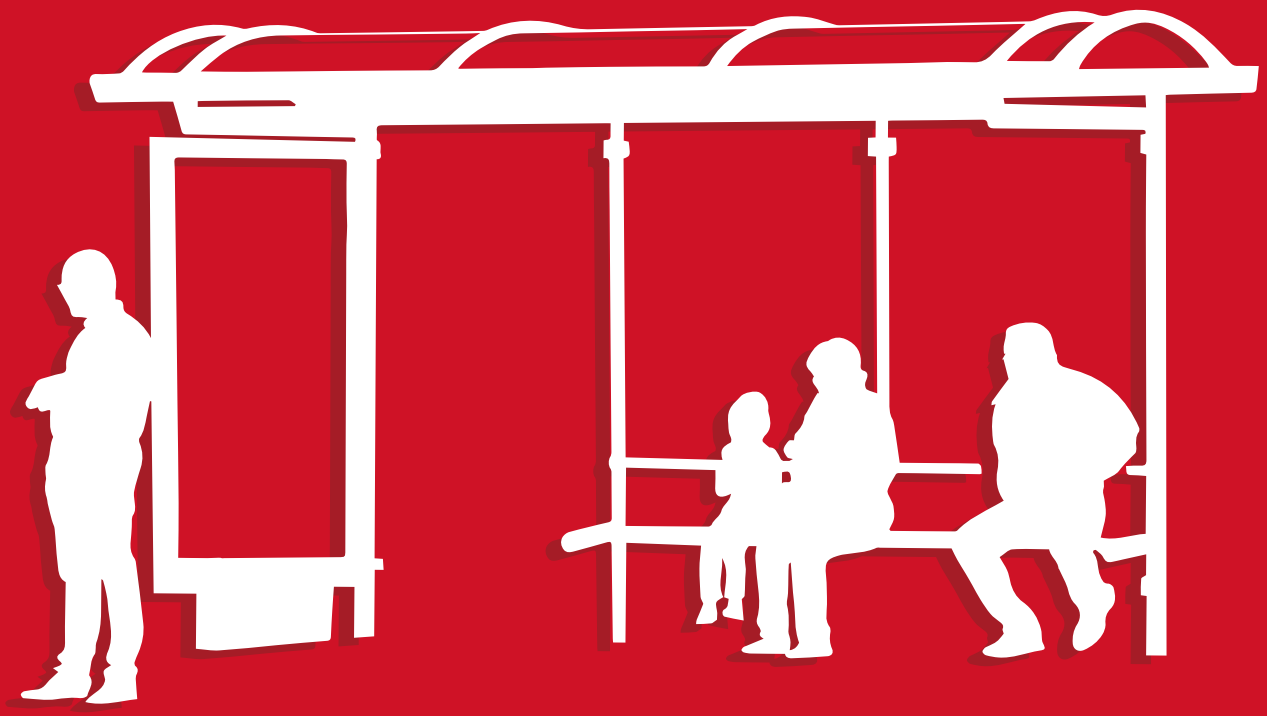

URBAN TRANSPORT SOLUTIONS FOR ACCRA

BAHMAN KASHI
Founder & CEO - Limestone Analytics
Adjunct Professor - Department of Economics, Queen's University

SARAH CARELLO
Researcher - Limestone Analytics

NATIONAL DEVELOPMENT PLANNING COMMISSION

COPENHAGEN CONSENSUS CENTER

GHANA PRIORITIES

COPENHAGEN CONSENSUS CENTER

info@copenhagenconsensus.com
www.copenhagenconsensus.com

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Urban Transport Solutions for Accra

Ghana Priorities

Bahman Kashi
Founder & CEO - Limestone Analytics
Adjunct Professor - Department of Economics, Queen's University

Sarah Carello
Researcher - Limestone Analytics

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Academic Abstract

Accra, the capital of Ghana, has been experiencing rapid population growth and increased demand for transport due to urban sprawl. In the face of these challenges there have been efforts to provide better transport options and improve the transport infrastructure but congestion, traffic accidents, and emissions from Accra's transport sector continue to be issues that need addressing. The city's demand for transport also continues to rise without the capacity to handle this volume with a sustainable, safe, and efficient transport system. The solution to these problems will require improvements in the infrastructure, efficient urban planning, and provision of affordable public transport. The report looks into what past evidence and literature suggests could improve urban transport in Accra and looks at the benefits and costs of investing in a Bus Rapid Transport System. The results of this analysis show that if the project leads to a 10% increase in average road speed, the intervention is economically feasible. Investment in Accra's infrastructure is needed but should be done with a holistic view of the transport system. This means more data and analysis is needed before determining the optimal transport solution.

