CO₂ purification and liquefaction.

Adding value through standardization and modularization.
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 maximize cost efficiencies through standardization and modularization, 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 designed 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 greenhouses horticulture through chemicals to enhanced oil recovery.

“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
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 standardization and modularization

Our entire portfolio is designed to leverage the benefits of standardization and modularization, which includes independent off-site fabrication, preassembly and pre-commissioning. Not only does modularization maximize 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, painting, 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 minimizes 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 modularized units with a single train. Customized 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 to all components simplifies maintenance. In addition, we deliver spare parts and can also look after maintenance and after-sales support.

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 adjust the process to meet 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 you need. 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.
**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. Boil-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 being drawn-off the bottom is sent to the storage tank or vaporized for various on-site solutions.

**Storage system and loading facilities**

The liquefied CO₂ is stored in pressurized 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 pressurized by means of additional compressors connected to the pipeline network.

**Flow diagram of a CO₂ purification and liquefaction plant**
Closer look at modularization.

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 modularized 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, ventilation, heating and AC

- Electrical equipment including transformer, MCC and switchgear
- Automation equipment including DCS/PLC, control room, fully automatic truck filling and weighing functions
- Product analysis unit
One-stop project realization

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
→ QHSE 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 optimization

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

Dr Christian Bruch
Member of the Executive Board
Collaborate. Innovate. Deliver.

Linde’s Engineering Division is a leading player in the international plant engineering business. Across the globe, we have delivered more than 4,000 plants and cover every step in the design, project management and construction of turnkey industrial facilities. Our proven process and technology know-how plays an indispensable role in the success of our customers across multiple industries – from crude oil, natural gas extraction and refining to chemical and metal processing.

At Linde, we value trusted, lasting business relationships with our customers. We listen carefully and collaborate closely with you to meet your needs. This connection inspires us to develop innovative process technologies and equipment at our high-tech R&D centres, labs and pilot plants – designed in close collaboration with our strategic partners and delivered with passion by our employees working in more than 100 countries worldwide.

From the desert to the Arctic, from small- to world-scale, from standardized to customized builds, our specialists develop plant solutions that operate reliably and cost-effectively under all conditions.

You can always rely on us to deliver the solutions and services that best fit your needs – anywhere in the world.

Discover how we can contribute to your success at www.leamericas.com

Get in touch with our team:
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Core competencies at a glance

**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 utilization plants
- Furnaces, fired heaters, incinerators

**Component manufacturing**
- Cold boxes 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 aluminium 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