
Plants, terminals and equipment
for the entire LNG value chain.
Paving the way
for LNG.
THE LINDE GROUP
Linde

Introduction.

Driven by increasing natural gas demand and decreasing costs along the whole LNG value chain (due to significant economies of scale, improvements in technologies, etc.), investments in LNG infrastructure are growing rapidly in the last years. LNG has turned from being an expensive and regionally traded fuel to a globally traded source of energy with rapidly diminishing costs.

In China, Norway and lately in particular in the US, petroleum fuels have been successfully substituted by LNG in various applications, mainly for heavy trucking, remote-power generation and marine fueling. Today the volumes are still relatively small, however studies indicate substantial demand for additional domestic LNG capacities in many countries. These include the entire Baltic Area (ECA) and South East Asia. As a consequence, an appropriate infrastructure consisting of small- to mid-scale LNG liquefaction plants, import terminals, LNG bunkering units and refuelling stations will be built up and/or expanded.

With more than 125 years of comprehensive experience in the handling of cryogenic liquids, Linde Engineering has a track record in the design and performance of a wide range of natural gas projects including upstream natural gas liquids recovery (NGL plants), feed gas pre-treatment and liquefaction, transport and distribution of LNG up to bunkering and regasification in both LNG import and export terminals.

Linde Engineering is well recognised as a reliable technology provider and EPC contractor, both by its customers and the financial world. In-house manufacturing capabilities for core cryogenic equipment, such as heat exchangers (both coil-wound and plate-fin type), vaporisers, pumps, expanders and vacuum-insulated piping, complement Linde Engineering's unique profile and enable it to customise the process design and core equipment.

Linde Engineering's integrated project management concept assures the handling of complex interfaces and delivers a plant, equipment or packaged unit in due time and quality.

The Linde Group offers innovative and economical solutions for the entire LNG value chain and has more than 40 years experience in designing, building and operating LNG plants and proprietary cryogenic equipment.

Linde brochures. Examples.

NGL/LNG plants and LNG terminals

- Natural gas liquid recovery. CRYO-PLUS™ technology.
- Natural gproduction in Stavanger.
- Baseload LNG production in Xin Jiang.
- LNG technology.
- Gateways to clean energy. LNG import terminals.

Cyogenic equipment and packaged units

- Cryostar: Equipment and expertise for industrial gas, LNG, hydrocarbons and clean energy
- Cryostar: Turbo expanders for cold production and energy recovery
- Cryostar: High-pressure pumps
- Cryostar: Small-scale liquefaction and distribution, biomethane and natural gas
- Aluminum plate-fin heat exchangers
- Coil-wound heat exchangers
- Coldboxes
- Manufacturing
- On-board LNG fueling systems
- EcoREL shipboard reliquefaction plant for LNG carriers
- LNG dispensers
- Columns and pressure vessels
- Vaporisation of cryogenic fluids
- EcoVAP LNG regasification plants
- Air-heated vaporisers
- Water-bath vaporisers

Abbreviations

PFHE	Plate-Fin Heat Exchanger
CWHE	Coil-Wound Heat Exchanger
BOG	Boil-Off Gas
FGSS	Fuel Gas Supply System
FPSO	Floating Production Storage and Offloading
FSRU	Floating Storage Regasification Unit
HPP	High-Pressure Pump
SMR	Single Mixed Refrigerant
mmscfd	million standard cubic feet per day
tpd	tonnes per day
mtpa	million tonnes per annum
ECA	Emission Control Area

Linde along the LNG value chain. Cryogenic equipment and packaged units.

NG processing (upstream) and NG delivery by pipeline


Process units/EPC

- Dehydration units
- C_{2+}/C_{3+} recovery, fractionation/isomerisation
- Caustic washing
- Sulphur recovery
- Nitrogen rejection
- Cryogenic methane purification
- Helium recovery, purification and liquefaction
- Helium storage (Helicon tank container)
- Cryogenic CO_2 rejection

Equipment/packaged units

- PFHE
- Coldboxes
- Cryogenic expander with cryogenic compressor and possible oil brake from 2–12 MW (TC series)
- Expander with process compressor and active magnetic bearings from 2–12 MW (MTC series)
- Expander with generator and oil-lubricated bearings from 2–12 MW (TG series)
- Hydrocarbon condensate and LPG pumps
- Pressure let-down: single and two-stage turbine (0.5–12 MW)
- Hermetic turbine (150–600 kW)
- Block-in-kettle PFHE
- Helium liquefier

NG liquefaction


Process units/EPC

- Hg removal
- Amine washing
- Mole sieve dehydration
- HHC removal
- NG liquefaction (series of patented processes with Mixed Refrigerant or Nitrogen Expansion Cycle)
- LNG storage tanks (flat-bottom, bullets, spheres)

