SUSTAINABLE CITIES THROUGH TRANSPORT: OPTIMISING URBAN INVESTMENTS IN AFRICA

ITDP

GROUPE DE LA BANQUE AFRICAINE DE DÉVELOPPEMENT
AFRICAN DEVELOPMENT BANK GROUP

Urban and Municipal Development Fund

VERSION 1.0

SEPTEMBER 2024

PREPARED BY

Carolyne Mimano, Chris Kost, and Taylor Reich, ITDP

Lew Fulton, UC Davis

ACKNOWLEDGEMENTS

The publication reflects suggestions and contributions from many stakeholders. We would like to express our sincere gratitude to them for offering their time and expertise.

Special thanks to Arturo Ardila-Gomez, World Bank; Alex Johnson, industry expert; Bob Stanway, industry expert; Constant Cap, UNEP; John Mark Mwanika, industry expert; Malindi Msoni, Zambia Institute for Policy and Research (ZIPAR); Magnus Lincoln Quarshie, industry expert; Michael Muchiri, Ministry of Roads and Transport, Kenya; Michael Kihato, industry expert; Rehana Mosajee, industry expert; and Winnie Mitullah, University of Nairobi.

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CONTENTS


SDE-SDER
SUNUBRT
143

EXECUTIVE SUMMARY

Africa's urbanisation is accelerating the demand for sustainable transport solutions. However, current investments are still heavily skewed towards private vehicle infrastructure, leading to traffic congestion, environmental degradation, and limited access to efficient public and non-motorised transport (NMT) options. **Sustainable Cities Through Transport: Optimising Urban Investments in Africa** examines pathways to address these issues by prioritising mass rapid transit, walking, and cycling, offering a vision of inclusive, low-carbon urban mobility.

The report outlines four investment scenarios: Business-as-Usual (BAU), Electrification, High Shift, and High Shift + Electrification. Under the BAU scenario, continued road expansions and car-centric infrastructure result in worsened congestion, increased emissions, and rising transport costs. The Electrification scenario focuses on transitioning to electric vehicles (EVs), which, while beneficial for reducing fuel consumption and air pollution, does not resolve congestion or improve urban accessibility. In contrast, the High Shift scenario, which emphasises significant investments in public transport and NMT infrastructure, presents a compelling solution. This approach envisions cities developing bus rapid transit (BRT) networks, cycle tracks, and pedestrian-friendly streets. It aims to transform urban mobility and reduce cumulative CO_2 emissions by 5,078 million metric tons of CO_2 equivalent (Mt CO_2e), which is well below the 1.5°C warming threshold, and also reduce urban infrastructure investment costs by over USD 2,140 billion. The High Shift + Electrification scenario combines the benefits of sustainable transport systems with electrification, delivering additional environmental and cost-saving advantages.

Financing sustainable urban transport is critical to achieving these outcomes. To support large-scale investments in BRT, cycle networks, pedestrian infrastructure, and electrified transport systems, governments must leverage a combination of public funds, private sector participation, and development finance. The report emphasises the need for clear, long-term investment strategies aligned with urban development goals. Mechanisms such as public-private partnerships (PPPs), international development loans, and innovative financing models like land value capture can help mobilise the necessary capital. Additionally, implementing demand management tools like congestion pricing and dynamic parking fees can generate revenue to support ongoing transport investments.

By adopting a comprehensive financing strategy and prioritising sustainable mobility, African cities can unlock significant economic, social, and environmental benefits. These investments will help create more equitable, accessible, and low-carbon cities that are prepared for the challenges of the future.

Figure 1. The 100% electric BRT system in Dakar, Senegal, launched in May 2024.

1 INTRODUCTION

Africa's economic potential is intrinsically linked to the development of transport infrastructure, which is vital for fostering economic growth, facilitating trade, and improving quality of life. Although need for long-distance trade corridors that enable the movement of goods has dominated the discourse around transport in the region, equally critical are the facilities for moving people in cities. As Africa becomes an urban continent, cities will require transport systems that are inclusive, efficient, and safe for all.

Presently, urban transport in Africa is characterised by the prevalence of unregulated, informal public transport. In the absence of dedicated road space for public transport, buses and minibuses are stuck in traffic, resulting in time-consuming and expensive trips. Most corridors lack well-designed walking and cycling facilities, and street designs usually prioritise the convenience of private cars over the needs of pedestrians and cyclists. Countries often lack proper design standards for urban streets, and existing manuals prioritise motorised vehicles over non-motorised modes of transport. Continued investments in road infrastructure and urban highways are inducing a shift to greater private vehicle use, resulting in growing congestion, travel costs, road safety risks, and greenhouse gas emissions.

Moving forward, African cities can move past the traditional focus on car-centric infrastructure and invest in innovative, low-carbon active mobility and public transport solutions. Investments in mass rapid transit corridors—especially bus rapid transit (BRT)—and improved city bus fleets dignify travel for users, making public transport attractive for all. Complete street designs improve safety and enhance the quality of life.

The key benefits of investing in comprehensive urban transport systems include reduced congestion, reduced fuel consumption, and travel time savings. Better access to jobs, education, and economic activities stimulates economic growth and boosts local businesses. In addition, sufficient investment in equitable non-motorised transport facilities and public transport systems leads to social equity, reducing income inequality and promoting social inclusion. Urban residents enjoy a better quality of life characterised by safer and more stress-free commutes. In this brief, the Institute for Transportation and Development Policy (ITDP) and the African Development Bank (AfDB), quantify the key economic and environmental benefits that can accrue from robust investments in sustainable, electrified urban mobility systems in the Africa region.

Despite the myriad of benefits associated with sustainable urban transport, investments in the sector are lagging. In the Africa region, public transport sector reforms are seen as risky, while non-motorised transport (NMT) is deemed old-fashioned and unnecessary. There is an urgent need to develop a long-term vision for cities, invest in adequate planning, and build the political will for systemic changes. By developing clear implementation plans and timelines, borrowing from global practices adapted for local context, and ensuring transparency in project implementation, African countries can de-risk urban transport projects and attract greater investment.

Figure 2. The car-free Agha Khan Walk in Nairobi, Kenya.


Afya kwa Kila

2 ASSESSING SUSTAINABLE TRANSPORT OPTIONS

Despite the slow growth in urban transport investments, an increasing number of cities are awakening to the immense benefits of comprehensive public transport, walking, and cycling networks. The allure of electrification also presents a compelling opportunity to reduce transport costs and counteract the mounting climate crisis. In this section we evaluate the key opportunities that government can leverage in order to adequately invest in urban transport, drawing lessons from case studies in the region. Cities can achieve the strongest impacts for residents and the climate by adopting a comprehensive approach incorporating effective land use planning policies, quality public transport systems, NMT, and parking management.

2.1. DESIGNING SUSTAINABLE CITIES

Key principles in designing sustainable cities include efficient land use and compact urban form, encouraging mixed-use development that integrates residential, commercial, and recreational spaces and minimising sprawl. Compact development optimises the use of infrastructure, resources, and energy, contributing to overall sustainability.

Transit-oriented development (TOD) can mitigate many of the impacts of poorly planned urban sprawl, including low-rise, fragmented development with poor provision of services and inadequate space allocated to streets, urban transport, and public spaces. Proactively planning for transport means ensuring the key transport corridors are identified and the pre-requisite right of way is allocated to appropriate mass rapid transit, walking, and cycling infrastructure based on demand. Cities should also prioritise green spaces. Urban greenery not only enhances aesthetics, but also contributes to improved air quality, temperature regulation, biodiversity, and a sense of community.

Given the diversity of urban forms in African cities, planners need to take a nuanced approach to developing TOD policies. In formal areas, cities can update building codes to mandate pedestrian-friendly urban design and eliminate off-street parking requirements. Informal areas require attention to land tenure, street improvements, and service provision, including upgrades in water, sewer, and drainage systems. Incremental in-situ upgrading of informal areas is a powerful means of improving services while minimising displacement of existing residents and businesses.

2.2. AVOIDING URBAN HIGHWAY CONSTRUCTION

Many cities have tended to design urban roads to maximise the amount of space for motor vehicle movement. Yet vehicle movement and mobility are not one and the same. Mobility is about getting people to where they want to go, efficiently, conveniently, and safely. Intercity highways and trade corridors should be efficiently redesigned when they get to urban areas.

While a road widening, flyover, or elevated highway may reduce congestion in cities temporarily, the improvement is usually short-lived. The reason is simple: expanding the available road space initially increases speed and comfort and thereby encourages people to travel more often and take longer trips in private motor vehicles. More and more users take to the route until the wider road returns to its original level of congestion—but with significantly more vehicles stuck in traffic. In addition, urban flyovers segregate neighbourhoods, reducing economic growth in those areas (ITDP, 2021). The government in turn may feel pressure to widen the road once again, but it is not possible to solve traffic jams by building larger and larger roads indefinitely. In fact, no city in the world has solved its mobility crisis by simply building more roads. On the contrary, some of the cities with the most elaborate road networks also have the worst congestion. New roads threaten historic urban neighbourhoods, and concentrate air pollution in highly populated areas, threatening people's health and causing other problems. Several cities, including Portland, San Francisco, and Seoul, have demolished urban highways due to these reasons.

Figure 3. A BRT terminal in Dar es Salaam, Tanzania.

Figure 4. Urban highways often segregate communities and marginalise vulnerable road users, leading to road safety challenges.

This action resulted in the reclamation of valuable urban real estate and subsequent redevelopment, resulting in increased tax revenue for these municipalities (ITDP and EMBARQ, 2012).

Mass rapid transit modes can carry large numbers of passengers without an exponential increase in road space requirements. A single BRT lane can carry 13,000 passengers per hour per direction (pphpd), and if passing lanes are added at stations, the capacity increases to 45,000 pphpd. The same lane can carry 800 cars per hour—only 1,200 to 1,600 persons at typical occupancy rates—assuming that the lane receives one half of the signal time at intersections. In narrower corridors with limited space, staggered stations can be used to incorporate passing lanes, ensuring the BRT system remains efficient and maintains high service quality.

Urban street design should accommodate all road users which including pedestrians, cyclists, public transport passengers, motorists, and freight transport. In addition, urban streets should ensure comfort and liveability by addressing key issues such as safety, efficiency, universal access, gender-sensitive designs, child-friendly streets, and environmental sustainability. Once an efficient public transport system is in place, governments can implement travel demand management policies to mitigate congestion, as described in section 2.8 below.

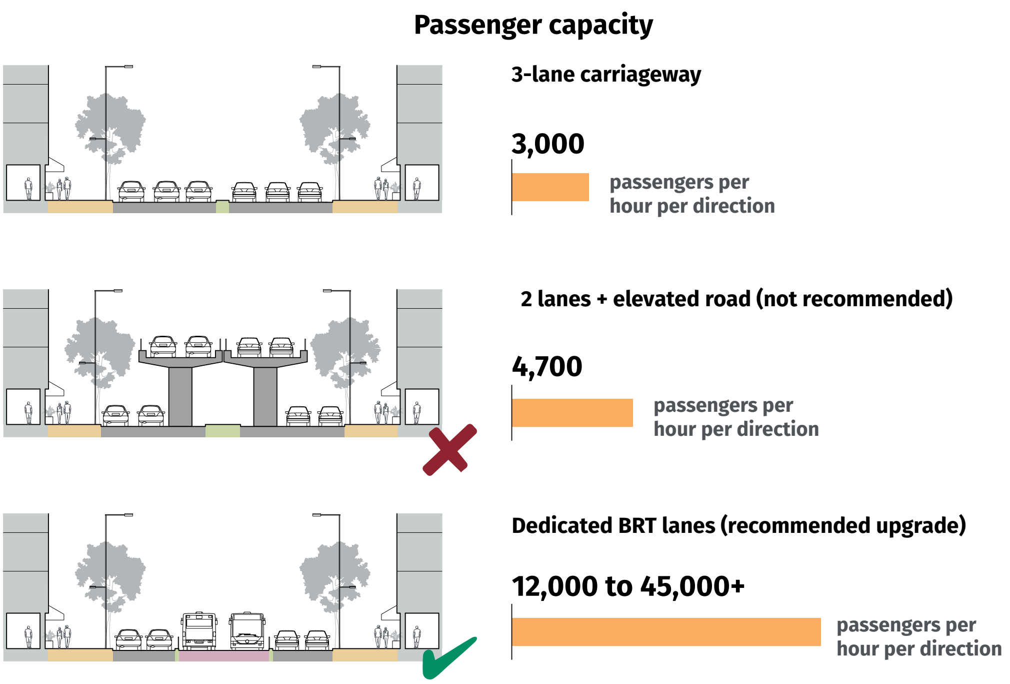

Figure 5. Dedicated public transport lanes can carry an order of magnitude more people than car-centric infrastructure.

