Strategy for LNG Market Development
Challenges and Countermeasures toward the Creation of Flexible LNG Market and LNG Trading Hub in Japan

[Executive Summary]

May 2nd, 2016
Ministry of Economy, Trade and Industry (METI)
1-1 Development of LNG Market Led by Japanese Companies

- Natural gas has expanded at the fastest pace over the past 40 years. Particularly in Asia, the import of LNG (liquefied natural gas) has substantially increased.
- In 1969, Tokyo Gas and Tokyo Electric Power started to import LNG for the first time, and since then Japanese electric power and gas companies have led the development of the global LNG market.
- Following Japan (the world's largest LNG importer accounting for one-third of the total), countries like China and South Korea have become significant LNG importers.

Changes in global energy supply mix

<table>
<thead>
<tr>
<th></th>
<th>1970</th>
<th>1990</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude oil</td>
<td>46%</td>
<td>39%</td>
<td>33%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>18%</td>
<td>22%</td>
<td>24%</td>
</tr>
<tr>
<td>Coal</td>
<td>30%</td>
<td>27%</td>
<td>30%</td>
</tr>
<tr>
<td>Nuclear power</td>
<td>0%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Hydro power</td>
<td>5%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Renewable energy</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: BP Statistics, Cedigaz

Changes in global LNG imports
### 1-2 Trends in LNG Price Gap between Japan and the West

<table>
<thead>
<tr>
<th></th>
<th>Before 2008</th>
<th>Since approx. 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Japan vs. Europe</strong></td>
<td>Small price gap (mainly in natural gas liquefaction and freight costs)</td>
<td>Large price gap (lower in Europe and higher in Japan) (European gas market liberalization, the revolution of gas price indices ⇔ Crude oil-linked prices, crude oil price hikes)</td>
</tr>
<tr>
<td><strong>Japan vs. the U.S.</strong></td>
<td>Small price gap (mainly in natural gas liquefaction and freight costs)</td>
<td>Large price gap (lower in the U.S. and higher in Japan) (Price drops mainly in the wake of the Shale Revolution) ⇔ Crude oil-linked prices, crude oil price hikes</td>
</tr>
</tbody>
</table>

### Changes in natural gas prices

![Graph showing changes in natural gas prices over time for Europe, U.S., and Japan.](image-url)

Source: trade statistics, IMF Primary Commodity Prices, Japan: JLC, the U.S.: Natural Gas spot price at the Henry Hub, Europe: Russian Natural gas border price in Germany
1-3 LNG Trade Models in the Past

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Impacts on Contract Terms</th>
<th>Impacts on Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG producers need to make <strong>a massive investment</strong> (especially in liquefaction</td>
<td><strong>Mostly long-term contracts</strong> that commit to taking a certain volume over the next 15–20</td>
<td><strong>Priced higher</strong> in most cases</td>
</tr>
<tr>
<td>facilities which require even greater investment than natural gas development and</td>
<td>years, and the percentage of spot contracts is small</td>
<td></td>
</tr>
<tr>
<td>production)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The market <strong>liquidity is low</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The majority of buyers are <strong>regionally monopolistic, public-utilities companies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When the demand increases, the availability of alternative supply sources is</td>
<td>**In many cases, a <strong>destination clause</strong> is attached to restrict reselling</td>
<td><strong>Priced higher</strong> when crude oil prices are</td>
</tr>
<tr>
<td>limited (<strong>seller's market</strong>)</td>
<td></td>
<td>high</td>
</tr>
<tr>
<td>LNG has been used largely as an <strong>alternative fuel</strong> to oil-fired power generation</td>
<td><strong>Linked to crude oil prices</strong></td>
<td></td>
</tr>
<tr>
<td>There are no objective price indices reflecting LNG supply and demand conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cost breakdown of LNG and crude oil value chains

Source: IEA, Institute of Energy Economics, Japan
2-1 Change in Environment (1): Divergent Oil and Gas Prices in the Wake of the Shale Gas Revolution

- Since the U.S. Shale Gas Revolution in the late-2000s, production costs have dropped sharply. In the medium- and long-term, **U.S. gas is estimated to remain at lower price levels than crude oil**.

- Now that the U.S. is about to drive the export of its natural gas, this should be the best opportunity for Japan to take advantage of oil and gas price divergence.

