Selected Slides

# Natural Gas Brightens DME's North American Future

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***Zeus Seminar - GTL North America***

**Houston, June 6, 2013**

# About the XTL & DME Institute℠

Educational service , formed in 2010, provided by Founding Directors, Dr. Ronald Sills (Ronald A. Sills, LLC), Dr. Theo Fleisch (Fuel Conversion Solutions, LP) and Director, Dr. Iraj Isaac Rahmim (E-MetaVenture, Inc), on all aspects of the XTL supply chain, including DME as a fuel and chemical feedstock. www.XTLinstitute.com

DME Fundamentals Tutorial at DME4 in Stockholm, September, 2010

XTL Tutorial at Future Fuels for Australia Conference in Brisbane, July, 2011


DME Fundamentals Tutorial at DME5 in Ann Arbor, April, 2013

Available as webinar (contact <XTL.Institute@gmail.com>)

- DME 5 Tutorial, April 2013
- DME Presentation at Zeus GTL North America, June 6 2013

# Outline

- Introduction
- About the DME value chain
- Projects
- Economics
- Next Steps
- Key Messages

# Why DME

- Multiple fuel markets particularly as LPG blend stock and transportation fuel.
- Production from multiple feedstocks – natural gas, coal and biomass.
- Methanol-derivative: Production technology available from multiple providers.
- Attractive economics
- Environmentally-friendly

METHANEX
A Responsible Care® Company

VOLVO
Volvo Group Trucks

MGC
MITSUBISHI GAS CHEMICAL COMPANY, INC.

KOGAS

HALDOR TOPSOE

TOTAL

IDA
International DME Association
DME 21st Century Energy

DME
Japan DME Forum

DME KOREA

China DME Association

# DME opportunities/projects showcased at recent conference in Michigan


METHANEX
A Responsible Care® Company

VOLVO
Volvo Group Trucks

HALDOR TOPSOE

Diversified CPC Int'l
Essential. Pure. Hydrocarbons.

MICHIGAN ENGINEERING
UNIVERSITY of MICHIGAN • COLLEGE of ENGINEERING

KOGAS

ALTERNATIVE FUEL TECHNOLOGIES

oberon FUELS

GasTechno
Energy Efficient Recycle

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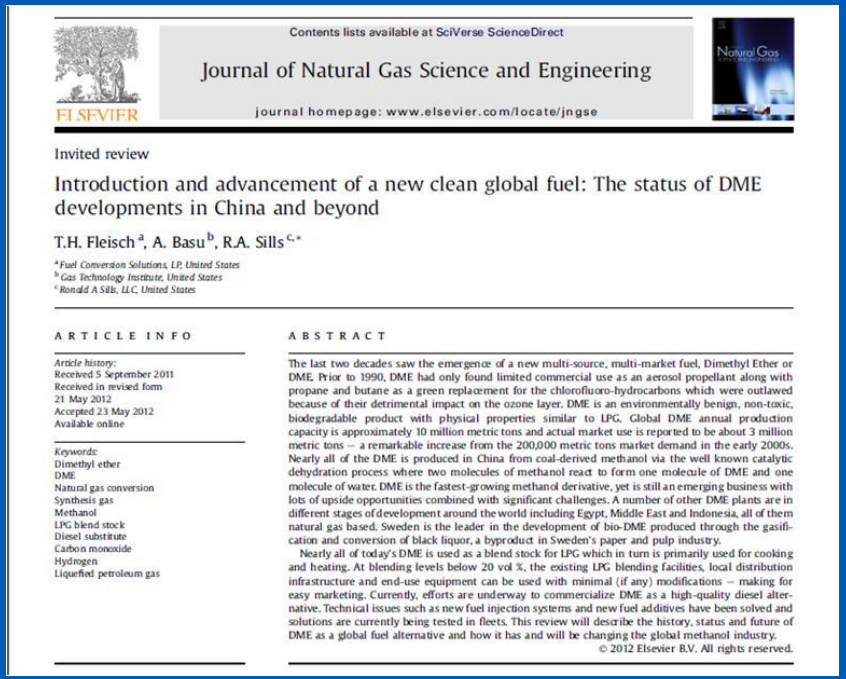

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Invited review

## Introduction and advancement of a new clean global fuel: The status of DME developments in China and beyond

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ABSTRACT

The last two decades saw the emergence of a new multi-source, multi-market fuel, Dimethyl Ether or DME. Prior to 1990, DME had only found limited commercial use as an aerosol propellant along with propane and butane as a green replacement for the chlorofluoro-hydrocarbons which were outlawed because of their detrimental impact on the ozone layer. DME is an environmentally benign, non-toxic, biodegradable product with physical properties similar to LPG. Global DME annual production capacity is approximately 10 million metric tons and actual market use is reported to be about 3 million metric tons – a remarkable increase from the 200,000 metric tons market demand in the early 2000s. Nearly all of the DME is produced in China from coal-derived methanol via the well known catalytic dehydration process where two molecules of methanol react to form one molecule of DME and one molecule of water. DME is the fastest-growing methanol derivative, yet is still an emerging business with lots of upside opportunities combined with significant challenges. A number of other DME plants are in different stages of development around the world including Egypt, Middle East and Indonesia, all of them natural gas based. Sweden is the leader in the development of bio-DME produced through the gasification and conversion of black liquor, a byproduct in Sweden's paper and pulp industry.

