

THE LINDE GROUP

Linde

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 400 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.



Coldbox erection for a SCALE 60 plant in Texas, USA.

“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
Linde Engineering Division

-15%
average power consumption
of our ASUs over the
last 10 years

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

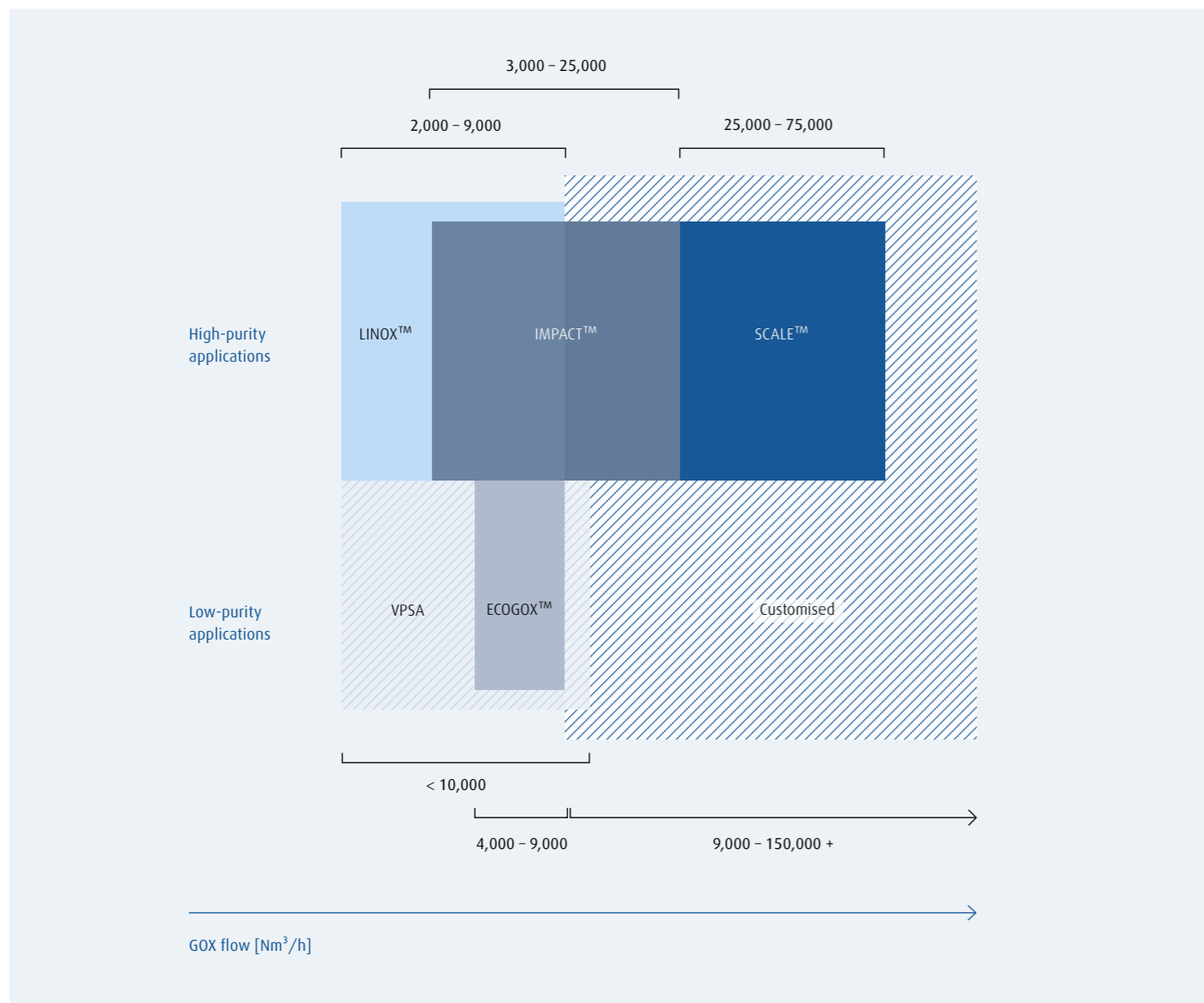
Modular plant solutions with a maximum degree of prefabrication

- LINOX™ Liquid production plants for bulk gas supply
- IMPACT™ Gaseous and liquid production plants for on-site and bulk gas supply
- SCALE™ Tonnage plants for on-site and bulk gas supply
- ECOGOX™ Low-purity gaseous production plants for on-site supply

Extended portfolio complementing our modular offering

- ▨ VPSA Vacuum pressure swing adsorption plants
- ▨ Customised plants Tailor-made plants

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



IMPACT 12 in Russia.



