

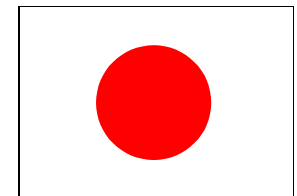


Prospect of Synthetic Liquified Gas

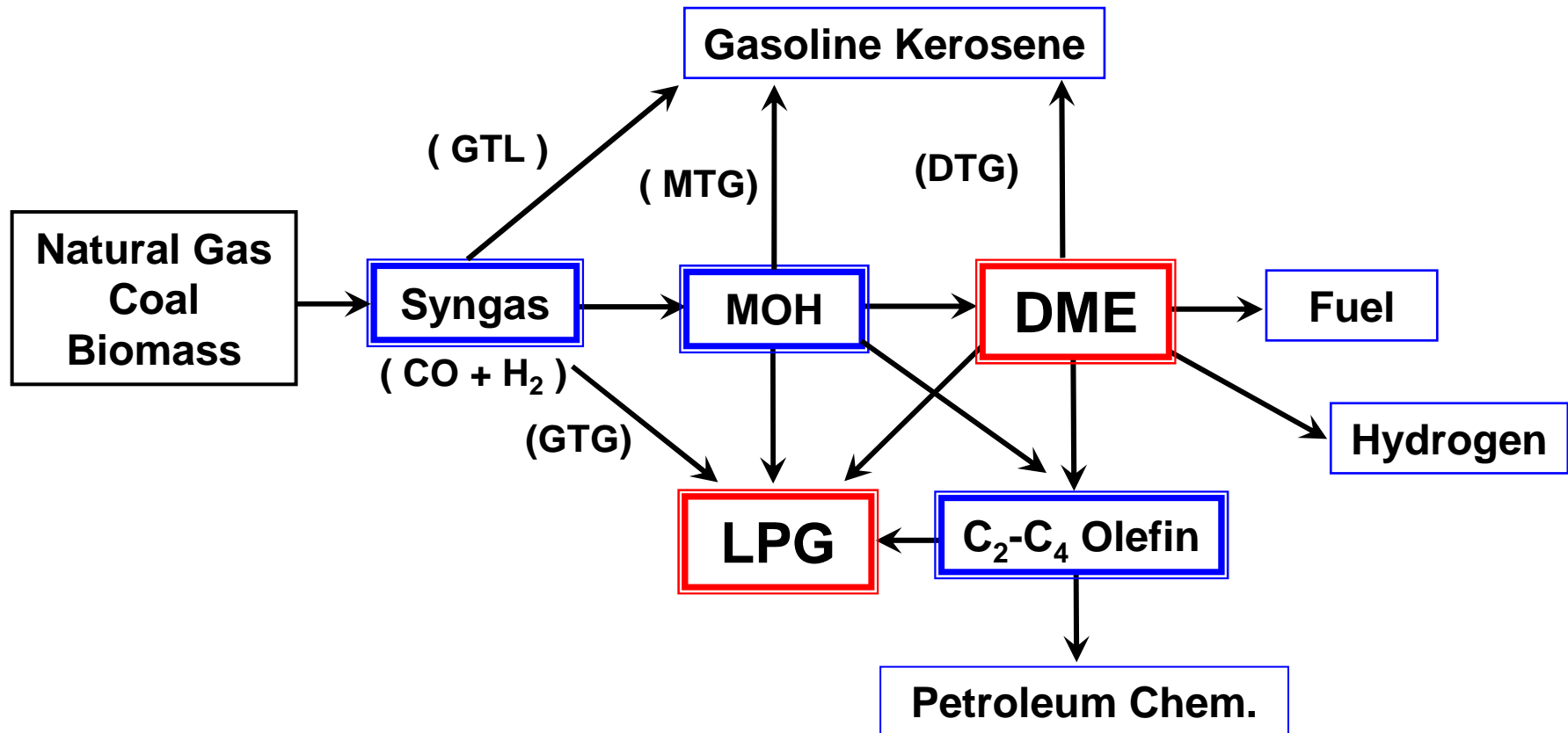
- DME and LPG -

The University of Kitakyushu
Kaoru Fujimoto

23rd World Gas Conference
Jun. 5-9, 2006

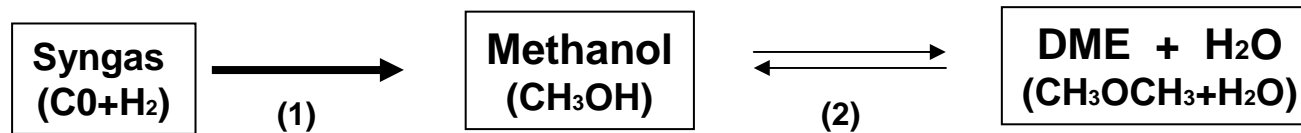


NEW SYNTHETIC FUEL SYSTEM

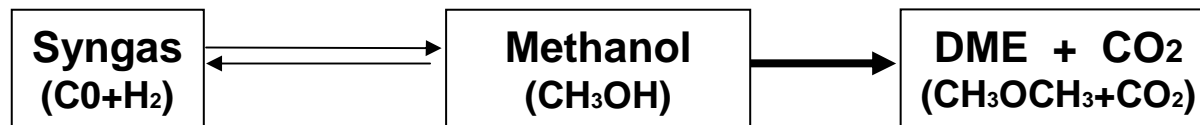


SYNTHESIS PROCESS FOR METHANOL AND DME

Indirect process



Direct process



PHYSICAL PROPERTY OF DME

	DME	CH ₄	C ₃ H ₈	CH ₃ OH	Diesel (FT)
Boiling point (°C)	-25.1	-161.5	-42.0	64.4	180-370
Density (g/cm ³ , 20°C)	0.67	-	0.49	0.79	0.84 (0.78)
Vapor pressure (atm, 25 °C)	6.1	246	9.3	-	-
Cetane number	<65	0	(5)	5	40-60 (70)
Heating value (kcal/kg)	6,900	12,000	11,100	5,000	10,000

