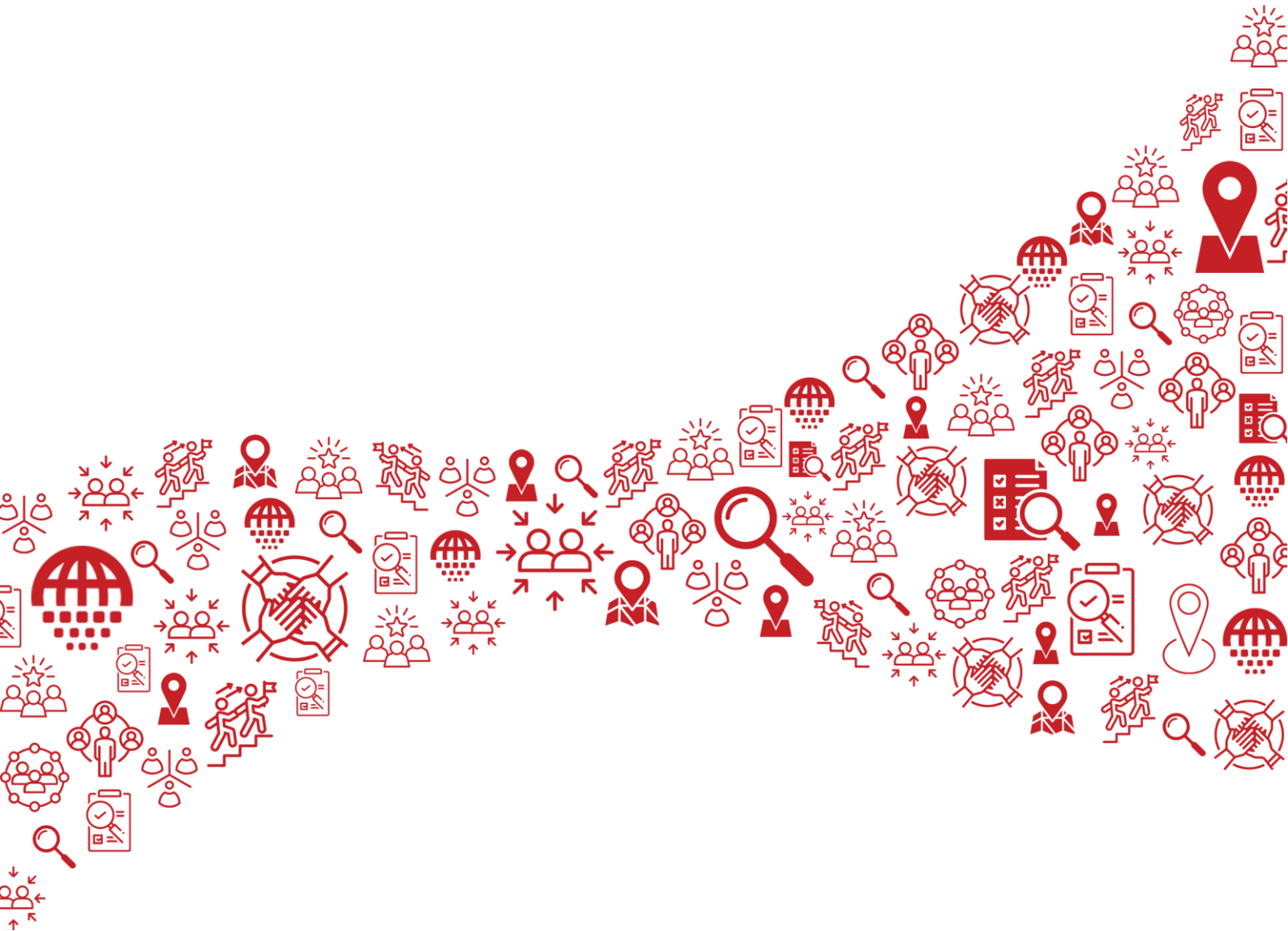


# The Economic Benefits of Sustainable Urban Mobility Globally, and How to Achieve Them

Research Report



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## ABSTRACT

Urban transport is at a crossroads amid urgent climate targets and evolving mobility trends and technologies. This discussion paper explores a transformative decarbonisation pathway for global urban transportation – via a future scenario dominated by electric vehicles (EVs) and by shared, public, and active mobility, with a significantly moderated role for privately owned cars. We compare this scenario to a business-as-usual, car-centric scenario. This paper builds on a series of studies that have focused on specific countries as well as providing global estimates. We also consider conditions and policies needed around the world to bring this much more sustainable scenario about. Overall, we find that a strong shift to electrification and shared mobility, integrated with robust public transit and safe facilities for walking and cycling, could dramatically reduce urban private motorized travel demand, energy use, and carbon emissions while yielding major economic savings. By 2050, our “high electrification/low-car” scenario cuts urban passenger transport energy use by over 75% and CO<sub>2</sub> emissions by over 85% relative to baseline trends. It also reduces total system costs on the order of 40%, translating to trillions of dollars in annual global savings by mid-century. Beyond these direct benefits, the transition to sustainable mobility offers substantial co-benefits that we discuss, but don’t attempt to measure here: improved access and social equity in transportation, reduced urban air pollution and noise, enhanced traffic safety, and new employment opportunities in electrified transport services. After presenting the analysis, we discuss the policies, investments and institutional reforms required to enable this paradigm shift, drawing on the “Safe System” approach to highlight the importance of systemic change over individual behavior change. The analysis underscores that a sustainable urban mobility transition is not only feasible but cost-effective, and can also support broader socio-economic development goals. Achieving this future, however, demands proactive governance, inclusive planning, and a transformative policy vision. We conclude with implications for policymakers, arguing that pursuing a high-electrification, low-private-car strategy is delivering economic efficiency and social well-being, while achieving climate targets in the most efficient way.



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# INTRODUCTION

**T**ransport plays a pivotal role in global sustainable development, enabling economic activity and personal mobility, yet it remains a major contributor to climate change, air pollution, and energy insecurity. Worldwide, transport CO<sub>2</sub> emissions have grown faster than those of most other sectors in the past decades, especially in emerging economies. In 2019, transportation accounted for approximately 24% of global energy-related CO<sub>2</sub> emissions, with the land transport segment (primarily road vehicles) responsible for the bulk of this share (around three-quarters). Urban areas – now home to over half of humanity – are at the forefront of this challenge, as rising incomes have led to surging vehicle ownership and use in cities worldwide (World Bank 2025). If current trends continue, by 2050 the global light-duty vehicle fleet could reach 2 billion or more, mostly combustion-engine cars, doubling annual transport carbon emissions to roughly 15–16 Gt CO<sub>2</sub> and worsening problems of traffic congestion, road fatalities, and social inequity in mobility access. At the same time, a convergence of innovations and policy pressures is creating opportunities to redefine the urban mobility paradigm.

However, the past decade also has seen rapid advances in vehicle electrification – electric cars, buses and two-wheelers are increasingly viable and are scaling up in many markets, driven by climate policies and technology improvements. Digitalization has enabled new mobility services such as ride-hailing, car-sharing, and integrated multimodal trip planning, giving rise to the concept of “Mobility as a Service” (MaaS) where mobility is provided on-demand rather than through private vehicle ownership. Meanwhile, many cities are investing in public transport and active travel infrastructure, recognizing the need to curb car dependence for livability and air quality. These trends align with the “three revolutions” scenarios developed by UC Davis and ITDP (Fulton, Mason and Meroux, 2017) on the electrification, automation, and sharing for transport– that could radically alter travel patterns and vehicle use this century. A scenario with widespread electrification, mobility services and greater use of public and active transport could cut global urban passenger transport CO<sub>2</sub> emissions by over 80% in 2050 relative to business-as-usual, versus only ~50% reductions if electrification is not accompanied by shared and public-mobility shifts.

The introduction of shared mobility and high-utilization vehicle fleets, coupled with greater use of transit and active mobility, has been identified as a key to unlocking massive benefits in reduced vehicle kilometers traveled (VKT) and associated externalities. However, realizing such a vision requires not just new technology but systemic changes in how we organize

mobility. Many barriers – institutional, economic, and behavioral – stand in the way of moving away from the entrenched private-car-centric model. Decades of automobile-oriented infrastructure and land-use patterns have locked in high levels of car dependency in many cities, and cities continue to invest heavily in roadway and vehicle infrastructure, at the expense of more sustainable modes. Automakers and related industries remain economically powerful and often resistant to change, and private cars continue to be seen as status symbols and a default mode of travel in numerous societies. Consequently, even as EVs rise in prominence, there is a risk that they simply replace internal combustion engine (ICE) cars one-for-one, perpetuating problems of congestion, inefficient asset use, and spatial sprawl. A narrow focus on vehicle technology alone – e.g. electrifying the fleet – without shifting the broader mobility system may not deliver the needed sustainability gains. As Lutsey (2015) and Creutzig (2016) caution, vehicle efficiency improvements can be offset by growth in travel demand if urban form and modal options remain unchanged.

This paper addresses the above challenges by analyzing a high-electrification, low-private-car scenario for global urban transport and examining its implications for travel behavior, energy use, CO<sub>2</sub> emissions, and costs. The paper revisits and builds on detailed scenarios contrasting a conventional “business-as-usual” (BAU) future with an alternative future featuring extensive electrification of vehicles and a major modal shift away from private cars; it takes a systemic perspective on the transition of the transport sector towards a system that provides access to sustainable mobility services for all (Fulton et al 2017 and 2021, Lah 2024). In our enhanced assessment, we incorporate updated data and broaden the scope to also evaluate economic outcomes, social equity considerations, employment implications, and governance requirements of such a mobility transition. In doing so, we synthesize findings from recent literature and scenario modeling on sustainable transport futures, including co-benefits like improved air quality, accessibility, and safety. We also take inspiration from the “Safe System” approach – originally developed in road safety – as a guiding framework for the kind of systemic, multi-faceted changes needed to achieve a safe and sustainable urban mobility system, moving away from behaviour change to a systemic change across the transport sector as provider of sustainable mobility services.

