

# Lurgi PowerMethanol™

Air Liquide's comprehensive solution for  
Methanol production from  $H_2$  and  $CO_2$





## An integrated solution

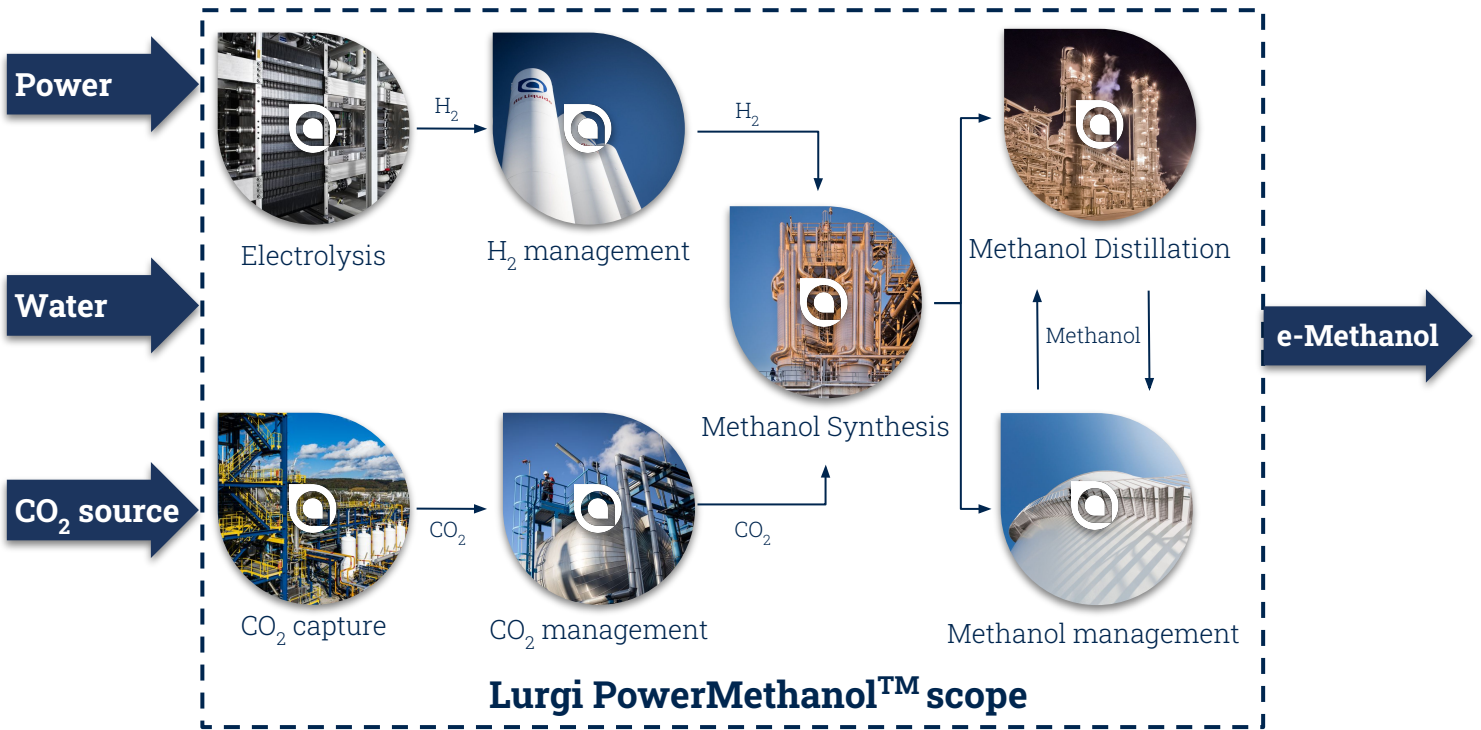
We provide a one-stop solution for integrated, flexible e-Methanol plants, combining our world-class, proven technologies in Methanol production, electrolysis, CO<sub>2</sub> capture, gas separation, and feedstock management. By leveraging the synergies between these technologies, we deliver a streamlined, high-performance solution.

Our advanced plant configuration ensures cost-efficient e-Methanol production from power, H<sub>2</sub>, and CO<sub>2</sub>, offering both flexibility and robustness to adapt to varying operational needs.

Designed for optimal H<sub>2</sub> conversion, our process setup maximizes efficiency while maintaining best-in-class production standards.



