Global DME Developments, with Focus on China

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International DME Association

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Outline

This presentation will focus on insights regarding the “who, why, when, where, and how” of DME commercialization activities particularly in China.

- About the IDA and the regional DME associations
- About DME including as LPG Blend Stock
- Latest DME Developments in China
- Economics
- Key Messages

The views expressed are intended to reflect primarily those of the International DME Association and selected presenters at major global DME conferences.

The pre-read, not all of which will be presented, is intended to provide you primarily with (a) DME background and (b) some elaboration to assist your understanding.

DME – International and Regional Associations

Over the past several years, global recognition of DME's potential manifested by the formation of 4 associations representing over 170 companies, technical institutes, universities and individuals.

2000 — DME Japan DME Forum

- **To coordinate Japanese National DME Initiative - $200 million over 2002-2005**
- **To develop DME manufacturing technology, shipping/distribution and marketing for multiple end-use applications**

2001 — IDA International DME Association — Dimethylether: A Fuel for the 21st Century

- **To promote public awareness and DME applications.**
- **Organize forums for information exchange**

2002 — DME KOREA

- **To advance understanding and use in Korea.**

2005 — **China DME Association**

- **To advance developments in China.**

International DME Association

Dimethylether: A Fuel for the 21st Century

Membership – 2006

Patron

- AB Volvo
- BP America Inc.
- Lurgi

Honorary

- James McCandless, USA
- Yotaro Ohno, Japan
- Spencer Sorenson, Denmark
- Ni Weidou, China

Regular

- Air Liquide
- Air Products & Chemicals
- Akzo Nobel
- Astaka Dodol, PT
- AVL List GmbH
- Aygaz A. S.
- Central Motor Wheel Ltd.
- Chemrec
- Elgas Limited
- Eni S.p.A.
- ForschungszentrumKarlsruhe GmbH
- Chemical Market Associates, Inc
- Haldor Tøpsoe A/S
- Korea Gas Corporation
- Marathon Oil Company
- Methanex Corporation
- Mitsui & Co. Ltd.
- Oil Search Ltd.
- Origin Energy Ltd.
- Shandong Juitai Chemical Industry Technology, Ltd
- Shell Global Solutions B.V.
- The Catalyst Group TGC/TCGR
- Union Chemical Laboratories, ITRI
- Wesfarmers Kleenheat Gas P/L

Individual

- Alan Richards, USA
- André Boehman, USA
- D. Cipolat, South Africa
- Ingemar Denbratt, Sweden
- Suichi Kajitani, Japan
- Colin Glasenberg, USA
- Martii Larmi, Finland
- David Mody, Canada
- Lars Pettersson, Sweden
- Pieter D. van Wijk, USA

Community Institution

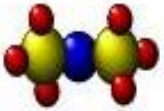
- Municipality of Växjö

About DME

Overview

- **Burns like natural gas**
- **Handles like LPG**
- **Similar to methanol with respect to:**
  - Manufacturing technology
  - Costs
  - Petrochemcal feedstock
- **Environmentally friendly with significant global consumer history as propellant.**
  - Clean burning
- **Outstanding diesel alternative fuel**
- **Very large market potential as synthetic LPG, diesel alternative and fuel for power generation**

