

Making our world more productive



EMOFLEX™ Gas Application Technology

Stands with Lithium Battery Industry to Steer the Future

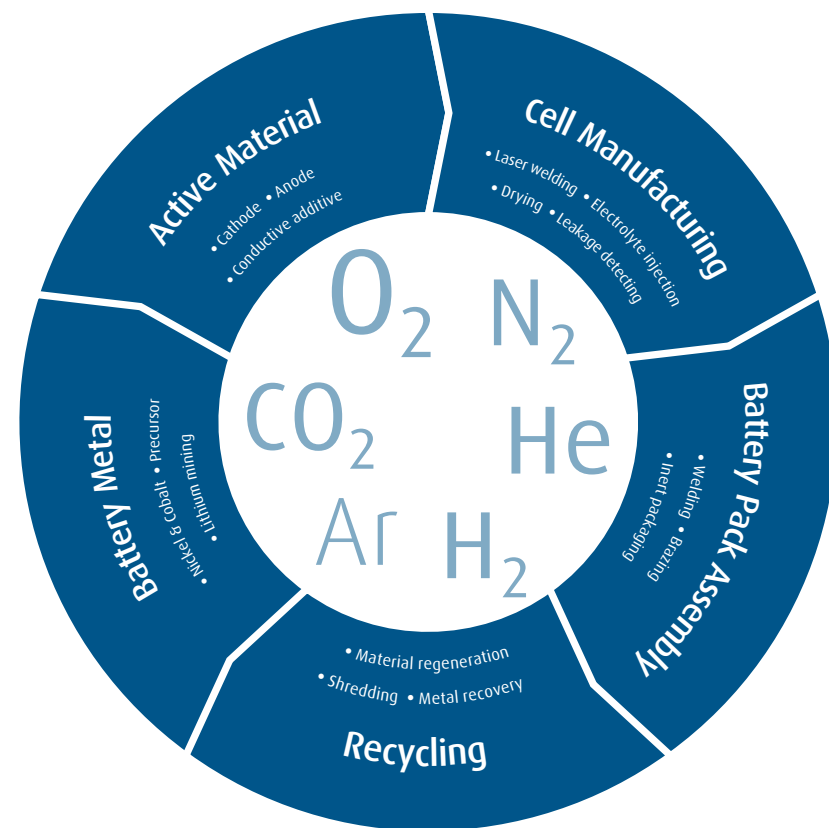


Contents

03 Optimal Gas Supply for Lithium Battery Industry

04 Linde Gas Supply and Application Technology in Battery Value Chain

06 EMOFLEX™ Gas Application Technology



Optimal Gas Supply for Lithium Battery Industry

As a leading global industrial gases and engineering company, Linde is making the world of lithium battery manufacture more productive every day by providing high-quality solutions, technologies and services. We work with our lithium battery customers from R&D and pilot scale to mass production. Through our proprietary gas production technologies and know-how, we work with our lithium battery customers from R&D and pilot scale to determine the optimal gas supply and impurity control that best fits their processes. As our customers go into mass production, they can take advantage of the earlier learning at an optimized overall cost of use, with also best-in-class safety, quality and reliability. Our global presence also ensures seamless replication when our customers start their facilities at different regions.

Linde has the technology, resources and people to help address climate changes. For more than 100 years, we have been providing solutions to help solve global energy challenges. Our company's mission of making our world more productive is fully aligned with the goals of addressing the global challenges of sustainable energy and climate change. Linde's world-class energy efficiency in the production, storage and transportation of gases helps our customers save money, energy and GHG emissions. Through our high-quality solutions, products, technologies and services, we help lower the carbon footprint of lithium battery manufacturing.

Linde's comprehensive gas product supply to meet customers' different needs

Linde develops a series of gas production equipment and supply solutions for different industries from the design and construction of gas production facilities to operation, distribution, installation and tailor-made logistics support. Linde provides numerous gas products and related solutions with customized systems, ranging from a packaged or bulk liquid storage tank to an on-site equipment or facility to meet the diverse needs of different customers around the globe.

- Professional design and construction of various on-site gas production facility
- Various gas products including oxygen, nitrogen, argon, carbon dioxide, helium and other special gases
- Application technologies for various steps of the lithium battery value chain, for lower costs, higher production rate and better quality