### Changes in Productivity of U.S. Oil and Gas

- **Shale gas** (left axis)
- **Shale oil** (right axis)

**2007 → 2016**

- Productivity increased to **about 6X**
- Drilling cost reduced to about **1/6X**

### Changes in U.S. Gas Prices and International Crude Oil Prices and Their Prospects

- **International crude oil prices** (Brent)
- **U.S. gas prices** (Henry Hub)

Source: Calculated by ANRE based on EIA data, BP Statistics
2-2 Change in Environment (2): LNG Demand is Led by Asian Countries and Growing all over the World

- Global LNG demand is expected to grow by about 45% by 2020.
- LNG demand will be **driven especially by Asian countries**. Malaysia shifted from a major LNG exporter to a net importer. Likewise, Indonesia is becoming a net LNG importer.
- Additionally, even countries in the Middle East, Latin America, and Eastern Europe are becoming LNG importers.

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**The number of LNG importing countries is increasing**

The countries that will start importing LNG by 2020

<table>
<thead>
<tr>
<th>Country</th>
<th>Amount (million tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodia</td>
<td>3</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1</td>
</tr>
<tr>
<td>El Salvador</td>
<td>0.7</td>
</tr>
<tr>
<td>Jordan</td>
<td>3</td>
</tr>
<tr>
<td>Latvia</td>
<td>3.7</td>
</tr>
<tr>
<td>Lithuania</td>
<td>2.2</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3.8</td>
</tr>
<tr>
<td>Maldives</td>
<td>3</td>
</tr>
<tr>
<td>Montenegro</td>
<td>1.5</td>
</tr>
<tr>
<td>Poland</td>
<td>3.6</td>
</tr>
<tr>
<td>Pakistan</td>
<td>5.2</td>
</tr>
<tr>
<td>Portugal</td>
<td>3</td>
</tr>
<tr>
<td>Romania</td>
<td>3.6</td>
</tr>
<tr>
<td>Singapore</td>
<td>6</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>3</td>
</tr>
<tr>
<td>Tanzania</td>
<td>1.5</td>
</tr>
<tr>
<td>Thailand</td>
<td>5</td>
</tr>
<tr>
<td>Turkey</td>
<td>3</td>
</tr>
<tr>
<td>Ukraine</td>
<td>3</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1</td>
</tr>
</tbody>
</table>

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Source: IEA, Institute of Energy Economics, Japan
2-3 Change in Environment (3): Shift in Major LNG Suppliers from Asian/Middle Eastern to U.S./Australian companies

- National oil and gas companies in countries in Southeast Asia and Qatar have had a great presence in LNG supply in the past.
- In the future, Southeast Asian countries become net LNG importers, while the supply from market-oriented, diverse private companies in the U.S., Canada, and Australia is expected to sharply increase.
- This should be the best opportunity for Japanese companies to share in the benefits from LNG businesses with market-oriented companies.

Outlook for LNG exports
(estimates from IEA New Policy Scenario)

Source: Prepared by ANRE based on IEA World Energy Outlook 2015
2-4 Change in Environment (4): Japanese Companies Becoming More Market Oriented

- With the liberalization of energy markets progressing, Japanese electric power and gas companies will not only find it increasingly difficult to forecast demand, but also face intensifying competition for better fuel procurement terms. As with their European counterparts, Japanese companies will be forced to become more market oriented.

- A change in the traditional approach taken by Japanese companies, which account for about 30% of the world's total LNG imports, has a potential for redefining how the LNG market should be operated.

Increasing spot and short-term LNG transactions
(about 5% in 2000 \(\rightarrow\) about 30% or 6X in 2014)

LNG procurement volume of Japanese electric power and gas companies
(accounts for about one-third the world total)

*Source: GIIGNL, trade statistics, ANRE data*
The global natural gas markets in North America, Europe, and Asia have been isolated from each other. In North America and Europe, natural gas is supplied to each market via the pipelines from gas fields in the region and/or neighboring countries. On the other hand, natural gas is transported as cargo from the Middle East/Southeast Asia in the form of LNG to each market in Northeast Asia. This situation resulted in the difference in gas prices among Europe, North America, and Asia (especially in the wake of the Shale Revolution).

In the future, large quantities of North American LNG will be supplied to the increasingly expanding Asian market. Furthermore, because Europe is going to increase the import of LNG, the Asian, European, and North American LNG markets will become multi-directional, which should encourage arbitrage trading and price convergence.

