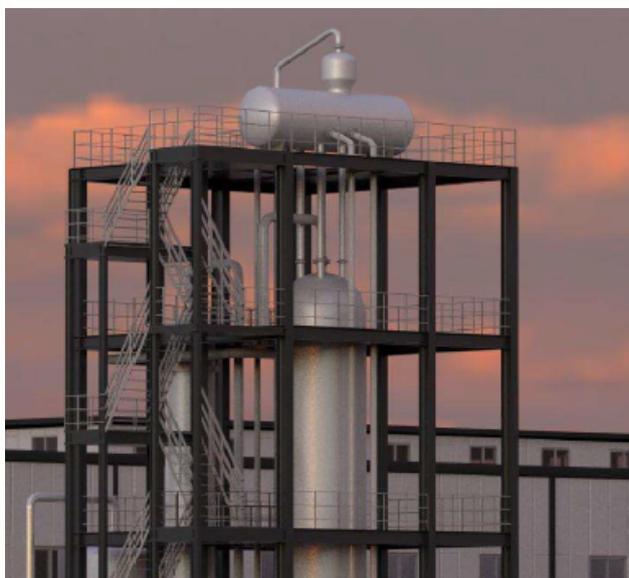




RENEWABLE METHANOL CATALOGUE

Discover our latest projects around the renewable methanol value chain.
Explore innovative solutions for your needs.



WELCOME

Headquartered in Madrid, Asmain is a Spanish engineering and equipment supply company with a significant international presence. We excel in three primary business areas:

- 1. Marine Projects:** We specialize in ports, shipyards, and vessels, providing cutting-edge solutions to enhance maritime infrastructure.
- 2. Energy Solutions:** Our focus is on the liquid natural gas and renewable hydrogen value chains, driving advancements in energy production and optimization.
- 3. Industrial Equipment Supply:** We provide essential equipment for infrastructure projects, including pipelines, structural steel, and modified marine containers.

With over 20 years of experience, Asmain has established multiple offices and expanded into key international markets, including Europe, Asia, the Middle East, and the Americas. This extensive network allows us to serve a diverse client base and adapt to market needs and regulatory environments.

Our products are highly customizable, easy to install, and maintain. We undertake basic and detailed engineering tasks to ensure the optimal functionality of our solutions. Leveraging our international experience, we integrate global best practices and innovative solutions into our projects, delivering high-quality results worldwide.

At Asmain, our core values of integrity, innovation, and customer success are at the heart of everything we do. We strive for continuous improvement and believe in the power of win-win cooperation to achieve remarkable outcomes. Our results-driven approach ensures that every project we undertake not only meets but exceeds expectations. We are committed to embracing new technologies and innovative practices to deliver cutting-edge solutions that create significant value for our clients and the communities we serve.

Join us at Asmain, your reliable ally!

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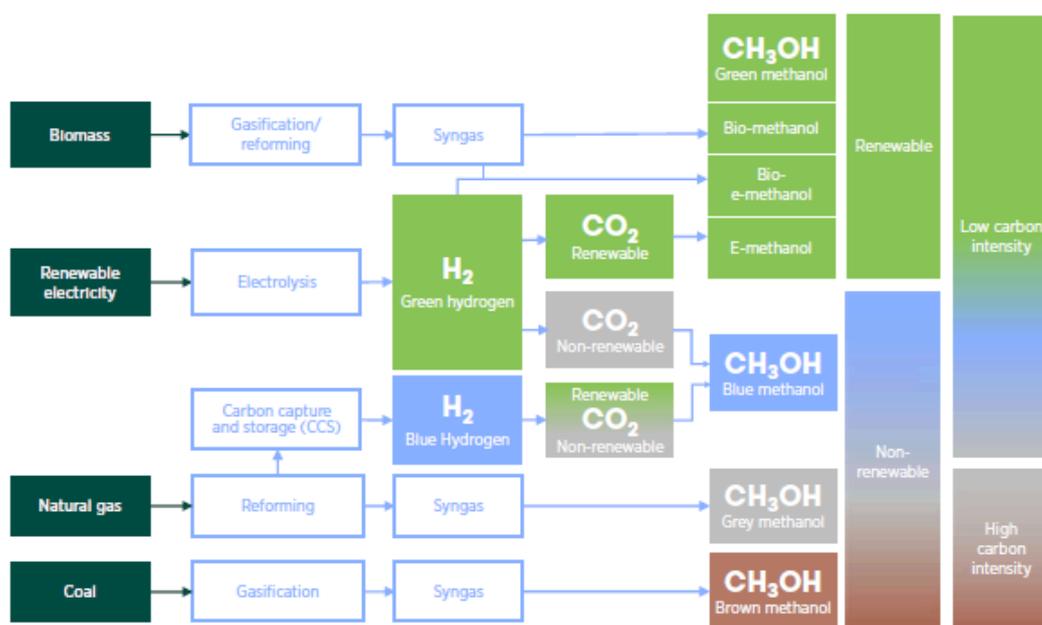
INTRODUCTION

Welcome to the Renewable Methanol Production Plant Section!