Equipment/packaged units

- CWHE
- PFHE
- Coldboxes
- NG and biogas liquefaction units for capacities up to 100 tpd
- Return gas blowers/BOG compressors
- Cryogenic expanders with cryogenic compressors and possible oil brakes (TC series)
- Expanders with process compressors and active magnetic bearings (MTC series)
- Expanders with generators and oil-lubricated bearings (TG series)
- Cryogenic liquid expanders with generators (LTG series)
- Hydrocarbon condensate and LPG pumps, Nitrogen companders, new companders (5 wheels), vertical sealless VS pumps
- EcoLNG micro-scale liquefaction units
- Sub-X® submerged combustion vaporisers for peak shaving plants

LNG shipping/distribution/regasification

LNG shipping incl. FPSO, FSRU, supply regasification vessel

Process units/EPC

- Floating LNG (Topsides, at least liquefaction island), CO_2 pre-cooled LNG processes
- On-board fuelling systems with water-heated vaporiser; LNG on-board bunkering system (bunker barge/ship)

Equipment/packaged units

- PFHE
- Coldboxes
- LNG tanks
- EcoBOT and EcoREL (BOG reliquefaction systems for large carriers), BOG handling systems, BOG compressors, BOG FGSS incl. HPP pumps, NG heaters, EcoVAP, LNG (sendout) vaporisers/FSRU regas packages
- Turbines and companders for expander liquefaction cycles
- Water-bath vaporisers (for Nitrogen)

LNG bunkering and distribution

Process units/EPC

- LNG bunkering:
- Complete bunkering stations, incl. own bullet-type LNG storage tanks (up to 1,250 m^3)
- LNG distribution:
- Complete LNG/CLNG fuelling station

Equipment/packaged units

- Standard tanks (bullet-type, flat-bottom)
- ISO containers
- LNG semi-trailers
- LNG pumps SUBTRAN (60 kW) and possible dispensing systems
- Water-bath vaporisers
- LNG/CNG re-fuelling stations (equipment)
- Reciprocating and centrifugal submerged pumps
- Ambient air vaporisers (up to 500 bar)
- Larger pumps for transfer and re-fuelling stations
- Dispensers incl. payment protocol interface

LNG terminals and regasification

Process units/EPC

- Complete small- to mid-scale LNG import terminals incl. own bullet-type tanks (up to 1,250 m^3) or steel-steel flat-bottom tank up to 20,000 m^3
- World-scale LNG import terminals (design and manufacturing of main equipment)
- LINORC™ (Linde Organic Rankine Cycle unit)

Equipment/packaged units

- BOG compressors
- Return gas blowers
- LNG vaporisers (water-bath, air-heated or Sub-X® submerged combustion type)
- Wobbe Index control
- LIN booster and LIN HP pumps
- LIN vaporisers
- Truck loading pumps

Linde along the LNG value chain. NGL/LNG plants and LNG terminals.

NG processing (upstream) and NG delivery by pipeline

NG liquefaction

Small-scale liquefaction plants

Linde technology

StarLNG™ standard plant concept with SMR (LIMUM® 1) or Nitrogen Expansion Cycle liquefaction process

EPC or EP scope

Process plants incl. pre-treatment, utilities, LNG storage and ship/truck loading facilities, HHC removal, nitrogen rejection

Proprietary equipment

Engineering, design, fabrication and site construction of process modules and key cryogenic equipment, e.g. PFHE/coldbox, LNG storage facility (bullet tanks up to 1,250 m^3), cryogenic expander, LNG pump, cryogenic vessel

Reference projects

- → Bergen (Norway) 120 tpd/0.04 mtpa
- → Kwinana (Australia) 180 tpd/0.06 mtpa

Mid-scale liquefaction plants

Linde technology

StarLNG™ standard plant concept with SMR (LIMUM® 3)

EPC or EP scope

Process plants incl. pre-treatment, utilities, LNG storage and ship/truck loading facilities, HHC removal, nitrogen rejection

Proprietary equipment

Engineering, design, fabrication and site construction of process modules and key cryogenic equipment, e.g. PFHE/coldbox or CWHE, LNG storage facility (pressurised sphere or atmospheric flat-bottom tank), cryogenic expander, LNG pump, cryogenic vessel

Reference projects

- → Stavanger (Norway) 900 tpd
- → Tuha (China) 1,300 tpd
- → Beinichuan (China) 813 tpd
- → Jimunai (China) 1,200 tpd
- → Jincheng (China) 1,337 tpd
- → Xinghe (China) 1,357 tpd
- → Bazhong (China) 960 tpd
- → Barra do Riacho (Brazil), FEED import/export LNG terminal 2 x 1.25 mtpa liquefaction
- → Marlin/Bintulu (Malaysia) 1,840 tpd boil-off gas reliquefaction

World-scale liquefaction plants

Linde technology

Patented MFC®/MFC® 3 triple mixed refrigerant cycle process

EPC or EP scope

Process plants incl. pre-treatment, utilities, LNG storage and ship/truck loading facilities, optional: integrated NGL recovery, nitrogen rejection, He recovery, purification and liquefaction

