Natural Gas and Japanese Energy Market
- opportunities and challenges

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2. Changes in Energy Policy
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4. Challenges
1. Japanese gas industry: an overview
1. Japanese Gas Industry

Primary Energy Supply and LNG Imports

**Primary energy supply**

<table>
<thead>
<tr>
<th>Year</th>
<th>Nuclear Power</th>
<th>Natural Gas</th>
<th>Coal</th>
<th>Hydropower</th>
<th>Petroleum</th>
<th>New energies, Renewable, Geothermal, others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td>13.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td>14.9%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td>19.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td>24.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit: $10^{18}$J

**Source:** Based on Agency for Natural Resources and Energy, "Energy White Paper 2014"

**LNG imports by utilities**

**Surge due to nuclear shutdown**

Unit: million tons

Source: Ministry of Finance, "Trade Statistics of Japan"
Trend of Gas Sales

1970 - 2013

Unit: billion m³ (41.8605MJ)

- Residential
- Commercial
- Industrial
- Other

Source: Japan Gas Association studies
New Gas Equipment for Optimum Energy Solutions

Cogeneration and fuel cells - balancing heat and electricity demand

Gas space cooling and heating - energy saving, reducing CO₂ emissions

Advanced industrial gas applications

Higher comfort and safety in kitchen
LNG Imports by Gas Utilities

Diversifying supply sources

FY2003
- 7 countries 18.1 million tons
  - Indonesia: 5.65
  - Malaysia: 5.6
  - Brunei: 2.1
  - Australia: 2.67
  - Qatar: 0.95
  - Oman: 0.8

FY2013
- 11 countries 24.3 million tons
  - Indonesia: 2.56
  - Malaysia: 8.44
  - Brunei: 1.6
  - Australia: 6.21
  - Qatar: 0.86
  - Oman: 0.72
  - Russia (Sakhalin): 2.79
  - USA (Alaska): 0.65
  - Yemen: 0.07
  - Nigeria: 0.06
  - Eq. Guinea: 0.33
  - Algeria: 0.33

Unit: million tons
2. Changes in Energy Policy
## Changes in Energy Policy - before and after Fukushima

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Policy focus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td></td>
</tr>
<tr>
<td>Energy security</td>
<td><strong>Zero-emission power: 70%</strong></td>
</tr>
<tr>
<td>Economic efficiency</td>
<td>Nuclear: 50%</td>
</tr>
<tr>
<td>Environment</td>
<td>Renewables/hydro: 20%</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>After</strong></td>
<td></td>
</tr>
<tr>
<td>Safety + Energy security + Economic efficiency + Environment</td>
<td>Diversifying power supply</td>
</tr>
<tr>
<td></td>
<td>Increased use of natural gas + Distributed generation</td>
</tr>
</tbody>
</table>
3. Deregulation of Energy Market - opportunities
Development of Energy Market Deregulation

New entrants’ market share (sales volume)

<table>
<thead>
<tr>
<th>Year (FY)</th>
<th>Gas</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>1999</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>2004</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>2005</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2007</td>
<td>10.1</td>
<td>4.2</td>
</tr>
<tr>
<td>2013</td>
<td>12.1</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Breakdown of new entrants by type of business (As of April 1, 2014  n=292 cases)
- Gas: 12.1%
- Electricity: 38%
- Petroleum & LPG: 12%
- Domestic natural gas: 8%
- Trading companies: 5%
- Others: 37%

Threshold:
- Gas: 2 million m³ -
- Electricity: 500kW -

Source: Agency for Natural Resources and Energy

Growth in new market participants with full liberalization

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3. Deregulation of energy market

Gas Business in Liberalized Energy Market

Expanding gas market

- Onsite use
- Fuel cells
- Cogeneration
- Excess power
- Community-wide power interchange

Growth in electricity market

- Power supply
- Power supply from distributed energy systems through grid

Gas supply

Gas supply to power plants
Nihonbashi Smart City in Tokyo

- 30% reduction in energy use and CO₂ emissions
- Improved resilience against natural disasters
  Essential electricity supply for business continuity program (BCP) at blackout

Enhanced urban disaster resilience

Source: Mitsui Fudosan Co., Ltd. website
Reducing total electric power generation cost and electricity bill

Use of low cost power sources to control generation costs

- Average unit generation cost
  - For all electricity generation

Potential district sharing and electricity sales

9.1 GW
(By year 2030)

- Electric power output
  - (Operating rate in response to volume of electricity demand)

- Base power supply
- Middle & peak power supply

- Alternative energies (where applicable)

- Petroleum, pumped storage hydro, etc.

