# Soot Free Transport System in Ghana: A Cost-Benefit Analysis


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# Outline of Presentation

1. Introduction
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# 1. Introduction (1/3)

- Public transportation services are important in many ways: provide mobility, shape land use and development patterns, generate jobs and enable economic growth, and support public policies regarding energy use, air quality and carbon emissions

- These characteristics can be important when considering the benefits, costs and optimal investment levels for public transportation.

- Diverting current passenger traffic to the BRT from other transport modes would provide widespread benefits, such as reduction of air pollution, travel time, road accidents and traffic congestion.

- The pilot BRT could contribute to the diversion of a very high proportion of current passenger ridership from trotro, taxi, bus and private vehicle to the BRT, which would accommodate the growing passenger traffic demand in Accra

# 1. Introduction (2/3)

- Investment in public transportation expands service and improves mobility, and, if sustained over time, can potentially affect the economy by providing:

  - travel and vehicle ownership cost savings for public transportation passengers and those switching from automobiles, leading to shifts in consumer spending;

  - reduced traffic congestion for those traveling by automobile and truck, leading to further direct travel cost savings for businesses and households;

  - business operating cost savings associated with worker wage and reliability effects of reduced congestion;

# 1. Introduction (3/3)

- business productivity gained from access to broader labour markets with more diverse skills, enabled by reduced traffic congestion and expanded transit service areas; and

- additional regional business growth enabled by indirect impacts of business growth on supplies and induced impacts on spending of worker wages.

- At a national level, cost savings and other productivity impacts can affect competitiveness in international markets.

# 2. Benefit Components (1/5)

A bus rapid transit system can provide a number of benefits to a diverse set of local and global stakeholders, from reduced greenhouse gas emissions to increasing social cohesion.

Some of these benefits have a larger economic value than others, and some can be translated into monetary terms more easily than others.

| **Category** | **Description** |
|---|---|
| Economic | Reduced travel times |
| | More reliable product deliveries |
| | Increased economic productivity |
| | Employment creation |
| | Improved work conditions |
| Social | More equitable access throughout the city |
| | Reduced accidents and injuries |
| | Increased civic pride and sense of community |
| Environmental | Reduced emissions of air pollutants |
| | Reduced noise |
| Urban form | Sustainable urban form, including densification along major corridors |
| | Reduced cost of delivering services such as electricity, water and sanitation |

# 2. Benefit Components (2/5)

(i) Travel Time Benefits: The average time that it takes a bus rider to make his or her trip would decrease with the implementation of a BRT system. These time savings are monetized and included as benefits in our model.

| **Data used in calculating time saved per year by BRT users** | |
|---|---|
| | **value** |
| former users of public transportation | 42,507 |
| average trip length | 20 |
| total time saved per year (Mil Hrs) | 12.9 |
| unit monetary value ($/Hour) | 0.22 |
| annual value of total money saved ($ Mil) | 2.77 |

# 2. Benefit Components (3/5)

(ii) <u>Change in emissions</u>: Vehicles and buses release GHGs and implementing a BRT system would substantially decrease air emissions from vehicles. This analysis estimates the reduction in social costs caused by the net decrease of such emissions.

$$E_K = \sum_i KRV_i \times FE_{ik} \times N_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

- $E_k$ = total vehicular emissions of pollutant, *k* (g/year)
- $KRV_i$ = Average vehicle kilometers travelled for vehicle type *i* [km/year]
- $FE_{ik}$ = emission factor for vehicle type, *i,* and of pollutant, *k* (g/km)
- $N_I$ = number of vehicles (number of trips) of type *i*

# 2. Benefit Components (4/5)

(iii) Health Benefits: Health benefits associated with controlling vehicular pollution maybe realised in diverse ways usually evident in reductions in mortality and morbidity cases.

- No study has been published using data for Ghana that estimate WTP to reduce mortality or morbidity. Adopted a study from South East Asia.

$$\boldsymbol{WTP_{GH} = WTP_{US}\left({}^{Y_{GH}}\!/_{Y_{US}}\right)^{\epsilon}} \text{ ………………………………………………………………………… } \textbf{(2)}$$

- $WTP_{GH}$ = Willingness to pay in Ghana
- $WTP_{GH}$ = Willingness to pay in US
- $\epsilon$ = income elasticity of willingness to pay (usually = 1)

