Deployment of Electric Buses by Janmarg: Opportunities and Challenges

Workshop on Electrification of Public Transport - Sept 23, 2019

Presented By Ahmedabad Janmarg Ltd.
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Ahmedabad Urban Bus Scenario

- Ahmedabad city is served currently by around 1000 buses
- Includes Standard (12m), Midi (9m), AC and non AC, Diesel / CNG / Electric Buses.
- Ahmedabad Municipal Transport Service (AMTS) is the traditional agency that operates around 750 buses.
- Ahmedabad Janmarg Ltd. (AJL) is SPV to establish, operate and manage the Bus Rapid Transit System (BRTS). AJL operates 250 buses.
## Comparison of using Electric v/s Diesel Buses:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diesel Bus</th>
<th>Electric Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Efficiency</td>
<td>AC Std : 2 km/L AC Midi : 3-3.5 Km/L</td>
<td>AC Std. : 1.5 kWh/Km AC Midi : 1 - 1.2 Kwh/Km</td>
</tr>
<tr>
<td>Fuel Cost</td>
<td>AC Std: Rs 35 per km AC Midi : Rs 20/km</td>
<td>AC Std : Rs 7.5 per Km AC Midi :Rs. 6 per km</td>
</tr>
<tr>
<td>Maintenance</td>
<td>High</td>
<td>Initial Stages: High Later Stages : Low</td>
</tr>
<tr>
<td>Manpower Costs</td>
<td>X</td>
<td>Initial Stages: 2X Later Stages : X</td>
</tr>
<tr>
<td>Major Cost Component</td>
<td>Fuel</td>
<td>Bus and Charging Infra Cost</td>
</tr>
<tr>
<td>Fuel infrastructure</td>
<td>Easy to access</td>
<td>Charging infra needs to be created at Depot</td>
</tr>
<tr>
<td>Gross Weight</td>
<td>16,200 kg</td>
<td>18,500 kg</td>
</tr>
<tr>
<td>Tyre life</td>
<td>Approx. 75000</td>
<td>Approx. 50000</td>
</tr>
</tbody>
</table>

- Bus Capital Cost higher in E Bus but fuel, and maintenance costs are lower over the life cycle.
- Initial O&M costs in E Bus are however higher due to technical support for system stabilization.
- Also, E-Buses require investment in charging infrastructure.
- Overall, E Bus Lifecycle costs are higher but now nearing conventional fuel buses.
- Presently, subsidies are required to make E Buses attractive.
## Electric Bus Deployment in Ahmedabad

<table>
<thead>
<tr>
<th>Round</th>
<th>No. of E Buses</th>
<th>Rate (Rs/Km)*</th>
<th>OEM / Operator</th>
<th>Technology</th>
<th>Funding by</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2018</td>
<td>50</td>
<td>58.60</td>
<td>Ashok Leyland</td>
<td>Swap : 18 Fast : 32</td>
<td>AJL, AMC &amp; CM Bus Scheme</td>
<td>11 Buses Operational</td>
</tr>
<tr>
<td>March 2019</td>
<td>300</td>
<td>62.00</td>
<td>Tata Motors</td>
<td>All Fast</td>
<td>AJL, AMC and CM Bus Scheme</td>
<td>AJL Board has approved</td>
</tr>
<tr>
<td>Oct 2019</td>
<td>300 proposed</td>
<td></td>
<td></td>
<td>FAME II</td>
<td></td>
<td>Under Bidding</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>650 E Buses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Rates are without Electricity Cost
- Decision on type of technology, number of chargers left to Operator
- Range of around 200 km per bus per day with Opportunity charging
- Period of Contract changed from 7+2 years to 8+2 years over successive contracts
Ahmedabad Experience in Procurement of First 50 E Buses

**First Attempt**

1. Tata Motors (TML)
2. Mahindra & Mahindra
3. Goldstone

**Second Attempt**

1. Tata Motors (TML)
2. Ashok Leyland (ALL)

<table>
<thead>
<tr>
<th>Price quoted by Eligible Bidder</th>
<th>Rs./km with Electricity cost</th>
<th>Rs.km w/o Electricity cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>With Subsidy</td>
<td>W/O Subsidy</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>TML</td>
<td>59.95</td>
<td>85.91</td>
</tr>
<tr>
<td>M&amp;M</td>
<td>7961</td>
<td>8703</td>
</tr>
</tbody>
</table>

*Electricity Rate Rs. 8/km quoted by L1*

**Outcome**

Bid Process was annulled due to high rates quoted even after negotiation.

LOI issued to Ashok Leyland at negotiated rated of Rs. 40.80 /km (10 Buses) and Rs. 63.12 / km (40 Buses)

*Saving of approx Rs. 25 to 30 crore over 7-9 years with decision to re-issue the RFP.*
Ahmedabad Experience in Procurement of Second 300 E Buses

**First Attempt**

1. Tata Motors (TML)
2. Evey Trans
3. Chartered – JBM JV

**Second Attempt**

1. Tata Motors (TML)
2. Evey Trans
3. Ashok Leyland (ALL)

**Price quoted by Eligible Bidder**

<table>
<thead>
<tr>
<th>Name</th>
<th>Rate without Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tata</td>
<td>78.50</td>
</tr>
<tr>
<td>Evey Trans</td>
<td>73.98</td>
</tr>
<tr>
<td>Chartered JBM</td>
<td>62.83</td>
</tr>
</tbody>
</table>

**Rs./km without Electricity cost**

<table>
<thead>
<tr>
<th>Name</th>
<th>Rate without Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tata</td>
<td>69.49 (62.00)</td>
</tr>
<tr>
<td>Evey Trans</td>
<td>69.66</td>
</tr>
<tr>
<td>ALL</td>
<td>93.51</td>
</tr>
</tbody>
</table>

**Outcome**

Bid Process was annulled in hope of better rates

**LOA being issued to Tata Motors at Rs 62.00 (inclusive of taxes and GST) negotiated rate**

Rate from Tata was negotiated down to Rs 62.00 from Rs. 69.49 leading to saving of around Rs 180 crore over 8 years. Also subsidy of Rs 25 per km available under CMBus.
- Battery packs were stacked inside the saloon area in the initial design.

