Progress in the Commercialization of DME

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World GTL 6 Summit

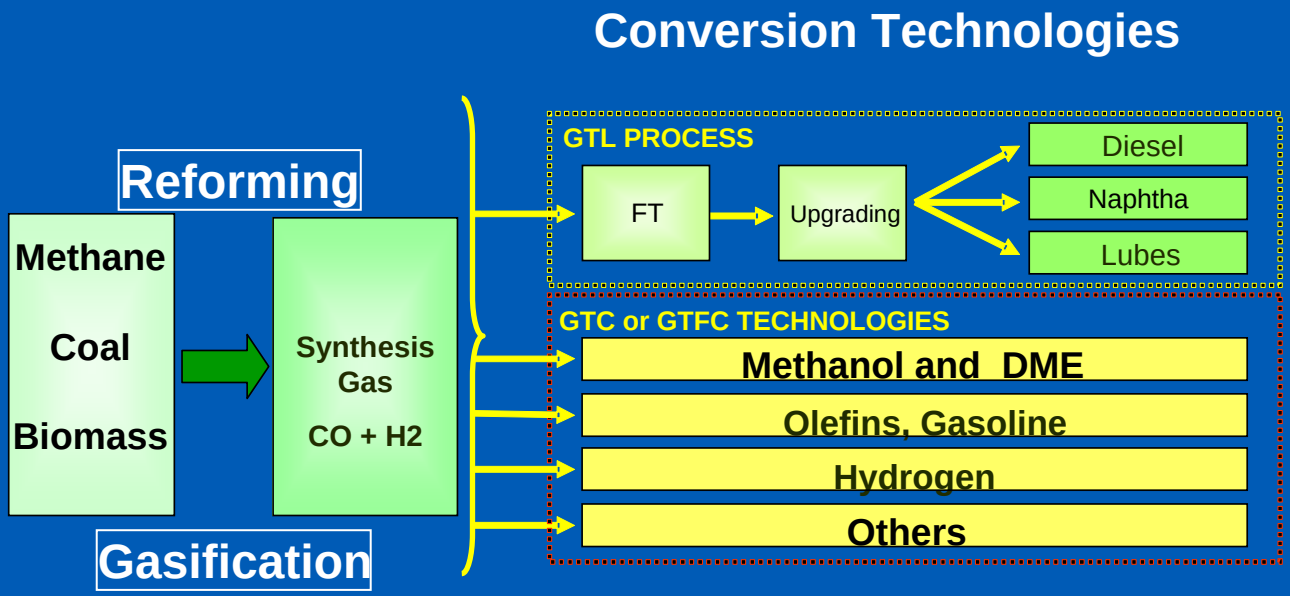
London