SCALE 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

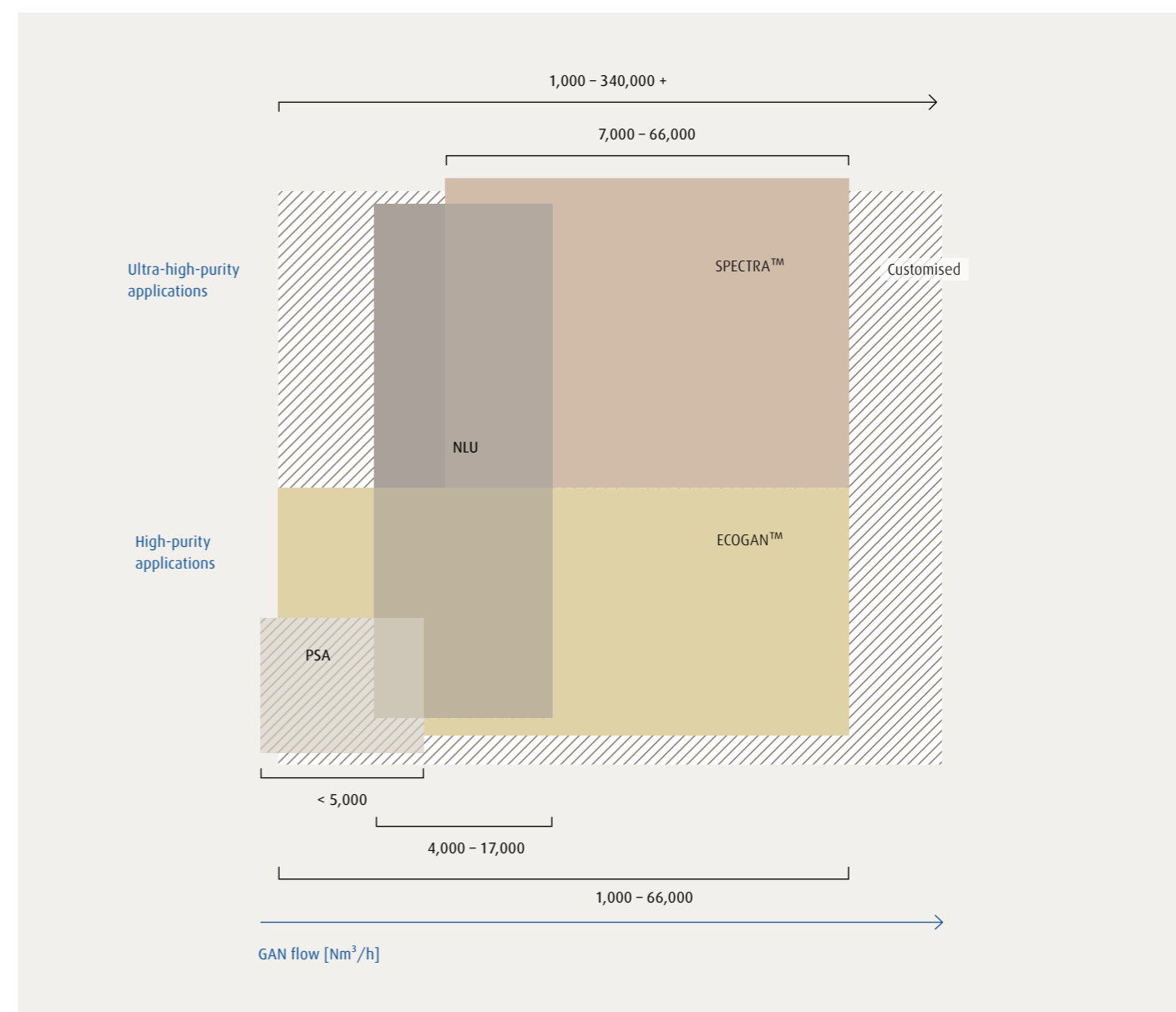
- SPECTRA™ Delivering highest purity levels for the electronics industry
- ECOGAN™ General applications with industrial purity levels
- NLU Nitrogen liquefaction units

Extended portfolio complementing our modular offering

- PSA Pressure swing adsorption plants
- Customised plants Tailor-made plants

1 ppb nitrogen purity ex coldbox

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



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 customised 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

Very close to
100%
level of reliability



Remote Operating Centre (ROC).

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

Dr Christian Bruch
Member of the Executive Board of Linde AG



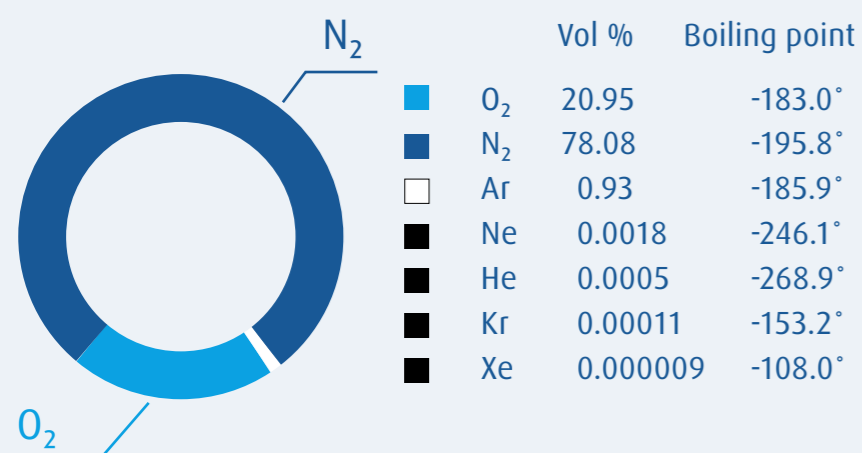
Typical design of a LINOX™ 3/5.

Linde Engineering.

Facts and figures.

Our air separation business.

Composition of air



Number of patents

150

new air
separation
patents in last
5 years

3,000+

air separation
plants have
been built
by Linde

400

air separation
units owned and
operated by The
Linde Group

World's largest single train
air separation unit built by

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

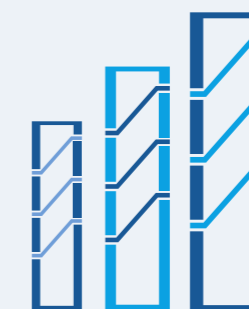
Read more:

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

Published by:

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

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 innovate 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 standardised to customised builds, our specialists develop plant solutions that operate reliably and cost-effectively under all conditions, from design to operations. 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.linde-engineering.com.

Get in touch with our air separation plant team:

Phone: +49 89 7445-3526, e-mail: airseparation@linde-le.com

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 utilisation 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 vaporisers
- Water bath vaporisers
- 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