Making our world more productive

CO_2 purification and liquefaction

Adding value through standardisation, modularisation and customisation

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

Familiar CO_2 applications include the carbonation of beverages.

Climate-friendly way to source CO_2.

"CO_2 is not only an environmental issue – it is a valuable feedstock."

Jürgen Velte
Managing Director
Linde Engineering Dresden

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. CO_2 emitters like power companies want to reduce their CO_2 emissions. This wish is echoed across many other industries where relatively concentrated streams of CO_2 occur. Re-utilisation of CO_2 is improving the carbon footprint.

Partner of choice

World leader in cryogenic technology, Linde has designed and supplied several CO_2 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.

Wide application spectrum

Our plants are engineered to produce gaseous or liquid CO_2 to the exact purity level you require – all the way up to food-grade quality as per EIGA or FDA. Major applications of liquid CO_2 include food and beverages, desalination, cooling, cryogenic cleaning, welding and cutting, and healthcare. Purified gaseous CO_2 is also used across a broad industrial spectrum from greenhouse horticulture through chemicals to enhanced oil recovery.

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

From a remote operation center plants can be operated via long distances.

Performance you need at a price you like.

Our broad CO_2 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 CO_2 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 CO_2 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.

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.

Minimum operating costs

Our CO_2 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 CO_2 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.

Fully automatic truck loading.

Closer look at CO_2 purification and liquefaction.

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

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 CO_2 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 (H_2S).

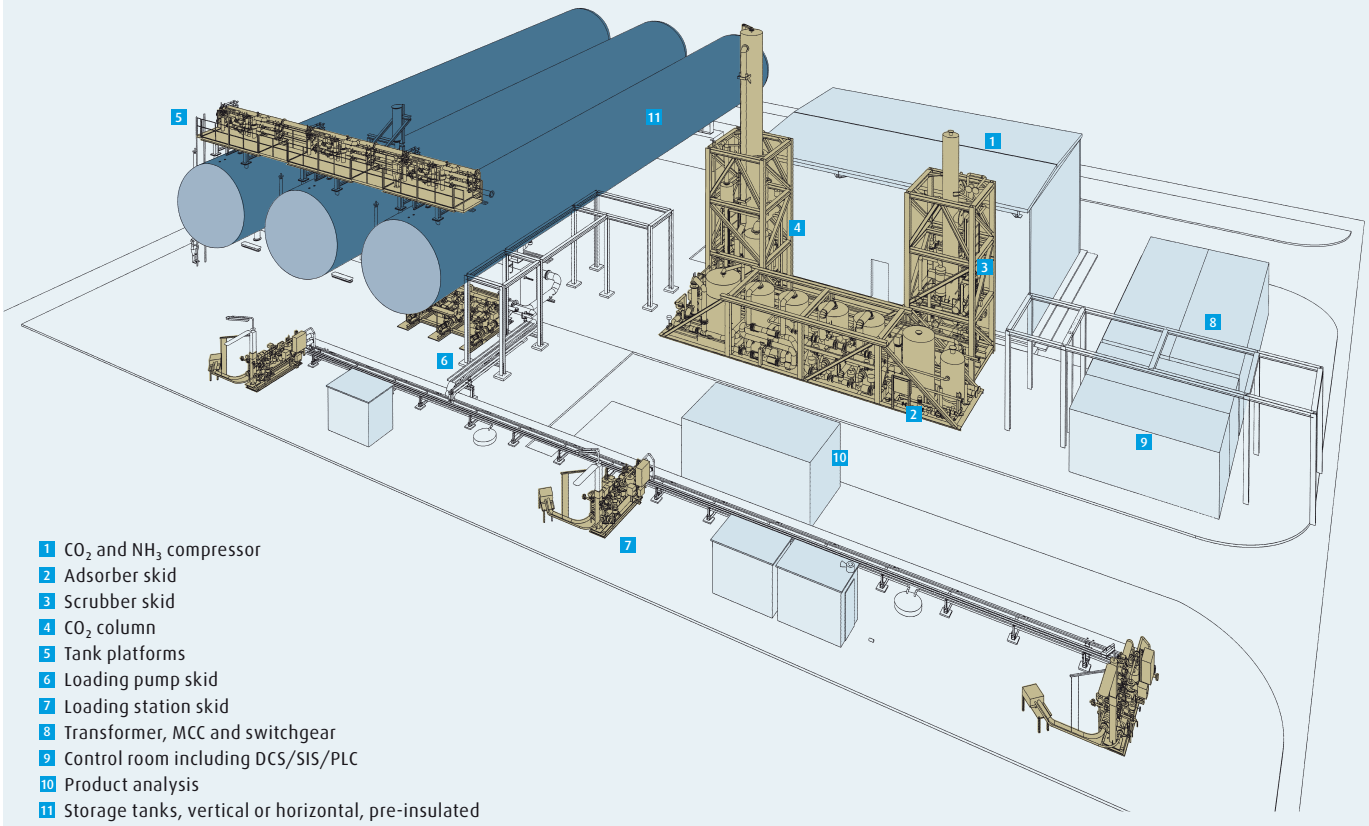
Scrubbing
The CO_2 gas is fed into the scrubber unit to wash and cool down the gas. This is also where water-soluble components such as alcohols are removed.

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 CO_2 gas passes through a reboiler followed by the CO_2 distillation column. The gas leaving the column at the top contains the inert components. The liquid CO_2 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 CO_2 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 CO_2 is pressurised by means of additional compressors connected to the pipeline network.

