INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VI, June 2026

Integrated transport planning for low-emission urban mobility: case studies from U.S cities

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DOI: https://doi.org/10.51583/IJLTEMAS.2026.150600111

Received: 26 June 2026; Accepted: 01 July 2026; Published: 16 July 2026

ABSTRACT

As urban areas account for over 70% of global carbon dioxide emissions, integrated transport planning has emerged as a critical mechanism for achieving low-emission urban mobility. This study examines the integration of land use and transportation planning as a strategy for sustainable mobility through a descriptive case study analysis of four major U.S. cities: New York City, San Francisco, Boston, and Los Angeles. The findings demonstrate a clear correlation between compact cities and sustainable modal shares. Compact cities such as New York City, San Francisco, and Boston successfully leverage high public transit modal shares to drive down per capita emissions. In contrast, sprawling metropolitan areas like Los Angeles remain heavily car-dependent. The findings also support existing discourse on sustainable urban mobility that city-wide electrification alone will not achieve the required long-term climate obligations, but rather depends on an interplay of compact city design, boosting public transit use, and accelerating the adoption of electric vehicles. Thus, this study proposes the ABC roadmap as a long-term strategy for cities to achieve their respective climate change obligations

INTRODUCTION

The global concentration of population and economic activity has increasingly shifted toward cities (Kodukula, 2018). Consequently, cities occupy a central position in the global climate crisis, contributing over 70% of total anthropogenic carbon dioxide emissions (Alves et al., 2023; Zhang et al., 2025). These emissions exacerbate urban heat island effects and hasten global warming, thereby undermining critical infrastructure, public health, property values, and overall community resilience (Deweerdt & Fabre, 2022). The transport sector represents a substantial source of these emissions, accounting for approximately 24% of global carbon dioxide output—a figure surpassed only by the power generation sector (Tiseo, 2025). Within this sector, road transport is the primary emission source, responsible for 75% of total transportation-related carbon pollution (Tiseo, 2025). Between 1970 and 2023, global transport-related emissions nearly tripled, a trend propelled by demographic expansion, migration patterns, urban sprawl, and economic development (Schwanen, 2015; Tiseo, 2025).

Recent projections suggest urbanisation is expected to increase at a rapid pace: by 2050, 68% of the world's population, which is equivalent to an additional 2.5 billion people, will live in cities, giving rise to around 325 new metropolitan areas (Ribeiro & Fachinelli, 2024; Thondoo et al., 2020; UN Department of Economic and Social Affairs, 2018). This demographic shift will intensify the demand for mobility and related services. Urban passenger transport demand is projected to increase by nearly 75% between 2019 and 2050 under current policy trajectories (ITF, 2022). In 2023, passenger cars alone contributed about 3.2 $GtCO_2$ (Statista, 2025). Urban freight demand is growing even faster than passenger demand by an estimated 164% over the same period, particularly in high-income countries such as the United States (US) (Bianchi Alves et al., 2023). Freight emissions grew five times more than passenger emissions in the US between 1990 and 2021, as a result of increases in freight trucking (US Department of Transportation, 2024).

As cities grow, there is an urgency to ensure they align their urban transport systems with long-term sustainability goals, if they are to avoid entrenched, high-emission development pathways. In the academic field, there is growing popularity indicating integrated transport planning as a key strategy for the development of low-emission urban mobility systems (Osvaldo & Harris, 2025; Xi et al., 2025; Yang et al., 2023; Leibowicz, 2020). This approach is typically structured around three core objectives. The first focuses on system-level spatial and

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infrastructure design that maximises accessibility and proximity to employment sites, services and key points in the city. This objective directly tackles travel demand and mobility intensity by decreasing the need for long or unnecessary trips. The second objective is about facilitating a modal shift towards more efficient and sustainable transport modes. This involves the use of public transport (buses, rail and others), active travel methods (walking, cycling and others) and new and shared mobility options. These modes typically deliver more energy use efficiency per passenger-mile, better access to key services, and less reliance on private and energy-consuming modes of transportation. The third objective relates to the shift to zero-emission technologies for all modes of transport, including passenger cars, freight trucks, buses, land-based off-road machinery and jet skis, aircraft, locomotives, maritime transport and related infrastructure systems, including pipelines. These technological transitions, along with spatial and behavioural shifts, can facilitate deep decarbonisation in the transport sector (Bianchi Alves et al., 2023; Daytec, 2018; Larkin et al., 2016; Nikolaeva et al., 2019; Richter et al., 2010; Schwanen, 2015; Taylor, 2017; UN-Habitat, 2020; Zignani et al., 2013).

Thus, this study aims to examine the various aspects of urban mobility to identify the key attributes needed for low carbon emissions. This case study approach is an initial catalogue of locally developed low-emission mobility initiatives undertaken by cities in the US as solutions to climate change issues. This approach is widely utilised by various authors across different topics related to low-emission urban mobility (Daytec, 2018; Ribeiro & Fachinelli, 2024; Schwanen, 2015), and as suggested by Flyvbjerg (2011), can enable conclusions which may also apply to other cities with less favourable conditions for systemic change.

The US is an appropriate setting as substantial shifts have been observed in the past few years, with US cities becoming more environmentally sustainable for urban delivery (Rula et al., 2025). From 2005 to 2021, GHG emissions decreased 17%, with transportation emissions accounting for 8.5% of the total (US EPA, 2026). The U.S. has set ambitious GHG emissions reduction goals to keep the global average increase in temperature below 1.5°C when compared to the pre-industrial era. More specifically, the U.S. has pledged to cut GHGs 50-52% from 2005 levels by 2030 in all sectors (UNFCCC, 2021). Further, the U.S. has established targets for 100% carbon pollution-free electricity by 2035 and Net-zero emissions by 2050 (US DOS, 2021).

