Years of Siemens

SIEMENS –
a technology company since 1847


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a technology company since 1847

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SIEMENS

Foreword

Dr. Roland Busch

Once you start looking for it, Siemens technology is everywhere. We commute in cars designed with Siemens software, built in factories running on Siemens automation, charged – if they happen to be electric – by renewable and decentralized Siemens smart grids. We work in smart buildings that keep us comfortable and healthy, with a carbon neutral footprint that keeps the planet healthy as well. We take trips on Siemens trains and on planes brought to life using Siemens technology. We rely on lifesaving drugs that were quickly brought to market thanks to Siemens innovations, and we deliver vital diagnoses via our computed tomography (CT) and magnetic resonance imaging (MRI) scanners, enabling fast and accurate care for patients around the world.

Over the last 175 years, our technology has been transforming the everyday and improving lives for billions of people. When reading this book, you will see many stories marked by technological breakthroughs and by visionary people – customers, partners, and colleagues – who were never satisfied with the status-quo and believed that through technology, we can drive progress.

One of my favorite moments is from 1868, when Werner von Siemens led the company on its first megaproject, the construction of the Indo-European telegraph line. Siemens technology connected two continents, making it possible to send a telegram from London to Calcutta in just 28 minutes instead of several days. The achievement was remarkable when you consider the technologies of the time and the hazardous conditions. The line crossed multiple countries, with the teams facing harsh weather conditions, bandits stealing equipment, and all the time trying to coordinate the installation of 70,000 telegraph poles across thousands of kilometers of inhospitable terrain.

Today, our business continues creating technology to solve our customers' biggest challenges, such as the 2,000-km-long high-speed railway network in Egypt, which will link 60 cities and benefit 90% of the Egyptian population. With factories such as Mercedes-Benz's most digital and sustainable automotive plant in Berlin. Or infrastructure systems such as Expo Dubai's first sustainable city in the desert, known as District 2020.

Looking forward, I believe that the next wave of growth and innovation for our customers and society will come from combining the real and the digital worlds, by releasing the power of the internet of things (IoT). It will enable our customers to drive productivity, to run their systems more efficiently and longer, and to do more while using fewer resources. We are already working on the next level of digital transformation, and we call it the industrial metaverse. It will be a virtual and immersive place that will transform the way in which we work and innovate, setting new standards for real-time collaboration at speed, across all the markets that we serve: manufacturing, buildings and infrastructure, transportation, and healthcare.

The geopolitical situation in 2022 is turbulent. After decades of peace, we are witnessing a war in Europe, a war that we strongly condemn. Paired with the effects of the pandemic and ongoing climate crisis, it has presented the world with multiple challenges. These can be better tackled by greater collaboration within ecosystems and through partnerships.

Technology has the power to create a better future and has repeatedly played an essential role in keeping our economy and society functioning during difficult times. It can pave the way to a more resilient and sustainable future, with digital transformation being the engine for growth and prosperity for years to come.

Dr. Roland Busch
President and Chief Executive Officer
of Siemens AG

Foreword

Dr. Nathalie von Siemens

Technological and economic disruption. Acceleration and networking. New kinds of work and communication. Society undergoing a metamorphosis. The world has not seen the kind of epochal transformation we're witnessing today since the nineteenth century.

175 years ago, the transforming factor was the incipient Industrial Revolution. One of its catalysts was the inventor and entrepreneur Werner von Siemens – one of the early visionaries who understood what opportunities the great transformation of his age offered, and helped decisively to shape them. Werner was a "brimming spirit", filled with curiosity and passion for technical and social innovation. He realized that the value of science and technology lay in their benefit to humanity. He addressed the social challenge of his day – the "social question" – and responded at his own company with specific arrangements like shorter work hours, profit sharing, and safeguards for invalids.

175 years later, digitalization is transforming our societies as profoundly as industrialization and the spread of electricity did in Werner von Siemens' day. 175 years later, the kind of change he experienced is happening again. And the company he founded is helping to shape the next epochal change – digitalization. An astonishing story.

But do we really feel like celebrating a birthday when we face such urgent concerns as the global impact of a pandemic, the visible effects of the climate crisis, and an ominous digital divide? When far too many people have no assurance of peace, enough food, education, basic medical care, an income from their own labors, or protection through the rule of law? And while people are losing their lives and homes every day in the war in Ukraine, only a few hundred kilometers from where Siemens was founded in Berlin, on October 1, 1847?

Especially in a time of crisis, when trust in institutions is waning, when global cooperation is in question and peaceful coexistence among people is under attack – especially in a time like this – we can take our company's history as a source of optimism, and draw inspiration from the stories in this book.

Because Siemens is an example of what we can accomplish when we work together. When we try together to find how technological and social innovation can help us overcome our challenges.

