OPERATIONAL ECONOMICS OF ELECTRIC BUSES IN CONTEXT OF MEGA CITY OF DELHI

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Background

Emission
The transport sector contributed to approximately 15% of the total emissions by energy sector, where, road transport has been the major contributor (88%) resulting in 142 million tonnes CO2.

Dependence on Oil Import
India is the third largest importer of crude oil in the world. Spend close to $85bn on oil imports. India is expected to spend $550bn on imported fuel for passenger mobility. That is close to one-fourth of its current annual GDP.

Air Pollution
In recent years owing to an increasing phenomena of pollution levels observed in cities in India owing to increased motorization rates there is a greater emphasis on adopting low carbon emitting modes in urban mobility in comparison to internal combustion engine vehicles.
“However there are knowledge gap when it comes to understanding the adoption of electric buses for public transit. This study is an attempt to understand the best procurement and charging operation models for electric buses in India”
Objectives

1. To assess the role and importance of electric bus in urban mobility

2. Analyse various methods and practises for quantification of electric bus operation in urban areas

3. To assess operational economics of electric buses in urban areas which included the lifecycle cost, charging station and battery swapping station cost

4. To assess the adoption of electric bus operation in Delhi

5. To propose guidelines for implementing EV policy adoption in various cities in India.
LITERATURE REVIEW
Procurement Models

**Net Cost Model**

- **Transport Authority**
  - Lease to transport authority
  - Purchase of bus
  - Share of advertisement revenue
  - Responsible for:
    - Collection of revenue from advertisement on bus
    - O & M and fare collection
    - Driver and conductor
  - Payment of license fee or fixed charge

- **Private Operator**

**Gross Cost Model**

- **Transport Authority**
  - Lease to transport authority
  - Purchase of bus
  - Share of advertisement revenue
  - Responsible for:
    - Collection of fare and advertisement revenue
  - Payment of license fee or fixed charge

- **Private Operator**

**Gross Cost Model: Eliminating Capex While Lowering Opex**

- The operator only assures a fee per KM with an assurance of a given number of KMs everyday with the contract running for a set number of years.

**Gross Cost Model**

- The contracts are bankable due to the fact that lower opex allows for enough cashflows to service EMIs. Defined contracts allow for financing on longer tenures.
Life Cycle Cost

• The lifecycle is often referred to as the sum of all the costs incurring during an asset’s useful life and allows for a more appropriate cost benefit analysis.

• The ‘realistic appraisal’ conducted through LCC analysis is reinforced by considering the time value of money.

\[
\text{Total LCC} = \text{Capital Cost} + \sum_{i=1}^{n} (\text{Operating Cost for given year } i + \text{Maintenance Cost for a given year } i) + \text{Vehicle Disposal Cost}
\]

<table>
<thead>
<tr>
<th>Life Cycle Cost Parameters</th>
<th>Capital Cost</th>
<th>Operational Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bus is procured with a debt of 80% and equity of 20%. Different cost components are listed below:</td>
<td>Electricity/Fuel cost</td>
</tr>
<tr>
<td></td>
<td>- Annual debt repayment on bank finance @ 10% interest</td>
<td>Driver</td>
</tr>
<tr>
<td></td>
<td>- Annual debt repayment on equity @ 15% interest</td>
<td>Other staff (Manager, secretarial, cleaner)</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>Disposal Cost</td>
<td>External Cost</td>
</tr>
<tr>
<td>Tyres and tubes</td>
<td>Salvage value @ 15% of vehicle cost</td>
<td>Human Health Cost</td>
</tr>
<tr>
<td>Battery replacement</td>
<td>Battery recycling cost</td>
<td></td>
</tr>
<tr>
<td>Spare parts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Maintenance Charges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overheads</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| | |
| | |

