



From the MixCache.com library

SAMPLE COPY

A History of Linde

MixCache.com

SAMPLE COPY

Table of Contents

- **Introduction**
- **Chapter 1** The Dawn of an Industrial Giant: Founding and Early Years
- **Chapter 2** Pioneering Refrigeration: Linde's Impact on Cold Technology
- **Chapter 3** Expansion into New Frontiers: Early Diversification and Growth
- **Chapter 4** The Great Wars and Industrial Resilience: Navigating Global Conflicts
- **Chapter 5** Post-War Reconstruction and European Economic Boom
- **Chapter 6** The Age of Gases: Developing Industrial Gas Technologies
- **Chapter 7** Global Ambitions: Early International Expansion
- **Chapter 8** Innovation in Engineering: From Cryogenics to Plant Construction
- **Chapter 9** Navigating Economic Shifts: Challenges and Adaptations in the Mid-20th Century
- **Chapter 10** Mergers and Acquisitions: Shaping the Modern Linde
- **Chapter 11** The Digital Revolution and Industrial Automation
- **Chapter 12** Environmental Stewardship: Linde's Role in Sustainable Practices
- **Chapter 13** Breakthroughs in Healthcare: Medical Gases and Technologies
- **Chapter 14** Asia's Rise: Expanding Presence in Eastern Markets
- **Chapter 15** The Americas: Growth and Consolidation Across the Atlantic
- **Chapter 16** Research and Development: Fueling Future Innovations
- **Chapter 17** Crisis and Transformation: Adapting to Global Challenges
- **Chapter 18** The Linde-Praxair Merger: Creating a Global Leader
- **Chapter 19** Synergies and Integration: Uniting Two Industrial Powerhouses
- **Chapter 20** Defining the Modern Linde: Structure, Strategy, and Vision
- **Chapter 21** Linde's Role in Emerging Technologies: Hydrogen and Clean Energy
- **Chapter 22** Corporate Culture and Values: The People Behind the Powerhouse
- **Chapter 23** Global Supply Chains: Ensuring Reliability and Reach
- **Chapter 24** Confronting Future Challenges: Geopolitics, Economy, and Innovation
- **Chapter 25** Linde's Enduring Legacy: A Global Company's Impact on the World

Introduction

In the annals of industrial history, few names resonate with the enduring power and global reach of Linde. From its nascent beginnings in the late 19th century to its current standing as a titan of industry, Linde's journey is a compelling saga of innovation, resilience, and an unwavering commitment to progress. This book, "A History of Linde: The Story of a Global Company," embarks on a comprehensive exploration of this remarkable enterprise, tracing its evolution from a pioneering vision to one of the world's largest and most influential companies. It is a narrative not just of technological breakthroughs and market dominance, but of the people, ideas, and strategic decisions that have shaped a global powerhouse.

Linde's footprint spans continents and permeates countless aspects of modern life, often in ways unseen but profoundly impactful. From the gases that fuel our industries and enable medical miracles to the engineering marvels that underpin critical infrastructure, Linde's contributions are fundamental to the fabric of our contemporary world. This book delves into the intricate tapestry of its operations, revealing how a company founded on refrigeration technology diversified, adapted, and ultimately thrived through periods of immense global change, economic upheaval, and technological revolution. We will explore its critical role in shaping industries, fostering scientific advancement, and consistently pushing the boundaries of what is possible.

The scope of this history is ambitious, mirroring the expansive nature of Linde itself. We will journey through pivotal moments, from the company's foundational years and its groundbreaking work in cryogenics, to its strategic expansion into industrial gases and plant construction. The narrative will navigate the tumultuous waters of two World Wars, economic booms and busts, and the relentless march of globalization. A particular focus will be placed on the transformative mergers and acquisitions, notably the monumental Linde-Praxair merger, which reshaped the competitive landscape and solidified the company's position as a global leader.