FUEL DME PRODUCTION

Direct process (JFE)

5t/d pilot plant at Kushiro (1999-2002) JAPAN

100t/d demonstration plant at Kushiro (2003-) JAPAN

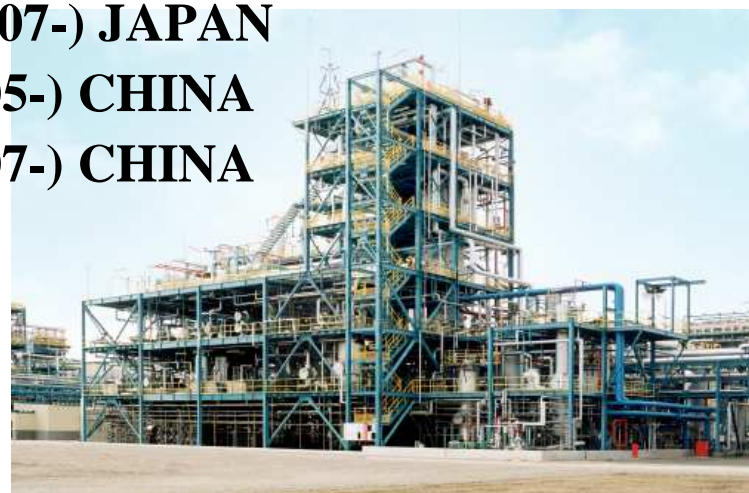
Indirect (methanol) process

Jiutai Chemical Corp., 100,000 ty (2005-) CHINA

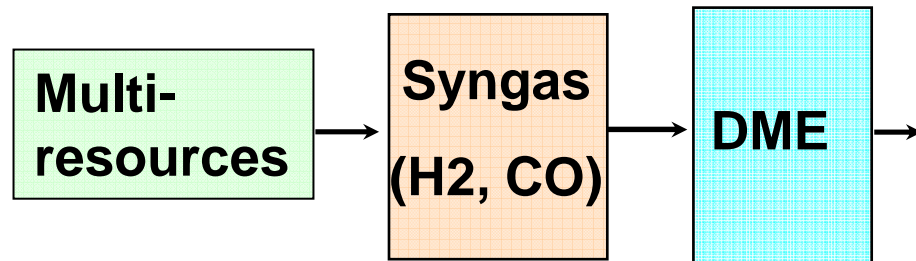
Mitsubishi Gas Chemical, 100,000 t/y (2007-) JAPAN