Theoretical Background

Much of the developed world's transportation systems were built at a time when economic efficiency was the primary planning criterion, and environmental protection or social equity were only minor considerations. However, in recent years, there has been an increasing demand for these systems to be focused on sustainability, with social and environmental goals alongside economic performance (Thondoo et al., 2020).

The Global Status Report on Transport, Climate and Sustainability provides evidence on the critical role of integrated transport planning for improving transport sustainability in cities. This approach facilitates coordinated decision-making in land use, infrastructure and transport investment to enhance overall system performance and mitigate negative externalities (SLOCAT, 2023). Integrated planning aims to ensure that economic, social and environmental aspects are balanced to ensure that policy and investment decisions achieve optimal outcomes in all three aspects of sustainable development, not at the expense of the others (Queensland Transport, 2003).

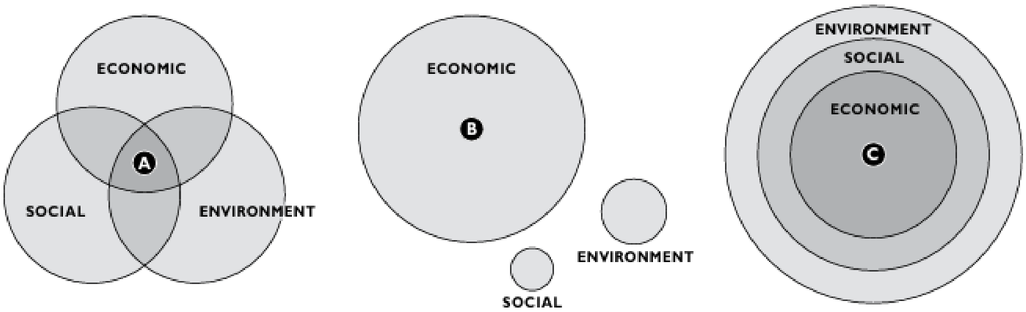

Figure 1. Approaches to sustainable mobility (Hickman, 2019)

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Most of the transport decarbonisation strategies have historically prioritised technological solutions such as cleaner vehicles and alternative fuels, often supported through subsidies while retaining an automobile-centred mobility system. However, these strategies have shown to be insufficient on their own to achieve long-term emissions reduction goals (McCahill, 2021; Medimorec et al., 2021; Milovanoff et al., 2020).

In contrast, more climate and sustainability benefits can be gained if policy focus is directed towards minimising unnecessary travel and promoting modal shift to more sustainable modes of transport like walking, cycling, and public transport. This holistic approach to travel avoidance and modal shift has been proven to achieve more significant emission reductions and greater co-benefits, such as better health and urban liveability (Liimatainen et al., 2018; Nag et al., 2019; SLOCAT, 2023).

Consequently, transport planning frameworks are increasingly adopting more holistic, people-centred approaches that prioritise accessibility and quality of life over vehicle throughput. The Economic and Social Commission for Asia and the Pacific (ESCAP) defines it as Avoid–Shift–Improve (ASI), a structured approach to reducing transport-related CO_2 emissions. ASI not only seeks to decarbonise transport systems, but to also improve social and economic outcomes by improving urban accessibility and overall quality of life (ESCAP, 2024). The ASI framework categorises actions at three levels (Figure 2):

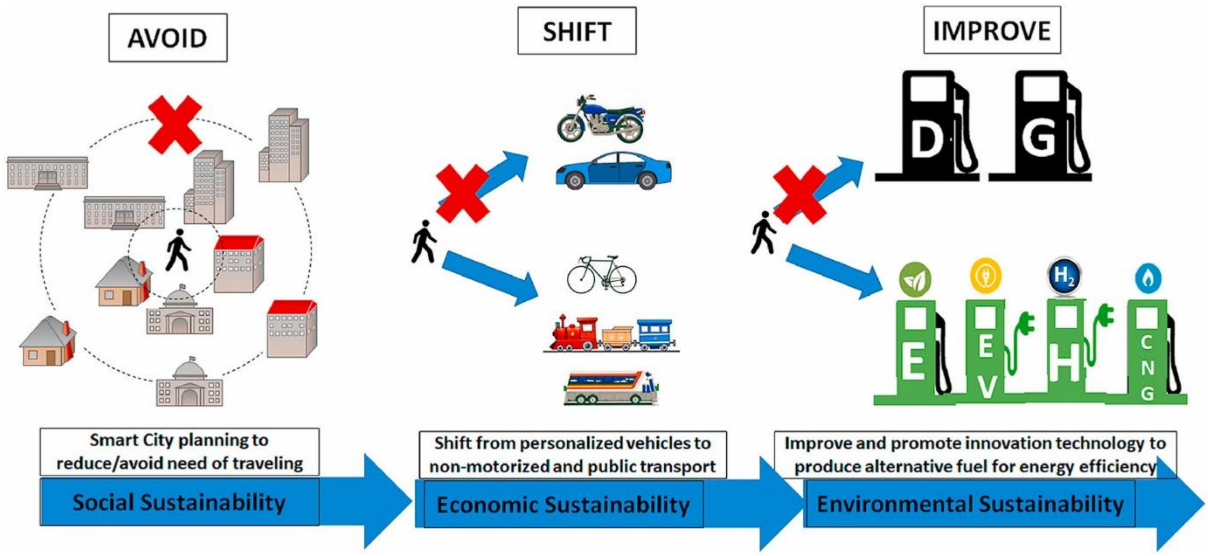

Figure 2: The ASI framework components (Shah et al., 2021)

