Comparative Analysis of BEST Buses and Electric Buses in India

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Abstract:- An overwhelming trend that marks the beginning of the transportation sector's energy transition is the electrification of public transportation. The public sector's considerable influence and predominance of public ownership define the transportation industry. Consequently, tendering processes Are frequently used to determine which bus delivery options are the most efficient. Based on a comprehensive analysis of the Polish bus market and in-depth interviews with individual vendors, this paper compares, assesses, and delineates the distinctions between the criteria applied in tenders for battery electric buses and diesel buses. The article additionally endeavors to ascertain whether the proportion of the vehicle price in the life cycle cost or total cost of ownership aligns with the weight assigned to the "vehicle price" criterion. The outcomes show There isn't a noticeable distinction between diesel and battery electric buses' tender requirements. Institutions that had previously created diesel bus acquisition patterns applied those patterns, for the most part, to battery electric bus tenders. As a result, the weights assigned to the criteria in tenders do not account for the benefits and drawbacks of either technology. Procedures for tendering are modified to meet regional needs and operational specifications. On current routes and schedules, electric buses frequently take the place of conventionally powered vehicles. Operational requirements are therefore known. This makes it possible to calculate the required number of vehicles as well as the fundamental technical and operational parameters (such as choosing the best charging technique and battery capacity). The charging strategy will therefore have an impact on the overall cost of ownership Opportunity charging is preferred for longer mileages, and overnight charging is preferred for shorter assignments. The electrification of public transportation is a massive trend that represents the first stage of the energy transition of the transportation sector. The transportation industry is defined by the significant influence of the public sector and the prevalence of public ownership. As such, tendering proceduresare widely employed to identify the most effective bus delivery options. This paper compares, evaluates, and discusses the differences between the specifications used in tenders for battery electric buses and diesel buses. It is based on a thorough examination of the Polish bus market and indepth interviews with specific vendors. The piece also aims to determine whether the percentage of the car price in the life cycle cost or overall cost of ownership is consistent with the importance given to the "vehicle price" factor. The results reveal no appreciable.

I. INTRODUCTION

There are Two Types Buses are:



Fig 1: Flowchart





Fig 2: Buses

II. TRADITIONAL BEST BUSES

BEST stands for Transportation and Brihanmumbai Electricity Supply. Denoting as a public entity in the state of Maharashtra in the city of Mumbai, it serves as a means of public transport in the suburban city and supplies power in the Mumbai region. In 1873, Brihanmumbai Electricity Supply and Transport was incorporated as "Bombay Tramway Company Limited", a tram company. In Wadi Bunder, the same company built its own thermal power plant in November 1905. It was built with the intention of using trams to supply parts of the city with electricity. Subsequently, "Bombay Electric Supply & Tramways" was the new name given to the corporation. In 1926, BEST started operating motor buses for commercial purposes. When the business was placed under the Municipal Corporation in 1947, its name was changed to "Bombay Electric Supply & Transport". The name was further changed to

'Brihanmumbai Electric Supply & Transport" in 1995. Under					
the	Municipal	Corporation,	the	organization	functions
inde	pendently.				

> Electric Buses:

An electric bus is classified as an electric vehicle (EV), which means that electricity is used as fuel instead of petrol or diesel. An electric bus runs exclusively on electricity, in contrast to a hybrid car, whicAlthough a newer alternative to more conventional buses, electric buses are quickly gaining popularity governments, among local for-profit transportation firms and school districts looking to implement EV technology. Electric buses, which are initially more expensive than other types, can bring financial savings over time.h in addition to battery power also uses an internal combustion engine. To make it clear that electric cars only run on electricity and no other form of energy, they are often referred to as "all-electric vehicles"

POINTS	TRADITIONALBEST BUSES	ELECTRIC BUSES
POWER SOURCE	Traditional buses are typically powered by diesel or compressed natural gas (CNG)	Electric buses are powered by electricity stored in batteries.
ENVIRONMENTAL IMPACT	Traditional buses produce emissions, contributing to air pollution	Electric buses are considered more environmental friendly
Fare price	Traditional buses are less fare price	Electric buses are expensive fare price.
NOISE POLLUTION	Traditional buses generate noise and vibrations.	Electric buses are not load and produce less make sound.
MAINTENANCE COST	Traditional buses have higher maintenance cost.	Electric buses have lower maintenance cost.
SUSTAINABILITY	Traditional buses are less sustainability	Electric buses are high sustainability.