The paper is structured as follows. Section 3 describes our methodology and scenario framework, outlining the key assumptions for the BAU and high EV/low-car scenarios. Section 4 provides a comparative overview of travel activity and decarbonisation outcomes in the two scenarios, including

mode shares, vehicle usage, energy demand and emissions to 2050. Section 5 looks into the economic impacts, assessing total system costs, cost efficiencies, and direct and indirect economic benefits of the sustainable mobility transition. Section 6 discusses social implications, particularly how an inclusive, service-oriented mobility system can improve equity and access. Section 7 examines the employment and industrial transitions associated with moving from a conventional automotive sector to electrified mobility services and public transport jobs. Section 8 addresses the institutional and governance reforms needed to enable systemic change and introduces the Safe System paradigm as a transformative imperative for sustainable mobility (Section 9). Finally, Section 10 concludes with policy implications, making the case that a high-electrification, low-car approach in urban transport is not only environmentally necessary but also economically and socially advantageous for cities worldwide.



# **1. PART 1. URBAN TRANSPORTATION DECARBONIZATION SCENARIOS**

### 1.1 Methodology and Scenario Framework

To investigate the long-term impacts of a low-car, high-electrification pathway, we developed two divergent scenarios for global urban passenger transport up to 2050: (1) a **Business-As-Usual (BAU)** scenario, and (2) a **High EV/Shared Mobility** scenario. The scenarios are defined by contrasting assumptions about technology adoption and travel behavior, drawing on the literature on transformative mobility futures. This is not meant to show two alternative scenarios but the bandwidth of possible pathways. Our approach revisits and builds on earlier “Three Revolutions” scenario analyses (e.g. **ITDP/UCD** study by Fulton et al., 2017) with an emphasis on electrification and shared modes; however, unlike our earlier assessment, we do not assume full automation in our core scenario, as explained below.

**Business-As-Usual (BAU):** The BAU scenario represents a continuation of current trends and 20th-century mobility patterns into the future. In this scenario, private automobiles remain the dominant mode of urban transport in most regions, largely powered by internal combustion engines. Vehicle ownership continues to rise in emerging economies as incomes grow, approaching car-saturation levels seen in the West. We assume only incremental improvements in vehicle fuel economy and a slow penetration of EVs. By 2050, conventional gasoline/diesel vehicles still comprise a large share of fleets, especially in developing countries. Urban land use in BAU follows prevailing trends of expansion and sprawl in many areas, leading to longer travel distances. Public transit and active modes (walking, cycling) see modest improvements but fail to significantly curb car mode share. In sum, BAU is a **car-centric future** with rising travel demand, only partial electrification, and persistent reliance on private vehicle travel for the majority of trips. This scenario mirrors the higher end of projections by agencies like the International Transport Forum (ITF) and International Energy Agency (IEA) where, without aggressive policies, transport emissions continue to grow to mid-century.

**High EV/Shared Mobility Scenario:** The alternative scenario envisions a profound shift in both technology and travel habits to achieve sustainable mobility. Key features of this scenario include:

- **Rapid Electrification:** There is an aggressive global rollout of electric vehicles across all categories – cars, motorcycles, buses – such that by 2040 nearly all new motorized vehicles sold are electric, and by 2050

virtually the entire road fleet is electrified. This aligns with many national policies targeting 100% zero-emission vehicle sales by the 2030s. We assume supportive policies (e.g. EV purchase incentives, combustion engine phase-out regulations) and falling costs of batteries drive this electrification. Importantly, the electric grid is assumed to decarbonise in parallel (consistent with a broader low-carbon energy transition), so that EVs deliver maximum climate benefit.

- **Shared & Active Mobility Domination:** Perhaps the most defining characteristic is **a major mode shift away from privately owned cars** toward shared, public, and non-motorized modes. Urban travel in 2050 is handled predominantly by walking, cycling (including e-bikes), public transport (buses, urban rail), and shared vehicles (e.g. pooled ride-hailing shuttles, car-share fleets), rather than individual car ownership. Cities greatly expand safe infrastructure for pedestrians and cyclists, and invest heavily in high-capacity public transit systems. New mobility services – from app-based ride-pooling to microtransit and scooter-sharing – fill gaps and provide convenient first/last-mile connectivity. We assume **behavioral and cultural shifts** occur: urban residents increasingly forego car ownership in favor of on-demand mobility services, enabled by digital platforms and attractive alternatives. By 2050, private car use in cities is minimal, essentially limited to special cases, while the average urban dweller makes most trips by walking, biking, transit, or using a shared vehicle when needed.
- **Urban Density and Design:** The scenario incorporates urban planning measures that support shorter travel distances and multimodal transport. City governments implement smart growth and **transit-oriented development**, curbing sprawl and enabling more people to live closer to workplaces and amenities. As a result, urban trip lengths stabilize or decline over time (particularly relative to BAU), contributing to lower overall passenger-kilometers traveled. We assume that by 2050 many cities have been restructured to be more compact and **pedestrian-friendly**, with land-use changes complementing the transport system changes.
- **Automation (Limited Role):** Unlike the full “3 Revolutions” scenario in some literature, we do not make automated (self-driving) vehicles a linchpin of this scenario, though we acknowledge they could further enhance it. For our core analysis, we assume automation remains limited or in controlled use (e.g. autonomous buses on fixed routes) up to 2030. By 2050, driverless technology may be widespread; our scenario allows for it as a possibility that reduces labor cost for transit and shared services, but it is not essential to achieve the mode shifts described. In effect, we consider automation a potential add-on that could amplify cost

savings (by eliminating drivers in ride-hailing, for instance) but **the fundamental shifts – electrification and sharing – stand on their own**. This focus keeps our scenario robust even if autonomous vehicles face delays or social acceptance issues.

Our analysis quantifies the implications of these scenarios on key metrics: total passenger travel (passenger-kilometers, PKM), vehicle activity (vehicle-kilometers, VKT), vehicle fleet size, energy consumption, CO<sub>2</sub> emissions, and aggregate economic costs. We use a systems accounting approach similar to Fulton et al. (2013, 2017) and ITF (2021) scenario models, applying global totals with regional differentiation implicitly considered in assumptions. Base-year (2015) data for travel activity, mode shares, and vehicle stocks are drawn from international transport databases. Scenario trajectories (2015–2050) for each mode were constructed by applying growth or reduction factors consistent with scenario narratives. For example, in BAU private motorized travel grows substantially in emerging markets, whereas in the High EV/Shared scenario private car VKT per capita declines after 2030 in most cities as shared mobility and transit options proliferate.

Energy use is estimated by applying modal energy intensity (MJ per passenger-km or per vehicle-km) to the travel activity, accounting for improvements over time (e.g. rising EV efficiency, conventional vehicle standards). Notably, the High EV/Shared case benefits from both a shift to inherently more efficient modes (e.g. trains, bikes) and efficiency gains within modes (electric drivetrains using far less energy per km than ICE vehicles). Emissions are computed from energy use and an emissions factor; in the EV scenario, direct tailpipe CO<sub>2</sub> is near-zero for road vehicles by 2050, so remaining transport emissions come from electricity generation (assumed on a trajectory to net-zero carbon by mid-century) and fuel use in modes like aviation which are outside our urban scope.

To compare **economic costs**, we consider both **capital and operating costs** for the transport system and vehicles in each scenario. This includes the annualized cost of vehicle purchases (private and public fleets), fuel/energy costs, maintenance, infrastructure investment (roads, parking, transit infrastructure), and operating expenses of transport services (transit operations, ride-hail services, etc.). We draw cost parameters from sources such as the IEA and World Bank for infrastructure costs, and industry data for vehicle costs. Notably, our cost comparison is from a **societal perspective** – summing private expenditures (e.g. households buying vehicles, fuel) and public expenditures (infrastructure provision, transit subsidies) to gauge total resource use. This allows us to assess which scenario is more cost-efficient at delivering mobility.

It is important to emphasize that our scenarios are exploratory and normative – they illustrate potential futures under certain assumptions, rather than predictions. The High EV/Shared Mobility scenario in particular represents an **ambitious transition pathway** that would require strong and sustained policy support globally. In the following sections, we present the outcomes of these scenarios and examine their implications. We also complement the quantitative results with qualitative discussions on policy, equity, and industry shifts, informed by case studies and literature, to build a comprehensive picture of a sustainable urban mobility transformation.

## 1.2 Travel Activity and Mode Share

The BAU and High EV/Shared Mobility scenarios diverge starkly in how people travel in cities by 2050. Figure 1 illustrates **the global passenger-kilometers travelled (PKT)** by mode in the BAU scenario, for the base year 2015 and projections in 2030 and 2050. In the BAU case, urban travel demand continues to grow unabated. Total urban PKT roughly doubles from 2015 to 2050, driven by population and economic growth. This growth is largely met by **private cars**: light-duty vehicle travel (sedan, SUVs) more than doubles to 2050, outpacing population such that per-capita car travel rises in many regions. By 2050, private cars (mostly ICE vehicles in BAU) still account for the majority of urban passenger travel worldwide. Other modes like public transit, walking, and cycling increase only marginally in absolute terms and decline in relative modal share. The BAU urban transport system thus resembles an amplified version of today's trends – more cars, longer distances, and continued dependency on automobiles for mobility.

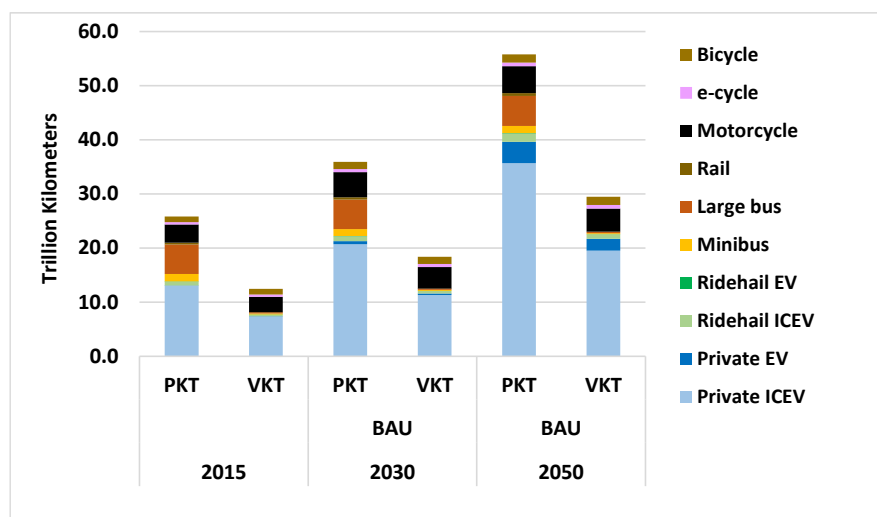


Figure 1: Passenger and vehicle kilometers travelled in the BAU scenario worldwide

Figure 2 adds the High EV/Shared scenario and compares this to the BAU. This scenario shows a peak and decline in total urban travel demand by mid-century. By design, this scenario includes land-use densification and mode shift policies that shorten or eliminate many trips. As a result, global urban PKT in 2050 is about **30% lower** than in the BAU case. This indicates that better urban planning and tele-access (e.g. remote work, local 15-minute city concepts) can moderate travel growth even as urban populations and economies expand. More striking is the **modal composition**: private car travel is largely supplanted by other modes. Personal cars go from ~50% of urban PKT in 2015 to only a small fraction by 2050 in the High EV/Shared scenario. Taking their place, **active modes** (walking, bicycles, e-bikes) and **public transport** carry a much larger share of travel.