Table 1. ASI theoretical framework for achieving sustainable mobility

	Core Objective	Mechanism of Action	Benefits	References
Avoid	Reduce overall transport demand by enabling access with fewer or shorter trips	land-use strategies that curb urban sprawl and promote dense, compact, and mixed-use development.	•Reduced distance travelled •Reduced citywide and transport-related emissions Improved public health (lower rates of obesity, high blood pressure, heart disease, and diabetes) •Reduced health-care expenditure	(Aggarwal & Jain, 2016; Buldeo Rai et al., 2022; Nakamura et al., 2013; M. Wang et al., 2017)

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Shift	promote the use of more sustainable (natural space- and energy-efficient) transport modes over less sustainable ones	• Walking and cycling infrastructure • Public transport investment • E-micromobility (e-bikes, e-scooters) • Multimodal system integration • Pooled mobility (ride-hailing, carpool)	• Reduced local air and noise pollution • Improved accessibility • Job creation • Greater economic productivity	(Adim et al., 2025; ITDP, 2019; SLOCAT, 2023; UN-Habitat, 2022)
Improve	Improve performance of vehicles, operations, and fuels across all modes	• Vehicle electrification • Motorisation management • Vehicle loading and flow optimisation • Alternative fuels	• Reduced GHG emissions • Improved local air quality • Greater social inclusion • Enhanced public health and safety	Adim et al., 2025; ITDP, 2019; SLOCAT, 2023; UN-Habitat, 2022)

Actions at the AVOID level are typically the least resource intensive and can have powerful cascading impacts that will support both SHIFT and IMPROVE strategies. Examples include land use and planning changes that shorten travel distances, which can make walking and cycling more viable and desirable, and thus promote a modal shift away from private car use. Concurrently, this spatial reorganisation could improve the viability and performance of low-emission mobility options such as electric mobility, by better matching infrastructure and mobility demand.

In addition to emissions reduction, interventions that are AVOID oriented can also have broader co-benefits of sustainable urban development. These can be more convenient access to services, more productive economies and employment opportunities from better spatial organisation. Other advantages include lower local air and noise pollution, better public health, road safety and social inclusion due to better access to mobility and urban opportunities.

METHODS

Research design

This study adopts a case study design integrated with a backcasting approach as both a scholarly and planning framework for analysing, investigating, and developing future-oriented solutions in the fields of transportation and mobility, sustainable technologies and sustainable system innovation, sustainable urban design, sustainable transportation systems, and sustainable city development (Bibri, 2018; Bibri & Krogstie, 2019). Backcasting is widely used in futures studies to explore uncertainties, support strategic decision-making, and guide policy formulation by expanding the range of feasible long-term options. Unlike forecasting, which extrapolates current trends into the future, backcasting begins with a clearly defined desirable future state and works backwards to identify the strategic actions required to achieve it. The central question guiding this approach is: *"If we want to attain a certain goal, what actions must be taken to reach it?"* (Bibri, 2018; Bibri et al., 2020).

Case study methodology is highly flexible and can be categorised into several design types, including descriptive, explanatory, exploratory, illustrative, cumulative, and critical instance, each selected based on the

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specific objectives of the researcher (Yin et al., 2018). In this study, a descriptive case study design was adopted. This approach is characterised by a focused and detailed examination about the phenomenon of sustainable urban mobility, where key questions and propositions are clearly articulated at the outset. It relies on an existing body of knowledge—referred to as a descriptive theory—which, in this context, relates to low-emission urban mobility within sustainable urban development. The design seeks to describe how integrated transport planning results in low-emission mobility in real-world urban contexts (Yin et al., 2018).

It is important to note that, within this research design, internal validity—that is, establishing causal relationships between variables—is not the central concern. Unlike explanatory case studies, which aim to determine cause-and-effect relationships, descriptive case studies focus on accurately portraying key characteristics, patterns, and processes associated with a phenomenon. As such, this study does not attempt to explain why or when specific outcomes occur, but rather to provide a comprehensive and context-rich description of the compact city as it relates to sustainable transport and urban development.

Case Sampling and Selection Criteria

Typically, case studies focus on a small number of cases; three or four is the ideal number of cases a researcher can handle for an in-depth exploration of the phenomenon under investigation (Schoch, 2020). This small sample size is common in qualitative research, where the emphasis is on obtaining rich, detailed data rather than achieving statistical generalisability.

