Member Economy Report

Current Status of Gas Industry in Japan

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The Japan Gas Association

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2. Overview of Japan’s Gas Industry
1. Japan’s Energy Situation
General Information on Japan

**Basic data**

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<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area</td>
<td>377,900 sq km</td>
</tr>
<tr>
<td>Population</td>
<td>127 M</td>
</tr>
<tr>
<td>Total exports</td>
<td>¥69.8 tn</td>
</tr>
<tr>
<td>Total imports</td>
<td>¥81.2 tn</td>
</tr>
<tr>
<td>Trade balance</td>
<td>-¥11,4 tn</td>
</tr>
<tr>
<td>LNG imports (FY 2013)</td>
<td>87.7 Mt</td>
</tr>
</tbody>
</table>

**Real GDP & GDP growth rates**

- **Real GDP (¥ tn)**
- **GDP growth rate (%)**

Sources: Ministry of Internal Affairs and Communications, Japan Statistical Yearbook; Cabinet Office, Annual Report on National Accounts; Ministry of Finance, Trade Statistics of Japan; IEEJ, Energy Economy Handbook
Primary energy supply: 537.6 million KLOE
Natural Gas: 131.6 million KLOE
Energy self-sufficiency: 8.7% (including nuclear)

Sources: Calculated from Agency for Natural Resources (METI), FY 2012 Energy Supply and Demand Report and Energy White Paper
Final Energy Consumption

<table>
<thead>
<tr>
<th>Final energy consumption</th>
<th>Natural gas (mainly city gas)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FY1990</strong></td>
<td><strong>FY1990</strong></td>
</tr>
<tr>
<td>359 M KLOE</td>
<td>17.8 M KLOE (5%)</td>
</tr>
<tr>
<td><strong>FY2012</strong></td>
<td><strong>FY2012</strong></td>
</tr>
<tr>
<td>370 M KLOE</td>
<td>39.8 M KLOE (11%)</td>
</tr>
<tr>
<td><strong>CAGR</strong></td>
<td><strong>CAGR</strong></td>
</tr>
<tr>
<td>+ 0.15%</td>
<td>+ 3.71%</td>
</tr>
</tbody>
</table>

Sources: Calculated from Agency for Natural Resources (METI), FY 2012 Energy Supply and Demand Report

CAGR: +1.04%

CAGR: -1.39%
LNG Imports

**LNG import volume**

Total LNG imports [FY2013]: 87.5 million tons

**LNG import by gas utilities**

[2013] 24.3 million ton (28% of total imports)

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**Source:** JGA, *Gas Business Handbook, 2014*
## Methane Hydrate Development

### Steps toward commercial gas extraction

<table>
<thead>
<tr>
<th>Phase</th>
<th>Time Period</th>
<th>Activities</th>
</tr>
</thead>
</table>
| Phase 1 | 2001-08 | • Basic research  
• Resource survey in Japan’s EEZ  
• On-shore production tests in Canada |
| Phase 2 | 2009-15 | • Offshore production tests  
  *World first gas extraction from ocean floor methane hydrate (March 2013)*  
• Long-term on-shore production tests in Alaska |
| Phase 3 | 2016-18 | • Preparations for commercial extraction  
• Comprehensive evaluation (e.g. economic viability, environmental impact) |

### Estimated resource areas

- Total size of resource areas: 122K sq km

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Source: JOGMEC

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Source: Research Consortium for Methane Hydrate Resources in Japan (MH21)
<table>
<thead>
<tr>
<th>BASIC VIEWPOINT</th>
<th>3E + S = Energy Security + Economic Efficiency + Safety + Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TARGET</td>
<td>Build a &quot;multilayered and diversified flexible energy supply-demand structure&quot;</td>
</tr>
</tbody>
</table>
| POLICY DIRECTIONS | - Creation of a multilayered supply structure with various energy sources  
                      - Promotion of a resilient energy supply structure  
                      - Promotion of new entrants into the energy market through structural reforms  
                      - Creation of an efficient energy market through providing various options to end users  
                      - Improvement of self efficiency by developing and introducing indigenous energies  
                      - Contribution to global warming countermeasures |
## Positions of Energy Sources in Strategic Energy Plan

### Nuclear

**Position in the 4th Strategic Energy Plan**
- Important base-load power source
- Reduce dependence as much as possible

**Policy directions**
- Possible restart of Sendai Nuclear Power Plant early next year followed by others

### Coal

**Position in the 4th Strategic Energy Plan**
- Important base-load power source with excellent supply stability and economics
- Reduce environmental burden

