

Mitsubishi Gas Chemical Co. Inc.



日露エネルギーフォーラム 2008

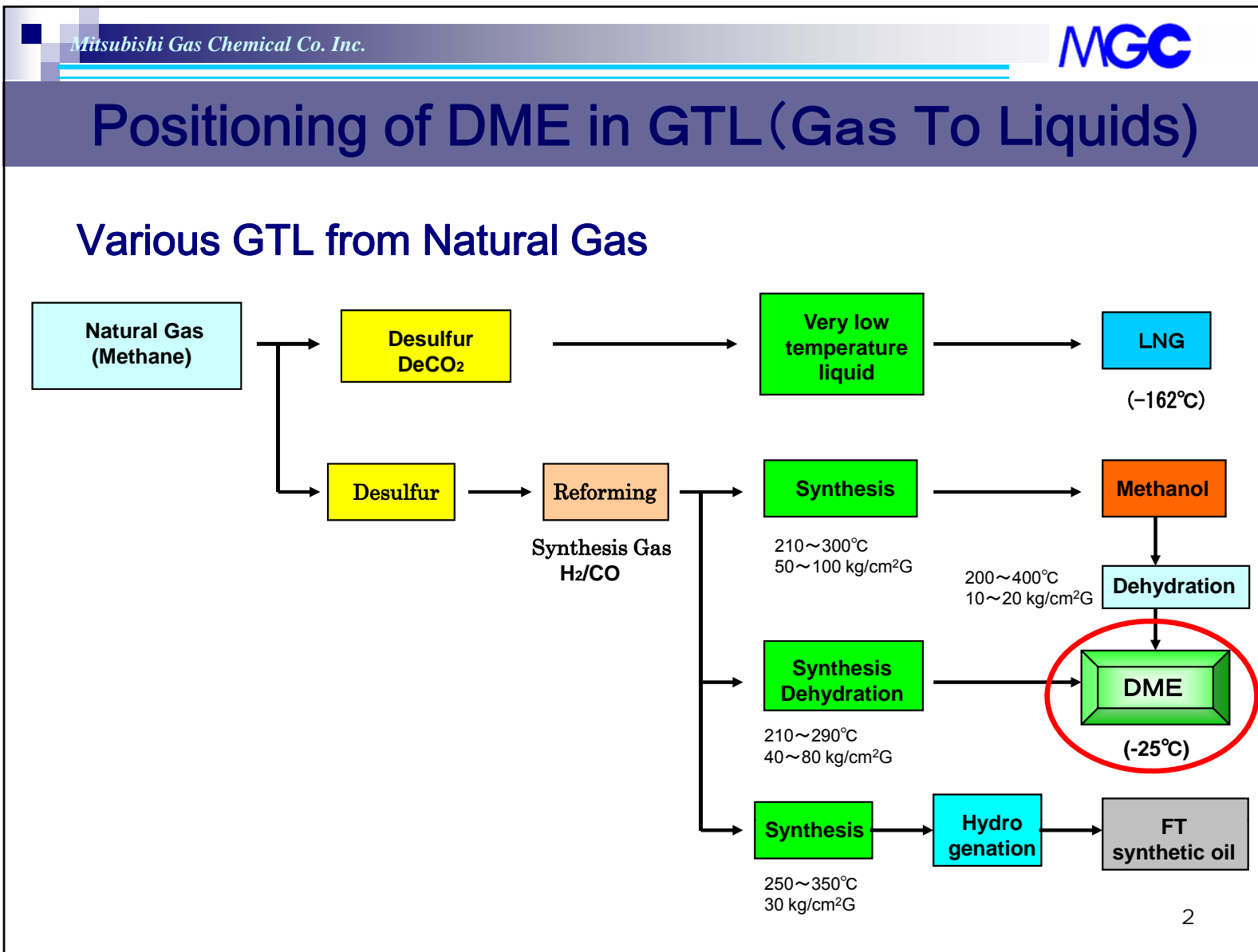
*Chemicals From Natural Gas
and
MGC's Activity in That Field
【UPDATE】*

November, 2008

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Mitsubishi Gas Chemical Co., Inc.*

Background of MGC on Methanol

- ***One of The Largest Methanol Suppliers / Marketers in The World***
- ***Investor & Shareholder ;***
 - ***AR-RAZI of Saudi Arabia***
 - ***METOR of Venezuela***
- ***MGC's Key Roles in The Methanol Project ;***
 - ***Process Owner***
 - ***Methanol Synthesis Catalyst Supplier***
 - ***Technical Services***
 - ***Plant Operation Support***
 - ***Marketing & Logistics***



Mitsubishi Gas Chemical Co. Inc.