Key Words: Infrastructure, Public Transport, Africa

Policy Abstract

The Problem

Accra is a growing city with increasing congestion and longer commute times. The city has experienced an average growth rate of 2% over the past ten years and is expected to continue growing from its current population of around 2.4 million. In the past few years, owning and operating a vehicle has become more affordable to a larger portion of Ghana's population. In Accra, this has increased the number of vehicles leading to higher levels of congestion. The city has also experienced significant urban sprawl and people have continued to move further from the central business district (CBD). As a result, people must commute longer distances as the CBD accounts for the main source of Accra's economic activity (Brookins 2019). In addition to creating large time costs and reduced safety for travelers, these factors have had an adverse impact on the environment.

Due to rapid population growth and the struggle to update urban planning to accommodate traffic volumes, most of Accra's population is served by the informal transport sector, which consists mainly of mini-buses, often referred to as tro-tros. Tro-tros are often older vehicles and it is customary for riders to fill them past capacity. The market remains mostly unregulated and creates safety risks, damages the environment, and contributes to congestion. Approximately 70% of the population use the informal system as their means of transport due to its flexibility and low cost. Tro-tros are a low-cost option for people to travel and have flexible routes that adjust according to demand. The second choice for transport is privately owned vehicles, which increases congestion and carbon emissions. Investments towards improving Accra's public transport have been made, but further solutions are needed in order to solve the issues caused by the higher volumes of traffic.

In order to reduce congestion, increase safety, and reduce emissions, there must be a change in the state of urban transport. This paper will investigate possible solutions to improve urban transport in Accra. Possible solutions include investment in infrastructure, urban planning, and a public transport system. This paper will highlight the costs and benefits of investing in a public transport system. This paper will also identify possible solutions that could improve the public transport system and identify alternative transport solutions if public transport is financially unsustainable. Although the costs and benefits of these alternative solutions have not been calculated due to lack of data, they should be considered before project

implementation. This will enable the city to optimally incorporate urban planning and infrastructure improvements into the design of a new public transport system.

The Cost of the Traffic in Accra

While traffic congestion currently creates a large time cost, it also represents a large potential benefit if travelling times can be reduced. To calculate this time cost, we assume that the average daily distance travelled is 27 kilometers (km) (UNEP 2016). The World Bank Implementation and Completion Results Report (ICR 2017) found that average traffic speed on the main arterial roads of Accra is 28 km per hour. This results in an average commute time of 58 minutes every day. The value of a project that can increase traffic speed to a flow rate of 36 km per hour and creates an estimated present value of $311,630,758 USD (GHS 1.73 billion) over 30 years with an 8% discount rate. Although the speed of Accra's traffic is limited by many factors, it can be improved. We will investigate factors causing this congestion and comment on how these might be improved to increase the flow of traffic and reduce the time costs associated with traffic. Another cost of Accra's transport system is attributed to a lack of safety. According to the Pedestrian Safety Action Plan for the Accra Metropolitan Assembly, the average annual number of accidents is near the average for African cities (AMA 2019). However, the number of accidents causing fatalities and injuries affecting pedestrians is much higher than most other African cities, and it has some of the most dangerous streets in the world for pedestrians (AMA 2019). Increasing the safety of pedestrians would benefit the large proportion of the population who either commute by walking or walk to access public transport. A project that could improve safety would have large potential benefits in terms of injuries and fatalities avoided.

Intervention 1: Bus Rapid Transport System

Overview

The project being analyzed will include investment in infrastructure for a BRT system, traffic management in order to support the system, and institutional strengthening to coordinate all the ministries involved in the planning, management, and monitoring of the BRT system. Investing in this project would have benefits including decreased time savings, increased safety for all road users, and reduced vehicle operation costs.

The World Bank and the Government of Ghana have made investments to improve the infrastructure in Accra and create institutions to support a public transport system. Since 2016,

buses have been purchased for Accra's bus system. By adding the additional components that make a BRT, including the construction and enforcement of a separate bus lane and institutional strengthening to support the BRT, buses can avoid being stuck in congestion with the rest of traffic, making it a more attractive choice for passengers.

Implementation Considerations

This analysis is performed on one possible solution to address Accra's urban transport issues. While the goal of this report is to highlight the costs and benefits of implementing a bus rapid transport system there are many other solutions and considerations policymakers should evaluate apart from a BRT. Assessing the most cost-effective solution would require more data than the authors had available at the time of writing this report.