May 17 - 19, 2006

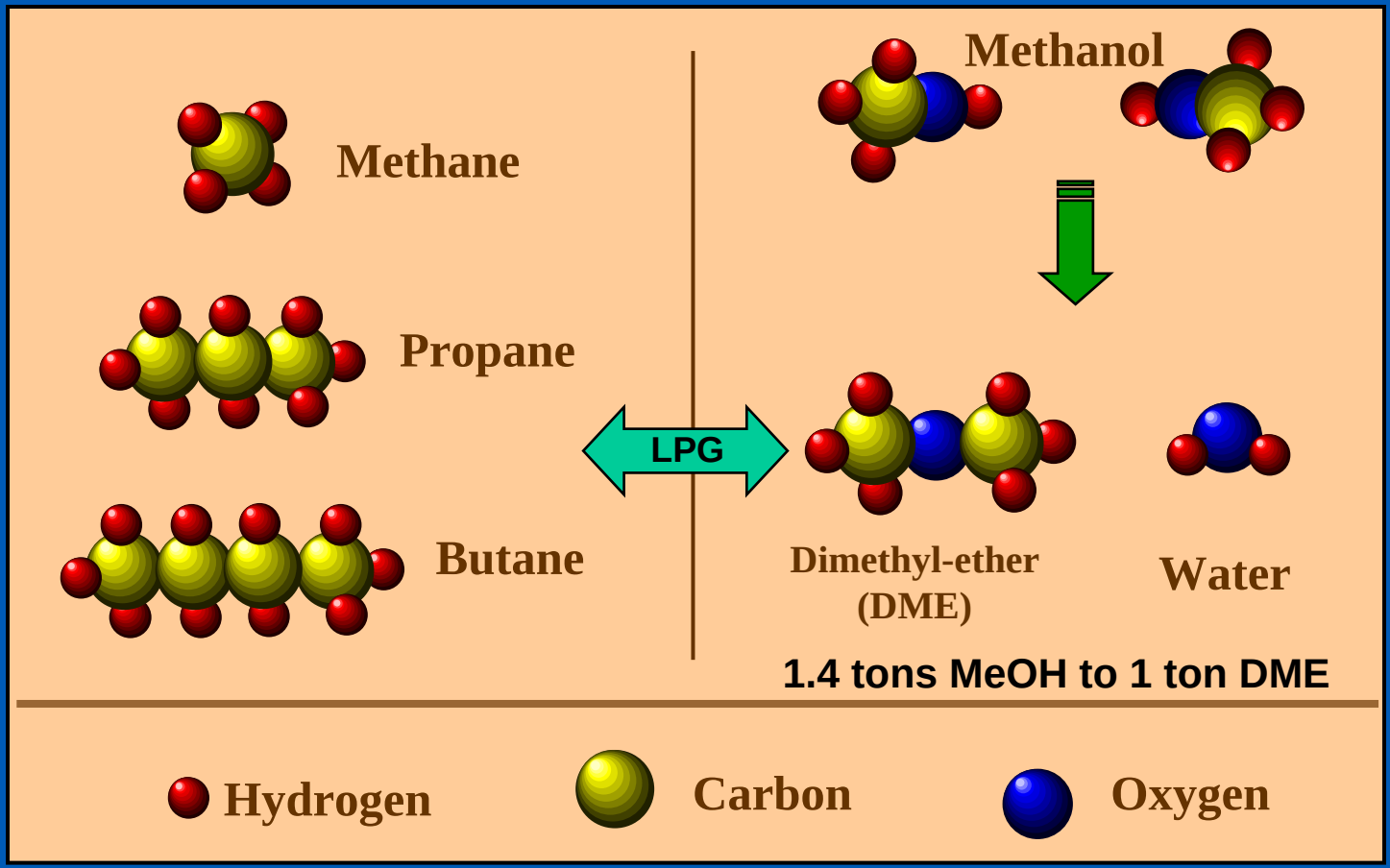
Outline

- Role of DME in GTP/XTP family
- Properties and markets
- Global developments
- Conclusion