Cylinder gas



Liquid gas Dewar



Microbulk gas supply



Liquid tank gas supply

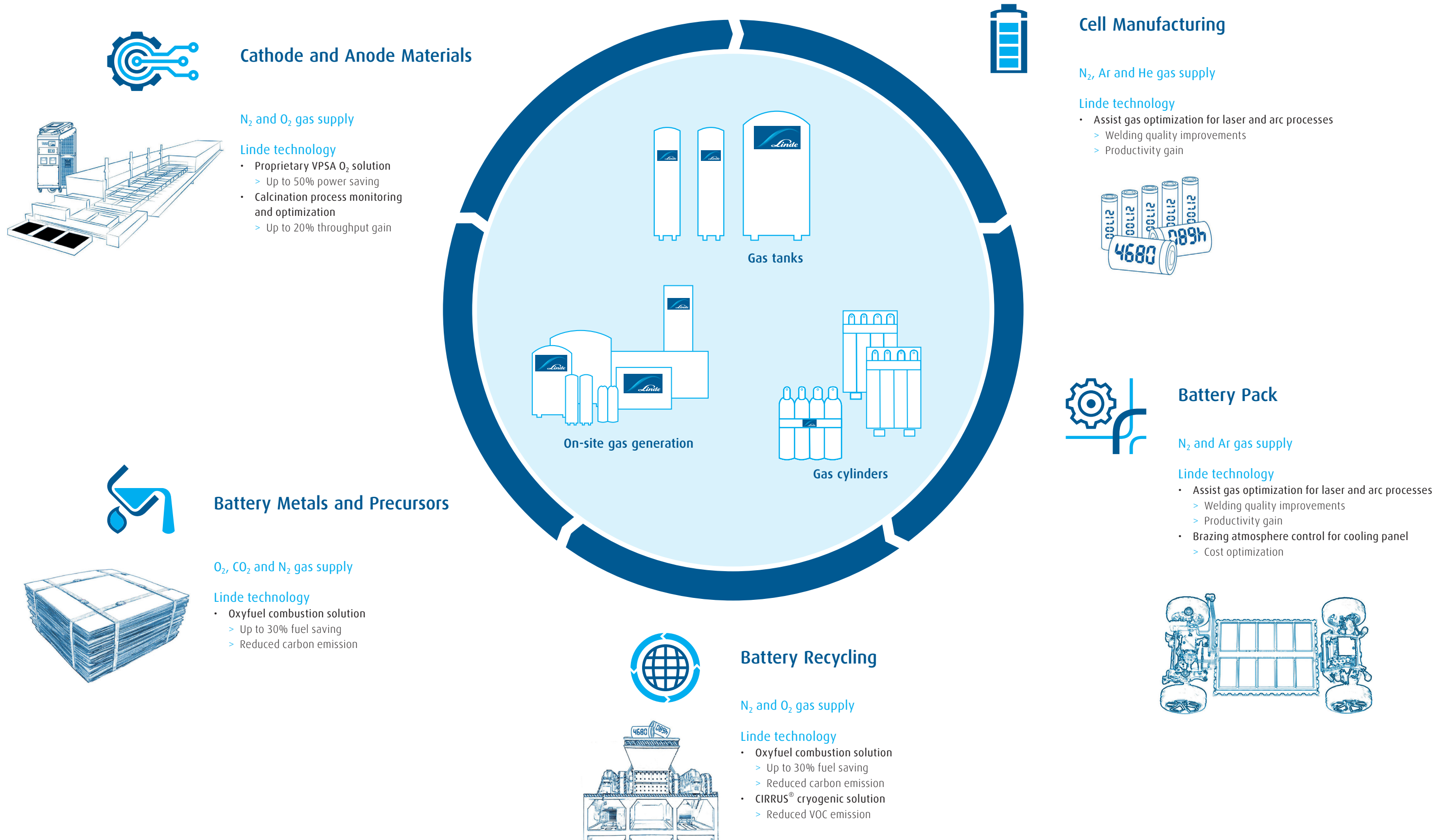


Vacuum Pressure Swing Adsorption (VPSA) small on-site gas supply



Cryogenic air separation unit, large on-site and pipeline gas supply

Linde Gas Supply and Application Technology in Battery Value Chain



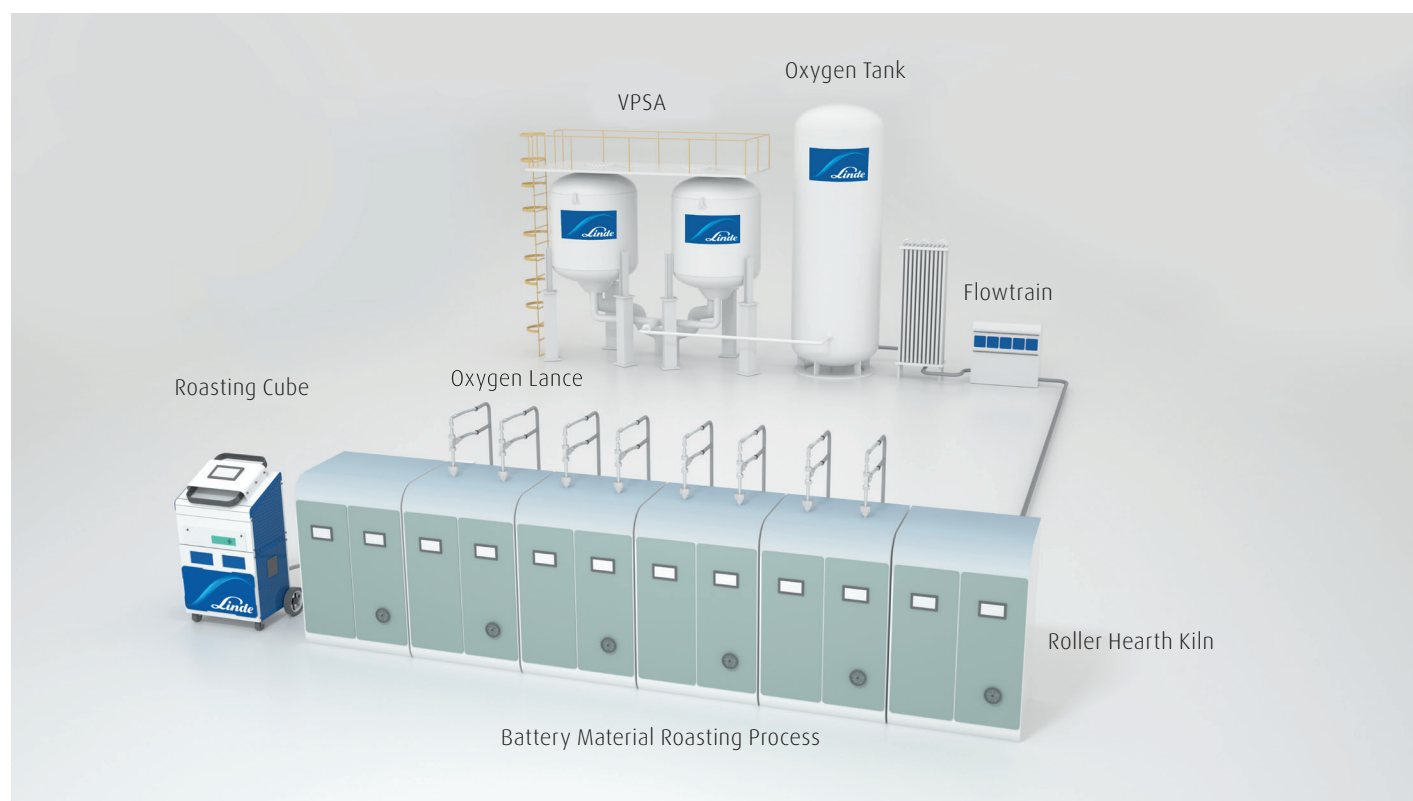
EMOFLEX™ Gas Application Technology

Innovative solution for the entire value chain of Lithium battery industry

Working with various customers in the lithium battery industry for over 10 years, Linde has accumulated rich experience and good understanding on many aspects of the industry, especially for active materials manufacturing and battery recycling. In cathode production, the active materials are calcinated in controlled atmospheres, which can be either oxygen for high nickel tertiary cathode or nitrogen for LiFePO_4 cathode. Linde's EMOFLEX™ technology for cathode making focuses on the monitoring and optimization of the furnace atmosphere. By monitoring the key components of the furnace atmosphere in real time, process variation can be detected early. Optimized atmosphere is critical to the cost and quality of cathode products, and it can also improve the cathode production throughput, which is critical as the industry scales up to match the fast-paced growth of electric vehicles. In battery recycling, extraction of valuable metals often involves a smelting process. Linde's oxyfuel technologies help recycling customers reduce fuel consumption and carbon emission.

As a pioneer and leader in the gas industry, Linde has been committed to providing high-purity and high-pressure industrial gases, gas mixtures and a series of industry-leading solutions and application equipment for laser customers for many years. In the assembly of lithium batteries, battery packs and electric vehicle (EV) chassis, laser and arc welding are widely used, in order to achieve efficient welding of same and