China: the “Move” to LNG

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Shell
China: the Largest LNG Market for Transportation

- LNG consumption in transportation 6.7mtpa in 2018
- Consumption growth rate >20% in 2017 and 18
- 2552 LNG refuelling sites

China Downstream LNG Market

- City Gas, 20%
- Industrial, 50%
- Transportation, 27%
- Power Gen, 3%

~20 million metric tons in 2017

~24 million metric tons in 2018

Number of LNG Vehicles in China

- Source: Sublime China Information
Drivers for Uptake of LNG as Transportation Fuel in China

- Policy and incentives
- Economy growth
- Availability of LNG supply
- Cost competitiveness of LNG
- Refuelling infrastructure

- Drivers for uptake of LNG in China include policy and incentives, economy growth, availability of LNG supply, cost competitiveness of LNG, and refuelling infrastructure.
Cost Competitiveness of LNG against alternative fuel

Zhejiang Pump Prices: Diesel and LNG
(Heating Value Equivalent, USD/kg)

Core driver of the development of LNG as transportation fuel

LNG Performance in Transportation Sector in China

Source: Sublime China Information, ICIS, Zhejiang Pricing Bureau, local Development and Reform Commission, own analysis
Policy and Incentives

*Usually prescribed to address environmental and air quality concerns*

- Promote LNG use in public transportation e.g. intra and inter city buses/coaches to reduce emission in densely populated areas.
- Encouraging policies on infrastructure development, “allow moderate over construction of LNG refuelling facilities”
- Subsidies for vehicle conversion
- Other transportation related regulation e.g. more stringent emission requirement, diesel truck ban in certain areas, etc
Availability of LNG Supply

• Crucial to the reliability of LNG as a transportation fuel and users’ confidence in this new fuel.

• Overall, healthy supply and demand balance in downstream LNG market in China.

• Challenge: seasonality, especially the uncertainty in winter supply shortage

Downstream LNG Supply in China

<table>
<thead>
<tr>
<th>Year</th>
<th>Ex Plant</th>
<th>Ex Terminal</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>3.95</td>
<td>1.94</td>
<td>20%</td>
</tr>
<tr>
<td>2014</td>
<td>5.94</td>
<td>1.91</td>
<td>20%</td>
</tr>
<tr>
<td>2015</td>
<td>7.11</td>
<td>3.69</td>
<td>27%</td>
</tr>
<tr>
<td>2016</td>
<td>8.22</td>
<td>5.53</td>
<td>47%</td>
</tr>
<tr>
<td>2017</td>
<td>10.05</td>
<td>10.18</td>
<td>47%</td>
</tr>
<tr>
<td>2018</td>
<td>9.88</td>
<td></td>
<td>18%</td>
</tr>
</tbody>
</table>

Source: Sublime China Information
Refuelling Infrastructure

Watch Out: Avoid the vicious cycle

- Reduced return and elaborate project approval procedures would discourage new investment
- The accessibility enabled development of LNG for transportation
- Fast growth of site may lead to drop of LNG consumption and return per site

Source: Sublime China Information
Building a Cleaner Transportation System in China
**LNG: Most Suitable Alternative for Long-Distance Haulage**

**QUALITATIVE COMPARISON OF NEW FUELS MIX**

<table>
<thead>
<tr>
<th></th>
<th>DIESEL</th>
<th>LNG</th>
<th>BIO LNG</th>
<th>GTL</th>
<th>CNG</th>
<th>HYDROGEN</th>
<th>ELECTRICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable for long-distance haulage</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Local emissions (SOx, PM)</td>
<td>-- --</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Global emissions (CO₂)</td>
<td>-- --</td>
<td>+</td>
<td>++</td>
<td>--</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Noise *</td>
<td>-- --</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Retail network</td>
<td>++</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Supply reliability</td>
<td>++</td>
<td>+</td>
<td>--</td>
<td>--</td>
<td>+</td>
<td>--</td>
<td>++</td>
</tr>
<tr>
<td>TCO vs diesel **</td>
<td>++</td>
<td>+/-</td>
<td>+/-</td>
<td>--</td>
<td>++</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Fuel price</td>
<td>+/-</td>
<td>+</td>
<td>--</td>
<td>--</td>
<td>+</td>
<td>--</td>
<td>++</td>
</tr>
<tr>
<td>Source</td>
<td>Oil</td>
<td>Natural gas</td>
<td>Organic waste</td>
<td>Natural gas</td>
<td>Natural gas</td>
<td>Varies</td>
<td>Varies</td>
</tr>
</tbody>
</table>

**LEGEND**
- -- -- : substantial disadvantage
- - : disadvantage
- +/- : neutral
- + : advantage
- ++ : substantial advantage

* Limited to spark ignition engines with sound intensity measured in watts/m² at peak load and idle conditions
** Estimation only. TCO depends among others on level of capex investments, fuel costs and the availability of tax incentives.
LNG as Bunker Fuel Can Make a Huge Difference

LNG has lower local emissions v.s. heavy fuel oil in marine engines

- **90%**

Emissions of particulates from natural gas combustion are 90% lower.

- Natural gas emits virtually no sulfur dioxide, so using more natural gas as fuel could emit less of the pollutants that cause acid rain.

Source: IMO 3rd GHG Study 2014

About 140 LNG fuelled vessels (133 inland waterways)
19 LNG bunkering stations (<50% in operation)
Summary

Cost Competitive

Reduce Emission

Quieter
Thank you