- 3-D design was showcased through virtual reality projection during chassis inspection at Chennai on 17/8/2018.

- The battery stacks found to be blocking inside view of the driver and outside view of the passengers which could lead to safety hazard and commuter's anxiety.

- Through detailed discussion and deliberations with AJL / CEPT team, Leyland was able to accommodate all the battery packs under the Chassis.
Bus Design: Wheel Hump Size - Resolved

- Lower / Uniform Floor height across the bus – preferred for BRTS.

- Higher battery weight - higher GVW necessitated **large wheels** increasing wheel hump size to 350 mm disturbing uniform floor

- Larger wheels leading to higher seat level for 2-3 rows seats on wheel-humps (approx 1200 mm)

- Solution proposed by AJL / CEPT by reducing Type of Tyre

**Before: With 295/80 R 22.5 tyre**

**After: With 275/70 R 22.5 tyre**
- Ashok Leyland has invited students of NID to provide innovative ideas for exterior color scheme through a design competition

**ELECTRIC BUS DECAL DESIGN**

**Dear NIDians,**

Ashok Leyland invites fresh exterior decal ideas from students of NID for newly developed Electric bus.

Your graphic should reflect electric, green energy, “Vibrant Gujarat” and carry the visual flavors of Ahmedabad.

The selected entry will be rewarded cash prize of Rs.70000/-

This competition open to all NID students.

Your entries must be submitted digitally through dhana.atvvc@ashokleyland.com

Use the images shown in this poster as templates for your work. Vehicle base color can be white.

Submit your final entry in JPEG and Coral draw format.

The judge’s decision will be final. All submitted concepts copyrights are owned by Ashok Leyland Ltd.
Bus Depot/Charging Space Created

- Space constrain in existing Depots of AJL
- Non availability of land for bus charging enroute BRTS Corridor
- Approx. 1 to 2 MW power required at every location for 1) Fast charging and 2) Battery Swapping
- Fast Charging Facility created at Naranpura
- Swap Charging Facility at Ranip
- Entire cost of Charging Infrastructure at the depots (Approx. Rs 13 crore) borne by bidder
Selection of Route for Swap Bus

1: Maninagar – Ghuma Gam – 21.2 km

9: Maninagar – Sola Bhagwat – 22.2 km

101, 201: RTO Circular – 27.2 km

8: Iskcon – Naroda Gam – 22.4 km

RTO Circular Route chosen for Swap Bus considering operational range of 30-40 Km and need to come back for swapping.
Naranpura Depot with Fast Charging Technology
Swap Charging Infrastructure at Ranip
Electric Buses: Present Status

Delivery of Electric Buses is underway. Flag off of the Buses was arranged.
Passenger Operations under Electric Buses have commenced on the busy and highly dense city area.
Buses parked in the Naranpura Depot.
Electric Buses : Present Status

- Interior of the Bus
First challenge and lesson is to prepare an RFP accommodating all needs of city with minimum or no expertise of technology.

As technology is evolving and unknown, Bus Performance Risk should be contractually allocated to the manufacturer only and not allowed to be passed on to any third party.

Be prepared for several rounds of trial, testing and iterations.

Depot construction & bulk power should be provided by Authority while Electric Charging Infra (Step down) and Charging Stations should be provided by operator- manufacturer.

Cost of operation is high without any subsidy so a mechanism is required to subsidize it.
E Bus Deployment: Lessons

- Depot space availability and Electric infra creation costs are major costs and challenges.

- Deployment of large electric fleet requires charging infrastructure and intelligent scheduling based on following criteria
  - Bus range
  - Depot locations
  - Route lengths
  - Minimising Dead Km
  - Deployment on high pollution routes
  - Deployment on routes with high visibility and occupancy
  - Avoid congested areas initially

- Requires high degree of prevision and planning for deployment
E Bus Deployment : Opportunities

- Clean and Green Public Transport initiatives by Government of India through DHI under FAME 1 and FAME 2 Schemes.

- Different OEMs compared to traditional OEMs are coming up with lots of innovations.

- Attracting citizens to ride in Clean and Green Public Transport.

- CM Bus Scheme in Gujarat for example offers a subsidy per operated km (capped at Rs. 25 per km) to approved cities as a viability gap funding. This model of subsidy is the best model which leaves decisions on type, size and number of buses, technology, operation output requirements etc. to the transport authority.
Thank you
850 Buses mostly on Gross Cost Contract

Revenue/Traffic Risk by AJL

Ahmedabad Janmarg Limited

Users of Bus Service

Bus Operation Concession

Bus Funding and Performance Risk on Operator

Selection Criteria: Lowest Cost of procurement and Operations (Per km rate)

Responsibility Includes
- Scheduling and Route Selection
- Fare Collection
- Fare Determination /Revision
- Providing Depot / Parking Yard

Payment per operated KM per Bus (In built payment revision formula to accommodate changes in fuel price and inflation)

Responsibility Includes
- Bus Procurement and Funding
- Bus Operation
- Bus Maintenance