Taking into account the size of its LNG demand and the proximity to LNG trade routes, our country has an advantage in terms of becoming an LNG trading hub (a base where many LNG trades take place, market prices are formed and publicly reported). This position would give Japan the best opportunity to procure LNG on more favorable terms.
3-1 Vision of LNG Trade Japan Should Pursue

### LNG trade in the past
- Largely long-term contracts
- Reselling restricted by destination clauses
- Pricing linked to crude oil prices

### LNG trade in the future
- Minimize long-term contracts. Increase short-term and spot contracts → Supply and demand stabilization
- Abolish or relax the destination clause. Utilize reselling and arbitrage trading → More reasonable Price
- Pricing reflecting LNG supply and demand → Price stabilization and transparency

- A highly fluid and global LNG market is required to bolster LNG trade in the future.
- At the same time, Japan, as the world’s largest LNG consuming country, should attempt to become an LNG trading hub, engaging in price formation, and dissemination → Improvements in positions of procurement negotiations and the ability to achieve reasonable LNG prices
- Taking these substantial changes in environment at home and abroad as an opportunity, Japan will accelerate every possible action to establish itself as an LNG trading hub some time in the first half of the 2020s.
### 3-2 Historical Roadmap of Western Crude Oil and Natural Gas Market Developments from the viewpoints of hub operators, price information providers, and oil/gas exchanges

<table>
<thead>
<tr>
<th></th>
<th>Crude oil markets</th>
<th>Western gas markets</th>
<th>LNG markets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S.</td>
<td>Europe</td>
<td>U.S.</td>
</tr>
<tr>
<td>Long-term contracts</td>
<td>before the oil crises NOCs, IOCs ↔ Public-utilities companies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ Direct contracts ]</td>
<td>IOC, OPEC ↔ Oil refining companies</td>
<td>before 1980s NOCs, IOCs ↔ Public-utilities companies</td>
<td></td>
</tr>
</tbody>
</table>

### Expansion of spot trades

#### Establishment of Trading Hubs

- 1970s thru 1980s
  - Oil crises ➔ Accumulation of oil related companies
  - Equipment: crude oil tanks, pipelines
  - Locations: e.g. Oklahoma, the U.S. +

- 1980s
  - Liberalization ➔ Emergence of gas hub operators
  - Equipment: pipelines, gas processing facilities
  - Locations: e.g. Louisiana, the U.S. +

- 1990s
  - Liberalization ➔ Pipeline network operation companies were separated
  - Equipment: pipelines, processing facilities
  - Locations: e.g. U.K. +

- 2010s
  - Liberalization ➔ Further third party access to LNG terminals

### Expansion of forward trades

#### Establishment of Price Indices

- 1980s
  - Information reported by price information agencies (WTI)

- 1980s
  - Information reported by price information agencies (Brent)

- 1990s
  - Information reported by price information agencies
  - (US gas prices such as Henry Hub)

- 1990s
  - Information reported by price information agencies
  - (European gas prices such as NBP)

- 2010s
  - Some price information agencies initiated reporting

### Future Trades

#### [exchanges ]

- 1980s
  - Started at NYMEX

- 1980s
  - Started at IPE (later acquired by ICE)

- since the 1990s
  - Started at NYMEX and ICE

- since the 1990s
  - Started at ICE

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3-3 "Three Base Elements" Based on Which Highly Fluid LNG Market Will be Realized

According to the history of Western crude oil and gas market developments, the following elements are considered important toward the realization of a highly fluid LNG market.

<table>
<thead>
<tr>
<th>Enhancement of Tradability</th>
<th>Crude oil Markets</th>
<th>Western Gas Markets</th>
<th>LNG Markets Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>In addition to energy companies, a number of traders and financial institutions participate in transactions.</td>
<td>• In addition to energy companies, a number of traders and financial institutions participate in transactions.</td>
<td>• In addition to energy companies, a number of traders and financial institutions participate in transactions.</td>
<td>• The number of participants is small (financial institutions, in particular)</td>
</tr>
<tr>
<td>A small quantity is transportable.</td>
<td>• A small quantity is transportable.</td>
<td>• A small quantity is transportable.</td>
<td>• The need to transport LNG via large cargo vessels. Ground cryogenic storage is burdensome.</td>
</tr>
<tr>
<td>The EC outlaws the attachment of a destination clause within the region.</td>
<td></td>
<td></td>
<td>• Many destination clauses remain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Open and Sufficient Infrastructures</th>
<th>Crude oil Markets</th>
<th>Western Gas Markets</th>
<th>LNG Markets Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>A large number of tanks are available to private businesses for receiving or delivering their crude oil.</td>
<td>• A large number of tanks are available to private businesses for receiving or delivering their crude oil.</td>
<td>• Deregulation allows third parties to access the gas infrastructure</td>
<td>• Limited third party access for LNG tanks in Japan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Infrastructure operating companies provide enough capacity in their large gas pipelines, LNG terminals, and underground storage facilities.</td>
<td>• Japanese natural gas pipeline is not well-connected. The existing underground storage facilities are for limited use. There is no professional infrastructure operating company.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price Discovery Mechanism Reflecting Supply and Demand</th>
<th>Crude oil Markets</th>
<th>Western Gas Markets</th>
<th>LNG Markets Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>The increase in spot trades boosts futures transactions.</td>
<td>• The increase in spot trades boosts futures transactions.</td>
<td></td>
<td>• Spot and future trades are still in early stages of development.</td>
</tr>
<tr>
<td>Designated exchanges such as NYMEX and ICE offer infrastructures required for matching and settlements.</td>
<td>• Designated exchanges such as NYMEX and ICE offer infrastructures required for matching and settlements.</td>
<td></td>
<td>• Price information from price information agencies is not reliable enough.</td>
</tr>
<tr>
<td>Price reporting agencies collect and publicly report price information.</td>
<td>• Price reporting agencies collect and publicly report price information.</td>
<td></td>
<td>• Exchanges are still immature.</td>
</tr>
</tbody>
</table>
4 "Three Fundamental Principles" Needed to Develop LNG Market