Toyo Engineering Corp., 100,000 t/y (2005-) CHINA

Toyo Engineering Corp., 210,000 t/y (2007-) CHINA



DME UTILIZATION



Home fuel

LPG substitute

FC fuel

Transportation fuel

Diesel fuel

FC vehicle

Hydrogen source

Power generation fuel

Gas turbine

Diesel co-generation

Chemical use

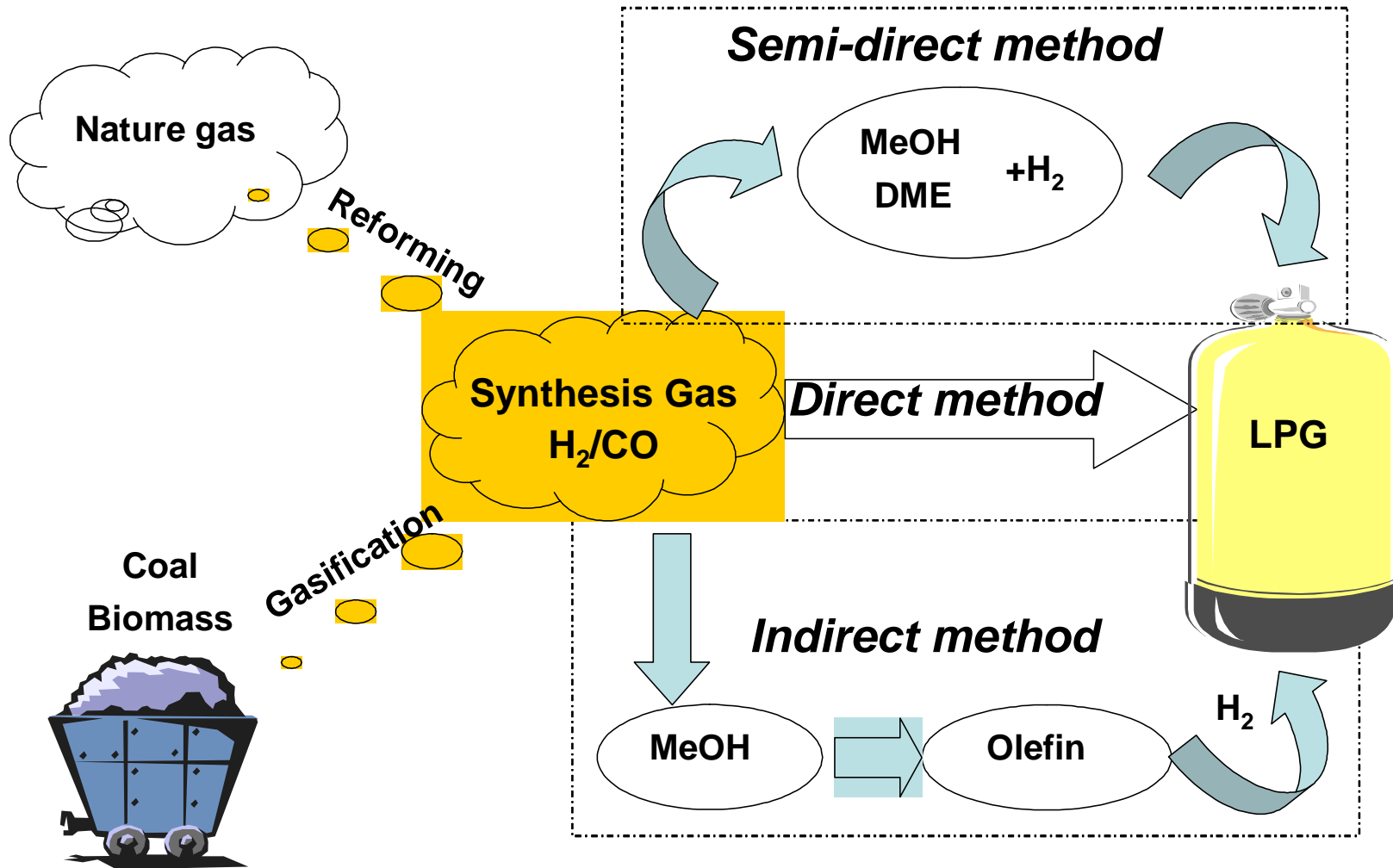
Olefin production

Methanol chemicals

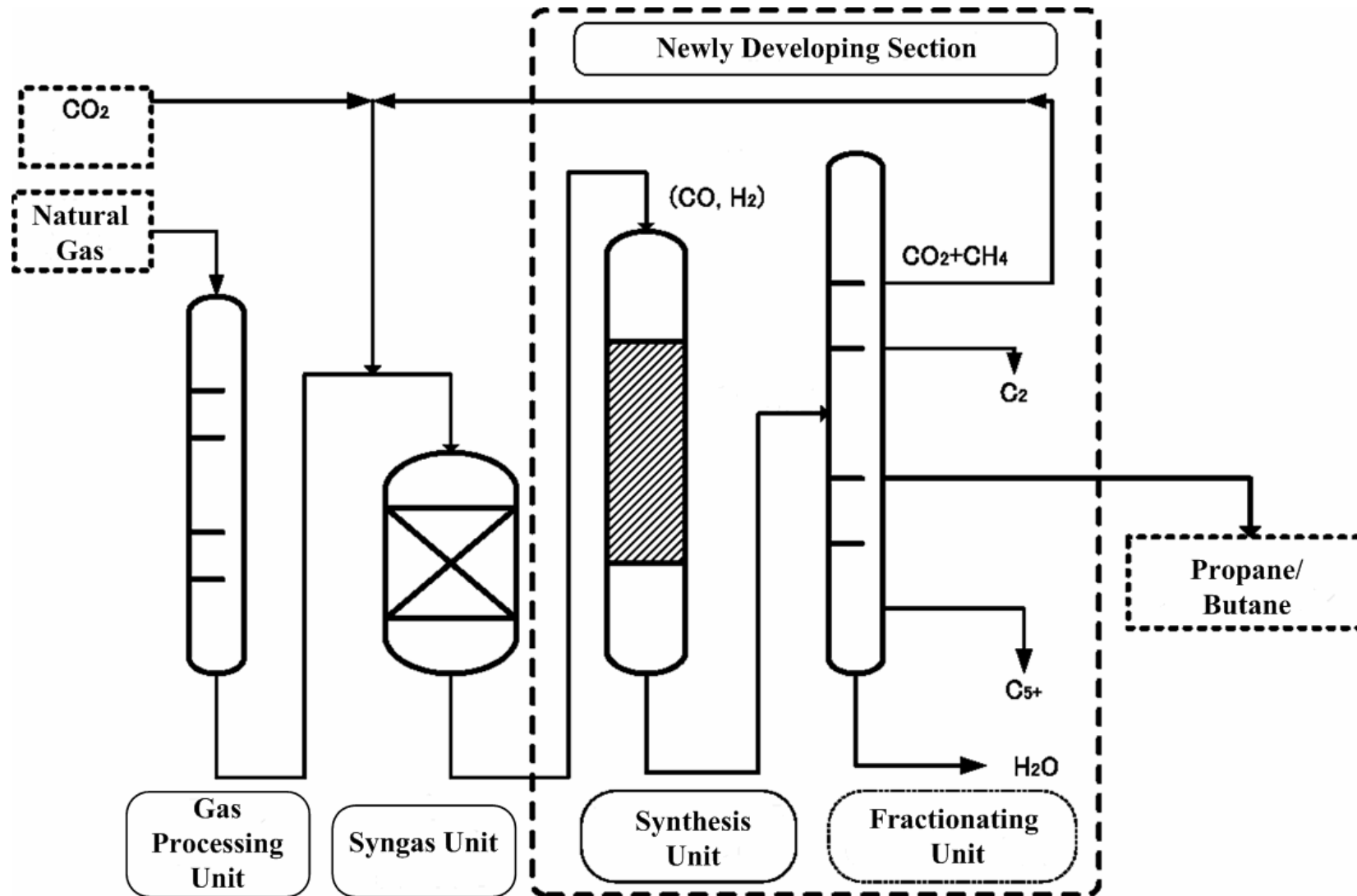
LPG production

Japan Gas Syn.