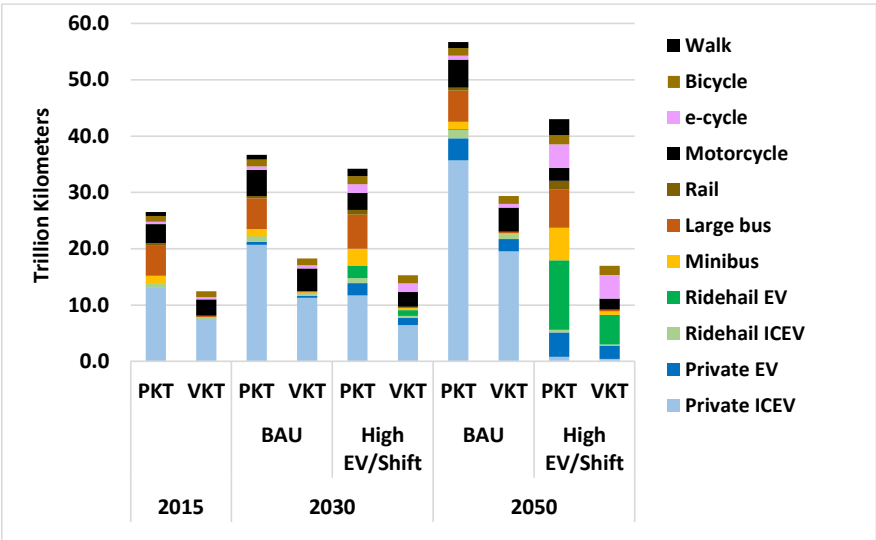


Figure 2: Passenger and vehicle kilometers travelled by mode and scenario worldwide

Figure 3 shows a similar picture in terms of trip shares. Walking accounts for almost half of all trips in all scenarios and is not shown here. Cycling and particularly electric biking boom as safe bike networks and e-bike technology allow trips of several kilometers; in many cities, e-bikes and scooters also replace a significant portion of what were motorcycle trips. **Public transit** (buses, BRT, metro, commuter rail) experiences massive expansion, supported by high investment; it becomes the backbone of urban mobility, especially for medium- and long-distance trips.

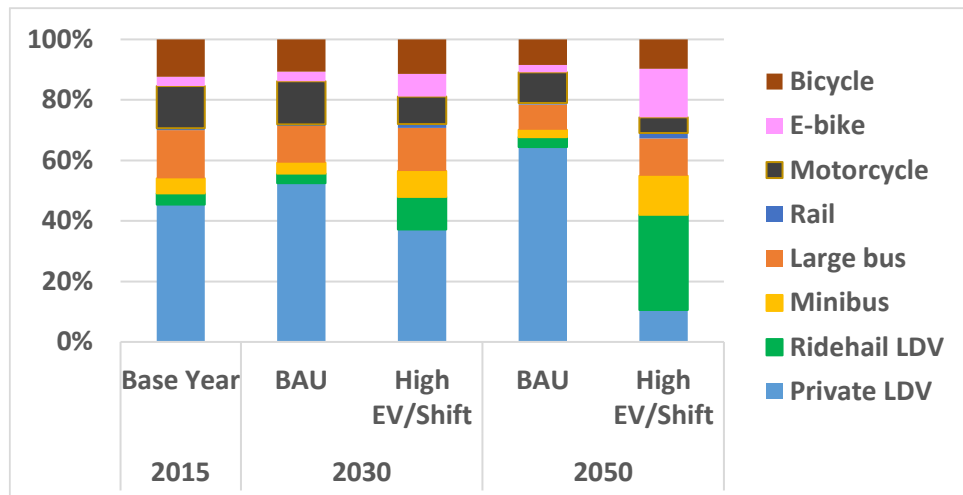


Figure 3: Global average trip mode shares by scenario, year

A novel element is the rise of **shared mobility services**. By 2050, a large share of urban trips – perhaps the single largest share by trip count – is served by shared vehicles in our low private car scenario. This includes a significant share of ride-hailing with pooled rides (multiple unrelated passengers per vehicle trip) and car-sharing clubs where users access vehicles on-demand for short durations. In our scenario we assume an average occupancy of ~2.5 persons for shared ride-hail trips in most of the world (somewhat lower in North America), thanks to widespread use of pooling. This effectively turns a portion of the car fleet into a form of quasi-public transport or “microtransit.” We acknowledge that encouraging individual riders to choose pooled rides can be challenging, but the use of strong pricing signals, pooled pickup and dropoff locations, and other innovations, may be able to help achieve this 2.5 average. And with pooled pickup and dropoff locations, vehicles would not have to drive very many extra kms to serve multiple people per trip.

Small **on-demand shuttles** (vanpool and minibuses seating 8–15) also proliferate, bridging the gap between taxis and buses. The net result is far fewer vehicles on the road doing far more work each: a smaller fleet of shared vehicles provides many more person-trips per vehicle than the enormous fleet of private cars in BAU.

To put numbers on the vehicle fleet: under BAU, the global stock of light-duty vehicles serving urban travel could exceed **2 billion by 2050**, given continued growth (Figure 4). In the High EV/Shared scenario, we estimate the total number of cars needed globally in cities might be lower than it was

in 2015 - on the order of **500 million** by 2050. This represents an extraordinary 75% reduction in the required vehicle stock. The reduction comes from two factors: (a) many trips shift to non-car modes (so fewer vehicles needed overall), and (b) each shared vehicle is utilized at a much higher rate, providing tens of trips per day and a high annual mileage. In fact, a shared autonomous EV in our scenario could travel **over 100,000 km per year**, replacing perhaps 5–10 privately owned cars which each might drive ~15,000 km/year or less. Thus, even though some shared vehicles are providing more mobility, their intensive use means far fewer idle vehicles sitting in parking lots – requiring far less land devoted to parking, and a huge efficiency gain for the system.

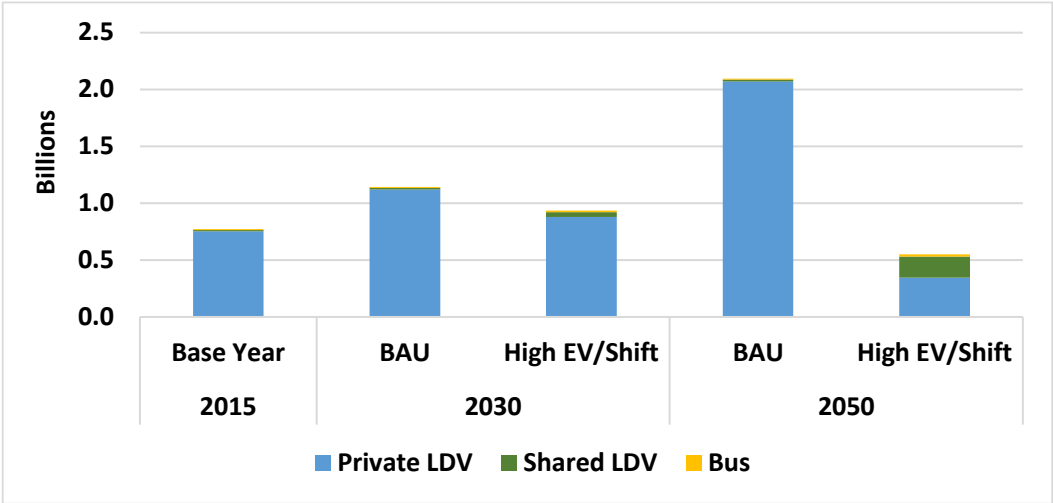


Figure 4: Global stock of private and shared LDVs and all buses by scenario and year

Thus an important implication of the dramatically lower vehicle count is the potential to repurpose urban space. Vast areas currently devoted to parking and wide roads can be converted to more productive uses – public spaces, green areas, or real estate – improving urban livability. Although we do not explicitly quantify land-use benefits here, this is a noteworthy co-benefit: the High EV/Shared scenario frees up significant urban land by eliminating many parking facilities and reducing road space needs, especially in city centers.

*1.3 Energy Use and Emissions*

The profound differences in travel patterns translate directly into divergent energy and emissions outcomes. In the BAU scenario, final energy consumption for urban passenger transport climbs steadily through 2050. A larger global fleet of mostly ICE vehicles and higher total VKT result in **ballooning fuel demand**. By 2050, BAU urban transport is consuming over 50 exajoules of energy per year – mostly

oil, on the order of hundreds of millions of barrels per year – implying not only high CO<sub>2</sub> emissions but also greater expenditures and potential energy security concerns for oil-importing nations. With slow electrification, any efficiency improvements (e.g. better fuel economy standards) are outweighed by more vehicles driving more kilometers. Consequently, global transport-related CO<sub>2</sub> emissions increase by over 50% between 2015 and 2050 in BAU. Our urban transportation BAU scenario, along with other emissions increases in transportation (such as the air and trucking sectors), far exceeds a Paris Agreement-compatible pathway and would make it virtually impossible to limit warming to 1.5–2°C).

