1. Most Recent News
2. Brief Introduction of Tokyo Gas
3. History of Residential Fuel Cell in Japan
4. Products
5. Key Factors in the Growth
6. Looking Ahead (Policy and Products)
Most Recent News

• The total (accumulated) number of residential fuel cell sold in Japan surpassed “100,000” units in September 2014.

Industry wide unified logo commemorating 100,000 units
1. Most Recent News

2. Brief Introduction of Tokyo Gas

3. History of Residential Fuel Cell in Japan

4. Products

5. Key Factors in the Growth

6. Looking Ahead (Policy and Products)
Brief Introduction of Tokyo Gas

• The largest natural gas distribution company (gas utility) in Japan having about 35% share of the gas distribution market.

• Imports natural gas (in liquefied form as LNG), regasifies LNG and distributes natural gas down to the end consumer (industrial, commercial and residential). Sells gas appliances and provide energy related services.

• Engages in power generation business as well as overseas business (upstream LNG projects, etc.)
Brief Introduction of Tokyo Gas

Upstream

- Natural Gas Well
- Liquefying Plant
- LNG Tanker
- LNG Terminal

Downstream

- Business/Industrial Customers
- Residential Customers
- Pipeline
- Power Plant
1. Most Recent News

2. Brief Introduction of Tokyo Gas

3. History of Residential Fuel Cell in Japan

4. Products

5. Key Factors in the Growth

6. Looking Ahead (Policy and Products)
## History of Residential Fuel Cell Development

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Japanese Government started PEM development and diffusion project named “Millennium Project”</td>
</tr>
<tr>
<td>2002</td>
<td>Prime Minister Koizumi declared commercialization of residential fuel cell in 3 years</td>
</tr>
<tr>
<td>2005</td>
<td>Large Scale Demo project started</td>
</tr>
<tr>
<td>2007</td>
<td>Stationary fuel cell chosen as part of “Cool Earth 50 (emissions reduction target) ” by Prime Minister Abe</td>
</tr>
<tr>
<td>2008</td>
<td>Fuel cell becomes part of “Fukuda Vision” by Prime Minister Fukuda</td>
</tr>
<tr>
<td>2009</td>
<td>Commercial sale of residential fuel cells begins in Japan</td>
</tr>
<tr>
<td>2012</td>
<td>Japanese Government set the target for the diffusion of residential fuel cells (accumulated installation of 1.4 million units by 2020 and 5.3 million units by 2030.</td>
</tr>
<tr>
<td>2014</td>
<td>The above target reconfirmed in Hydrogen and Fuel Cell Road Map</td>
</tr>
</tbody>
</table>
Number of Units Sold in Japan

- **2009**: 2,550
- **2010**: 7,448
- **2011**: 9,998
- **2012**: 19,282
- **2013**: 37,525
- **2014 (1/2 year)**: 71,805

**Stable Increase**

- **Single Year**
- **Accumulated**
PEFC still the majority but SOFC is looking to gradually increase.

- Natural gas has bigger share over LPG at the moment.
- Installation to newly built houses is dominant, however, further potential to develop existing houses market.
1. Most Recent News

2. Brief Introduction of Tokyo Gas

3. History of Residential Fuel Cell in Japan

4. Products

5. Key Factors in the Growth

6. Looking Ahead (Policy and Products)
The Value to the Customer

- Power generation at home
- Lower carbon emission (reduces 1.3t-CO2/yr)
- Lower total energy bill

Covers about 50-60% of power demand of a typical house hold.

\[ \text{CH}_4 + 2\text{H}_2\text{O} \rightarrow 4\text{H}_2 + \text{CO}_2 \]

\[ 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{CO}_2 \]

Electricity
Hot water
Heating

Exhoast Heat

Air (O\textsubscript{2})
City Gas (CH\textsubscript{4})

electricity heat
# The Most Recent Models (Residential)

<table>
<thead>
<tr>
<th>Model</th>
<th>Type of gas</th>
<th>Rated power output</th>
<th>Power generation Efficiency (LHV)</th>
<th>Efficiency of heat recovery (LHV)</th>
<th>Size of FC unit</th>
<th>Size of Tank unit</th>
<th>Tank volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Panasonic PEMFC</td>
<td>natural gas: NG (town gas)</td>
<td>750 W</td>
<td>39 %</td>
<td>56 %</td>
<td>400W × 1850H × 400D</td>
<td>147 L</td>
<td></td>
</tr>
<tr>
<td>② TOSHIBA PEMFC</td>
<td>LPG/NG (town gas)</td>
<td>700 W</td>
<td>37.5% / 38.5%</td>
<td>55.5%</td>
<td>560W × 1850H × 400D</td>
<td>200 L</td>
<td></td>
</tr>
<tr>
<td>③ JX SOFC</td>
<td>LPG/NG (town gas)</td>
<td>700 W</td>
<td>45 %</td>
<td>42 %</td>
<td>780W × 1000H × 300D</td>
<td>90 L</td>
<td></td>
</tr>
<tr>
<td>④ AISIN SOFC</td>
<td>NG (town gas)</td>
<td>700 W</td>
<td>46.5 %</td>
<td>43.5 %</td>
<td>563W × 900H × 302D</td>
<td>90 L</td>
<td></td>
</tr>
</tbody>
</table>

