

# Fuel Applications for Methanol

Gregory Dolan, CEO IHS World Methanol Conference -- Berlin 5 October 2019

## **MI HISTORY**

- The Methanol Institute (MI) was established in 1989
- 30 years later, MI recognized as the trade association for the global methanol industry
- Facilitating methanol's expansion from our Singapore headquarters and regional offices in Washington DC, Brussels, and Beijing











#### BROAD FEEDSTOCK RANGE, MANY APPLICATIONS





## GLOBAL METHANOL FUEL EXAMPLES



https://www.methanol.org/energy/



## **RENEWABLE METHANOL REPORT**





- 2 February: MI releases *Renewable Methanol Report* prepared by ATA Insights
- Contents:
  - Executive summary
  - Why consider renewable methanol?
  - Renewable methanol production
  - Case Studies: CRI, Enerkem, BioMCN
  - Applications and uses of renewable methanol
  - Conclusions and how to find out more
- <u>https://www.methanol.org/renewable-</u> <u>methanol/</u>



## **RENEWABLE METHANOL REPORT**





Renewable methanol is an ultra-low carbon chemical produced from sustainable biomass, often called biomethanol, or from carbon dioxide and hydrogen produced from renewable electricity.

**Renewable Methanol Emission Reductions:** CO2 by up to 95%; NOx by 80%; virtually eliminating SOx and Particulate Matter (PM)



#### **RENEWABLE METHANOL TRACKER**



Methanol category	Commercial	Feasibility and R&D		
Bio- methanol	"BASF (GER) ■ BioMCN (NL) ■ Enerkem (CAN) ■ New Fuel (DEN) ■ Nordic Green (DEN) ■ OCI (USA)	Biogo (GER)     Biogo (GE		
Renewable methanol	© CRI (IC) © Innogy (GER) © Air Co (USA)	<ul> <li>Advanced Chemical</li> <li>ETH Zurich (CH)</li> <li>Technologies (CAN)</li> <li>Asahi Kasei (JPN)</li> <li>Blue Fuel Energy (CAN)</li> <li>Blue Fuel Energy (CAN)</li> <li>Maire Tecnimont (IT)</li> <li>bse Engineering (GER)</li> <li>Haldor Topsoe (DEN)</li> <li>Catalytic Innovations (USA)</li> <li>CRI (CN/GER)</li> <li>Gensoric (GER)</li> <li>Infraserv (GER)</li> <li>Liquid Wind (SE)</li> <li>MefCO2 (GER)</li> <li>Neo-H2 (USA)</li> <li>Port of Antwerp (BE)</li> <li>Quantiam Technologies (CAN)</li> <li>STEAG (GER)</li> <li>Swiss Liquid Future (CH)</li> <li>thyssenkrupp (GER)</li> <li>USC (USA)</li> <li>ZASt (GER)</li> </ul>		
Low carbon methanol	GPIC (BAH) Methanex (CAN) QAFAC (QAT) SABIC (KSA)	©Carbon2Chem (GER) ©FRESME (SE) ©GasTechno (USA) Of Haldor Topsoe (DEN) ©Maverick Synfuels (USA) ©OPTIMeoH (GER)		







#### EU IS COMMITTED TO ESTABLISH A CARBON NEUTRAL ECONOMY BY 2050 – RENEWABLE ENERGY ACCOUNT FOR 95%

#### **EUROPEAN COMMISSION GHG REDUCTION OBJECTIVES FOR 2050**





- It is assumed, the electricity generation achieves zero net emissions by 2050
- The transport sector target is less than for the overall economy
- The transport sector needs to cut its greenhouse gas emissions by 80% to 95% by 2050 compared to 1990



Source: European Commission, FEV



#### IN 2050 GERMANY WILL RELY ON IMPORTED CHEMICAL ENERGY CARRIERS – BUT THEY HAVE TO BE SYNTHESIZED FROM RENEWABLES

#### IMPORT OF SYNTHETIC FUELS IN 2050 EQUALS UP TO 50% OF TODAY'S MINERAL OIL IMPORTS



Primary energy carriers in PJ

Source: European Commission, BMWi Energiedaten, AG Energiebilanzen, ewi gGmbH "Evolution scenario"