Proprietary equipment

Engineering, design, fabrication and site construction of process units and key cryogenic equipment, e.g. CWHE, LNG storage facility (atmospheric flat-bottom tank) with partner companies, LNG pump, cryogenic vessel, PFHE

Reference projects

- → Hammerfest (Norway) 1 x 4.3 mtpa
- → Puerto La Cruz (Venezuela), FEED 1 x 4.3 mtpa

Linde technology

CRYO-PLUS™ customised and standard plant concept for NGL C_{2+}/C_{3+} recovery and fractionation

EPC or EP scope

Process plants including pre-treatment, utilities and truck loading, optional: nitrogen rejection, methane purification, integration with LNG plant

Proprietary equipment

Engineering, design, fabrication and site construction of process modules and key cryogenic equipment

Reference projects

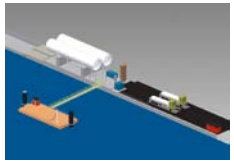
(Number of trains x capacity in mmscfd)

- → Canadian County (USA) 1 x 150
- → Parachute Creek (USA) 1 x 350
- → Mayfield Western Oklahoma (USA) 1 x 200
- → Cottonwood (USA) 1 x 60
- → McKenzie City (USA) 1 x 100
- → Stateline I+II (USA) 2 x 100
- → Canadian Valley (USA) 1 x 200
- → Williston (USA) 1 x 100
- → Poza Rica (Mexico) 1 x 200
- → Tamaulipas (Mexico) 2 x 200
- → Constanta (Romania) 1 x 140

Linde along the LNG value chain. NGL/LNG plants and LNG terminals.

LNG bunkering and terminal storage

LNG bunkering



EPC or EP scope

Complete bunkering station including own bullet tanks up to 1,250 m^3

Proprietary equipment

Engineering, design, fabrication and site construction of key cryogenic equipment and systems, e.g. LNG pump and dispensing system, water-bath vaporiser, LNG subcooling system with LIN for BOG handling

Reference projects

- Rotterdam (Netherlands), basic engineering 1 x 500 m^3 pressurized bullet LNG storage tank (future extension 2 x 500 m^3), truck loading with 2 x 70 m^3/h loading bays
- Bremerhaven (Germany), as above
- Hamburg (Germany), as above
- Agotnes (Norway) 1 x 450 m^3 pressurised bullet LNG storage tank

Small-scale LNG import terminals

EPC or EP scope

Complete LNG import terminal including own bullet tanks up to 1,250 m^3 and LNG vaporiser

Proprietary equipment

Engineering, design, fabrication and site construction of key cryogenic equipment and systems, e.g. truck loading station, BOG compressor, return gas blower, LNG subcooling system with LIN for BOG handling, steam-heated vaporiser

Reference projects

- Pori (Finland), FEED
  5 x 1,000 m^3 pressurised bullet LNG storage tanks (future extension 4 x 1,000 m^3), truck loading with 2 x 70 m^3/h loading bays

Mid-scale LNG import terminals

EPC or EP scope

Complete LNG import terminal including LNG storage tanks (flat-bottom LNG tanks with partners), LNG vaporiser and recondenser

Proprietary equipment

Engineering, design, fabrication and site construction of key cryogenic equipment and systems, e.g. BOG compressor, return gas blower, LNG vaporiser, Wobbe Index control, LIN booster and LIN HP pump, LIN vaporiser

Reference projects

- Nynäshamn (Sweden) 12.7 tph regasification rate, 20,000 m^3 full containment LNG tank, truck loading with 2 x 75 m^3/h loading bays
- Lysekil (Norway), 21 tph regasification rate, 30,000 full containment LNG tank, truck loading with 2 x 100 m^3/h loading bays

World-scale LNG terminals

EPC or EP scope

LNG import terminal excluding LNG storage tanks (by partners only), LNG vaporiser and recondenser

Proprietary equipment

Engineering, design, fabrication and site construction of key cryogenic equipment and systems, e.g. flat-bottom LNG tanks, BOG compressor, return gas blower, LNG vaporiser, Wobbe Index control, LIN booster and LIN HP pump, LIN vaporiser, Organic Rankine Cycle key components

Reference projects

- Barra do Riacho (Brazil), FEED LNG import terminal 435 tph regasification rate, 2 x 160,000 m^3 full containment LNG storage tanks with membrane technology

Engineering excellence – every step of the way.

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 economic success of our customers and partners around the globe is of primary importance. With a clear focus on efficiency, sustainability and growth, we cooperate with you to develop customised solutions for projects of all sizes and degrees of complexity. The aim is always on finding a solution that is optimal both technically and economically. Linde's Engineering Division has already delivered more than 4,000 plants worldwide.

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
- Biotechnology plants
- Carbon capture and utilisation plants
- Furnaces, fired heaters, incinerators

Core competencies in plant 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

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