

Green Chemicals & Fuels

Technologies to produce green
chemicals and fuels made from
non-edible bio feedstocks and waste



Air Liquide Group

A world leader in gases, technologies and services for industry and healthcare

Air Liquide is present in 60 countries with 66,500 employees and serves more than 4 million customers and patients. Oxygen, nitrogen and hydrogen are essential small molecules for life, matter and energy. They embody Air Liquide's scientific territory and have been at the core of the Group's activities since its creation in 1902.

Taking action today while preparing the future is at the heart of Air Liquide's strategy. With ADVANCE, its strategic plan for 2025, Air Liquide is targeting a global performance, combining financial and extra-financial dimensions. Positioned on new markets, the Group benefits from major assets such as its business model combining resilience and strength, its ability to innovate and its technological expertise.

The Group develops solutions contributing to climate and the energy transition—particularly with hydrogen—and takes action to progress in areas of healthcare, digital and high technologies.

Air Liquide Engineering & Construction

A technology partner of choice

Air Liquide Engineering & Construction builds the Group's production units (mainly air gas separation and renewable/low carbon Hydrogen) and provides external customers with efficient, sustainable, customized technology and process solutions.

Our core expertise in industrial gas, energy conversion and gas purification, enables customers to optimize natural resources.

We cover the entire project life-cycle: license engineering services / proprietary equipment, high-end engineering & design capabilities, project management & execution services. In addition, we also offer efficient customer services through our worldwide set-up.

As a technology partner, customers benefit from our research and development to achieve energy transition goals.

Our full suite of Technologies

Electrolyzers

Low carbon Hydrogen & Ammonia

Hydrogen Liquefaction

CO₂ Capture & Liquefaction

Air Gases

Methanol

Natural Gas Treatment

Green Chemicals & Fuels

Turboexpanders

5

Manufacturing
Centers incl. one
JV Gigafactory

13

Countries with
Technology &
Execution Centers
& front-end offices

174

Patent
applications
filed in 2024



Advancing for a sustainable future

Air Liquide is deeply committed to creating a positive impact on both the environment and society. Our strategy and actions are designed to address crucial challenges the world faces today, where we can make an impact and thus invent a sustainable future.

Climate, health, energy, mobility, sovereignty, the digital revolution...
There are many global societal challenges that call for immediate
– and collective – responses.

At Air Liquide, we are ready.

Ready to deploy our solutions wherever they are needed, and ready to accelerate whenever the situation requires it. Whether it is supporting our customers on their decarbonization journey, deploying hydrogen to make mobility more sustainable, or contributing to the growth of digital technologies, we offer concrete solutions to help society move forward.

To reduce our own CO₂ emissions, we have set key milestones to reach carbon neutrality:

- by 2025, -30% reduction in Carbon Intensity
- by 2035, a -33% reduction in absolute Scopes 1 & 2 emissions
- by 2050, reach carbon neutrality across the entire value chain.

A man wearing a white hard hat with the Air Liquide logo, safety glasses, and a dark blue and red work jacket is looking off to the side. He is standing in front of a complex industrial structure with yellow and blue pipes. A blue text box is overlaid on the image.

**Air Liquide's suite
of Lurgi™ Technologies
for the production of green
chemicals & fuels have been
well-proven for many years.**



