

Making our world more productive



Modular air separation plants

Proven technology offering cost and schedule gains





Linde is a reliable partner capable of meeting your individual needs.

Meeting today's gas supply challenges in air separation.

Companies considering investing in air separation units need to balance a number of factors. A reliable design offering minimal technical risk and maximum operational flexibility is essential to ensure process continuity and meet stringent safety standards. Construction logistics and implementation timeline can also be key considerations, particularly in areas that are difficult to access. In addition, plant owners face a number of financial constraints. Rapid return on investment is essential in today's increasingly competitive economic climate. Companies must look at both capital and operating expenditure (CAPEX and OPEX) over the entire plant lifetime to ensure a realistic assessment of total cost of ownership.

Modular design for time, cost and reliability gains

Linde is one of the largest and most experienced suppliers of air separation plants and industrial gases worldwide. We have delivered over 3,000 air separation plants around the globe and operate more than 550 air separation units (ASUs) ourselves. Building on our long-standing experience in both plant engineering and operation, we have developed a portfolio of modular air separation units to meet today's ASU challenges. These plants provide the best solution for our clients' varied needs, offering:

- Rapid time-to-solution through extensive prefabrication and pre-testing
- Simplified on-site logistics and lower CAPEX thanks to modular design
- Fast-track equipment fabrication and delivery
- State-of-the-art technology and design for reliable operation
- Ease of maintenance for low OPEX
- Professional support services from consulting to commissioning and start-up
- High power efficiency through proprietary process development
- Peace of mind thanks to our strong focus on, and excellent track record in, quality, health, safety and environmental (QHSE) protection

Industry-proven expertise

We serve clients across a broad range of industries. The hands-on experience we have gathered enables us to recommend, design and deliver the perfect fit for individual needs – regardless of the industry you operate in. Our references span:

Metals

- Iron and steel
- Non-ferrous metals including gold, copper, nickel, lead and zinc

Chemicals

- Ethylene oxide, NH₃ synthesis, petrochemicals

Energy and gasification

- IGCC, biomass and coal gasification, oxyfuel, natural gas, synthetic fuel, partial oxidation, coal-to-liquid, gas-to-liquid

Electronics

- Electronics, semiconductors, solar cell panels

Other industrial gases applications

- Healthcare
- Food processing
- Glass
- Pulp and paper
- Environmental technology, etc.



Erecting the coldbox at a NOVON™ plant in Texas, USA.

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

Jürgen Nowicki
Executive Vice President
Linde plc and CEO of
Linde Engineering

-15%

average power consumption
of our ASUs over the
last 10 years

Read more:
linde-engineering.com/adsorption_plants
linde-engineering.com/air_separation_plants

Our oxygen plant portfolio – meeting your individual needs.

At Linde Engineering, we understand that technical requirements vary from one industry to another. We have therefore developed a range of modular oxygen units so you can match your investment to your defined supply needs.