**Policy directions**
- Development of advanced coal fired power generation
  - IGCC (Integrated Coal Gasification Combined Cycle)
  - A-USC (Advanced Ultra Supercritical Power Plant)
- Practical realization of CCS after 2020

### Renewables

**Position in the 4th Strategic Energy Plan**
- Important diverse and promising domestic low carbon energy source

**Policy directions**
- Review of feed-in tariff (FIT) program launched in 2012

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**Impact on future natural gas demand**
# Position of Natural Gas in Strategic Energy Plan

## Position in the 4th Strategic Energy Plan

- **Important energy source with expanded role**
- Fuel for intermediate-load power station

## Characteristics

- Least carbon intensive among fossil fuels
- Low geopolitical risk thanks to disperse reserves

## Policy directions

- Procurement cost reduction
  - Diversification of supply source, contractual terms, etc.
- Steady energy shift toward wider natural gas use
- Sophisticated and efficient natural gas use
  - Diversified application (distributed generation, cogeneration, etc.)
## Gas Market Liberalization

### Liberalization of gas retail market

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</tr>
</thead>
<tbody>
<tr>
<td><strong>Threshold for liberalization</strong>&lt;br&gt;(Annual contracted volume)</td>
<td>2 mil. m$^3$</td>
<td>1 mil. m$^3$</td>
<td>0.5 mil. m$^3$</td>
<td>0.1 mil. m$^3$</td>
<td><strong>Full Liberalization?</strong></td>
</tr>
<tr>
<td><strong>Share of gas demand in liberalized market</strong></td>
<td>46%</td>
<td>50%</td>
<td>54%</td>
<td>61%</td>
<td>?</td>
</tr>
</tbody>
</table>

### Share of new market entrants

- **Sales volume (left axis)**
- **Share of new entrants (right axis)**

<table>
<thead>
<tr>
<th>(bcm)</th>
<th>2 M m$^3$</th>
<th>1 M m$^3$</th>
<th>0.5 M m$^3$</th>
<th>0.1 M m$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>'95</td>
<td>0.15</td>
<td>2.0%</td>
<td>7.4%</td>
<td>12.1%</td>
</tr>
<tr>
<td>'99</td>
<td>2.0%</td>
<td>7.4%</td>
<td>10.1%</td>
<td>28.4%</td>
</tr>
<tr>
<td>'04</td>
<td>1.05</td>
<td>2.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'07</td>
<td>2.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'13</td>
<td>2.84</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The Japan Gas Association
2. Overview of Japan’s Gas Industry
Gas utilities’ service areas

Approximately 5% of land area is covered by 207 gas utilities

Service areas of private gas utilities

Service areas of public gas utilities

Source: JGA, Gas Energy News
The Japan Gas Association

Each vertically integrated gas utility is responsible for entire process of “gas value chain” from gas procurement to distribution to sale of city gas.

Overview of Japan’s gas industry

- LNG import terminal
- High-pressure transmission pipeline
- Pressure control room
- Power plant
- Customers
- Domestic natural gas
Supplier diversification

- New suppliers
  (Queensland, North America, East Africa, etc.)

Pricing diversification

- US/European gas price-indexed formula
- Futures market and Asian hub price

Delivery mode diversification

- LNG vessel fleet
- International pipeline

Resource diversification

- LNG from unconventional gas
- Methane hydrate

<table>
<thead>
<tr>
<th>US LNG</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeport</td>
<td>(2018-)</td>
</tr>
<tr>
<td>Osaka Gas:</td>
<td>2.2 Mt/year</td>
</tr>
<tr>
<td>Cove Point</td>
<td>(2017-)</td>
</tr>
<tr>
<td>Tokyo Gas:</td>
<td>1.4 Mt/year</td>
</tr>
<tr>
<td>Cameron</td>
<td>(2018-)</td>
</tr>
<tr>
<td>Tokyo Gas:</td>
<td>0.52 Mt/year</td>
</tr>
<tr>
<td>Toho Gas:</td>
<td>0.3 Mt/year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Queensland LNG</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>QCLNG</td>
<td>(2015-)</td>
</tr>
<tr>
<td>Tokyo Gas:</td>
<td>1.2 Mt/year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New Addition to LNG vessel Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo Gas: 2 x SPB type vessels</td>
</tr>
<tr>
<td>Osaka Gas: 2 x “Peapod” vessels</td>
</tr>
</tbody>
</table>
Wider use of gas in the industrial sector has been the driver of sales volume increase.
Competitive environment surrounding natural gas