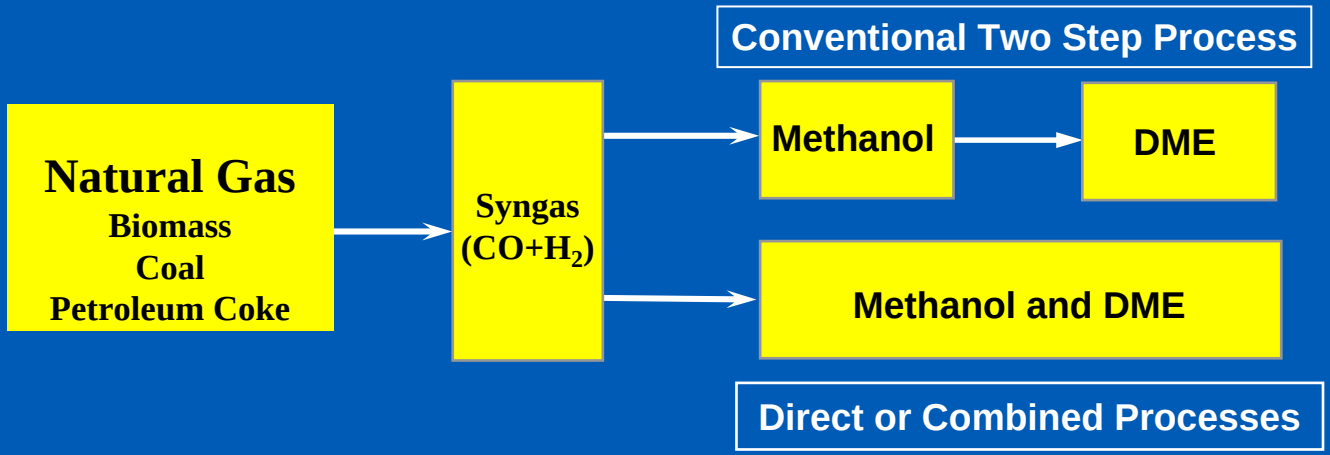
DME: a member of the GTP or XTP family



What is DME? "Synthetic LPG"



Methanol and DME production



- Same chemistry, different engineering
- Methanol to DME conversion is very simple and cheap
- Similar Capex and Opex (<10% delta; lower than GTL-FT!)
- Co-production feasible
- First plants: all 2 step technologies

Comparison GTL-FT, Methanol and DME

	GTL-FT	Methanol	DME
Technology availability	restricted	Global choice	Global choice
Efficiency Thermal/carbon	60/77	70/82	70/82
Process steps	3	2	3 or 2
Project size	>0.5 bcfd	<0.5 bcfd	<0.5 bcfd
Environmental benefits	+ incremental	+ incremental	++ Step change
Markets	traditional	mostly new	new

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About DME

- Handles like LPG
- Manufactured from/with methanol
- Environmentally friendly
- Large market potential as synthetic LPG, diesel alternative and fuel for power generation
- Feedstock for hydrogen, olefins and gasoline
- The “ideal” diesel fuel

Properties of methanol and DME

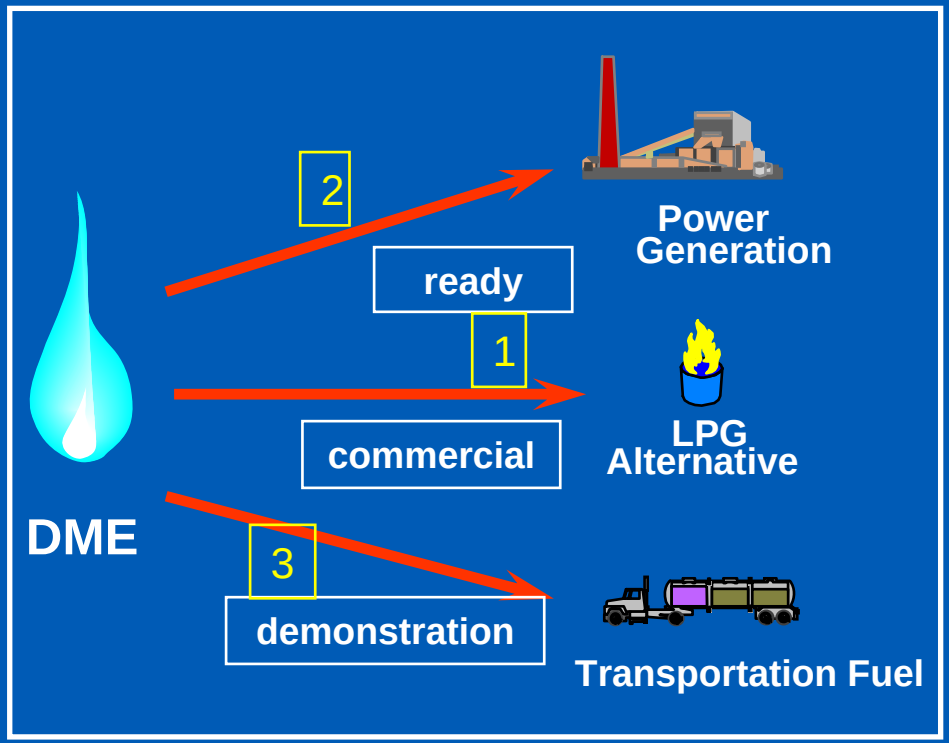
Property	DME	Propane	Methanol
Boiling Point (deg C)	-25	-42	65
Vapor Pressure @ 20 C (bar)	5.1	8.4	0.3
Liquid Density (kg/m^3)	670	500	790
Lower Heating Value (kcal/l)	5200	5900	3200
Auto Ignition Temp (deg C)	235-350	470	465
Explosion/Flammability Limit in air (vol %)	3.4-17	2.1- 9.4	7.3-36
Octane, (R+M)/2	low	104	100
Cetane	60+	5	5