Typical layout of a CO_2 purification and liquefaction plant



1 CO_2 and NH_3 compressor
2 Adsorber skid
3 Scrubber skid
4 CO_2 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% CO_2

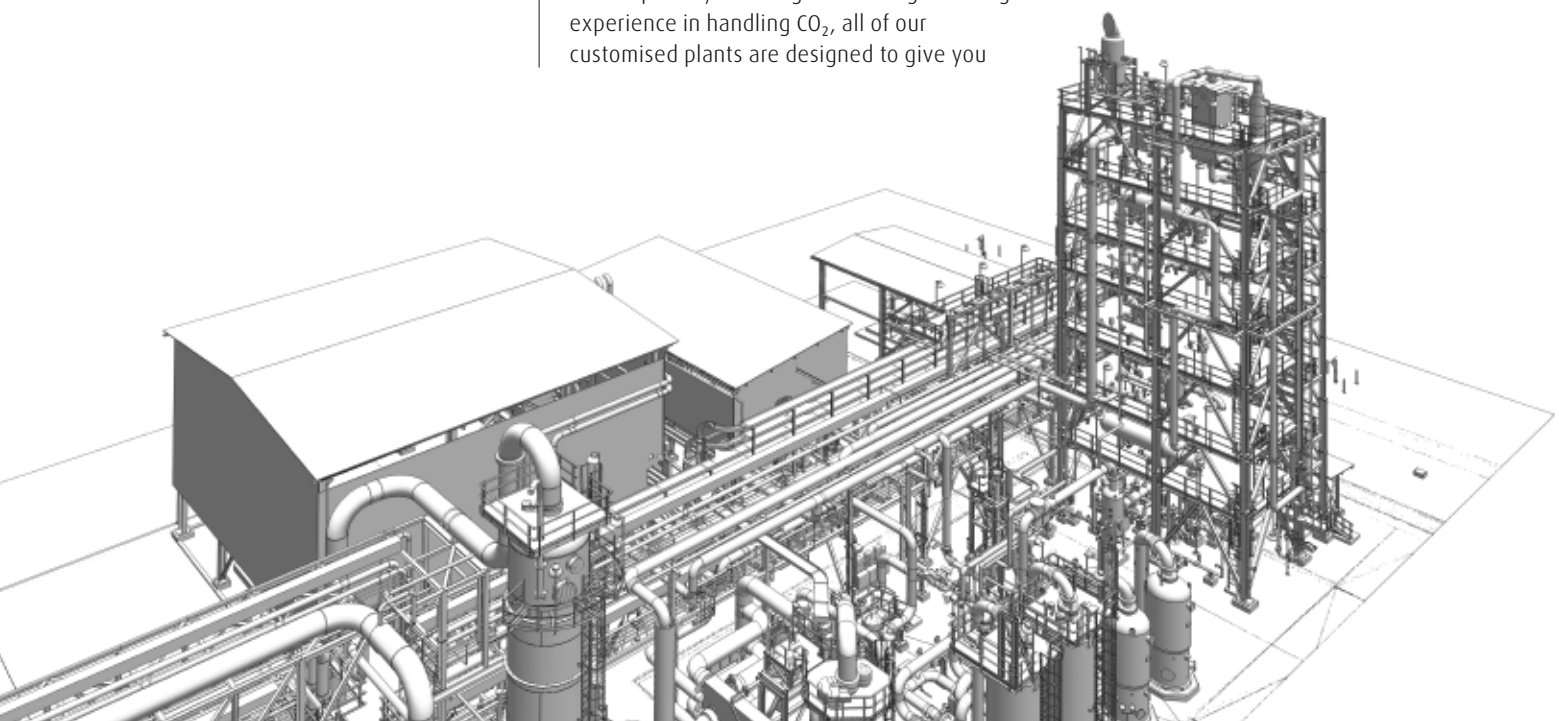
A modular plant which was built by Linde Engineering is located in Manchester, United Kingdom. It was built in 2017 and produces 100 t/d of liquid CO_2 in food grade quality.

One of the largest CO_2 purification and liquefaction plants, producing 1,000 t/d CO_2, was built as a customised project by Linde Engineering in Rotterdam, NL.

Customised purification and liquefaction plants.

Innovative answers to individual challenges

Rounding out our proven portfolio of modular CO_2 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 CO_2, 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.



If needed, the CO_2 can be stored underground. A plant using this technology was built in Maxdorf, Germany.

Several removal technologies capture the CO_2 from different off-gas streams. One of these plants was built in the United Arab Emirates and removes 26,100 Nm^3/h CO_2 from syngas.

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 CO_2 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

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 CO_2 handling
- Feasibility studies to EPC turnkey supplies

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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

Plant engineering
- → Air separation plants
- → LNG and natural gas processing plants
- → Petrochemical plants
- → Hydrogen and synthesis gas plants
- → Adsorption plants
- → Cryogenic plants
- → Carbon capture and utilization plants
- → Furnaces, fired heaters, incinerators

Component manufacturing
- → Coldboxes and modules
- → Coil-wound heat exchangers
- → Plate-fin heat exchangers
- → Cryogenic columns
- → Cryogenic storage tanks
- → Liquefied helium tanks and containers
- → Air-heated vaporizers
- → Water bath vaporizers
- → Spiral-welded aluminum pipes

Services
- → Revamps and plant modifications
- → Plant relocations
- → Spare parts
- → Operational support, troubleshooting and immediate repairs
- → Long-term service contracts
- → Expert reviews for plants, operations and spare part inventory
- → Operator training

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