- Primary energy use will be shortened by 50% compared to 2008
- Fossil fuels will provide only 5% of the total primary energy consumption
- Import of renewable electricity to Germany will increase
- Up to one third of the total energy consumption might be covered by Power-to-Fuels, thereof
  - 75% are imported from outside Europe
  - 17% are imported from inside Europe





WWW.METHANOL.ORG

## POTENTIAL TO STORE EXCESS RENEWABLE POWER





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# **GERMAN 2030 CLIMATE PLAN**

 Fuel cells and fuels produced with <u>power-to-x</u> <u>technology</u> are said to play an important role in future freight transport and the government plans to support "development and large-volume scaling" of electrolysis and other refinery procedures for electricity-based and climate-neutral fuels.

Merkel's Cabinet agrees 'climate packet,' environmentalists say it's paltry

20 September 2019

https://www.dw.com/en/merkels-cabinet-agrees-climatepacket-environmentalists-say-its-paltry/a-50517157









# **GERMAN C3 MOBILITY**

- C3 Mobility for Closed Carbon Cycle
- Joint public/private partnership with German Ministry of the Economy and Energy and German automotive industry
- Two-year, € 24 million program





#### METHANOL ALREADY ESTABLISHED PLATFORM MOLECULE FOR THE CHEMICAL INDUSTRY/ FUEL PRODUCTION AND AN EXCELLENT FUEL!

#### METHANOL IS A PROBABLE SOLUTION TO IMPORT RENEWABLE ENERGY TO GERMANY/EUROPE

MeOH is used as fuel already	MeOH is promising alternative for SI and commercial engines
<ul> <li>First series production M100 truck, claiming 18% costs savings/vear</li> </ul>	<ul> <li>Methanol is cheap to produce</li> <li>Established product and building-block (chemical industry)</li> <li>Handling and infrastructure is considered to be more complex</li> <li>Available applications very limited (EN228 limits MeOH to 3% v/v, but push from Asia)</li> </ul>
<ul> <li>Methanol is used from M5 to M100</li> </ul>	Methanol +/o o +/o o o/-
Applications range from PC to HD	Methanol utilization in transport will significantly rise



Source: bigwheels.my



## **ITALY M15/E5 BLENDING**

- 21 November 2017: With Italian Prime Minister, the CEOs of Eni and Fiat Chrysler Automobile sign MOU for joint development of technology reducing CO2 of road transport vehicles
- Eni had developed an "A20" fuel blend of 15% methanol and 5% bioethanol
- New blend demonstrated in 5 FCA Fiat 500 vehicles in Eni's Enjoy car-sharing fleet







# **A20 RESULTS**

- "... the new alternative fuel emits up to 3% less in CO2 exhaust emissions quantified using the new Worldwide Harmonized Light Vehicle Test Procedures (WLTP).
- "The formula was designed to reduce direct and indirect CO2 emissions and is compatible with the majority of petrol cars sold from 2001 onwards..."





#### Eni and FCA have developed A20, a new fuel that pairs emissions reduction with energy efficiency

San Donato Milanese (Milan), 3 April 2019 - Within the scope of the agreement signed in November 2017, Eni and FCA have teamed up to develop "A20", a new fuel with a low level of emissions due to its 15% methanol and 5% bio-ethanol alcohol content. By harnessing its low carbon content, bio component and high octane number, the new alternative fuel emits up to 3% less in CO<sub>2</sub> exhaust emissions quantified using the new Worldwide Harmonized Light Vehicle Test Procedures (WLTP).

The formula was designed to reduce direct and indirect CO<sub>2</sub> emissions and is compatible with the majority of petrol cars sold from 2001 onwards, which accounts for more than 60% of the petrol cars in Italy, equivalent to approximately 12 million vehicles.

An initial test run of five Flat 500s from the Eni Enjoy fleet in Milan ended successfully a few weeks ago. The cars were rented out around 9,000 times and travelled for 50 thousand kilometres during the 13 months of the test without experiencing any problems, demonstrating a reduction in emissions and better performance as a result of the high octane number.

In the meantime, EnI and FCA are working to improve the A20 formula even further by increasing the amount of hydrocarbon components from renewable sources with a view to further reducing "WeiHo-Wheel" CO; emissions (this parameter evaluates emissions by taking production, transport and fuel consumption into consideration).