DME Markets

CFC Replacement

Today

Three Primary Applications...



Future

DME offers material markets

Target Products	Potential market size MMTPA
Benchmark: LNG	*140 (actual)*
GTL-FT: Diesel	1100
GTL-FT: Crude Oil	3800
Ammonia	130
Methanol, chemical	34
Methanol/DME to Olefins	140
Methanol/DME to Gasoline	900
Methanol to DME (syn-LPG)	215
2020 Asia DME demand	200

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Recent key developments

- Commercial plants in China with domestic fuel customers
- World production tripled in 3 years (150ktpa to 450tpa)
- Mega-methanol projects proven (Atlas with BP, Methanex, Lurgi)
- Successful completion of Volvo Afforhd diesel project; numerous other fleet testing

DME - Global Activities

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

DME
Japan DME Forum

Korea DME Forum

China DME Association

International DME Association

Dimethylether: A Fuel for the 21st Century

Membership – 2006

Patron

- AB Volvo
- BP America Inc.
- Lurgi

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.
- Forschungszentrum Karlsruhe GmbH
- 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

Honorary

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

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

Red color *indicates a new member (joined since DME 1)*

IDA

International DME Association

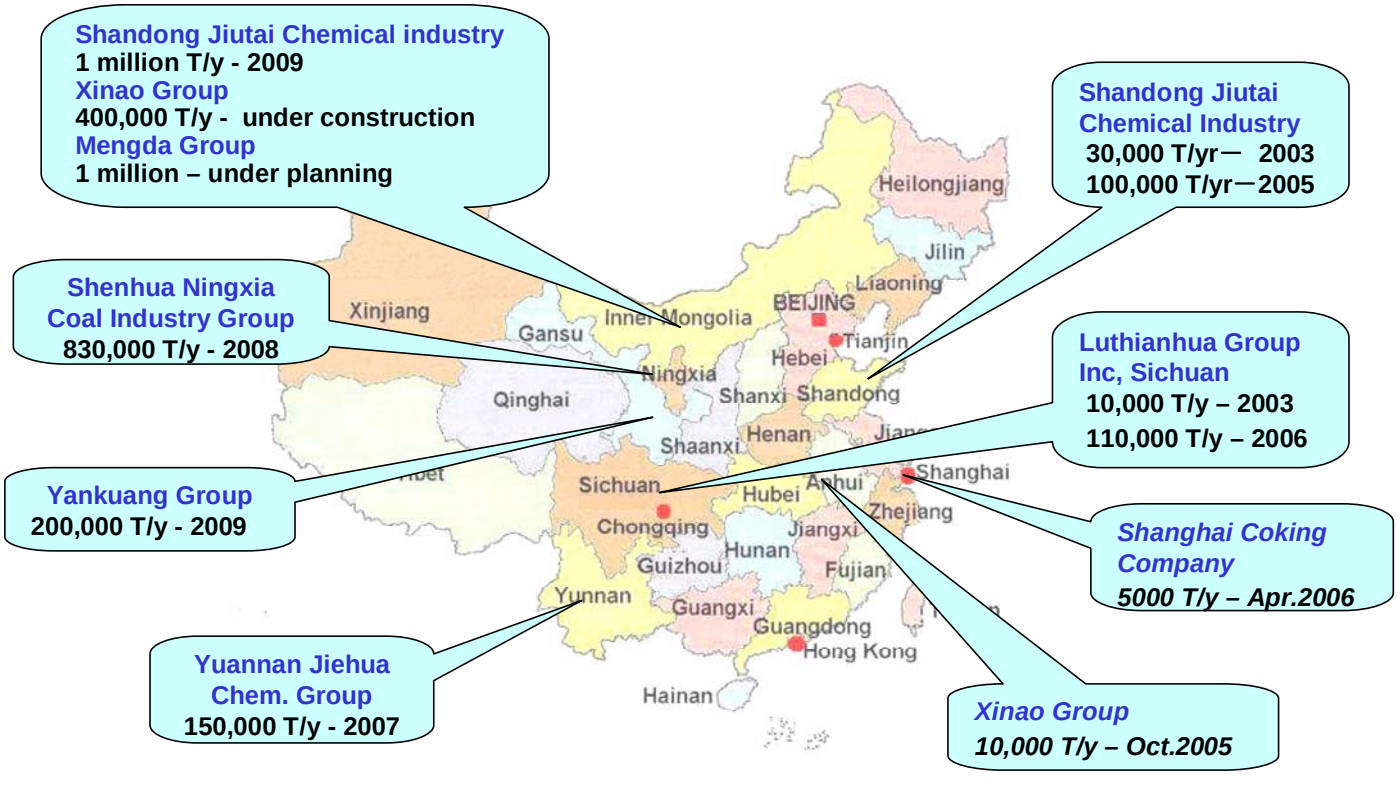
Dimethylether: A Fuel for the 21st Century

DME 2: May 15 -17, 2006

Key messages from DME 2 conference

- DME is commercial reality (~450ktpa)