- LNG/BTG (conventional)

- LNG combined (high efficiency)

- Coal

- Nuclear hydro

- Cogeneration Fuel cell

Using the Electric Power Supply Capacity of Distributed Energy Systems

3. Deregulation of energy market
Gas Vision 2030: expanded use of natural gas

### Steps to be taken by 2030

<table>
<thead>
<tr>
<th>Description</th>
<th>2012</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cogeneration</td>
<td>4.82 GW</td>
<td>30 GW</td>
</tr>
<tr>
<td>2. Gas airconditioning</td>
<td>13 million RT</td>
<td>26 million RT</td>
</tr>
<tr>
<td>3. Industrial heat demand</td>
<td>11.5 %</td>
<td>25.0 %</td>
</tr>
<tr>
<td>4. Residential fuel cell</td>
<td>40,000 units</td>
<td>5.3 million units</td>
</tr>
<tr>
<td>5. Natural gas vehicle (NGV)</td>
<td>40,000 units</td>
<td>0.5 million units</td>
</tr>
</tbody>
</table>

### Expected benefits

- **Electric power supply stability**
  - 15% of annual electricity demand
- **Energy reduction effects**
  - Energy conservation: 8.26 million kloes/year
- **CO₂ reduction**
  - 62 million tons-CO₂/year

Source: Japan Gas Association, “Expand Natural Gas Use to 2030.” Revised since October 27, 2011 release
Disseminating Fuel Cells for the Home

Residential fuel cell system sales

- Total 5.3 million units
- Total 0.1 million units
- New construction condominium
- Existing single family house
- New construction family house

Polymer electrolyte fuel cell (PEFC) sales launch
Generating efficiency 35.0%

Solid oxide fuel cell (SOFC) sales launch
Generating efficiency 46.5%

More compact
Higher generating efficiency
Lower cost
Next-generation fuel cells (under development)

Introduction of fuel cells for condominiums
Introduce stand alone operate systems during blackouts

2009  2010  2011  2012  2013  2014  2030

3. Deregulation of energy market
Gas Vision 2030: Expanded Use of Natural Gas

Gas in primary energy supply in 2030

- City gas sales volume
  - 2009: 33.8 billion m³
  - 2030: +30 billion m³

City gas demand expands to 15%

Current primary energy shares (2009, prior to 2011 earthquake)

- Natural gas: 7%
- All other energy sources

Source: Adapted from Ministry of Economy, Trade and Industry, "Comprehensive Energy Statics"

Fuel sources for power in 2030

- On-grid Power supply
  - Renewable energies
  - Nuclear power
  - Coal
  - LNG
  - Petroleum

- Off-grid Power supply
  - Cogeneration (entering the grid)
  - Cogeneration (on-site consumption)

Total power demand

- 85%
- 15%
4. Challenges
4. Challenges and Opportunities

Soaring “Asian Premium”

- LNG price on arrival in Japan
- U.S. Henry Hub spot price
- Russian gas @ Germany
- Average Japan crude oil import price (right axis)
## Securing Economical and Stable LNG Supply

### Diversification

#### Supplies
- USA, Canada, Mozambique, etc.

#### Pricing
- Introducing US and European pricing
- Formation of futures market and Asia market

#### Delivery systems
- International pipeline: Russia to Japan, Russia via China and South Korea

#### Resources
- Developing methane hydrate

### Import of US LNG

<table>
<thead>
<tr>
<th>Location</th>
<th>Gas Utility</th>
<th>Volume (mtpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeport</td>
<td>Osaka Gas</td>
<td>2.2</td>
</tr>
<tr>
<td>Cove Point</td>
<td>Tokyo Gas</td>
<td>1.4</td>
</tr>
<tr>
<td>Cameron</td>
<td>Tokyo Gas</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>Toho Gas</td>
<td>0.3</td>
</tr>
</tbody>
</table>
### Towards Commercialization of Methane Hydrate

**Japan’s methane hydrate development program**

| 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 in Japan’s EEZ  
|                 | • Long-term on-shore production tests in Alaska |
| Phase 3 2016-18 | • Preparations for commercial extraction  
|                 | • Comprehensive evaluation  
|                 | (e.g. economic viability, environmental impact) |

Source: Japan Oil, Gas and Metals National Corporation (JOGMEC) and Research Consortium for Methane Hydrate Resources in Japan (MH21) homepages

World first gas extraction from ocean floor methane hydrate (March 2013)
Thank you.