# A highly integrated technology solution for e-Methanol



## Minimum interfaces

- Maximized synergies between the process units
- License, EP(C) & Operations support
- One comprehensive set of process guarantees

## Dynamic operation

- Suitable design for fluctuating power,  $H_2$  and  $CO_2$  availability
- Flexible production to unlock hourly matching and capitalizing power market opportunities

## Optimized cost of ownership

- Excellent  $H_2$  and  $CO_2$  valorization
- Optimized availability
- High energy efficiency
- Air Liquide's perspective coming from its own assets

## Optimized production with renewable feedstock

Our proven Methanol Synthesis technology, combined with an intelligent feedstock buffering system, ensures maximum plant uptime and reliable e-Methanol production, even with fluctuating renewable feedstock availability.

To enhance operational stability, our predictive advanced process control minimizes load variations during flexible operation, enabling seamless and operator-friendly plant control while maintaining efficiency and performance.



# Lurgi PowerMethanol™

## Key features:

- **Air Liquide's industry-leading expertise:** cutting-edge technology, EP(C) solutions, and comprehensive operations support
- **Cost-effective catalyst solution:** first-fill catalyst with no subscription required
- **Flexible feedstock options:** Utilizing CO<sub>2</sub> from both renewable sources and industrial capture
- **Modular plant design available:** efficient pre-engineered modular plant solutions (EPF)

Up to  
**99%**  
H<sub>2</sub> conversion in  
the Synthesis

Up to  
**99%**  
CO<sub>2</sub> emission  
reduction vs.  
conventional

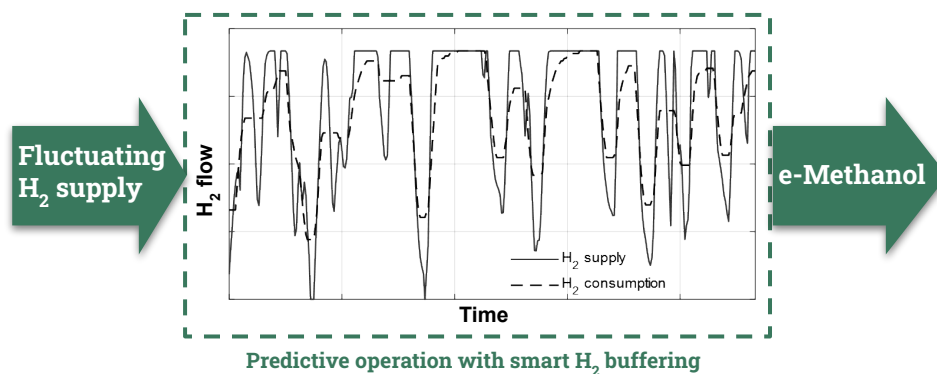
**53**  
LP Methanol™ +  
MegaMethanol™  
plants put into  
operation

**25+**  
years of expertise  
in Methanol  
Synthesis from  
CO<sub>2</sub> and H<sub>2</sub>



## Integrated Methanol production, a flexible and reliable solution

Our e-Methanol technology is engineered for process efficiency, flexibility, and safety. Designed to seamlessly integrate with diverse feedstock sources and operational conditions, it ensures consistent, high-performance production across various settings. With optimized storage solutions and advanced control systems, our process efficiently manages fluctuations in renewable energy supply, enhancing both stability and sustainability.



This flexibility not only maximizes the utilization of renewable resources but also ensures consistent and reliable e-Methanol production contributing to sustainable and cost-effective operation.



Modularized Lurgi PowerMethanol™



# Proton Exchange Membrane (PEM) Electrolysis

## Key features:

- **Efficient production:** converts water and renewable energy into H<sub>2</sub> using advanced technology
- **Cutting-edge PEM electrolysis technology:** ideal for harnessing variable wind and solar power
- **High efficiency & reliability:** delivers superior gas quality with optimized energy use
- **Easy operation & low maintenance:** designed for user-friendly operation
- **Modular design for cost optimization:** skid-based system reduces installation costs and enhances transportability

