COMPARATIVE RESEARCH ON LNG RECEIVING TERMINALS AND FSRU.

PRESENTER:
GROUP 4
• ZHANG DONGSHA,
• SHEN NING,
• LYU JUN,
• LI LI,
• ZHANG YINGHUA

INSTRUCTOR:
PROF. ROGER SMITH

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1.1 LNG VALUE CHAIN

Floating Storage & Regasification Unit (FSRU)

Onshore Receiving Terminal

1. EXPLORATION & PRODUCTION
2. LIQUEFACTION
3. SHIPPING
4. STORAGE & REGASIFICATION
END USERS
1.2 CARGO HANDLING SYSTEM

Unloading Hose
Storage Tanker
Regasification Plant
Gas Export
1.3 DEVELOPMENT OF FSRU WORLDWIDE

A recent report from IGU estimated that approximately 50 by 2025, with a combined capacity to import 200mtpa. This is an increase of 60% from end-2016.
1.4 CHINESE FSRU MARKET

- 10th, Dec. 2013, CNOOC declared that Chinese first floating LNG project - CNOOC Tianjin LNG project began to supply natural gas for Tianjin, which triggered the high concern in the energy Industry and shipbuilding industry. It is the first time in China using floating storage regasification unit.

- 2nd Feb. 2015, Hudong-Zhonghua shipyard completed a 170,000 m³ LNG-FSRU repair and conversion project, which is the first time in china doing such projects.

- In December 2016, Zhoushan Taiping signed a small 26,000 m³ FSRU order.
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2.1 BIRD’S-EYE VIEW OF A LNG TERMINAL
2.2 LNG REGASIFICATION CAPACITY WORLDWIDE

By January 2017
UOM: MTPA

Japan, 197, 43%
US, 129, 1%
South Korea, 101, 35%
Spain, 49, 21%
China, 49, 56%
UK, 35, 21%
India, 27, 75%
France, 25, 36%
Mexico, 17, 25%
Turkey, 16, 54%
Taiwan, 13, 118%
Brazil, 12, 11%
Italy, 11, 40%
Egypt, 10, 75%
UAE, 10, 37%
Netherlands, 9, 4%
Indonesia, 9, 36%
Argentina, 8, 47%
Canada, 8, 3%
Belgium, 7, 15%
Singapore, 6, 36%
Portugal, 6, 23%
Kuwait, 6, 66%
Chile, 6, 59%
Thailand, 5, 50%
Small Mktts*, 30, 46%
2.3 LNG TERMINALS IN CHINA

Total: 14
### 3.1 CAPEX COMPARISON

**CAPEX Comparison Of Terminal with FSRU (3MTPA)**

<table>
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<tr>
<th>Component</th>
<th>LNG Terminal</th>
<th>FSRU</th>
</tr>
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<tbody>
<tr>
<td>Jetty including piping</td>
<td>US$60m</td>
<td>US$60m</td>
</tr>
<tr>
<td>Unloading Lines</td>
<td>US$100m</td>
<td>N/A</td>
</tr>
<tr>
<td>Tanks 1X180000m3</td>
<td>US$85m</td>
<td>In FRSU</td>
</tr>
<tr>
<td>FSRU Vessel</td>
<td>N/A</td>
<td>US$250m</td>
</tr>
<tr>
<td>Process equipment</td>
<td>US$130m</td>
<td>In FRSU</td>
</tr>
<tr>
<td>Utilities</td>
<td>US$60m</td>
<td>N/A</td>
</tr>
<tr>
<td>On-shore Infrastructures</td>
<td>N/A</td>
<td>US$30m</td>
</tr>
<tr>
<td>Land Fee and others</td>
<td>US$125m</td>
<td>US$20m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>US$560m</strong></td>
<td><strong>US$360m</strong></td>
</tr>
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</table>
3.2 OPEX COMPARISON

- The operating cost of the FSRU is usually 2.5% of capex each year, but the actual USD/day-rate will depend on the location of the FSRU. Sources quote OPEX in the range of US$20,000-45,000/day.
- As for LNG terminal, the cost will be US$20000-40000/day.
3.3 SCHEDULE COMPARISON

In general, a LNG receiving terminal will cost Owner 36-40 months to construct comparing with 27-36 months for a new built FSRU.
### 3.4 COMPARATIVE ANALYSIS

<table>
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<tr>
<th>Features</th>
<th>FSRU</th>
<th>Terminal</th>
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<tbody>
<tr>
<td>Send-out capacity</td>
<td>Small</td>
<td>Big</td>
</tr>
<tr>
<td>Expansion</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Storage</td>
<td>Fixed</td>
<td>Large</td>
</tr>
<tr>
<td>Peak-shaving ability</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Strategic storage</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>No existing harbor available</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>earth moving and heavy Construction</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Short term gas market need</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Fast track need for gas market</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Financing difficult and lack of capital</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>No land available for onshore terminal</td>
<td>✓</td>
<td>✗</td>
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2. INTRODUCTION TO LNG TERMINAL

3. COMPARISON OF LNG TERMINAL AND FSRU

4. CONCLUSIONS
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- FSRU enjoys advantages when considering factors such as economic efficiency, flexibility, responding time to market requirements, environment protection and land required in operation.

- LNG terminal, due to its better peak shaving ability and expandability, can easily deal with seasonal fluctuations in demand and fulfill national strategic storage demands in comparison with FSRU.
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“Verily by Beauty it is that we come at Wisdom.”