Currently, methanol is produced almost exclusively from fossil fuels. However, methanol can also be made from other feedstocks that contain carbon, including biomass, biogas, waste streams, and CO₂ (for example captured from flue gases or through DAC). Renewable methanol can be produced using renewable energy and renewable feedstocks via two routes:

- Bio-methanol is produced from biomass. Key potential sustainable biomass feedstocks include: forestry, agricultural waste and by-products, biogas from landfill, sewage, MSW, and black liquor from the pulp and paper industry.
- Green e-methanol is obtained from CO₂ captured from renewable sources (e.g. via BECCS or DAC) and green hydrogen, i.e. hydrogen produced with renewable electricity.

To qualify as renewable, all feedstocks and energy used to produce the methanol need to be of renewable origin (e.g. biomass, solar, wind, hydro, geothermal). The methanol produced by either route is chemically identical to methanol produced from fossil fuel sources.



Principal methanol production routes (IRENA, Innovation Renewable Methanol 2021)

BIO-METHANOL

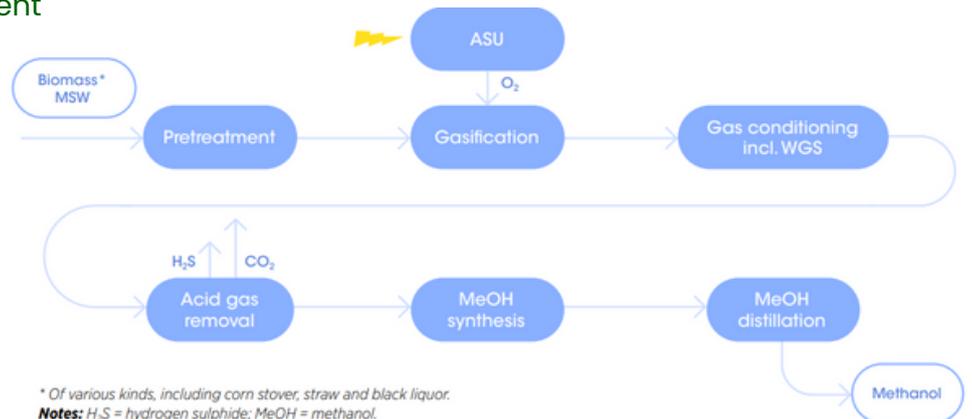
Bio-methanol stands as a beacon of sustainability in our quest for cleaner energy solutions. Derived from renewable sources such as biomass, agricultural waste, or even carbon dioxide, bio-methanol represents a significant stride towards a greener future. Its production not only reduces reliance on fossil fuels but also curtails carbon emissions, aligning with global efforts to combat climate change. With its versatile applications spanning from fuel for transportation to raw material in chemical production, bio-methanol emerges as a pivotal player in our transition towards a more sustainable and resilient energy landscape. Join the bio-methanol revolution and pave the way for a brighter, cleaner tomorrow.



PRODUCTION FROM BIOMASS AND MSW

Production of methanol from biomass and MSW is similar to the technologies used in the commercial gasification-based industry. The main processes in a conventional methanol plant are:

- Feedstock pretreatment
- Gasification
- WGS
- Gas cleaning
- Methanol synthesis
- Methanol purification