**35+**

electrolyzer plants put in operation for customers

**20 MW**

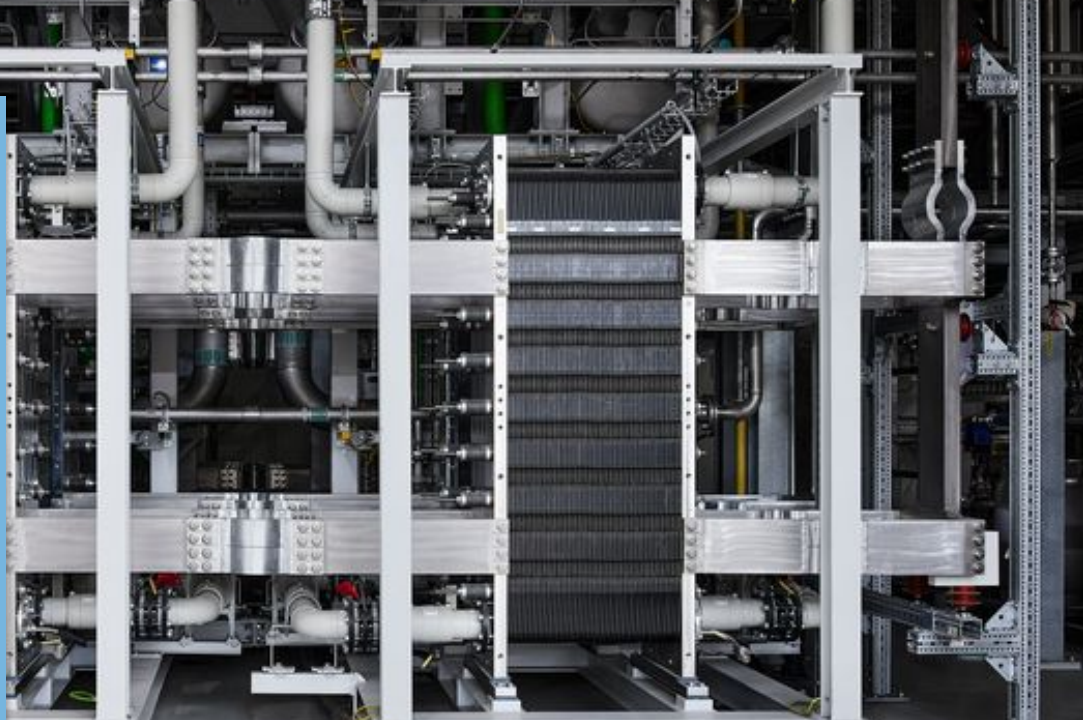
Air Liquide Trailblazer plant in operation (2024)

**200 MW**

Air Liquide Normand'Hy project under construction

**A GIGAWATT ELECTROZER FACTORY**

Highly automated with robotics and digitalization



## Large scale electrolyzers with proven operational experience

Air Liquide, in the frame of its partnership and joint-venture with Siemens Energy, co-manufactures the industry-leading Siemens Energy Elyzer P-300 PEM electrolyzer platform. This advanced technology has already been successfully deployed in the 20 MW Trailblazer plant in Germany, engineered, owned, and operated by Air Liquide, demonstrating exceptional operational flexibility. It will also be a key component of Air Liquide's upcoming 200 MW Normand'Hy and ELYgator projects.

With extensive experience in integrating electrolyzer technology and optimizing balance-of-plant systems, Air Liquide delivers both renewable and low-carbon hydrogen through an over-the-fence (OTF) model and offers cutting-edge solutions for advanced electrolyzer plants.



Normand'hy Electrozer plant under development in France

# CO<sub>2</sub> Capture and Management Solutions

## Cryocap™

- Highly efficient for CO<sub>2</sub> sources >15% concentration
- Delivers high purity CO<sub>2</sub>
- Enables one-step production of liquid CO<sub>2</sub>

## Amine Wash

- Most suitable for CO<sub>2</sub> sources <15% concentration
- Can be powered by recovered waste heat for greater energy efficiency

## Rectisol™

- Designed to handle the most challenging CO<sub>2</sub> feed gases including gasification derived streams
- Effectively removes CO<sub>2</sub> with multiple impurities

## Recticap™

- Among the most energy efficient solutions for CO<sub>2</sub> removal

Up to  
**99%**  
CO<sub>2</sub> capture rate

Up to  
**99.9%**  
CO<sub>2</sub> product purity

Up to  
**99.7%**  
availability

Down to  
**0**  
tpd steam import possible



## A comprehensive portfolio for CO<sub>2</sub> capture from various sources

Cryocap™ uses cryogenic processes to efficiently capture CO<sub>2</sub>. As a combination of various proprietary Air Liquide technologies, it is adaptable to multiple applications. It is currently the only full-scale cryogenic carbon capture technology with an industrial reference (Port Jerome, France) in the global CCS market.