When selecting cases, the researcher employed a purposeful sampling strategy, which involves choosing cases that are information-rich and relevant to the research questions. This approach contrasts with quantitative research, where random sampling is used to ensure representativeness of the entire population (Seawnght & Gerring, 2008). Purposeful sampling allowed the researcher to illuminate the different dimensions of low-emission mobility transitions

The selection process of cities for case study investigation was based on the availability and accessibility of literature in the public domain, on how the cities behave in the present in terms of what has been realised and the implementation of plans based on the corresponding practices and strategies associated with low-emission urban mobility. This entails the ongoing and future activities being, and yet to be, undertaken in accordance with the time horizon set in the planning and development documents of the cases. Moreover, low-emission urban mobility involves a set of indicators as described by the ASI framework, which ensures that each case provides sufficient evidence

Based on these criteria, the cases of New York City, San Francisco, Boston, and Los Angeles were selected. These cities fall within the category of large and globally significant metropolitan areas in the US and are characterised by varying levels of ambition and progress in the field of low-emission urban mobility, making their planning practices and development strategies particularly suitable for analysis. This selection is further supported by the international positioning of these cities in global mobility and sustainability rankings. For instance, the 2022 urban mobility readiness index identifies the case cities as among the top-performing in terms of urban mobility readiness, with San Francisco topping the index (Oliver Wyman Forum, 2022). In addition, the 2024 US Transportation Climate Impact Index ranked New York City second, San Francisco third, Los Angeles fourth and Boston eighth for low-carbon transport, using key indicators from the ASI framework(Streetlight Data, 2024).

Data Sources

Case study research typically draws on multiple sources of evidence, such as interviews, archival records, documentation, observations, and physical artefacts, to provide a holistic understanding of the phenomenon under investigation (Olugbenga & Ridwan, 2025; Schoch, 2020). However, the selection of data sources is guided by the nature of the research questions. In this study, the focus is on the design strategies of low-emission cities and the extent to which these strategies balance environmental, economic, and social sustainability outcomes. This focus informed the scope, framing, and management of data collection.

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The study relies primarily on qualitative data obtained from multiple documentary sources through systematic searches of online databases. Primary data sources consist of official documents produced by public and private institutions, including master plans, comprehensive plans, policy frameworks, strategic agendas, and project reports related to low-emission urban mobility in New York City, San Francisco, Boston, and Los Angeles.

In addition, secondary data sources were utilised to complement and contextualise the primary data. These include reports, academic journal articles, conference proceedings, newspaper articles, and research outputs produced by organisations and scholars not directly involved in the implementation of low-emission initiatives. The combination of primary and secondary sources enhances the robustness of the analysis by enabling triangulation and providing multiple perspectives on the cases.

Data Analysis

Following data collection, the information was critically evaluated to identify patterns, relationships, and gaps relevant to the research objectives (Yin et al., 2018). A thematic analysis approach was employed as the primary analytical method. This qualitative technique is well-suited to the analysis of textual data and enables the systematic identification, organisation, and interpretation of patterns (themes) within large datasets(Omoataman, 2025).

Thematic analysis is inherently flexible and not tied to a specific theoretical framework, allowing it to be applied across different epistemological perspectives (Braun & Clarke, 2006). It is particularly appropriate in this study due to the volume and diversity of documentary data. The analysis focuses on meaning embedded within textual content while also considering the context in which the data were produced, which is especially important when working with secondary data (Sirilakshmi et al., 2024).

A deductive approach to thematic analysis was adopted, whereby the coding and interpretation of data were guided by pre-existing concepts derived from the literature, including the ASI framework and principles of sustainable urban form. This approach allows for a structured examination of how established theoretical constructs are reflected in real-world cases.

FINDINGS

Land Use Strategy of US cities for low-emission mobility

Land use is broadly acknowledged as a significant factor in sustainable urban form, and is generally expressed in terms of the “five Ds”: density, diversity, design, destination accessibility, and distance to transit (Ewing & Cervero, 2010). Density is the number of people or dwellings per unit of land area. Diversity is a measure of land-use mix within a neighbourhood and is an indicator of the presence of complementary functions, such as residential housing, retail outlets, educational institutions, and employment centres, in close proximity. Design refers to the physical structure and layout of the built environment, such as the street connectivity, block patterns, and pedestrian infrastructure, and well-designed urban areas tend to promote walking and cycling, and minimize the need for private vehicles (Grasser et al., 2013; Wang et al., 2016). Destination accessibility is the ease of access for residents to get to key services, work, and facilities within the community and throughout the broader city. Distance to transit refers to the distance from which people have to travel to reach public transport nodes like bus stops or railway stations. Both have been shown to be very correlated with a higher public transport use and greater active transport, especially if destinations are close and public transport is also close (Wang et al., 2016).

Recent estimates of population density identify New York City as one of the most densely populated cities in the US, with over 29,000 people per square mile. San Francisco is right behind New York City with over 18,000 people per square mile. Boston has over 13,000 people per square mile, and lastly, Los Angeles has over 8,000 people per square mile (US Census Bureau, 2025). Higher population density often leads to shorter travel distances because destinations become closer to origins. Shorter distances are easier and more convenient to walk or cycle, and reduce car use (Grasser et al., 2012; Y. Wang et al., 2016).

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Land use mix development is widely recognised as an important driver of walking behaviour and overall physical activity levels. When the mix combinea a variety of facilities into a small geographic area, which decreases the need for motorised transport and makes everyday destinations more accessible. This spatial configuration has been shown to promote walking as a viable mode of transportation and increases residents' level of routine physical activity (Christian et al., 2011).

New York City exhibits one of the most diverse land-use patterns in the US. The city’s zoning framework accommodates eleven broad land-use categories, including low-density one- and two-family residential areas, multi-family walk-up and elevator apartment buildings, mixed residential-commercial developments, commercial districts, industrial and manufacturing areas, transportation and utility infrastructure, public facilities and institutions, open spaces and recreational areas, parking facilities, and vacant land (NYC, 2026a).