# CHINA M100

- Dec 2018: MIIT completes acceptance of all methanol pilot demonstration programs
- March 2019: MIIT and 7 other ministries announce methanol policy paper for M100
- MI issues press release and briefing report
- <u>https://www.methanol.org/wp-content/uploads/2019/03/A-Brief-Review-of-Chinas-Methanol-Vehicle-Pilot-and-Policy-20-March-2019.pdf</u>
- "Paper 61" encourages commercialization of M100 vehicles
- Approval of 32 product models from 9 methanol vehicle manufacturers
- MI and MIIT Chongqing Methanol Vehicle Conference, 11-13 October









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# CHINA M100

- Currently over 20,000 methanol-fueled taxis operation for total of 125 million kilometers
- M100 methanol fuel consumption for taxi is 13.5 litres/100 km, with energy consumption of 237.8 MJ



Table 2 Taxi Fuel Cost Comparison of Taxi in Jin Zhong City							
	Gasoline	CNG	M100				
Fuel Price RMB/L	5.51	3.5 RMB/m <sup>³</sup>	1.8				
Fuel Economy L/100km	8	8.8 m³/100km	13.5				
Fuel Cost Saving %	37.5	10.6					

Note: the fuel price is based on the operation in November of 2015;









## **REGULATIONS DRIVE SHIPPING MARKET**

- The International Maritime Organization has adopted emission regulations transforming the shipping industry
- In 2020, global SOx reductions take effect
- By 2040 requires 40% GHG reduction, and 50% by 2050







# **METHANOL VESSELS ON THE WATER**



# WATERFRONT SHIPPING – AUGUST LAUNCH



"We are very excited by the performance of our first seven methanol-fuelled vessels that have proven the safety and reliability of the technology. With this second generation of vessels, we will benefit from innovative technological advances that will continue to optimize performance and efficiency," says Paul Hexter, President, Waterfront Shipping Ltd. "On an energy-equivalent basis, methanol is cost competitive over energy price cycles and we see significant value creation opportunities from using a methanol flex-fuel engine." 20 August

https://www.globenewswire.com/news-

release/2019/08/20/1904546/0/en/Industry-Welcomes-Second-Generation-Low-Emission-Methanol-Fuelled-Vessels.html









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#### MAN DUEL-FUEL ENGINE WATERFONT CONFIGURATION



"We developed the ME-LGIM engine in response to interest from the shipping world in alternatives to heavy fuel oil. With the growing demand for cleaner marine fuels, methanol is a sulphur-free alternative that meets the industry's increasingly stringent emission regulations." **René Sejer Laursen, Promotion Manager at MAN Energy** 

Solutions

https://marine.man-es.com/two-stroke/2-stroke-engines/me-lgim

# **METHANOL GLOBAL PORT AVAILABILITY**





According to a survey conducted by the Methanol Institute – an industry body whose members include companies involved in methanol production and distribution – methanol is already potentially available from most of the world's top ports (by tonnage). Chris Chatterton, the institute's chief operating officer, told ShipInsight on 22 August that its full data will be published "in about a week" but provided a summary that showed its survey had covered 151 ports, of which 97 had "methanol directly in, or in close proximity to, the port." Those include 88 of the top 100 ports. 23 August

> https://shipinsight.com/articles/methanol-fuel-what-youneed-to-know



## **METHANOL BUNKERING EASY AND CLEAN**

- Liquid at atmospheric pressure
- Available in many ports around the world and along rivers
- Low infrastucture cost
- Flexible, modular system
- Environmentaly friendly as it's biodegradable













# METHANOL INDUSTRIAL BOILERS IN CHINA

- Industrial boilers are widely used for heating and industrial stream
- Many cities in China prohibiting use of coal and diesel fuels
- Capacity ranged from 1 to 80 ton/hour
- One steam ton capacity consumes 110 kg of methanol, and runs 24/7
- Methanol fuel is used neat or as blend with diesel fuel
- Standards developed with MI and Methanex support
- Estimated more than 1500 units, consuming over 3 MMT methanol in 2019
- Growing to 5 MMT by 2022