To conduct this analysis, updated data on traffic flow, vehicle operational costs, use of the tro-tro system, and pedestrian traffic should be collected and analyzed. This would allow project implementers to improve traffic management such as optimizing turning lanes for buses, coordinating the public transport services to include complementary bus routes and tro-tros as a feeder system to the BRT, and implement required infrastructure improvements. This would also allow for a more complete analysis of the benefits of the project.

Costs and Benefits

Costs

The costs associated with this project include investment and operational cost of the BRT system. The value of the investment and operational costs are presented below in Table 1, assuming an 8% discount rate. The investment and operational costs are presented Table 1 below. This is looking at an investment period of 4 years and operational period of 30 years.

Table 1: Costs of BRT Project

Items	Cost (USD)	Cost (GHS)
Investment Cost	$80,664,758	447,951,565
Operational Cost	$132,513,092	735,878,328

Benefits

The benefits included in the cost benefit model are time savings from reduced congestion and reduced carbon emissions from decreased vehicle operation costs in Accra. Another potential benefit of the BRT system is increased safety. Although this benefit was not quantified in the model, it will be further discussed in the analysis. The benefits for the BRT are presented in the Table 2 below. These figures are based on an operational period of 30 years. We assume that time is valued at the rate of urban hourly wages and that carbon is valued in the first year (2020) at 29.9 USD and that the value of carbon emissions will grow by 2% each year.

Table 2: Benefits of BRT Project

Items	Benefit (USD)	Benefit (GHS)
Time Saving	$311,630,758	1,730,563,505
Carbon Emissions Averted	$6,522,656	36,221,937

BCR Summary Tables and Graph

Benefit-Cost Ratio

Table 3 and Table 4 provide summaries of the BCR for the proposed project with Table 3 presented in U.S. dollars and Table 4 presented in Ghanaian Cedi. Although the BCR is greater than 1.0 at both a 5% and 8% discount rate, it is less than 1.0 when the discount rate is increased to 14%. The quality of evidence for each of the discount rates is rated as “Medium”. Similarly, Figure 1 provides a visual representation of the costs and benefits by type.

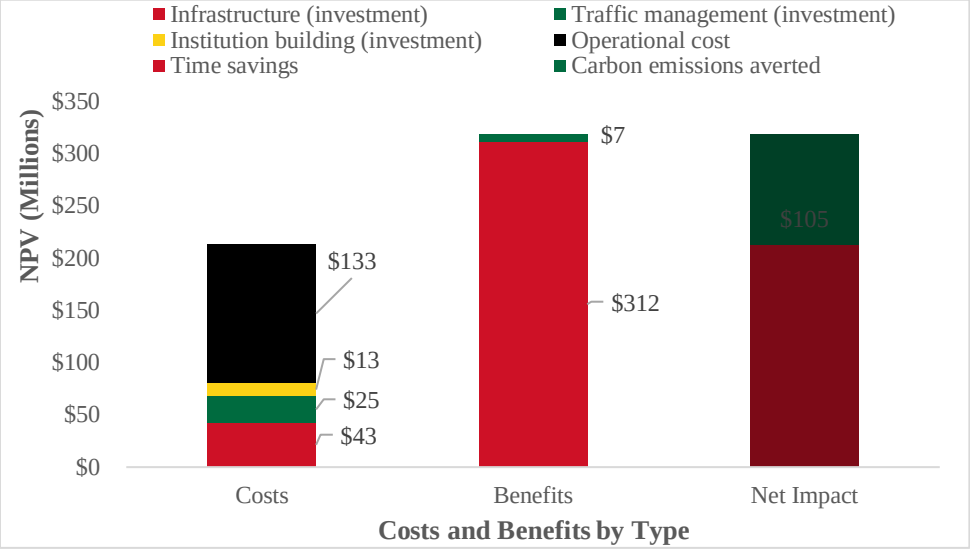
Table 3: Summary of Benefits and Costs, USD

Discount Rate	Benefit (USD)	Cost (USD)	BCR	Quality of Evidence
5%	593,883,852	283,055,362	2.10	Medium
8%	318,153,413	213,177,850	1.49	Medium
14%	114,164,630	142,891,826	0.80	Medium

Table 4: Summary of Benefits and Costs, GHS

Discount Rate	Benefit (GHS)	Cost (GHS)	BCR	Quality of Evidence
5%	3,297,985,503	1,571,877,188	2.10	Medium
8%	1,766,785,443	1,183,829,893	1.49	Medium
14%	633,984,734	793,514,031	0.80	Medium

