Natural Gas in China’s Transport Sector

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Market Status

Driving Factors

Main Challenges
China’s NGV increased dramatically from 1.1m in 2010 to 5m in 2015 (including 0.2m LNGV), with a yearly growth rate of near 40%. China now ranks first in terms of NGV numbers across the world.

Source: Li Yongchang, CBNRI
According to the national plan, China’s production capacity of LNGV and CNGV will reach 1.2m/year in total by 2020, in which 1.0m are cars and 0.2m are buses and trucks.
Diesel HDV in 2014: 97.9%

LNG HDV in 2014: 2.1%
<table>
<thead>
<tr>
<th>NG Vehicle &amp; EV</th>
<th>Natural Gas Vehicle</th>
<th>Electric Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuel</strong></td>
<td>CNG</td>
<td>Battery Electricity Drive</td>
</tr>
<tr>
<td></td>
<td>LNG</td>
<td></td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Clean and efficient, fully combusted</td>
<td>Electric control system</td>
</tr>
<tr>
<td></td>
<td>CNG——High pressure in canister, risk</td>
<td>Battery technology and life</td>
</tr>
<tr>
<td></td>
<td>LNG——safe, big tank</td>
<td>Electric motor</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>CNG Vehicle - short distance, small vehicle</td>
<td>HPEV &amp; BEV</td>
</tr>
<tr>
<td></td>
<td>LNG Vehicle - long distance, 500~1000km, heavy duty</td>
<td>Passenger &amp; Commercial</td>
</tr>
</tbody>
</table>
LNG vehicle development slows after oil price fell

- Less economic competitive with low oil price
- Overall freight industry depressed

Data source: China Automotive Engineering Society, ICIS
China’s Ministry of Transport delivered a pilot project list of LNG vessels in 2014. It covered 978 vessels in total, in which only 106 are inland river LNG vessels, including 69 newly built vessels and 37 retrofitted vessels.
Now 32 out of 34 provincial districts in China have natural gas vehicles.

Shandong, Xinjiang and Sichuan rank top 3, with a number of more than 0.4m NGV respectively.

NGV were initially developing in inland provinces with rich natural gas resources, later NGV were popular among coastal provinces with LNG accessibility.

LNG vessel pilot projects are mainly in southeastern coastal areas like Zhoushan, Shanghai and Lianyungang, while inland projects are primarily in Changjiang River, Xijiang River, Jinghang Canal and Danjiangkou reservoir.
Market Status
Driving Factors
Main Challenges
<table>
<thead>
<tr>
<th>Environmental Protection Driven</th>
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<tbody>
<tr>
<td>Natural Gas has a relatively high calorific value. Its emission of combustion are mainly water and CO2, with much less SO(_2), NO(_x) and lead. It’s more environmental friendly than other fossil fuels.</td>
</tr>
<tr>
<td>Most types of NG car only emit 110-140g CO2 per kilometer, however, a gasoline car emits more than 200g of CO2 per kilometer. (Wang, 2014).</td>
</tr>
</tbody>
</table>
Fuel Economy Comparison: CNG vs Petrol

Taking example of a taxi running 350 kilometers per day:

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Unit</th>
<th>Consumption per 100 km</th>
<th>Price (RM)</th>
<th>Daily Cost (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>93#Gasoline</td>
<td>Liter</td>
<td>8</td>
<td>5.6</td>
<td>156.8</td>
</tr>
<tr>
<td>CNG</td>
<td>Cubic Meter</td>
<td>8.2</td>
<td>4.5</td>
<td>129.2</td>
</tr>
</tbody>
</table>
Fuel Economy Comparison: LNG v.s. Diesel

LNG Price to Diesel Price, 2014-2016
Note: LNG calorific value 49.9MJ/KG, 0# calorific value 46MJ/KG, Source: CEIC, CBNRI
Technical Advantage

- High maturity of NGV technology. Taxis and cars can easily get refitted from gasoline powered to natural gas powered.

- Better safety evaluation. ①High burning point ②Low density, hard to detonate。 ③High octane value.

- Better emission standard. National V standard are widely used in natural gas vehicles, while it still takes 2 or 3 tears for gasoline/diesel vehicle to adapt national V standard.

- Natural Gas engine is low-temperature tolerant. Also, its service life is longer due to not emitting particulate matter.
Market Status

Driving Factors

Main Challenges
CNG/LNG Refueling Station Network is Too Weak

- Insufficient number of stations
- Gas station cost too high
- Difficulty in getting land
- Approval process too verbose
Incomplete Standard System

Existing Standard

- Completed Vehicle Inspection
- Natural Gas Engine
- Dedicated Device
- Gas Container
- Gas Quality

Standard lacking

- Dual Fuel Engine Standard
- Vehicle Detection Standard
- CNG/LNG Refueling Metering Standard
High Upfront Cost, Insufficient Maintenance Resource

- Hard for drivers to troubleshoot a NGV on its own.
- Insufficient NGV technicians.
- Maintenance resources unevenly distributed.
- Maintenance time too long.
- Lack of NGV special parts.
THANK YOU!

Q&A