

Methanol the fuel for the future



Research Centre for
Greenhouse Gas Innovation

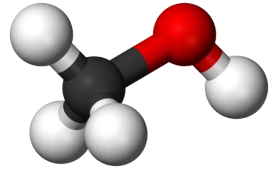
Liane M Rossi

Institute of Chemistry

University of São Paulo, Brazil

20 Sept 2023

Methanol (CH₃OH): What is used for?



METHANOL

DANGER

HIGHLY FLAMMABLE LIQUID AND VAPOR. TOXIC IF SWALLOWED. TOXIC IF INHALED. TOXIC IN CONTACT WITH SKIN. TOXIC IF ABSORBED. CAUSES DAMAGE TO ORGANS.

PREVENTION Keep away from heat/sparks/open flames/hot surfaces. No smoking. Use appropriate explosion-protected equipment. Use only well-ventilated areas. Wear safety glasses. Avoid breathing vapors. Do not breathe dust/fumes/mist. Wash hands thoroughly after handling. Do not eat, drink or smoke when using the product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/protective footwear.

SAFETY DATA SHEET (SDS) INFORMATION See the SDS for detailed information on the properties and uses of this product. For more information, contact the manufacturer or your local safety representative.

STORAGE Store in a cool, well-ventilated area. Keep away from heat and flames.

DISPOSAL Dispose of contents/container to a licensed chemical disposal agency in accordance with local, state and federal regulations.

For more information, contact the manufacturer.

METHANOL

DANGER

HIGHLY FLAMMABLE LIQUID AND VAPOR. TOXIC IF SWALLOWED. TOXIC IN CONTACT WITH SKIN. TOXIC IF INHALED. CAUSES DAMAGE TO ORGANS.

PREVENTION Keep away from heat/sparks/open flames/hot surfaces. No smoking. Use appropriate explosion-protected equipment. Use only well-ventilated areas. Wear safety glasses. Avoid breathing vapors. Do not breathe dust/fumes/mist. Wash hands thoroughly after handling. Do not eat, drink or smoke when using the product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/protective footwear.

SAFETY DATA SHEET (SDS) INFORMATION See the SDS for detailed information on the properties and uses of this product. For more information, contact the manufacturer or your local safety representative.

STORAGE Store in a cool, well-ventilated area. Keep away from heat and flames.

DISPOSAL Dispose of contents/container to a licensed chemical disposal agency in accordance with local, state and federal regulations.

For more information, contact the manufacturer.

GASOLINE

DANGER

HIGHLY FLAMMABLE LIQUID AND VAPOR. CAUSES SKIN IRRITATION. MAY CAUSE ASTHMATIC EFFECTS. MAY CAUSE CANCER. WITH EXHAUST, FUMES OR VAPOR FROM COMBUSTION, MAY CAUSE HEADACHE, Dizziness, NAUSEA, VOMITING, AND OTHER ADVERSE EFFECTS. MAY CAUSE DROWSINESS OR DIZZINESS. CAUSES DAMAGE TO ORGANS. WITH EXHAUST, FUMES OR VAPOR FROM COMBUSTION, MAY CAUSE HEADACHE, Dizziness, NAUSEA, VOMITING, AND OTHER ADVERSE EFFECTS. MAY CAUSE DROWSINESS OR DIZZINESS. CAUSES DAMAGE TO ORGANS.

PREVENTION Keep away from heat/sparks/open flames/hot surfaces. No smoking. Use appropriate explosion-protected equipment. Use only well-ventilated areas. Wear safety glasses. Avoid breathing vapors. Do not breathe dust/fumes/mist. Wash hands thoroughly after handling. Do not eat, drink or smoke when using the product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/protective footwear.

SAFETY DATA SHEET (SDS) INFORMATION See the SDS for detailed information on the properties and uses of this product. For more information, contact the manufacturer or your local safety representative.

STORAGE Store in a cool, well-ventilated area. Keep away from heat and flames.