Table 1: Difference Between Best Buses and Electric Buses

Objectives of Best Buses

- To Study the Environmental impact of traditional buses and electric buses in terms of emissions and energy consumption.
- To Study the passenger experience and satisfaction of traditional buses and electric buses .
- To study the cost efficiency of electric buses and traditional buses .

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• To study the Performance and Reliability of electric buses and tradtional buses.

III. LITRATURE REVIEW

Bharadwaj S. et al (2017) examined in their research paper the problem of traffic congestion being caused on the roads which makes the travel by BEST buses a little troublesome for the passengers. It leads to more time in reaching the said destination. Also it increases the consumption of fuel and leads in increase in the emission of harmful gases in the environment. The researchers are trying to analyze the effect of the emission of harmful greenhouse gases by the buses. https://www.sciencedirect.com/science/article/pii/S2352146 51730589 6t

David Levitan, C Ramiro Rodriguez, Teresita Humana, Gabriel Correa Perelmuter A number of options are being investigated in the context of the energy transition to gradually replace urban transportation vehicles that run on diesel fuel. In this essay, a response to the following query is put forth: Which bus technology, in terms of cost, energy consumption, and greenhouse gas emissions, is more efficient? An integrated index made up of three indices measuring well-to-wheel energy use, global warming potential in terms of carbon dioxide equivalent emissions, and total cost of ownership is presented as a way to assess various fleet urban bus technologies. https://scholar.google.co.in/scholar?q=review+of+literature +on+comp

arative+analysis+of+best+buses+and+electric+buses&hl=en &as_sdt=0&

as_vis=1&oi=scholart#d=gs_qabs&t=1698900484624&u= %23p%3DW7 dLEbdqm5gJ

Moataz Mahmoud, Ryan Garnett, Mark Ferguson, Pavlos Kanaroglou Evidence suggests that the role of electric buses in public transit is important if we are to take steps to reduce climate change and the environmental impacts of fossil fuels. Several electric alternatives are currently operationalized, and the debate about which is most suitable is attracting considerable attention. This article offers a thorough analysis of the different performance characteristics of the battery, fuel cell, and hybrid types of electric buses. Based on simulation models and operational data provided by various scholars in various contexts, the economic, operational, energy, and environmental aspects of each technology are thoroughly reviewed. By comparing 16 characteristics side by side, the study creates an allencompassing evaluation of electric buses that helps with decision-making.

Concentrate. The various performance traits of battery, fuel cell, and hybrid electric bus types are thoroughly analyzed in this article. The economic, operational, energy, and environmental aspects of each technology are reviewed in detail, with specific reference to simulation models and operational data provided by different scholars in different contexts. https://doi.org/10.38124/ijisrt/IJISRT24JUN1353

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arative+analysis+of+best+buses+and+electric+buses&hl=en &as_sdt=0&

as_vis=1&oi=scholart#d=gs_qabs&t=1698900741512&u= %23p%3D5eCMHmlB0YJ

Desai D. et al (2019) identified in the research paper about the 8 days strike that took place in January 2019 by the employees of the Brihanmumbai Electricity Supply and Transport (BEST) regarding demanding for higher wages. Because of the strike, nearly 3 million daily commuters had to suffer. The crisis also brought into light about how the incident stand stilled the city's transportation services. The BEST has the devised a financial assistance plan of INR 1 Billion every month. The research paper helps in understanding the challenges for the BEST and as well as offering suggestions to regain the financial stability.