Figure 1: Summary of Benefits and Costs by Type, USD



Introduction

Many cities in the developing world are experiencing rapid growth, urban sprawl, and a population that has increasing access to motor vehicle transportation. This has had negative consequences in the form of congestion that takes away hours of people's day, environmental damage, and traffic accidents becoming one of the leading causes of death mainly in developing countries. Accra, the capital of Ghana, has been subject to all of these issues. While attempts have been made to improve transport, the city still has large amounts of congestion and is lacking the infrastructure needed to handle the city's current level of transport demand. The rise of the informal sector makes the implementation of public transport more difficult as it offers a low-cost alternative. In this context, we use a cost benefit methodology to determine the effect of a BRT being implemented in Accra. In addition, we will discuss other barriers that should be addressed and alternative solutions that we did not have the data to analyze. The analysis of a BRT is proposed as an illustrative case due to the required data collection and urban planning and design that would be needed in order to implement the project.

Bus Rapid Transport: An Illustrative Case of Urban Transport Improvements

Description of intervention

The consideration being analyzed is a Bus Rapid Transport (BRT) system. This system includes buses that run in separate lanes from other modes of traffic. This allows the buses to bypass the congestion of the roads and makes them a preferable method of transport. They also feature improved information and ticketing systems to make them more convenient. The construction and enforcement of a separate bus lane potentially makes the BRT an attractive transport choice for people. It also has the potential to reduce congestion and increase traffic speed by reducing the demand for other modes of transportation. However, buses must compete with alternative transport options such as tro-tros, informal service mini-buses, and private vehicles. Tro-tros are a low cost and flexible method of travel that many people in Accra prefer. If the buses are in congestion with the rest of traffic, then tro-tros will remain the preferred option.

The World Bank and the Government of Ghana began the implementation of a BRT system but ran into cost overruns in the construction of the Odaw Bridge. They also made investments to improve the institutions that govern transport infrastructure in Accra. However, due to the

cost overruns, they implemented a smaller set of routes but were not able to implement all of the components of the BRT (Brookins 2019).

The project being analyzed will expand the current BRT system to include investment in infrastructure, improved traffic management in order to support the system, and institutional strengthening to coordinate all the ministries involved in the planning, management, and monitoring of the BRT system. Investing in this project would have several benefits, including increased time savings, increased safety for all road users, and decreased vehicle operation costs. Due to the lack of updated data available at the time of analysis, we will only value the benefits associated with increased time savings and reduced carbon emissions. For the implementation of this project, updated data on traffic flows, vehicle operational costs, use of the tro-tro system, and pedestrian traffic should be collected and analyzed. This would allow for optimal integrations of urban planning and coordination and regulation of the public transport services (including complementary bus routes and tro-tros) to work as a feeder system with the BRT. This would also allow for a more complete analysis of the benefits of the project.

Data

The data for this evaluation came from multiple sources evaluating the effect of implementation of a BRT in Accra and public transport in African Cities overall. The main sources for the BRT system in Accra include the World Bank Implementation and Completion Results Report and UNEP proposal for the Ghana Ministry of Roads and Transport. We referenced other sources in order to ensure that our assumptions are supported with evidence where appropriate. The goal of this report is to identify what we know about urban transport in Accra, to suggest possible solutions, and to highlight where evidence is lacking and what knowledge gaps need to be considered before implementing a public transport system. For this reason, we also look at the literature analyzing other cities across Africa to suggest solutions that should be considered prior to implementation.

Literature Review

Accra, like many other large cities across Africa, is experiencing a growing urban population and a public transport system that is not equipped to handle this demand. Kumar and Barrett (2008) conducted a study on 14 African cities to assess the issues with the public transport system that are causing increasing level of congestion across African cities. Due to high levels of demand for travel there has been huge growth in the use of mini-buses as a mode of transit.

In Accra, minibuses (often called tro-tros) represent a large percentage of the road traffic. The size of tro-tros gives them greater maneuverability but due to their limited seating capacity also contribute to the congestion problem. The market also has weak regulatory enforcement which allows for older vehicles to be run even when unsafe (Kumar and Barrett 2008, 5). These older vehicles often break down and create more carbon emissions that contribute to the city's air pollution. Tro-tros offer an affordable and flexible transport option to meet people's demand but in the long run the system will need to be changed or replaced to address congestion and safety as the city continues to grow.

