

# Easy ways to boost your productivity.

Fine-tuning key links in your process flow can give you the tools to optimise capacity, reliability and flexibility for a healthier bottom line.

Various agents of change are at work within the refining industry. Refineries are increasingly challenged to process heavier, more sour crude with a higher sulfur content as these fractions gain in importance in today's oil industry. At the same time, increasingly stringent environmental regulations are lowering the permissible sulfur content of refinery products. This means that refineries have to desulfurise crude more effectively and this can lead to production bottlenecks. This is exacerbated by rising competition, especially as emerging markets enjoy the benefits of easier access to feedstock and lower labour costs. These forces are prompting many refining operators to explore ways of increasing efficiency and lowering their emissions – ideally without having to make massive investments in new equipment and technologies.



*“To remain online and productive, we rely on Linde’s industrial services for fast, secure gas supplies on demand. A reliable partner is essential in unexpected situations or if we have short-term changes in demand – particularly during start-ups, peak periods and maintenance activities.”*

Roland Kühl  
Process Unit Manager North (Hydrotreater and Crude Units) at Raffinerie Heide GmbH

### Every link counts

At Linde Gas, we believe that small adjustments can often deliver surprisingly big improvements at many key steps in the refining process chain. Our aim is to help you unlock the full efficiency and profitability potential of your refining operations with smart, selective and safe investments in gases, application technologies and professional services.

We invest heavily in R&D to keep you at the cutting edge of gas-enabled innovation. To ensure our technologies transfer smoothly from the lab to the real world, we also collaborate closely with our Engineering Division, building on the in-depth, hands-on experience we have gained building and operating steam methane reformers, fired heaters, air separation units, pressure swing adsorption plants and hydrogen plants around the world.

### Trusted partner for many key steps in the refining process

You can rely on us for all of your industrial gas needs in refining. We support applications such as blanketing, purging, pressure control and pipe pigging with secure, reliable on-site or bulk supply schemes for gases such as nitrogen. Meeting your instrumentation needs, our full range of specialty gases are used for emissions monitoring, process control and optimisation across a number of critical processes. On the application technology front, we have developed a number of oxygen enrichment solutions to increase the efficiency and flexibility of Claus plants and fluid catalytic cracking (FCC) units, as well as to intensify combustion in various process furnaces. We also offer wastewater treatment and air emission solutions. Regardless of your gas-related needs, you can look forward to smarter, cleaner and more economical refining operations with Linde.

up to  
**170 %**  
capacity increase

For more information, visit or contact us:  
[www.linde-gas.com/refineries](http://www.linde-gas.com/refineries),  
[www.linde-engineering.com](http://www.linde-engineering.com),  
[refineries@linde-gas.com](mailto:refineries@linde-gas.com)

# Application technologies.

*“The SURE® double combustion process gives us maximum capacity increase and great flexibility. Off all the oxygen enrichment technologies applied in our Claus units, we consider SURE to be the most reliable and the easiest to operate.”*

Tariq Malik P.E.  
Principal Refining Consultant  
CITGO Petroleum Corporation

## Oxygen enrichment technologies for Claus plants

Faced with growing competitive pressures, many refineries are moving to lower-grade crude oil and also converting low-value, sulfur-rich heavy fractions into more profitable commodities. This increases the hydrogen sulfide and ammonia feed streams, however, which can bottleneck operations. Oxygen enrichment of the process air is a proven, flexible way to debottleneck your operations while increasing flexibility. It has also been proven to maximise ammonia destruction in the Claus furnace, and thus eliminate detrimental effects in downstream Claus sections. We offer a full range of solutions based on the level of process intensification you require.

- SURE low-level oxygen enrichment with custom OXYMIX® gas injection devices and OXYMIX Flowtrain control system for oxygen dosing – offering up to 30 percent increase in capacity
- SURE mid-level oxygen enrichment with a SURE burner – enabling up to 75 percent capacity increase
- SURE high-level oxygen enrichment with a SURE burner based on double combustion technology – delivering up to 170 percent capacity increase

## Oxygen enrichment for FCCs

Similarly, in FCCs, oxygen enrichment can increase efficiency and help to burn off the coke from the catalyst. Our oxygen enrichment technologies have been shown to increase regenerator capacity by up to 35 percent.

