CO₂ purification and liquefaction

Adding value through standardisation, modularisation and customisation

Making our world more productive
CO₂ purification and liquefaction

Climate mitigation in focus

Rising environmental and climate mitigation pressures mean that more and more companies are looking for flexible solutions to improve their carbon footprint. CO₂ emitters like power companies want to reduce their CO₂ emissions. This wish is echoed across many other industries where relatively concentrated streams of CO₂ occur. Re-utilisation of CO₂ is improving the carbon footprint.

Partner of choice

World leader in cryogenic technology, Linde has designed and supplied several CO₂ purification and liquefaction plants – including the world’s largest units delivering the industry’s highest availability levels. Our plants are therefore the solution of choice where performance, quality and reliability are a must. Depending on your needs, we cover the full project lifecycle – extending from engineering through supply and construction right up to all-inclusive turnkey solutions on a lump-sum basis.

All plants are designed to maximise cost efficiencies through standardisation and modularisation, while giving you the flexibility you need to adapt to variations in feed gas sources. Design highlights include a compact footprint and ease of maintenance.

Climate-friendly way to source CO₂.

Wide application spectrum

Our plants are engineered to produce gaseous or liquid CO₂ to the exact purity level you require – all the way up to food-grade quality as per EIGA or FDA. Major applications of liquid CO₂ include food and beverages, desalination, cooling, cryogenic cleaning, welding and cutting, and healthcare. Purified gaseous CO₂ is also used across a broad industrial spectrum from greenhouse horticulture through chemicals to enhanced oil recovery.

“CO₂ is not only an environmental issue – it is a valuable feedstock.”

Jürgen Velte
Managing Director
Linde Engineering Dresden

Carbon dioxide can be used to enhance plant growth in greenhouses.

Familiar CO₂ applications include the carbonation of beverages.

Sensitive foodstuffs can be rapidly and gently frozen with carbon dioxide.

Familiar CO₂ applications include the carbonation of beverages.
Performance you need at a price you like.

Our broad CO₂ plant portfolio is geared towards ensuring the perfect fit for individual application requirements. You can rely on our specialists to recommend the configuration that strikes the best balance between your performance requirements and investment constraints. With a CO₂ plant from Linde, you can look forward to the following benefits:

The capacity and purity you want

All of our systems support on-stream applications requiring gaseous or liquid CO₂ with purity levels of up to 99.99%. Capacities vary from 30 to 360 metric tonnes per day for modularised units with a single train. Customised solutions or several modular trains support capacities above this.

Minimum operating costs

Our CO₂ plants are designed for the highest levels of energy efficiency. Ease of maintenance and automated operations further reduce operating costs. A distributed control system (DCS) or programmable logic controller (PLC) dynamically adjusts the process to accommodate changes in the feed gas compositions or plant load.

Advanced flexibility

We engineer our CO₂ purification and liquefaction plants to give you the flexibility you require. For instance, operational capacity can be easily adjusted to the desired output level. The plant design can be adapted to all variations in feed gas sources and be started up and shut down within a matter of hours.

Remote control

To increase manageability even further, our plants come with an optional dedicated port that can be connected to a communication board for remote control. Plants can even be powered up and shut down in remote mode. In addition, we can supply fully automatic product analysis, truck loading and weighing equipment.

Maximum availability and ease of maintenance

Offering exceptional availability rates of almost 100%, all of our plants are engineered for excellence, featuring premium components to ensure maximum operational uptime.

Easy accessibility of all components simplifies maintenance. In addition, we deliver spare parts and can also look after maintenance and after-sales support.
Variety of sources:
Our plants support a variety of higher-purity feedstock sources such as:
- Ammonia
- Ethylene oxide/glycol
- (Bio) ethanol
- Natural wells
- Refineries
- Synthesis gas
- Biogas
- Natural gas sweetening

Closer look at CO₂ purification and liquefaction.

Step-by-step process flow

Pre-cooling and compression
This unit cools down the water-saturated feed gas and then separates the water. The cooled gas is sent to the CO₂ compressor to increase the pressure up to operating conditions. Boil-off gas from the storage tanks can also be recycled to the compressor. Various adsorbers can be added downstream as required to remove additional components such as hydrogen sulfide (H₂S).

Scrubbing
The CO₂ gas is fed into the scrubber unit to wash and cool down the gas. This is also where water-soluble components such as alcohols are removed.

Drying and adsorption
The remaining water and traces of other chemical components are removed from the gas stream in the interchangeable dryers. Depending on requirements, various adsorbers and filters are installed downstream in order to remove further components such as carbonyl sulfide (COS).

Liquefaction
The dry CO₂ gas passes through a reboiler followed by the CO₂ distillation column. The gas leaving the column at the top contains the inert components. The liquid CO₂ product drawn off the bottom is sent to the storage tank or vaporised for various on-site solutions.

Storage system and loading facilities
The liquefied CO₂ is stored in pressurised tanks. For transportation purposes, it is pumped through the respective loading facilities into trucks, railway cars and ships. For gaseous on-site applications, the CO₂ is pressurised by means of additional compressors connected to the pipeline network.

