Implementation Challenges of E-buses
- Shenzhen Case

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The World Bank
Data on E-bus deployment in China

- More than 250,000 Electric Buses in China by the end of 2018

Number of buses by type by the end of 2018:

- Diesel: 3,319,955 (49%)
- New Energy: 341,405 (51%)
- Electric: 2,545,545
- Plug-in Hybrid: 86,860

Graph showing the number of NEBs from 2015 to 2018.
Shenzhen Bus Group and its electrification

- Shenzhen achieved 100% e-bus fleet by the end of 2017, with total 16759 e-buses;
- Shenzhen Bus Group: about 1/3: about 5900 e-buses by the end of 2017;
- Pilot: 2011:125 e-buses procured; 2013: 180 e-buses procured;
- Brands: BYD(79%); NJL(17%); WZL(4%)
- WB and SBG are working together for a case study on SBG’s e-bus experience
Challenge 1: new technology and its maturity

- Pilot and trial: understanding the key issues and challenges through piloting;
- Communication with the industry and follow with the latest e-bus technology;
- Closely follow the government policy signals;
- Chose good products

Slow-charging; large capacity and long run

- Almost can fully replace the diesel fleet
- Easier fleet arrangement;
- Less charging dependency at the beginning;
- More purchase subsidies;

Fast charging; small capacity and charge at terminals

BYD: K8
- Length: 10.5m
- Distance: 250km
- Weight: 12.2ton
Challenge 2: high price of e-bus

- Take advantage of subsidies from national level and local level;
  - BYD; 10.5m; 250km; 1,580,000RMB in 2016
  - After purchase subsidies: 580,000RMB; comparable to diesel bus (400,000-500,000RMB)
  - Operation subsidies – 80,000RMB per year
- ‘Purchase + financing lease + buy-back’ deal
  - Require the bidders (manufacturers) to look for better mortgage deal;
  - Require the bidders to buy-back the diesel buses;
- Savings on fuel costs and maintenance costs
  - Fuel cost: 40L diesel/100km: 204RMB
    100kwh/100km: 100RMB
    One year savings per ebus on fuel cost: 98,000RMB
  - 8-year Warranty on key parts – especially on battery, electric engine and control: less maintenance costs
## Challenge 2: high price of e-bus (cont.)

### TCO Comparison (8 years)

<table>
<thead>
<tr>
<th>(k RMB)</th>
<th>Diesel</th>
<th>EB - 2016</th>
<th>EB - 2019</th>
<th>EB - after 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus Price</td>
<td>508</td>
<td>1,580</td>
<td>1,000</td>
<td>850</td>
</tr>
<tr>
<td>Purchase Subsidy</td>
<td>0</td>
<td>-1,000</td>
<td>-180</td>
<td>0</td>
</tr>
<tr>
<td>Energy</td>
<td>937</td>
<td>480</td>
<td>480</td>
<td>480</td>
</tr>
<tr>
<td>Maintenance</td>
<td>391</td>
<td>304</td>
<td>304</td>
<td>304</td>
</tr>
<tr>
<td>Operation Subsidy</td>
<td>-30</td>
<td>-640</td>
<td>-640</td>
<td>0</td>
</tr>
<tr>
<td>TCO present value</td>
<td>1,806</td>
<td>724</td>
<td>964</td>
<td>1,634</td>
</tr>
</tbody>
</table>
Challenge 3: Charging facility

- Collaborate with charging service provider
  - SBG no need to invest on charging infrastructure;
  - Charging service provider could liaise with the Grid and government regarding any grid capacity issue;
  - SBG (bus operator) pays charging service fee;
  - One key challenge is the land: Some charging service provider has the resources of land

Install at the key terminals with several bus lines → Give priority to terminals with longer-distance bus lines → Land from Charging service provider: optimize bus lines
Challenge 4: Operation

• Preparation before operation:
  – Training for drivers
  – Training for maintenance staff: a) trained by manufacturers; b) trained by bus company;

• Optimization of bus lines considering the characteristics of e-bus

• Charging arrangement:
  – All e-buses receiving full-charging at night (23:00 – 7:00)
  – In most cases, the e-buses of morning shift and afternoon shift can run for the whole shift;
  – One-day shift e-buses would need a quick charge during the day time;
  – Clear guidance to drivers regarding when&where to charge for each bus;
Environment Benefits

- Initial findings from the GHG emission from diesel and electricity
  
<table>
<thead>
<tr>
<th>Type of Bus</th>
<th>Fuel consumption/100km</th>
<th>( \text{CO}_2 ) (kg/100km) In Shenzhen</th>
<th>( \text{CO}_2 ) (kg/100km) In Beijing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Bus</td>
<td>40 L</td>
<td>105.40</td>
<td>105.40</td>
</tr>
<tr>
<td>Electric Bus</td>
<td>100 kWh</td>
<td>58.74</td>
<td>72.63</td>
</tr>
</tbody>
</table>

- The team is working on emissions for the whole cycle of e-bus
  - Battery production carbon emission is a major part;
Key factor: strong support from government

• How the central/local governments look at the public transport?
  – Semi-Public Service;
  – Effective/efficient way to mitigate congestion, pollution and GHG;
  – Image of a nice city;

• Other measures/policies from local government:
  – Travel Demand Management (TDM)
  – Plate rotation
  – Car purchase quota
  – Low-emission zone
Thank you!