Characteristics of DME

Items	DME	Propane	Butane	Methane	Methanol	Diesel
Chemical Formula	CH ₃ OCH ₃	C ₃ H ₈	C ₄ H ₁₀	CH ₄	CH ₃ OH	–
Higher Heating Value kcal/kg	7,570	12,030	11,830	13,080	5,420	10,950
kcal/L	5,060	5,940	6,850	5,560	4,300	9,200
kcal/Nm ³	15,620	23,760	30,630	9,340	–	–
Boiling Point (°C)	–25.1	–42.0	–0.5	–161.5	64.6	180~370
Cetane Number	55~60	5	10	0	5	40~55
Liquid Density (g/cm ³ , 20°C)	0.668	0.49	0.57	–	0.796	0.84
Gas Specific Gravity (via Air)	1.59	1.52	2.00	0.55	–	–
Combustion Point (°C)	350	457	430	540	464	316
Explosion Limit (%)	3.4~27.0	2.1~9.5	1.9~8.5	5.0~15.0	5.5~36.0	0.6~6.5

Oxygen content rate : 34.8%

Has good environmental characteristics
Does not emit particulate matter (PM) when it burns

Cetane number : 55 or more

Can be utilized as a substitute of diesel oil for diesel vehicle

High efficiency-Clean Vehicle

Liquefaction by pressurizing
(about six atmospheric pressures)

Can be utilized in existing LPG infrastructure (ex. Tankers and Tanks)

Decentralized Energy System

Extracting hydrogen easily and voluminously

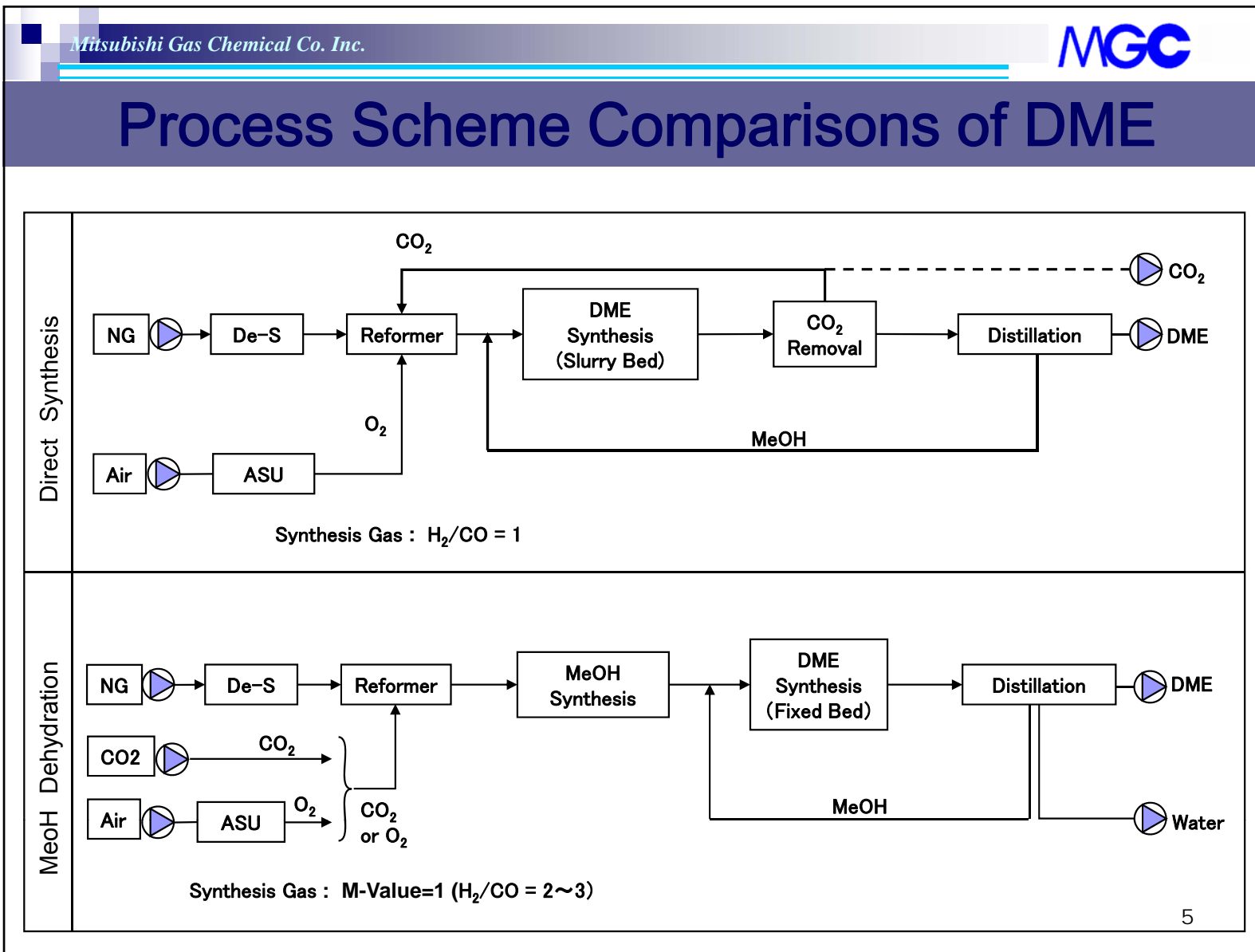
Can be utilized as an energy source of fuel cell