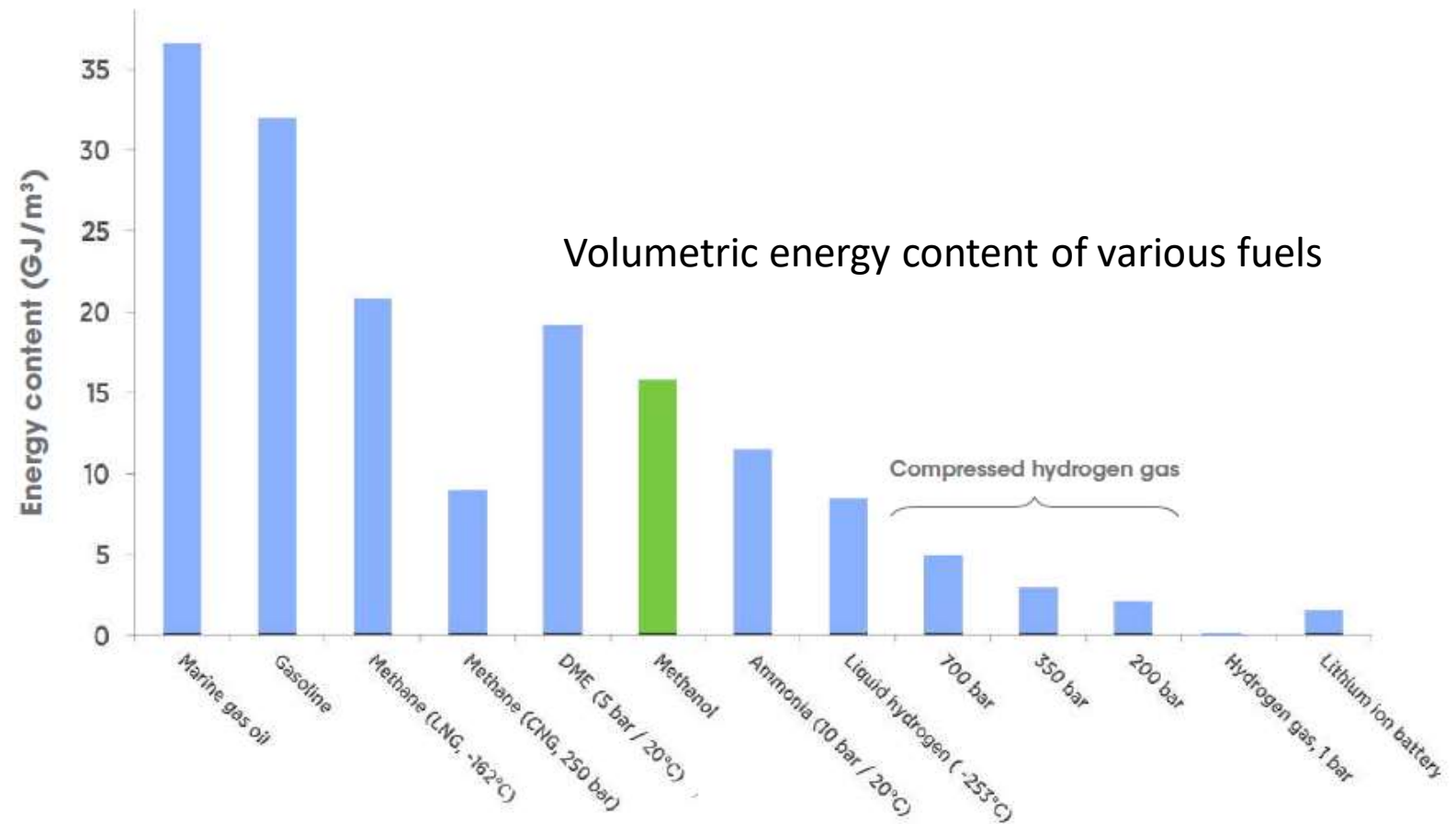
DISPOSAL Dispose of contents/container to a licensed chemical disposal agency in accordance with local, state and federal regulations.

For more information, contact the manufacturer.