Historically, land use mix was driven by concerns about public health, safety, and property values, with a focus on separating residential areas from industrial zones to prevent fires, pollution, and overcrowding (NYC, 2026b). In contrast, the city’s modern mixed-use zoning encourages walkable, integrated communities where people can live, work, and shop in proximity (Kalei, 2024). Research on New York City's mixed-use zoning confirms that land-use diversity and mixed-use development are key contributors to physical activity (Fry et al., 2021).

The City of San Francisco features a diverse mix of land uses that facilitate access to residential, commercial, and recreational opportunities (San Francisco, 2022). The city's land-use and transportation integration policies emphasise concentrating housing, employment, and services near transit corridors to reduce automobile dependency and support sustainable mobility. A study comparing land-use strategies within the San Francisco Bay Area finds that improving the jobs-housing balance yields greater reductions in vehicular travel than bringing retail and consumer services closer to residential areas (Cervero & Duncan, 2006). However, recent evidence indicates that the region has experienced rapid job growth that has greatly exceeded housing production, driving up housing prices (Blumenberg & King, 2024; Blumenberg & Speroni, 2024). The mismatch between jobs and housing potentially contributed to an increase in commute distance, as workers relocated to outlying neighbourhoods in search of affordable housing.

Boston's land use is also characterised by a high mix of commercial, residential, and institutional spaces(City of Boston Planning Department, 2026b, 2026a). The city's comprehensive plan, Imagine Boston 2030, identifies the development of a mixed-use core as a central strategy for accommodating growth, increasing access to opportunity, and supporting sustainable transportation(Boston, 2018). The plan emphasises enhancing existing neighbourhoods, expanding transit-accessible growth areas, and encouraging mixed-use housing and employment centres.

The plan recognises that concentrating jobs, housing, and services within accessible locations can reduce travel demand and improve connections between neighbourhoods and economic centres (Boston, 2018). Areas such as Downtown Boston, Seaport, Back Bay, Kendall Square, and the Fairmount Corridor demonstrate increasing integration of residential, commercial, institutional, and recreational uses. The city's complementary mobility strategy, Go Boston 2030, further links land-use planning with transportation investments to create vibrant, transit-oriented communities (Boston, n.d.).

The compact urban structure (Integrating a mix of residential, commercial, and recreational functions within high-density nodes) of New York City, Boston, and San Francisco reduces the necessity for long-distance commutes by ensuring daily needs are met locally and supports high levels of public transport use (Aston et al., 2021; Ewing & Cervero, 2017; Hache et al., 2019). Future progress towards carbon neutrality would therefore depend less on increasing density and more on preserving affordability and preventing displacement in high-accessibility areas

Unlike the other cities, Los Angeles requires substantial structural transformation to reach the 2050 low-emission mobility vision. Enhancing the physical environment requires prioritising pedestrian-oriented infrastructure and permeable street networks to encourage active travel over short distances. This necessitated a transition toward

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complete streets that balance human-scale aesthetics with safety to reduce the perceived barriers to cycling and walking (Aston et al., 2021).

Historically, the city developed through extensive automobile-oriented suburban expansion characterised by the separation of residential, commercial, and industrial land uses(Chamberlain & Riggs, 2016). This pattern contributed to longer travel distances and a high reliance on private vehicles.

In recent years, however, Los Angeles has increasingly embraced mixed-use and transit-oriented development (Los Angeles Department of City Planning, n.d.). The city's planning policies, including the Mobility Plan 2035 and Transit-Oriented Communities initiatives, seek to concentrate housing, employment, and services around major transit corridors and rail stations (LA City, 2016). These policies aim to transform traditionally segregated land-use patterns into more integrated urban environments that support walking, cycling, and public transport. Research examining redevelopment around rail transit stations found that the city has actively sought to encourage mixed-use projects near transit infrastructure, although existing zoning regulations and established land-use patterns have sometimes constrained these efforts (Schuetz et al., 2018)

Transition to Sustainable Modes of Transportation

According to Tyler and Ward(2011), transportation systems are fundamentally embedded within urban structure due to the strong interdependence between transport and land use. This relationship implies that a city's land-use configuration directly influences travel behaviour and modal choice(US DOT, 2025). For example, active modes such as walking and cycling, and public transport use may become more viable choices in compact cities than in sprawling ones.

Based on the American Community Survey (ACS) five-year estimates for 2014–2018, New York City demonstrates a highly transit-oriented mobility structure consistent with its compact urban form. Commutes by public transport (56.2%) are more common than commutes by personal car (22.4%). Other modes include carpooling (4.5%), walking (9.9%), and cycling (1.2%). The modal split is more even in San Francisco, with 32.9% of trips made by private car, 34.2% by public transport, 11.4% walking, 4% cycling and 7.3% carpooling. Boston also has a balanced modal split, with 38.8% of trips made by personal vehicle, 33.4% by public transportation, 14.7% by walking, 2.2% by cycling, and 5.9% by carpooling. In contrast, Los Angeles is significantly car dependent, with 69.4% of travels by private vehicles. Carpooling accounts for 8.8%, public transport 9.4%, cycling 1% and walking 3.5%. Given the spatial scale of the city, it creates a significantly greater mobility demand, with around 129 billion miles travelled in 2022 and associated emissions of 27.3 $MtCO_2e$, largely from private cars. In comparison, New York City and San Francisco had much lower volumes of travel, 37 and 8 billion miles, respectively, and emissions of 3.7 and 1.3 $MtCO_2e$, respectively, showing the link between urban form, travel behaviour, and transport-related emissions (Oliver Wyman Forum, 2026a; 2026b; 2026c).