Transport infrastructure in Accra is not capable of meeting the demand of the growing urban population and is not maintained to the required level. The density of paved roads per 1000 inhabitants in Accra (and many other cities in Africa) is at the extreme low end of developing cities (Gwilliam 2011, 228). Bad road conditions make public transport by bus less favorable due to their lack of maneuverability compared to a mini-bus, taxi, or motorcycle. Increasing the number of paved roads and improving the maintenance of existing roads should be considered in a public transportation project. This could change many people's preferred choice of transport to BRT and have a positive impact on the speed at which vehicles can drive safely. These improvements offer significant benefits in terms of reduced time cost and vehicle operation costs (Gwilliam 2011, 74).

In order to reduce urban traffic congestion there is a need for improved management of Accra's urban roads that integrates the many ways roads are currently used. In Accra, a common problem is that street vendors and vehicle parking take up pedestrian walkways or street lanes. This obstructs traffic flow and creates unsafe situations. Urban planning needs to be able to incorporate the needs of pedestrians, parking, and street vendors into their urban transport plans. Incorporating the multiple uses of current street space will prevent blockages in the road that decrease road capacity and create safety hazards (Gwilliam 2011, 230). Finding solutions to complex urban planning issues, such as where street vendors and parked cars should be located, will not be easily addressed.

In Accra and other African cities, there is a need for coordination between urban planning, investment and maintenance of infrastructure, and public transit. These components are all interrelated and their dependence upon each other must be considered. Kumar and Barrett's study found that the number of government ministries that were all involved in the planning, regulating, licensing, and monitoring of urban transport leads to confusion and a lack of

integration among them (Kumar and Barrett 2008, 6). Any effective project in urban transport for Accra would need to fully understand the role of each institution and be involved in the strengthening and coordination of these institutions to ensure the efficiency and sustainability of the transport system. All projects affecting the infrastructure, traffic management, and public transport should be coordinated because attempting to improve one on its own risks failing if improvements of the others are needed but not implemented.

Calculation of Costs and Benefits

Investment Cost

The investment costs include the required expenditures to improve he BRT system, including segregated bus lanes, interchange facilities, terminals, stops, a depot, and facilities for pedestrians. According to the Accra BRT project proposal by UNEP and the Ministry of Roads and Transport, these investments will include one BRT lane per direction. To make the BRT system sustainable, investments are also needed to strengthen institutional capacity and traffic management. These investments will include increasing levels of enforcement, regulation, and management of the public transit system. Improved traffic management involves the prioritization of BRT vehicles on roads and at intersections. In addition, traffic management can be improved by installing technology that will report information about bus location and time of arrival. These features will help to attract greater use of the buses by making the BRT more convenient and reliable.

Table 5 provides a summary of the investment costs totaling $93 million (GHS 517 million) with U.S. dollars adjusted to 2020 levels. These costs will be incurred over the first four years of implementation and represent an NPV of $80.6 million (GHS 447.9 million) at an 8% discount rate.

Table 5: Investment Costs

Inputs		Value (USD)	Value (GHS)	Source of verification
I^{BRT}	Investment in infrastructure for BRT	$49,220,000	273,330,965	UNEP 2016
$I^{Traffic}$	Traffic management	$28,890,000	160,433,393	UNEP 2016
$I^{Institutions}$	Institution building	$14,980,000	83,187,685	UNEP 2016
Calculation				
Cost:	$C1_t^{Government} = I^{BRT} + I^{Traffic} + I^{Institutions}$			

Operational Cost

The second cost of the BRT is the operational costs, which are based on fuel costs, distance traveled, maintenance, and wages for operating the BRT system. Fuel costs account for the largest share of operation costs and assumes buses will use standard diesel fuel. The estimated kilometers travelled daily by bus assumes of 8 hours of service per day at 365 days a year. This assumption is based on findings from the UNEP report for the Ministry of Transport. Although the analysis considered the extension of the daily hours of operation, this greatly impacted the cost of the project and is not used in this study. During project implementation, updated data on peak travel times should be evaluated to accommodate the most travelers. Similarly, running buses for extended periods in off peak hours will likely increase costs and may not be worthwhile.

Table 6 provides a summary of the key variables used to calculate the operational costs, including an assumed operations cost of $1.64 per km (GHS 9.10 per km). These costs are incorporated into the model beginning in the 4th year after the project has started and are accounted for through the project lifecycle. In total, these costs represent an NPV of $132.5 million (GHS 735.8 million) at an 8% discount rate.