Ever since Siemens was founded, more than four million people here, with a vast range of roles, jobs, skills and backgrounds, have been doing exactly that. For 175 years, they have been laying the groundwork for the future anew, together, every day.

October 1, 2022, is the day to honor them.

My warmest thanks to you,
and all the best for the future,

Dr. Nathalie von Siemens
Chairwoman of the Siemens
Familiy Shareholders' Council

Introduction

“Transforming the everyday for a better tomorrow” for 175 years

2022 is an important year at Siemens. We’re celebrating a big birthday. Some of the world’s most valuable companies were only founded within the last half century or less – but Siemens has been around for 175 years.

What once began as a start-up in a Berlin back courtyard in 1847 is now one of Germany’s most famous global brands.

When it was founded, Siemens made an important contribution to globalization by revolutionizing communications with a new kind of pointer telegraph. Today we’re helping to shape the digital transformation, and combining the digital and real worlds like no other company.

Throughout the 175 years since it was founded, Siemens has been working to improve people’s everyday lives with technology. And that aim provides fresh motivation every day for our roughly 300,000 employees.

But what does improving the everyday really mean, specifically? It means things such as advancing medical technology, creating sustainable transportation options, making buildings more efficient, and digitalizing production.

Better medical care, sustainability, intelligent resource management – and ultimately, a better quality of life. Those are our most important goals.

But we don't just talk about those goals at Siemens. For 175 years we've been proving how technology can achieve them.

And that's what we mean when we talk about technology with purpose. Not technology for its own sake, but as a way of achieving real improvements.

For us today, technology with purpose also means taking the knowledge the company has been gathering for generations, in all the many fields we've worked in across 175 years, and connecting it to the digital world. Because that's what will enable us to overcome the challenges that people all over the world are facing today.

The chapters that follow highlight some of the way stations in our evolution from a start-up to a global corporation that has contributed in major ways toward achievements on a global scale through every generation of its long history.

Technology with purpose is very much in the tradition of our founders, Werner von Siemens and Johann Georg Halske. The Siemens Historical Institute has preserved several thousand letters that record the founding generation's thinking and strategies. If one reads these carefully, one can discover ideas and concepts which can be useful and helpful for the present:

Impact – "The words 'I want to!' contain a powerful magical force when they are meant seriously and energy is behind them." – Werner von Siemens, 1854

Werner von Siemens was among those who recognized the disruptive nature of technology. He realized that technology could be an important resource in transforming entire societies for the better. And the situation is no different today than it was back then. Werner von Siemens' goal was always clear – to solve specific problems with technology. That was already evident in his first product, a pointer telegraph with a novel design and a level of reliability that surpassed all previous rivals, making a crucial contribution toward the advance of electrical communications. Werner von Siemens' impact was equally profound nearly twenty years later, when he opened up the way to the global electrical era by making the dynamo-electric principle usable practically. He had not discovered that principle. But he developed the first dynamo that made it practical to apply – the first one to have an impact. He pulled all the threads together, cut out the complexity, and found solutions that changed the world.

Even as a young man, he was one of the first to recognize that the future would belong to electrical telegraphy – a communications technology that was as novel back then, in the 1840s, as the internet was toward the end of the 20th century. That's why he and his business partner Johann Georg Halske founded a startup

that concentrated entirely on this new technology. Werner von Siemens was sure technology can improve the world. And he was able to contribute toward that improvement.

Purpose – "Ideas alone have little value. The value of an invention lies in its practical implementation." – Werner von Siemens, 1865

"The process of invention is useful and clearly successful only when it is closely linked to production for the purpose of addressing directly relevant questions." – Werner von Siemens, 1886

Werner von Siemens was a visionary, an inventor, a technician. But most of all, he was a maker. Every idea, every technological innovation only acquired value through "practical implementation." Only when an invention can "address directly relevant questions" does it have a purpose. That was the attitude behind the most important contributions Siemens made toward the world's progress. The breakthrough in telegraph technology that was the company's beginning; the construction of the dynamo, with which Siemens boosted power generation to a whole new level of efficiency; the high-speed trains that were already barreling down Siemens test tracks at 210 kilometers an hour early in the 20th century – behind all these was the inventive spirit, inquisitiveness, and willingness to shake up the status quo, qualities that continue to motivate Siemens today.

This is how Werner von Siemens established a purpose at Siemens that the company has been committed to for 175 years now. In the past, Siemens improved the everyday with telecommunications, power generation, and medical technology, with modern home appliances and high-speed trains. Today, combining the digital and real worlds is opening up entirely new opportunities.