DME- A Solution for Energy Security and Environmental Protection in China

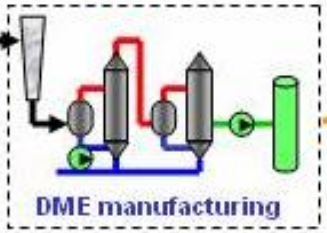


Coalbed methane

Coal

Natural gas

Biomass



DME

Alternative fuel

DME Economy

IC engine
Gas turbine
Power generation
Co-generation
Air conditioning

Vehicle
Transportation

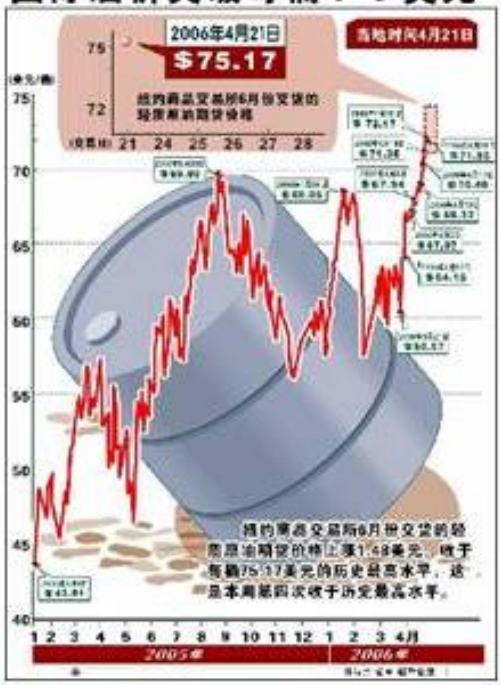
LPG alternative
household
Refrigerant

DME as LPG Blend Stock

- DME/LPG blending work (BP, ENI)
- Completely miscible
- Below 20 %v DME, existing LPG infrastructure can be used
- THIS IS THE PRIMARY MARKET
  - Existing/growing market
  - High value market
  - Relatively easy blending
- Challenges:
  - Regulatory permits
  - Validation of blending on large scale

Recent activities in DME manufacture

国际油价突破每桶７５美元



- Continuously increasing oil and LPG price strongly promote DME production.
- High price of methanol in recent years strongly stimulate the production of methanol.
- Both leads to “hot” investment and construction of methanol and DME plant in China

DME Utilization - LPG Alternative

- China is the 3rd largest LPG consumption country, with LPG import volume ranks 2nd in the world.
- Due to continuously increasing LPG price and attractive economics of DME, DME as alternative of LPG for cooking and heating has find a market in China.
- LPG/DME blends (up to 30% blend of DME with LPG) has been well used for household in Shandong, Anhui and Guangdong provinces.

DME in China

Year	Thousands T/yr DME	Thousands T/yr MeOH
2004	40	50
2005	150	220
2006	275	385

Currently Operating

Shandong Jiutai Chemical Industry
30,000 T/yr — 2003
100,000 T/yr — 2005

Lutianhua Group Inc, Sichuan
10,000 T/yr – 2003
110,000 T/yr – 2006

Shanghai Coking/Huayi Company
5000 T/yr – Apr.2006

Xinao Group
10,000 T/yr – Jan. 2006

1 MT DME requires 1.4 MT methanol

DME in China

Plants operating, under construction, in planning stage

Year	Thousands T/yr DME	Thousands T/yr MeOH
2004	40	50
2005	150	220
2006	275	385
2007	940	1,300
2008	1,600	2,200
2009	4,200	5,800
2010	8,400	11,700