Table 6: Operational Costs

Inputs		Unit	Value	Source of verification
O^{Cost}	Cost of operation per km	USD	$1.64	ICCT 2012
K^{Bus}	Km travelled daily by each bus	Km	273	UNEP 2016
N^{Buses}	Number of buses operating on route	#	90	World Bank 2017
O^{Days}	Days of operation annually	#	365	UNEP 2016
Calculation				
Cost:	$C2_t^{Government} = O^{Cost} \times K^{Bus} \times N^{Buses} \times O^{Days}$			

Travel Time Savings

One of the most significant benefits from implementing a BRT system is a reduction in travel time. The World Bank estimates that the BRT would serve 50% of the traffic flow on Accra's arterial roads (2017). In Vijayawada, Andhra Pradesh it was estimated that the implementation of a BRT would lead to a 30% increase in average traffic speed (Dey and Malhotra 2018, 22). We believe the increase in average speed times would be similar in Accra for two reasons. Fist, Accra and Vijayawada have similar populations, geographic sizes, and motorization rates. Second, this increase in speed is in line with the targets set for the World Bank's urban transport project. Time saved in traffic can be used for productive purposes and is therefore valued using urban wages. The projected value of urban wages over 30 years were provided by Copenhagen Consensus Center and adjusted to represent the value of one hour (V^{Time}). We consider the sensitivity of the project to a speed change of 20% or 10% above current levels, as this variable would impact the number of travelers choosing to ride on the BRT system.

Table 7 provides a summary of the key variables used to calculate the time saving benefits, including an assumed time value of $1.33 per hour in Accra (GHS 7.37 per hour). These benefits are incorporated into the model beginning in the 4th year after the project has started and are accounted for throughout the project lifecycle. In total, these benefits represent an NPV of $311.6 million (GHS 1.73 billion) at an 8% discount rate.

Table 7: Time Saving

Inputs		Unit	Value	Source of verification
T	Average daily traffic (2020)	#	60,733	UNEP 2016
$S^{Without}$	Average speed of traffic without project	Km/h	28	World Bank 2017
$S^{Increase}$	Increase in average speed of traffic with project	%	30%	Dey and Malhotra 2018
G^{Demand}	Growth in demand for travel on route (annual)	%	7%	UNEP 2016
U^{BRT}	Percentage of traffic using BRT	#	50%	World Bank 2017
S^{Buses}	Speed of buses	Km/h	35	World Bank 2017
K^{Daily}	Daily kilometres traveled	Km	27	UNEP 2016
V^{Time}	Value of one hour in Accra (2020)	USD	1.33	CCC
Calculation				
Benefit :	$B1_t^{Passenger} = \left[\left[\frac{K^{Daily}}{S^{Without}}\right] - \left[\frac{K^{Daily}}{S^{Without} \times S^{Increase}}\right]\right] \times (1 - U^{BRT}) + \left[\left[\frac{K^{Daily}}{S^{Without}}\right] - \left[\frac{K^{Daily}}{S^{Buses}}\right]\right] \times (1 - U^{BRT}) \times T^{t-t_0} \times V^{Time}$			

Reduction in Carbon Emissions

In Accra, the high volume of vehicular traffic creates carbon emissions and environmental damage. We assume carbon emissions will be reduced by providing an alternative mode of transportation that reduces the overall number of vehicles compared to what would happen without the BRT system. In 2012, the transport sector represented approximately 48 percent of national emissions (UNEP 2016). By shifting many travelers from tro-tro travel or personal vehicles to a BRT system, carbon emissions from the transport sector could be reduced significantly. This calculation assumes a bus travels an average of 273 kilometers per day at 365 days a year. Another vital assumption is that 50% of traffic will transfer from personal vehicles or tro-tros to the BRT. This figure is based on the World Bank report for the implementation of the BRT and has been used for similar projects in the developing world.

The baseline scenario for Accra's carbon emissions is based on 2012 data of vehicle traffic and the growth rate of transport demand, which is estimated at 7% per year (UNEP 2016). These

figures are based only on car/taxi, motorcycle, and bus emissions as these are the vehicle emissions that are expected to change with the BRT.

