DME as LPG Blendstock: A Disruptive or Sustaining Innovation?

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Outline

This presentation will address the “what, who, where, when and why” of global DME commercialization activities as a LPG blendstock.

- About DME
- Opportunities/Challenges
- Key Messages

“The LP Gas Industry is ready to welcome DME, the other liquid gas and to market it”

James Rockall, Managing Director, World LP Gas Association, DME 2 Conference, London, 2006

About DME

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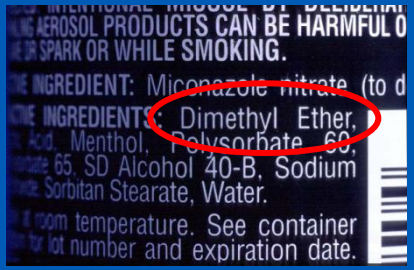
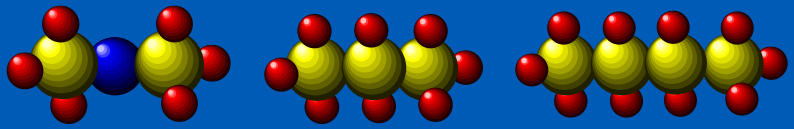
Overview - Dimethyl ether

- Colorless gas at normal temperature and pressure, with a sweet ether odor
- Burns like natural gas, and handles like LPG
- Manufactured from methanol, which is produced from natural gas, coal or biomass
- Environmentally friendly with significant global consumer history as propellant
- Large market potential as LPG blendstock, diesel alternative and fuel for power generation



www.AboutDME.org

DME has similar physical properties as LPG but different thermal properties

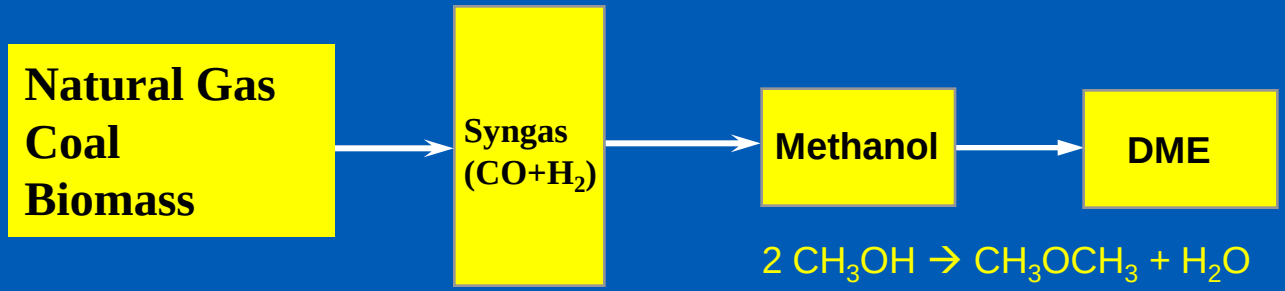


Property	DME	Propane	N-Butane
Boiling Point (deg C)	-25	-42	-1
Vapor Pressure @ 20 deg C (bar)	5.1	8.4	2.1
Liquid Density @ 20 deg C (kg/m^3)	668	501	610
Lower Heating Value (MJ/kg)	28.4	46.4	45.7
Octane, (R+M/2)	10-15	104	94
Cetane	55-60	5	10

- 1.6 MT DME equivalent to 1 MT LPG
- 1.2 m^3 DME equivalent to 1 m^3 LPG

How is DME produced today

DME is a synthetic fuel that can be produced from natural gas, coal and biomass



$2\ CH_3OH \rightarrow CH_3OCH_3 + H_2O$

1.4 MT methanol → 1 MT DME

- Methanol route uses conventional technology with numerous technology providers*.
- DME is a “synthetic fuel” with a relatively high cost structure.
- Methanol industry recognizes DME represents a significant energy market.

* Methanol to DME: Haldor Topsoe, Lurgi, Toyo Engineering and Mitsubishi Gas Chemicals.