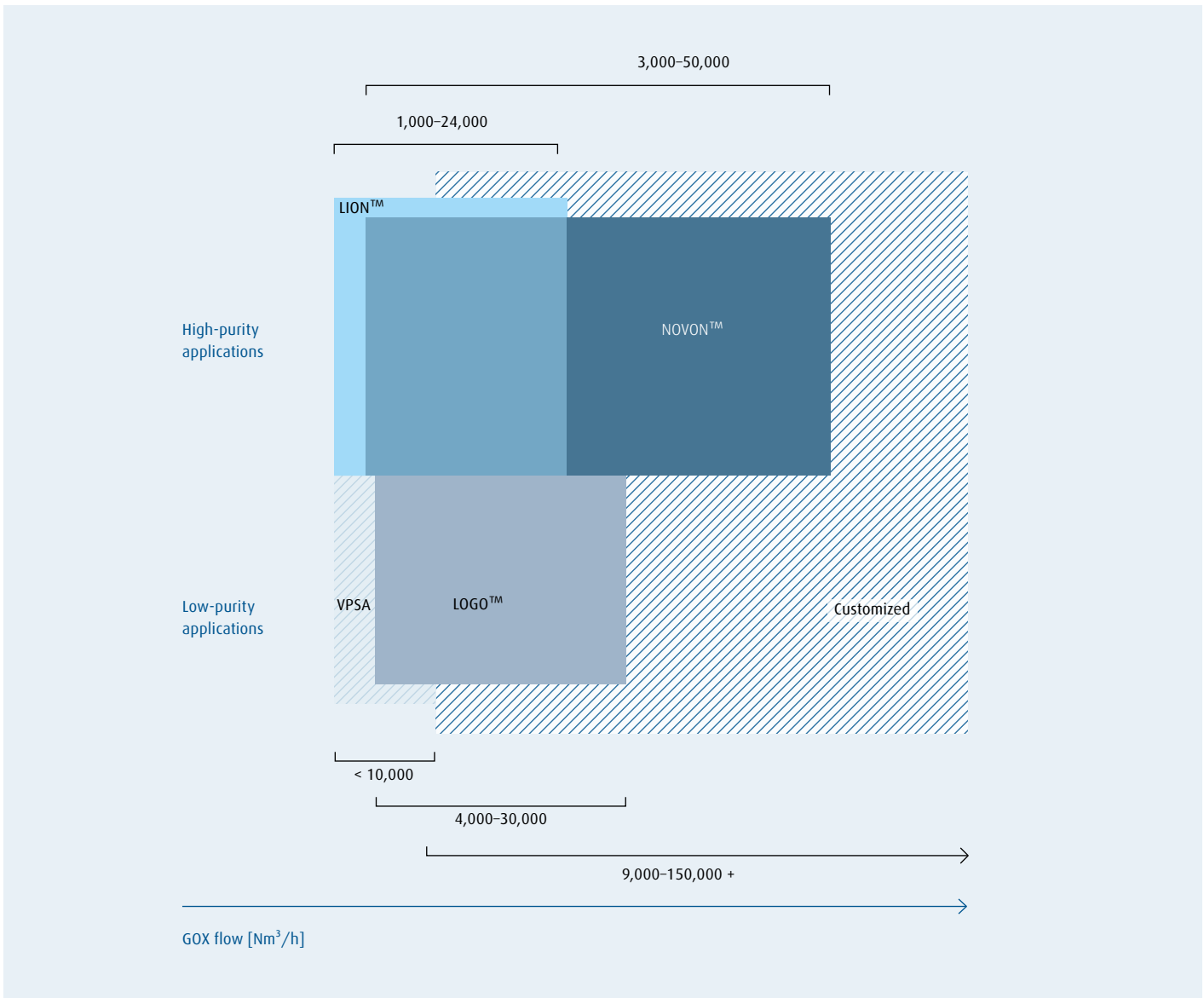
Oxygen plants at a glance

Modular plant solutions with a maximum degree of prefabrication

- LION™ High purity liquid oxygen, nitrogen and argon for bulk gas supply
- NOVON™ High purity gaseous and liquid oxygen, nitrogen and argon for on-site and bulk gas supply
- LOGO™ Industrial-grade oxygen and nitrogen for on-site supply

Extended portfolio complementing our modular offering

- VPSA Vacuum pressure swing adsorption plants
- Customized plants Tailor-made plants





NOVON™ 12 in Russia.



NOVON™ 30 in China.



SPECTRA 30 in Taiwan.

Our nitrogen plant portfolio – the perfect match.

One size does not fit all. We know that technical requirements can vary significantly from one market segment to another. Our nitrogen offering ranges from low-volume models up to high-flow units and even includes a specially developed range for ultra-high-purity needs, so you can always be sure that you get precisely what you need – no more and no less!