Table 8 provides a summary of the key variables used to calculate the benefits from reduced carbon emissions. We value carbon as provided by Copenhagen Consensus Center of 29.9 per ton adjusted for inflation (GHS 166.2). This social cost of carbon is also subject to growth over time of 2% per year. Other key variables include $20.8 for reduced traffic emissions in the first year (GHS 158.3) and $14.86 for reduced bus emissions (GHS 82.5). These benefits are incorporated into the model beginning in the 4th year after the project has started. In total, these benefits represent an NPV of $6.52 million (GHS 36.2 million) at an 8% discount rate. This represents a very low portion of the benefits of this project, which is due largely to the fact that the largest benefit in terms of carbon emissions comes far in the future due to the growing rate of traffic.

Table 8: Carbon Emission Reduction

Inputs		Unit	Value	Source of verification
$E^{Traffic}$	Carbon Emissions in Accra in first year	USD	20.8	(UNEP 2016)
E^{BRT}	Carbon Emissions from buses per year	USD	14.86	(UNEP 2016)
$V^{Emissio}$	Value of one metric ton of carbon emission (2020)	USD	29.9	CCC
G^{Value}	Growth in value of carbon emissions	%	2%	CCC
U^{BRT}	Percentage of traffic using BRT	#	50%	World Bank 2017
Calculation				
Cost:	$B2_t^{Ghana} = [E^{Traffic} - (E^{BRT} + (1 - U^{BRT}) \times E^{Traffic})] \times V^{Emissions}(1 + G^{Value})^t$			

Safety

The third benefit is the increased safety that is expected to occur with the implementation of a BRT. This is based on the expected reduction in accidents due to decreased motorization, an improved transport system, and well-trained public drivers. This would reduce the potential contact between buses and other vehicles. We conducted research of studies evaluating the safety implications of new BRT systems in various cities. These studies found that the impact on safety was highly dependent on the infrastructure investments that accompanied the BRT.

While contact with buses and vehicles were often reduced, different bus lane systems and boarding designs lead to varied outcomes for pedestrian safety.

Results from the secondary research showed that the implementation of a BRT system had mixed results when it comes to safety improvements. First, comparing urban environments across countries and even within countries is difficult due to the structural differences of BRTs in each city (Vecino-Ortiz and Hyder 2015). The other issue is that many studies lacked proper counterfactuals in analyzing the true impact of the BRT on safety reductions. The empirical data does not support any conclusion that there is an increase in safety due to the implementation of a BRT. Therefore, we concluded there is not currently enough evidence to assume a direct relationship between implementing a BRT and improved safety.

Assessment of Quality of Evidence

Many of the key data points and assumptions relating to the costs and benefits were sourced from the World Bank project appraisal document and the UNEP report of a BRT in Accra. We therefore believe that this data has identified the values for these estimations as accurately as possible. The body of literature exploring how BRT systems have had an impact in various cities has not presented conclusive results on the effectiveness of BRTs and has highlighted how comparing across urban environments in this capacity may be inappropriate.

Sensitivity Analysis

We analyze the project at three discount rates as given by the Copenhagen Consensus Center for the Ghana Priorities. The project is highly sensitive to movements in the discount rate. Importantly, at a 14% discount rate this project does not have enough benefits to outweigh the costs. We also performed a sensitivity analysis to see how movements in the assumed increase in road speeds affected the project BCR. An expected 30% increase in speed was estimated using the World Bank estimate for Accra's BCR and was on par with other analyses for similar transport projects. However, if the assumed traffic speed increases by only 20%, the benefits are significantly reduced but the project still results in a positive return at discount rates of 8% and 5%. The assumed traffic speed has an impact on the number of travelers using the BRT and other modes of transportation. Fewer people using the BRT would impact carbon emissions levels, as more people would be using personal vehicles. However, sensitivity analysis of this variable showed that increased carbon emissions had minimal effects on BCR. The most important assumption is related to the reduced congestion that results from increased traffic

speeds. This analysis shows that the benefits will outweigh the costs of the project if average speeds increase by 10%.

Table 9 and Table 10 provide a summary of the sensitivity analysis at different discount rates and model assumptions regarding increased traffic speeds. Table 9 provides benefits and costs in U.S. dollars, while Table 10 provides these same figures in the Ghanaian Cedi.