Typical layout of a CO₂ purification and liquefaction plant

1. CO₂ and NH₃ compressor
2. Adsorber skid
3. Scrubber skid
4. CO₂ column
5. Tank platforms
6. Loading pump skid
7. Loading station skid
8. Transformer, MCC and switchgear
9. Control room including DCS/SIS/PLC
10. Product analysis
11. Storage tanks, vertical or horizontal, pre-insulated
Modular purification and liquefaction plants.

Benefits you can count on

Our modular portfolio is designed to leverage the benefits of modularisation, which include independent off-site fabrication, preassembly and pre-commissioning. Not only does modularisation maximise cost efficiencies and quality, it also reduces risks as well as on-site installation time and effort.

All our prefabricated skids are preassembled and completely tested prior to delivery. In fact, our preassembly and pretesting concept has reduced installation effort, commissioning expense and on-site risks by up to 90%. In addition, a compact layout minimises your space requirements and enables a relocation of your entire plant.

Our modularised units typically support capacities between 30 and 360 metric tonnes per day with a single train.

99.99 vol% CO₂

A modular plant which was built by Linde Engineering is located in Manchester, United Kingdom. It was built in 2017 and produces 100 t/d of liquid CO₂ in food grade quality.
Innovative answers to individual challenges

Rounding out our proven portfolio of modular CO₂ purification and liquefaction plants, we also develop, engineer and construct customised plants to meet more exacting application requirements. Possibly even combining several modular trains, a customised build is ideal, for instance, for capacity requirements in excess of 360 metric tonnes per day. Building on our long-standing experience in handling CO₂, all of our customised plants are designed to give you the flexibility you require. The plant design can be adapted to all variations in feed gas sources and be started up and shut down within a matter of hours. Regardless of the size and complexity of your project, you can rely on our project team to deliver a turnkey solution on time and on budget.

Customised purification and liquefaction plants.

One of the largest CO₂ purification and liquefaction plants, producing 1,000 t/d CO₂, was built as a customised project by Linde Engineering in Rotterdam, NL.
Benefits at a glance

→ Modularised and tailor-made solutions
→ Comprehensive capacity range
→ Availability
→ Reliability
→ Efficiency
→ Compact footprint
→ Less maintenance
→ Easy accessibility
→ After-sales support
→ Minimum operating costs (OPEX)
→ Long-term experience in CO₂ handling
→ Feasibility studies to EPC turnkey supplies

One-stop project realisation.

As a leading player in the international plant engineering business, we cover every step in the design, project management and construction of industrial plants. Regardless of the size and complexity of your project, you can rely on our project team to deliver a turnkey solution on time and on budget. You can also select standalone services to support the various steps in your individual project.

Covering the full value chain of carbon dioxide

Starting off with carbon capture, through CO₂ purification and liquefaction to the point of sequestration, we provide solutions for the whole carbon value chain. Please contact our sales team for more information.

“Close ties between Linde Engineering and Linde Gas mean we can combine global reach and operational experience with technology.”

Sebastian Holz
Vice President Sales & Technology

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If needed, the CO₂ can be stored underground. A plant using this technology was built in Maxdorf, Germany.

Several removal technologies capture the CO₂ from different off-gas streams. One of these plants was built in the United Arab Emirates and removes 26,100 Nm³/h CO₂ from syngas.
Your partner for the production and processing of gases

Delivering reliable process plants for maximum capital efficiency
Linde has been optimizing gas processing technologies for 140 years, successfully delivering more than 4,000 plant engineering projects around the globe. Favoring trusted, lasting business relationships, the company collaborates closely with customers to enhance plant lifecycle productivity and innovate process flows. The company’s proven gas processing expertise plays an indispensable role in the success of customers across multiple industries – from natural gas and oil refining through petrochemicals and fertilizers to electronics and metal processing.

Operational excellence along the entire plant lifecycle
We work closely with our customers to gain an in-depth understanding of individual needs. Building on the unique synergies of Linde as an integrated plant operator and engineering company, Linde offers innovative process technologies and services to exceed our customers’ reliability and profitability expectations. This commitment to innovation extends along the entire plant lifecycle. The LINDE PLANTSERV® service team supports customers every step of the way – from maintenance and repairs to full revamps. Leveraging the latest digital technologies to offer on-site and remote operational and support services, we consistently take asset performance to the next level.

Making the impossible possible
From the desert to the Arctic, from small- to world-scale, from standardized to customized designs, Linde’s engineering specialists develop solutions that operate under all conditions. The company covers every step in the design, project management and construction of gas processing plants and components. Customers can always rely on Linde to deliver the plants, components and services that fit their needs best – anywhere in the world.

Discover how we can contribute to your success at www.linde-engineering.com

Get in touch with our sales team:
Phone +49 351 250-3203, inquiry: www.linde-engineering.com/contact

Core competencies at a glance

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