Three Roots for LPG Synthesis



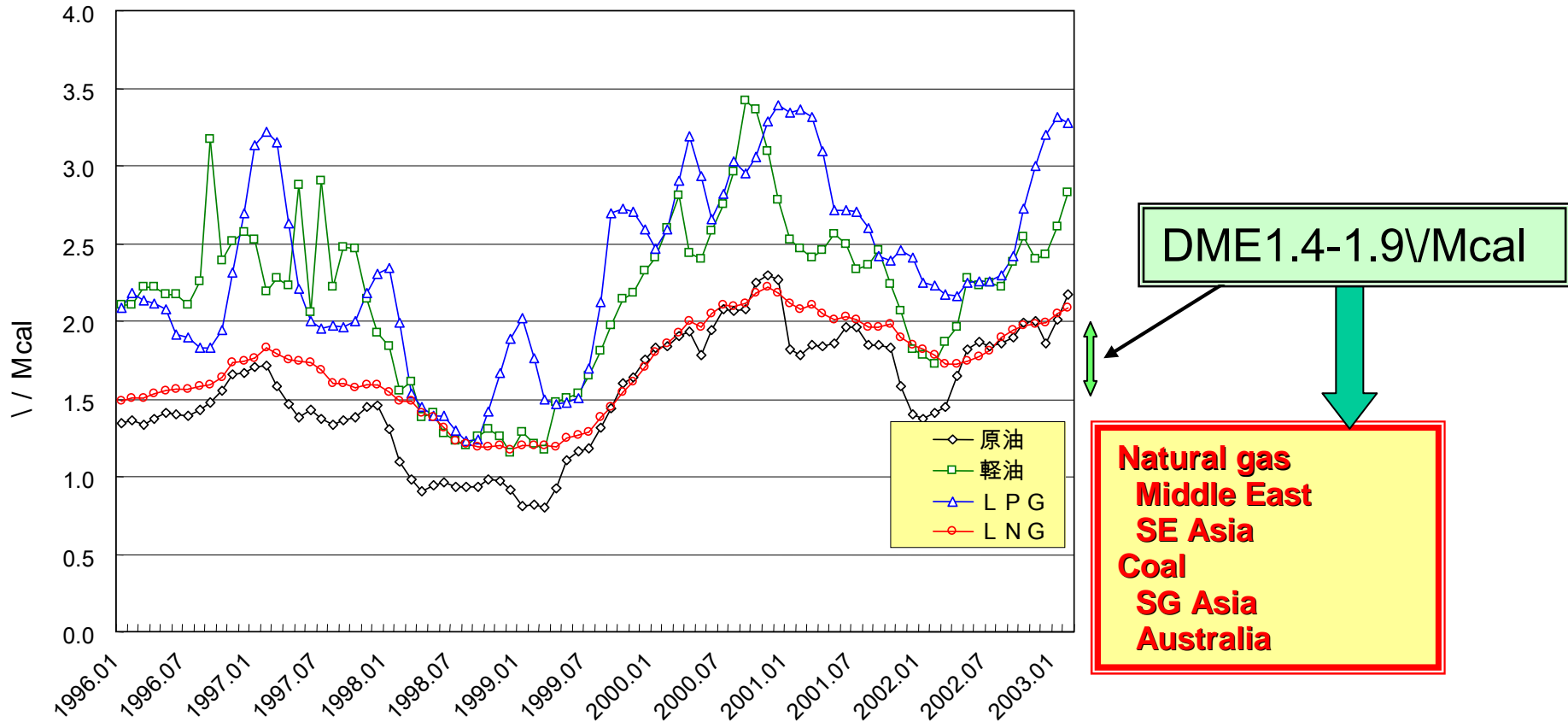
Schematic Diagram of LPG Synthesis Plant



CONCEPT OF DME AS ENERGY

- 1. DME is a synthetic fuel**
- 2. DME can be manufactured from many resources**
- 3. DME is a clean fuel**
- 4. DME can be used for multi way**
- 5. DME is no toxic and gas-liquid**
- 6. DME is an energy-media even superior to electricity**

CALCULATED DME PRICE (CIF JAPAN)