2.3. SELECTING PUBLIC TRANSPORT MODES

To design and implement efficient mass rapid transit systems, governments need comprehensive data on commuter movements within cities, including the frequency of services, vehicle occupancy levels, and boarding and alighting patterns, among other critical aspects. With travel demand data in hand, governments can construct demand models, enabling the identification of the most efficient routes and mass rapid transit (MRT) modes. Interviews with the public can help enrich quantitative information and reveal issues that commuters face. For small and medium-sized cities, efficient formal public transport services should be encouraged. Sustainable urban planning should be prioritised to ensure these cities grow sustainably and allocate equitable resources to all transport modes. New public transport systems should facilitate seamless movement for commuters, minimising the number of transfers required during their journeys and enhancing reliability.

Governments can prioritise corridors for MRT implementation based on a quantitative analysis of factors such as existing public transport demand and the speed of existing public transport services. Next, the choice of an appropriate MRT mode of transport for a corridor involves a comprehensive evaluation to ensure efficiency, sustainability, and responsiveness to community needs. While one mode of transport can work for one city or corridor, it might not be the most appropriate for another. The following are factors governments can consider when choosing the most appropriate mode:

- **Capacity**: A crucial consideration is the level of capacity required along the identified corridor. Metro systems offer high capacity in comparison to other modes. High-end metro systems like the one in Hong Kong are known to have a capacity of over 80,000 passengers per hour per direction (pphpd). More typically, metros have a capacity of less than 30,000 pphpd. BRT systems can be designed for a wide range of demand levels. With small modifications to station designs, bus sizes, and operations, the capacity can be enhanced in a modular fashion. BRT capacity can start as low as 4,000 pphpd and go up to 13,000 with a single lane per direction at stations and as high as 45,000 pphpd with passing lanes. Light rail transit (LRT) systems have a capacity of around 14,000 pphpd, similar to a single-lane BRT system.
- **Capital and operational costs:** Metro systems, although offering high capacity, remain one of the most expensive forms of MRT, at over USD 100 million per kilometre. Governments and cities in the Africa region often associate metro systems with prestige and modernity. As a result, more cities are planning for expensive metro system where the demand does not warrant the heavy outlay associated with the technology. Given the fiscal challenges in most countries, governments are better off investing in BRT systems, which have adequate capacity and much more affordable implementation costs of around USD 10 million per kilometre. For the cost of a few kilometres of metro, a city can implement a full BRT network. The operational costs of BRT systems are considerably lower than that of commuter rail, light rail, and metro systems.
- **Flexibility:** Rail systems can be more efficient for longer direct trips with minimal transfers. In a rail system, passengers need to navigate stairways, corridors, and multiple platforms if they want to switch between two lines that meet at a transfer station. In a BRT system, the bus itself can turn from one corridor to another, allowing passengers to stay on the same vehicle all the way to their destination. Since buses can move freely among multiple corridors, direct services can be provided for all of the major origin-destination pairs in the system. In addition, buses are not limited to the dedicated BRT corridors—a bus can travel anywhere there is a road. With buses with doors on both sides, the routes can extend beyond the network of dedicated corridors, where needed. Direct services bring the system closer to the user’s doorstep, eliminating the need for transfers to intermediate modes or feeder buses.
- **Implementation timelines:** Given adequate political support, BRT can be implemented in under three years, from the planning stages through to construction and operations. Metro systems on the other hand require 10 to 20 years to implement due to the need to excavate tunnels and stations and or construct elevated tracks.

- **Local context:** While metro and commuter rail systems generally entail importing trainsets and other specialised equipment, many countries in the Africa region have existing bus assemblies that can manufacture the vehicles needed for a BRT system. Cities also can incorporate existing public transport operators in system operations, reducing job losses while also enhancing local capital formation.

Once a corridor is identified, responsible agencies and development partners should work to complete the entire public transport network, avoiding the implementation of redundant infrastructure on a single corridor. For instance, a city should avoid building a metro line along a BRT alignment if the existing system is able to meet the demand. A complete network ensures that all passengers in a city receive quality services, which also encouraging mode shift. If MRT networks are planned according to demand, the largest cities are likely to have a few metro corridors on the alignments with highest demand, paired with much more extensive BRT networks. A megacity that has a sizable metro network but lacks BRT corridors is probably missing the opportunity to implement more affordable MRT technology that can serve a greater number of passengers in proportion to the level of investment. BRT systems can offer the last-mile connectivity to multiple destinations that metro systems are not able to provide. Medium-sized cities with moderate corridor demand can serve all corridors through an integrated BRT and city bus network

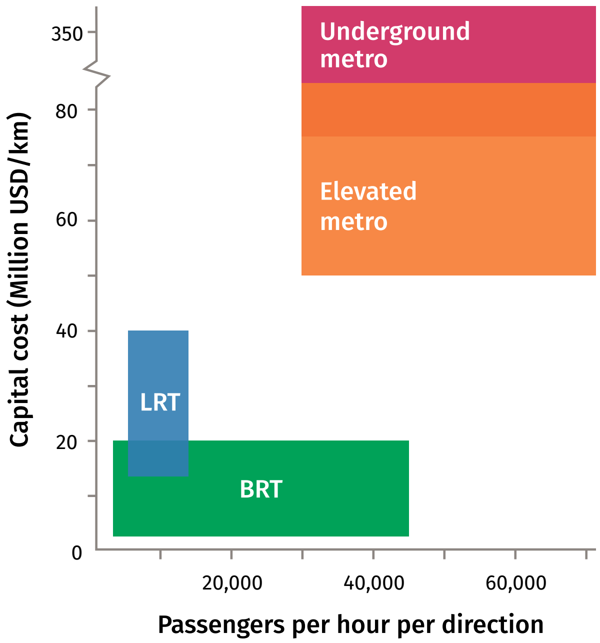

Figure 6. BRT can serve a range of passenger volumes at moderate costs, while metro systems offer high capacity at a very high cost.

THE ADDIS ABABA LIGHT RAIL

The Addis Ababa light rail began operations in 2015 and is one of the first light rail systems in the region. The 34 km system, which is partly elevated, is estimated to have cost USD 558 million (Rogers, 2023). The passenger volume is estimated at 3,434 passengers per hour per direction (Hook, 2021). The LRT has experienced challenges in maintenance of the rolling stock, resulting in irregular services and intervals of 12 minutes between trains and severe overcrowding (Vörös, 2019). Electricity challenges also have led to the halting of services at times.

Figure 7. The proposed BRT corridor on Faisal Street in Cairo.

RAPID TRANSIT INITIATIVES IN GREATER CAIRO

The Cairo Metro, officially known as the Metro Al-Qāhirah, began operations in 1987. The metro system was developed to address the increasing population and traffic congestion in the city and currently has three operational lines with a fourth line under construction. The metro had an estimated ridership of 3.5 million passengers per day as of 2019 (RailwayTechnology, 2021). Cairo is also planning a first phase 41.5 km BRT corridor from the industrial area of 6th of October City to Giza Square. The corridor has 39 stations, three terminals, and one depot. Four services will operate with a fleet of approximately 120 buses, carrying 126,000 passengers per day. The government is also implementing a second BRT line along Cairo's Ring Road. These moves provide a great opportunity for the expansive city to shift from highway building to inclusive transport.

Table 1. BRT infrastructure costs in the Africa region.

City	Phase/line	Length (km)	Cost (USD)	Cost per km (USD)
Johannesburg	Rea Vaya BRT Phase 1	25.5	362,100,000	14,200,000
Dar es Salaam	BRT Phase 1	20.9	241,314,113	11,546,130
Cairo	Western Corridor BRT	40.0	150,093,056	3,752,326
Addis Ababa	B2 BRT corridor	19.2	202,054,795	10,523,687
Dar es Salaam BRT	BRT Phase 2	20.3	165,153,657	8,135,648
Agadir	BRT Line 1	15.0	108,042,698	7,202,847
Dakar	BRT Phase 2	18.4	342,850,000	18,633,152
Average				10,230,258

Table 2. Rail infrastructure costs in the Africa region.

City	Mode	Phase/line	Length (km)	Cost (USD)	Cost per km (USD)
Cairo	Metro	Line 4, phase 1	19.0	2,450,000,000	128,947,368
Cairo	Metro	Line 3, phase 2	7.2	525,000,000	72,916,667
Cairo	Metro	Line 3, phase 3	17.7	5,800,000,000	327,683,616
Casablanca	LRT		31.0	745,000,000	24,032,258
Addis Ababa	LRT		34.0	558,823,529	16,435,986
Abidjan	Metro		37.5	1,923,913,043	51,304,348
Average					103,553,374

Table 3. Overview of public transport modes and daily ridership

City	Mode	Length (km)	Daily ridership
Addis Ababa	LRT	34.0	56,000
Lagos	Metro (Blue Line)	13.0	4,778
Johannesburg	Gautrain Metro	80.0	55,000
Cape Town	MyCITI BRT	-	75,000
Nairobi	Commuter Rail	148.4	13,000
Johannesburg	Rea Vaya BRT	59.0	56,000
Dar es Salaam	BRT	20.9	200,000

2.4. PUBLIC TRANSPORT SYSTEM DESIGN: BUS RAPID TRANSIT

MRT systems need to be well designed to serve the intended users efficiently. This section discusses the key features of BRT, one of the most common MRT modes under implementation in the Africa region. For a BRT to operate well, designers need to plan the bus fleet, service frequencies, station locations, and station sizing in line with commuter patterns and demand levels. The infrastructure design should support the value proposition of efficient, reliable, affordable, and shorter commutes, prompting residents to switch from private vehicle and paratransit use. BRT planning and design should also consider the diverse needs of women and persons with disabilities. This includes prioriting safety, regular services, comfort, accessibility, and connectivity through quality non-motorised transport. In addition, governments should start planning for the industry transition, adopting an effective strategy for engagement of the existing industry and gross cost contracting for quality services. Key features of BRT systems include the following:

- **Service planning:** The service design needs to match service frequencies to expected demand levels. A well-designed BRT system enables the majority of commuters to reach their final destinations with few or no transfers. One way to do this is by offering direct services that extend beyond BRT corridors.
- **Dedicated, median-aligned BRT lanes:** Separate lanes with physical barriers ensure that BRT lanes are not used by regular traffic. The dedicated lanes allow for quick and efficient bus movement. Median alignment ensures there is no conflict or delay caused by vehicles turning onto side streets or into adjacent properties. In areas where demand is high and the right of way is limited, bus lanes should be prioritised.

THE AAYALOLO BUS SERVICE IN GHANA

In Accra, Ghana, when the government lacked the capital to invest in continuous dedicated bus lanes, mixed traffic movements led to fierce competition between the newly launched Aayalolo bus service and other paratransit operators, who would use the bus stops and bus lanes marked for Aayalolo in the absence of security personnel. Competition for passengers at bus stops delayed commutes, and as a result, the system lacked scheduled efficient service and had no advantage over private vehicles or regular paratransit.

Figure 8. High-quality BRT corridors incorporate dedicated bus lanes, central station platforms, and good NMT access.

THE LAGOS BRT LITE

The Lagos BRT Lite, which was launched in 2008 and is recognised as one of the pioneering bus priority corridors in Africa, was aimed at reducing the heavy congestion in one of Africa's most populous cities. The 22 km system had 65% of BRT lanes physically segregated from traffic, 20% separated by road markings, and 15% in mixed traffic and was estimated to cost USD 1.7 million per km (Mobereola, 2009). However, the BRT lite faces several challenges related to its infrastructure and operations. One of the major challenges is the lack of dedicated lanes, which leads to delays and competition with paratransit systems. Undersized stations and limited frequencies make it difficult for the BRT-lite system to effectively serve the city.

- **Central station platforms:** Central stations help cities save on the cost of having two stations on either side of the corridor. In addition, they enable more convenient cross-platform transfers from one route to another. A BRT station should contain ramps, a fare collection area, and a boarding area. Ramps should be constructed with tactile paver blocks and with a slope not exceeding 1:12, making it convenient for people with disabilities.