STITUTE

https://www.methanol.org/energy/boiler -cookstoves/







Methanol Boiler





# METHANOL COOK STOVES IN CHINA



- Different types methanol cook stoves: Single heating, stir fry, steaming
- Widely used in restaurants, central kitchens, mainly cost-driven
- Simple storage and transportation, filling the gap of pipeline NG supply
- Fuel: 100% methanol to methanol blends usually with water
- Market for Cooking Application over 5 MMTs in China in 2019
- Growing to 7-8 MMT by 2022



## GLASS/CERAMIC KILNS AND TOBACCO DRYING



- China also developing other new markets for the use of methanol:
  - Glass/ceramic kilns China produced 60% of world's glass products; methanol produces cleaner flue gas for superior finish; 4 MT/month average methanol demand; retrofit costs = €1,350
  - Tobacco drying One in every 3 cigarettes smoked in the world are smoked in China; Provides state with more revenue than Sinopec and CNOC combined







### METHANOL A HYDROGEN CARRIER FOR FUEL CELLS

- Blue World Technologies (Denmark)
- Palcan (China)
- Advent Technologies (USA)
- Horizon Energy Systems (Singapore)
- Oneberry (Singapore)
- Altergy (USA)
- Serenegy (Denmark)
- SFC Energy (Germany)
- Toshiba (Japan)
- Ultracell (USA)





















# COMMERCIAL OFFERINGS FOR STATIONARY POWER





## DENMARK'S BLUE WORLD TECHNOLOGIES AND CHINA'S PALCAN

#### MANUFACTURING PLANTS: 50,000 UNITS/YEAR





Launch Reception: Blue World Technologies presenting plans for large-scale manufacturing facility

Blue World Technologies today presents plans for the world's largest methanol fuel cell factory located at the Port of Asborg ready for global asport of clean energy technology. Methanol fuel cell components will be produced in high volume enabling electric vehicles to have a 2000km range with 3 minutes metheling time.

Blue World technology is newly founded but has ambitious goals from the start by targeting the most potential markets in form of automotive and electric mobility. The challenge is deuriting, but also the possibility to really make a difference in the world.

Today the mayor of Aalborg. Mr. Thomas Kastrup Lanam is attending the kunch reception of Blue World Technologies on the Port of Aalborg. Furthermore, plans for the world Largest methanol field all manufacturing facility will be presented.



1 - Blue World Technologies - fuel cell factory visualization

Volume production of methanol fuel cells

Blue World Technologies will establish a state-of-the-art manufacturing plant for a unique fuel cell technology platform utiliting methanol as a fuel. The plant will be highly specialized in the production of materials and components for the fuel cell and stack which can be compared to the engine block of a car. The overall effort will require several hundreds of new employees for both development and operations. The factory will be built and have initial manufacturing activity during 2019.

#### 🕨 Our Development Plan 🏾

#### Palcan

"Build a 50,000 sets of fuel cell module production base (2018)"

 Industrial Base: Cixi, Zhejiang province
 Total investment of 100 million
 Achieve 50,000 sets of fuel cell module production capacity.

► Market target : Electric logistics vehicle, mobile charging vehicle, communication backup power supply, civil-military integration.









### METHANOL FUEL CELL EV RANGE EXTENDER

- 2015: Denmark opens EU's first methanol fuel pump
- Cars/vans use RMFC technology as range extender Increasing range of battery powered vehicles from 200 to 1000 kilometers
- April 2019: Beijing Auto Show: AlWays unveils Gumpert RG Nathalie methanol fuel cell electric supercar with a 1,200 km range and a top speed of 300 km/h
- 2020: Commercial production Nathalie





https://www.rolandgumpert.com/en/



# CHINA FUEL CELL PIVOT

- China now has just 1,500 FCVs and 23 hydrogen fuelling stations
- March 2018: MIIT releases plans for hydrogen fuel cell promotion as "new energy vehicles"
- Targets: 2020 5,000 FCVs; 2025 50,000 FCVs; 2030 – 1 million FCVs
- Pivot away from EV subsidies and moving support to hydrogen fuel cells
- Emphasis on commercial vehicles: buses and trucks, long-haul
- Methanol fuel cells included as New Energy Vehicles













**CONTACTS** 





