Annex 59
Lessons learned from Alternative Fuels Experience

Japanese case studies

KOYAYASHI Masayuki

Organization for the promotion of low emission vehicles
Introduction

Two alternative fuels were investigated

- Natural gas
- Low blend biofuels (Bio Ethanol and Bio Diesel)

Ten groups were interviewed

- Natural gas: 6
  - 2 university professors, a gas industry (2 companies, 1 organization),
    1 automobile manufacturer

- Low blend biofuels: 4
  - 3 university professors, 1 researcher
Main background of introduction

**Main background**

- Tighter diesel exhaust regulations
- NGV introduction policy
- Subsidy from Gov.
  - Vehicle purchase
  - Station construction
  - Station operation
  - Tax incentives etc.
- Roadside air pollution
- Expansion of gas demand
- Contribution to environmental issues
- Active promotion of NGV in gas industry

**Social needs to introduce NGV**
(Reduction of NOx, PM)

- NGV development and sale
- Active NGV introduction of customer

**Dissemination** (total 48,000 units as of 2019)
Market introduction status.

Sales number of NGVs

- PC: Passenger Car
- LD: Light Duty
- SV: Small Vehicle
- MD+HD: Medium Heavy Duty
- GV: Garbage Vehicle
- BUS: Bus
- Others

Natural gas
Evaluation of market introduction

Result of market introduction
+ A certain number of NGV became popular because of the growing awareness of improving the atmospheric environment in society.
+ However, the advance of the technology to improve the emissions from diesel vehicles has reduced the superiority of NGV, and their use has stagnated.

Estimated factors for market introduction
+ There are various factors that have led to the market introduction of NGV as follows.
  a. The society (for example, transportation companies, shippers, automotive manufacturers, and government etc.) has a high awareness of improving the air pollution.
  b. Generous government incentives (subsidies for purchases, infrastructure construction, etc.) have been promoted for social needs.
  c. The use of existing diesel vehicles has partly been regulated to improve the atmospheric environment, and the spread of NGV has increased.

Country specific situations
Since oil crisis of the 1970s, imports of natural gas as one of the alternative fuels to oil have greatly increased to reduce oil dependency, making it a large and stable fuel in Japan. Therefore, it is considered to be an important fuel from the viewpoint of ensuring energy security.
Current situation & Barriers

Present

- Cleaner and more efficient diesel vehicles
- Decreased accessibility to station

Past

- Subsidy from Gov.
  - Vehicle purchase, Station construction
  - Station operation, Tax incentives etc.
- Tighter diesel exhaust regulations
- Decreased NGV development motivation
- Decreased NGV conversion Station construction
- Cheaper fuel price, Decisive advantage of fuel price?
- Decisive advantage of fuel economy?
- Good reputations

Deceleration of station spread

- Declined NGV introduction needs
- Relative decrease of NGV advantage
- Decreased attractiveness of vehicles

Diffusion slowdown

- Decreased motivation to introduce NGV
- Subsidy in 2011
- Declined NGV introduction needs

Relative decrease of NGV advantage

- Tighter diesel exhaust regulations
- Decreased accessibility to station
- New value?
Key factors for success and main barriers

+ **Key factors for success**
  Greater awareness of air pollution improvement in society (transportation companies, shippers, automobile manufacturers, government etc.).

- **Main barriers**
  In a free competition market, after the environmental performance of conventional vehicles improved, there was little reasons/motivation to provide customers attractive products with advantages regarding the performance and practicality of natural gas vehicles over conventional vehicles.

**Lessons learned in this case:**
In a free competition market, it is very important to provide attractive products to customers in a timely manner according to the needs of society. Otherwise, it will be necessary to introduce a strong policy in a regulatory way.
Main background of introduction

Main background

**COP3** held in Kyoto (1997.12)
Increasing environmental awareness    Recycling
Local production for local consumption of energy    Regional promotion

Low blend biofuels

Utilization of biofuels for automotive fuel

High concentration (B100)