Nitrogen plants at a glance

Modular plant solutions with a maximum degree of prefabrication

- SPECTRA™ Ultra-high purity nitrogen for the electronics industry
- INSPIRE™ Nitrogen for applications with industrial purity levels
- PULSE™ Nitrogen liquefaction units

Extended portfolio complementing our modular offering

- PSA Pressure swing adsorption plants
- Customized plants Tailor-made plants
- SOS Small on-site nitrogen plants

1 ppb

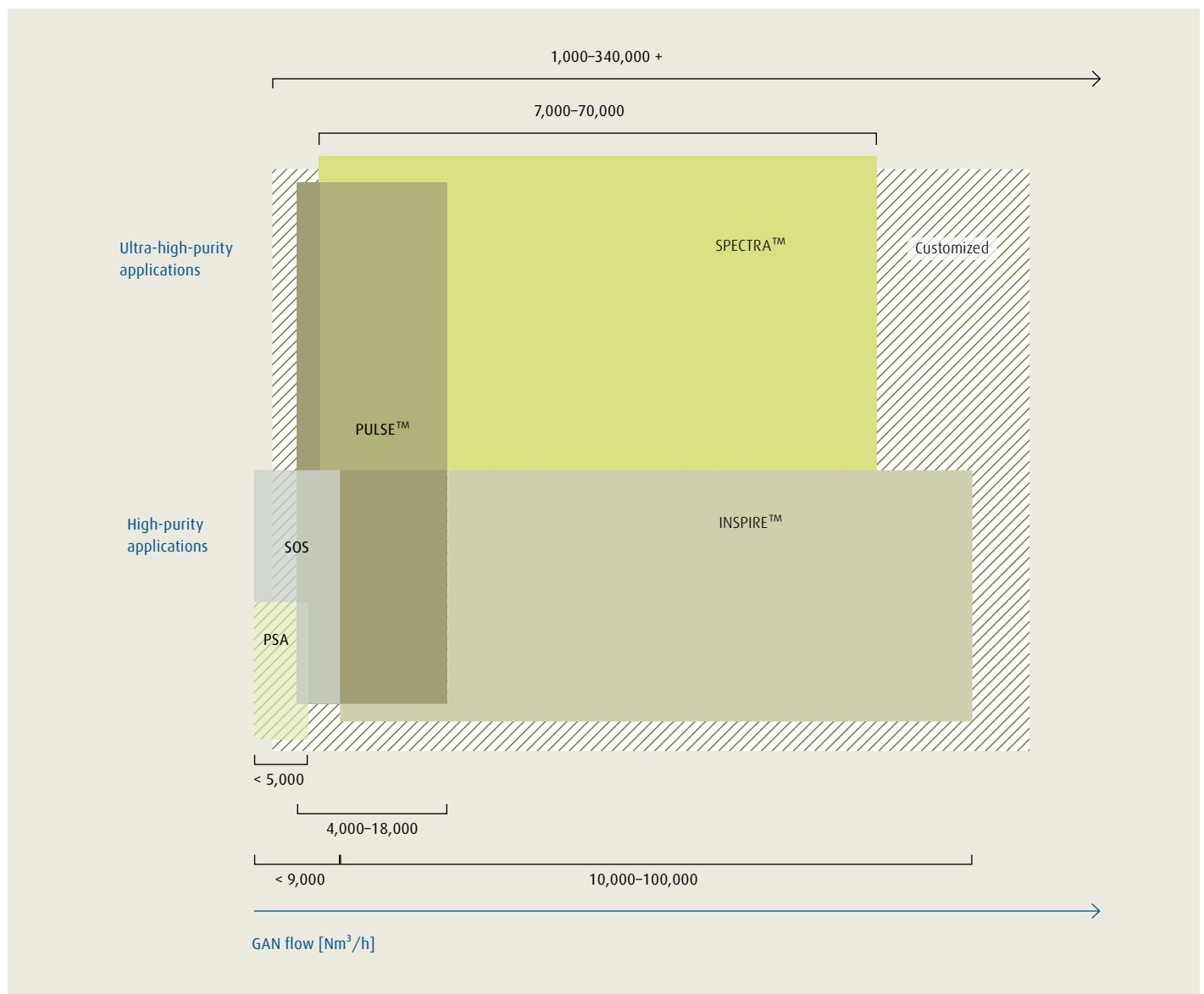
nitrogen purity

ex coldbox

Read more:

linde-engineering.com/adsorption_plants

linde-engineering.com/air_separation_plants



Very close to
100%
 level of reliability

Engineering excellence in action.