Shandong Jiutai Chemical industry 1 million T/yr - 2009

Xinao Group

400,000 T/yr - under construction

Mengda Group

1 million T/yr – under planning

Lutianhua Group

200,000 T/y – under planning

China Nat. Coal/Sinopec

3,000,000 T/yr – 2010

Yigao Chemical Co

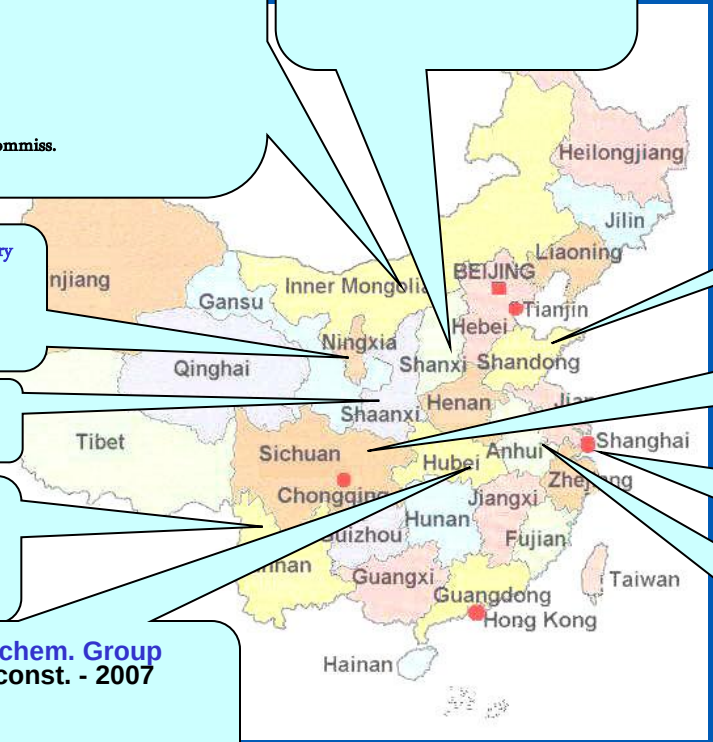
20,000 T/yr– Aug 2006 wet commiss.

Shanxi Lanhua Sci–Tech

100,000 T/yr – under construction, 2007

Lanhu Group

1,000,000 T/yr-under planning



Shenhua Ningxia Coal Industry Group

210,000 T/yr -2007

To 830,000 T/yr - 2008

Yankuang Group

200,000 T/yr - 2009

Yuannan Jiehua Chem. Group

150,000 T/yr – 2007

Under construction

Hubei Zhongjie Petrochem. Group

100,000 T/yr – under const. - 2007

Hubei Biocause Pharmaceutical

100,000 T/yr – under planning -2007

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DME in China: Plants by 3 Companies

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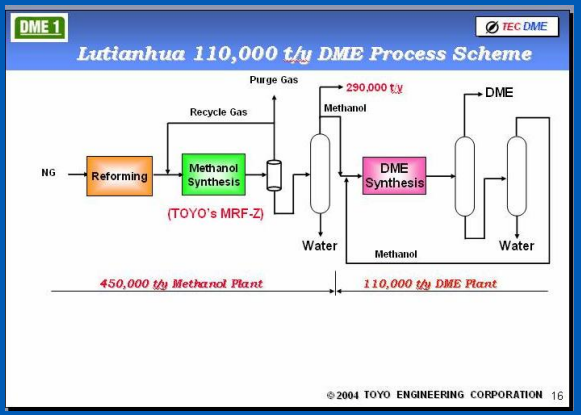
Lutianhua Group

- 2 operating plants with 3rd in planning stage
- First plant (10,000 T/yr) in started-up in 2003
- Established supply chain as LPG alternative
- Current capacity 120,00 T/yr
- Natural gas-derived methanol as feedstock
- Toyo dehydration technology
- Planning 200,000 T/yr from coal-derived methanol

10,000 T/y DME Plant



Shandong Jiutai Chemical Industry

- 2 operating plants with 3rd in planning stage
- First plant in started-up in late 2003
- Capacity 130,00 T/yr → 1,130,000 T/yr
- Coal-derived methanol as feedstock
- Using own dehydration technology (Patent ZL01107996.7.)
- 50,000 + customers as LPG alternative (Sept 2005)
- Studying other applications
- Member of IDA

JIUTAI ENERGY 久泰能源

DME

新奥集团
XinAo Group

XinAo's Plan for building DME plants

- 10,000 T/yr plant started up in. Jan 2006
- Coal-derived methanol, from 600,000 T/y plant in Inner Mongolia, under construction. Methanol will be converted to DME in the four other plants, loacted in Langfang, Bengbu, Yantai and Luoyang.