New York, Boston, and San Francisco consider public transit as the centrepiece of sustainable mobility, most particularly for low-income earners (Abreu & Conway, 2023; Basu & Ferreira, 2021; Mostofi, 2021). In 2022, the most common public transit modes used in New York City for weekday trips were the subway and buses (NYC DOT, 2022). Cycling and walking became attractive "green modes" during COVID-19 for essential and recreational travel when people avoided crowded transit (Abreu & Conway, 2023; Pase et al., 2020). The majority of the weekday walk trips were less than a mile and under 10 minutes(NYC DOT, 2022). A study by Ashraf et al.(2021) investigated the impacts of Citi Bike—the largest bike-sharing program in the world—on the subway ridership in New York City and discovered that a 10% increase in the number of bike-sharing trips in New York City increased the average daily subway ridership by 2.3%, strengthening the sustainable network. San Francisco hosts several shared micromobility programs (SMPs) that provide shared conventional bicycles, Shared e-bikes and e-scooters (Frye et al., 2024).

In the U.S., about 45 million trips were made using shared e-scooters and e-bikes in 2018 (Chang et al., 2019). The average length of trips on e-scooters is typically between 0.72 km and 4.5 km, and the average duration of e-scooter trips ranges from 8 to 20 minutes, as reported in international studies (Şengül & Mostofi, 2021). In Southern California, approximately 97 percent of residents reside within two miles of a transit station, which is

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typically considered to be a very convenient distance for walking or e-micromobility access to a transit station (SCAG, 2012). As a result, e-micromobility modes are well suited for trips less than 8 km, which make up about 50-60% of all trips in the United States (McKinsey, 2019). This highlights a substantial opportunity for modal shift towards e-micromobility, particularly in car-dependent cities such as Los Angeles. In support of this, Bedmutha et al. (2020) reported that the substitution of conventional motorised transport trips in the 5–8 km range with e-micromobility could lead to a reduction in the transport energy demand of around 50%. At the same time, there is substantial investment in financial and planning resources to expand public transport and active travel infrastructure, with the overall goal of decreasing vehicle miles travelled in accordance with the state's greenhouse gas reduction goals.

However, the findings also indicate important limitations. While increasing active transport can generate environmental and health benefits, evidence from compact-city modelling suggests that highly motorised cities such as Los Angeles may experience an increase in cyclist and pedestrian injuries if infrastructure improvements do not accompany modal shifts (Stevenson et al., 2016). Consequently, a successful modal shift requires not only behavioural change but also substantial investment in safe and accessible infrastructure.

Environmental Improvements and Transport Decarbonisation

San Francisco has become a model for urban climate action, reaching a 41% reduction in GHGs from 1990 levels by 2019, six years before the original target (San Francisco Department of the Environment, 2021). A business-as-usual (BAU) analysis of current estimates indicate that the city will continue to achieve its climate goals without needing to reduce total mobility demand compared to 2022 (Oliver Wyman Forum, 2026c). However, the San Francisco Municipal Transportation Agency (SFMTA) anticipates that the city will grow by another 200,000 residents and 150,000 jobs by 2040, which will add strain to the city's transportation system, housing, and public services (SFMTA, 2019a).

In response, San Francisco has been investing in sustainable transit-oriented development, including the Bay Area Transit-Oriented Affordable Housing (TOAH) Fund. The programme is designed to support the development of affordable housing, community services, fresh food markets, and other amenities in neighbourhoods that are close to key transit corridors, with the goal of creating equitable development around transit corridors. As of 2021, TOAH-funded projects had provided nearly 2,300 affordable housing units (Metropolitan Transportation Commission, n.d.).

In addition to these efforts, the city has boosted investments in walking and biking infrastructure with the Active Communities Plan and other measures aimed at realising the 15-minute city vision and decreasing reliance on personal vehicles (SFMTA, 2023; Jin et al., 2024). At the same time, San Francisco's Electric Vehicle Ready Community Blueprint seeks to ensure that 80% of all trips are made using low-carbon modes by 2030 and that all private vehicle traffic becomes electric by 2040 (SFMTA, 2019b). These goals are supported by California's mandate for all new cars sold after 2035 to be zero-emission vehicles (The Ministry of Foreign Affairs, 2020).

While these improvements have been made, there are still issues to be addressed. The city's high density urban form makes it challenging to implement charging infrastructure, especially in multi-family residential buildings. In addition, charging facilities are not evenly distributed across neighbourhoods, with fewer found in neighbourhoods of colour and lower-income (SFMTA, 2019). Such differences show the need to make the transition to low carbon mobility equitable and accessible to everyone (The Ministry of Foreign Affairs, 2020).

New York City has made notable strides in achieving its long-term climate goals by cutting GHG emissions by around 17.1% below 2005 levels (Brown & Binder, 2024). Much of this progress has been achieved by implementing the city's 80x50 Plan, which is designed to cut emissions by 80% by 2050 through a mix of electricity grid decarbonisation, transport electrification, increased public transport investment and demand management initiatives, including congestion pricing (New York City, 2016).