- **Adequate station sizing and passing lanes at high-demand stations**: The boarding area should provide sufficient space for people waiting for buses as well as circulation space for people entering or leaving the station. To reduce station congestion, high demand stations need passing lanes and multiple docking bays. Stations must be long enough to allow the sub-stops to function independently of one another. The distance between the independent sub-stops should be at least 1.7 times the bus length (31 m for an articulated bus) to enable buses to manoeuvre easily. Space should be reserved in the median for the addition of new sub-stops based on the future growth in passenger demand. Passing lanes allow for express services, which offer faster commercial speeds than all-stop services and reduce station congestion.
- **Platform-level boarding:** The station platform height should be the same as the bus floor height. Level boarding allows for ease of movement and reduces the amount of time that the bus needs to remain stopped at the station. Platform level boarding also ensures accessibility for women, children, and persons with disabilities, allowing them to travel efficiently and independently.

Figure 9. Level boarding allows for ease of movement and reduces the amount of time that the bus needs to remain stopped at stations.

- **Off-board electronic fare collection:** Off-board fare collection ensures fewer travel delays, more convenience for passengers, reduced revenue leakage, and automated ridership data for service optimisation. The fare collection area should contain system information displays and a place for customers to recharge smart cards and make enquiries. Passengers tap their smart cards or smartphones at turnstiles and proceed to the boarding area.
- **Intersection treatments:** At intersections, signal cycles that prioritise BRT movements can be implemented to minimise delays and disruptions. Turns across BRT lanes should be avoided to reduce intersection delays. Instead, vehicles can make a series of turns and then cross perpendicular to the corridor. In this way, signal cycles can be limited to two phases. BRT stations should be set back at least 40 m (i.e., the length of two articulated buses), to allow sufficient space for bus queues and mixed traffic queues.
- **Split flyovers and underpasses:** In situations where a flyover is required, it should be split to accommodate median aligned BRT lanes and stations, to avoid delays and conflicts between buses and mixed traffic.

- **Gross cost contracting:** BRT systems should have competitively tendered bus operating contracts. Systems should incorporate multiple operators in order to enable government to replace a failing operator and have more leverage to use “quality-of-service” contracting, where penalties for poor performance on one company can be given back to the industry as a reward for good performance by the other companies. In a gross cost contract, payment to bus operators is based on the number of kilometres travelled. The government receives revenues from an independent fare collection company, allowing it to withhold payments to the bus operators if services are substandard.

THE DAR ES SALAAM BRT

The Dar es Salaam BRT system is hailed as one of the most successful BRT systems in the region. The 20.9 km phase one of the BRT has an average daily ridership of 200,000 passengers. The 20.3 km phase 2 corridor is currently under construction at a cost USD 159.3 million net of taxes (African Development Bank, 2023). Unlike the Lagos BRT, the Dar es Salaam BRT system is silver rated and a true BRT system that encompasses dedicated lanes and adequate station capacity based on demand, platform-level boarding, off board electronic fare collection, and BRT priority at intersections. The city has already begun implementing additional phases of the BRT system, which will span a network of 154.5 km of trunk corridors. Over the years since the launch of operations in 2016, the system has gone through operational changes to improve efficiency, including an increase in the bus frequencies to reduce overcrowding. The Dar es Salaam Rapid Transit Agency (DART) has contracted the Emirates International Group (ENG) as a second operator on the BRT phase 1 network. ENG is expected to bring additional buses to ease overcrowding and improve operations along the corridor. Having multiple operators along the corridor is also expected to improve the quality of service. The city is also planning to issue a global competitive tender for the operations of BRT phase 2.

Figure 10. The Dar es Salaam BRT network is expected to span 154.5 km. The government is currently developing TOD plans to facilitate mixed-use developments along BRT corridors.

BRT IN SOUTH AFRICA

South Africa has implemented the most expansive bus rapid transit (BRT) infrastructure in the region, including the Rea Vaya in Johannesburg (operational since 2009), MyCiTi in Cape Town (operational since 2011), and A Re Yeng BRT in Tshwane (inaugurated in 2014). Plans are also underway to complete the Rustenburg Yarona BRT system. Cape Town's MyCiTi system has an estimated daily ridership of 75,000 while Rea Vaya carries 56,000 passengers per day. Despite good infrastructure designs in the South African BRT systems, operational challenges persist. These challenges include the lack of competitive tendering in operations and a failure to manage the operation of competing services by minibus taxis. Addressing these challenges is crucial for optimizing the efficiency and ridership potential of the BRT systems. The government also has invested in the Gautrain system, a regional rail system whose ridership reached 55,000 trips per day but then declined due to intense competition from ride-hailing services, particularly for airport trips (Gautrain, 2019).

2.5. ELECTRIFICATION

As African nations increasingly embrace the shift toward electric vehicles (EVs), there is a notable potential for reduced dependence on fossil fuels, contributing to a decrease in air pollution and greenhouse gas emissions. This not only aligns with global sustainability goals but also addresses local air quality concerns. Additionally, the adoption of electric vehicles can stimulate economic growth by fostering a new industry around EV manufacturing, charging infrastructure development, and associated technologies. Furthermore, the reduced operational costs of electric vehicles, compared to traditional internal combustion engine vehicles, can alleviate the financial burden on both individual users and public transport operators. However, electrification on its own complicates the urban conundrum in Africa. Electrification of the current paratransit fleets without modernising the industry does not improve efficiency or quality of service. In addition, with tax-free and or reduced taxes on electric vehicle imports, private vehicle use will become even more attractive, further

Figure 11. Articulated e-bus operating on the Dakar BRT corridor.

increasing congestion and the incentive to build wider car-centric roads and parking spaces rather than investing in affordable public transport and housing.

Congestion in urban areas and poor-quality public transport have resulted in exponential two-wheeler growth in many African cities. While these vehicles are great for first- and last-mile access, many cities are seeing two-wheelers supplant buses as a main mode for commutes on trunk corridors. To date, the lack of effective laws and policies to govern two-wheeler use has led to increasing traffic crashes and high fatality rates. Cities in the region continue to experience a rise in motorcycle crashes owing to speeding, lack of traffic calming on the roads, and lack of proper regulation (Njoroge, 2022). The problem is widespread across the continent and particularly high in Togo, Benin, Mauritius, Mali, Côte d'Ivoire, and Morocco (Bezabeh, Mohamed, Tripodi, & Govert Schermers, 2022). This has led to high healthcare costs for the government and urban residents, with some hospitals dedicating full wings to crash victims (Naturinda & Kamoga, 2023).

The growing calls for charging stations for electric two-wheelers further tend to shift the government's focus away from implementing critical public transport infrastructure such as bus depots, terminals, and bus shelters, which are non-existent in most cities. Yet ensuring that the right public transport infrastructure is in place is the only sustainable way to ensure African cities are efficient and liveable. A more holistic approach to vehicle electrification in Africa holds the promise of creating a cleaner, more sustainable transport ecosystem, fostering economic opportunities and enhancing the well-being of local communities. Electrification of MRT systems such as BRT can help shift people from private vehicle use, resulting in reduced energy requirements and pollution.

ELECTRIC PUBLIC TRANSPORT IN THE AFRICA REGION

Marrakech's trolleybus BRT was inaugurated in 2017. The buses are electric and powered by solar energy through overhead power lines for 3 km, while for the rest of the 8 km journey, the buses use batteries. Other Moroccan cities such as Casablanca, Rabat, and Agadir continue to invest in tramways and additional BRT corridors.

Dakar's 18.4 km BRT corridor was launched in 2023 and officially began operations in May 2024. The USD 400 million system is fully electric and is designed to carry up to 300,000 passengers daily (European Investment Bank, 2017).

2.6. MODERNISING INFORMAL TRANSPORT

Paratransit, commonly known as informal transport, stands out as one of the most contentious modes of transport in the Africa region. There is a growing consensus urging the re-evaluation of informal transport, advocating for its recognition as a vital and popular means of commuting. However, while informal transport serves the majority in African cities, it is clear that the service quality needs improvement. Without addressing service quality challenges, including unnecessary transfers, long journeys and wait times, and lack of integrated services, city residents increasingly will opt to use private modes of transport.

Government regulation is essential in ensuring quality of service and efficient travel. Cities should modernise their bus system by ensuring services are run by multiple bus companies contracted by the government. Formalising the system ensures that the government has control in enforcing overall quality while also managing and improving the route network for better integration. The government oversight ensures that the under supply of services and use of old dilapidated vehicles and the over-supply of vehicles in high demand is controlled. A shift to better regulation is especially critical in countries such as South Africa, where the minibus taxis are efficient in serving dispersed urban centres with low populations. In Kigali, the city formalised the bus system and incorporated electronic payment solutions, improving overall service quality.

A crucial component in optimising quality is ensuring the inclusion of necessary infrastructure such as bus stops and terminals in urban design. Well-designed bus stops offer a comfortable, weather-protected waiting area for public transport passengers while leaving clear space for pedestrian movement behind the shelter. Bus stops should be included in the

Figure 12. Well-designed bus terminals offer comfortable waiting areas for passengers.

street designs from the onset and should be provided at intervals based on demand. While most African cities have begun planning for terminals in cities, the selected locations do not consider commuter patterns and the convenience required for passengers to efficiently transfer from one route to another. Terminals should be located close to essential services and should include public toilets with baby changing facilities, organised vending kiosks, and cycle parking. To ensure adequate access, footpaths and cycle tracks near terminals should be wide to accommodate large volumes. Cities also require publicly owned bus depots, which can facilitate the scale-up of through the provision of charging facilities.

2.7. PEDESTRIAN AND CYCLE NETWORKS

For cycling and walking to be safe and comfortable for people of all gender and ages, cities should implement complete NMT networks serving all city areas and key destinations through the shortest possible routes. Cycles occupy minimal street space—only around one-tenth of the space occupied by a car. Cycling on a segregated track is often faster than using a private motor vehicle, particularly for short- to medium-distance trips. Cycling infrastructure also extends the reach of public transport stations. Walking is an essential mode that offers first- and last-mile connectivity for all other modes. Walking is the most affordable, efficient, and low emission mode of transport. Interconnected walking networks with short block lengths allow for short and direct routes through neighbourhoods.

The physical design of streets and the provision of footpaths, cycle tracks, crossings, and other infrastructure is crucial to managing motor vehicle speeds and creating a safe walking and cycling environment. Adequate walking infrastructure should be provided in core urban areas, areas with high pedestrian demand, and areas around public transport stations. Well-designed NMT networks encourage private vehicle users to walk and cycle. Cities in the region have begun implementing NMT infrastructure. However, a lot more needs to be done to ensure the infrastructure is universally accessible, encouraging commuters to switch modes.

Creating safe urban spaces involves slowing down traffic on smaller streets through systematic measures. Shared lanes, where vehicle speeds are limited to 15 km/h, are considered safe for pedestrians and cyclists. For speeds up to 30 km/h, separate footpaths are recommended, while cyclists can still use the road. On larger streets, it is important to prioritise physically separated pedestrian and cycle infrastructure alongside traffic calming measures for safe crossings. Keeping speed limits up to 50 km/h on urban streets ensures a comprehensive approach to urban safety and mobility.

2.8. FOOTPATHS

In crafting urban environments, the design of pedestrian infrastructure plays a vital role in shaping the usability and inclusivity of streets and cities. NMT infrastructure is sometimes an afterthought, constructed without proper design and with subpar materials. To counter this, a proactive approach emphasising thoughtful consideration and prioritisation is essential. Implementation should consider urban utilities such as internet cables, electricity, water, and sewerage systems, to avoid constant re-carpeting of NMT infrastructure.

A minimum clear width of 2 m is recommended for footpaths to ensure adequate comfort and accessibility. For areas with high pedestrian volumes, wider footpaths should be provided. To prevent water logging and constant encroachment by other modes, footpath should be elevated 150 mm above the carriageway and bollards should be added at a spacing of 900 mm. Bollards ensure universal access for people using wheelchairs and are more user friendly in comparison to railings and barriers, which segregate pedestrians from the street. It is also important to consider persons with disabilities, women, children, and the elderly by incorporating ramp slopes of 1:12. Tactile paving is also key to guide people with visual impairments. To enhance the overall walking experience, government agencies should prioritise the preservation of trees in urban areas. It is crucial to ensure the ongoing planting of trees along streets, fostering a continuous canopy that provides shade for pedestrians. This commitment to tree preservation and planting not only beautifies our cities but also contributes to a more pleasant and sustainable walking environment.

Another key challenge in urban design is the treatment of footpath heights at property entrances. Footpaths should have constant height at property entrances to ensure universal access. Ramps should be provided for vehicles, with a slope of 1:6 to 1:12 (maximum 1:4).