Presented at DME 2 Conference, May 2006, Zou Benzheng

DME Utilization in China - as an Automotive Fuel

Engine R&D

Prototype bus

Road test

A Fleet of DME buses Demonstration

Shanghai Project

R&D | Demonstration | Volume applications

1997 → 2005 → 2008 2010

DME in China

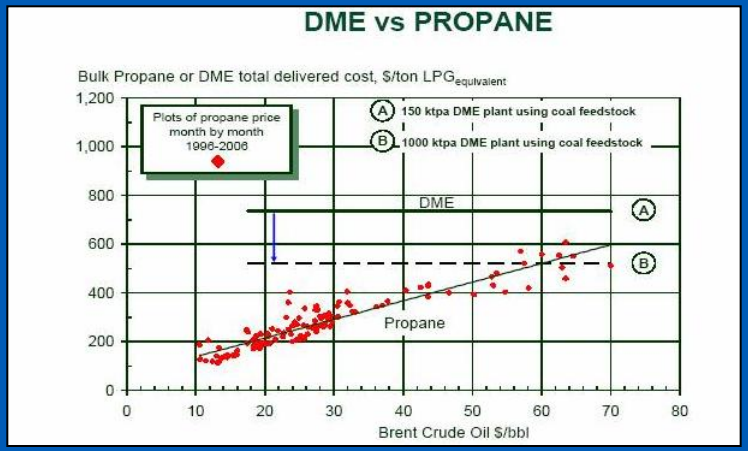
Key Observations

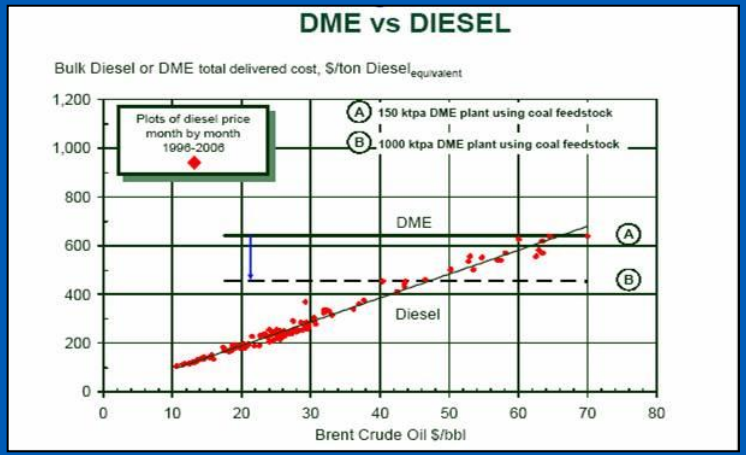
- Produced primarily from coal-derived methanol
- Market Stage
  - Commercialized at small but rapidly growing scale: LPG blend stock
  - Development: Diesel alternative
- Active companies: Shandong Jiutai, Lutianhua Group and Xinao Group
- Announced production capacity growth rate is huge; that is, greater that doubling every year from 2004 to 2010
- Key Drivers: Coal monetization, market pull for new energy supplies, utilizing existing LPG infrastructure for distribution/utilization, environmental need for clean transportation fuels

Economics

Coal-derived DME, from 1,000,000 T/y plant, is competitive with:

- **Propane/LPG at crude oil prices greater than $60/bbl**
- **Diesel at crude oil prices greater than $45/bbl**





Source: Charles Fryer, Tecnon OrbiChem Ltd, UK, May 2006

Global Challenges

- Raising awareness of DME
- International standards
- Competition with other fuels
- Lack of first successful, LARGE plant

Key Messages

Dramatic progress has been made in the first 10 years in understanding and advancing the DME business

- **DME**
  - **Proven manufacturing technologies**
  - **Large, high value fuel markets**
  - **Robust economics**
- **Global DME effort is led by Asia because of need for LPG and clean transportation fuel**
- **DME has become a COMMERCIAL REALITY**
  - **The first commercialization of fuel DME is as a LPG blend stock in China**
  - **Chinese companies rapidly gaining production, distribution and marketing experience**
- **DME is fastest growing methanol derivative**