Human Health Cost
## COMPARISON OF DIFFERENT ELECTRIC BUS BY DIFFERENT MANUFACTURERS

<table>
<thead>
<tr>
<th>S. No</th>
<th>Specification</th>
<th>Manufacturer</th>
<th>Length of Bus</th>
<th>Type of Bus</th>
<th>On Board Battery (in KWH)</th>
<th>No of Seats</th>
<th>Range (in Km)</th>
<th>Indicative Benchmark Price (in Lakh ₹)</th>
<th>Subsidy @ ₹20,000 per kWh (in Lakh ₹)</th>
<th>Cost per Metre (in lakh ₹)</th>
<th>Cost per KM Range (in lakh ₹)</th>
<th>Cost per Seat (in lakh ₹)</th>
<th>Cost per KWH (in lakh ₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length: 9m AC Range: 150 km Floor Height: 900 mm Seating Capacity: 31 Battery Capacity: 125KWH</td>
<td>Tata Motors Ltd</td>
<td>9</td>
<td>AC</td>
<td>125</td>
<td>31</td>
<td>150</td>
<td>117</td>
<td>25</td>
<td>13.0</td>
<td>0.8</td>
<td>3.8</td>
<td>0.94</td>
</tr>
<tr>
<td>2</td>
<td>Length: 9m AC Range: 200 km Floor Height: 650 mm Seating Capacity: 31 Battery Capacity: 162KWH</td>
<td>Goldstone - BYD</td>
<td>9</td>
<td>AC</td>
<td>162</td>
<td>31</td>
<td>200</td>
<td>155</td>
<td>32.4</td>
<td>17.2</td>
<td>0.8</td>
<td>5.0</td>
<td>0.96</td>
</tr>
<tr>
<td>3</td>
<td>Length: 9m Non AC Range: 200 km Floor Height: 650 mm Seating Capacity: 31 Battery Capacity: 162KWH</td>
<td>Goldstone - BYD</td>
<td>9</td>
<td>Non AC</td>
<td>162</td>
<td>31</td>
<td>200</td>
<td>144</td>
<td>32.4</td>
<td>16.0</td>
<td>0.7</td>
<td>4.6</td>
<td>0.89</td>
</tr>
<tr>
<td>4</td>
<td>Length: 9m AC Range: 80 km Floor Height: 890 mm Seating Capacity: 27 Battery Capacity: 124KWH</td>
<td>VE Commercials Ltd</td>
<td>9</td>
<td>AC</td>
<td>124</td>
<td>27</td>
<td>80</td>
<td>139.83</td>
<td>24.8</td>
<td>15.5</td>
<td>1.7</td>
<td>5.2</td>
<td>1.13</td>
</tr>
<tr>
<td>5</td>
<td>Length: 12m AC Range: 150 km Floor Height: 900 mm Seating Capacity: 40 Battery Capacity: 125KWH</td>
<td>Tata Motors Ltd</td>
<td>12</td>
<td>AC</td>
<td>125</td>
<td>40</td>
<td>150</td>
<td>135</td>
<td>25</td>
<td>11.3</td>
<td>0.9</td>
<td>3.4</td>
<td>1.08</td>
</tr>
<tr>
<td>6</td>
<td>Length: 12m AC Range: 300 km Floor Height: 400 mm Seating Capacity: 40 Battery Capacity: 250KWH</td>
<td>Goldstone - BYD</td>
<td>12</td>
<td>AC</td>
<td>250</td>
<td>40</td>
<td>225</td>
<td>200</td>
<td>50</td>
<td>16.7</td>
<td>0.9</td>
<td>5.0</td>
<td>0.80</td>
</tr>
<tr>
<td>7</td>
<td>Length: 12m AC Range: 300 km Floor Height: 400 mm Seating Capacity: 40 Battery Capacity: 250KWH</td>
<td>Goldstone - BYD</td>
<td>12</td>
<td>Non AC</td>
<td>250</td>
<td>40</td>
<td>225</td>
<td>186</td>
<td>50</td>
<td>15.5</td>
<td>0.8</td>
<td>4.6</td>
<td>0.74</td>
</tr>
</tbody>
</table>
COMPARISON OF DIFFERENT ELECTRIC BUS BY DIFFERENT MANUFACTURERS

1. **Cost per Metre**
   9m AC and 12m AC of same manufacturer (Tata Motors) cost per metre of 12m AC is 1.7 lakhs less than that of 9m AC.

2. **Cost per kWh**
   On comparing the electric bus of different battery capacity i.e. 125kWh and 250 kWh, cost per kWh is 0.28 lakhs less than that of 125 kWh bus.

3. **Recommendation**
   We can recommend to procure 12m electric bus rather than 9m electric bus in cities having enough RoW for 12m bus.
## ELECTRIC BUS PROCUREMENT IN INDIAN CITIES

### Bid Prices in Different Cities (₹ per km)

<table>
<thead>
<tr>
<th>City</th>
<th>9 Meters AC</th>
<th>9 Meters Non AC</th>
<th>12 Meters AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bengaluru*</td>
<td>38.03</td>
<td>51</td>
<td>46.1</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>44.81</td>
<td>51</td>
<td>49.11</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>48</td>
<td>57</td>
<td>46.1</td>
</tr>
<tr>
<td>Mumbai</td>
<td>57</td>
<td>70</td>
<td>49.11</td>
</tr>
<tr>
<td>Jaipur</td>
<td>70</td>
<td></td>
<td>46.1</td>
</tr>
</tbody>
</table>