Figure 13. Walkway in Kisumu.

NMT INVESTMENTS IN KISUMU

Under the World Bank-financed Kenya Urban Support Program (KUSP), the City of Kisumu implemented the USD 2.1 million Kisumu Triangle pedestrian improvement project. As part of the project, the city built 1.5 km of walkways along Oginga Odinga Street, Ang’awa Avenue, and Jomo Kenyatta Highway. The project included storm water drainage improvements, installation of utility ducts, installation of solar streetlights, and construction of public toilets. Tabletop pedestrian crossings were constructed to provide safe, universally accessible crossing points for pedestrians. Construction of the 8.1 km, USD 6 million second phase of the project is partially completed. By improving walkability along these streets, the city will be able to encourage city residents to opt for NMT. Vulnerable groups including women, persons with disabilities, and school children will be able to experience safe pedestrian crossing. The developments are based on the Kisumu Sustainable Mobility Plan, which identifies mobility as one of the essential keystones towards the growth of the city and advocates for the prioritisation of public transport and enhanced mobility through safe street design.

2.9. CYCLE TRACKS

Well-designed cycle tracks attract more users, especially for medium and short trips within cities. It is important to ensure cyclists are safe by implementing cycle tracks that are physically separated from the carriageway—as distinguished from painted cycle tracks, which offer little protection. Physical separation for safety can include medians or curbs.

Smooth material such as asphalt should be used, as distinguished from paver blocks which are very uncomfortable for cyclists. To ensure comfort, cycle tracks should have a clear width of at least 2.0 m for one-way movement and 3.0 m for two-way movement. The recommended width should be clear of obstructions such as utility poles and shrubs. To prevent encroachments by cars, bollards should be added at a spacing of 1.2 m. One bollard placed in the middle of the cycle track can allow for cyclists to pass on either side.

In existing and upcoming electrification policies, the potential for e-bikes in providing efficient carbon free travel is often ignored. Tax incentives for private vehicles and

Figure 14. Cycle track in Dar es Salaam.

Figure 15. A bikeshare system in Cairo, Egypt. Government incentives in promoting bicycle use and the adoption of e-bikes are crucial in ensuring widespread adoption.

motorcycles often do not include e-bicycles yet operating and maintaining an e-bike is generally more affordable than using a car or a motorcycle. In congested urban areas, e-bikes offer a practical and efficient means of transport and can navigate through traffic, avoiding parking challenges, and providing a quicker way to reach destinations compared to traditional bicycles. Implementing supportive infrastructure and policies is crucial for the growth e-bikes in the Africa region.

2.10. AVOIDING FOOTBRIDGES AND UNDERPASSES

Pedestrian bridges encourage speeding by private vehicles, displace pedestrians and cyclists, and reinforce the dominion of vehicles over people in streets. Pedestrian bridges are also inconvenient and lack universal access, resulting in everyday challenges for people with disabilities, parents with strollers, and people carrying luggage. Extensive ramping may be installed to accommodate wheelchairs and cyclists, but long crossing distances and steep slopes still discourage use. Footbridges are often installed with the stated objective of enhancing the safety of pedestrians. However, despite their high cost, they are often avoided by pedestrians because of these reasons. At-grade crossings are a more affordable and inclusive alternative.

2.11. CROSSINGS

Street design in African cities should consider the movements patterns and access to markets, workplaces, and schools. Facilitating these movements requires well-placed at-grade pedestrian crossings aligned with desire lines. To optimise the movement of vehicles,

Figure 16. Traffic calmed crossing in Kisumu, Kenya.

cyclists, pedestrians, and other users, crossings should be signalised or raised to the level of the footpath to provide universal access and traffic calming. Pedestrian crossings should have a width of 5 m or width equivalent width to the adjacent footpath, whichever is larger. The height of tabletop crossings should also match the height of the adjacent footpaths. Drainage inlets should be provided upstream of the tabletop crossing to prevent waterlogging.

NMT INVESTMENTS IN ETHIOPIA

Addis Ababa developed its NMT Strategy in 2018, which calls for the implementation of 60 km of cycle infrastructure in the city by 2022, and 200 km by 2028. To that end, the Addis Ababa City Roads Authority (AACRA) has developed a 4.5 km cycle track on the Hachalu Hundessa (old Transafrica Highway) corridor, connecting the Haile garment factory and Jemo secondary city centre. Additionally, the city constructed a bi-directional 3 km cycle track from Addis Ababa City Hall to Meskel Square, featuring wider furnished walkways on both sides. The city is currently constructing cycle tracks on additional corridors, including 4 km from Bole Airport-Goro Road and 11 km from Kality-Tulu Dimtu. In addition, the Addis Ababa City Administration, through the initiative of the Prime Minister, is implementing the Corridor Development that aims to improve the walkways and cycle tracks in Addis Ababa as per the NMT strategy and the Addis Ababa Cycle Network Plan. This project spans 50 km along the following corridors: Meskel Square to Bole, Megenagna to Ayat, Megenagna to Arat Kilo, Mexico to Sarbet, Piazza to Meskel Square, Wollo Sefer to Gotera, Megenagna to Bole, and Mexico to Meskel Square.

The Addis Ababa NMT Strategy also aims to create a bikeshare program that is integrated with the city's public transport system. These actions support 10-year targets including maintaining the NMT mode share at or above 60% and ensuring women constitute 50% of cyclists.

In 2020, the Ethiopia Ministry of Transport and Logistics launched a 10-year national Non-Motorised Transport (NMT) Strategy with the aim of institutionalizing a more equitable approach to transportation, emphasizing NMT. This initiative aligns with the government's objective of reducing the country's greenhouse gas emissions by 64% by 2030. The transport sector has a specific target to reduce 10 tCO2e, which constitutes 4%

Figure 17. Footpath and cycle track along Churchill Avenue in Addis Ababa, Ethiopia.

of the total emissions reduction goal. The NMT Strategy calls on the central government to allocate funds exclusively to urban road projects that incorporate sufficient facilities for cyclists, pedestrians, and public transport users. Local authorities must allocate a minimum of 33% of their transport budgets to NMT infrastructure and a maximum of 33% to private vehicle infrastructure to qualify for national funding. Secondary cities through their regional government, such as the Bahir Dar City Administration, Adama City Administration, Hawassa City Administration, Gondar, and Dire Dawa, are building walkway improvements and cycle tracks.

Figure 18. Walkway in Dire Dawa, Ethiopia.

Figure 19. Clearly defined on-street parking areas in Kigali, Rwanda.

2.12. TRAVEL DEMAND MANAGEMENT

The key to tackling congestion is reducing the number of vehicles on streets rather than increasing street widths to accommodate an ever-growing number of vehicles. This can be done through various means, including parking management and congestion pricingAt a larger scale, compact, walkable transit-oriented development is the key to reducing congestion by keeping trip lengths short.

To manage parking, governments need to weigh the demand for parking against the needs of other road users, especially pedestrians, cyclists, and public transport users. Street trees and public spaces, such as footpaths, parks, and pedestrian plazas, should not be sacrificed to accommodate parking. Parking management should emphasise the efficient use of existing parking areas rather than expansion of the parking supply. Parking prices should vary according to the demand for parking in a particular area at a specific time. Parking fees should be proportionate to the space occupied, and motorcycles should be charged a fraction of the rate for cars. Dynamic pricing discourages long term parking especially in high-demand areas, encouraging private-vehicle users to opt for public transport and non-motorised modes. Electronic fee collection systems generate data on parking demand and facilitate efficient enforcement.

Given that parking is not a public good and is a resource specific to private-vehicle users, governments should not build or subsidise multi-level parking structures in cities. Parking services may be created and managed by the private sector on private land if the demand for such service exists without subsidy. To reduce the growth in off-street parking, governments should improve existing building codes by abolishing parking minimums and off-street parking. Instead, cities should adopt parking maximums that restrict provision of excessive parking spaces, especially along MRT corridors. To the extent that developments do provide parking, governments can ensure that a percentage of off-street parking slots are EV-ready through policy.

In African countries where cities lack adequate resources for urban development, congestion pricing could be a good means of managing private vehicle use while also generating revenues. Congestion pricing involves charging fees for vehicles entering cities using certain roads during periods of high traffic demand. The revenues can be used to improve public transport infrastructure and facilities for walking and cycling. London charges a daily fee of USD 19 for driving in congestion charge zones (Transport for London, 2023), while Stockholm charges SEK 135 (USD 13) per day (Transport Styrelsen, 2020). In Singapore, revenues from congestion pricing amounted to approximately 1.6 percent of GDP for the financial years 2014-2018, or around USD 1.4 billion (Theseira, 2020). Singapore charges vehicles according to the vehicle size, location, and time of day.

Figure 20. Bollards prevent encroachments by parked vehicles in Kisumu, Kenya.


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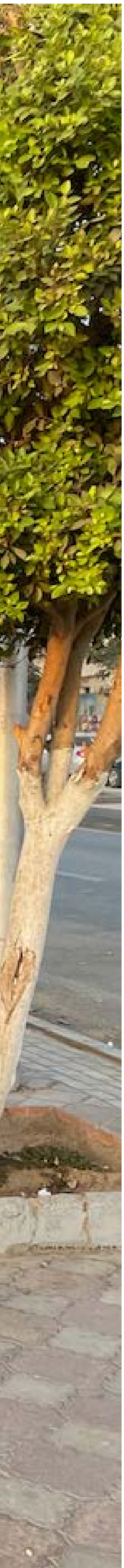
3 MOBILITY SCENARIOS FOR AFRICAN CITIES



To pinpoint the opportunities for investment in mobility systems in African cities, this study examines four distinct mobility scenarios using a what-if spreadsheet model. Under the "Business as Usual" (BAU) scenario, African cities continue to invest in car-centric infrastructure. In the second scenario, "Electrification," cities and national governments pursue ambitious electrification targets but do not attempt to change the trajectory toward greater use of private motor vehicles. Under the third scenario, "High Shift," cities aggressively invest in sustainable mobility to encourage a shift to public transport use, walking, and cycling. Under this scenario, cities also pursue compact urban planning to reduce trip lengths and improve walkability. They also adopt travel demand measures to manage vehicle use. The final scenario, "High Shift + Electrification," combines High Shift and Electrification to explore the combined benefits if cities pursue both strategies in tandem. This assessment compares these scenarios to BAU in 2030 and 2050, providing insights in changes in infrastructure costs and emissions. The model uses 2015 as a base year for data consistency and reliability.

3.1. MODEL DATA SOURCES AND ASSUMPTIONS

3.2. POPULATIONS AND TRAVEL BEHAVIOUR

This research relies on the World Urbanisation Prospects population projections as a basis for forecasting urban travel. Our delineation of "urban" encompasses metropolitan areas with populations above 300,000 (United Nations, 2018). To capture variations in travel patterns within the region, we modelled three sub-regions: North Africa, Sub-Saharan Africa (excluding South Africa), and South Africa as an individual country.

Table 4. Urban population by region, 2015 to 2030 (millions).

Region	Urban population		
	2015	2030	2050
North Africa	102	138	196
Sub-Saharan Africa	353	640	1,226
South Africa (country)	36	47	60

Using representative city-level mode split data from city master plans and the MobiliseYourCity Global Monitor (MobiliseYourCity, 2021), we estimated typical mode splits for each region in the 2015 base year. We classified cities in three categories: cities with a population below 1 million, and cities with a population from 1 to 5 million, and cities with a population above 5 million. We then calculated the weighted average of the mode splits based on the population within the city size category. Data from household surveys were used to inform the average daily trip rates, which range from 2.0 to 2.5, depending on the city size. We then used the trip rates, mode share, and population data to calculate the total trips. To calculate the trip lengths, we estimated total city radius based on size, distinguishing between urban populations and densities in the core and peripheral areas. We then used the average trip lengths to calculate the passenger kilometres travelled (PKT).

Figure 21. A wide, shaded footpath in Aswan, Egypt.

Table 5. Mode splits by region, 2015.