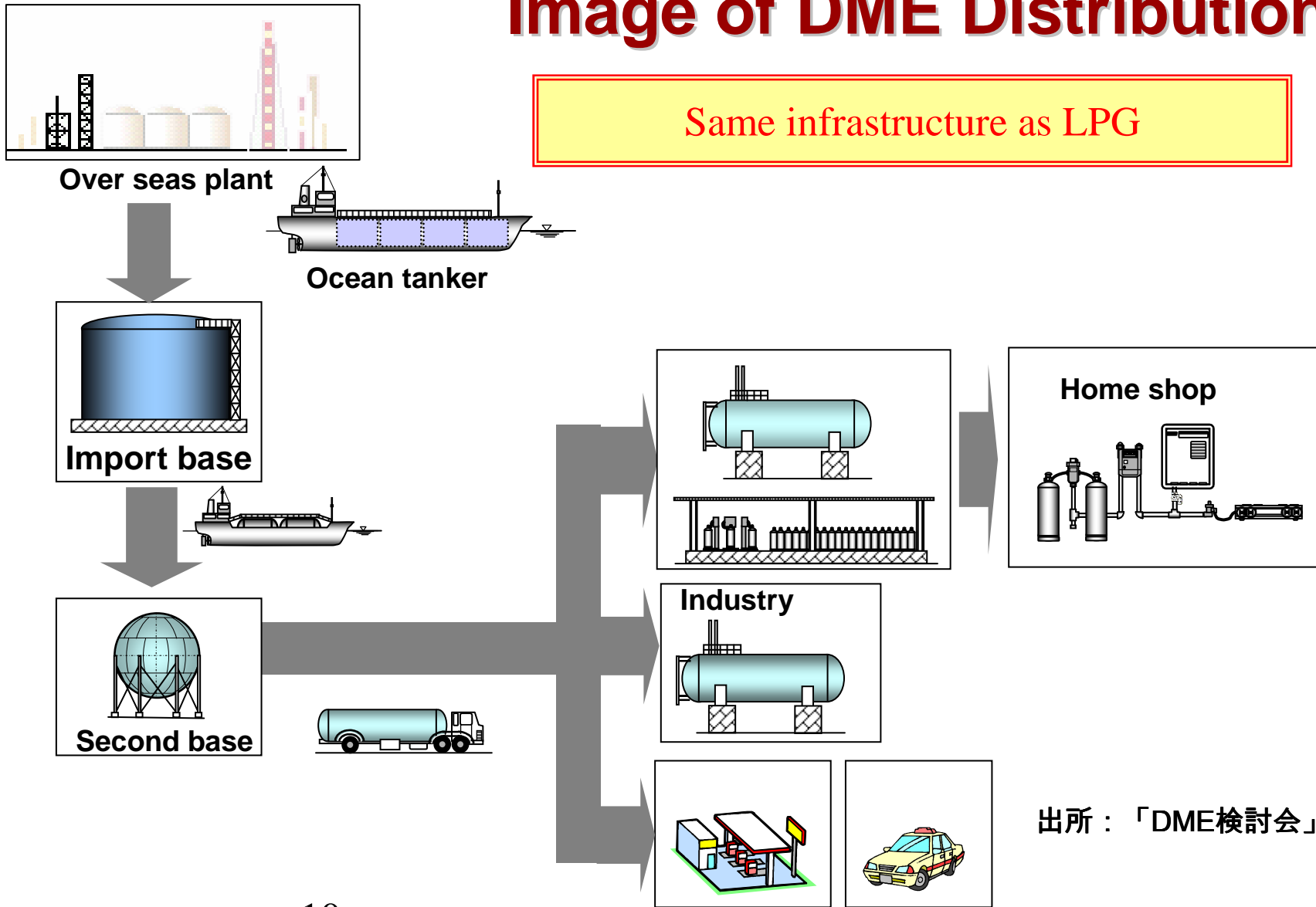


エネルギー-CIF価格変動動向 (1996年1月 ~ 2003年2月)