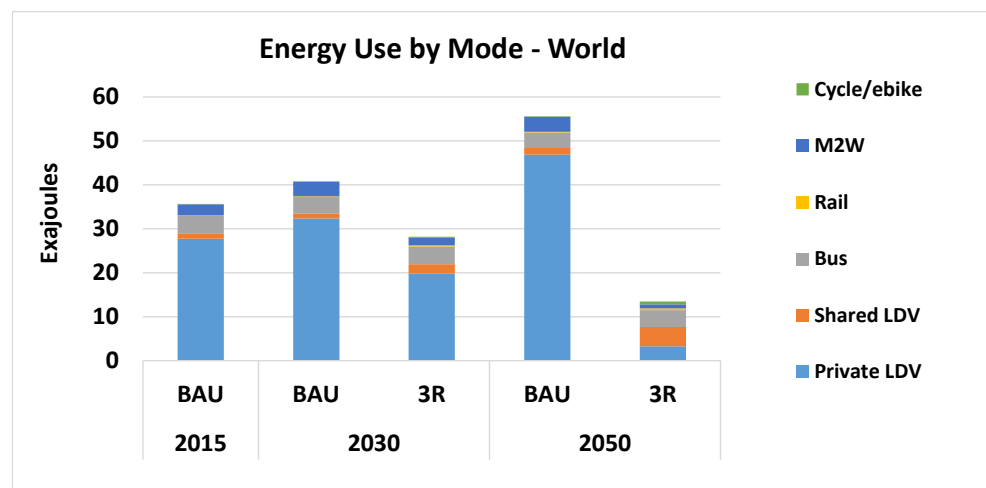


Figure 5. Global energy use by scenario and year, ICE and electric vehicles

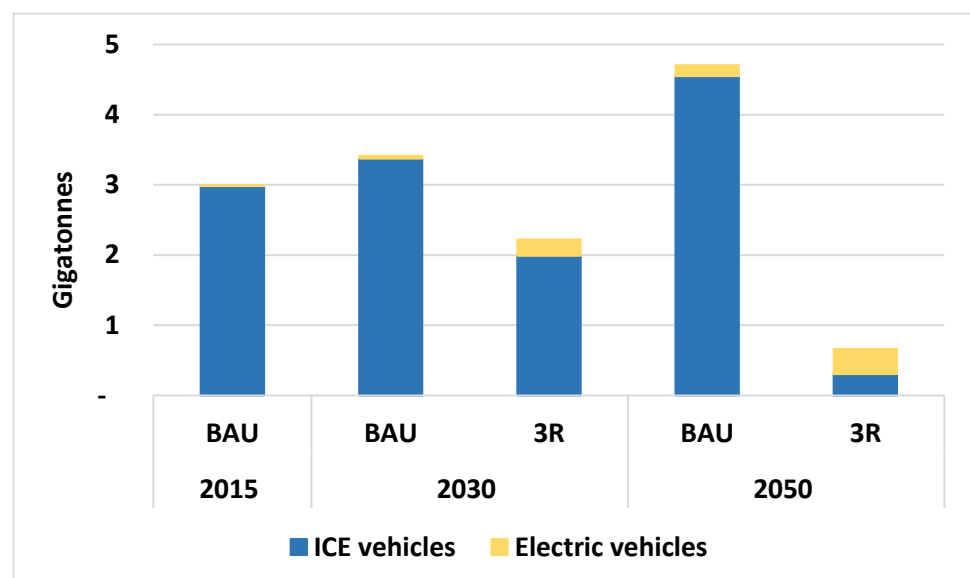


Figure 6. Global stock of private and shared LDVs and all buses by scenario and year

As shown, in the BAU LDV travel and as a result, energy use and CO<sub>2</sub> emissions rise rapidly out to 2050. By contrast, the High EV/Shared Mobility scenario achieves a dramatic reduction in these aspects, especially a decarbonisation of urban transport.

Several reinforcing effects drive this outcome:

- **Reduced Travel Demand:** As noted, total VKT is much lower than BAU (vehicle kilometers in 2050 are over 50% less than in BAU). Fewer vehicle-kilometers means proportionally less energy required, all else equal.
- **Mode Shift to Low-Energy Modes:** The scenario shifts travel into inherently more energy-efficient modes. Trains and buses carry large numbers of passengers with relatively small energy inputs (especially electric rail, which is very efficient per passenger-km). Walking and cycling, of course, use negligible external energy. Even the use of small shared vehicles optimizes loads and reduces empty running. These shifts avoid the enormous energy waste of single-occupant cars. Studies have shown that high vehicle occupancy and multi-modal systems can vastly improve energy productivity in transport.
- **Electrification Efficiency:** By 2050 all remaining motorized vehicles – including cars, two-wheelers, and transit vehicles – are assumed to be **electric** in this scenario. This yields a huge gain in tank-to-wheel efficiency: battery-electric drivetrains typically use 2–3 times less energy per kilometer than equivalent gasoline engines, because electric motors are more efficient and regenerative braking recovers energy. Thus, even for the VKT that still occurs, the energy intensity is sharply lower.
- **Cleaner Energy Source:** With electricity as the dominant transport fuel, the carbon intensity per unit of energy is greatly reduced over time as power grids decarbonise (per our assumption consistent with global climate mitigation scenarios). Even in the interim, shifting from oil to a diversified energy mix for transport can reduce CO<sub>2</sub> per km, especially as renewables grow in the mix. For instance, an average EV in 2040 might produce a fraction of the CO<sub>2</sub> per km that a petrol car does, even accounting for electricity emissions.

Combining these factors, the high EV/low-car scenario cuts urban passenger transport emissions absolutely – not just relative to BAU, but below today's levels. We find that by 2050, urban transport CO<sub>2</sub> emissions in this scenario could be roughly **80–90% lower than BAU**. In fact, emissions peak before 2030 and then decline steeply, approaching approximately **1–2 Gt CO<sub>2</sub>** by 2050 (with remaining emissions primarily from power generation for transit and EV charging). This is in line with other aggressive mitigation scenario results. For example, the aforementioned 3R scenario analysis found an ~85% reduction in global urban transport CO<sub>2</sub> by 2050 vs BAU, and IEA's net-zero pathway envisions near elimination of oil use in land transport by 2050 (with any residual emissions offset by carbon removal). Achieving such cuts in the transport sector is crucial for meeting overall climate targets; transport has lagged other sectors in decarbonisation to date, so these findings illustrate a possible path to close the gap.

It should be noted that our scenario's success in cutting emissions does hinge on **complementary decarbonisation of electricity**. If power sectors don't clean up, widespread electrification could largely shift emissions rather than eliminate them. Still, even in a moderately decarbonised global grid scenario, the net greenhouse gas emissions per km of EV travel tend to be far lower than ICE vehicles in most regions. Additionally, the sheer reduction in total energy demand in the sustainable scenario eases the burden on the energy supply side. The scenario's lower transport energy demand means renewable energy deployment can more easily keep pace and provide the required electricity without strain.

Beyond CO<sub>2</sub>, the shift to EVs and reduced driving yields major improvements in **urban air quality**. Tailpipe pollutants (NO<sub>x</sub>, PM) from ICE vehicles are essentially eliminated by electrification, and the large drop in VKT further cuts tailpipe emissions and those from tire and brake wear. Many cities struggling with smog and particulate pollution (e.g. in South Asia) would see major health benefits from cleaner urban air – a co-benefit not quantified in our model, but highly significant (transport emissions cuts could prevent thousands of premature deaths annually from air pollution by 2050, according to public health studies). Likewise, the scenario's emphasis on active transport has public health upsides (more physical activity) and traffic safety gains (fewer cars typically lead to fewer severe crashes, as discussed later).

In summary, the comparative overview shows that an urban mobility future centered on electrified, shared, and active transport can achieve the dual goals of **dramatically reducing carbon emissions and improving travel efficiency**. The BAU trajectory, by contrast, would entrench unsustainable patterns and associated problems. In the next section, we turn to the economic dimension – examining how the costs of providing mobility differ between these futures, and whether the low-carbon path also makes sense from a financial and economic efficiency standpoint.

#### *1.4 Economic Impacts and System-Level Cost Efficiency*

A critical question for policymakers is whether a sustainable mobility transition is affordable and economically beneficial. We address this by comparing **the total costs** of the BAU vs. High EV/Shared Mobility scenarios, including vehicle costs, fuel/energy, infrastructure, and operational expenses. The analysis reveals that the sustainable scenario is not only viable but in fact significantly more cost-efficient than BAU in the long run, yielding multi-trillion dollar savings. This section details these findings and explores the direct and indirect economic impacts of the

transition.

Our scenario results indicate that a car-dominated future would be extremely costly to maintain, whereas a shared electric mobility system can deliver the same or better mobility for far less resource expenditure. This is shown in Figure 7, and described and broken down into components below.

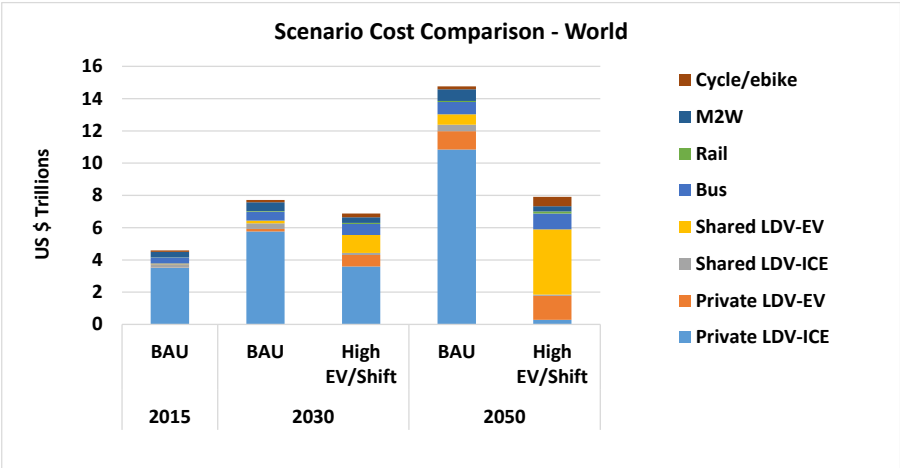


Figure 7. Total cost by scenario and mode

We have assumed a range of vehicle purchase and operating costs, along with system infrastructure and operating costs, for example for public transit. agencies and ride sharing services. The basic picture of our cost estimates, at the global average level, are shown in Figure 8. What is striking as that while private modes such as cars and motorcycles are relatively low-cost per vehicle kilometer, and mass transit modes such as rail systems are high cost, on a per-passenger-km basis, it is quite the opposite. The cost per passenger-km for well utilized systems (high ridership, frequent service) which is true for much of the world, results in low costs per person moved. Rail becomes one of the cheapest forms of travel, along with buses and bicycles. These underlying assumptions drive the results, that shifting future travel growth from private vehicles to mass modes and cycling, saves society large sums of money.