Mode	Mode share North Africa	Sub-Saharan Africa	South Africa
Private LDV	11.4%	7.5%	20.3%
Ridehail LDV	0.5%	0.4%	1.5%
3W	1.1%	1.6%	0.2%
Minibus	33.3%	27.6%	37.4%
Large bus	6.7%	3.1%	7.5%
BRT	0.0%	0.0%	0.0%
Rail	2.7%	0.0%	0.8%
Motorcycle	1.8%	11.5%	1.0%
Bicycle	2.7%	2.9%	1.6%
Walk	39.9%	45.3%	29.6%

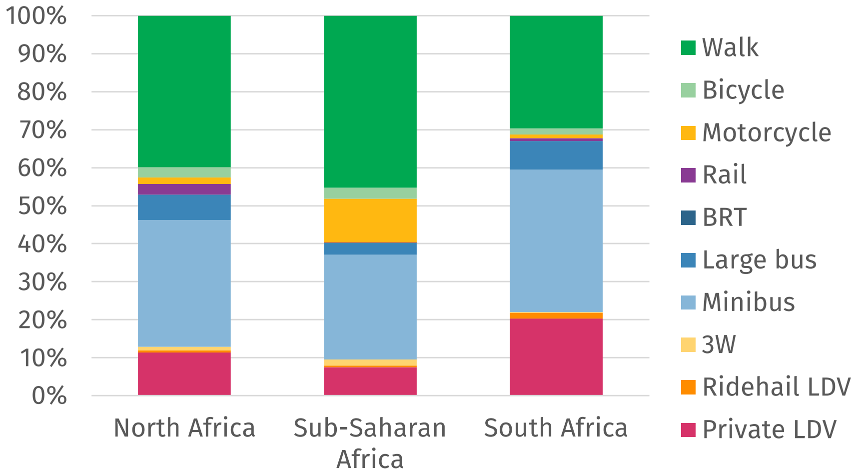


Figure 22. Mode splits by region, 2015.

Table 6. Urban travel activity, 2015.

Mode	Billion passenger-km per year North Africa	Sub-Saharan Africa	South Africa
Private LDV	56.1	144.6	47.1
Ride hail LDV	1.9	5.3	2.6
3W	2.6	15.8	0.3
Minibus	164.4	529.3	86.6
Large bus	32.9	60.2	17.4
BRT	0.0	0.6	0.0
Rail	13.5	0.4	1.9
Motorcycle	3.9	88.7	1.0
E-bike	0.1	0.2	0.0
Bicycle	1.4	5.9	0.6
Walk	14.9	58.0	5.2
Total	291.8	908.8	162.7

The model assumes a roughly uniform increase in daily trips, driven by growing city populations and household incomes. However, the mode shares, trip lengths, and vehicle kilometres associated with those trips vary depending on the scenario characteristics, as described in this section.

In order to generate estimates of the roadway and public transport infrastructure that will be required to meet the demands of urban passenger travel in the four scenarios, we assumed an elasticity of 1: for example, if car travel doubles, the km of roadways also will double. We handled cycle tracks differently because Africa does not yet have a sufficient network of cycle tracks to establish a ratio of cycle tracks needed for a given level of cycling. Based on a study of twelve Latin American cities (ITDP, 2022), we estimate the infrastructure that will be needed to meet bicycle travel demand on the basis of urban population density: a bicycle lane built in a denser neighbourhood will serve more residents. On the basis of the model published in 2022, we estimate that 0.47 uni-directional infrastructure kilometres are needed per million bicycle or e-bicycle PKT. For public transport, we estimated bus fleet sizes and rapid transit network lengths based on expected ridership. We estimated 0.5 km of a single-side footpath is needed for every km of roadway.

3.3. VEHICLE COSTS

We estimate the public and private costs associated with vehicles, operations, fuel, infrastructure, and maintenance as follows:

- **Vehicle and fuel costs**: We estimate the lifecycle expenses associated with vehicle purchase, refuelling, infrastructure construction, and maintenance. This encompasses BRT, rail systems, roads, parking, cycle tracks, and footpaths. We incorporate the costs of refuelling and recharging infrastructure into the fuel price, forming part of the overall fuel costs per unit of energy dispensed. We differentiate costs by region, vehicle technology, and fuel type where applicable. The model relies on MoMo 2015 estimates and projections for vehicle purchase costs. MoMo modelers conduct surveys on vehicle prices globally and develop techno-economic assessments for both ICEs and EVs. MoMo provides estimates of cost increments for electric vehicles based on required components, particularly emphasising the declining cost of batteries over time.
- **Vehicle operations cost and total cost of ownership:** Our estimates rely on the on-road efficiency of vehicles, fuel prices projected by the IEA for different parts of the world (without taxes included), and the average travel per year for various vehicle types (assuming all LDVs travel the same distance per year). The net result, encompassing vehicle purchase cost, constitutes our estimation of the total cost of ownership (TCO).
- **Infrastructure construction and maintenance cost:** We consider the cost of infrastructure, encompassing construction and maintenance for roads, parking facilities, track and rail yard facilities, cycle tracks, and footpaths. We generate cost estimates on per-km basis with an estimated life of 50 years. For parking, we estimate the costs per square meter. We derive costs for road, NMT, and parking facilities from IEA (2013), updating them to current (2020) dollars with region-specific adjustments and updates. For mass rapid transit, we estimate typical infrastructure costs based on the cost of recent BRT and rail projects in the region. We merge commuter rail, light rail, tramways, and metro under one “rail” category in the model. We project changes over time due to increases in costs of labour materials, and economies of scale. We charge infrastructure if it needs to be built in the modelled year, considering the number of vehicles added in that year. Additionally, we estimate infrastructure cumulatively for all vehicles entering service over the 2015-2050 projection period. In scenarios where vehicle numbers decline, such as in the High Shift scenarios for certain regions, we do not reduce the amount of infrastructure, but the construction cost in the horizon year is zero.
- **Public transport operating costs:** The model includes the operating costs of public transport vehicles, including driver wages, vehicle maintenance, logistics, and management.

3.4. EMISSIONS

To calculate the greenhouse gas emissions from the urban trips, we estimate the vehicle kilometres travelled based on PKT, fuel type, and vehicle occupancy. We then calculate the factors for emissions per vehicle-km. We include emissions from three sources:

- **Well-to-wheel (WTW) fuel/electricity:** Our estimates of vehicle fuel efficiencies follow IEA's Mobility Model (IEA, 2022). For electricity grid emissions factors, we assume an extremely optimistic ('maximum feasible') decarbonisation of Africa's electric grid, consistent with IEA's Sustainable Development Scenario (IEA, 2019).
- **Vehicles:** We obtain costs for vehicle manufacture, maintenance, and disposal from two sources: ITF (2020) and ICCT (2021). Evaluation of vehicle production and disposal emissions considers manufacturing, delivery at sale point, maintenance, and disposal of the vehicle. It includes the environmental impacts of material extraction, processing, vehicle component fabrication such as battery production, assembly of vehicle, production of vehicle, use of fluids, delivery to sale point, and disposal (end of life treatment when the vehicle is scrapped).
- **Infrastructure:** This includes the construction and maintenance of roads, BRT, rail systems, cycle tracks, and parking spaces. Our estimates were also based on ITF (2020).

Table 7. Emissions factors (g CO_2e per passenger-km): North Africa.

Mode	Propulsion	2015	2030				2050			
		Base Year	BAU	HS	EV	HS & EV	BAU	HS	EV	HS & EV
Private car	ICE	226	144	140	139	135	113	117	77	41
Private car	Electric	N/A	152	145	165	156	30	42	31	43
TNC car	ICE	245	171	156	176	149	121	95	101	48
TNC car	Electric	N/A	356	N/A	112	112	310	252	56	75
Minibus	ICE	84	82	60	82	59	69	34	57	20
Minibus	Electric	40	26	19	26	19	8	4	9	4
Large bus	ICE	53	51	42	50	42	38	27	16	16
Large bus	Electric	N/A	22	19	23	19	8	6	11	7
BRT bus	ICE	16	16	13	13	13	12	10	10	10
BRT bus	Electric	N/A	3	4	3	3	1	1	1	1
Rail	Electric	7	4	4	4	4	2	2	2	2
Motorcycle	ICE	67	54	51	53	50	44	23	25	23
Motorcycle	Electric	N/A	52	39	43	43	22	10	26	23
E-bike	Electric	18	13	26	35	25	18	13	20	13
Bicycle		38	23	21	25	20	18	14	19	14

Note: BAU = Business As Usual scenario, HS = High Shift scenario, EV = Electrification scenario, HS & EV = ElectrificationaAnd High Shift scenario

Table 8. Emissions factors (g CO_2e per passenger-km): Sub-Saharan Africa.

Mode	Propulsion	2015	2030				2050			
		Base Year	BAU	HS	EV	HS & EV	BAU	HS	EV	HS & EV
Private car	ICE	186	135	142	131	137	108	110	90	70
Private car	Electric	167	95	136	123	161	23	31	24	33
TNC car	ICE	160	118	115	119	113	90	78	82	65
TNC car	Electric	N/A	137	216	54	624	95	112	23	26
Minibus	ICE	66	59	59	59	59	20	21	7	11
Minibus	Electric	41	19	19	19	19	5	5	6	6
Large bus	ICE	37	32	33	32	33	12	13	7	7
Large bus	Electric	15	14	14	14	14	6	6	6	7
BRT bus	ICE	18	15	13	13	13	5	4	4	4
BRT bus	Electric	N/A	3	4	3	3	0	0	0	0
Rail	Electric	23	21	24	21	24	15	14	15	14
Motorcycle	ICE	75	60	59	60	59	47	43	41	16
Motorcycle	Electric	58	38	40	38	40	16	17	18	22
E-bike	Electric	41	31	52	59	53	27	14	37	14
Bicycle		60	39	35	40	35	30	15	31	15

Table 9. Emissions factors (g CO_2e per passenger-km): South Africa.

Mode	Propulsion	2015	2030				2050			
		Base Year	BAU	HS	EV	HS & EV	BAU	HS	EV	HS & EV
Private car	ICE	198	149	146	143	141	104	110	54	8
Private car	Electric	523	141	135	175	156	32	48	33	49
TNC car	ICE	246	203	177	206	181	143	110	123	87
TNC car	Electric	N/A	292	220	141	184	237	223	51	45
Minibus	ICE	73	70	69	69	68	58	47	56	44
Minibus	Electric	42	20	20	20	20	5	4	5	4
Large bus	ICE	66	60	51	59	50	50	33	31	31
Large bus	Electric	N/A	21	17	21	18	7	5	7	5
BRT bus	ICE	22	22	21	19	21	17	16	14	14
BRT bus	Electric	N/A	5	5	5	5	1	1	1	1
Rail	Electric	17	8	15	8	15	2	5	2	5
Motorcycle	ICE	57	46	44	45	43	36	33	25	10
Motorcycle	Electric	N/A	N/A	15	44	26	11	5	13	13
E-bike	Electric	N/A	18	23	24	24	22	11	17	13
Bicycle		36	20	18	20	19	14	11	17	11

3.5. BUSINESS AS USUAL SCENARIO

In the Business as Usual (BAU) scenario, urban centres persist in channelling investments toward car-centric infrastructure, neglecting the development of public transport, walking, and cycling facilities. In this scenario, cities focus on constructing urban flyovers and wider roads primarily to accommodate motor vehicles, with minimal or no consideration for pedestrians and cyclists. The relentless expansion of motor vehicle infrastructure contributes to urban sprawl, thereby increasing trip distances and encouraging the use of private cars. Higher speeds result in an inhospitable environment for walking and cycling, prompting a significant shift from active mobility to private motorised modes.

Cities, regrettably, fail to invest adequately in public transport, resulting in diminished mode shares for paratransit and rapid transit. As the mode shares for walking, cycling, and public transport decline, private cars and two-wheelers absorb the escalating travel demand. With regard to mass rapid transit, it is assumed that changes in BRT and rail ridership through 2030 only would accommodate projects already in the pipeline, including BRT and tramways in Morocco; LRT, monorail, metro, and BRT in Cairo and Alexandria; the metro in Abidjan; BRTs in Addis Ababa, Nairobi, Dakar, and Dar es Salaam; and the rehabilitation of commuter rail in some cities.

The BAU assumptions vary by region. North and South Africa see reduced walking and paratransit use and increased private car reliance. Sub-Saharan Africa anticipates higher motorcycle and private vehicle use, alongside decreased walking and paratransit reliance.

3.6. HIGH SHIFT SCENARIO

The High Shift scenario represents a significant departure from the BAU scenario, particularly in terms of transport investments and subsequent travel patterns. While the overall increase in daily trips remains consistent, cities under this scenario proactively facilitate a shift towards public transport and NMT by enhancing the availability of high-quality alternatives to private vehicle usage.