https://www.sciencedirect.com/science/article/abs/pii/S 2213624X20301188

Dhingra S. et al (2012) conducted in their research paper that BEST buses faces a lot of problems which result into congestion problems, discomfort for the commuters, increase in the time of travel and as well environmental pollution it causes. So as to handle and resolve this problems, the BEST are trying to bring certain changes in the scheduling and increasing the number of this passenger buses so as to solve the problem of sustainability. The researchers also try to propagate the system of Integrated Mass Transportation which comprises the current Western as well as the Central Railway corridor by introducing two new vehicles which are Battery-charged vehicle and Sky bus. The benefits of this buses are explained in the research paper.

https://www.researchgate.net/publication/268598363_ Sustainable_Tr ansportation_Strategy_for_Mumbai_Bombay_Region_Usin g_an_Integr ated_Mass_Transit_Systems_Approach

- > Limitations
- As it is a recent topic, not much research paper are there for the purpose of references.
- Some of the respondent did not respond to the question carefully.
- The material was insufficient for the research.
- Comparative analysis of traditional buses and electric buses is a huge concept in itself, 150 respondents won't preview the complete picture.
- > Hypothesis
- H₀- Electric Buses are not Environmental friendly . H₁- Electric Buses are Environmental friendly.
- H_o. Electric buses are more expensive fare H₁. Electric buses are less expensive fare.

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IV. RESEARCH METHODLOGY

Title of the Research Study: COMPARATIVE ANALYSIS OF BEST BUSES AND ELECTRIC BUSES IN MUMBAI.

• Sources of Data Collection:

> Primary Data:

The primary data has been obtained from the selected group of population (Passengers)with the help of questionnaire.

Sampling Decisions:

• Sample Size:

Appropriate number of sample size i.e 150 was put to used for the purpose of collecting primary Data from the selected passengers.

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• Sampling Method:

Non-probability sampling design based on convenient sampling method has been used for this research study.

Secondary Data:

The secondary data has been obtained from published as well as unpublished literature on the topic and from Journals, Research Articles, Thesis, websites.

Techniques of Data Analysis:

The collected primary data has been preceded considering the designing of the structured and non-disguised questionnaire. The primary data has been scrutinized, edited and validated and thereafter it has been presented in the form of data chard, graphs, and diagrams as the case may be.



Fig 1: Showing the Gender of Respondents

Table 1	1:	Showing	the	Gender	of F	Respo	ondents
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GENDER	PERCENTAGE
MALE	47.4%
FEMALE	52.0%
PREFER NOT TO SAY	0.6%

• INTERPRETATION: In the above figure we can say that 47.4% of respondent are male passenger. 52.0% of respondent are female passenger. 0.6% of respondent are other passenger. Majority of respondents that is 52.0% are female passenger.

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> Data Analysis and Interpretation:



Fig 2: Do you Use BEST Buses?

Table 2: Do you Use BEST Buses?

RESPONSE	PERCENTAGE
YES	78.3%
NO	21.7%

• INTERPRETATION: In the above figure it showing that how many passenger travelling in BEST Buses . Majority of respondents response i.e 78.3% said yes they are travelling in BEST buses. 21.7% said no they are not travelling in BEST Buses.



Fig 3: What is your Primary Mode of Transportation for Daily Travelling?

DAILY TRAVELLING	PERCENTAGE
BEST BUSES (TRADITIONAL)	30.3%
ELECTRIC BUSES	42.8%
PRIVATE VEHICLES	17.8%
OTHER	9.2%

Table 3: What is your Primary Mode of Transportation for Daily Travelling?

• INTERPRETATION: In the above figure it showing the primary mode of daily transportation travelling. Majority of respondent i.e 42.8% passengers are travelling In Electric buses. 30.3% passengers are travelling in BEST Buses (travelling) 17.8% passengers are travelling in private vehicles. 9.2% passengers are travelling in others.