Opportunities/Challenges in LPG Market

DME/LPG Inter-changeability studies

Objective : To verify maximum levels of DME that can be added to LPG with no substantial or very small modification of distribution system and impact on domestic applications:

- Combustion properties
- Storage and handling
- Materials compatibility

Combustion Methodology: Tested five cooking hobs with types of different burners

Conclusion: Optimal concentrations 15-20%v DME in LPG

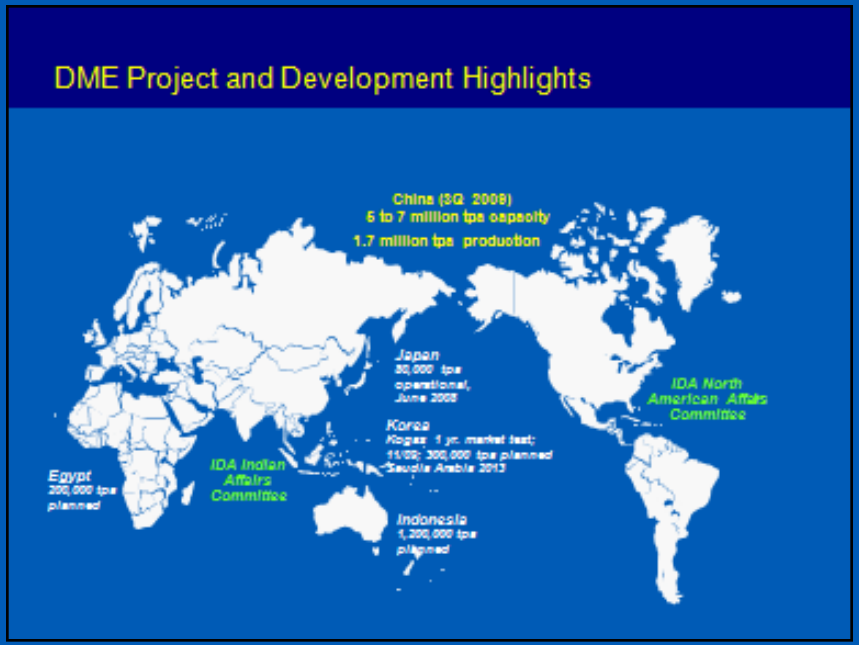
LPG/DME blends (up to 20%) have been successfully and safely tested in H1 2008 by Total in China