Table 9: BCR Sensitivity (USD)

Discount Rate	Benefit (USD)	Cost (USD)	BCR	BCR (20% increase in road speed)	BCR (10% increase in road speed)
5%	593,883,852	283,055,362	2.10	1.79	1.43
8%	318,153,413	213,177,850	1.49	1.27	1.02
14%	114,164,630	142,891,826	0.80	0.68	0.54

Table 10: BCR Sensitivity (GHS)

Discount Rate	Benefit (GHS)	Cost (GHS)	BCR	BCR (20% increase in road speed)	BCR (10% increase in road speed)
5%	3,297,985,503	1,571,877,188	2.1	1.79	1.43
8%	1,766,785,443	1,183,829,893	1.49	1.27	1.02
14%	633,984,734	793,514,031	0.8	0.68	0.54

Policy Discussion

This analysis shows how implementing a BRT could produce a positive BCR. However, we did not have enough access to data to analyze the potential prices and revenues of the BRT system. If this information becomes available, these factors should be considered prior to implementation of a transport system to determine the financial feasibility of the project. One potential barrier to setting an optimal price for BRT customers is the existing price structure and flexibility of tro-tros. To set a higher price relative to tro-tros, the BRT will have to incentivize customers by offering greater time savings (bus speed versus road speed) and reliable transport services. If the demand for buses, even with separated and enforced lanes, is expected to be lower than tro-tros, it may be feasible to subsidize the BRT fares in order to reduce congestion and carbon emissions.

An expanded BRT system is not the only solution to the issues of urban transport in Accra. Many other potential options have been proposed in other African cities and by the Accra Metropolitan Assembly. At the time of writing we did not have the data to study these options, but they should be considered prior to the implementation of a new transport project if collection of the necessary data is possible.

The Accra Resilience Strategy suggests a strategy to improve urban transport by upgrading the city's tro-tro system. This project would include enforcement of registration, licensing, and quality standards for all public transport including tro-tros. It would also include supporting tro-tro owners with investment packages for them to acquire upgraded vehicles that would be safer and produce less carbon emissions (AMA 2019). This project has the capability to reduce congestion, increase safety, and reduce carbon emissions. To conduct a cost benefit analysis on this investment, data would need to be collected on the operation of the tro-tro system. This information could be used to estimate the financial sustainability of the new investment, including the number of mini-buses, the investment and operation costs, and the expected revenues, among other factors.

Another proposed solution involves the strategic improvement of intersection design to reduce bottlenecks and increase safety. While there have been some intersection improvements by the Accra Metropolitan Assembly, these interventions should be expanded across the city in order to improve traffic flow and make walking safer for those who walk both for commuting and to access public transport. The Pedestrian Safety Action Plan by the Accra Metropolitan Assembly (2019) has created an action plan for improving pedestrian safety at intersections including improving the design of high crash locations and providing walkways on high pedestrian traffic roads (AMA 2019). This project could have great benefits, including improved traffic flow and reduced pedestrian fatalities and injuries. Evaluation of the costs and benefits of these projects requires updated data on traffic and vehicle operational costs in Accra.

Conclusion

There is a need in Accra to invest in an integrated urban planning strategy to include improved infrastructure, traffic management, and public transport. There are many potential solutions including rehabilitation of the tro-tro system, redesign of problematic intersections, improved paving, increased enforcement of laws and regulations, and the implementation of an expanded BRT system. These projects should also be implemented and coordinated together so that they complement rather than compete against each other.

The implementation of a Bus Rapid Transit system could result in a BCR of 1.49 if the project achieves an increase in speeds of 30% and the analysis uses a discount rate of 8%. The project is sensitive to movements in the discount rate and the percentage change in road speeds, which would reduce the benefits if ridership of the buses is much lower than expected. The analysis would be greatly improved by the inclusion of the benefits of vehicle operation costs (individual and tro-tro), as this would capture the value of commuters no longer traveling by personal vehicle or tro-tro. Unfortunately, this data was not currently available. However, the results from Dey and Malhotra (2018) indicate that vehicle operating cost savings are only about 13% of the timesavings benefits. This suggests the quantum of omitted benefit may not be particularly large. Another potential addition to this analysis would be to look at the cost of coordinating the tro-tros to work as a feeder system to the BRT, as well as ensuring the walking routes to public transport were safer and easier. Adding these components to the project would make the BRT a much more attractive transportation alternative.

Overall, Accra's rapid growth and urban sprawl is creating large costs to society in terms of time lost and environmental damage. There is a need to improve Accra's transport system, however, there remains uncertainty about the magnitude of the impact of urban transport projects due to the heterogeneity in urban environments and a lack of data traffic and road conditions in Accra. Public transport options such as the BRT offer great benefits when implemented efficiently and in certain contexts. At the same time, similar projects have had little or no impact in other contexts. For this reason, we do not believe it is the only or the best option but could have the benefits shown in this paper if implemented well. Further analyses would need to be done to better understand how to make the BRT work best for Accra, such as choosing optimal bus routes and setting optimal prices.

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