上記数値は、為替変動の影響を避けるために、円ドルレート\100/\$で換算した。

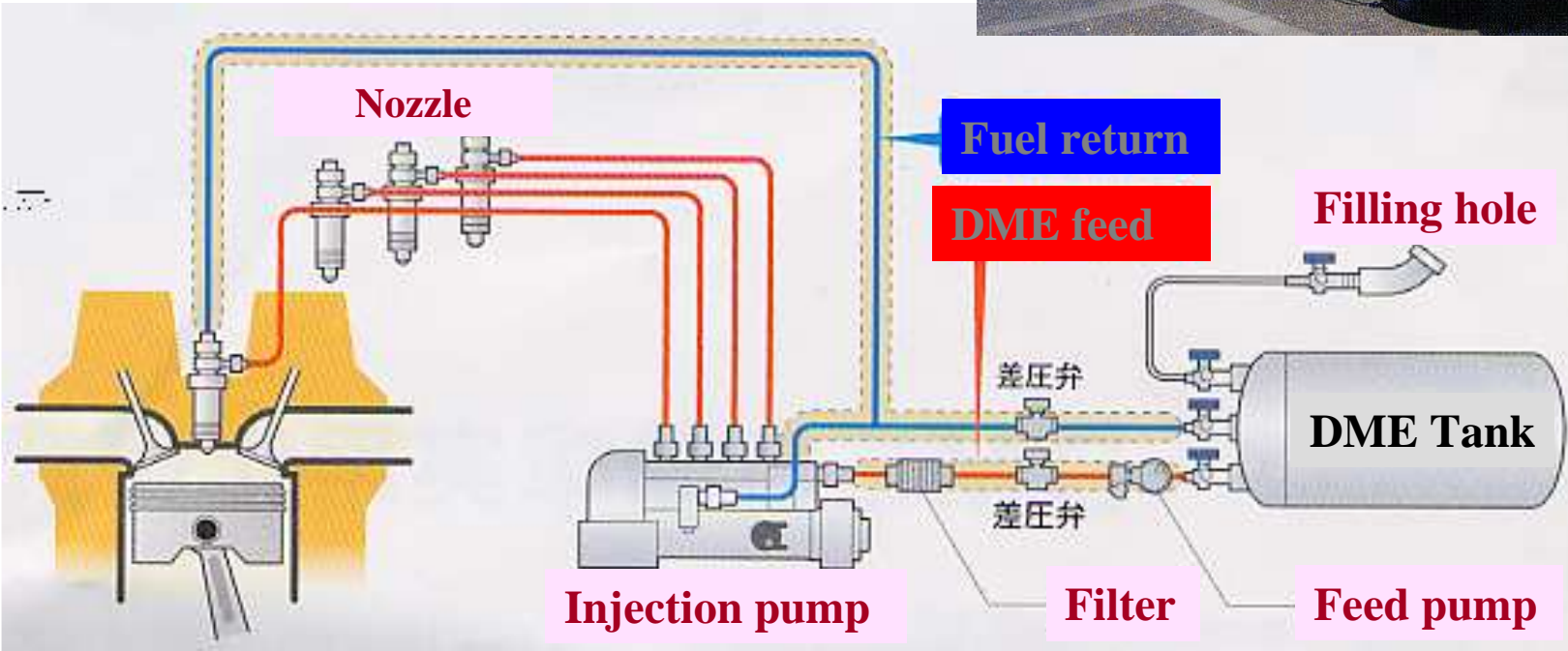
Image of DME Distribution

Same infrastructure as LPG



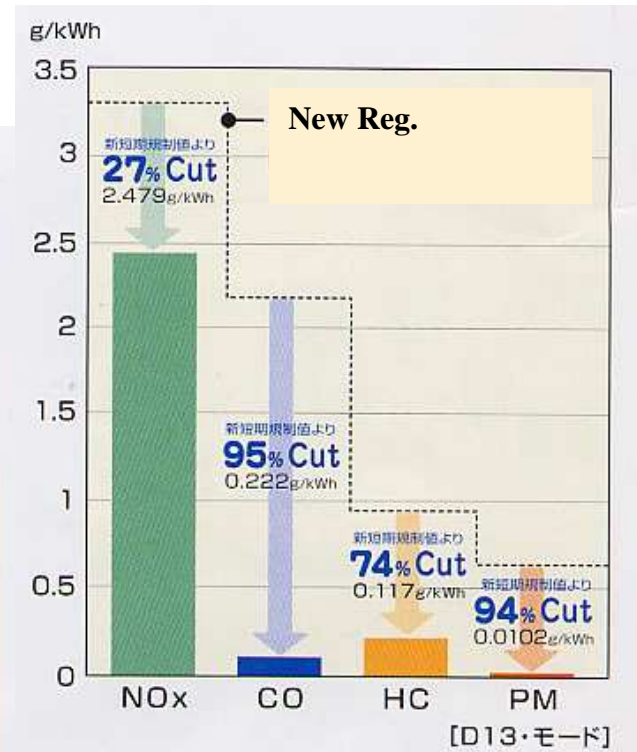
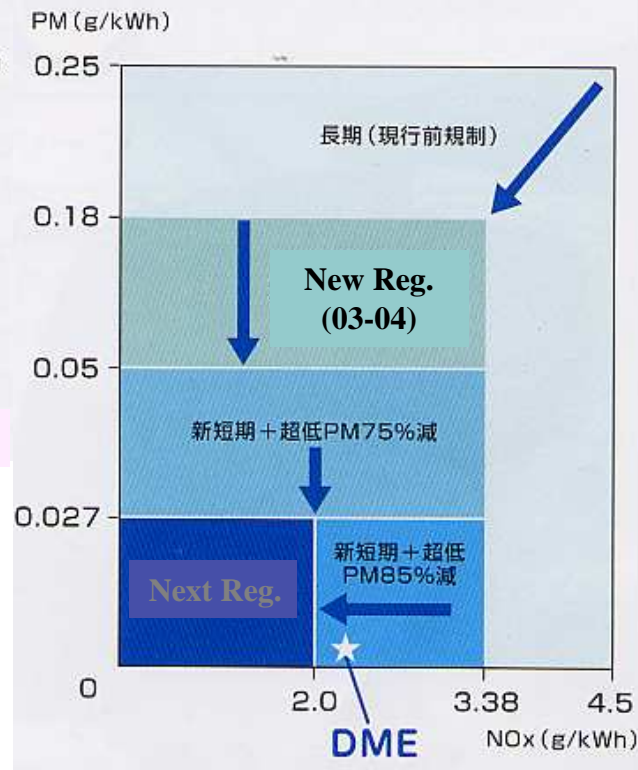
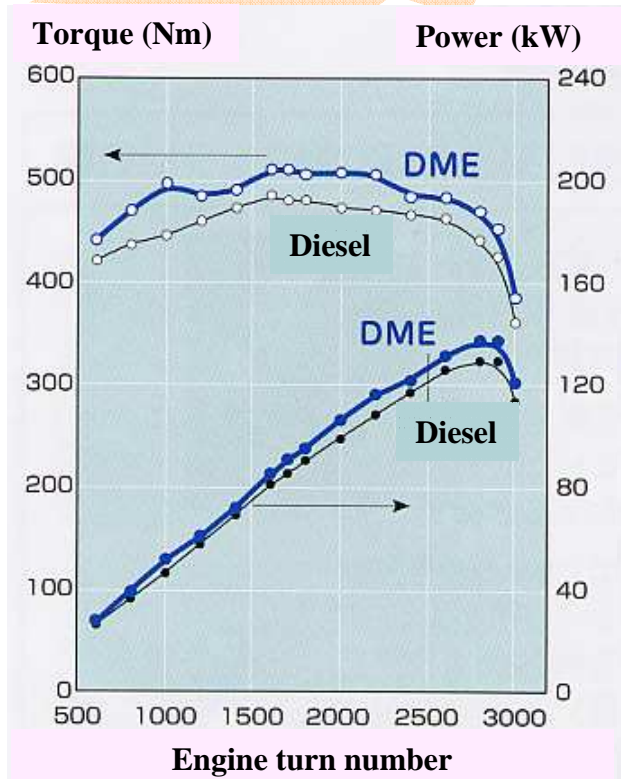
出所：「DME検討会」報告書