*Town gas: Gas used in town areas, typically for residential heating and cooking.*
<table>
<thead>
<tr>
<th>Characteristics by Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PEFC</strong></td>
</tr>
<tr>
<td>• Lower power gen efficiency (higher heat recovery)</td>
</tr>
<tr>
<td>• More flexible operation (daily start &amp; stop, etc)</td>
</tr>
<tr>
<td>• Larger unit size</td>
</tr>
<tr>
<td>• Lower unit price</td>
</tr>
<tr>
<td><strong>SOFC</strong></td>
</tr>
<tr>
<td>• Higher power gen efficiency (lower heat recovery)</td>
</tr>
<tr>
<td>• Less flexible operation (continuous operation)</td>
</tr>
<tr>
<td>• Smaller unit size</td>
</tr>
<tr>
<td>• Higher unit price</td>
</tr>
</tbody>
</table>
Combination with PV (Double Generation)

Power from PV can be sold to the grid at fixed rate (FIT)

PV + ENE-FARM = “Double Generation”
• Panasonic and Tokyo Gas started sale of ENE-FARM designed for apartments in April 2014 (important in further increasing customer base).
1. Most Recent News
2. Brief Introduction of Tokyo Gas
3. History of Residential Fuel Cell in Japan
4. Products
5. Key Factors in the Growth
6. Looking Ahead (Policy and Products)
Governmental Support

Alignment with the National Environmental Policy

Japanese Gov’t
Local Gov’t
Industry

Governmental Support (Subsidy to End Customer, Joint Promotion)

<Japanese Government’s Subsidy per unit to the end customer (PEFC)>

Budget Request for FY 2015:
PEFC=0.25 MM Yen/unit
SOFC=0.30 MM Yen/unit
Collaboration with the Housing Industry

Promotes Eco-Friendly House

Home Builders

Gas Utilities

Promotes Fuel Cell
Role of Gas Utilities

- Took part in the development of fuel cell systems (brought in such expertise as chemical reforming of gas).
- Had a large customer base and sales forces targeting the residential sector.
- Continuously put effort on the promotion of ENE-FARM.
- Had the organization and capability to provide comprehensive maintenance service.

*Many gas utilities provide “ten-year full support (maintenance without charge)” to the end customer.*
The Typical Flow of the Products

Fuel Cell Manufacturer → Tokyo Gas → Joint development of ENE-FARM

Contractor

Home Builder

End Customer

Newly Built House

Maintenance Service

Existing House

End Customer

Tokyo Gas Lifeval (Service Shop)
Adaptation of unified brand “ENE-FARM”

“ENE-FARM Partners”
Organization to promote ENE-FARM (consisted of home builders, land developers, fuel cell manufacturers, energy utilities). Established in 2013.

*Many other organizations promoting or supporting “ENE-FARM” (FCCJ, ACEJ, JGA)
1. Most Recent News
2. Brief Introduction of Tokyo Gas
3. History of Residential Fuel Cell in Japan
4. Products
5. Key Factors in the Growth
6. Looking Ahead
Product Side

- Reduction in unit price and unit size will continue, and in this, more SOFC fuel cells could emerge in the future.
- SOFC fuel cells with higher output (3-10kW or even 250kW) will most likely emerge in several years (mainly targeting the commercial sector).
- Residential fuel cell to become integrated further into energy management systems and other smart energy technologies.
- Products catered to the apartment market will become important in continuing the fast paced growth in Japan.
Japanese government has a target to build an accumulated installation of 1.4 million units of residential fuel cell by the end of FY2020 and 5.3 million units by the end of FY2030 ("Strategic Road Map for Hydrogen and Fuel Cell" was compiled and published in June 2014. http://www.meti.go.jp/english/press/2014/0624_04.html

Actual governmental support (subsidy system, etc.) after FY2015 (FY2016 and onwards) is yet to be determined (the current subsidy system originally planned to end in FY2015).
(Appendix) 1st PEM Fuel Cell in Europe

1. High efficiency
   - Power Generation: 750W
   - Power generation efficiency: 37%
   - Overall efficiency: 90%

2. For Environment
   - Reduce 50% of CO2
   - ※ Compare with conventional heating systems

3. Easy to Use
   - Operate and Monitor by Mobile device
Thank you for your attention