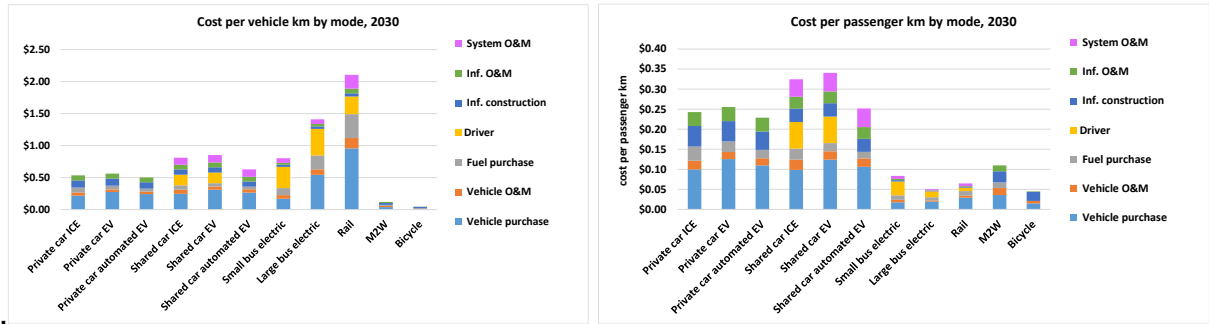


Figure 8. Travel costs per vehicle-km and per passenger-km, global average estimates for 2030

As shown, in the BAU scenario, the combination of continued vehicle fleet growth and heavy infrastructure needs leads to mounting costs on households, governments, and businesses:

- Vehicle Ownership Costs:** By 2050, nearly 2 billion private cars in BAU mean trillions of dollars spent globally each year to manufacture, purchase, and maintain those vehicles. Even at a modest average vehicle price of ~\$25,000 (including many cheaper models in developing countries), the capital cost of 2 billion vehicles would be on the order of \$50 trillion if they were all replaced once. In practice, those costs are borne over time, but annual new car purchases in BAU still represent enormous outlays. By contrast, in the shared mobility scenario the world needs only a quarter of that fleet – perhaps ~500 million vehicles – many of which are smaller, simpler EVs (including a large share of two-wheelers). Assuming an average cost of \$15,000 for these vehicles (a mix of cars and cheaper two-wheelers), that’s about \$7.5 trillion total capital cost. In essence, the world avoids building on the order of one and a half trillion dollars’ worth of vehicles each year over multiple decades, resulting **in over \$40 trillion in cumulative vehicle capital savings** by 2050.
- Fuel and Energy Costs:** Under BAU, oil consumption for urban transport would remain extremely high, implying huge expenditures on gasoline and diesel. At roughly \$2–3 per gallon, the annual fuel bill for the global car fleet could approach **\$2 trillion per year by 2050** (this aligns with IEA projections of ~\$2T on road fuels in a no-policy scenario). In the EV/Shared scenario, oil demand plummets – most vehicles use electricity, and overall energy demand is lower. Electric vehicles have higher efficiency and typically lower “fuel” cost per km; moreover, many trips shift to essentially cost-free modes like walking and cycling. Even accounting for electricity costs, the scenario saves trillions in energy expenditures. These savings free up national income that would otherwise go to fuel imports and can be redirected to other productive uses. Reduced oil demand also shields economies from volatile oil prices and improves energy security (a strategic economic benefit).
- Infrastructure and Operational Costs:** A sprawling car-centric system requires continuous investment in roads, highways, parking structures, and traffic management, alongside maintenance of this infrastructure. We estimate that in BAU, governments worldwide would need to spend on the order of **\$ trillions per year on road infrastructure by 2050**, especially in rapidly urbanizing regions building new highways. In the sustainable scenario, a significant portion of these costs can be avoided. Since total VKT is much lower, there is less wear-and-tear and less need for expanding road capacity. Parking infrastructure in city centers can be trimmed dramatically when private car use

drops. Our calculations suggest that the High EV/Shared scenario would require **hundreds of billions of dollars less per year in road infrastructure spending** than BAU by 2050. On the other hand, this scenario does call for greater investment in public transport systems and pedestrian/cycling infrastructure. We project that global transit capital and operating expenditures might need to roughly double compared to BAU by 2050 – reaching about \$1 trillion per year, vs \$800 billion in BAU. Likewise, substantial funding is needed for sidewalks, bike lanes, and universal design upgrades for accessibility. Even so, the extra ~\$200 billion per year spent on transit and active modes is **dwarfed** by the savings from the private vehicle side. By one estimate, every dollar invested in transit yields \$20 in savings from avoided car costs in the 2050 timeframe. In essence, the reduced need for new cars, roads, and parking frees up financial resources that more than cover the costs of building and operating robust transit networks.

Overall, summing all components, we find that the High EV/Shared scenario becomes decisively cheaper than BAU around 2030 and the gap grows thereafter. By 2050, the **annual total** cost of urban passenger transport in the sustainable scenario is on the order **of \$8–10 trillion less** than in BAU. In other words, the world could save roughly 5–6% of global GDP each year by mid-century by adopting the sustainable mobility pathway. This striking result is consistent with other studies; for instance, Fulton et al. (2017) found about **\$5 trillion per year** savings by 2050 in a 3R scenario, and our updated numbers (which factor even greater vehicle reductions and future cost trends) suggest the savings could reach or exceed double that figure. These are **direct cost** savings (vehicles, fuel, infrastructure) and do not even count externalities.

To further illustrate the breakdown, **Figure 2** presents a comparison of cost components by scenario. The left panel shows global transit system costs in 2030 and 2050 under BAU and the EV/Shared scenario; the right panel shows the corresponding costs for private vehicles (cars and two-wheelers). While transit expenditures are somewhat higher in the sustainable scenario (an intentional result of providing vastly expanded service), the private vehicle costs in BAU utterly dominate the picture. In 2030, BAU world spending on private cars (purchases, ownership, and roads for them) is projected to exceed \$8 trillion, whereas the EV/Shared scenario trims that by about \$1 trillion (with more people using other modes). By 2050, the **cost divergence** is enormous: BAU might require on the order of \$16 trillion per year to support its vehicles and roads, whereas the sustainable scenario might require only \$8 trillion – a **\$8 trillion/year difference**. That \$8T saving could finance the entire world transit systems (\$1T/yr) **eight times over**. This emphasizes how economically inefficient the

private-car paradigm can be at scale, and conversely how cost-effective a shared electric mobility system could be.



## **2. PART 2. THE BENEFITS OF SUSTAINABLE URBAN MOBILITY**

## 2.1 Direct Economic Benefits and Efficiency Gains

**A** high-electrification, low-private-car urban mobility pathway based on **Avoid–Shift–Improve** strategies offers dramatic improvements in economic efficiency. By 2050, our integrated scenario of compact urban form (avoiding unnecessary travel), robust public/active transport (shifting modes), and electrified vehicles (improving technology) cuts urban passenger transport energy use by over 75% and CO<sub>2</sub> emissions by over 85% relative to business-as-usual. It also reduces total transport system costs by roughly 40% – on the order of \$8–10 trillion in annual savings by mid-century. These efficiency gains create enormous economic value that can be reinvested in other productive sectors and infrastructure.

Several factors make the sustainable mobility scenario far more cost-effective than a car-centric trajectory:

- **Higher vehicle and modal efficiency:** Shared mobility fleets use vehicles much more intensively (rather than sitting idle 95% of the time) and mode shifting to high-capacity transit or active travel dramatically reduces energy and space use per passenger. Together, these changes mean far fewer vehicles and resources are needed to move people, yielding huge cost savings.
- **Energy savings:** By eliminating most oil consumption, the scenario improves national trade balances and energy security. Money no longer spent on gasoline can circulate in the local economy. Electricity (especially from domestic renewables) is cheaper and more stable in price than imported fuel. Studies indicate that transitioning to EVs could save trillions by avoiding fuel costs and refining expenses (Phadke et al., 2021).
- **Reduced congestion and external costs:** With fewer cars on the road, cities experience less traffic delay (boosting productivity through time savings) and lower negative externalities. Improved air quality, safer streets, and less noise all translate into significant social and economic benefits (e.g. lower health care costs and accident expenses).

At the **household level**, this pathway can greatly lower transportation expenses. In car-dependent societies, households often spend around 10–15% of their income on vehicles and fuel. In a shared mobility paradigm, most mobility needs can be met through affordable public transit passes, on-demand rides, or bike-sharing, with no large upfront car purchases. Households pay

only for trips they actually take, freeing up income for other uses. For many families – especially in lower-income groups – a well-designed Mobility-as-a-Service system could significantly reduce the financial burden of mobility.

From a **macro-economic** perspective, the shift to sustainable mobility functions like a broad productivity boost in the transport sector. Trillions of dollars that would have been spent on private vehicles, fuel, and sprawling road infrastructure can be redirected to more productive investments (education, clean energy, etc.). The business-as-usual car-based system is rife with inefficiencies – unused parked cars, fuel wasted in traffic – and removing those inefficiencies removes a drag on economic growth. While substantial public investment is required to expand transit and active mode infrastructure, the net savings of the sustainable scenario provide the resources to do so. Policymakers can redirect a portion of these savings into public transportation and active mobility infrastructure. In short, the sustainable mobility transition is economically prudent: it delivers the same or better mobility with far less wasteful spending, turning the old “climate action vs. economy” narrative on its head.

## *2.2 Social Equity and Access to Mobility*

Beyond cost efficiency, a sustainable urban mobility system delivers profound equity benefits by improving affordable access to transportation. In the car-centric status quo, mobility advantages and disadvantages are unevenly distributed. Those who cannot afford automobiles – often low-income households, youth, the elderly, or persons with disabilities – are left with limited, inferior options. They may endure long, unreliable commutes on inadequate transit or be constrained to a small radius of opportunity. Research has shown that lack of affordable transport can trap people in poverty by restricting access to jobs and services (Lucas, 2012; Banister & Berechman, 2000). Meanwhile, wealthier individuals with cars enjoy fast, flexible travel – a divide that reinforces socio-economic inequality. Car-oriented development also tends to isolate peripheral communities not served by transit and can exacerbate safety concerns (for example, women facing unsafe walking conditions if public transit is poor).