"A History of Linde" is more than a chronological account; it is an exploration of the forces that drive corporate longevity and global significance. Readers will gain insight into the strategic foresight that allowed Linde to anticipate and capitalize on emerging technologies, from the digital revolution to the burgeoning hydrogen economy. We will examine the company's unwavering commitment to research and development, its embrace of environmental stewardship, and its vital role in the healthcare sector. Furthermore, the book will illuminate the unique corporate culture and values that have sustained Linde's success, examining how its people have been instrumental in navigating challenges and seizing opportunities across diverse markets, including the dynamic economies of Asia and the Americas.

Ultimately, this book promises to offer a multifaceted perspective on a company that has not only witnessed history but has actively shaped it. It is intended for anyone interested in the trajectory of global enterprises, the impact of industrial innovation, and the intricate interplay of business, technology, and society. By understanding Linde's past and present, we gain a clearer vision of the enduring legacy of a truly global company and its ongoing impact on the world.

SAMPLE COPY

CHAPTER ONE: The Dawn of an Industrial Giant: Founding and Early Years

The story of Linde begins not with a sprawling industrial complex, but with the focused intellectual curiosity of a young German engineer named Carl Paul Gottfried von Linde. Born on June 11, 1842, in Berndorf, Bavaria, he was the son of a Lutheran minister. Despite expectations to follow his father's calling, Linde developed an early fascination with mechanical engineering, a path that would ultimately reshape multiple industries and lay the groundwork for a global enterprise. His family moved to Munich in 1854, and several years later, he embarked on his engineering studies at the Swiss Federal Institute of Technology in Zurich.

At the prestigious Zurich Polytechnic, Linde's intellectual appetite was whetted by renowned professors such as Rudolf Clausius, Gustav Zeuner, and Franz Reuleaux. These mentors introduced him to fundamental concepts in heat engines and thermodynamics, igniting a spark that would eventually lead to his groundbreaking work in refrigeration. Even a youthful expulsion in 1864 for participating in a student protest couldn't derail his trajectory; Reuleaux, recognizing his talent, helped him secure an apprenticeship at a cotton-spinning plant.

Linde's early professional life saw him move through various engineering roles, gaining invaluable practical experience. He worked at Borsig in Berlin, a prominent locomotive manufacturer, from 1864 to 1866, where he was involved in the construction and delivery of steam locomotives. This was followed by a stint as the head of the technical department at the newly established Krauss locomotive factory in Munich. These roles provided him with a strong foundation in mechanical design and manufacturing processes, essential skills for the innovations that would soon follow.

In 1868, at the age of 26, Linde joined the newly established Technical University of Munich as a lecturer, quickly becoming a full professor of mechanical engineering in 1872. It was during his time here, specifically between 1873 and 1877, that his research delved deeply into heat theory. This academic environment provided the ideal setting for his groundbreaking investigations into refrigeration, a field ripe for significant advancement.

The impetus for Linde's foray into refrigeration was not purely academic; it was driven by a very practical industrial need. Bavarian purity laws, which prohibited brewing beer during the warmer months, posed a significant challenge to brewers. One such brewer, Gabriel Sedlmayr IV of the Spaten Brewery in Munich, a friend of Linde and

president of the German Brewer's Union, approached him to develop a reliable refrigeration system that would allow for year-round beer production. The existing methods of using natural ice were simply unreliable and insufficient.

Linde's research culminated in his first refrigeration system, which utilized dimethyl ether as a refrigerant. This pioneering machine was built by Maschinenfabrik Augsburg (now MAN AG) and installed at the Spaten Brewery in 1873. While this early prototype proved promising, it was not without its flaws. The dimethyl ether system was not entirely gas-tight, leading to leaks and even explosions, causing injuries to workers.

Undaunted, Linde continued to refine his designs, quickly transitioning to a more robust and safer refrigerant: ammonia. His theoretical studies, published in the Bavarian Industry and Trade Journal in 1870 and 1871, laid the groundwork for his practical inventions. In 1876, he patented a compressed ammonia vapor-cycle refrigerator, a system that would prove to be a significant breakthrough in industrial cooling. This innovation was a game-changer, offering a reliable and efficient method for continuous operation.