DME Truck (8 ton)

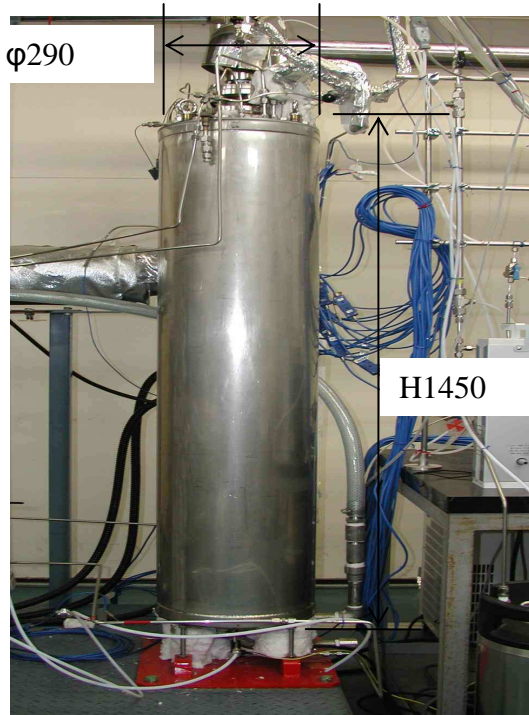
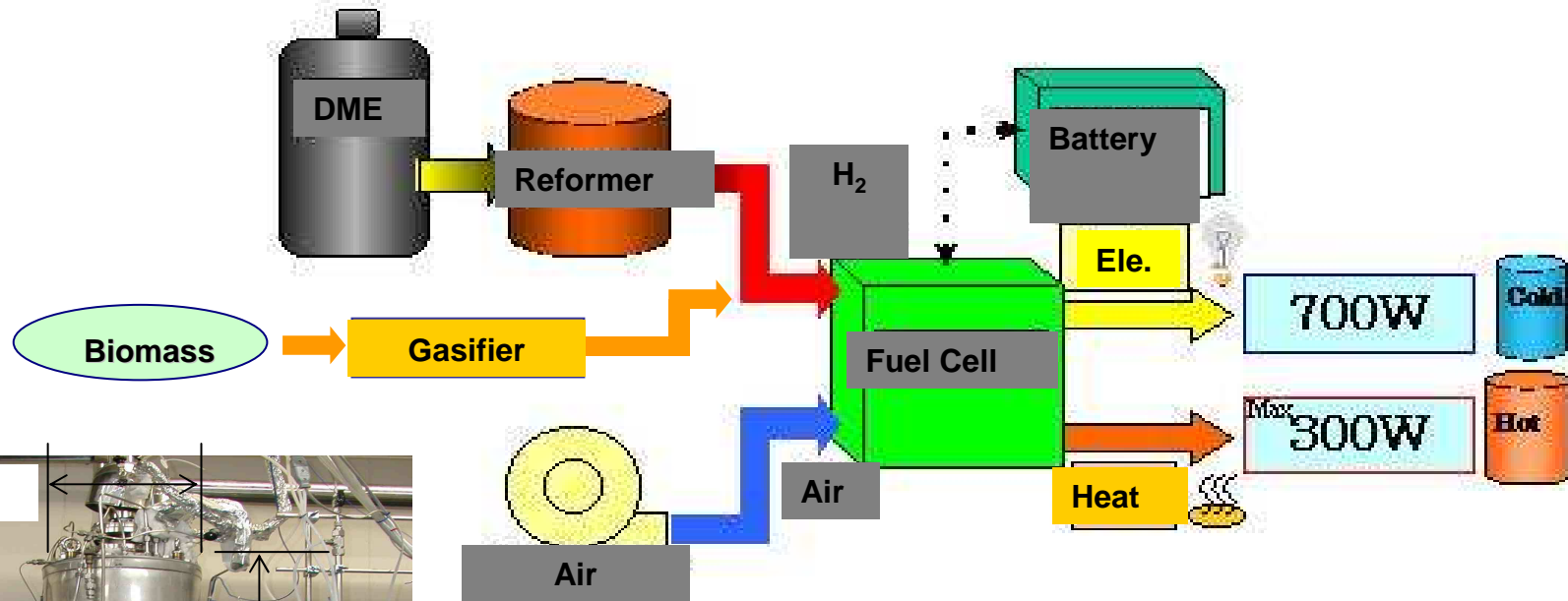


High Power

CLEAN OFF GAS



DME FUEL CELL SYSTEM



Fuel	DME
Output	5kW
Hydrogen occurrence ability	4Nm³/hr
Reforming Cata.	CuZn/Solid acid
Reforming Temp.	350°C
Constitution	Reformer, CO Remover, Water evaporation device, Combustion burner