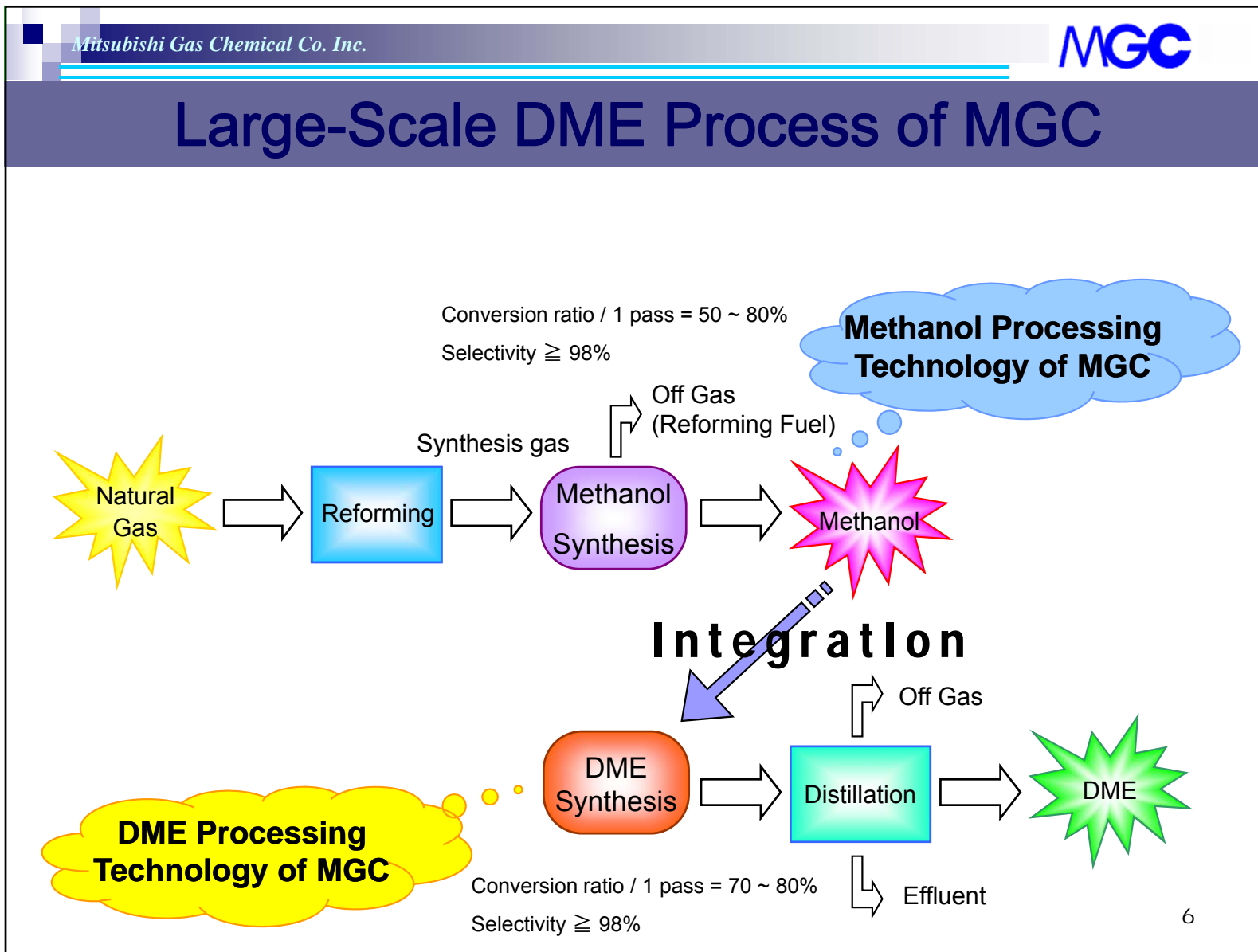
Hope of hydrogen energy society

No color and No smell / Low toxicity

Proved as aerosol propellant

Mitsubishi Gas Chemical Co. Inc.		MGC							
Environment Conservation									
The Volume of Greenhouse Gas Emissions by Fuels and by Power Generations (Trial calculation)									
	DME		Petroleum		Coal		LNG (CNG)		
By the type of fuel (Simple complete combustion)									
Greenhouse gas (g-c/1000kcal)	69.1		①80.4 ②79.4 ③74.3		96.8		58.6		
DME/Fuel (%)			①86% ②87% ③93%		71%		118%		
By the type of power generation									
Transmission end efficiency (%)	GTCC	BTG	BTG		BTG		GTCC	BTG	
Greenhouse gas (g-c/kwh)	115	149	174		212		98	127	
DME/Fuel (%)			66% (GTCC)	86% (BTG)	54% (GTCC)	70% (BTG)	117% (GTCC)	90% (GTCC)	117% (BTG)
By the type of engine									
Engine efficiency (TNO Report)	DE		DE	OTTO			OTTO		
Greenhouse gas (g-c/kwh)	169.8		195	220			168.0		
DME/Fuel (%)			87%	77%			101%		
* Each LCA should be valued individually because the value changes greatly by each project structure. 4									





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History of DME Process in MGC

1965 DME Processing technology development

1966 1,000tpa Plant (Affiliated company of MGC)

1981 6,000tpa Plant (Niigata factory of MGC)

1984 3,600tpa Plant

(License of South Korea to LG Chemical)

1990 25,000tpa Plant

(License of Netherlands to AKZO)

2008 80,000tpa Plant (Niigata factory of MGC)





DME Promotion Project

 Mitsubishi Gas Chemical Company, Inc.



ITOCHU Corporation



Japan Petroleum Exploration Co., Ltd.



Taiyo Oil Company, Limited



TOTAL Di-Methyl Ether Japan Ltd.



Toyota Tsusho Corporation




JGC Corporation



Mitsubishi Heavy Industries, Ltd.