The **High EV/Shared Mobility** scenario can significantly narrow these mobility inequities. Key features that promote a more inclusive transport system include:

- **Affordable mobility services:** By replacing private car ownership with on-demand mobility (rideshare, bike-share, etc.), upfront costs are removed. Mobility-as-a-Service packages allow people to travel as needed without buying a car. With appropriate subsidies or tiered pricing for low-income users, this ensures even the poor have access to basic mobility without crippling expenses.
- **Robust public transport (with last-mile connectivity):** The scenario builds an extensive, high-quality transit network as a backbone, and complements it with on-demand shuttles, shared e-bikes/scooters, and other first/last-mile services. Frequent buses, metros, and trams ensure that even those who cannot drive can conveniently reach jobs, schools, and services, while on-demand micro-transit and shared micromobility extend affordable coverage to low-density or peripheral areas. This combination prevents “transit deserts” and makes reliable mobility available in every neighborhood, effectively bridging the gap between the mobility-rich and mobility-poor. By designing transit and streets for universal accessibility (e.g. wheelchair-friendly stations), even the elderly and disabled can travel independently.
- **Lower cost burdens & economic opportunity:** In the sustainable scenario, overall transport expenditures for a low-income household should drop. No longer forced to own an old car or pay exorbitant fares for informal transport, families can devote more of their budget to food, housing, or education. Improved mobility access also has a well-documented “mobility multiplier” effect on economic inclusion – connecting people to a wider job market and services leads to better employment prospects and incomes (Bryceson et al., 2003). By freeing residents from geographic and financial mobility constraints, the city taps the full potential of its workforce.

Together, these changes make urban mobility more of a **public good**. An individual’s ability to get around is less determined by personal wealth or physical ability and more by a collective provision of services. The broader social effects are considerable. With better transport options, previously marginalized groups (low-income groups, women, young and old individuals, people with disabilities) can participate more fully in economic and social life. Communities become more connected across class and geographic divides when reliable transit links diverse neighborhoods. There are also safety and health co-benefits: improved mobility options also enhance personal safety (by reducing the need for long, risky walks at night) and benefit public health through cleaner air and fewer traffic injuries. By democratizing mobility, the scenario fosters social inclusion and urban quality of life. Ultimately, a sustainable mobility future **levels the playing field** – turning mobility from a

privilege of the few into a basic service for all. Far from being in conflict, climate action in transport, economic efficiency and social inclusion can go hand in hand. A mobility transition that boosts transit, walking, and cycling inherently makes cities more equitable and livable.

### *2.3 Employment and Industrial Transitions*

Transforming the urban mobility system will inevitably disrupt existing industries and labor markets while also creating new opportunities. The shift away from a car-centric model has two major labor implications: **contraction of some conventional automotive jobs** and **growth of new jobs** in transportation services, infrastructure, and clean tech.

On the one hand, producing and servicing fewer private vehicles means the **automotive manufacturing sector** will likely shrink over time. If cities are using far fewer cars (through shared use and longer-lasting electric fleets), annual vehicle production could decline substantially relative to business-as-usual. Electric vehicles also have simpler powertrains and generally require less labor to assemble than combustion-engine cars – an electric motor and battery pack involve fewer precision parts than a complex gasoline engine. Moreover, automation technologies are being adopted in vehicle factories, further reducing labor needs. These trends suggest that without countervailing measures, jobs in conventional auto manufacturing and maintenance (mechanics, engine suppliers, fuel retailers, etc.) will decline. Regions heavily reliant on automaking (like Germany’s auto industry hubs, or the American Midwest) are vulnerable to job losses if they do not adapt. Studies warn of structural unemployment in auto-industrial regions if workers are not retrained for new roles (Marquardt, 2017). Indeed, analyses indicate that without policy intervention, the EV and mobility transition could tilt net employment negative in manufacturing (Jahn, 2016).

On the other hand, the sustainable mobility transition **spurs job growth** in many emerging areas, which can offset – and potentially exceed – those losses. Instead of spending on millions of private cars, society will be investing in transit networks, new mobility services, and electrification projects – all of which are more labor-intensive per dollar:

- **Public transport & infrastructure:** Building and operating transit systems creates a multitude of jobs (civil engineers, construction workers, transit vehicle manufacturers, bus drivers, train operators,

maintenance technicians, etc.). Expanding rail, bus, and cycling infrastructure employs people in the local economy and cannot be easily outsourced. Many studies find that transit investments generate more jobs per expenditure than highway or auto manufacturing.

- **Mobility services:** The growth of shared mobility and “Mobility as a Service” generates jobs in companies providing ride-hailing, car-sharing, bike-sharing, and related services. These range from drivers and fleet managers to app developers and data analysts running the platforms. New mobility business models – micro-mobility rentals, integrated mobility apps, autonomous shuttle services – are essentially part of the digital service economy. This sector can become a significant source of jobs for young tech-savvy workers and entrepreneurs.
- **EV charging and clean energy:** The electrification of transport requires deployment of vast charging networks and upgrades to power grids. This creates demand for electricians, electrical engineers, and construction crews to install and maintain charging stations in cities, along highways, and in parking facilities. Utility companies and specialized firms will hire workers to expand renewable electricity generation, since transport electrification drives up power demand.
- **New manufacturing & tech:** As conventional car output falls, other manufacturing rises – e.g. electric buses, battery packs, micro-mobility devices (electric bikes and scooters), and high-tech components. Producing these at scale offers new manufacturing employment opportunities. Furthermore, the digitalization of mobility (e.g. software for integrated ticketing and traffic management) creates high-skill jobs in software development, data analytics, and IT services.

Studies increasingly suggest that, with the right policies, the net employment effect of this transition can be **neutral or positive**. The labor-intensive nature of transit operations and infrastructure building tends to outweigh the jobs lost in automated vehicle manufacturing. For instance, one European study found that shifting to electric, shared mobility could ultimately create more jobs than it eliminates, since labor-intensive transit operations can outweigh losses in car manufacturing (Cambridge Econometrics, 2018). The outcome, however, depends on managing the transition deliberately.

To ensure the shift is socially **just** and to avoid concentrated job losses, policymakers must implement supportive measures:

- **Retraining and education:** Workers from the auto sector need pathways into growing fields – e.g. a diesel engine mechanic retrained to maintain electric buses, or a factory worker taught to assemble

batteries or install charging stations. Governments can fund vocational training, apprenticeships, and partnerships with industry to equip workers with the new skills needed (electric, digital, etc.).

- **Regional economic diversification:** Automotive-dependent regions should be targeted for investment in new mobility industries. Incentives can encourage EV manufacturers, battery gigafactories, or train assembly plants to set up in former auto manufacturing hubs. This helps replace old jobs with new ones in the same communities. Transition funds and strategic planning can repurpose facilities and retain local workforces.
- **Labor protections and inclusion:** As new jobs are created, ensure they offer decent wages and job security. Policymakers should work with labor unions and employers to bring job standards in line with best practices (Never & Betz, 2014). Also, diversity and inclusion initiatives can ensure that women, minority groups, and displaced workers have access to training and employment in the green mobility sector.
- **Stakeholder engagement and planning:** Involving workers, industries, and local communities in transition planning builds trust and leads to better outcomes. Proactive dialogue (e.g. a national mobility transition task force) can identify upcoming layoffs and mobilize resources in advance. Phasing in policies over time – for example, gradually tightening emission standards while scaling up alternative industries – allows labor markets to adjust and workers to find new opportunities.

It is also important to recognize the **indirect economic benefits** that a sustainable transport system provides. Better urban mobility improves overall economic productivity by reducing travel delays and connecting employers with a larger labor pool. It can spur growth in sectors like tourism (cities with good public transport and walkability are attractive destinations) and retail (pedestrianized, transit-served districts tend to be economically vibrant). These broader effects mean the transport transition can catalyze job creation beyond the transport sector itself, amplifying the employment gains.

Notably, regions with strong automotive industries today have an opportunity to reinvent themselves as leaders in the new mobility economy. They can leverage their engineering expertise, skilled workforce, and industrial base to manufacture electric buses and trains, develop smart mobility software, or export integrated mobility services. Reframing transport as a service and investing in innovation can allow these regions to remain competitive and even **increase** employment while meeting climate goals. In effect, the same companies and workers that once built combustion-engine cars can be at the

forefront of building the sustainable mobility systems of the future.

The transition to sustainable urban mobility can be managed to **boost net employment** and distribute benefits widely, but it will not happen automatically. It requires foresight and supportive policies to protect workers and communities through the change. If handled correctly, the outcome is a win-win: a cleaner, more efficient transport system that also **delivers good jobs** and greater social equity. A proactive, inclusive approach to governance is essential – which is the focus of the next part of this report.

## **PART 3. POLICY AND GOVERNANCE REFORMS FOR SYSTEMIC CHANGE**

Achieving the sweeping changes in our high-EV, low-car scenario is not primarily a question of technology – it is a question of governance and institutions. A supportive policy and institutional environment is essential to enable a systemic urban mobility transformation. Key governance dimensions include coordination across levels of government, integrating policies across sectors, building coalitions for change, and reorienting financial flows.

### *3.1 The Need for Integrated Multi-Level Governance*

Urban transport involves multiple jurisdictions and stakeholders, so multi-level governance alignment is critical. Cities control local land use, public transport operations, and street design; they are on the front line of implementing bike lanes, bus rapid transit, pedestrian zones, and congestion charges. However, they often depend on national and state frameworks for funding and authority. National governments set vehicle standards, fuel taxes/subsidies, and climate targets, and they allocate budgets for infrastructure. If local and national policies are not coordinated, they can undermine each other – for example, a city’s push for cycling might be counteracted by national fuel subsidies encouraging driving, or a country’s EV incentives might stall if cities fail to install chargers. Similarly, metropolitan regions require coordination across municipal boundaries (e.g. a regional transport authority to integrate suburban rail and bus networks). Successful mobility transitions therefore require vertically integrated policy packages: cities, regions, and national governments working in concert toward shared objectives (Lah, 2017). Some national governments now provide dedicated funding and legal authority to cities for sustainable transport initiatives, illustrating the importance of top-down support. International cooperation (through development banks and city networks) further aids knowledge transfer and financing for big projects. In essence, all levels of governance must pull in the same direction; aligning their strategies avoids fragmentation and unlocks synergies.