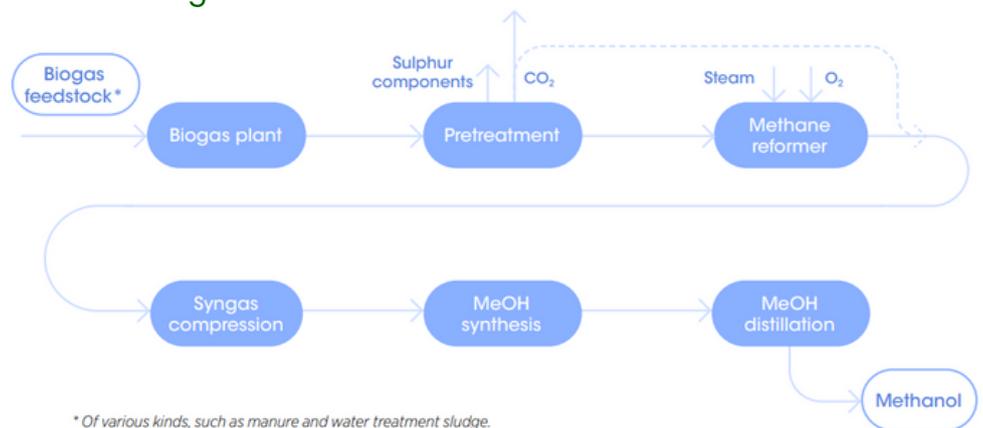


Gasification-based methanol plant (IRENA, Innovation Renewable Methanol 2021)

PRODUCTION FROM BIOGAS

Producing bio-methanol from biogas presents a compelling solution in the pursuit of renewable energy. Biogas, derived from organic waste materials through anaerobic digestion, serves as an abundant and readily available feedstock for bio-methanol production. The main processes in a conventional methanol plant are:

- Feedstock collection: anaerobic digestion
- Biogas upgrading
- Gasification
- Methanol synthesis
- Methanol purification



Reformer-based methanol plant (IRENA, Innovation Renewable Methanol 2021)

PRODUCTION UNITS

Bio-methanol from biomass, msw, and biogas

Innovative electronic methanol technology, a distinctive feature of which is extremely low energy consumption. Through the production process, advanced energy-saving equipment and intelligent control systems are designed to minimize power consumption, increase productivity, and reduce operating costs.

- Structural stability
- Durable
- High specific surface area
- Uniform bulk density

Syngas Production Unit

- High pressure, high temperature, > 700°C
- Gasification agents (air, oxygen, water vapor, carbon dioxide)
- Feedstock: Biomass/Biogas
- Partial combustion (pyrolysis, oxidation, reductive reforming reactions)

Methanol Synthesis Unit

- Low and medium pressure reaction 3.0 ~ 5.0 MPa
- 200 ~ 300°C
- 10-1200kt/a
- Automatic control, easy temperature control

Methanol Synthesis Catalyst

- Black cylinder with spherical caps of two ends (CuO, ZnO, and AL2O3)
- 3 - 5 years of service life
- Size: $\Phi 5\text{mm} \times (4-5\text{mm})$
- >60m²/g specific surface area
- 1.2kg/L $\pm 0.05\text{kg/L}$ bulk density

E-METHANOL



E-methanol is a liquid product easily obtainable from CO₂ and green hydrogen through a one-step catalytic process. Produced through a Power-to-X technology, e-methanol is considered an electrofuel (e-fuel) and electrochemical.

There are different ways to produce e-methanol through electromechanical processes:

- Electrolysis of water to hydrogen followed by catalytic methanol synthesis.
- Electrolysis of water and carbon dioxide to syngas followed by catalytic methanol synthesis.
- Direct electrocatalytic synthesis of methanol from water and carbon dioxide.

PRODUCTION UNITS

Electrolysis of water to hydrogen followed by catalytic methanol synthesis

Innovative electronic methanol technology, a distinctive feature of which is extremely low energy consumption. Through the production process, advanced energy-saving equipment and intelligent control systems are designed to minimize power consumption, increase productivity, and reduce operating costs.

- Structural stability
- Durable
- High specific surface area
- Uniform bulk density

Hydrogen Production Unit

- 4.6 ~ 5.5 kWh/Nm³ H₂(DC)
- Single set maximum capacity
- Up to 1500Nm³/h (single set stable operation)
- 160000 hours of service life

Methanol Synthesis Unit

- Low and medium pressure reaction 3.0 ~ 5.0 MPa
- 200 ~ 300°C
- 10-1200kt/a
- Automatic control, easy temperature control

Methanol Synthesis Catalyst

- Black cylinder with spherical caps of two ends (CuO, ZnO, and AL2O3)
- 3 - 5 years of service life
- Size: Φ5mm x (4-5mm)
- >60m²/g specific surface area
- 1.2kg/L ±0.05kg/L bulk density

THANK YOU

Thank you for exploring our Renewable Methanol Production Plant Section!

We hope this journey has provided valuable insights into the potential of methanol as a clean and sustainable fuel for transportation. As we continue to innovate and drive forward the transition to a greener future, your interest and support are invaluable.

Stay connected with us for the latest updates and developments in renewable energy and sustainable transportation. Together, we can create a brighter, cleaner, and more sustainable tomorrow. Thank you once again for joining us on this journey towards a methanol-powered future.

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