Value proposition for our customers

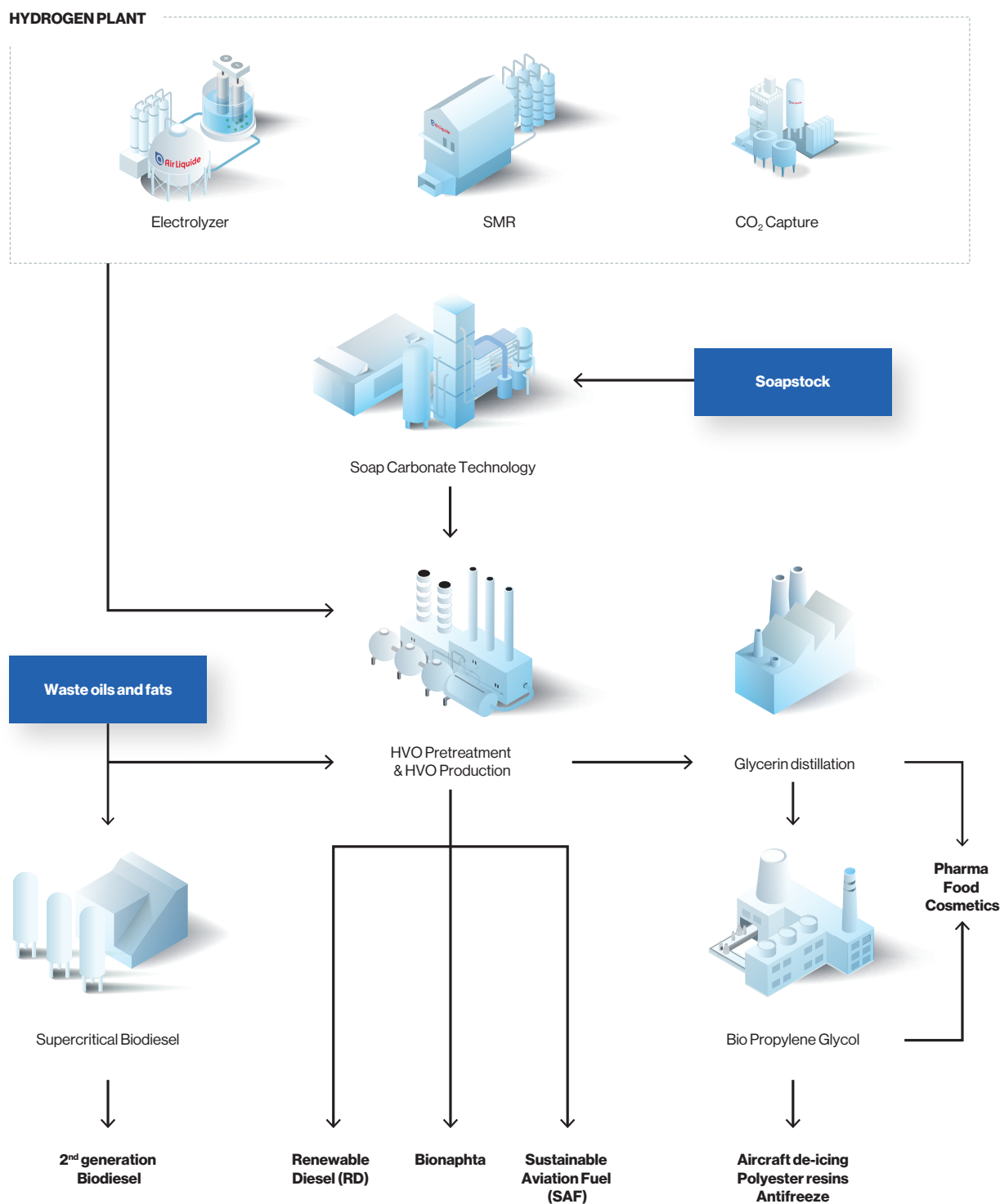
For our green chemicals & fuels customers, we deliver proven, reliable technologies combined with cutting-edge innovation to help customers tackle critical challenges, such as reducing greenhouse gas emissions, minimizing waste, and maximizing operational efficiency. Our solutions offer cost-effective access to a wide range of feedstock materials, enabling the production of high-value products that are gaining market significance.