**Natural gas**

- Gas cooking stove
- High-efficiency water heater, fuel cell
- Floor heating, gas fan heater
- Fuel cell, Eco-will (gas CHP for residential use)

**Residential use**

- Cooking
- Water heating
- Space heating
- Electricity

- Induction heating cooker
- CO<sub>2</sub> refrigerator heat pump, electric or kerosene boiler
- Electric air conditioner, electric or kerosene space heater
- Grid power, Renewable energy

**Commercial and industrial use**

- Air conditioning
- Heat
- Electricity

- Electric heat pump, ice thermal-storage
- Oil fueled boiler
- Grid power, Renewable energy

**Other energies (electricity, LPG, oil, etc.)**

- Absorption type, GHP
- Gas fueled boiler
- Gas CHP
JGA’s “Gas Vision 2030”: Toward wider use of natural gas

<table>
<thead>
<tr>
<th>Major Targets</th>
<th>2012</th>
<th>2030</th>
</tr>
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<tbody>
<tr>
<td><strong>Cogeneration</strong></td>
<td>4.82 GW</td>
<td>30 GW</td>
</tr>
<tr>
<td><strong>Gas air conditioning</strong> (peak shaving effect)</td>
<td>14 GW equivalent</td>
<td>26 GW Equivalent</td>
</tr>
<tr>
<td><strong>Industrial heat demand</strong> (market share)</td>
<td>11.5%</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Residential fuel cell</strong> (units)</td>
<td>40,000</td>
<td>5.3 mil. (incl. LPG fueled)</td>
</tr>
<tr>
<td><strong>Natural gas vehicle</strong> (units)</td>
<td>40,000</td>
<td>500,000</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Expected Effects</th>
</tr>
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<tbody>
<tr>
<td><strong>Stabilize Power Supply</strong></td>
</tr>
<tr>
<td>• 15% of total power demand</td>
</tr>
<tr>
<td>• Peak shaving effect: 38 - 43 GW</td>
</tr>
<tr>
<td><strong>Save Energy</strong></td>
</tr>
<tr>
<td>• 826 KLOE</td>
</tr>
<tr>
<td>(2% of total final energy consumption)</td>
</tr>
<tr>
<td><strong>Reduce CO2 Emission</strong></td>
</tr>
<tr>
<td>• 62 mil. ton - CO2</td>
</tr>
<tr>
<td>(5% of total CO2 emission)</td>
</tr>
<tr>
<td><strong>Boost Economy</strong></td>
</tr>
<tr>
<td>• CAPEX: 1.2 - 1.5 trillion yen</td>
</tr>
</tbody>
</table>

Source: Japan Gas Association, “Expand Natural Gas Use to 2030“ Revised since October 27, 2011 release
Wider use of cogeneration systems

Cumulative installed generation capacity

For own use (15.1 GW)
For sales to grid (10 GW)
Existing: 4.9 GW as of 2013

Performance upgrades and incentive measures are essential to achieve this aggressive target
Wider use of residential fuel cell

Roadmap toward popularization

[million units]

Termination of current government subsidy

Pre-popularization Period

Introduction Period

Popularized

1.4 m units

5.3 m units

1.0 m units

0.1 m units

'10 '15 '20 '25 '30

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Smart Energy Network centered around Gas Cogeneration System

Wider adoption of renewable and unutilized energy sources

- Wind power generation
- Biomass power generation
- Photovoltaic systems (heat and electricity)
- Fuel cells
- Gas cogeneration
- Gas pipelines

Enhanced energy security

- Securing energy supply to priority facilities in case of disasters

Grid power network

- Natural gas stations
- Hydrogen stations
- Fuel cell vehicles

Energy-saving/Low-carbon energy management

- Peak load mitigation, energy conservation & carbon reduction
- Area-wide heat sharing via heat supply network

Diversification of transportation fuel

- Natural gas vehicles
- Fuel cell vehicles

Wider adoption of distributed energy systems

- Natural gas cogeneration
- Fuel cells
- Gas air conditioning

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Death toll from City gas related accidents in Japan has declined from 100+ to almost ZERO in 35 years.
Thank you for your attention.