Fig 4: If you have used Electric BEST Buses, What is your Overall Satisfaction Level?

PERCENTAGE				
23.0%				
50.7%				
22.4%				
2.0%				
2.0%				

Table $4 \cdot$ If you	i have used Electric	· REST Buses	What is your	Overall Satisfaction	Level?
Tuble 4. If you	i nuve useu Liceure	DLDI Dusco,	what is your	Overall Satisfaction	LCVCI.

• INTERPRETATION: In the above figure it showing the satisfaction of Electric buses. Majority of respondent i.e 50.7% passengers are satisfied with the Electric buses. 23.0% passengers are very satisfied with Electric buses .22.4% passengers are neutral with the electric buses.2.0 are dissatisfied with the Electric buses. 2.0 are very dissatisfied with the electric buses.



Fig 5: Are you Aware of Any Difference in Fares between Traditional BEST Buses and Electric buses?

Table 5: Are you Aware of Any Difference in Fares between Traditional BEST Buses and Electric buses?

AWARE OF FARE	PERCENTAGE	
YES	68.4%	
NO	31.6%	

• INTERPRETATION: In the above figure its showing that aware of fares differences between electric and traditional buses. Majority of respondents i.e 68.4% passengers are aware of fares differences . 31.6% passengers are not aware of fares differences in traditional and electric buses.



Fig 6: If yes, Please Indicate your Perception of the Fare Difference?

FARE DIFFERENCE	PERCENTAGE
Electric buses are more expensive	19.7%
Electric buses are more similarly price	44.7%
Electric buses are cheaper	17.8%
I Don't know	17.8%

Table 6: If yes, Please Indicate your Perception of the Fare Difference?

• INTERPRETATION: In the above figure perceptions of the fare difference. Majority of respondents said that 44.7% are more similar fare in electric buses. 19.7% said that are more expensive electric buses. 17.8% said that are cheaper electric bus fare. 17.8% respondents don't know about fare.



Fig 7: Which Types of Buses is Generally Considered to have Lower Emissions?

LOWER EMISSIONS	PERCENTAGE
BEST BUSES	14.5%
ELECTRIC BUSES	53.9%
BOTH HAVE SIMILAR EMISSIONS	19.7%
IT DEPENDS ON THE MAINTENANCE PRACTICES.	11.8%

Table 7: Which Types of Buses is Generally Considered to have Lower Emissions?

• INTERPRETATION: In the above figure it showing that lower emissions of buses . Majority of respondents i.e 53.9% said that electric buses are lower emissions.19.7% said that both have similar emissions. 14.5% said that BEST Buses are lower emissions. 11.8% said that it depends on the maintenance practices of buses.



Fig 8: Have you Noticed any Differences in the Frequency of Service Between Traditional BEST Buses and Electric Buses?

FREQUENCY SERVICE	PERCENTAGE
Yes, Electric buses are more frequent	27.0%
Yes, Traditional buses are more frequent	43.4%
No, both are Equally frequent	17.8%
I don't know	11.8%

Table 8: Have vo	ou Noticed an	v Differences in the	Frequency	of Service Between	Traditional BEST	Buses and Electric Buses?
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• INTERPRETATION: In the above figure showing the frequency of service between traditional and electric buses . Majority of respondents 43.4% said yes to traditional buses are more frequent. 27.0% said yes to electric buses are more frequent . 17.8% said no, both are equally frequent . 11.8% they don't know about frequency between buses.

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Fig 9: What Factors Influence your Choice of Traditional and Electric Buses ?

Table 9: Have you Notic	ed any Differences in the Fr	equency of Service Between	Traditional BEST Buses and Electric Buses?
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BUSES	PERCENTAGE
FARE	30.1%
ENVIRONMENTAL CONCERNS	54.2%
COMFORT	58.2%
CONVENIENCE	47.1%
SPEED	30.7%
AVAILABILITY	32.7%

• INTERPRETATION: In the above figure Majority of respondents that 58.2% of respondents are comfort .54.1% of respondents are environmental concern. 47.1% are convenience. 32.7% of respondents are Availability. 30.7% of respondents are speed. 30.1% of respondents are fare of electric buses.



