Business Models and Contracting Structures for Electric Buses - Practices and Lessons

National Workshop on Transitioning to Electric Mobility in Lao People’s Democratic Republic

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Why is Business Model relevant for E-buses?

E Buses operations is a collection of systems, requiring multiple stakeholders to work together

- **Transit System**
- **Stations and Terminals**
- **Depots and Maintenance**
- **Batteries and BMS**
- **Control systems & Motor**
- **Fully Built Bus**
- **Charging System**
- **Charging Management**
- **Step Down Transformers**
- **Grid**
- **HT Supply**

- **Transit Agency**
- **Bus Operator**
- **Bus OEM**
- **Bus Operator**
- **Energy Solution Provider (ESP)**
- **Energy Utility**
- **Energy Utility**
- **Grid Manager**

Further, E Buses have comparable TCO, but have high upfront costs versus lower operating costs, requiring upfront capital investment. The complexities necessitate an incentivised contractual arrangement, several of which are possible.
India’s Experience with E-buses

**Business Models in India**

**Model 1: Outright Purchase Model**
- Adopted by few cities like Kolkata, Indore, Jaipur, Guwahati and Jammu under FAME I.
- Many difficulties in deployment and operations.

**Model 2: Gross Cost Contract**
- Mandatory Model under FAME II.
- More than 3000 e-buses have been procured out of which 900 e-buses are operational.

**Model 3: Utility Provider Led Model**
- Experimented by NTPC in Andaman Nicobar. Not replicated further.

*Predominant Model in India is Gross Cost Contract (GCC).*
Convergence Energy Services Ltd. (CESL), a PSU under Ministry of Power has selected the operator for procurement, operation and maintenance of 5450 E-buses in 5 Indian cities – Availing the incentives available under FAME II.

Why Pooled Procurement?
To homogenise and aggregate demand

Business Model Used
Gross Cost Contract

Contract Period
12 Years (with 10 lakh assured km)

Outcome of Pooled Procurement
TATA Motors won the tender in all Categories

Advantages
Economies of Scale

Lowest Ever price was discovered

<table>
<thead>
<tr>
<th>Type of Bus</th>
<th>Rate (Rs/Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 m Low Floor AC</td>
<td>47.49</td>
</tr>
<tr>
<td>12 m Low Floor Non-AC</td>
<td>43.49</td>
</tr>
<tr>
<td>12 m Std. Floor Non-AC</td>
<td>44.99</td>
</tr>
<tr>
<td>9 m Std. Floor AC</td>
<td>41.45</td>
</tr>
<tr>
<td>9 m Std. Floor Non-AC</td>
<td>39.21</td>
</tr>
</tbody>
</table>

Aggregation of demand and centralised procurement seems to have provided better economics. However, merits of common specification and service conditions are yet to be proven.
Business Model - Shenzen

**KEY TAKEAWAYS**

- The 3e warranty system takes complete care of the vehicles till the end of its lifetime.
- Partnership among operators, manufacturers, financial organizations and charging companies significantly reduced the technology uncertainty and spread the cost burden.

**Business Model**

- **National and Local Governments**
  - Pay for the whole bus in 3 parts
  - Vehicle sale and Production Subsidy

- **Financial Leasing Company**
  - Lease the Buses
  - Lease the Buses

- **Bus Operating Company**
  - Operating Subsidy
  - Lifetime Charging Contract
  - Charging Service, Battery Leasing, Repair and Maintenance

- **E-Bus Manufacturer**
  - Provides trained technicians

- **Charging Service Provider**
  - Provides charging service staffs

**Source:** Case Study: Electric buses in Shenzhen, China, 2020 by Zeyuan Song, Yingqi Liu, Hongwei Gao, Suxiu Li

**Note:** 3e System includes battery, electric motor, and controller
The new system seeks to split the ownership and operation of assets by having fleet suppliers and bus operators, while the transport authority manages depots. Maintenance costs have significantly reduced due to the involvement of manufacturers.
**Business Model – Sweden Cities**

**Key Takeaways**

Variety of models in the same country shows that models may need to be tweaked according to local context.