Low blend (B5, E3 (ETBE))
The annual consumption of automotive fuels in 2018

<table>
<thead>
<tr>
<th>Automotive fuels</th>
<th>Fuel consumption (2018)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>—</td>
<td>2,726 PJ</td>
</tr>
<tr>
<td>Gasoline</td>
<td>48,846,328 kL</td>
<td>1,630 PJ</td>
</tr>
<tr>
<td>ETBE</td>
<td>1,940,000 kL</td>
<td>54.7 PJ</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>25,584,245 kL</td>
<td>973 PJ</td>
</tr>
<tr>
<td>LPG</td>
<td>1,323,415 kL</td>
<td>66.3 PJ</td>
</tr>
<tr>
<td>Natural gas</td>
<td>44,076 km³</td>
<td>1.82 PJ</td>
</tr>
</tbody>
</table>

*Biodiesel is not described because it is very small.*
Evaluation of market introduction

Result of market introduction
The most widespread case is ETBE made from bioethanol for a gasoline base material. However, the amount is about 0.69% of the fuel for vehicles in energy basis, and other cases of market introduction are almost converged, so it cannot be said that it has spread enough.

Estimated factors for market introduction
The Third Conference of the Parties to the Framework Convention on Climate Change (COP3) in December 1997 was an opportunity to foster the domestic use of biofuels to reduce CO2 emissions. In addition, it is thought that the momentum of local production and local consumption of energy in the background of recycling of waste cooking oil and of regional development was a factor to introduce biofuels.

Country specific situations
Although there is a possibility that a certain amount of biofuel resources can be procured in Japan, there is no system for procurement in large quantities, and it is also hard to import a certain amount of bioresources which worldwide trade is small. Therefore it was difficult to disseminate it throughout the country.
Current situation & Barriers

- **High concentration (B100)**
- **Low blend (B5, E3)**

Utilization of biofuels for automotive fuel

- Alternative Energy Law (Duty of effort)
- Quality Assurance Law (Restricted to low concentration fuel)
- Local projects
- Complexity of handling multiple systems
- Electricity from bioresources (FIT)
- Possible spread?

Vehicle problems

- New vehicles: Technology available
- Existing vehicles: Not applicable

AMF: Bad evaluation case

- Decreased willingness on vehicle development and fuel supply
- Higher fuel price
- Stagnation in diffusion

FIT: Feed-in Tariff
AMF: Alternative Motor Fuels
Key factors for success and main barriers:

Japan relies on imports for most of its energy resources. Therefore, in a free competition market, it has been difficult to disseminate biofuels in view of higher cost, difficulty to procure a certain amount of raw material of biofuels, and convenience of its use.

Lessons learned in this case:

In a free competition market, cost, supply stability, and convenience of alternative fuels are important compared to conventional fuels.
<table>
<thead>
<tr>
<th><strong>Summary</strong></th>
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<tbody>
<tr>
<td><strong>Natural gas</strong></td>
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</tbody>
</table>
| **Estimated factors for market introduction** | • The society has a high awareness of improving the air pollution.  
• Generous government incentives have been promoted for social needs.  
• The use of existing diesel vehicles has been regulated to improve the atmospheric environment.  
• In December 1997, COP3 was held in Kyoto, Japan, and this was an opportunity to foster the domestic use of biofuels to reduce CO2 emissions. |
| **Measures taken** | • Subsidy for biofuel infrastructure development, manufacturing facilities, etc.  
• Tax incentives |
| **Today's market introduction status** | The spread of NGV has been stagnant.  
Just small amount of E3 (ETBE), B5 and B100 are on sale. |
| **Key factors for success** | • Greater awareness of air pollution improvement in society (transportation companies, shippers, automobile manufacturers, government etc.).  
• At present, it is not widespread. |
| **Key factors for main barriers** | • After the environmental performance of conventional vehicles improved, there was little reasons/motivation to provide attractive products with advantages regarding the performance and practicality of NGVs.  
• Japan relies on imports for most of its energy resources. And it has been difficult to disseminate biofuels in view of higher cost, difficulty to procure a certain amount of raw material of biofuels, and convenience of its use. |
| **Lessons learned** | • In free competition market, it is very important to provide attractive products in a timely manner according to the needs. Otherwise, it will be necessary to introduce a strong and regulatory policy.  
• In a free competition market, cost, supply stability, and convenience of alternative fuels are important compared to conventional fuels. |
END

Thank you very much for your kind attention.