Source: [1] Methanex, www.methanex.com [2] International Renewable Energy Agency 2021 (<https://irena.org/publications/2021/Jan/Innovation-Outlook-Renewable-Methanol>)

Methanol is a cleaner-burning alternative fuel

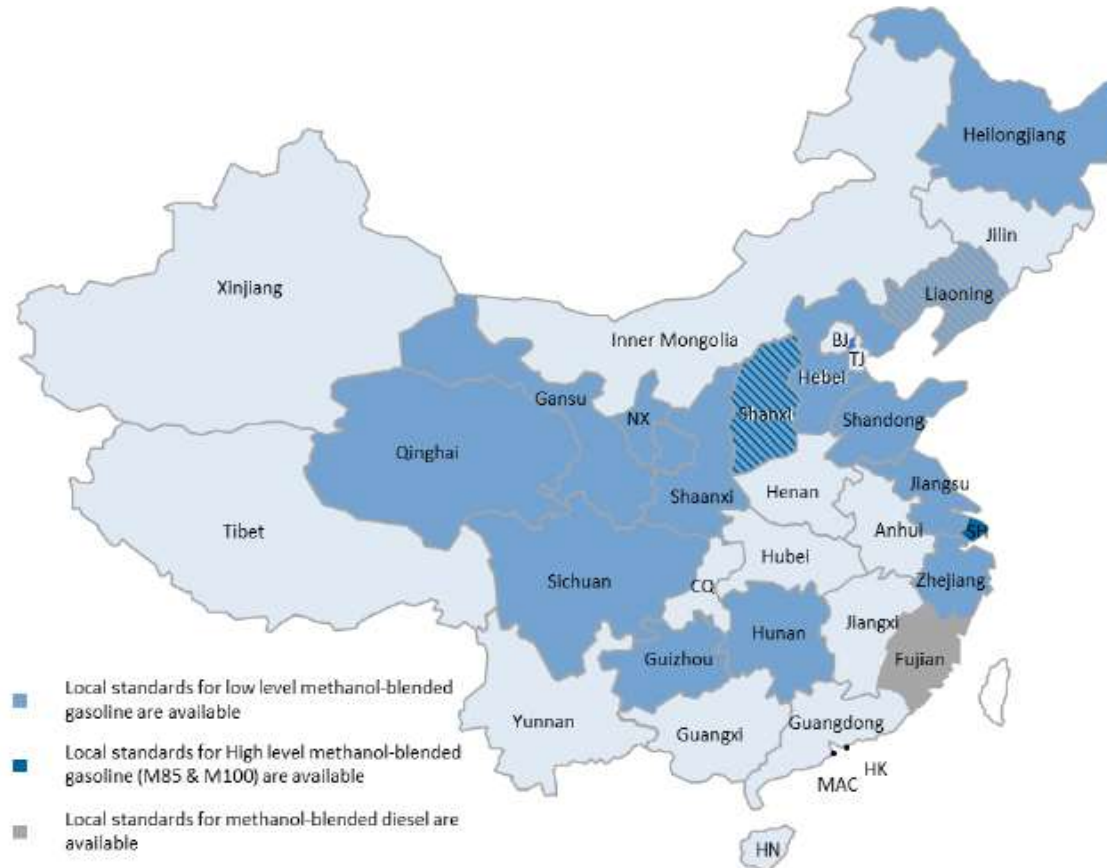
- It can be transported and **stored easily and safely**, being a liquid at room temperature. It is biodegradable and a highly efficient energy carrier, burning cleanly and producing no soot or particulates.
- It has a **high-octane rating (109 RON)** providing better energy conversion than either gasoline or diesel. In many regions different **blends of methanol with gasoline diesel** are in use, with 3% and 15% already seen in Europe and China, respectively.
- Authorities in **China are also promoting M100** (100% methanol) in light vehicles, buses and trucks. **Marine transport is increasingly turning to methanol** as a clean replacement for bunker fuel and it continues to grow in popularity for industrial boilers and cookstoves.



Source: International Renewable Energy Agency 2021 (<https://irena.org/publications/2021/Jan/Innovation-Outlook-Renewable-Methanol>)

Methanol as a blending fuel in China

Province	Local Methanol Fuel Blending Standards*	Implemented Since
Shaanxi	M15 & M25	2004
Sichuan	M10	2004
Heilongjiang	M15	2005
Liaoning	M15, M20 (methanol-blended diesel)	2006
Qinghai	M5, M10 & M15	2006
Shanxi	M5, M15, M85 & M100	2008
Fujian	M15 (methanol-blended diesel)	2009
Gansu	M15 & M30	2009
Jiangsu	M45	2009
Zhejiang	M15, M30 & M50	2009
Guizhou	M15	2010
Hebei	M15	2010
Hunan	M15, M25 & M30	2012
Shanghai	M100	2012
Shandong	M15	2013
Ningxia	M15 & M30	2014