## Oxygen enrichment for fired heaters

Fired heaters may also be bottlenecking refining operations. Here too, oxygen enrichment is an innovative way to enhance furnace performance by up to 35 percent and reduce NOx emissions by up to 45 percent. This is a low-CAPEX, flexible solution and thus an ideal strategy for operators looking for a low-risk, high-return and short-payback route to enhanced furnace operations.

## Wastewater treatment

One of the key environmental issues facing a refinery is the amount of wastewater that is produced for each barrel of oil refined. Here we can help with pH control solutions for the alkaline wastewaters that accumulate when reaction vessels and pipelines are washed out, for instance. If you do not have bio-treatment facilities, we can also provide oxygen services or even deliver a purpose-built bio-treatment system.

- SOLVOCARB® CO<sub>2</sub>-based water treatment system for neutralisation and excellent pH control
- SOLVOX® oxygen dissolution units for aerobic biological treatment and oxygen upgrades
- Ozone to part-oxidise/break down non-biodegradable organics

## Air emissions control

Tighter air pollution controls mean that many operators looking to expand need to find a way to do so without increasing nitrogen oxides (mainly NO and NO<sub>2</sub>) emissions. However, NOx removal technologies typically operate at high temperatures – often with adverse side effects for other equipment. We have developed a low-temperature oxidation process to help you overcome this challenge. This sophisticated solution provides the highest NOx removal capabilities commercially available, achieving efficiency rates in excess of 95 percent. We also offer cryogenic condensation solutions to reduce volatile organic compounds (VOCs) levels significantly.

- LoTOx® NOx removal unit to control particulates, sulfur dioxide and NOx emissions from FCCs, for example
- CIRRUS® VEC cryocondensation technology to recover VOCs for recycling or controlled disposal from gaseous effluent streams



*“All our services build on the synergised expertise we have gained as an engineering and gases player, coupled with the hands-on experience and insights we have acquired through the operation and maintenance of countless plants for our customers worldwide.”*

Walter Hocker  
Head of market segment chemicals & environment at Linde Gas

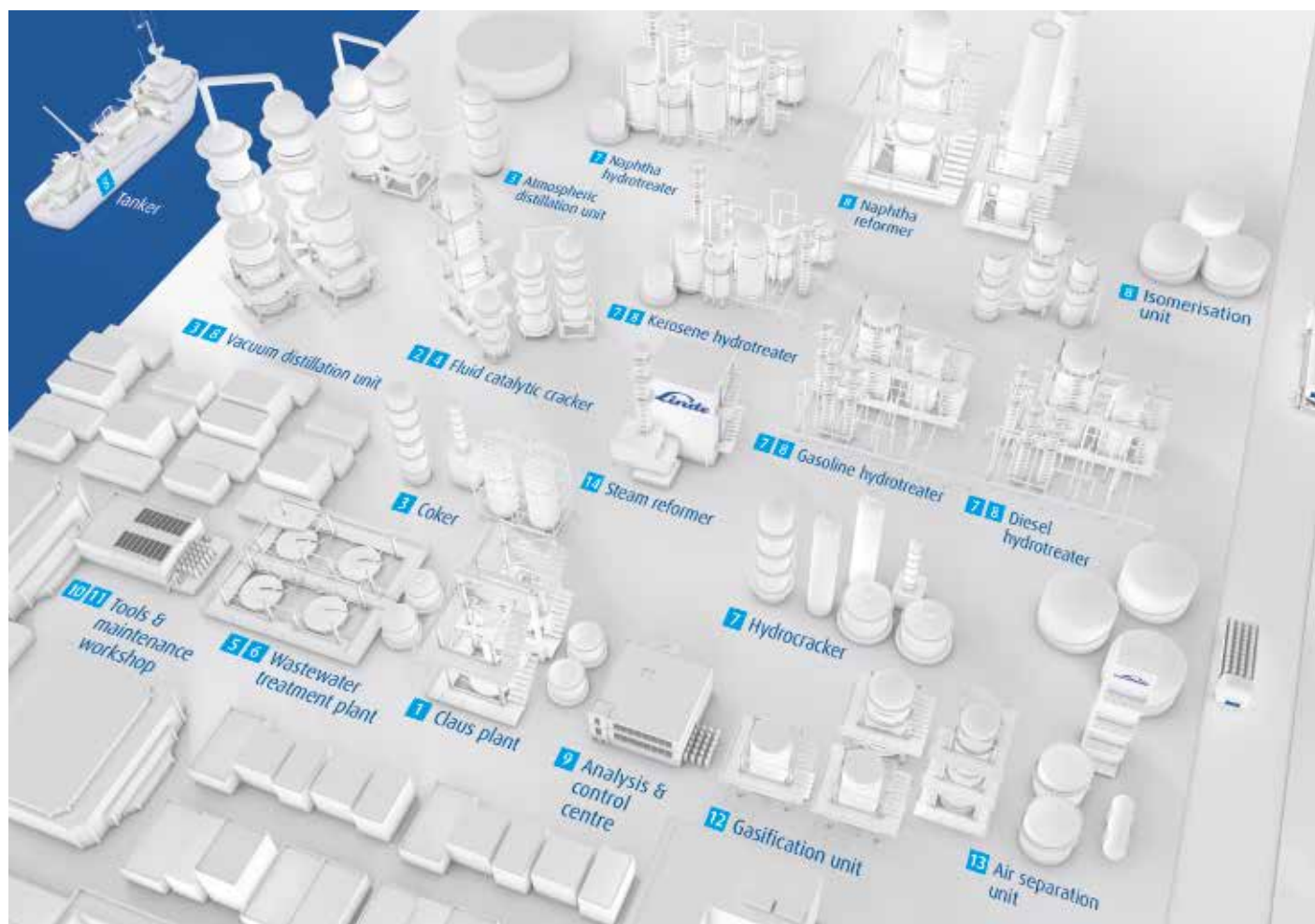
## Professional services and process know-how.