### *3.2 Policy Integration and Co-Benefit Packaging*

Just as important is horizontal integration of policies across sectors and objectives. Transport, land use, environment, and finance policies have historically been siloed, but a sustainable mobility transition demands a coordinated package. An integrated policy package combines regulatory measures, investments, and pricing incentives so that they reinforce each other. For example, a city might introduce a low-emission zone (banning the most polluting vehicles) while simultaneously expanding transit service and offering electric vehicle incentives – making the clean option convenient and

affordable. Likewise, discouraging sprawl through land-use planning (e.g. transit-oriented development) complements investments in mass transit, creating a virtuous cycle of accessible, compact urban growth. By packaging policies, governments can also maximize co-benefits and build broad support. A cycling infrastructure plan, for instance, can be framed not only as a climate measure but also as a public health and safety initiative (since it reduces air pollution and traffic accidents). This framing appeals to diverse constituencies, thereby forming coalitions for implementation. Well-designed packages can actually lower the total cost of achieving climate and mobility goals (Justen et al., 2014). In essence, the Avoid–Shift–Improve elements work best in unison: vehicle electrification must go hand-in-hand with mode shift and demand management. Achieving such coordination often requires breaking bureaucratic silos – for example, creating joint planning teams across transport, urban planning, and environment departments. By planning transport, urban development, and energy in tandem, cities can ensure that each policy lever (regulations, infrastructure, incentives) complements the others, leading to greater overall impact.

### *3.3 Overcoming Institutional Barriers and Vested Interests*

A major challenge for systemic change is overcoming the inertia of existing institutions and the resistance of vested interests. Decades of car-oriented planning have built up powerful interests – automotive industries, oil lobbies, highway departments, and even cultural preferences – that can slow down change. Governance reform must tackle these barriers through deliberate shifts in mandates and coalitions. Key steps include:

- **Institutional reorientation:** Agencies and ministries historically focused on road-building and automobile promotion need to redefine their missions toward providing **mobility for people**. For example, a city transport department can shift from merely managing traffic flow to prioritizing public transit, pedestrian safety, and emissions reduction. Traditional highway departments can be transformed into mobility agencies that also support transit, walking, and cycling.
- **Phasing out perverse incentives:** Governments should identify and gradually remove policies that unintentionally encourage car dependence – such as fuel subsidies, tax breaks for company cars, or parking minimums in zoning. Phasing these out is politically difficult but feasible with strong leadership and measures to cushion vulnerable groups (for example, redirecting fuel tax revenue to improve affordable transit).
- **Building coalitions:** Successful transitions often depend on forging

**multi-actor coalitions** that can outweigh the opposition of entrenched interests (Lah, 2024). City mayors, businesses interested in clean technology or livability, public health advocates, transit rider organizations, environmental NGOs, and labor unions can find common cause in sustainable mobility reforms. By uniting these stakeholders around co-benefits – cleaner air, safer streets, modern urban services, job creation in transit and EV industries – policymakers can counterbalance traditional lobbies. Notably, even some automakers and tech companies are now investing in EVs and shared mobility, aligning themselves with the new direction given the right policy signals.

- **Long-term vision and policy stability:** Because transport investments and mode shifts play out over decades, consistent policy direction is vital. Frequent political reversals (one city administration builds bike lanes, the next tears them out) can derail progress. To guard against this, governments can enshrine long-term targets in law (e.g. a national commitment to net-zero transport emissions by 2050) and set up independent bodies to monitor progress. Developing all-party or multi-stakeholder agreements on key initiatives (for instance, a metropolitan mobility plan that survives successive mayors) also helps. Institutionalizing public participation in planning – so that citizens have a voice in the vision – can make policies more resilient to political shifts.

By addressing these institutional factors, cities and countries can break out of the status quo path dependency. The case of road safety provides a hopeful analogy: many countries managed to drastically cut traffic fatalities by changing institutional mindsets and priorities (adopting Vision Zero goals, reforming traffic laws, etc.) even against initial resistance. Similarly, transport decarbonisation can move from niche to mainstream if it is embedded in core agency missions and supported by a broad consensus.

### *3.4 Adopting a "Safe System" Approach for Sustainability*

We draw inspiration from the **"Safe System"** approach in road safety to guide sustainability governance. The Safe System philosophy, originally developed to eliminate traffic fatalities (Tingvall & Haworth, 1999), holds that the transport system should be designed to be safe by default – engineers, policymakers, and vehicle manufacturers share responsibility to ensure that inevitable human errors do not result in serious harm. Instead of blaming individual road users, the system is built so that safe outcomes are the norm. We propose an analogous mindset for decarbonising and improving urban mobility: the system should be **designed for sustainability by default**, rather than relying on individual behavior change alone (Lah, 2024). In practical terms, this means:

- **Make sustainable modes the easiest and most reliable choice:** Clean and efficient mobility options must be the most convenient, available, reliable and affordable. If clean options like reliable public transport and safe cycling and walking routes are far more convenient, then these modes become the natural choice for most trips. People should not have to sacrifice convenience to behave sustainably; the system has to favour low-carbon travel by design.
- **Align prices and policies with societal objectives:** Individuals respond to the incentives and disincentives built into the system. In a sustainability Safe System, pricing and regulations automatically guide behavior in the right direction. For example, fuel taxes or urban road pricing can internalize environmental costs so that driving is more costly and clean modes are relatively cheap. Emission standards, low-emission zones, and parking limits likewise nudge travelers away from high-carbon choices automatically. In essence, policy should lock in sustainable behavior at a broad scale, just as seat-belt laws and speed limits improved safety system-wide.
- **Lock in infrastructure for low-carbon mobility:** Infrastructure investments have long-lasting effects. A Safe System for sustainability prioritizes infrastructure that will inherently shape travel toward sustainability decades into the future – for instance, building comprehensive transit networks, safe pedestrian areas, and bike highways, while refraining from projects (like new urban highways) that reinforce car dependence. This creates a path dependency in favor of sustainable travel, ensuring that even if political winds shift, the built environment continues to facilitate low-carbon choices.

Adopting this Safe System approach implies a shift in accountability: it is not only travelers who must choose rightly, but system designers (planners, engineers, officials) who must deliver conditions under which the sustainable choice is the default. It fosters a culture of shared responsibility – government, industry, and communities all collaborate to achieve safety and sustainability outcomes. Rather than putting the onus on individual virtue (“drive less”), authorities accept responsibility to provide good alternatives and shape incentives. This approach encourages continuous improvement: if emission or safety targets are missed, policy makers treat it as a system design issue and fix policies or infrastructure, rather than blaming users. Concretely, governance innovations following this ethos could include multi-stakeholder “mobility transition councils” that regularly convene city officials, transport providers, employers, and citizen groups to review progress and troubleshoot challenges. The Safe System perspective thus cultivates a problem-solving partnership among all actors and helps maintain momentum through political cycles.

### 3.5 Aligning Finance and Investment

Realigning financial flows and incentives is a crucial part of systemic change. A sustainable mobility future will not materialize without shifting how trillions of dollars are spent. Governments should reform how they evaluate and budget transport projects to fully account for social costs and benefits. Traditional methods often undervalue transit or cycling because they ignore external benefits like cleaner air, climate protection, and health improvements. Updating appraisal guidelines to include climate, health, and equity impacts (Litman, 2019) will make sustainable projects clearly more cost-effective and help steer investments away from carbon-intensive infrastructure.

New financing mechanisms are also needed to fund transit and active mobility. Cities can leverage public-private partnerships and capture the increase in land values around transit (“land value capture”) to finance new lines. Revenues from congestion charges or carbon pricing can be earmarked for improving public transportation. Equally, governments should redirect spending away from new highways and eliminate fossil fuel subsidies, using those funds to support clean mobility. For example, phasing out fuel subsidies or generous car allowances and investing the savings in transit upgrades or e-bike incentives directly shifts resources toward sustainable modes. Such reforms should be structured to be equitable – for instance, protecting low-income commuters by concurrently lowering transit fares or providing targeted rebates.

International development finance also has a role: multilateral development banks and climate funds are increasingly prioritizing sustainable transport projects (mass transit, transit-oriented development, electric bus fleets) and can provide low-interest loans or grants, especially in emerging economies. Building local capacity to plan and execute such projects is part of governance reform, ensuring cities can absorb and effectively use available green finance.

Aligning financial incentives with sustainable mobility **means making the money match the mission**. By reforming analyses, budgets, and funding strategies, policymakers can ensure that economic signals and funding flows support – rather than hinder – the transition. When the true benefits of sustainable transport are recognized and its projects find funding, the economic efficiency of the scenario (as discussed in Part 1) can be realized in practice.

### *Discussion: Towards a Safe and Sustainable System: A Transformative Pathway*

The changes required amount to a paradigm shift rather than marginal adjustments. Small improvements – a bit more fuel efficiency here, a new bus line or bike lane there – will not keep pace with rising travel demand or overcome entrenched problems like induced traffic and rebound effects. Avoiding a high-carbon, gridlocked future requires a fundamental, systemic shift in urban mobility, simultaneously addressing technology, infrastructure, and behavior through an integrated strategy.

Relying on a single solution or on individuals to voluntarily change habits is not sufficient. For instance, electrifying all cars without reducing car dependence would still leave congestion and access problems unsolved. A comprehensive approach is needed – combining compact land-use planning to avoid excessive travel demand, large-scale improvements in transit and active travel options to enable mode shift, and vehicle electrification for remaining trips. Sustainability must be built into the urban environment by default (Lah, 2024): setting bold standards (e.g. phasing out combustion engines by a certain date), redesigning streets to prioritize transit, walking and cycling, and implementing pricing that discourages high-emission travel. The goal is that the easiest way to get around is also the cleanest and safest way.

The urgency to act on this transition cannot be overstated. Because infrastructure and urban form change only slowly, decisions made in the 2020s will determine the 2040s. Delaying action risks locking in car-dependent patterns that are hard to reverse. To meet climate targets and avoid irreversible trends, major steps – from phasing out internal combustion engines and establishing zero-emission zones to massively expanding transit and cycling networks – must be initiated now, not decades later. Early action also secures the economic benefits sooner and gives industries and workers more time to adapt.