In the High Shift scenario, cities commit to substantial investments in infrastructure, including footpaths, cycle networks, and bikeshare systems. Walking and cycling facilities, including bikeshare are recommended to ensure improved and dignified mobility for short trips and access to public transport nodes, promoting a shift from motorised modes for

Figure 23. Rea Vaya BRT in Johannesburg, South Africa.

Table 10. Projected density shifts across scenarios.

Region	Annual change in urban density			
	2030		2050	
	BAU	High Shift	BAU	High Shift
North Africa	-1.5%	0.0%	-1.5%	0.5%
Sub-Saharan Africa	0.0%	0.0%	-1.0%	0.5%
South Africa	-1.0%	0.0%	-1.0%	1.0%

short trips. Even with investments in NMT infrastructure, it is expected that as economies rise, there will be a mode shift from walking to cycling and public transport use. In addition, governments and road agencies need to review existing road manuals and street designs, prioritising the movement of people over vehicles in urban areas. Cities also invest in quality public transport systems including expanded bus services equipped with modern high-capacity vehicles, dedicated BRT corridors, and, in the case of the largest cities, metro systems. Furthermore, this scenario envisions cities taking steps to reform the paratransit industry, aiming to enhance its efficiency and reliability. An integral component of the High Shift scenario scenario involves increasing the number of buses operating within regulated public transport systems. In terms of mass rapid transit, the 2030 High Shift scenario assumes that cities commission planned BRT and metro systems and construct some additional BRT corridors. In the 2050 High Shift scenario, we assume that governments prioritise BRT systems, given the cost and flexibility advantages of this mode. We assume that cities limit rail projects to the highest demand corridors, complementing larger networks of BRT. Overall, cities are assumed to choose the most efficient mode for each corridor, ensuring integration rather than duplication of services to reduce investments costs.

In North Africa, it is expected that public transport use will shift towards BRT and large buses from minibuses, reducing congestion on the roads. This will be complemented by efficient use of rail systems. In Sub-Saharan Africa, motorcycle usage sees slower growth compared to the BAU scenario, with commuters opting to using public transport (BRT, large buses, and minibuses). In South Africa, minibus industry reforms are recommended to maintain existing public transport mode share, complemented by existing BRT and rail systems. Private vehicle use is expected to be low relative to BAU, owing to a combination of measures in support of public transport and active mobility infrastructure.

Beyond infrastructure enhancements, the High Shift scenario incorporates urban planning interventions geared towards fostering compact, mixed-use, and walkable communities with convenient access to frequent public transport. This approach aims to curtail trip lengths, making it easier for residents to walk or cycle for some of their daily journeys. To understand existing and future trends in densification and urban expansion in the region, we used data from the Atlas of Urban Expansion (2016). Below are the assumed density changes per region.

3.7. ELECTRIFICATION SCENARIO

The Electrification scenarios assumes a policy transition promoting the maximum feasible rate of vehicle electrification for cars, buses, and motorcycles. This scenario maintains the travel behaviour assumptions of the BAU scenario: there is no conscious effort to invest in NMT or public transport, or to adopt land use reforms.

The rate of electrification notes existing trends and assumes a high rate of electrification of motorcycles and 3-wheelers in Sub-Saharan Africa and rapid electrification of private cars in North and South Africa. Like in the BAU scenario, there is a large increase in private vehicle use, and some of the public transport, walking, and cycling trips are replaced by motorcycle use. The Electrification scenario does not resolve congestion challenges given the continued heavy usage of private cars, but the scenario brings about an improvement in air quality and a reduction in noise pollution.

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Table 11. North Africa mode split under the BAU and High Shift scenarios.

Mode	Mode split (%)				
	2015	2030		2050	
		BAU	High Shift	BAU	High Shift
Light duty vehicle (LDV)	11.4%	19.4%	17.6%	36.3%	21.9%
Ride hail/shared taxi	0.5%	3.4%	1.7%	3.6%	1.7%
3W	1.1%	1.1%	0.6%	0.1%	0.1%
Minibus	33.3%	35.2%	33.2%	32.2%	24.6%
Large bus	6.7%	5.7%	8.7%	1.7%	9.7%
BRT	0.0%	0.5%	1.6%	0.7%	9.7%
Rail	2.7%	1.7%	2.1%	1.4%	2.3%
Motorcycle	1.8%	2.4%	1.9%	2.1%	0.4%
E-bikes	0.0%	0.0%	0.5%	0.1%	1.6%
Bicycle	2.7%	2.8%	3.2%	3.3%	5.7%
Walk	39.9%	27.9%	29.0%	18.7%	23.8%

Table 12. Sub-Saharan Africa mode split under the BAU and High Shift scenarios.

Mode	Mode split (%)				
	2015	2030		2050	
		BAU	High Shift	BAU	High Shift
Light duty vehicle (LDV)	7.5%	11.2%	9.3%	25.5%	11.2%
Ride hail/shared taxi	0.4%	1.0%	0.8%	2.1%	1.7%
3W	1.6%	2.2%	2.0%	2.5%	2.0%
Minibus	27.6%	24.5%	25.8%	11.0%	20.2%
Large bus	3.1%	2.7%	5.0%	2.0%	6.5%
BRT	0.0%	0.3%	0.5%	1.4%	9.6%
Rail	0.0%	0.0%	0.0%	0.7%	1.9%
Motorcycle	11.5%	22.0%	14.8%	29.3%	5.9%
E-bikes	0.0%	0.0%	0.2%	0.1%	1.3%
Bicycle	2.9%	1.8%	3.5%	1.2%	4.3%
Walk	45.3%	34.4%	38.1%	24.4%	35.4%

Table 13. South Africa mode split under the BAU and High Shift scenarios.

Mode	Mode split (%)				
	2015	2030		2050	
		BAU	High Shift	BAU	High Shift
Light duty vehicle (LDV)	20.3%	28.3%	23.2%	40.6%	25.6%
Ride hail/shared taxi	1.5%	3.2%	2.6%	5.9%	3.6%
3W	0.2%	0.2%	0.1%	0.1%	0.0%
Minibus	37.4%	34.5%	36.4%	25.1%	25.6%
Large bus	7.5%	5.4%	7.4%	3.7%	8.7%
BRT	0.0%	0.4%	0.5%	0.2%	3.1%
Rail	0.8%	0.5%	2.7%	1.2%	4.0%
Motorcycle	1.0%	1.0%	1.0%	0.8%	0.5%
E-bikes	0.0%	0.0%	0.3%	0.1%	1.5%
Bicycle	1.6%	1.5%	1.8%	1.7%	2.9%
Walk	29.6%	25.0%	24.2%	20.6%	24.5%

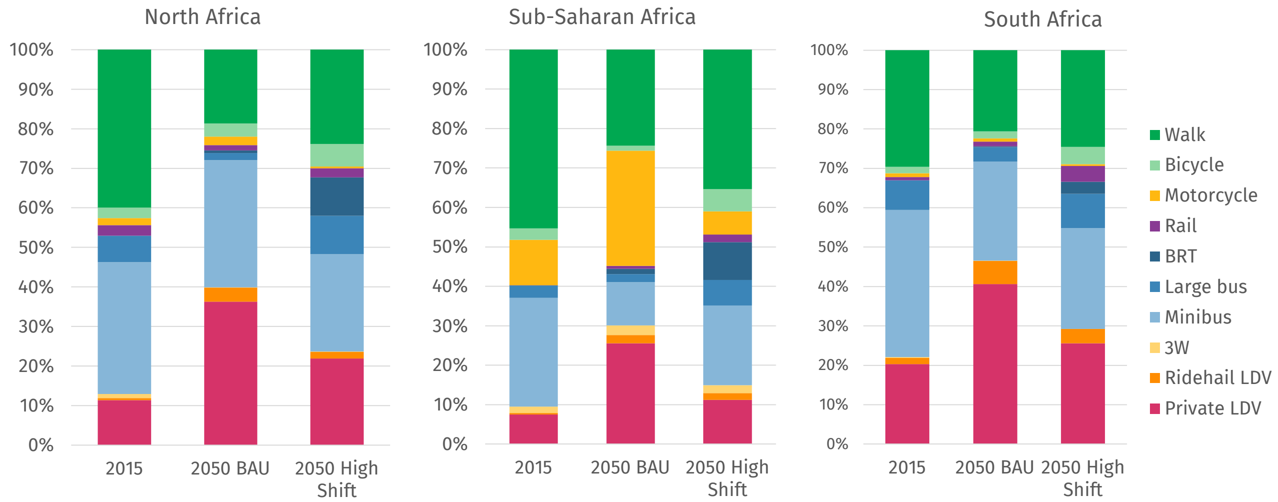

Figure 24. Mode splits by region, 2050.

Table 14. Travel activity under the BAU and High Shift Scenarios (billion passenger-km per year).

Mode	2015	2030		2050	
		BAU	High Shift	BAU	High Shift
Private LDV	247.8	765.7	579.1	3,464.3	1,184.5
Ridehail LDV	9.7	64.7	39.2	227.3	124.3
3W	18.6	46.2	38.5	94.9	72.4
Minibus	780.3	1,507.2	1,392.3	1,801.6	1,904.3
Large bus	110.5	187.4	286.4	255.3	632.3
BRT	0.6	17.5	34.1	157.4	844.7
Rail	15.8	17.1	25.9	100.1	187.0
Motorcycle	93.6	433.8	268.1	1,371.8	198.6
E-bike	0.3	0.3	2.9	1.5	42.2
Bicycle	7.9	11.8	20.0	16.3	75.1
Walk	78.1	111.9	115.5	149.6	194.5
Total	1,363.3	3,163.6	2,801.9	7,640.2	5,460.0

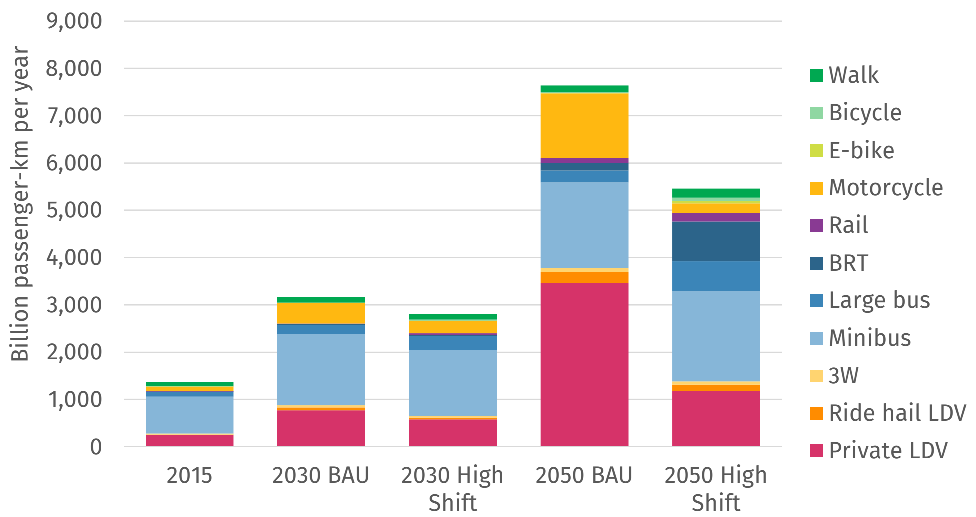

Figure 25. Travel activity under the BAU and High Shift scenarios.

Table 15. Share of vehicles that are electrified: North Africa.

Mode	BAU Stock shares (%)			Stock shares (%)			Electrification Stock shares (%)			Stock shares (%)		
	2015	2030	2050	2015	2030	2050	2015	2030	2050	2015	2030	2050
LDVs	0	4	8	0	3	5	0	25	98	0	10	90
2- and 3-wheelers	0	5	10	0	3	5	0	25	98	0	10	90
Buses	0	5	10	0	3	5	0	25	98	0	10	90

Table 16. Share of vehicles that are electrified: Sub-Saharan Africa.

Mode	BAU Stock shares (%)			Stock shares (%)			Electrification Stock shares (%)			Stock shares (%)		
	2015	2030	2050	2015	2030	2050	2015	2030	2050	2015	2030	2050
LDVs	0	4	8	0	3	5	0	25	98	0	10	90
2- and 3-wheelers	0	5	10	0	3	5	0	25	98	0	10	90
Buses	0	5	10	0	3	5	0	25	98	0	10	90

Table 17. Share of vehicles that are electrified: South Africa.