While emissions are expected to drop in the transport sector by 2035, BAU estimates shows that current trends are not enough to meet the city's long-term climate goals (Oliver Wyman Forum, 2026b; Synapse Energy

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Economics, 2019). The findings indicate that behaviour change would need a mix of accelerated electrification of vehicles, and increased investments in public transport services and active mobility to achieve the Paris Agreement. A modelling study of urban car fleets has shown that combining electric vehicles with rapid, large-scale investment in infrastructure that promotes modal shifts to active travel and public transport can help in meeting the Paris-consistent budgets (Winkler et al., 2023)

Given their fixed and relatively short routes, transit buses are a great early application of electric vehicles. By 2040, the Metropolitan Transportation Authority (MTA) promises to have replaced its entire bus fleet with zero-emission vehicles (MTA, 2024). State initiatives have also been implemented to promote rapid electric vehicle adoption, such as EVolve NY and Charge Ready NY, which have increased charging infrastructure and offered financial incentives for electric vehicle adoption to consumers and organisations (New York Power Authority, 2024; NYSERDA, 2026).

In addition to its electrification initiatives, New York City has continued to boost its already comprehensive public transit network. Residents have many options for sustainable travel, including subways, buses, commuter rail, ferries, walking and Citi Bikes. Since 2023, MTA have increased service on 12 subway lines. In 2025, subway ridership broke post-pandemic records multiple times, hitting 4.65 million customers on one day in December (MTA, 2026). In addition, findings by Ashraf et al.(2021) also indicate that the development of Citi bike infrastructure has increased both bike sharing and subway ridership

Frequent, reliable, and accessible bus services remain central to New York City's sustainable mobility strategy and broader efforts to reduce transport-related emissions. Recognising the critical role of public transport in facilitating modal shift away from private vehicle use, MTA implemented several initiatives to improve service quality and accessibility. A notable example is the redesign of the Queens bus network, which simplified existing routes, introduced 11 new services, expanded overnight operations, and improved transit accessibility for more than 68,000 residents. The redesign also increased the availability of “10-minutes-or-better” service for an additional 124,000 passengers, making public transport a more attractive and convenient travel option (MTA, 2026).

Complementing these transit improvements, New York City introduced congestion pricing in January 2025, representing one of the most significant demand-management interventions in the United States. Early evidence suggests that the policy has generated substantial environmental and mobility benefits. Within the Congestion Relief Zone, air pollution – in the form of particulate matter 2.5 micrometers and smaller – dropped by approximately 22%, while the city also reported reductions in traffic volumes, peak-hour delays, road traffic collisions, and noise complaints. Additionally, the scheme has generated significant toll revenues that can be reinvested in public transport infrastructure and service improvements (Nutt, 2025).

The city must continue to build on these policies by taking even bigger, bolder, and more ambitious actions to reduce emissions from cars, buses, and trucks and to meet economy-wide emissions reduction targets. By implementing policies at the scale needed to achieve 55% reductions by 2035, New York can build on this leadership and fulfil the promise of being a national climate leader (Synapse Energy Economics, 2019).

Although Los Angeles is known for its heavy car dependency, made remarkable progress toward its long-term environmental targets, achieving a 30% reduction in emissions compared to the 1990 baseline in 2022 (Romero, 2024). However, only a fraction of these reduction were due to the transportation sector; the majority were due to decarbonisation in the electricity sector and building energy efficiency. BAU estimates indicates that current trends are not enough to meet the city's long-term climate goals (Oliver Wyman Forum, 2026a). Since the city already benefits from a low-carbon intensive, renewable grid, transitioning to a decarbonised transport future necessitates accelerating the electrification of private and public transit, and investing in infrastructure, such as dense housing that lowers the need for mobility (Oliver Wyman Forum, 2026a; The Ministry of Foreign Affairs, 2020; US Department of Transportation, 2024).

Electrification of vehicles has been the focus of the City's decarbonisation strategy, as shown in the Zero Emission 2028 Roadmap 2.0, which was created in anticipation of hosting the 2028 Olympic and Paralympic

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VI, June 2026

Games (The Ministry of Foreign Affairs, 2020). The Roadmap serves as the city's primary framework for reducing transport-related emissions by accelerating the electrification of passenger vehicles, public transit fleets, freight vehicles, and charging stations (City of Los Angeles Transportation Electrification Partnership, 2018).

The programme has made good progress since its inception. In 2023, 25% of all new vehicles sold in Los Angeles County were electric vehicles, up from 6.12% in 2018. Similarly, the proportion of electric vehicles operating on county roads increased from 0.75% to nearly 5% over the same period. Over 29,000 public and workplace charging stations were installed in Los Angeles County, which is about 35% of the initial Roadmap goal of 84,000 chargers by 2028. There has also been some progress in public fleet electrification. 44 out of LA Metro's 2,000 buses were electric and approximately 7.48% of the Los Angeles Department of Transportation (LADOT) bus fleet (City of Los Angeles Transportation Electrification Partnership, 2024).

In 2024, Los Angeles furthered its climate action efforts with the Zero Emission 2028 Roadmap 3.0, reflecting the urgency of the climate crisis. The revised strategy aims to cut emissions and air pollution by another 25%, by substantially scaling up the targets for charging stations from 84,000 to 129,000 and for 45% electrification of school buses (City of Los Angeles Transportation Electrification Partnership, 2024). These are significant steps, but Los Angeles' urban size, decentralised development and increasing population mean that electrification may not be enough to meet long-term transport decarbonisation targets.

To further advance its low-emission mobility objectives, Los Angeles must complement its electrification strategy with measures that encourage a substantial shift away from private vehicle use. A key priority should be increasing public transport ridership through the implementation of the Los Angeles County Metropolitan Transportation Authority Long Range Transportation Plan (LRTP), a 30-year, $400 billion investment programme designed to expand, modernise, and improve the county's extensive transit network (Jager, 2020). By enhancing service coverage, reliability, and connectivity, the LRTP can make public transport a more attractive alternative to car travel.