For your convenience, we bundle our application technologies and gases with a wide selection of professional services. These extend from cylinder tracking to gas and even full-blown facility management. We also offer preventive maintenance, safety audits and safety training to ensure that all gases – oxygen in particular – are always stored and handled responsibly and safely. Including:

- SECCURA® automated gas supply services and ACCURA® gas stock management services
- Safety audits and training
- Preventive maintenance and repair

- Full range of HiQ® specialty gases, equipment and services for process measurement, emissions control, instrument calibration, leak detection and combustion control
- Full range of gas supply modes and tailored schemes for nitrogen, oxygen, hydrogen, carbon dioxide, etc. – also including construction and operation of H<sub>2</sub>, O<sub>2</sub> and N<sub>2</sub> generation plants





Assistance available from Linde in a refinery.

## Linde refinery solutions.

- 1 SURE oxygen enrichment (O<sub>2</sub>e) portfolio for sulfur recovery in Claus plants
- 2 Oxygen enrichment for improved FCC performance
- 3 Improved performance and reduced NO<sub>x</sub> emissions in fired heaters with O<sub>2</sub>e
- 4 LoTox NO<sub>x</sub> removal technology in FCCs
- 5 SOLVOX oxygen dissolution units for aerobic biological treatment and oxygen upgrades
- 6 SOLVOCARB water treatment system for neutralisation and pH control with CO<sub>2</sub>
- 7 Hydrogen supply solutions for hydrocracking and hydrotreating
- 8 Industrial services for purging, cooling and blanketing based on tailored nitrogen supply schemes
- 9 HiQ specialty gases for process measurement, calibration and leak detection
- 10 Welding gases for maintenance and repair
- 11 CRYOCLEAN® dry ice cleaning
- 12 Oxygen supply solutions to enhance process efficiency
- 13 Air separation units for on-site production of oxygen
- 14 Broad portfolio of plants to meet individual volume needs

Reduce NO<sub>x</sub>  
emissions by up to  
**95 %** or more.

For more information, visit or contact us:  
[www.linde-gas.com/refineries](http://www.linde-gas.com/refineries),  
[www.linde-engineering.com](http://www.linde-engineering.com),  
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