Mode	BAU Stock shares (%)			Stock shares (%)			Electrification Stock shares (%)			Stock shares (%)		
	2015	2030	2050	2015	2030	2050	2015	2030	2050	2015	2030	2050
LDVs	2	10	20	0	5	13	2	30	98	0	15	65
2- and 3-wheelers	2	10	20	0	5	13	2	30	98	0	15	65
Buses	2	10	20	0	5	13	2	30	98	0	15	65

3.8. ELECTRIFICATION AND HIGH SHIFT SCENARIO

In the Electrification and High Shift scenario, policy and investments combine the High Shift scenario with the Electrification scenario, resulting in an increase in electrified sustainable modes. Cities spearhead electrification of public transport and enact policies to encourage electrification of bicycles, 2-whelers, 3-wheelers, and private vehicles. Overall, there is a concerted effort to encourage walking, cycling, and public transport use, but also to reduce emissions through electrification.

3.9. RESULTS

The four scenarios described above lead to different outcomes. In this section, we examine the economic and environmental implications of the policy and investment choices made by cities and national governments.

3.10. INFRASTRUCTURE REQUIREMENTS

As cities grow, there is a need for additional urban infrastructure. However, the cost and type of infrastructure varies based on the policy decisions that governments make. Under the BAU and Electrification scenarios, cities build more extensive road networks and a large number of parking spaces due to the increasing demand from private vehicle use.

In the High Shift and High Shift + Electrification scenarios, governments adopt improved urban planning policies, and invest in walking, cycling, and public transport infrastructure, thereby reducing the need for infrastructure and fuel spending. Commuters can also save on costs associated with vehicle purchase, insurance, and repairs and instead use efficient and affordable public transport systems.

Table 18. Passenger km travelled under the Electrification + High Shift scenario.

Mode	Billion-person-km travelled per year in 2030 under EV+HS scenario			Billion-person-km travelled per year in 2050 under EV+HS scenario		
	North Africa	Sub-Saharan Africa	South Africa	North Africa	Sub-Saharan Africa	South Africa
Light duty vehicle (LDV) - ICE	120.9	339.6	72.7	15.1	73.7	6.7
Light duty vehicle (LDV) - Electric	9.5	29.6	9.3	218.4	769.5	105.8
Ride hail - ICE	8.5	23.0	5.8	7.7	37.4	4.9
Ride hail - ICE	0.3	1.4	0.4	5.8	62.6	6.0
3W - ICE	1.2	21.8	0.1	0.0	0.0	0.0
3W - Electric	0.8	14.6	0.1	0.3	72.0	0.1
Minibus - ICE	217.5	919.8	102.9	25.8	153.3	39.2
Minibus - Electric	24.2	102.2	25.7	232.3	1,379.7	73.9
Large bus - ICE	56.9	177.4	20.8	10.1	49.3	13.3
Large bus - Electric	6.3	19.7	5.2	91.1	443.5	25.1
BRT - ICE	9.2	16.6	0.8	10.2	72.9	0.1
BRT - Electric	2.3	4.2	1.1	91.7	656.4	13.3
Rail	15.2	0.8	9.9	24.1	144.5	18.4
Motorcycle - ICE	5.3	234.2	1.8	0.5	48.9	0.3
Motorcycle - Electric	0.6	26.0	0.2	1.5	146.6	0.9
E-bikes	2.1	6.3	0.5	7.7	62.2	2.0
Bicycle	2.9	11.6	1.0	5.8	50.9	2.0
Walk	15.1	93.4	7.0	17.9	167.8	8.9
Total	498.6	2,042.2	265.2	765.9	4,391.2	320.9

3.11. DIRECT AND INDIRECT COSTS

By fostering compact cities designed around walking, cycling, and electrified public transport, African cities stand to achieve substantial savings. Our assessment considers the direct public and private expenditures associated with urban passenger transport, encompassing vehicle costs, fuel expenses, and infrastructure investments. The scenarios do not include other indirect costs such as congestion, road traffic fatalities and injuries, air and noise pollution, and the adverse health effects of high pollution and sedentary, car-centric lifestyles.

Table 19. Total extent of road/track by year and scenario (thousand km or equivalent).

Infrastructure type	Length (thousand one-way lane-km or equivalent)								
	2015	2030				2050			
		BAU	HS	EV	HS & EV	BAU	HS	EV	HS & EV
Footpaths	34.1	61.3	261.5	61.3	261.9	155.8	374.2	155.9	374.8
Cycle tracks	0.2	0.8	2.8	0.8	2.6	1.1	25.3	1.1	25.3
BRT lanes	0.0	1.5	3.0	1.5	3.0	10.8	58.4	10.8	58.4
Rail track	0.9	0.9	1.2	0.9	1.2	4.0	7.4	4.0	7.4
Roads	340.5	613.3	523.1	612.9	523.7	1,558.0	748.5	1,559.3	749.6
Parking	211.7	611.1	482.9	612.4	484.2	1,847.1	758.1	99.7	760.7

Table 20. Cumulative investment requirements under the BAU and Electrification scenarios.

Mode	Facility	BAU and Electrification, cumulative through 2030		BAU and Electrification, cumulative through 2050	
		Quantity purchased	Cost (billion USD)	Quantity purchased	Cost (billion USD)
Road and LD EVs	Infrastructure construction and maintenance (thousand lane-km)	272.77	698.98	1,217.48	3,119.80
	Total infrastructure and maintenance cost	476.89	643.81	1,085.63	3,086.48
	Electric vehicle purchase cost increment over ICE (including chargers) (million vehicles purchased)	1.70	8.55	13.90	44.21
	Total (billion USD)		1,351.34		6,250.49
Bus	Large buses purchased (million)	0.18	33.47	0.48	115.97
	BRT buses purchased (million)	0.00	1.03	0.04	16.50
	Minibuses purchased (million)	3.94	179.03	10.61	624.03
	Infrastructure construction (regular roadway for all buses) (thousand lane-km)	0.00	0.00	0.00	0.00
BRT	Infrastructure construction, two-way (thousand km)	0.72	14.41	5.39	122.23
	System costs for all buses except BRT (drivers, fuel, insurance, operation) based on billion VKM	88.44	73.47	215.86	221.32
	Additional system costs for BRT (billion VKM)	3.22	2.45	44.93	32.46
	Total (billion USD)		303.86		1,132.51
Rail	Train cars purchased (thousand)	1.59	1.31	12.94	13.54
	Infrastructure construction, two-way (thousand km)	0.02	2.53	1.61	209.12
	System Costs for rail (billion VKM)	3.20	3.34	17.59	23.79
	Total (billion USD)		7.18		246.45
Bicycle	Bicycles purchased (million)	50.07	6.71	126.24	23.51
	Ebikes purchased (million)	0.66	0.62	5.29	6.04
	Infrastructure for bikes (thousand lane-km)	0.29	0.04	0.46	0.14
	System	0.00	0.00	0.00	0.00
	Total (billion USD)		7.38		29.69
Walkways	Walkway, one side (thousand km)	13.64	1.11	60.87	4.97
Total			1,670.87		7,664.11

Table 21. Cumulative investments requirements under the High Shift and High shift + EV Scenarios.

Mode	Facility	High Shift and Electrification + Shift, cumulative through 2030		High Shift and Electrification + Shift, cumulative through 2050	
		Quantity purchased	Cost (billion USD)	Quantity purchased	Cost (billion USD)
Road and LD EVs	Infrastructure construction and maintenance (thousand lane-km)	183.21	469.48	409.12	1,048.36
	Total infrastructure and maintenance cost	432.11	583.35	636.67	2,015.86
	Electric vehicle purchase cost increment over ICE (including chargers) (million vehicles purchased)	6.59	33.20	72.43	224.70
	Total (billion USD)		1,086.03		3,288.92
Bus	Large buses purchased (million)	0.25	46.17	0.94	219.31
	BRT buses purchased (million)	0.01	2.01	0.23	84.88
	Minibuses purchased (million)	3.39	157.12	9.36	547.28
	Infrastructure construction (regular roadway for all buses) (thousand lane-km)	0.00	0.00	0.00	0.00
BRT	Infrastructure construction, two-way (thousand km)	1.45	15.45	27.74	344.85
	System costs for all buses except BRT (drivers, fuel, insurance, operation) based on billion VKM	107.60	85.10	213.05	186.15
	Additional system costs for BRT (billion VKM)	6.25	4.68	216.47	156.64
	Total (billion USD)		310.53		1,539.09
Rail	Train cars purchased (thousand)	2.44	2.65	23.60	26.11
	Infrastructure construction, two-way (thousand km)	0.18	20.04	3.25	421.54
	System Costs for rail (billion VKM)	4.13	4.71	30.30	37.76
	Total (billion USD)	0.00	27.40	0.00	485.42
Bicycle	Bicycles purchased (million)	58.24	7.67	203.86	36.91
	Ebikes purchased (million)	27.40	21.33	144.39	156.23
	Infrastructure for bikes (thousand lane-km)	1.48	0.22	12.54	3.76
	System	0.00	0.00	0.00	0.00
	Total (billion USD)		29.23		196.91
Walkways	Walkway, one side (thousand km)	113.74	9.27	170.10	13.88
Total			1,462.45		5,524.23

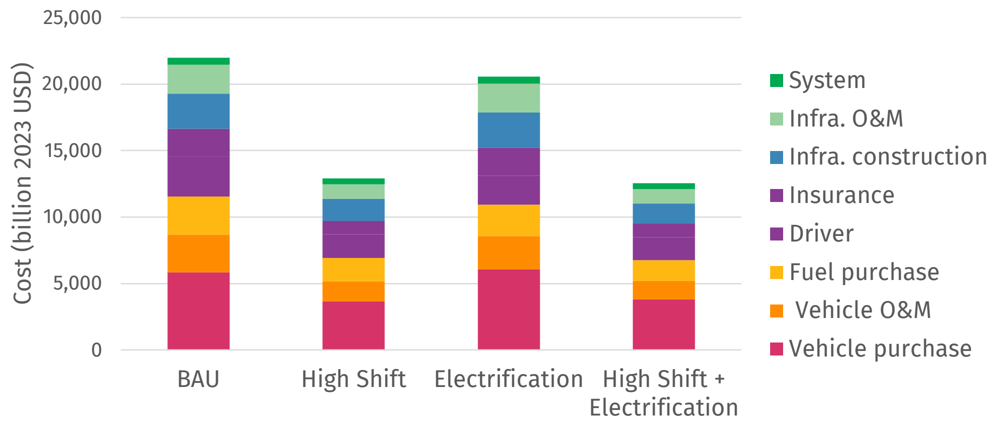

Figure 26. Public transport infrastructure and maintenance costs under the different scenarios through 2050.

3.12. GREENHOUSE GAS EMISSIONS

Mitigating greenhouse gas emissions from transport in Africa requires a multifaceted approach that addresses various aspects of the transport system. Our analysis shows that the High Shift scenario exhibits a swifter pace of greenhouse gas reduction in comparison to the Electrification (Only) scenario. Furthermore, the High Shift scenario contributes to a decreased urgency for grid decarbonisation by reducing the overall energy demand. This is especially crucial given that most African countries are still improving their electricity grids and also considering the lack of a consistent electricity supply in countries such South Africa and Nigeria.

Table 22. Annual greenhouse gas emissions, 2050 (million tonnes CO_2e/year).

Emissions source	BAU	High Shift	Electrification	High Shift + Electrification
Fuel & electricity	418	166	61	22
Infrastructure	25	11	25	11
Manufacture	57	32	88	49
Total	500	209	174	82

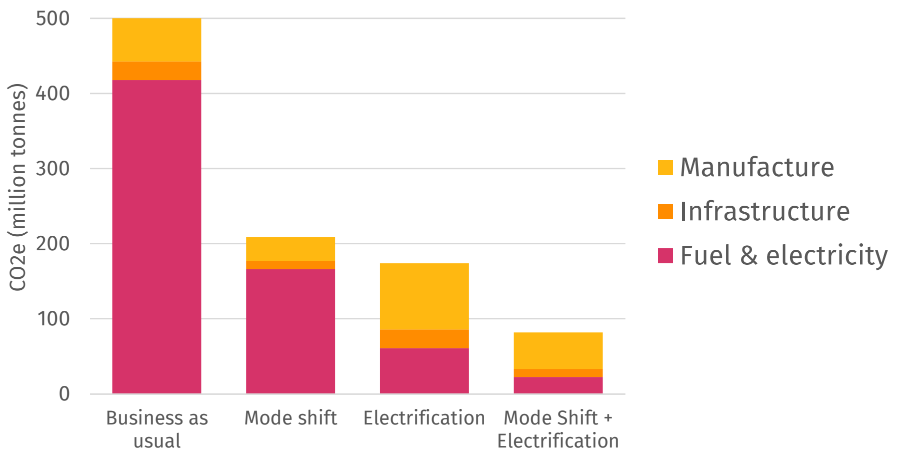

Figure 27. Source of emissions in the transport sector.