**Globalism**
- **Government-led:**
  - Communication with the international community
  - Dialogue with LNG producing countries
  - Cooperation with LNG consuming countries
- **Private-sector-led:**
  - Collaboration with overseas players

**Action-Oriented**
- **Government-led:**
  - The development of trading environment and market surveillance
  - Support measures such as demand expansion policies
- **Private-sector-led:**
  - Charge of mindset for proactive market utilization
  - Contribution to the development of benchmark prices. Negotiations for abolishing the destination clause.

**Private First**
- **Government-led:**
  - An extra step forward to support private sector effort (e.g., international coordination, policy incentives)
- **Private-sector-led:**
  - Solve the "chicken-and-egg dilemma" by taking specific actions
5-1 Specific Actions to be Taken

<< Improved Tradability >>

(1) Relax or abolish the restriction for reselling requirement (i.e., the destination clause) in LNG contracts

- Government-led: Encourage large LNG consuming countries to jointly relax or abolish the destination clause (i.e. Japan, Europe, Korea, China, and India account for 80% of the world's total LNG imports).
- Private-sector-led: In negotiations for LNG procurement, request relaxation or elimination of the destination clause.

(2) Public financing towards smoothly launching the project and developing the flexible LNG market

- Government-led: Projects which help develop the flexible LNG market (e.g., the utilization of Asian gas benchmark prices, and the combination of shipments to Japan and reselling to third countries) will be positively evaluated by public financing entities.

(3) Diversifying the LNG market by expanding the demand for gas and LNG

- Government-led: Domestic activities include the promotion of ENE-FARM, fuel cells and LNG bunkering (marine fuel). Overseas activities include policy dialogue with key Asian countries with substantial market opportunities for gas business.
- Private-sector-led: In order to aggressively expand gas demand, sales promotion activities will be strengthened, and overseas gas business should be promoted.

(4) Rapid LNG receipt and delivery

- Government-led: Smooth procedures for having LNG carriers berth at the discharging port (in cooperation with the Ministry of Land, Infrastructure and Transport)
- Private-sector-led: The standardization of LNG carriers and related facilities should be proposed to ISO and at other relevant meetings
5-2 Specific Actions to be Taken (Continued)

<< Benchmark Prices Reflecting Supply and Demand >>

(5) The establishment of price discovery mechanisms reflecting LNG supply and demand in Japan
- Government-led: The government supports the Tokyo Commodity Exchange in strengthening its matching and price reporting functions.
- Government-led: The government promotes the use of benchmark prices reflecting LNG supply and demand in Japan (supplied by multiple price information service companies), promoting fair competition.
- Private-sector-led: Proactive information sharing to improve the reliability of price indices and applying the price indices to actual LNG contracts.

<< Open and Adequate Infrastructure Developments >>

(6) The increased capacity of LNG terminals, underground storage facilities, and long-distance pipelines so that third parties can use them for LNG receipt/delivery and trading purposes.
- Government-led: The realization of "third-party access" to the existing LNG terminals (part of the Gas System Reform)
- Government-led: The government will study new policy incentive and an institutional framework so that open LNG terminals, long-distance pipelines, underground storage storages, and other infrastructures will be developed in an adequate, reliable manner.
- Private-sector-led: Before the LNG market is successfully developed and put in place, private companies should develop new business models including infrastructure operating businesses and energy trading.

<< Other Actions >>

(7) Strengthening the cooperation with gas consuming and producing countries
(8) Continuing talks with private-sector players
(9) Future project studies and review on an ongoing basis