms of operation, energy efficiency and traffic safety (Universität Kassel et al., 2020).

School Streets in Limerick City (Ireland)

The School Streets initiative at An Mhodscoil in Limerick City aimed to transform the streetscape in front of the school. Prior to its implementation, the layout and allocation of the adjoining street space did not support a safe or functional environment for active travel modes such as walking and cycling, as shown in Figure 16. Hazardous driving behaviours and narrow, poorly designed footpaths created safety risks and impeded visibility and access for both pedestrians and cyclists.

To address the previously identified safety concerns and the fact that 44% of students travelled to school by car, the adjoining streets underwent a series of infrastructure upgrades. These changes were supported by over 95% of parents, who favoured improvements that would enhance student safety.

On the street at the front of the school, upgrades included widened footpaths, removal of guard rails, and the addition of visual enhancements such as pencil bollards, planters and coloured dots on both the carriageway and footpath. In addition to the improvements shown in Figure 16, a designated bus bay was introduced as well as curb extensions with in-street planting, and the existing pedestrian crossing was raised to improve pedestrian visibility. Furthermore, vehicle traffic (except for crèche buses, residents and staff) was restricted from the area directly outside the school gates from the hours of 8:00-9:00am and 1:15-2:45pm during student drop-off and pick-up times.

Figure 16. The front of An Mhodscoil before and after implementation of the School Street.



To reinforce the School Street measures, signage, school communications to parents, and placemaking elements at the front of the school were implemented. These combined interventions help to inform road users, discourage car use, and reduce traffic speeds through a narrowed carriageway.

Smarter Travel Workplace and Campus Programme (Ireland)

Delivered by the National Transport Authority, this voluntary programme works directly with large employers and educational institutions to promote sustainable commuting among staff and students. Participating organisations receive tailored support to develop and implement workplace or campus travel plans. These plans include practical measures such as improved cycling and walking facilities, car-sharing schemes, flexible working arrangements, and promotional campaigns to encourage behavioural change. Organisations also benefit from access to tools such as online travel surveys, action planning resources, and seasonal challenges such as Walktober and Marchathon, which promote active travel through team-based competitions.

A central feature of the programme is the Smarter Travel Mark. This is a national recognition scheme that celebrates and incentivises organisational leadership in sustainable mobility. The Mark is awarded to workplaces and campuses that demonstrate a strong, measurable commitment to reducing car dependency and promoting more sustainable travel choices among employees and students. The certification is structured across three progressive levels – Bronze, Silver and Gold – each reflecting the depth and impact of an organisation’s efforts. To achieve the Mark, organisations must implement a comprehensive travel plan that includes practical measures such as improved cycling and walking infrastructure, carpooling initiatives, flexible working arrangements, and active engagement campaigns.

The Your Journey Counts campaign (Ireland)

Launched in 2023, the Department of Transport’s flagship emissions reduction communications campaign aims to inspire more people across Ireland to walk, scoot, cycle, or use public transport where possible. As a fully integrated, multi-platform communications initiative, Your Journey Counts reached audiences through TV, PR, radio, print (both local and national), social media, digital channels, and out of home outdoor advertising. The campaign aims to highlight Ireland’s commitments under the Climate Action Plan to reduce transport related emissions by 50% by 2030, in an engaging, positive and inclusive way, showcasing how individual actions can make a difference at the collective level. The campaign has run multiple times each year since its launch with past campaign performance insights used to refine and evolve the media buying approach on an ongoing basis.

Phases of the campaign target different user groups. For example, since 2023 a special focus has been placed on rural communities, using tailored messaging to highlight improvements in regional public transport links via local print titles and radio stations. The key objective of this activity was to showcase the many improvements and increased passenger uptake of local/rural public transport services. In 2025, a new youth-oriented, digital-first phase of the campaign was rolled out. This concentrated on social media, showcasing the climate-related benefits of public transport and active travel using short form video content and influencer collaborations.

Sustainable Travel Towns (UK)

Following the “Smarter Choices – Changing the Way We Travel” report, the UK government invited tenders under the Sustainable Travel Town initiative to implement smarter travel choices in towns (UK Department of Transport, 2004). The report made the case that “smarter choice” measures could potentially reduce

traffic and support travel behaviour change. The main aim was to ascertain the effects of a population making “smarter choices” on a townwide level, along with complementary infrastructure. Complementary infrastructure, in this instance, meant local authorities were free to invest in active travel measures such as bike lanes and walkability improvements. Three towns, Darlington, Peterborough and Worcester, were selected for the programme.

The public response was overwhelmingly positive. The towns showed a reduction in traffic levels by 2%, and the number of car trips per resident was reduced by 7–10%. The results for bus patronage were mixed; Darlington saw a slowing of the decline in bus usage, and after some high initial growth, Peterborough’s bus ridership stabilised at an increase of 6% in 2014. Worcester showed a sustained increase in bus patronage even after the scheme ended.

Active travel investments delivered positive outcomes that held even after the scheme was officially shuttered. Darlington saw cycling uptake increase by 50–100%, while Peterborough saw walking increase by 18%. Finally, school travel planning measures induced more parents and children to use active or shared travel measures to get to school.

Annex B: List of Working Group participants

Ryosuke ABE, Japan
Jessica ANDERSSON, Sweden
Nicholas CAROS, International Transport Forum
Matthew CLARK, United Kingdom
Eric CORNELIS, Belgium
Nicolas COULOMBEL, France
Nicolás CRUZ GONZÁLEZ, MobiliseYourCity
Jens DANGSCHAT, Austria
Nina ELTER, International Road Federation
Felix HEIZLER, Germany
Luke INMAN, United Kingdom
Matthew IRELAND, International Transport Forum
Mikko JÄÄSKELÄINEN, Finland
Konstantinos KEPAPTSOGLU, Greece
Christopher KNOTT, United Kingdom
Benoit LEBOT, France
Grace LYNCH, Ireland
Markus MAILER, Austria
Joris MARREL, France
Anna MASUTTI, Italy
Lucile MENDOZA, France
Soichiro MINAMI, Japan
Akinori MORIMOTO, Japan
Se-il MUN, Japan
Sabrina MURPHY, Ireland
Jonathan SAKS, United Kingdom (co-chair)
Melanie SCHADE, European Platform on Mobility Management
Stefan SEER, Austria
Niels SELSMARK, Denmark
Kabith SIVAPRASAD, United Kingdom
Maurizio TIRA, Italy (co-chair)
Hinko VAN GEELEN, Belgium
Charles WAIN, United Kingdom

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Demand Management to Facilitate Efficient Urban Transport

By 2060, more than 70% of humanity is expected to live in urban areas. If current trends continue, demand for urban travel is expected to increase further between 2025 and 2060 – 69% for vehicle-kilometres travelled and 81% for passenger-kilometres travelled – reflecting rising incomes, a shift towards private vehicles, and longer trips as cities expand spatially to accommodate population growth. Negative externalities from increased urban transport could include congestion-related delays impacting labour productivity, environmental impacts and road safety hazards.

Urban travel demand management, defined as the application of strategies and policies to increase the efficiency of transport systems by reducing or redistributing travel demand in space and time, can help residents pursue their desired activities while reducing negative externalities.

Drawing on lessons and best practices from a wide range of international case studies, this report addresses the key challenges in urban travel demand management planning and implementation and offers actionable policy recommendations.