Recognized as a state-of-the-art solution, amine-based technology effectively removes CO<sub>2</sub> from a wide range of synthesis and flue gases. Air Liquide has extensive experience in designing and operating amine-based units, ensuring reliable and efficient performance.

Air Liquide's Rectisol™ and Recticap™ physical absorption technologies use cold methanol for high-efficiency removal of acid gases and CO<sub>2</sub> from high pressure syngas. With over 70 years of expertise in designing and operating rectisol units, Air Liquide delivers proven, cutting-edge solutions for the most demanding applications.

<b>ABSORPTION</b>	Syngas		<b>AMINE WASH</b>	} Heat-driven
	Flue Gas		<b>FG AMINE WASH</b>	
	H <sub>2</sub> Production		<b>RECTICAP™</b>	} High efficiency for large scale
	Gasification		<b>RECTISOL™</b>	

<b>CRYOGENIC</b>	H <sub>2</sub> Production		<b>CRYOCAP™ OXY</b>	} Adapted to concentrated sources (> 15 % CO <sub>2</sub> dry)
	Oxycombustion		<b>CRYOCAP™ NG</b>	
	Steel Production		<b>CRYOCAP™ Steel</b>	} Electricity powered
	Flue Gas		<b>CRYOCAP™ FG</b>	
	Natural Gas		<b>CRYOCAP™ XLL</b>	} CO <sub>2</sub> product gaseous or liquid
	CO <sub>2</sub> Liquefaction		<b>CRYOCAP™ H2</b>	



# Gas Separation Technology

## Key features:

- **Enhanced H<sub>2</sub> utilization** for improved efficiency
- **Increased CO<sub>2</sub> utilization** using advanced membrane technology
- **Optimized energy efficiency** through selective recovery from Purge Gas
- **Precise gas composition control** for Methanol Makeup Gas and Reactor Inlet Gas



## World-leading PSA and membrane technology

Air Liquide's Pressure Swing Adsorption (PSA) units are compact, fully skid-mounted, and pre-tested for seamless outdoor and unmanned operation. Utilizing the most advanced adsorbents and patented high-efficiency cycles, our PSA systems maximize recovery and productivity, achieving typical on-stream factors above 99.9%. Fully automated operation ensures reliability and ease of use.

Air Liquide's advanced membranes are specially designed for high-purity H<sub>2</sub> and CO<sub>2</sub> recovery, while effectively rejecting inert gases such as N<sub>2</sub> and Ar from H<sub>2</sub>-rich gas streams. With superior chemical resistance, high-temperature tolerance, and the ability to withstand transmembrane pressures above 90 bar, our membranes are among the most robust and selective membranes available. Their modular, skid-mounted design enables scalability, low maintenance, and easy expansion, with no moving parts and minimal manpower requirements.

**97**

PSA systems designed and built

**150+**

H<sub>2</sub> membrane skids in operation

Up to  
**99.999%**  
H<sub>2</sub> purity

Up to  
**98%**  
H<sub>2</sub> recovery



Membrane unit



PSA unit

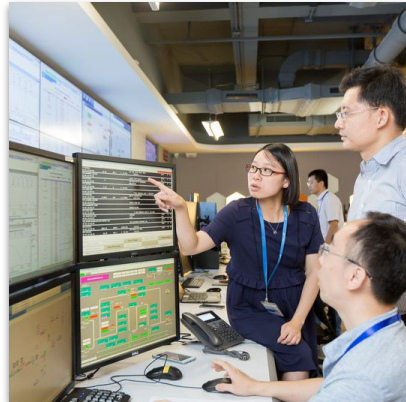
# Air Liquide Engineering & Construction

Your partner for any successful project model



## Process Technology

Licensing engineering services & proprietary equipment



## Conceptual Design & Front-End Engineering

High-end engineering & design capabilities



## Integrated Solutions

Project Management & execution services



**17**

Operating Centers & Front-end Offices

**5**

Manufacturing Centers

**50+**

years of innovation in Methanol

**183**

Patent Applications filed in 2023





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