There is also a competitive and strategic element: cities and countries that lead in this transition will also gain economic advantages. Pioneering clean mobility technologies and services can create new industries and jobs, and cities with superior transportation and quality of life are more successful in attracting businesses and talent. In contrast, those that cling to outdated models risk seeing their industries fall behind and their cities become less competitive and less liveable.

Many benefits of sustainable mobility materialize quickly – less congestion, cleaner air, safer streets, more vibrant public spaces – which helps convert skeptics and

build public support. People notice when buses run smoothly, bike lanes make commuting easier, or air pollution drops, and they often come to support and even demand further changes. These positive feedbacks mean that bold initial steps can create momentum for the transition.

Transformative changes often encounter resistance from status-quo interests or skeptical citizens. Leaders – whether mayors, ministers, advisors, entrepreneurs or community organizers – must clearly communicate the long-term vision (safer, healthier, more inclusive cities) and push through difficult decisions (such as reallocating road space from cars to people). When citizens see the tangible improvements, initial resistance can turn into broad support. Keeping the public involved and informed throughout helps maintain momentum across political cycles.

Moving to a sustainable urban mobility system is undeniably challenging, but it is achievable and enormously beneficial. **Incremental changes will not suffice** – a coordinated, systemic transformation is imperative. The reforms highlighted above – better governance, integrated policy packages, new coalitions, and a Safe System design approach – provide a roadmap for this transition. The next section summarizes the key policy recommendations and implications for decision-makers.



# **CONCLUSIONS AND POLICY IMPLICATIONS**

Our analysis of a high-electrification, low-private-car future for urban transportation demonstrates that such a paradigm is not only technically feasible and environmentally necessary, but also economically prudent and socially beneficial. By 2050, a global urban mobility system rooted in electrification, shared mobility, public transit, and active travel can slash energy use and emissions by an order of magnitude, deliver trillions in net savings, and vastly improve quality of life in cities. These findings overturn the misconception that climate mitigation in transport comes at economic or social cost. On the contrary, the sustainable pathway provides an array of direct and indirect benefits for the economy and society.

Realizing this potential requires strong and sustained policy action starting now. The window to avoid locking in a high-carbon, car-dependent future is time-bound – decisions made in the 2020s (about urban development, vehicle technology, infrastructure investments) will shape travel patterns for decades. Below we outline key policy implications and recommendations to enable the transition to sustainable urban mobility:

1. **Set a Clear Vision and Targets:** Policymakers at all levels should articulate a bold long-term vision for sustainable, zero-emission mobility, backed by concrete targets. A clear vision (analogous to “Vision Zero” for traffic safety or national net-zero emissions pledges) provides direction and accountability. To be embedded better in society and the economy a stronger emphasis on the social and economic benefits, without losing sight of climate targets, can help shaping the narrative, highlighting the benefits rather than limiting factors of sustainable mobility.
2. **Invest in Public Transport and Active Transport Infrastructure:** Make a massive scale-up of public transport and active mode infrastructure a top infrastructure priority. Governments should significantly increase funding to expand and upgrade urban mass transit systems – metro and commuter rail lines, bus rapid transit (BRT) corridors, modern electric bus fleets – treating these investments as essential infrastructure on par with highways or utilities. At the same time, allocate substantial resources to pedestrian and cycling infrastructure: wide sidewalks, protected bike lanes, and safe intersections in all urban neighborhoods. The returns in terms of congestion relief, emissions reduction, and accessibility justify the expense. While public-private partnerships and international development funds can help, much funding must be reallocated domestically (e.g. shifting budgets from road expansion toward transit and active modes). The payoff is cities that move people much more efficiently and equitably.

3. **Implement Demand Management:** Complement improvements in alternatives with policies that actively disincentivize private car use in dense urban areas. Effective tools include congestion pricing or urban road tolls (as implemented in London, Singapore, Stockholm), low-emission zones that restrict or charge the most polluting vehicles, and stringent parking policies (reducing minimum parking requirements, pricing street parking, and limiting parking supply in transit-rich areas). These measures send a market signal that driving in crowded city centers imposes costs on society, and they encourage commuters to switch to cleaner modes. Although politically challenging, such measures can be phased in gradually and framed as part of a broader plan that uses the revenue to improve public transport, which increases public acceptance. Cities that have implemented these policies have seen notable drops in traffic and pollution, and the revenues have been usefully reinvested in transit upgrades.
4. **Electrify All Vehicle Fleets:** Alongside modal shift, pursue aggressive vehicle electrification for the remaining motorized travel. Set clear timetables and regulations to transition all new vehicle sales to zero-emission – many leading jurisdictions are already targeting 2035 or earlier for 100% zero-emission new car and bus sales. Implement supporting policies: purchase incentives or tax credits for EVs in the early market phase; strict fuel economy or emission standards that effectively require a shift to EVs; and robust investment in charging infrastructure (streamlined permitting for private chargers and public installation of widespread fast-charging stations, especially in underserved areas). Electrifying public bus fleets should be a priority given the immediate benefits for urban air quality and the exemplary effect it has. A clear regulatory trajectory (such as zero-emission vehicle mandates) gives industry certainty and accelerates innovation and cost reduction in clean vehicle technology.
5. **Integrate New Mobility Services with Transit:** Embrace emerging mobility services (ride-hailing, car-sharing, micro-mobility) as complements to public transit rather than competitors. Regulators and transit agencies should collaborate to integrate these services into the overall transport network – for example, via integrated journey-planning apps and unified payment systems that allow a traveler to use an on-demand shuttle, a train, and a shared bike on one ticket. Cities can set rules so that ride-pooling services fill transit gaps (e.g. serving off-peak or low-density areas) rather than merely poaching riders from existing transit lines. Data-sharing requirements can ensure city planners have access to anonymized usage data from private providers, enabling better planning of the combined system. By steering new mobility to first/last-

mile roles and hard-to-serve markets, policymakers can harness innovation to enhance the reach and convenience of public transport, rather than undermine it.

6. **Prioritize Equity in Mobility Policies:** Embed equity considerations in all transportation policies so that the benefits of sustainable mobility are widely shared and no group is left behind. For example, provide discounted transit fares or credits to low-income residents (using revenues from pricing policies to fund them); ensure new transit lines and bike lanes reach poorer and peripheral neighborhoods, not just city centers; and build in measures (exemptions, rebates, improved transit alternatives) to protect those who might be disadvantaged by policies like congestion charges or low-emission zones. Engage disadvantaged communities in the planning process to identify needs (better wheelchair access, safer routes, etc.) and ensure a just transition – one where cutting emissions and congestion also improves mobility options for historically underserved populations.
7. **Manage the Employment Transition:** Prepare the workforce for changes in transport-sector jobs and actively support workers in transitioning to new roles. Governments should work with industry and labor unions to establish retraining and upskilling programs for jobs in the emerging mobility ecosystem – for example, helping automotive production workers learn skills for electric vehicle manufacturing or battery assembly, and training conventional mechanics to service electric drivetrains. Simultaneously, spur job creation in new mobility sectors by incentivizing EV manufacturing, battery production, and charging infrastructure enterprises (especially in regions losing traditional auto jobs). Expanding public transit also directly creates good jobs (drivers, maintenance technicians, etc.), which can absorb workers leaving declining industries. Governments can use procurement and industrial policies to favor local production of buses, trains, and batteries, anchoring new employment domestically. Include labor groups in transition planning to reduce resistance. If managed well, the sustainable mobility shift can yield a net gain in jobs – in transit operations, construction, and clean-tech – that more than offsets losses in legacy auto sectors.
8. **Strengthen Institutions and Governance:** Implement governance reforms that support an integrated, long-term approach to sustainable transport. Cities should develop and regularly update comprehensive Sustainable Urban Mobility Plans (SUMPs) that integrate transport, land use, and environmental objectives in line with climate targets. National governments can support this by tying funding to such plans and

ensuring local actions align with national commitments. Establish interdepartmental and intergovernmental coordination bodies (e.g. a transport-climate council including transport, energy, finance ministries and city leaders) to break silos and harmonize policies. Strengthen metropolitan transport authorities to plan and manage transport across municipal boundaries. Institutionalize citizen participation in planning to build support and accountability. To ensure consistency over time, embed key mobility and emission targets in law and set up independent bodies to monitor progress and uphold long-term commitments.

9. **Leverage the “Safe System” Approach for Sustainability:** Learn from the advancements in road safety and transfer it to the sustainability realm. Applying the Safe System mindset means that unsustainable mobility patterns are a system design failure rather than an individual failure. This puts a bigger focus on the provision of infrastructures, services and regulations that enable transport users to be mobile in a sustainable way, which changes the culture in transport agencies of proactive adjustment of the physical and regulatory system and service provision
10. **Foster Innovation and Experimentation:** Embrace innovation, pilot projects, and adaptive learning as part of the policy process. Given rapid technological changes, cities should allow “sandboxes” or trial runs for new mobility ideas. For example, pilot an autonomous electric shuttle service on a feeder route to gauge impacts. Learn from these tests and iterate. Invest in smart city technologies (IoT sensors, data platforms, AI for traffic management) to optimize the system and spur private-sector innovation. Guide innovation toward societal goals: encourage ideas that reduce car dependency, and set boundaries on those that might increase congestion or energy use.

Transforming urban mobility is a complex, long-term endeavour that demands political will, public support, and continuous adaptation. Yet the rewards for pursuing sustainable mobility are tremendous and multi-faceted: cleaner air, safer and more inclusive streets, reduced public and private spending on transportation, and a meaningful contribution to climate stability. The alternative – clinging to the status quo – would impose far greater costs and risks in the long run, from climate-related disasters to public health crises and endless economic waste on congestion and oil dependency.

Cities have repeatedly reinvented their transportation systems when faced with new challenges and opportunities – from horse-drawn carriages to streetcars to automobiles. Today, we have the opportunity to reimagine our cities and mobility – aiming for an inclusive, human centred and efficient transport system that drives economies and enables participation in society at least cost. By

combining resource and energy efficient form of electric mobility, sharing, and active mobility, and by implementing the forward-looking policies outlined above, we can usher in an era of sustainable urban mobility that provides efficient access for all. This transition is not a utopian ideal driven by environmental concerns, it is a practical economic consideration that combines future-ready. The evidence presented here makes a compelling case that a high-electrification, low-car strategy is the most cost-effective and equitable path forward. It is now up to public officials, businesses, and communities to turn this vision into reality – ensuring that the cities of 2050 are green, inclusive, and prosperous for generations to come.



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