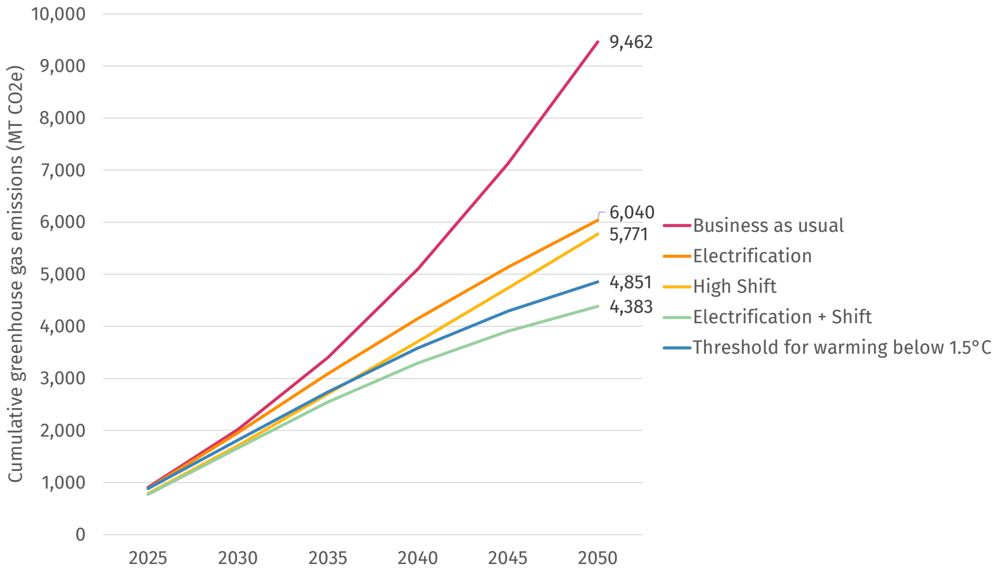

Figure 28. Greenhouse gas emissions by scenario and year.


PAPA GUEYE FALL
Guichet

4 FINANCING SUSTAINABLE URBAN TRANSPORT

4.1. RAPID TRANSIT INFRASTRUCTURE AND OPERATIONS

Governments are actively exploring financing mechanisms for public transport infrastructure and services. They are examining options such as government budgetary support via tax revenue, financing from multilateral development banks (MDBs), and private sector engagement. Escalating fiscal constraints have led governments to show a growing interest in relying on private sector investment for infrastructure development. This trend is evident in the increasing number of public-private partnership (PPP) projects in the region and the expanding presence of toll roads and highways under private sector management. However, exclusive private sector investment generally is not a feasible option for public transport systems because farebox revenue is not sufficient to cover capital and operating costs. Globally, public transport systems operate through subsidies from government to ensure adequate frequency and affordability.

Although private sector is unlikely to cover the full cost of a rapid transit corridor, a common arrangement is for the government to build the infrastructure (e.g., BRT corridors, stations, terminals, and depots) while the private sector contributes a sizable portion of the investment in the rolling stock and operations. It is important that the government and private sector share operational risks. Without some contribution from government, the private sector is likely to transfer operational risks to commuters through higher fares, affecting affordability and use. In addition, with minimal government oversight, the investor is likely to cut corners and allow the vehicles and service quality to deteriorate over time. Given that the private sector's main motive is profit, the government should play an active role in system planning and determine the key parameters for private sector engagement. Governments should define infrastructure specifications such as station sizes and designs, presence of passing lanes, bus fleet sizes, and service frequencies. Competitive bidding for construction and operations can reduce implementation costs.

Figure 29. BRT station in Dakar, Senegal.

DAKAR BRT BUSINESS MODEL

The World Bank and the European Investment Bank financed construction of the 18.3 km Dakar BRT corridor. On the other hand, the BRT bus fleet is financed, procured, and operated by the private sector through a 15-year concession agreement signed in Mar 2021. The private sector partner, Dakar Mobilité, constitutes Meridiam and Fonds d' Investissement du Sénégal (Senegal Investment Fund, or FONSIS) under a 70/30 shareholding agreement. FONSIS shares, which are essentially government shares, are expected to be sold back to local operators within two years. The overall private sector investment amounts to USD 144 million, with an additional USD 22 million financed by the World Bank's Multilateral Investment Guarantee Agency (MIGA).

The risks to the private sector are mitigated through clearly outlined risk and role allocation in the operating agreement, including a minimum revenue guarantee, minimum passenger guarantee set at 100,000 passengers per day, and automatic fare revision of +1.9 percent per annum. The operator is expected to collect revenues as well as maintain the necessary infrastructure. The government, on the other hand, will ensure adequate operations and passenger volumes on feeder services. The BRT fares are zone-based and were set based on affordability through preference surveys and existing fares as well as the financial viability of the concession. To accommodate vulnerable groups, estimated to constitute 17 percent of potential riders, the system will charge a reduce fare of 50 percent of the normal rate. The government will pay USD 17 million to the concessionaire over the 15-year period to offset the revenue loss due to the reduced fare. It is also worth noting that since the project is deemed financially viable with an economic internal rate of return (EIRR) of 18.9 percent, the concessionaire is expected to pay a concession fee to the government.

4.2. ACTIVE MOBILITY

Unlike rapid transit projects, NMT projects are often perceived as being too small to attract financing from multilateral development banks but also lack adequate funding from governments. Cities around the region have been working to incorporate NMT in core areas and on major corridors, with funding from local government. However, policy initiatives and coordination are essential in making sure that national and local governments, multilateral development banks, and other partners prioritise NMT infrastructure in all future projects. Financing for NMT along key corridors can be incorporated in large infrastructure projects (e.g., a BRT corridor) to improve viability. Pilot projects, car-free zones, and events such as car-free days and high-level bike rides with decision makers and industry practitioners are key in envisioning how cities could be improved through dedicated walking and cycling infrastructure. As an additional measure, governments can implement bikeshare systems, which enhance carbon-free movement for short trips or last-mile access to public transport. Globally bikeshare projects are implemented through sponsorship through advertising by the private sector.

4.3. URBAN PLANNING POLICIES

As Africa urbanises, there is a need for adequate planning and investment support from both national and local governments. This can be achieved by establishing adequate institutional frameworks and using urban planning as a tool to guide the growth of urban areas. There is also a need to have clear budgets and revenue sources to expand the provision of basic services as densities increase. Cities should explore innovative financing options such as land value capture (i.e., property tax, betterment levy, developer fees, public land leasing, recycling public assets) and bond issuance. Through TOD, cities can use the leasing of idle land and revenues from land rates to improve transport systems and utilities, creating a more vibrant urban environment and promoting more liveable compact cities. Cities in the region have begun conceptualising how mass transit corridors can be improved and in turn create additional revenue for governments.

Figure 30. A park in Aswan, Egypt. Open spaces in cities improve air quality, promote biodiversity, manage stormwater, sequester carbon, and encourage physical activity, leading to better public health and environmental sustainability.

5 CONCLUSION

Under the High Shift & Electrification scenario described in this report, sustainable transport infrastructure is considerably less costly in comparison to the BAU scenario. Efficient transport investments in Africa can act as catalysts for economic growth, fostering job creation and improving overall accessibility. The benefits of sustainable urban transport will extend far beyond economic considerations and also extend to social, environmental, and health benefits. As the global community grapples with climate change, low-carbon transport systems will be an essential contributor to greenhouse gas mitigation.

Moving forward, governments, multilateral development banks, and the private sector need to rethink planned investment to ensure a more sustainable and responsible outlook for African cities. The role of government in directing investments towards sustainability is vital. By having clear implementation plans, adequate project preparation, and a holistic outlook toward integrated and equitable cities, governments can steer the way forward on sustainable urban transport. Climate finance and grants from multilateral development banks can play a significant role in supporting adequate project planning, ensuring projects are bankable and ready for investment. Development partners need to expand the volume of financing for sustainable mobility and invest in efficient, cost-effective, and climate friendly modes of transport. Lastly, there is need for continuous learning on best practices across the different institutions to ensure that cities learn from each other on how best to implement and integrate urban projects.

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Figure 31. BRT station in Dar es Salaam, Tanzania.


SUNUBRT
PAPA GUEYE FALL
Porte 8
Petersen
Accès
PMR
PMR access
PORTE 1
Porte 3

6 WORKS CITED

African Development Bank. (2023, November). Retrieved from https://projectsportal.afdb.org/dataportal/VProject/show/P-TZ-DB0-021

Atlas of Urban expansion. (2016).

Bezabeh, Mohamed, Tripodi, & Govert Schermers. (2022). Motorcycle Safety in Africa. Abidjan, Côte d'Ivoire: African Development Bank.

European Investment Bank. (2017). Bus Rapid Transit in Dakar.

Gautrain. (2019). Integrated Annual Report.

Hook, D. W. (2021). China's Overseas Lending for Transport Projects.

ICCT. (2021, 7 20). Retrieved from A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars: https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/

IEA. (2013). Retrieved from Global Land Transport Infrastructure Requirements: https://www.iea.org/reports/global-land-transport-infrastructure-requirements

IEA. (2019, 12 4). Introducing the Sustainable Development Scenario. Retrieved from https://www.iea.org/events/introducing-the-sustainable-development-scenario

IEA. (2022). World Energy Outlook 2022. Retrieved from https://www.iea.org/reports/world-energy-outlook-2022

ITDP. (2021). Highways and Zoning: Tools of Racist Policy. Retrieved from itdp.org: https://www.itdp.org/2021/03/10/highways-and-zoning-tools-of-racist-policy/

ITDP. (2022a). Making the Economic Case for Cycling. Retrieved from https://www.itdp.org/wp-content/uploads/2022/06/Making-the-Economic-Case-for-Cycling_6-13-22.pdf

ITDP. (2022b). Why Infrastructure Matters: Active Mobility, Public Transport and Economic Growth in African Countries.

ITDP and EMBARQ. (2012). The life and death of urban highways.

ITF. (2020, 9 17). Good to Go? Assessing the Environmental Performance of New Mobility. Retrieved from https://www.itf-oecd.org/good-go-assessing-environmental-performance-new-mobility

Ministry of Transportation, Ghana and Ghana Statistical Service. (2013). Second national household transport survey. Accra: Ghana Statistical Service.

Mobereola, D. (2009). Africa's first bus rapid transit scheme : the Lagos BRT-Lite system. Sub-Saharan Africa Transport Policy Program (SSATP) discussion paper ; no. 9 Washington, D.C. : World Bank Group.

MobiliseYourCity. (n.d.). Global Monitor.

Naturinda, & Kamoga. (2023). Reckless motorcyclists run amok in Kampala, leaving families in agony. The East African.

Njoroge, J. (2022). East Africa's boda boda boom that turned into major public health concern. Nation Media.

Orascom Construction PLC. (2022, November). https://orascom.com/updates/orascom-construction-consortium-signs-a-contract-for-cairo-metro-line-4-phase-1/. Retrieved from

Figure 32. BRT station in Dakar, Senegal.

https://orascom.com/updates/orascom-construction-consortium-signs-a-contract-for-cairo-metro-line-4-phase-1/

People-oriented cities. (2021). The Role of BRT in Post-Pandemic South Africa. RailwayTechnology. (2021, January). Retrieved from Railway-technology.com: https://www.railway-technology.com/projects/cairo-metro/?cf-view

Rogers, D. (2023, January). Most trains on Addis Ababa's light rail system grounded for want of spare parts. Retrieved from ttps://www.globalconstructionreview.com/most-trains-on-addis-ababas-light-rail-system-grounded-for-want-of-spare-parts/

Theseira, W. (2020). Congestion Control in Singapore. International Transport Forum Discussion Papers; No. 2020/10. Paris: OECD Publishing.

Transport for London. (2023). Congestion charge. Retrieved from https://tfl.gov.uk: https://tfl.gov.uk/modes/driving/congestion-charge

Transport Styrelsen . (2020). Stockholm congestion taxes modified on 1 January 2020. Retrieved from Transport Styrelsen : https://www.transportstyrelsen.se/en/Forms/Road/

United Nations. (2018). World Urbanization Prospects 2018.

Vörös, I. T. (2019, January). Revisiting Chinese Transportation Projects in Ethiopia.

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