Renewable methanol and DME developments

Eelco Dekker, Chief EU Representative
Methanol Institute
Gothenburg, September 19th, 2018
01 Driving forces
Broad feedstock range, many applications

**Feedstock**
- Natural gas: ~65%
- Coal: ~35%
- Biomass & renewables: <1%

**Conversion**

**Derivatives**
- Formaldehyde 27%
- Acetic acid 9%
- MTBE 8%
- MTMA 2%
- Gasoline blending 9%
- MTO 18%
- Methylamines 3%
- DME 8%
- Biodiesel 3%
- Solvents 4%
- Chloromethanes 2%

**Products**
- Other 7%

**Markets**
- Appliances
- Automotive
- Construction
- Electronics
- Fuel
- Paint
- Pharma
- And more...

Source: IHS
Developments driven by three forces

- Supply
- Legislation
- Demand
02 Renewable methanol supply
Starting with biomass

Sustainable biomass
(residues, MSW, etc)
Modern approach to biorefining

Sustainable biomass (residues, MSW, etc)

Fermentation

Biogas

Biomethane

Reformer

Syngas

Reactor & distillation

Bio-methanol

Courtesy QAFAQ

BioMCN, The Netherlands
Or gasification to syngas

Sustainable biomass (residues, MSW, etc)

Gasification

Syngas

Reactor & distillation

Bio-methanol

Courtesy QAFAQ

Enerkem, Canada
And from pulp mill processes

Sustainable biomass (residues, MSW, etc)

Kraft process

Reactor & distillation

Bio-methanol

Courtesy QAFAQ

Södra, Sweden

METHANOL INSTITUTE

WWW.METHANOL.ORG
E-methanol provides a whole different route

Renewable electricity

Electrolysis

Carbon capture

H₂

Syngas

Reactors & distillation

Renewable methanol

CRI, Iceland

Courtesy QAFAQ

WWW.METHANOL.ORG
Whereas hybrid pathways increase efficiency

Sustainable biomass (residues, MSW, etc)

Fermentation
Gasification

Biogas

Biomethane

Reformer

Syngas

Reactors & distillation

Renewable electricity

Electrolysis

H₂

Bio-methanol

Renewable methanol

Courtesy QAFAQ

KIT, Germany
Opening routes to bio-DME

Sustainable biomass (residues, MSW, etc)

Fermentation

Gasification

Biogas

Biomethane

Reformer

Syngas

Reactor & distillation

Bio-methanol

Courtesy QAFAQ

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Methanol fuel use is increasing.
Fuel use developing globally
Clean energy solutions drive new markets

- Road
- Power
- Heat
- Marine
Solutions for gasoline and diesel engines

- **Low blends**
  - FAME

- **Mid level blends**
  - MD95

- **High blends**
  - DME
Alternative marine fuel developments

**COMBUSTION ENGINE**
- 7x +4x chemical tankers
  - MOL, WL, Marininvest
  - 2 stroke MAN
  - new build
- 1x ROPAX ferry
  - Stena Line
  - 4 stroke Wärtsila
  - retrofit

**FUEL CELL**
- 1x Pilot boat
  - Swedish Maritime Admin.
  - high speed Scania, Volvo, a.o.
  - retrofit
- 2x Tourist boat
  - Innogy HTWG Konstanz
  - Serenergy fuel cell stacks
  - retrofit
- 1x Ferry
  - Viking Line
  - retrofit

**PROJECT and R&D**
- Cruise ships, fishing boat, barge, dredge, a.o.
  - Billion Miles, Summeh/Martec, HyMeth Ship, Lean Ships, Methaship, a.o.
  - SI hybrid, dual fuel, etc.
  - new build & retrofit
Powering low emissions electricity

- Fuel cells
  - Stationary back up power
  - Hotel load
  - Range extender

- Gensets

- Turbines
Displacing solid fuels to provide clean heat

- Industrial boilers
- Cook stoves
Different stages of the life cycle

sales

- DME
- OME
- OME
- MD95
- M100
- GEM
- Turbines
- Generators

- M3
- M15
- MTBE
- biodiesel

boilers

- marine
- cook stoves
- fuel cell

introduction

growth

mature

decline
04 Moving forward
The future is bright

Legislation drives changes to clean, renewable alternatives

Methanol, and its derivatives offer many benefits

Especially when made from sustainable feedstocks

In a range of different applications from cars to ships, from power to heat

Essential to remove prejudices against methanol
05 Contacts
CONTACTS

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A global industry association

- First formed in 1989, the Methanol Institute (MI) serves as the trade association for the global methanol industry.
- MI represents the world’s leading methanol producers, distributors and technology companies from offices around the world.

MI provides value to its members by:
- Ensuring safe handling of methanol and its derivatives
- Promoting methanol growth by furthering methanol as an essential chemical commodity and an emerging source of clean and renewable energy
- Influencing global regulatory and public policy initiatives that impact the methanol industry
2018 members
At different stages of development

<table>
<thead>
<tr>
<th>Methanol category</th>
<th>Commercial</th>
<th>Feasibility and R&amp;D</th>
<th>Stopped or On-hold</th>
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</thead>
<tbody>
<tr>
<td><strong>Bio-methanol</strong></td>
<td>• BioMCN (NL) • Enerkem (CAN) • New Fuel (DEN) • Oberon (USA)</td>
<td>• Biogo (GER) • Enerkem (NL) • LowLands Methanol (NL) • Södra (SE)</td>
<td>• BioMCN (glycerine) (NL) • Chemrec (SE) • Range Fuels (USA) • Schwarze Pumpe (GER) • Värmlands Metanol (SE) • Woodspirit (NL)</td>
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<tr>
<td><strong>Renewable methanol</strong></td>
<td>• CRI (IC) • Innogy (GER)</td>
<td>• Blue Fuel Energy (CAN) • CRI (CN) • Infraserv (GER) • Liquid Wind (SE) • Port of Antwerp (BE) • STEAG (GER) • Swiss Liquid Future (CH) • ZAST (GER)</td>
<td></td>
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<tr>
<td><strong>Hybrid methanol</strong></td>
<td></td>
<td>• Haldor Topsoe (DEN) • OPTIMeoH (GER)</td>
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<tr>
<td><strong>Low carbon methanol</strong></td>
<td>• GPIC (BAH) • Methanex (CAN) • QAFAC (QAT) • SABIC (KSA)</td>
<td>• Carbon2Chem (GER) • FRESME (SE) • NCF (CN)</td>
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