Fig 10: Do you think the Introduction of Electric Buses has had a Positive Impact on Air Quality in the City ?

AIR QUALITY	PERCENTAGE
YES	89.5%
NO	10.5%

Table 10: Do you think the Introduction of Electric Buses has had a Positive Impact on Air Quality in the City ?

• INTERPRETATION: In the above figure it shows that the positive impact on air quality in the city. The majority of respondents i.e 89.5% said yes to positive impact on air quality in the city. 10.5% said no to the positive impact on air quality in the city.

V. CONCLUTION

It is appropriate to refer to Electric busses as the Mumbai second lifeline for transit. Most people in the city consider public transportation to be a basic requirement. The study's findings demonstrate the importance of BEST busses for those in the lower income bracket. According to the analysis, men from lower-class backgrounds favor buses over those from moderate- and higher-class backgrounds. However, in the case of women, it is evident that they choose buses over cars, regardless of their financial situation. Since BEST buses give the general public access to jobs, they should offer more services. Additionally, since women rely more on buses for a variety of reasons, specific services should be offered to them.

FINDINGS

Nowadays many of the people are travelling in Electric buses because the fare of the electric buses are less expensive or affordable fare to the passengers. Electric buses are produce lower emission, pollution and etc. Electric buses are environmental friendly. The passenger are satisfied with the electric buses. The electric buses are very comfortable for passengers.

SCOPE OF STUDY

Evaluate the performance, reliability, and efficiency of BEST buses and electric buses, considering factors like speed, range, energy consumption, and passenger capacity. Examine the infrastructure needs for electric buses, including charging stations, maintenance facilities, and their impact on urban planning and development.

• Investigate the latest technological advancements in electric bus systems and how they compare to the technology used in BEST buses.

RECOMMENDATIONS

- There should be free Wi-Fi facilities in electric bus.
- The focus of the transit authorities is on building the Capacity of their electrical department, as it will play A crucial role in ensuring energy security in the future.
- Need for electric bus-specific training for their staff,
- As most of the responsibilities for charging and
- Maintenance are handled by the private bus operators.

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APPENDIX

- ➤ Name:
- ➤ Gender:
- Male
- Female
- Prefer Not To Say

> Occupation:

- Students
- Self employed
- Retired
- Homemaker
- > Do You Use BEST Buses?
- > Yes
- > No

> What Is Your Primary Mode of Transportation For Daily Travelling?

- BEST Buses (Traditional)
- Electric buses
- Private vehicles
- Other
- > On The Scale Of 1 To 5, How Satisfied Are You With The Current BEST Bus Service (Traditional)?
- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

▶ Have You Ever Used an Electric Buses for your Travelling?

- Yes
- No
- > If You Used Electric BEST Buses, What Is Your Overall Satisfaction Level?
- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied
- > Are You Aware of Any Difference in Fares Between Traditional BEST and Electric Buses?
- Yes
- No
- > If Yes, Please Indicate your Perception of the Fare Difference?
- Electric buses are more expensive
- Electric buses are more similarly priced
- Electric buses are cheaper
- I don't know

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> Which Types of Buses is Generally Considered to Have Lower Emission?

- BEST Buses
- Electric Buses
- Both have Similar Emission
- It depends on the maintenance practices

> Have You Noticed Any Differences In The Frequency Of Service Between Traditional BEST Buses And Electric Buses?

- Yes, Electic Buses are more frequent
- Yes, Traditional Buses are more frequent
- No, both are Equally frequent
- I don't know

> What Factors Influence Your Choice of Traditional Buses and Electric Buses?

- Far
- Environmental concerns
- Comfort
- Convenience
- Speed
- Availability

> Do You Think The Introduction Of Electric Buses Has Had A Positive Impact On Air Quality?

- Yes
- No