- China is major producer and consumer
- Market order: LPG – diesel – power
- Robust economics: ~$4-6/MMBTU delivered
- Production from coal, gas and biomass
- Easy production from methanol
- Emerging DME to olefins business
- Numerous diesel fleet testing: 2010 commercial

Domestic DME Production



Quantities Involved – Production

	2004	2010	2020
LP Gas	212MT	250MT	340MT
DME	150KT	<10MT	<70MT

Conclusion

- LP Gas is a popular and growing fuel in the world
- The WLPGA exists to promote its use and facilitate market development
- DME and LP Gas have very similar handling conditions and physicochemical properties
- As mixtures or separately, DME and LP Gas can often be used as SUBSTITUTES.
- The LP Gas industry is ready to welcome DME, the other liquid gas and to market it.

Conclusions

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

- DME has become a COMMERCIAL REALITY
- First manufacturers: methanol producers
- Global DME effort is led by Asia because of need for LPG and clean transportation fuel
- DME
  - Proven manufacturing technologies
  - Low cost XTP option
  - Large, high value fuel markets
  - Robust economics

Take aways

1. “DME is synthetic LPG” (with a twist)
2. “DME is easy” (manufacture, distribute, market)

Back-up

DME plants

China 1 (Lutianhua, Toyo, gas)	**10 ktpa**	**2003**
China 2 (Shangdong, coal)	**100 ktpa**	**2004**
China 3 (Lutianhua, Toyo, gas)	**110 ktpa**	**2006**
Iran 1 (Zagros, HTAS, gas)	**800 ktpa**	**2008**
Japan 1, 2, 3 (3 consortia)	**~2,000 ktpa**	**2010**
China 4 (Shangdong, coal)	**1,000 ktpa**	**2010**