REMODELING OF EXISTING APPARATUS

Development of DME retro-fit diesel engine for co-generation system

Period : 2001-2003 (2 years)

Partners : Yanmar Diesel, Iwatani, AIST

Fund : JNOC's fund (approx. 1.6m\$)

Verification of DME fuelling to existing boilers on retrofit basis

Period : 2001-2003 (2 years)

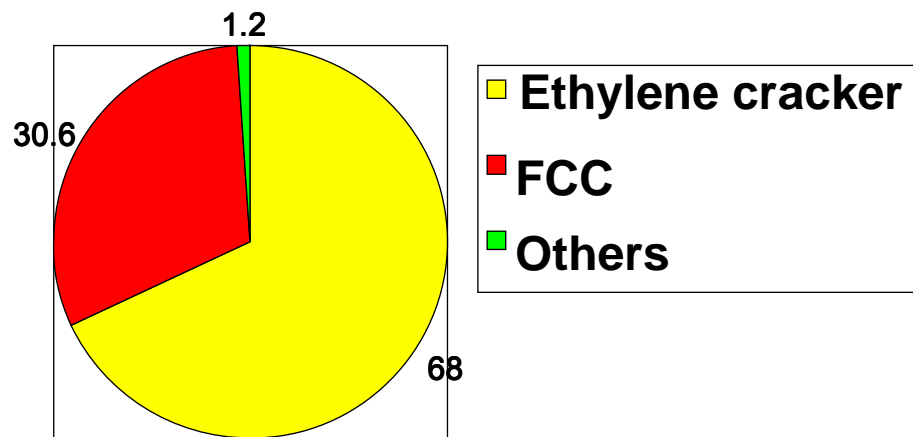
Partners : MHI

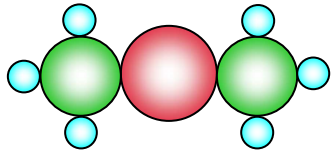
Fund : JNOC's fund (approx. 1.6m\$)

DTO Process

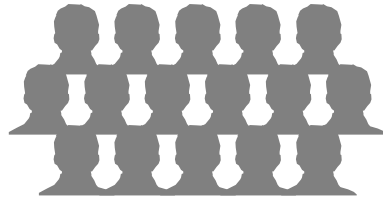
Product (C-wt%)	DME feed Ethylene max %	DME feed Propylene max %	Naphtha feed (Commercial)
Ethylene	48	5	32
Propylene	31	50	17
Butenes	9	23	8
$C_2=C_3$	1.5	0.1	1.8

WORLD PROPYLEN PRODUCTION



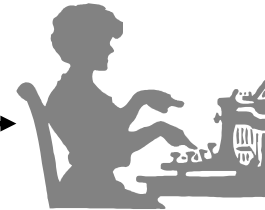
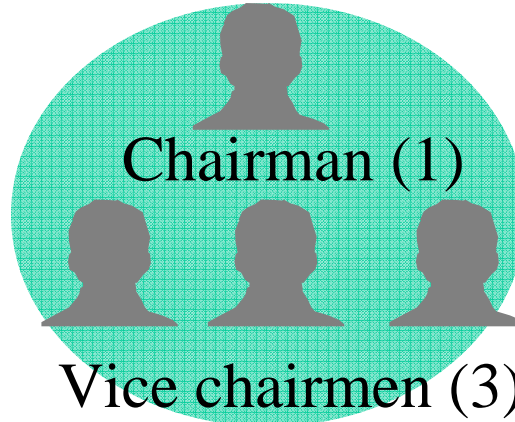


JapanDMEForum



109 Members

Organization of JDF



Secretariat

Board of Executive Directors (17)
(Incl. Chairman & Vice chairmen)

Managing Committee (8)

Members

Planning Committee

- Administration Group (4)
- Codes/Standards Group

Technical Committee

- Manufacture Group (59)
- Utilization Group (58)

(46) member will join in the above one, two or three groups.
(The number of the member in each groups was updated on Dec.6, 2002)

JDF'S THREE STUDY GROUPS

1 . Utilization Group

**Power generation /system including gas turbine
Household/industry fuel, DME diesel related technologies
Emission tests from diesel engine
Marketing study, Road test of DME vehicle**

2. Production Group (Manufacturing Group)

**Production technologies, 100t/d demo-plant construction
Economic and LCA analysis of DME production by multiple processes
Ocean transportation, etc**

3. Codes & Standard Group (Legislative Group)

Studies for standardization of DME fuel in Japan

JDF'S CONCEPT ON INTERNATIONAL TREND

- 1. In east Asian countries DME will be introduced quickly as home fuel.**
- 2. Diesel DME will be introduced soon**
- 3. Technologies and infrastructures are not sufficient.**
- 4. JDF will co-operate with other countries.**

SOCIAL SUBJECTS

- 1. Present regulation is not suitable for the introduction of DME**
- 2. Social consensus is not sufficient.**
- 3. Financial support should be made for its introduction.**
- 4. Application of special Tax such as “Environmental Tax” is expected.**

SUMMARY

- 1. A variety of new technologies has been developed which utilize DME as the new generation clean fuel and chemicals.**
- 2. A large DME production plants are ready to be constructed for starting in 2006. Lower CIF price than gas oil can be expected.**
- 3. Establishments of supply system is expected easy by utilizing existing system (LDG diesel)**
- 4. DME will contribute to promote the energy security in many countries.**