Proven track record for predictable project outcomes

Having delivered over 4,000 industrial plants worldwide, we have a long-standing, proven track record as a leading engineering, procurement and construction (EPC) partner. Our global procurement and construction capabilities give you the best of both worlds by combining our international reach with local market advantages and synergies. Project-specific execution models package these capabilities into customized workflows, building on state-of-the-art technologies for lowest total cost of ownership. Skilled and experienced commissioning teams ensure smooth start-up and hand-over. We also offer expert global support – either remotely or through our on-site teams.

Cost and time efficiencies

Our modular plant concept, which includes extensive prefabrication and pre-testing of key modules, combined with Linde standard specifications, greatly accelerates your on-stream times. Additionally, these plants permit remote operation. Local staff are only required for plant start-up, routine checks and maintenance, thus contributing to the reduction in lifecycle costs.

Designed for reliability and availability

We design and manufacture all key cryogenic components in-house to ensure the highest standards of performance and quality. Our availability and reliability concept is based on a fully functional split of the overall supply system into the air separation plant and the backup unit. This split achieves reliability levels very close to 100 percent.

Sophisticated interlock functions protect the plant against unforeseen failures or operator errors and keep the plant in a safe condition even in the event of a power failure.

Prefabrication for rapid time-to-solution

- Plate-fin heat exchangers in self-supporting steel casings
- Columns in self-supporting steel casings
- Coldbox sizes designed for road transport
- Molecular sieve valves on skids
- Cryogenic pumps on skids
- Plant control system in air-conditioned, pre-wired and shop-tested container
- Electrical medium-voltage switchgear in shop-assembled container



Remote Operating Center (ROC).



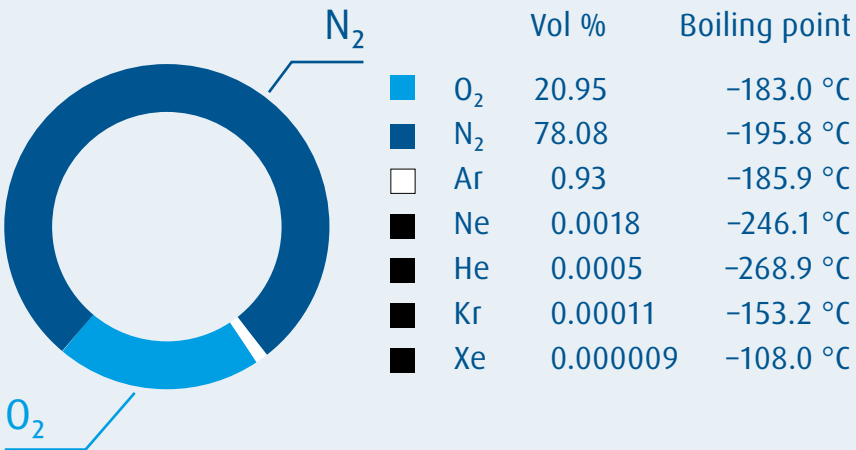
Typical design of a LION™ 3/5.

Linde Engineering.

Facts and figures.

Our air separation business.

Composition of air



Number of patents

180+

innovations in air separation filed for patent application in the last 5 years

3,000+

air separation plants have been built by Linde

550

air separation units owned and operated by Linde

World's largest single-train air separation unit delivers

5,250 tpd
oxygen

1902

... World's first air separation unit for oxygen production

1990

... Linde introduced argon production by rectification

19%
TCO
 (Total Cost of
 Ownership)
 savings in past
10
YEARS

Heat exchanger

1,700 m²/m³
 max. surface

-15%

average power consumption
 of our ASUs over the last
 10 years

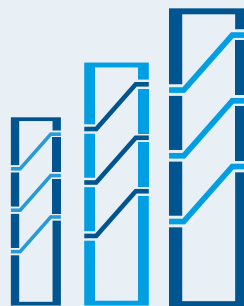
Read more:

linde-engineering.com/air_separation_plants



Linde air separation units
 built in more than

90
 countries



Biggest
 prefabricated coldbox:

Height 70 m
Weight 800 t

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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 air separation plant team:

Phone +49 89 7445-3526, 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