Source: [1] Methanex, www.methanex.com [2] International Renewable Energy Agency 2021 (<https://irena.org/publications/2021/Jan/Innovation-Outlook-Renewable-Methanol>)

Methanol as a marine fuel

Methanol is an innovative alternative fuel solution with many benefits



Methanol

Environmental

- Low emissions
- Safe, environmentally friendly
- Bio-degrades rapidly in water

Available

- Available globally
- Long history of safe handling
- Straightforward bunkering with existing infrastructure

Affordable

- Low incremental investment
- Competitive fuel costs
- Liquid fuel flexibility

Proven

- Successfully in use today
- Commercialization activity expanding



Diesel bunker fuel



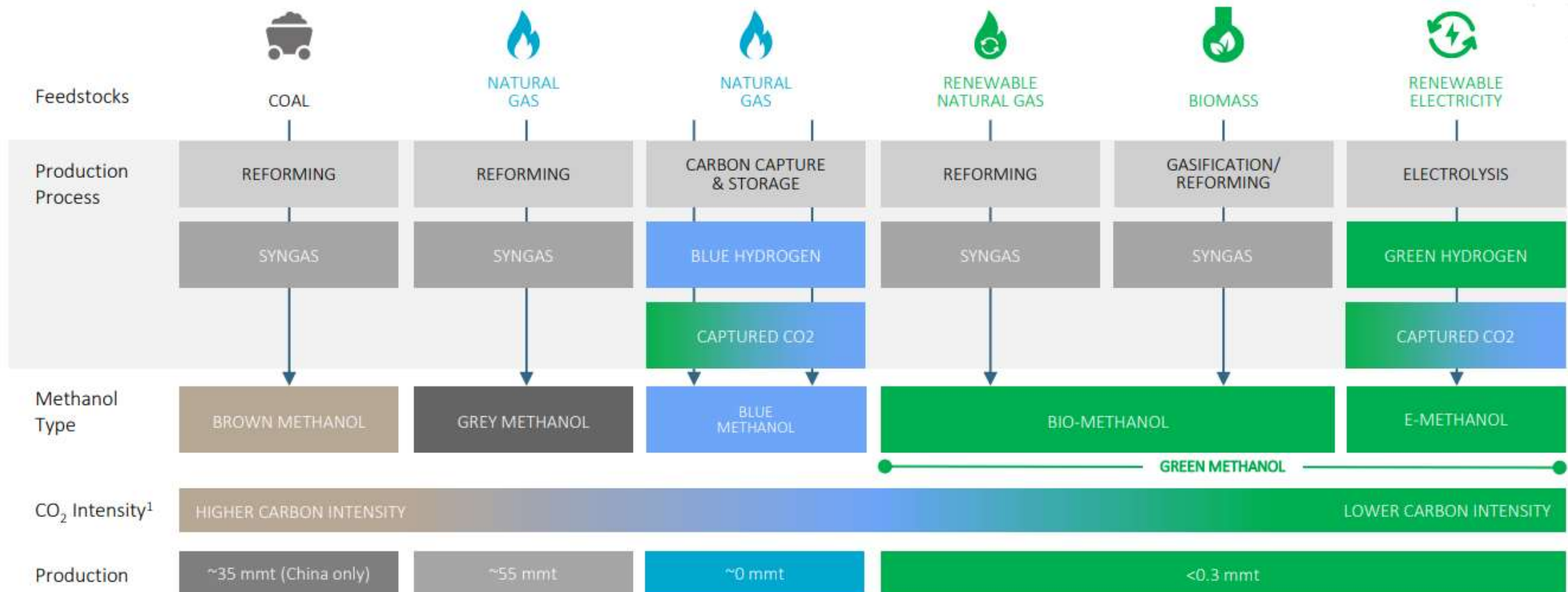
Emission reductions when compared to heavy fuel oil



Compared to conventional marine fuels, conventional and renewable methanol reduce CO₂ emissions during combustion by ~15% and ~95% , respectively.