- **Feedstock Flexibility:** we empower customers with the ability to utilize diverse waste oils and future materials, including plastics, non-edible sugars (second generation), and algae oil and more. This flexibility lowers financial and regulatory risks, provides operational adaptability, and supports decarbonization efforts.
- **Proven Reliability:** our technologies, rooted in traditional Lurgi™ solutions, are backed by decades of success, offering a low-risk investment. We guarantee reliability with full confidence in our expertise and delivery capabilities.
- **Innovative Technology Solutions:** we excel in developing innovative technologies from pilot to industrial scale, minimizing risk for our customers. With a highly experienced team and proven technological building blocks, we ensure seamless scalability.
- **Holistic Solutions:** we offer integrated solutions for the production of green chemicals and fuels, providing a flexible package that ranges from basic engineering and licensing to comprehensive turnkey solutions.
- **Highest Quality Standards:** when partnering with customers, we apply the same stringent quality standards we use in our own operations. This ensures safety, reliability, and efficiency, drawing on our extensive experience in designing, manufacturing, and operating plants.

Value chain overview

Our range of green chemicals and fuels technologies enable the treatment and conversion of various low-quality waste oils, fats and derivatives, which have traditionally been considered to have little or no value, into high-quality feedstocks and final products, for application in a range of markets.

Hydrotreated Vegetable Oils (HVO) Model





Our green chemicals and fuels technologies

At Air Liquide Engineering & Construction, we provide a diverse range of green chemicals and fuels technologies tailored to meet the specific needs of our customers across various industries, including chemical, personal care, food, pharma, and energy sectors.

Driven by continuous innovation and customer feedback, our solutions utilize non-edible bio feedstocks and waste to produce green chemicals and fuels, delivering significant reductions in carbon emissions compared to traditional methods. These technologies are a vital part of our commitment to supporting the global energy transition and helping customers achieve their sustainability goals.



Bio Propylene Glycol (BioPG) Technology

Key Advantages:

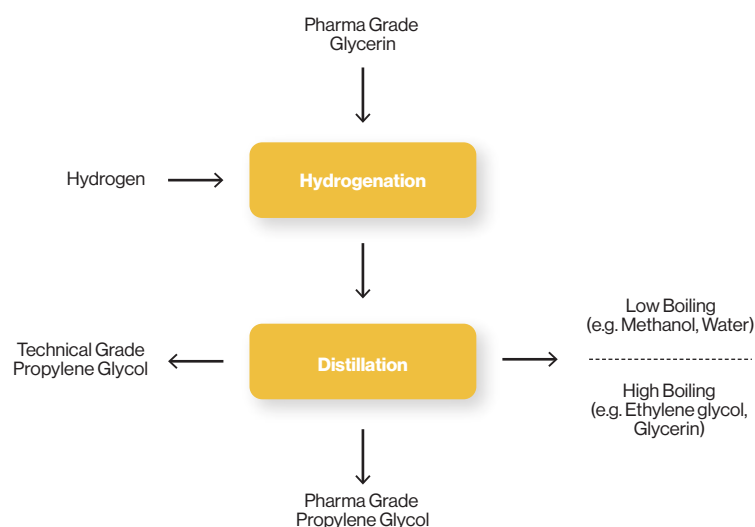
- **Cost-effective feedstock:** Glycerin offers a more affordable alternative to fossil-based materials.
- **Smaller, flexible operations:** Ideal for medium-sized customers, our standalone units operate independently from petrochemical basins.
- **High product purity:** Free from oligomers and polypropylene glycols, ensuring higher-quality output.
- **Reduced risk:** Avoids hazardous chemicals like propylene oxide.
- **Significant emissions reduction:** Up to 70% lower greenhouse gas emissions compared to conventional production.

Customers are increasingly seeking cost-effective, lower-carbon alternatives to fossil-based propylene glycol, a key ingredient in products like unsaturated polyester resins, paints, de-icing solutions, food solvents, deodorants, and toothpaste.

BioPG is a renewable, drop-in replacement for traditional propylene glycol, offering significant environmental benefits.

Using BASF-licensed technology, our solution enables the production of pharma-grade BioPG from glycerin with up to 70% lower greenhouse gas emissions than petrochemical methods.