### Bid Prices in Different Cities (₹ per Seat km)

<table>
<thead>
<tr>
<th>City</th>
<th>9 Meters AC</th>
<th>9 Meters Non AC</th>
<th>12 Meters AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bengaluru*</td>
<td>1.23</td>
<td>1.65</td>
<td>1.15</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>1.45</td>
<td></td>
<td>1.23</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>1.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mumbai</td>
<td>1.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jaipur</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mumbai</td>
<td>2.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangalore*</td>
<td>1.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyderabad</td>
<td>1.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RELATION BETWEEN COST PER KM AND ITS DETERMINANTS

It is observed that there is a huge variation in tender conditions in different cities which results in variation in cost per km. under gross cost model.

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As mentioned in earlier section, the cost per km is a function of assured km to procure electric buses in GCC model. This section analyses how assured kms depends on the different attributes of the city, for which three parameters are taken into account.

### Average Speed of the City
The average speeds of 5 cities i.e. Bengaluru, Hyderabad, Ahmedabad, Mumbai and Jaipur are regressed with the assured km of electric operations in each city. The relation between average speed and assured km is given in the figure below.

![Graph showing the relation between Average Speed (kmph) and Assured kms](image)

*y = 36.532e^{0.0902x} 
R² = 0.7314*

### Congestion Index

**Congestion Index = 1-(A/M)**

Where,

M: Desirable average journey speed on major corridors of a city during peak hour, which is assumed as 30 KMPH, and

A: Average speed on major corridors of a city during peak hours

![Graph showing the relation between Congestion Index and Assured kms](image)

*y = 420.03e^{-2.094x} 
R² = 0.717*

### Urban Radius

Urban radius is accumulation of population or households by their distance from the city Centre. The point at which the slope of graph between population and distance from city centre drastically changes is considered as urban radius of the city.

\[
Urban Radius = \frac{ATL - 2.9762}{0.6853}
\]

![Graph showing the relation between Urban Radius (km) and Assured kms](image)

*y = 264.34e^{-0.027x} 
R² = 0.685*
## ANALYSIS OF ASSURED KM AND ITS DETERMINANTS

<table>
<thead>
<tr>
<th>City</th>
<th>Tender</th>
<th>Average Speed</th>
<th>Congestion Index</th>
<th>Urban Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bengaluru</td>
<td>200</td>
<td>185</td>
<td>183</td>
<td>179</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>225</td>
<td>203</td>
<td>195</td>
<td>209</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>200</td>
<td>220</td>
<td>225</td>
<td>222</td>
</tr>
<tr>
<td>Mumbai</td>
<td>150</td>
<td>162</td>
<td>159</td>
<td>164</td>
</tr>
<tr>
<td>Jaipur</td>
<td>150</td>
<td>223</td>
<td>225</td>
<td>164</td>
</tr>
</tbody>
</table>

From the table, it is clear that urban radius of the city is most efficient to estimate the assured km, as the percentage of error between actual and estimated in existing 5 cities is least.
Profile of Case Study Area – Delhi

- Area: 1483 sq km
- PCTR: 1.55
- Average Trip Length: 10.20 km
- Population (2018): 18.9 million
- Population Density: 9340 person/sq km
- Total Fleet Size: 5950 (4303+1647)
### Profile of Case Study Area – Delhi

#### Dead Kms of Routes from Depots

<table>
<thead>
<tr>
<th>Depots</th>
<th>Average of Dead kms</th>
<th>Sum of Number of Buses in operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBM Depot</td>
<td>15.7</td>
<td>126</td>
</tr>
<tr>
<td>Kair Depot</td>
<td>24.6</td>
<td>222</td>
</tr>
<tr>
<td>Kanjhawla Depot</td>
<td>22.3</td>
<td>153</td>
</tr>
<tr>
<td>Kushak Nallah Depot</td>
<td>12.6</td>
<td>352</td>
</tr>
<tr>
<td>Okhla Depot IV</td>
<td>15.7</td>
<td>148</td>
</tr>
<tr>
<td>Raj Ghat Depot</td>
<td>13.0</td>
<td>108</td>
</tr>
<tr>
<td>Seemapuri Depot</td>
<td>17.5</td>
<td>134</td>
</tr>
<tr>
<td>Sunehari Pulla Depot</td>
<td>14.9</td>
<td>191</td>
</tr>
</tbody>
</table>

#### Route Performance

<table>
<thead>
<tr>
<th>Route</th>
<th>Avg Operational Km/Day</th>
<th>Avg Units Consumed (kWh)</th>
<th>Avg kWh/Km</th>
</tr>
</thead>
<tbody>
<tr>
<td>473</td>
<td>194.77</td>
<td>181.86</td>
<td>0.88</td>
</tr>
<tr>
<td>TMS</td>
<td>203.47</td>
<td>183.11</td>
<td>0.93</td>
</tr>
</tbody>
</table>

- Govt. of NCT of Delhi has initiated a trial run of electric buses in order to understand the intricacies of operating these buses.