The ammonia-based machine was a marked improvement. It was more compact, weighed and cost half as much as its predecessor, and was significantly easier to assemble and maintain. The first of these ammonia compressors, featuring two vertical cylinders and using glycerin as a sealant, was built in 1876 and supplied to the Dreher brewery in Trieste, then part of Austria. This marked a revolutionary step for lager beer production, enabling precise temperature control essential for fermentation.

The commercial success of Linde's refrigeration technology quickly became apparent. By 1879, with his inventions gaining traction, Carl von Linde made a pivotal decision: he resigned from his professorship to fully dedicate himself to the commercialization of his refrigeration systems. On June 21, 1879, in Wiesbaden, Germany, he founded the "Gesellschaft für Lindes Eismaschinen Aktiengesellschaft" - Linde's Ice Machine Company - along with five partners. One of these partners was a wealthy Rhineland brewer, who, like Sedlmayr, clearly understood the immense benefits of mechanical refrigeration for the brewing industry.

Despite a somewhat slow start due to a challenging German economy, the business began to pick up rapidly in the 1880s. The efficiency and reliability of Linde's new refrigeration technology offered substantial advantages, particularly to breweries. By 1890, the company had sold an impressive 747 machines, not only to breweries but also to slaughterhouses and cold storage facilities across Europe. The demand for efficient and dependable cooling was undeniable, and Linde's machines were meeting that need with remarkable success.

The company's early years were characterized by a strategic shift from simply selling

refrigeration machines to also engineering and supplying entire ice factories where these machines would be installed. This proactive approach helped to overcome initial sales sluggishness and broaden the market for their technology. As the refrigeration business flourished, Linde also co-founded Gesellschaft für Markt-und Kühlhallen in Berlin, further expanding into the operation of cold stores.

While Carl von Linde maintained an active role in his company, for the first decade of its existence, he also took a sabbatical from teaching to serve as its sole director. After the company was firmly established and thriving, he returned to his professorship, continuing to direct the company's operations from the academic sphere. His dedication to both scientific inquiry and entrepreneurial application proved to be a powerful combination.

Linde's relentless pursuit of innovation didn't stop at practical refrigeration. His work quickly moved into the realm of lower-temperature systems. An order from the Guinness brewery in Dublin in 1892 for a carbon dioxide liquefaction plant spurred his research into industrial-scale low-temperature refrigeration. This particular project served as a catalyst for his investigations into air liquefaction, a field that would prove to be even more transformative than his initial refrigeration work.

By 1894, Linde was deeply engaged in developing a process for the liquefaction of air. His efforts bore fruit in 1895 when he successfully achieved the continuous liquefaction of air, producing liquid air at a remarkable rate of 3 liters per hour at -190°C . This monumental achievement was based on the Joule-Thomson effect, utilizing a counter-current heat exchanger, a process independently developed by both Linde and William Hampson, and now known as the Hampson-Linde cycle. He filed for patent protection for his process in 1895.

The liquefaction of air was a pivotal moment, not just for Linde but for the entire industrial world. It laid the foundation for modern cryogenics and opened up entirely new possibilities for industrial gas production. The ability to separate the components of air—primarily oxygen and nitrogen—on an industrial scale was a breakthrough with far-reaching implications for various industries, from healthcare to metallurgy.

In 1897, in recognition of his significant scientific and industrial contributions, Carl von Linde was knighted, thereafter being able to append the honorific "von" to his surname, becoming Carl von Linde. This honor underscored the profound impact his work was having on society and industry. The small company founded on the principle of mechanical refrigeration was now on the cusp of a new era, poised to become a global leader in industrial gases, all thanks to the pioneering spirit and relentless ingenuity of its founder.

This is a sample preview. Purchase the book to read the full content.

Visit MixCache.com to purchase the complete book.

SAMPLE COPY