With two industrial-scale reference plants and proven project success, our process transforms low-value glycerin into a high-value commodity, promoting a sustainable, circular economy.



Hydrotreated Vegetable Oils (HVO) Pretreatment Solutions

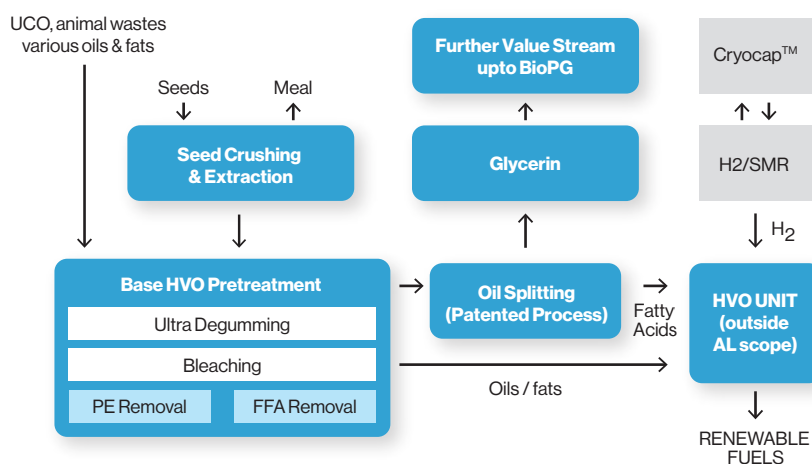
Key Advantages:

- Decades of experience in oils and fats refining.
- Proven expertise in large-scale degumming and bleaching.
- Compliance with HVO licensor specifications.
- Low chemical and utility consumption.
- Total feedstock flexibility to meet client needs.
- Integrated solutions from seed to final product with minimal capital investment.
- Focused on operational efficiency, from engineering to after-sales support.
- Improved yield, reduced hydrogen use, and no solid waste through oil-splitting technology.

As demand for Hydrotreated Vegetable Oils grows, Air Liquide provides innovative solutions for producing this key biofuel, which plays a vital role in reducing carbon emissions as a diesel replacement and Sustainable Aviation Fuel (SAF).

HVO processes convert low-grade fats, oils, and waste into valuable fuels with significantly lower greenhouse gas emissions. Feedstocks range from used cooking oil to tallow and by-products like Fatty Acid Distillates (FAD) and algae oil. To protect hydrotreating catalysts, these feedstocks must be pre-treated. Air Liquide's pre-treatment solutions efficiently remove impurities, ensuring consistent product quality while reducing the carbon intensity of production.

Our patented oil-splitting technology reduces operating costs by cutting hydrogen consumption, eliminating solid waste, and extending catalyst life — even with lower-quality feedstocks. It also yields glycerin, a valuable by-product for other applications. Additionally, our solutions can integrate hydrogen generation and carbon capture to further minimize the carbon footprint.



Supercritical Biodiesel Technology

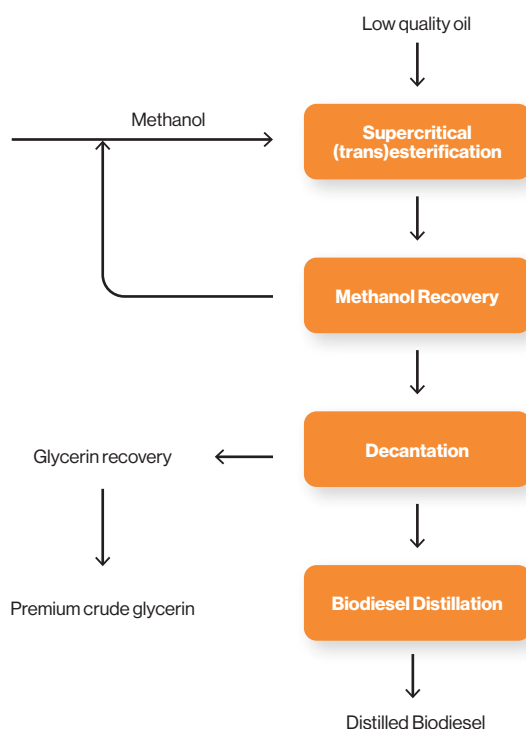
Key Advantages :