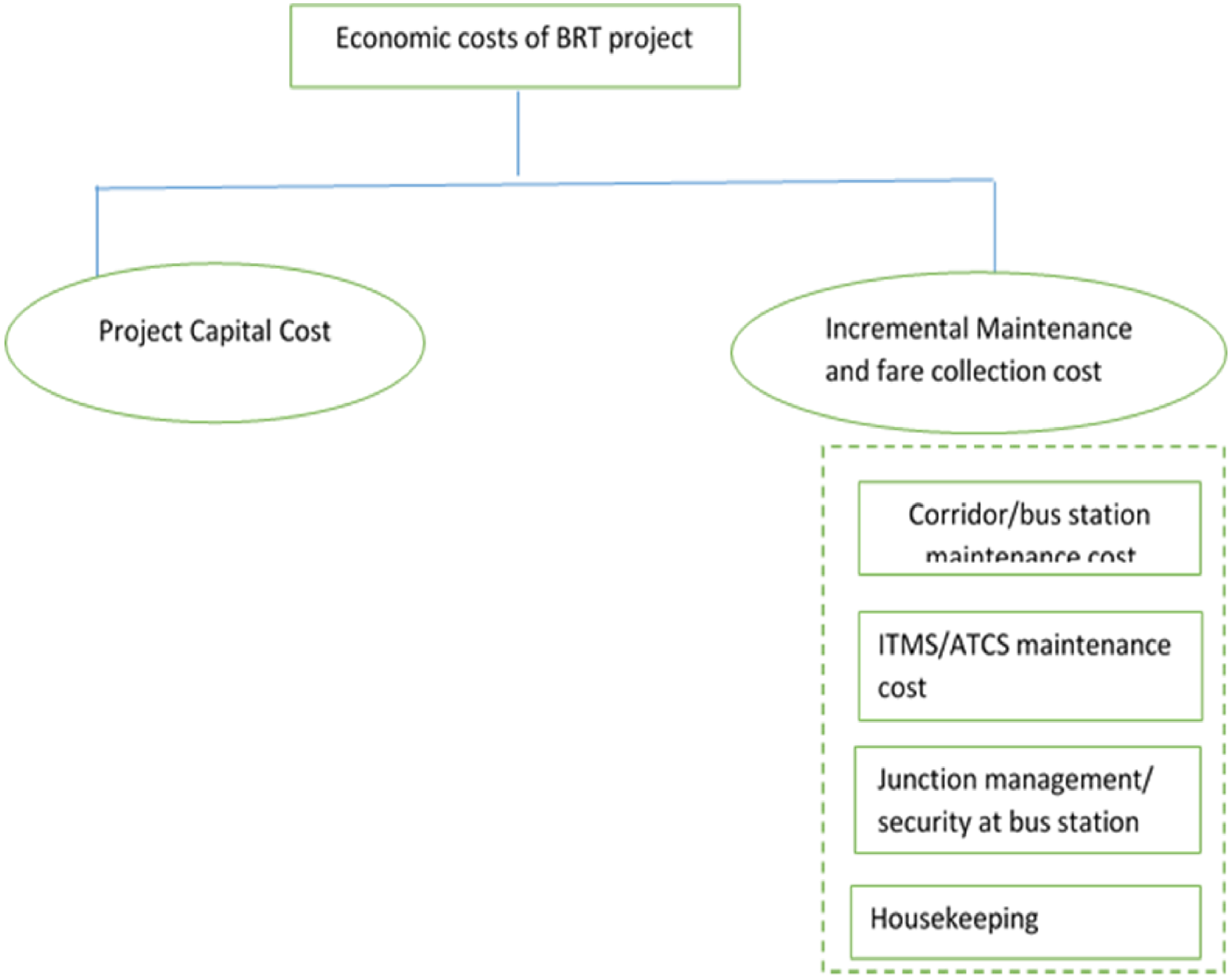
# 2. Benefit Components (5/5)

- (iv) Employment created: a BRT system also provide an opportunity for job creation in terms of drivers, depot managers, among. This will have a wider economic impact in terms of aggregate demand and revenue generation for the government.

# 3. Cost Components (1/2)

The cost of a modern BRT system is also subject to cost escalation, but since the total project cost of a modern BRT system is likely to be anywhere from one half to one fifth as much as the total project cost of the BAU technology, the base-level cost differential between the two systems is enormous regardless of how fast the costs or either system escalate.