**Inference**

- Kushak Nallah Depot have the least dead miles and highest number of buses in operations. So the routes originating from it should be given highest priority for electric bus operations.
- Average energy consumption without AC is 0.88-0.9 kWh/km
Methodology for calculation of cost/km in Delhi

Regression between Cost/km and Assured km in present 5 cities

\[ Y (\text{Cost per km}) = 143.67e^{(-0.006 \times \text{Assured kms})} \]

Relate assured km with 3 parameters

- Average Speed of the City (Wilbur Smith Report 2008 X Correction Factor)
- Congestion Index of the City \((CI=1-(\text{Moving Speed}/\text{Avg Speed}))\)
- Urban Radius of the City \(\text{UR}=[(\text{ATL}-2.9762)/0.5027]\)

Calculate the assured km from the above parameters for Delhi

- \(1.6376 \times \text{Avg Speed}^{1.638} = 201 \text{ km}\)
- \(420.03 \times e^{-2.094 \times \text{Cl}} = 193 \text{ km}\)
- \(264.34 \times e^{0.027 \times \text{UR}} = 191 \text{ km}\)

Taking the assured as per urban radius = 191 km

- Cost per km (9m AC Electric Bus) = ₹48.92
- Cost per km (9m Non AC E-Bus) = ₹44.64
- Cost per km (12m Non AC E-Bus) = ₹49.89
- Cost per km (12m AC E-Bus) = ₹54.68

Ratio of AC Bus/Non Ac Bus = 1.11
Ratio of 12m Bus/9m Bus = 1.09
ALTERNATE MODELS FOR PROCUREMENT
GCC MODEL FOR PROCUREMENT OF ELECTRIC BUS (12M AC) IN DELHI

Under this procurement, the operator will start making profit after 4 years of operations.
BATTERY LEASING MODEL FOR PROCUREMENT OF ELECTRIC BUS (12M AC) IN DELHI

Pay for the Bus, Lease the Battery

Battery Leasing Cost = Battery Cost + \sum_{i=1}^{n} (Recharging electricity Cost for given year i + Maintenance & Repair Cost for a given year i)

- Capacity of the Battery: 250 kWh (Range 200km)
- Cost of the Battery: INR 36,87,500 (INR 14,750 per kWh)
- Maintenance & Repair: INR 12,54,870 (INR 1.5 per km)
- Recharging Electricity: INR 51,12,433 (INR 6.1 per km)

LCC of 12m AC Electric Bus

- Cost in Lakhs
  - Bank Debt: 150.8
  - Equity: 47.3
  - Insurance: 19.6
  - Manpower: 72.0
  - Spare: 8.1
  - Battery Leasing: 133.4
  - Tyres: 4.5
  - AMC: 49.0
  - Overheads: 18.7
  - Salvage Value: -16.4
  - Total: 487.0

Urban Mobility India Conference & Expo 2019
STRATEGIES
STRATEGY 1 – OPPORTUNITY CHARGING

Assumptions

<table>
<thead>
<tr>
<th>Battery Capacity:</th>
<th>Charger Capacity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>125kWh</td>
<td>320kWh</td>
</tr>
</tbody>
</table>

Type of Charger: CHAdeMO

Time to Charge: 30-40 mins

Total Buses in Operation: 352

Chargers Required: 66

Cost of Electrical Work per kWh: ₹2,597

Cost of Civil Work per sqm: ₹850

Delta Fast Charger (CHAdeMo) 320 kW

<table>
<thead>
<tr>
<th>Equipment Price</th>
<th>₹ 87,23,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation Charge</td>
<td>₹ 96,000</td>
</tr>
<tr>
<td>Transportation Charge</td>
<td>₹ 76,800</td>
</tr>
<tr>
<td>GST (18%)</td>
<td>₹ 16,01,280</td>
</tr>
<tr>
<td>Electrical Work</td>
<td>₹ 8,24,320</td>
</tr>
<tr>
<td>Civil Work</td>
<td>₹ 40,800</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>₹ 113,62,400.00</strong></td>
</tr>
</tbody>
</table>
STRATEGY 1 – OPPORTUNITY CHARGING