- **Feedstock flexibility:** Handles a wide range of oils and fats with free fatty acid content from 0% to 100%.
- **Automated operation:** Continuous process that adjusts automatically to feedstock variations.
- **No catalyst needed:** Eliminates the use of acidic or caustic chemicals.
- **High-quality output:** Produces distilled biodiesel and premium crude glycerin without salts.
- **Proven technology:** Commercial-scale plants in operation.
- **Cost-effective:** Lower capital investment compared to conventional biodiesel technologies with feed pretreatment.

In a competitive market, customers need efficient, flexible, and innovative biodiesel production solutions that handle waste oils and fats.

Air Liquide's supercritical biodiesel technology, licensed by Inventure Renewables, offers a game-changing alternative to conventional methods. It eliminates the need for a catalyst and feed pretreatment, making it ideal for low-quality waste oils, while producing high-quality biodiesel and premium crude glycerin.

Less capital-intensive than a typical HVO project, this solution is perfect for small and medium-sized customers.



Soap Carbonate Technology

Key Advantages:

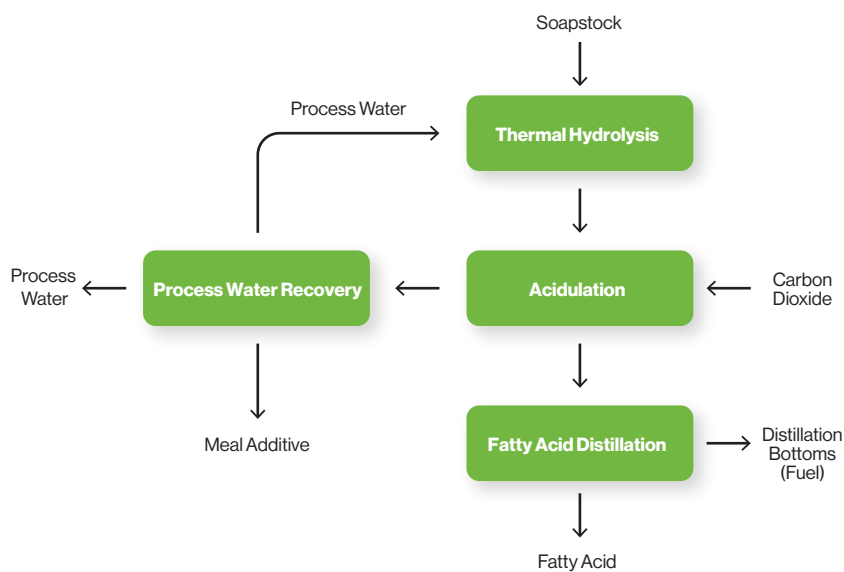
- Feedstock flexibility: Handles all types of soapstock and fatty matter.
- Safe, automated operation: No dangerous chemicals required.
- High-quality output: Produces easily marketable crude or distilled fatty acids.
- Sustainable byproducts: Concentrated by-products usable as animal feed or for biogas.
- Easy integration: Simple bolt-on unit for existing refineries.
- Low carbon, zero-liquid discharge process using CO₂ as an acidulation agent.

Many of our customers are looking to efficiently utilize byproducts and waste streams from their operations.

Air Liquide's Soap Carbonate technology, licensed by Inventure Renewables, transforms low-value soapstock, a byproduct of edible oil refining and biofuels production, into high-purity distilled fatty acids using carbon dioxide instead of sulfuric acid.