Methanol production

- Conventional methanol reduces air pollution and GHG emissions;
- methanol from renewable sources can support long-term decarbonization

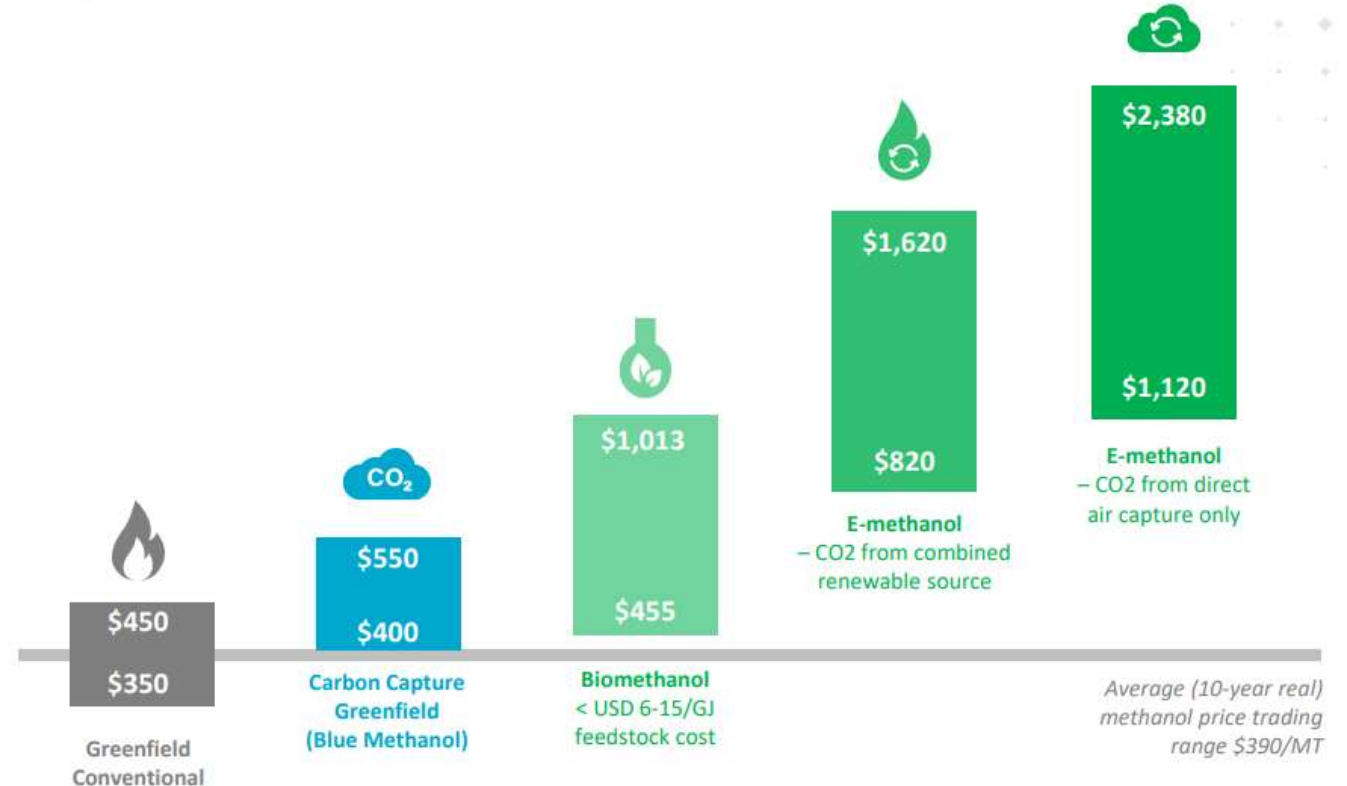


Source: <https://www.methanex.com/sites/default/files/investor/MEOH%20Investor%20Presentation%20-%20June%202022.pdf>

Price of Methanol x feedstock

- Price response required to incentivize new low-carbon methanol production
- In the long-term we expect methanol pricing will respond to incent investment as demand for low and zero carbon methanol increases from market segments with Scope 3 emission goals
- The cost for lower emission methanol is expected to decrease as technologies mature and become scalable

Range of current capital and production costs for different forms of methanol
USD \$/tonne of methanol*



Source: <https://www.methanex.com/sites/default/files/investor/MEOH%20Investor%20Presentation%20-%20June%202022.pdf>. 2021 Irena Report and internal estimates. * Exchange rate used USD 1 = EUR 0.9

CO₂ to Methanol Pilot Plant under construction at USP



CARBONIC

<https://www.carbonicnetzero.com/>