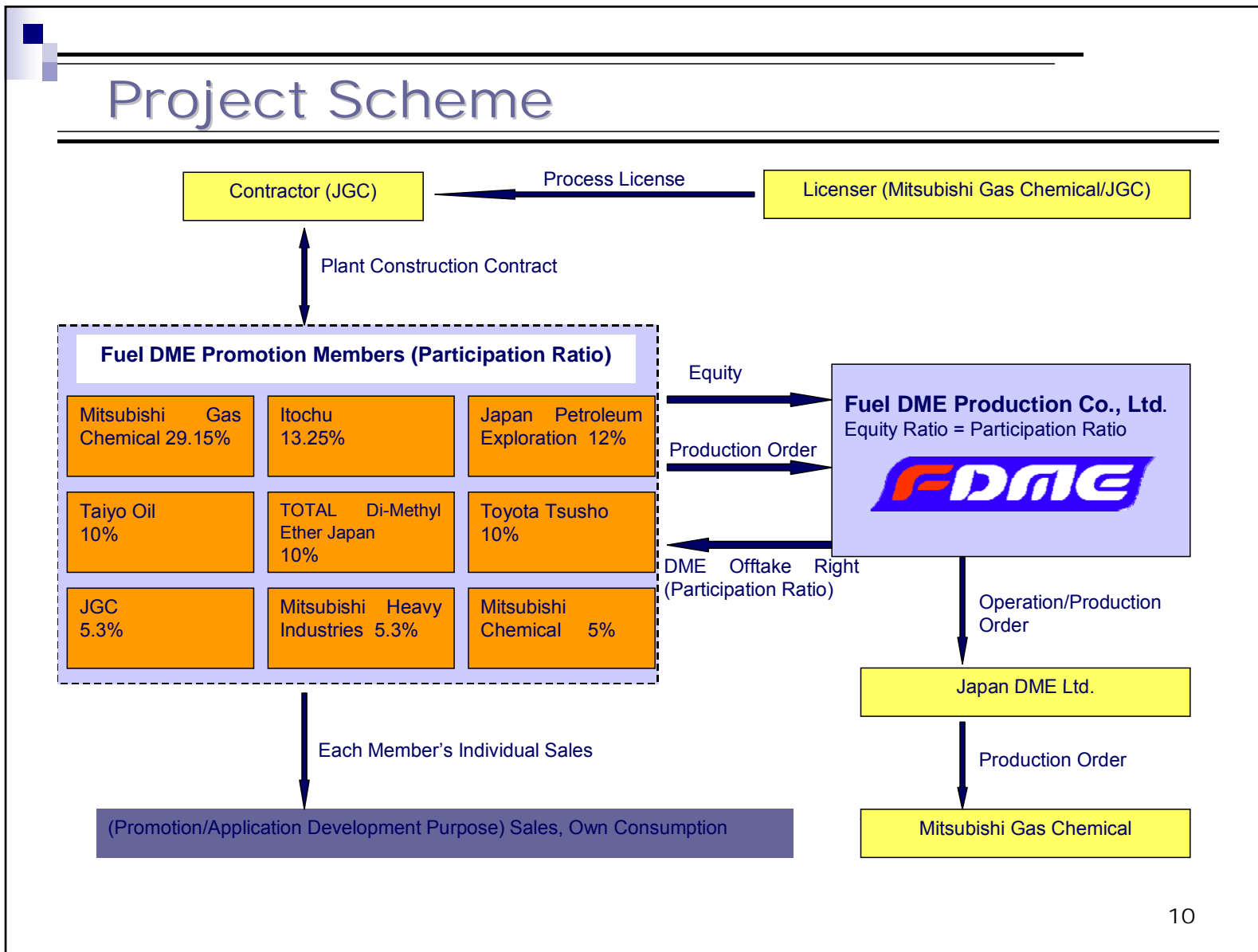
Mitsubishi Chemical Corporation

Mitsubishi Gas Chemical Co. Inc. 

Project Purpose

- Acknowledgements to potential users by DME physical supply
- Regulatory
 - DME product standards
 - DME handling standards
 - Tax system at promotion phase
- Application
 - Long term test for application technologies
- New technology establishment as DTO