Nearly all of today's DME is used as a blend stock for LPG which in turn is primarily used for cooking and heating. At blending levels below 20 vol %, the existing LPG blending facilities, local distribution infrastructure and end-use equipment can be used with minimal (if any) modifications – making for easy marketing. Currently, efforts are underway to commercialize DME as a high-quality diesel alternative. Technical issues such as new fuel injection systems and new fuel additives have been solved and solutions are currently being tested in fleets. This review will describe the history, status and future of DME as a global fuel alternative and how it has and will be changing the global methanol industry.



http://www.sciencedirect.com/science/article/pii/S1875510012000650

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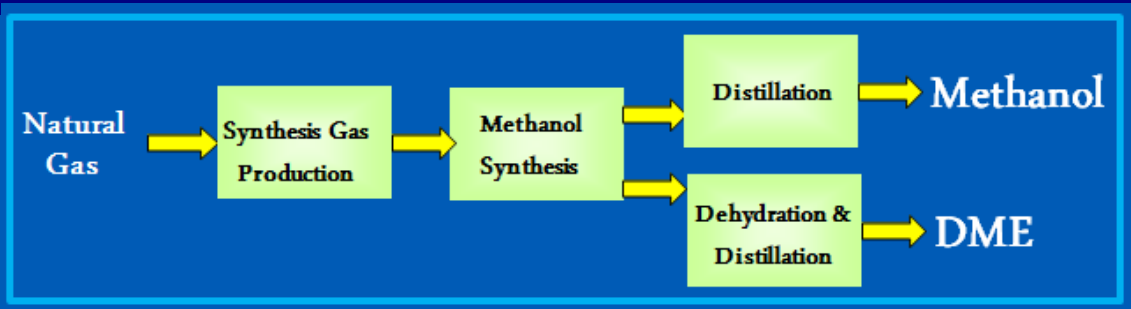
# Cost of Methanol and DME




## Bases

- Natural Gas @ $4/MMBtu
- 5,000 mtpd Methanol Plant @ $750/tpa, $1.3 billion (2013 $)
- 3,500 mtpd DME Plant @ 8% more than methanol plant, $1.4 billion
- 68/71% LHV thermal efficiency, Methanol /DME respectively
- Capital Costs @ 20% of CAPEX, capital recovery factor for ~12% DCF ROR after taxes, 20 yr economic life, 100% equity
- Operating Costs @ 6% of CAPEX includes maintenance, supplies, labor, catalyst & chemicals, electricity & water, general plant overhead and insurance. Process gas include in cost of natural gas. property taxes not included.

# Cost of Methanol and DME

## Illustrative Example

Methanol and DME produced in large-scale plants in U.S. Gulf Coast from natural gas