dissimilar metals. By simulating the laser welding application scenarios and working conditions of battery manufacturing process, the welding process parameters are optimized from the perspective of gas types and applications. As a result, the quality and stability of the welding are improved. For lithium battery and EV manufacturers, this means increased productivity and, in some cases, also better product safety.

Linde provides stable and reliable industrial gas supply, innovative and targeted gas application technology, as well as prompt and proactive technical services for the customers in the Lithium battery industry. The complete solution is backed by technical expertise with close cooperation with the customer at all steps to maximize the customers' return on investment.



Linde offers a complete portfolio of gas solutions to optimize the Lithium battery cathode material production process.



About Linde

Linde is a leading global industrial gases and engineering company with 2021 sales of \$31 billion (€26 billion). We live our mission of **making our world more productive** every day by providing high-quality solutions, technologies and services which are making our customers more successful and helping to sustain and protect our planet.

The company serves a variety of end markets including chemicals and energy, food and beverage, electronics, healthcare, manufacturing, metals and mining. Linde's industrial gases are used in countless applications, from life-saving oxygen for hospitals to high-purity and specialty gases for electronics manufacturing, hydrogen for clean fuels and much more. Linde also delivers state-of-the-art gas processing solutions to support customer expansion, efficiency improvements and emissions reductions.

For more information about the company and its products and services, please visit www.linde.com

Linde GmbH
Dr.-Carl-von-Linde-Strasse 6–14
82049 Pullach
Germany

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