Adopted from: Electric buses for Swedish public transport services, 2019 by Anna-Cecilia Lundström, Matilda Ninasdotter Holmström, Erik Torstensson and Matilda Eriksson.
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Activity</th>
<th>Country</th>
<th>Chile</th>
<th>Sweden</th>
<th>Västra Götaland</th>
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<tr>
<td></td>
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<td>City / Region</td>
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<td>Santiago</td>
<td>Stockholm</td>
<td>Scania</td>
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<td>1</td>
<td>Ownership of buses</td>
<td>FC</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
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<tr>
<td>2</td>
<td>Funding For Procurement</td>
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<td>FC</td>
<td>PO</td>
<td>PO</td>
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<td>3</td>
<td>Supply of Buses</td>
<td>VM (Through Lessee)</td>
<td>VM (Through Lessee)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>4</td>
<td>Bus Operational Services</td>
<td>G + PO</td>
<td>G + PO</td>
<td>PO</td>
<td>PO</td>
</tr>
<tr>
<td>5</td>
<td>Bus Maintenance Services</td>
<td>G + PO</td>
<td>VM</td>
<td>PO</td>
<td>PO</td>
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<tr>
<td></td>
<td><strong>Battery</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>FC</td>
<td>PO</td>
<td>PO</td>
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<td>ND</td>
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<td>VM</td>
<td>PO</td>
<td>PO</td>
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<td>4</td>
<td>Systematic tracking of Battery Usage</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td>5</td>
<td>Replacement of Battery</td>
<td>PO</td>
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<td>ND</td>
<td>ND</td>
</tr>
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<td>6</td>
<td>Disposal and Recycling of battery</td>
<td>VM</td>
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<td>ND</td>
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<td><strong>Charging Infrastructure</strong></td>
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<tr>
<td>1</td>
<td>Ownership of Charging Infra.</td>
<td>CSP (Gets Rent)</td>
<td>FC</td>
<td>G</td>
<td>G + PO</td>
</tr>
<tr>
<td>2</td>
<td>Land Acquisition for Charging Infra.</td>
<td>G</td>
<td>ND</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>3</td>
<td>Supply of Chargers</td>
<td>VM (Through ESP)</td>
<td>VM (Through ESP)</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>4</td>
<td>Charging Infrastructure Construction</td>
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<td>PO</td>
<td>PO</td>
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<td>5</td>
<td>Charging Infra. Service Provisions</td>
<td>CSP</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
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<tr>
<td>6</td>
<td>Charging Infra. Management</td>
<td>CSP</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
</tr>
<tr>
<td>7</td>
<td>Electricity Provision for Charging Infra.</td>
<td>G</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td><strong>Staff Requirement</strong></td>
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<tr>
<td>1</td>
<td>Staff needed for Operation</td>
<td>VM</td>
<td>VM</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>2</td>
<td>Staff Needed for Maintenance</td>
<td>VM</td>
<td>VM</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

Legend:
- **Government (G)**
- **Finance Company (FC)**
- **Private Parties (PO)**
- **Charging Service Provider (CSP)**
- **Partnership (G + PO)**
- **Vehicle Manufacturer (VM)**
- **Not Discussed (ND)**
E-Bus Business Models Across the Globe

Inclined towards Unbundling and Outsourcing
Lessons from Global Experience

Mandated OEM Participation
To reduce technological and Operational Risk

Strong Contractual Arrangements
Multiple stakeholders are involved, hence the responsibilities to be defined clearly and risk to be passed on to the party best able to bear it

Warranty for Battery and Drivetrain
To mitigate the battery risk as it is about 40% of the bus cost
# Criteria for Selection of E-Bus Business Model

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Risks to be mitigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does it address Performance Risk of Buses?</td>
<td>Technology Risk</td>
</tr>
<tr>
<td>2. Assures Effective Use of Existing Resources?</td>
<td>Operations Risk</td>
</tr>
<tr>
<td>3. Aligned to timing and quantum of available funds?</td>
<td>System Maintenance Risk</td>
</tr>
<tr>
<td>4. Is the Contract easy to manage?</td>
<td>Support Infrastructure Development Risk</td>
</tr>
<tr>
<td>5. Is the Market for suppliers and Service Providers sufficiently evolved?</td>
<td>Labour relationship Risk</td>
</tr>
<tr>
<td></td>
<td>Funding Risk</td>
</tr>
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<td></td>
<td>Contract Management Risk</td>
</tr>
</tbody>
</table>

## Risks to be mitigated

1. Risk of managing new technology in absence of inhouse capacity
2. Availability of skilled and trained driving manpower is very crucial for e-bus operations
3. Each system component i.e EV drivetrain, batteries, charging infra, electric infra requires different skill sets and expertise.
4. Performance of Charging Infrastructure and availability of HT power
5. E-buses may replace existing buses hence the existing manpower needs to be used.
6. Availability of upfront capital subsidy OR periodic funding
7. Inhouse capacity is required for management of complex contracts compared to goods procurement.
Public Transport in Lao PDR

- Less than 1% trips on Public Transport
- Very buses and bus-based transit. IPT-based operators with fragmented operators.
- Net cost basis/low fare
- Cost recovery is assured only when
  - Occupancy is high (waiting for passengers, crowding, operations only on truck routes)
  - Use of old and unsafe vehicles
  - Compromise on **Comfort, Reliability and Punctuality**
- To bring in E-mobility, a threshold scale will be required or otherwise it will remain subsidised.
Lao PDR BRTS E- Bus Contracting Model

Vientiane Capital State Bus Enterprise (Public)

Bus OEM

Supplies 55 E Bus

Maintenance Support through Long Term AMC / Warranties

BRT Company

Share Holder Agreement

Bus Operator (Private)

Funding: Buses from ADB and Partners

Operations from Fare + Parking Revenue

Bus Operator Contract (GCC with incentives)

Depot Construction Contract

Depot + Charging Infrastructure

Bus Operator

(Vientiane Capital State Bus Enterprise (Public))

(Bus Operator (Private))

Bus Operator Contract

Funding: Buses from ADB and Partners Operations from Fare + Parking Revenue

Depot Construction Contract

(Vientiane Capital State Bus Enterprise (Public))

(Bus Operator (Private))

Depot + Charging Infrastructure
Lessons for Lao PDR

• Movement towards E-Mobility in Public Transport should be taken as an opportunity to reform Public Transit.
• From fragmented, target to make the industry consolidated, resourceful and formal.
• The Business model can evolve as the market for E mobility changes. Initially funding challenges due to bankability issues will limit options.
• Government must step in to create capable, bankable Public Transit institutions which can benefit from scale, funding ability and operational capability.