This process reduces wastewater, eliminates hazardous chemicals, and produces valuable feedstock for biofuels like HVO and supercritical biodiesel.

The versatile, modular design allows easy integration into existing operations at various scales.

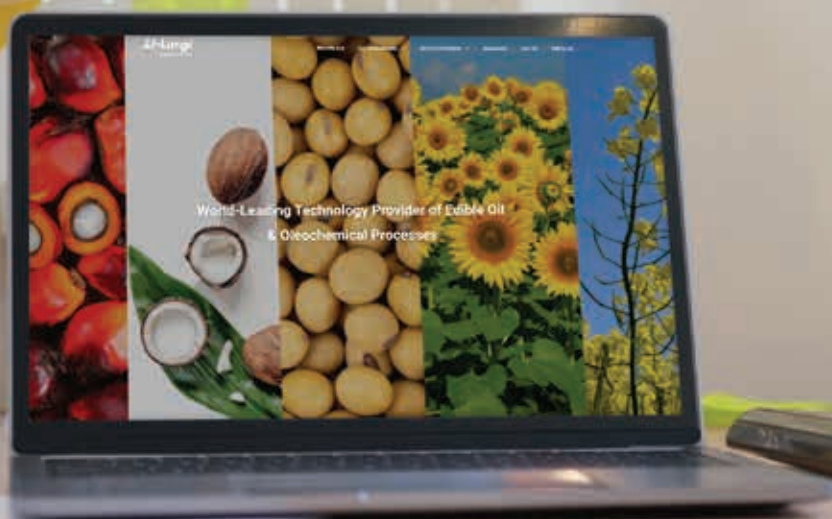


Edible Oils, Oleochemicals & Biofuels Technologies Our Partnership with JJ-Lurgi Engineering

JJ-Lurgi Engineering Sdn. Bhd. (JJLE), a joint venture between Jebsen & Jessen Pte. Ltd. and Air Liquide Engineering & Construction, is a leading provider of engineering solutions for the edible oil, oleochemicals, and biofuels industries.

With extensive expertise, JJLE offers customizable technologies for oil seed extraction, edible oil refining, fats modification, oleochemicals, and biodiesel production, helping clients reduce waste and cost.

For more information, visit jj-lurgi.com



Our experience

BioPG Plant: ORLEN Południe, Poland

Air Liquide Engineering & Construction partnered with ORLEN Południe to deliver Poland's first BioPG plant, using glycerol from biodiesel production to create renewable propylene glycol (BioPG).

The plant completed its first year of operation in 2023. Leveraging BASF's proven technology, the plant has an annual capacity of 30,000 metric tons, meeting 75% of Poland's propylene glycol demand. Our scope included licensing, basic engineering, proprietary equipment and commissioning services, contributing to ORLEN's goal of CO₂ neutrality by 2050.

HVO treatment plant development, USA

Air Liquide and JJ-Lurgi Engineering collaborated on the successful launch of an HVO pre-treatment plant in the US, processing 750 tons per day of renewable feedstocks like animal fats and plant oils.

The facility supports the production of renewable diesel and Sustainable Aviation Fuel (SAF).

The project, completed in early 2024, achieved all performance targets, marking the first HVO pre-treatment plant in the region and making a positive contribution to a more sustainable energy market.

Supercritical Biodiesel Plant: Hyundai Oilbank, South Korea

Air Liquide designed South Korea's first Supercritical Biodiesel plant for Hyundai Oilbank, which began operation in March 2024.

The facility produces 130,000 tons per year of biodiesel from low-quality waste oils without requiring a catalyst. The process, licensed from Inventure Renewables, ensures high-quality biodiesel and premium crude glycerin.

This project supports Hyundai Oilbank's shift toward eco-friendly energy and meets Korea's growing biodiesel mandate. Our global engineering team delivered significant capex reductions and increased feedstock flexibility, ensuring ongoing support for capacity expansion and diverse operations.



Contact us

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