**Bases**

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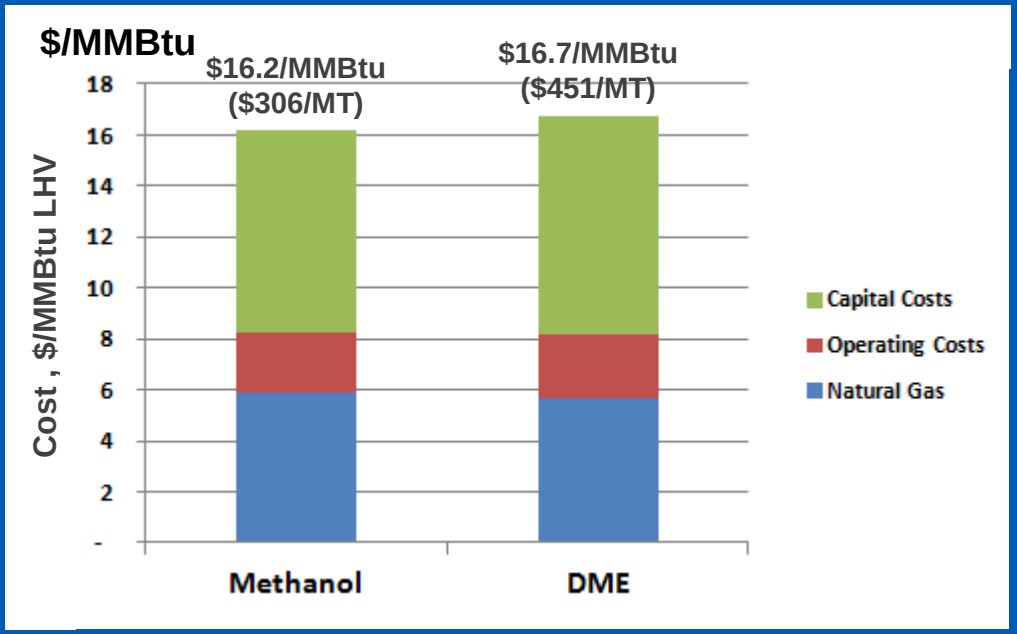
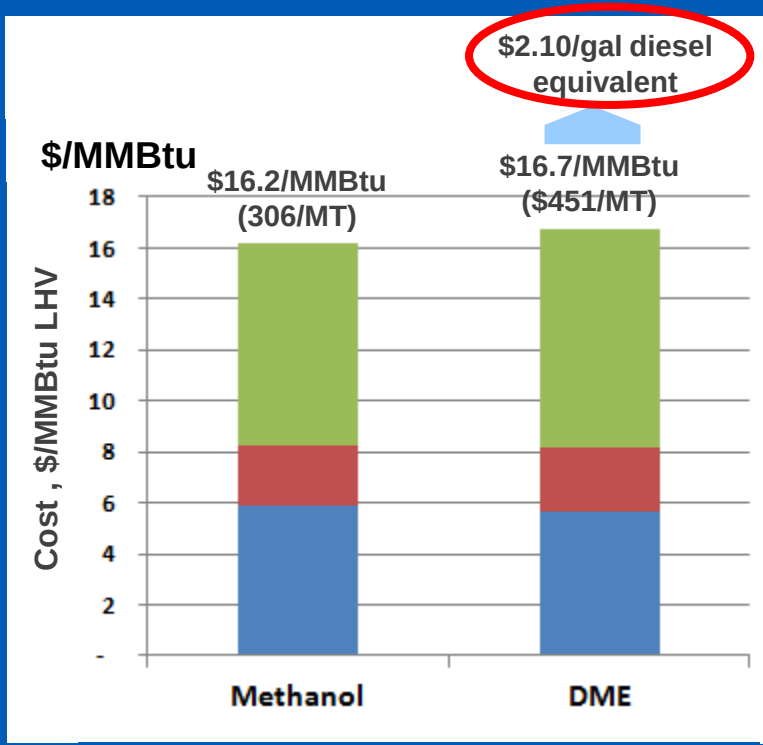
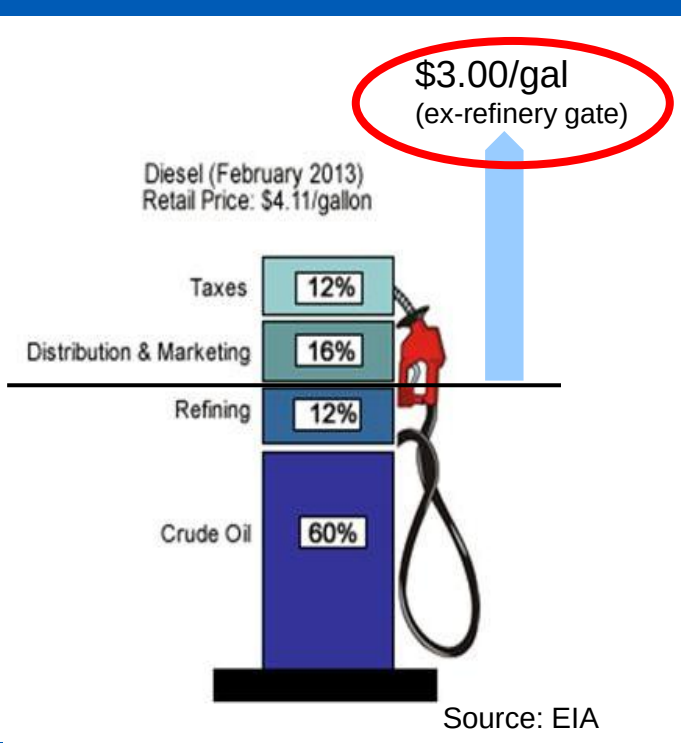
- 5,000 mtpd Methanol Plant @ $750/tpa
- 3,500 mtpd DME Plant @ 8% more than methanol plant
- 68/71% LHV thermal efficiency, MeOH/DME
- Capital Costs @ 20% capital recovery factor for ~12% DCF ROR



# DME cost of $16.70/MMBtu ($451/MT) is equivalent to $2.10/diesel gal, which is less than the current diesel price of $3.00/gal (ex-refinery gate)




Source: EIA

Memo: Comparison for illustrative purposes

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***Acknowledgments***

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***Disclaimer***

The lecturers have prepared this presentation utilizing reasonable care and skill in applying methods of analysis consistent with normal industry practice.

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