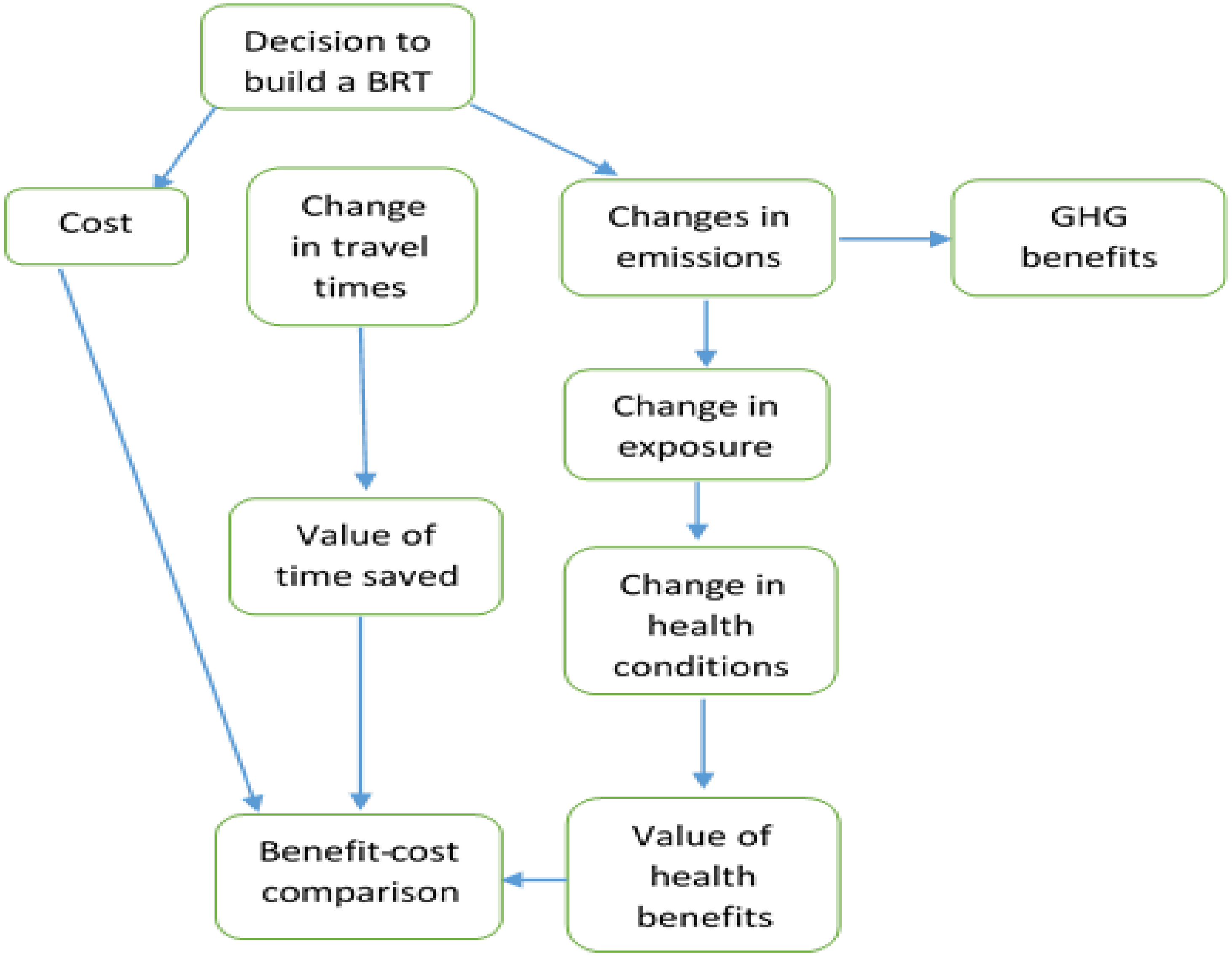
It is believed that the initial cost the BRT project will be high but over the period the cost will stabilise and will be comparatively lower than the BAU option.



# 3. Cost Components (2/2)

- In this we focused on two major costs:
  - Project capital cost
    - ✓ Cost of bus, infrastructure, depots, etc.
  - Maintenance cost (life-cycle cost)
    - ✓ Fuel, bus maintenance, periodic bus overhauls, etc.

# 4. CBA Results (1/2)



# 4. CBA Results (2/2)

- Construction period: 2017
- Operation period: 20years

| | Value ($ Million) |
|---|---|
| **Total Benefits** | **2507.35** |
| **Total Costs** | **2470.03** |
| **NPV** | **37.32** |
| **B-C Ratio** | **1.02** |
| **Discount Rate** | **7.05%** |

# 5. Sensitivity Analysis

- Increasing discount rate to 10%

| | Value ($ Million) |
|---|---|
| **Total Benefit** | **3248.25** |
| **Total Cost** | **3096.66** |
| **NPV** | **151.58** |
| **B-C Ratio** | **1.05** |
| | |

# 6. Recommendations & Conclusion

- The cost-benefit analysis conclude that the project is viable and must be undertaken.
- It must be acknowledged that the positive NPV was based on the assumption that there is not going to be a mixed traffic on the BRT corridor.
- This means that as a matter of policy, the BRT should not compete with the minivans on corridor.
- Since the study made a lot of assumptions and adopted some data from other studies, further work must be done as and when appropriate data is available.

# 7. Assumptions

**Assumptions for the study**

1. No major road network improvements in BRT enclave
2. Constant inflation
3. Straight line depreciation of 10%
4. Average useful life of a soot free bus (10 years)
5. No of BRT buses
6. Assumption of VKT for BRT (50,000km in Kenya)
7. Load factor for BRT
8. real discount rate of 7.5%
9. inflation of 16.5%
10. adopted health benefit value from Mexico
11. Project period = 20 years
12. Assumed constant operational cost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