LCC of Electric Bus (12m AC) with Fast Charger

- Bank Debt: 116.2
- Equity: 36.5
- Insurance: 15.1
- Charging Infra: 22.7
- Manpower: 72.0
- Spare: 8.1
- Battery Leasing: 108.9
- Tyres: 4.5
- AMC: 49.0
- Overheads: 18.7
- Salvage Value: -12.7
- Total: 439.2
STRATEGY 2 – DEPOT CHARGING

Assumptions

- Battery Capacity: 320kWh
- Charger Capacity: 50kWh
- Type of Charger: Bharat Charger
- Time to Charge: 6-8 hrs

Total Buses in Operation: 352
Chargers Required: 352

Delta Charger (CHAdeMO) 50kW

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Price</td>
<td>₹ 13,63,000</td>
</tr>
<tr>
<td>Installation Charge</td>
<td>₹ 15,000</td>
</tr>
<tr>
<td>Transportation Charge</td>
<td>₹ 12,000</td>
</tr>
<tr>
<td>GST (18%)</td>
<td>₹ 2,50,200</td>
</tr>
<tr>
<td>Electrical Work</td>
<td>₹ 1,28,800</td>
</tr>
<tr>
<td>Civil Work</td>
<td>₹ 40,800</td>
</tr>
<tr>
<td>TOTAL</td>
<td>₹ 18,09,800.00</td>
</tr>
</tbody>
</table>
STRATEGY 2 – DEPOT CHARGING

LCC of Electric Bus (12m AC) with Slow Charger
STRATEGY 3 – BATTERY SWAPPING

- **Small Battery**
  - *Lower cost of Bus*

**Battery Swapping**

- **Time to Swap**: 2.5 minutes
- **No of swaps**: 24 buses/hr
- **Battery charge**: 30 min/battery

**Cost/Swapper**
- ₹26.78 lacs

**Area/swapper**
- 200 sqm

**Civil Work**
- ₹4,000/sqm

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"Major end terminals are taken as optimal location for swapping station"

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<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Buses in operation</th>
<th>Time to swap (mins)</th>
<th>No of Swappers</th>
<th>No of Fast Charger (320kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambedkar Nagar Terminal</td>
<td>20</td>
<td>50</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Anand Vihar ISBT</td>
<td>77</td>
<td>193</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Tehkhand Depot</td>
<td>13</td>
<td>33</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Harsh Vihar</td>
<td>27</td>
<td>68</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Kashmere Gate ISBT</td>
<td>59</td>
<td>148</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Shahdara Terminal</td>
<td>27</td>
<td>68</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Shivaji Stadum Terminal</td>
<td>23</td>
<td>58</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Sultanpuri Terminal</td>
<td>48</td>
<td>120</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Uttam Nagar Terminal</td>
<td>58</td>
<td>145</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>352</strong></td>
<td><strong>14</strong></td>
<td><strong>44</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total Cost**
- **Total Infra Cost**: ₹4.87 Cr
- **Total Charger Cost**: ₹49.9 Cr
- **Total Battery Cost**: ₹65.7 Cr
- **Total Cost (For 352 buses)**: ₹120.6 Cr
STRATEGY 3 – BATTERY SWAPPING

LCC of Electric Bus (12m AC) with Battery Swapping

- Bank Debt: 139.5
- Equity: 43.8
- Insurance: 18.2
- Charging Infra: 34.3
- Manpower: 72.0
- Spare: 8.1
- Battery Leasing: 113.8
- Tyres: 4.5
- AMC: 49.0
- Overheads: 18.7
- Salvage Value: -15.2
- Total: 486.7
CONCLUSION

“Study points out that there is need to develop a robust model for electric bus operation”

Life cycle cost of electric bus is less than CNG bus with zero emissions.

Electric buses of 12m are more cost efficient in terms of seat kms.

In bidding, cost per km is dependent on assured kms which is determined by urban radius of the city.

Electric buses should be procured on BATTERY LEASE MODEL.

Opportunity charging operation is most cost effective for electric buses. Charger of high capacity should be use to charge the electric buses.
In urban areas electric buses should be procured on battery lease model as it decreases the upfront investments of the vehicle.

- Optimized charging and operations of electric buses, bus operators would be collaborated with charging infrastructure providers to furnish most of the routes with charging facilities.
- There should be standardization of charger types.
- Utility funded installations
Thank You