Source: Mario Marchionna, ENI, AEGPL Congress, Austria, May 2009

DME / LPG Blending – Factors Driving Growth

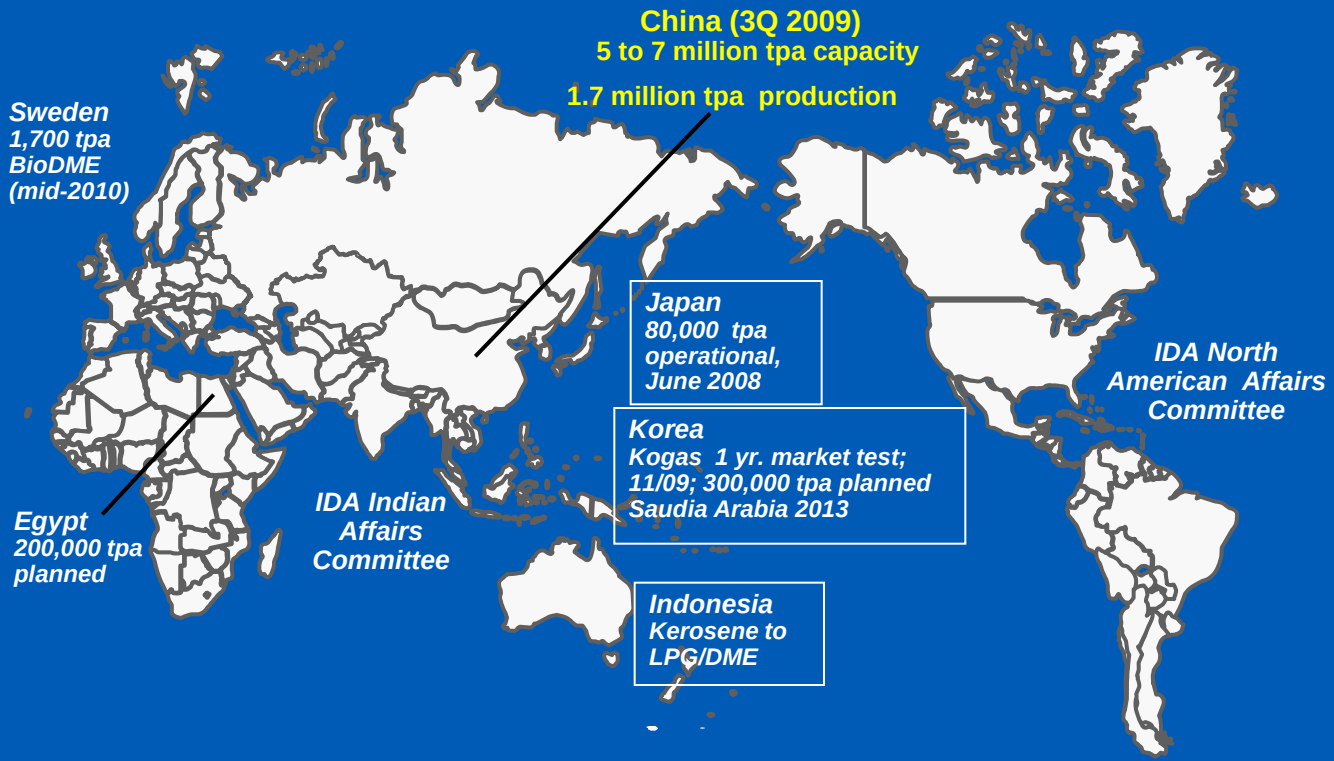
More than 80% of DME currently produced is blended with LPG

- Blending~20% DME/ 80% LPG
- Market development best in countries that:
  - Import LPG
  - Have local feed stocks to produce DME
- Largest market is China (5+MMTPY installed capacity)
- Major companies in Japan, Egypt, Indonesia, Korea and India preparing to enter this market



DME Project and Development Highlights

The best markets are in those countries that import LPG and/or have domestic feedstock to make DME.



Let's look at the global LPG market* to understand DME prospects for significant near-term growth

- Projected LPG demand (2012) in Res/Com markets: 130 million MT in world including:
  - 53 million MT in Asia
  - 18 and 15 million MT in North America and Europe, respectively

Potential DME Market in Asia as LPG blendstock:
*15 million MT (9 MT LPG equivalent)*** *based on 2012 LPG demand*

* Source: Purvin & Gertz
**20 vol% DME = 25 wt% DME.

Challenges

DME as LPG Blendstock

- Standards and Regulations
- Robust economics

Key Messages

DME as LPG Blendstock

- Significant progress has been made in the past 15 years in understanding and advancing DME as a new fuel.
- DME/LPG blending for cooking/heating is already a significant market and has large potential growth ahead, particularly in Asia.
- The best markets are in countries that import LPG and/or have domestic feedstock to make DME.
- Unlike LPG, DME is not a by-product. DME is a synthetic fuel that can be produced from natural gas, coal and biomass.

The DME market is growing but still in early stages, and challenges remain.

Save the Date: September 6-9, 2010, 4th International DME Conference, Stockholm

Questions

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Acknowledgments and Disclaimer

Acknowledgments

Ronald A. Sills LLC gratefully acknowledges the significant information provided by others used in this presentation, particularly by the International DME Association and its members.

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Backup Slide

DME – International and Regional Associations

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

2000 — Japan DME Forum

- **To coordinate Japanese National DME Initiative**
- **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.**

2005/9 — **China DME Association**

- **To advance developments in China.**