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Uses of Fuel DME

Power Generation

Diesel Truck

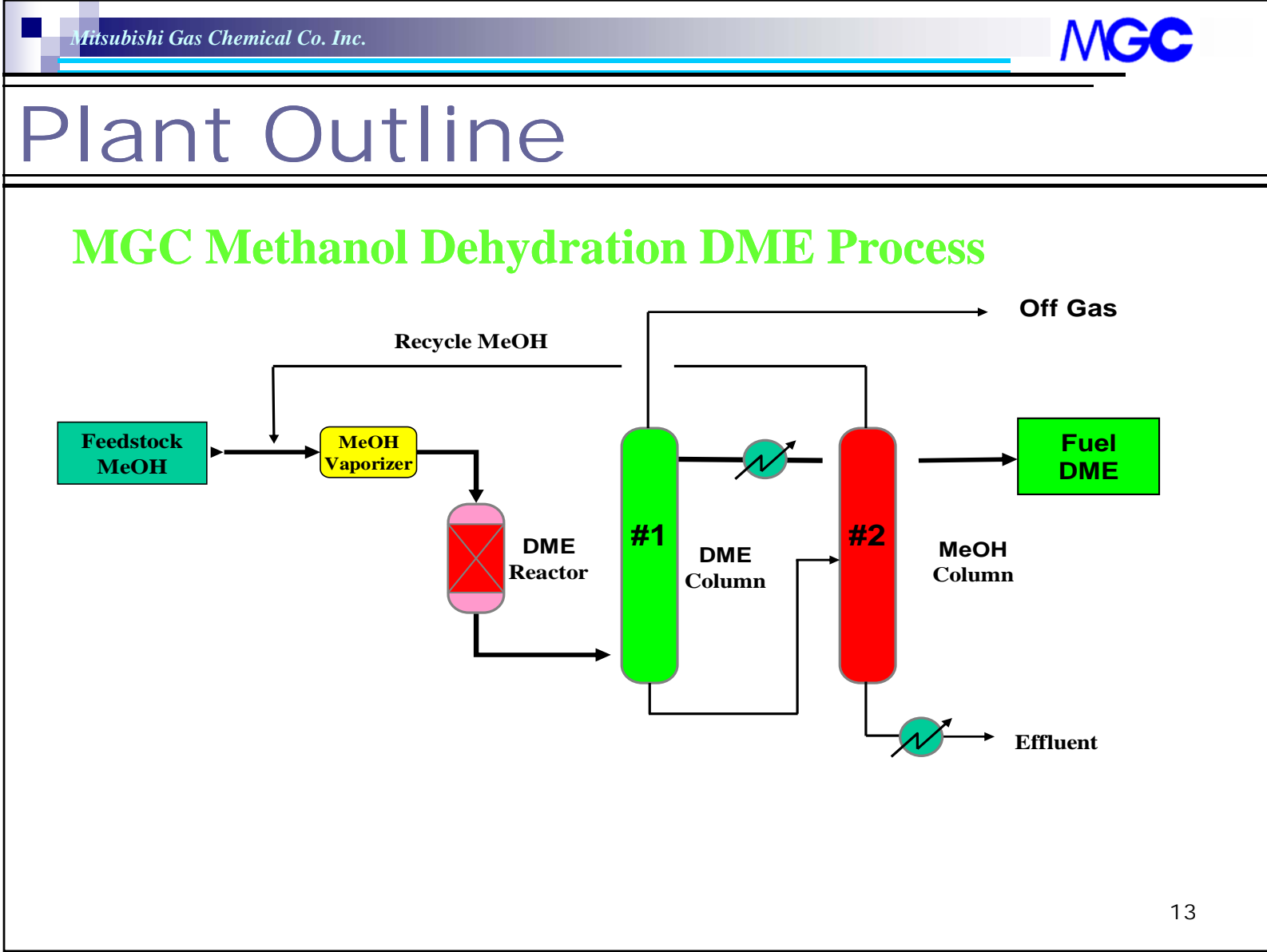
Industrial Use

Others

Fuel DME Promotion Plant

Plant Outline

- Products: Fuel grade DME
Purity 99% (according to JIS TS)
- Annual Production Capacity: 80,000ton
expandable to approx. 100,000ton
- Plant Construction Amount:
Approx. 2.5billions Japanese Yen
- Feedstock: Imported Methanol
Transportation by pipeline from Mitsubishi Gas Chemical (MGC)'s owned existing Methanol import terminal at Niigata East Port to MGC Niigata Factory
- Production Process:
MGC Methanol Dehydration Process
(commercially established technology)





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Progress of Construction Work



Governmental Support

Ministry of Economy, Trade and Industry Policy

- **Supports for technology development of DME production and application have been provided**
- **2007 Fiscal Year**
 - **Demonstration of boiler, household gas appliance, gas engine with LPG/DME mixed fuel**
 - **Demonstration of diesel power generation system with DME/bio mixed fuel**

Ministry of Land, Infrastructure and Transport

- **Supports for DME truck practical use have been provided**
- **DME truck practical model project is under planning for promotion of the next-generation low emission heavy-duty vehicles**

Ministry of the Environment

- **Supporting system for municipality's introduction of DME vehicles is under examination**



DME's Position at National Strategy (Ministry of Economy, Trade & Industry)

Basic Energy Plan (Revised on 2007 March)

- Policies to Promote/Spread DME
 - Technical Development of New Energy
 - To Promote Development of DME Automobiles to Meet Economic Requirements
 - Expansion of Demand
 - To Enhance DME as the Alternative for LPG in Industrial Sector in the Short-term Trend
 - Securement of Clean Energy, DME
 - To Realize Lower Manufacturing Cost and Development of Application Equipment for DME Promotion



DME's Position at National Strategy (Ministry of Economy, Trade & Industry)

Outline of 2008 Subsidy Plan

- Subsidy for Modification and/or
New Construction of DME Boilers
 - 150 Million Japanese Yen
(≒ US\$1.5Mil)
 - DME Does not Contain Sulfur, and is Expected to
Contribute to Diversification of Energy like LPG Substitute
 - In Order to Promote DME Utilization, the Subsidy should
be Used for Development of DME Application