In addition, continued investment in active transportation infrastructure is essential. The Mobility Plan 2035 provides a strategic framework for improving walking and cycling facilities through enhanced safety, accessibility, and network connectivity. Expanding protected cycling lanes, pedestrian-friendly streets, and first- and last-mile connections to transit hubs would further support sustainable travel behaviour. Los Angeles could also leverage its relatively affordable public transport fares to attract additional riders while prioritising safety, service quality, and passenger experience. Furthermore, expanding and incentivising shared mobility services—including car-sharing, bike-sharing, and shared e-scooter and moped programmes—would provide residents with flexible and low-carbon travel options (Oliver Wyman Forum, 2026a).

Between 2005 and 2023, Boston has achieved a 23.8% reduction in emissions, showing substantial progress towards its climate goals (Boston, 2025). Half of these cuts have been achieved through state and regional actions to decarbonise electricity generation and to cut fossil fuel use in buildings. BAU estimates indicates that current trends are not enough to meet the city's long-term climate goals (Boston, 2026). Accelerating actions of existing goals and targets in the sectors with the greatest potential for near-term emissions reductions.

The goal of Boston's strategy is not only to electrify vehicles, but also to shift to other modes of transportation, such as walking, cycling, and public transit. The city aims to lower emissions in both passenger and freight transport, as well as increase sustainable mobility opportunities, like the other case study cities. These efforts are complemented by the work of Go Boston 2030 and Imagine Boston 2030, which combine transportation planning, land use planning, and climate policy to foster compact, transit-oriented development and decrease reliance on cars.

Consequently, these measures show that electrification is an important part of decarbonisation, but long-term climate goals will also need to be met using substantial investments in public transport, active mobility and land use planning to reduce the need for road transport. This integrated approach is part of the wider goals of sustainable urban mobility, which posits that plans for reducing transport emissions should focus on adopting electric vehicles, as well as prioritising measures that lead to avoiding unnecessary trips and shifting to more sustainable modes (Liimatainen et al., 2018; McCahill, 2021; Medimorec et al., 2021; Milovanoff et al., 2020; Nag et al., 2019; SLOCAT, 2023).

CONCLUSION

This study has examined the low emission urban mobility systems in New York City, San Francisco, Los Angeles, and Boston to understand their planning practices and development strategies. Evidence from the study has shown the importance of integrated transport planning in achieving sustainable urban mobility. Success will depend on coordinated action across sectors, sustained investment, and a shared commitment to equitable climate action that delivers measurable improvements in affordability, public health, and quality of life.

As shown in New York, San Francisco, and Boston, implementing compact city design solutions that prioritise access and proximity to work opportunities, community services, and other destinations tends to reduce the travel distance of the people within those cities. In addition, compact urban designs

create favourable conditions for walking, cycling, and public transport use. Consequently, residents in these cities are more likely to utilise sustainable transport modes such as subways, buses, commuter rail, and bike-sharing systems. In contrast, Los Angeles' more dispersed urban structure and longer travel distances continue to reinforce dependence on private vehicles, despite recent efforts to promote transit-oriented development and active transportation.

Overall, the findings indicate that effective low-emission urban mobility requires a balanced integration of environmental, economic, and social sustainability objectives. Planning and investment decisions should therefore prioritise strategies that simultaneously reduce travel demand, increase the attractiveness of sustainable transport modes, and accelerate the transition to clean energy technologies

Strategic Synthesis of Findings

Building on the findings of this study, this study proposes the ABC strategy as a practical guide for cities to achieve their long-term climate obligations.

- **Accelerate:** Cities should accelerate the adoption of electric vehicles and charging stations through policy instruments such as rebates, and congestion pricing.
- **Boost:** Cities should boost investment in sustainable and space-efficient mobility systems. This includes expanding public transport networks, improving walking and cycling infrastructure, supporting bike-sharing and shared mobility services
- **Compact:** Cities should seek to more compact urban development patterns that concentrate housing, employment, services, and amenities around major public transport corridors. Maintaining a strong job–housing balance and promoting transit-oriented development can reduce travel demand, shorten trip distances, and enhance the viability of public and active transport modes.

Future Direction

This study contributes to the ongoing debate on sustainable urban mobility by introducing the ABC Strategy as a roadmap for cities aiming to achieve low-emission mobility and long-term climate goals. The study illustrates how transport electrification, sustainable mobility investments, and compact urban development can help reduce transport-related emissions, drawing on examples from New York City, San Francisco, Boston, and Los Angeles.

However, more research is needed to validate and conceptualise the proposed strategy in terms of its robustness, applicability and transferability to other urban settings. The case cities analysed in this study are primarily relatively prosperous metropolitan cities with well-developed public transport systems, institutional capacity, and financial resources. The same approach may not produce the same results in other developing cities, such as Lagos, where factors such as informal settlements, lack of transport infrastructure, poor land use planning and

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limited fiscal capacity could impact the implementation. To better understand how the ABC strategy is effective, it is necessary to evaluate the feasibility in other cities in Africa, Asia and Latin America, with consideration of how contextual factors influence its effectiveness. A realist approach can be adopted to explore the effectiveness of the strategy and to understand the conditions involved.

Lastly, future research should focus on operationalising the ABC Strategy by creating a detailed list of indicators and performance measures to help policy makers track progress and compare cities. This would enhance the usefulness of the framework and enable its use as a strategic planning tool to promote sustainable, resilient and low-carbon urban mobility systems.

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