CO₂ purification and liquefaction.
Adding value through standardisation and modularisation.
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. In particular, they are keen to meet the carbon dioxide (CO₂) needs without generating new streams of this gas. One solution is to recycle CO₂ from off-gas streams that would otherwise be vented to the atmosphere. CO₂ recycling with an on-site solution not only contributes to climate and environmental protection, it also has the added bonus of low supply costs and immediate availability of the gas.

Partner of choice

World leader in cryogenic technology, Linde has designed and supplied several CO₂ purification and liquefaction plants worldwide – 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 solution 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 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.

Climate-friendly way to source CO₂.

Many welders rely on CO₂ as a shielding gas in welding and cutting applications.

“Understanding our customers’ needs, offering a value-creating solution and executing are key capabilities at Linde Engineering.”

Jürgen Nowicki
Managing Director
Member of the Board of Directors

Carbon dioxide can also 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.

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

Many welders rely on CO₂ as a shielding gas in welding and cutting applications.
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:

Cost efficiencies through standardisation and modularisation

Our entire portfolio is designed to leverage the benefits of standardisation and modularisation, which includes 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 – containing equipment, piping, valves, instrumentation, paint, insulation and cabling connected to the skid’s own remote I/O box – are preassembled and tested to the maximum degree prior to delivery. In addition, a compact layout minimises your space requirements and this level of prefabrication means you can easily relocate your entire plant.

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 100 to 500 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.

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.

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.

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Closer look at CO₂ liquefaction and purification.

Variety of sources

Our plants support a variety of feedstock sources such as:

- Ammonia
- Ethylene oxide/glycol
- (Bio) Ethanol
- Natural wells
- Refineries
- Synthesis gas
- Biogas
- Natural gas sweetening processes

Broad application spectrum

- Beverage carbonation
- Food industry
- Greenhouses
- Desalination plants
- Chemical applications
- Enhanced oil recovery
- Cooling/dry ice
- Welding/cutting
- Health services

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. Bovef-off gas from the storage tanks can also be recycled to the compressor. Oil filters and 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 vapourised 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.

Flow diagram of a CO₂ purification and liquefaction plant

99.99 vol% CO₂

Typical standardised design of a CO₂ purification and liquefaction plant.
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.

**Broad service spectrum**

- **Project development services**
  - Technical design
  - Front-end engineering
  - Feasibility studies
  - Market analyses
  - Financial models
  - Licensing
  - Profitability analyses

- **Business services**
  - Project management
  - Project control
  - Quality assurance and cost control
  - Scheduling and expediting
  - Contract management
  - O&M management
  - After-sales service

- **Engineering services**
  - Basic engineering
  - Process design
  - Process calculation
  - Safety analyses
  - Authority permit engineering
  - Equipment specification
  - Material specification and strength calculation
  - Automation
  - Electrical engineering
  - Construction engineering
  - Civil and steel structure
  - Plant design
  - As-built documentation

- **Construction and start-up support**
  - Planning of construction and start-up
  - Supervision of civil and construction works
  - Construction execution
  - Commissioning and start-up supervision
  - Operator training
  - Performance demonstration and plant optimisation

"Our people, operational excellence and patented technologies empower us to deliver value to our customers.”

Dr Christian Bruch  
Member of the Executive Board

**Closer look at modularisation.**

**Benefits you can count on**

Our preassembly and pretesting concept has been shown to reduce installation effort, commissioning expense and on-site risks by up to 90%. This reduces erection time correspondingly. The main equipment, i.e. the compressor packages, plus the adsorber and column skids are supplied fully assembled inside a steel structure. All electrical equipment, such as the motor control centre (MCC) and switchgear, plus all automation and analysis equipment comes in tailor-made containers.

**Skids and containers at a glance**

We supply a number of highly modularised skids to include piping, valves, transmitters, cabling, cable trays and a remote I/O box.

**Skids ready for easy transportation on roads**

- CO₂ compressor and NH₃ compressor with oil unit
- Adsorber skid including adsorbers and other equipment
- Scrubber skid including column and other equipment
- CO₂ column skid including column and other equipment

**Skids ready for easy transportation in containers**

- Tank platforms
- Loading pump skid
- Loading station skid

**Container solutions including lighting, heating, ventilation and AC**

- Electrical equipment including transformers, MCC and switchgear
- Automation equipment including DCS/PLC, control room, fully automatic truck filling and weighing functions
- Product analysis unit

**Storage tanks**

- Storage tanks, vertical or horizontal, pre-insulated

**CO₂ purification plant.**

**CO₂ storage and sequestration plant.**
Collaborate. Innovate. Deliver.

Linde’s Engineering Division, a leading player in the international plant engineering business, covers every step in the design, project management and construction of turnkey industrial plants. Drawing on our extensive, proven process know-how, we set the standards for innovation, flexibility and reliability with ground-breaking concepts and a dedication to engineering excellence.

The success of our customers and partners around the globe is of primary importance. With a clear focus on efficiency, sustainability and growth, we develop customised solutions for projects of all sizes and degrees of complexity. We have already delivered more than 4,000 plants worldwide and always aim to find the best technical and economic solution for our customers.

Core competencies in plant engineering:
- Air separation plants
- LNG and natural gas processing plants
- Petrochemical plants
- Hydrogen and synthesis gas plants
- Chemical plants
- Adsorption plants
- Cryogenic plants
- Carbon capture and utilisation plants
- Furnaces, fired heaters, incinerators

Core competencies in component manufacturing:
- Packaged units and coldboxes
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic columns
- Cryogenic tanks
- Air-heated vaporisers
- Water bath vaporisers
- Spiral-welded aluminium pipes

Get in touch – find the best solution.

Hydrogen and synthesis gas plants
Phone +49.351.250-3760
hs2@linde-le.com

Linde AG
Engineering Division, Dr.-Carl-von-Linde-Strasse 6 –14, 82049 Pullach, Germany
Phone +49.89.7445-0, Fax +49.89.7445-4908, info@linde-le.com, www.linde-engineering.com