Sustainability – "The interest of the group forms a high-ranking law that must take precedence over individual interests." – Werner von Siemens, 1863

"The money I've earned would burn my hand like a red-hot poker if I didn't offer the expected share to my loyal assistants." – Werner von Siemens, 1868

Werner von Siemens showed by his example that success and responsibility go together. From its very beginnings, Siemens as a company has been committed to that combination, with a corporate culture that focuses on long-term thinking about employees' well-being as well as the enterprise's own stability.

Werner von Siemens described the principle in his memoirs: "It became clear to me early on that satisfactory development of the constantly growing firm could be brought about only if it was possible to develop cheerful, spontaneous cooperation of all employees in promotion of their own interests." And he acted on that principle. At a very early point,

still in the 19th century, the company took an entirely unusual degree of responsibility for its workforce – whether by providing health insurance for the staff, or including them in profit sharing, or introducing a voluntary company retirement pension plan. Social benefits such as these have always put Siemens far ahead of its time.

But those benefits would be possible only if the company could do business successfully. And one prerequisite for that kind of long-term success was to produce real benefit for society as a whole, and to be willing to think in new and even disruptive ways. Our founder took a holistic view of the requirements for that kind of success. Even in his day, the "satisfactory evolution" of the company included a fusion of first-class technology, a motivated workforce, and effective organization. And that is still true today with our environmental, societal, and governance (ESG) framework that looks at sustainability from every angle. DEGREE (Decarbonization, Ethics, Governance, Resource Efficiency, Equity, Employability) is built on those principles.

One hundred seventy-five years is a long time. To make the tale of those years as intriguing and inspirational as possible, we've focused on the most important way stations in the company's history. So the six chapters that follow concentrate on the most incisive developments – the ones that show how ever since it was founded, every generation at Siemens has made very clear contributions toward improving people's everyday lives.

They show how from 1847, the year of its founding as a start-up in a back courtyard in Berlin, Siemens grew by the end of the 19th century into an electrical equipment corporation of global importance. How it survived the hard times of two World Wars and a dictatorship, and achieved an arduous recovery in the years of the "economic miracle." We also show how from the end of the 20th century right down to today, Siemens has helped shape the process of globalization and digitalization.

As everyone did 175 years ago, when the discovery of how to tap electricity changed the world, today we're again experiencing a transformative revolution. Digitalization is bringing about changes with implications that are at least as far-reaching as those of electrification in the 19th and 20th centuries. Climate change faces us with a challenge on a scale that has never been seen before in human history. But unlike the days when Werner von Siemens founded his start-up, today the company can draw guidance and strength from its long, successful history. And from the example set by its founder.

Siemens remains committed to that standard today: technology with purpose, to improve people's everyday lives. That is what some 300,000 Siemens team members are working on every day.

Come join us now on a journey across 175 years – from 1847 to 2022.

1847–1879

Founding and early growth years

When Siemens was founded in 1847, the world was in the midst of a second industrial revolution. Electrification was the emerging technology that changed the world from the mid-19th century onward, rather like computers and smartphones changed ours. Siemens was a pioneer in this global revolution of communications, energy, and transportation. It affected everyone.

Werner von Siemens – an "inventor-entrepreneur"

Werner von Siemens,[1] born in 1816, understood early on that new developments in the science of his day, such as groundbreaking findings about electricity, had the potential to transform society, including the everyday life of families and individuals. To unlock this potential, however, it was not enough to be a scientist – one had to know how to make scientific findings useful. This was precisely the task that Werner von Siemens set for himself. He believed that "the value of an invention lies in its practical implementation"[2] – in turning science into applied technology.

His breakthrough was the design of an improved **pointer telegraph**, refining earlier developments. His apparatus made it possible to transmit messages in the form of electrical signals across long distances, without distortion and with relative ease of use for the first time.

Siemens' improvements were a key contribution to revolutionizing communications – and thus to laying the foundations for globalization. The proliferation of this technology did for the 19th century what the internet did for our times.

Werner von Siemens' electric pointer telegraph of 1847 (replica)

Johann Georg Halske, 1850

Werner von Siemens, ca. 1847

The Siemens & Halske "start-up"

But Werner von Siemens' innovation was not yet a marketable product – it was an idea. He needed money to build a "hardware start-up" that could produce the device he had developed. He formed this company together with precision mechanic **Johann Georg Halske** in 1847. The two had secured an investment in the amount of 6,842 Taler from a relative who acted as a kind of angel investor.

The **company** started with ten employees in a back courtyard in Berlin-Kreuzberg. This was a humble beginning. But Werner, now 30 years old, was convinced that the new technology and his invention in particular would be unstoppable. "Until now, there has been no company of this kind ever," he said in 1847, the year he and Halske started up their business. "I have no doubt," Werner said in the same year, "that I will prevail and get all telegraphic matters in Prussia in my hands."[3]

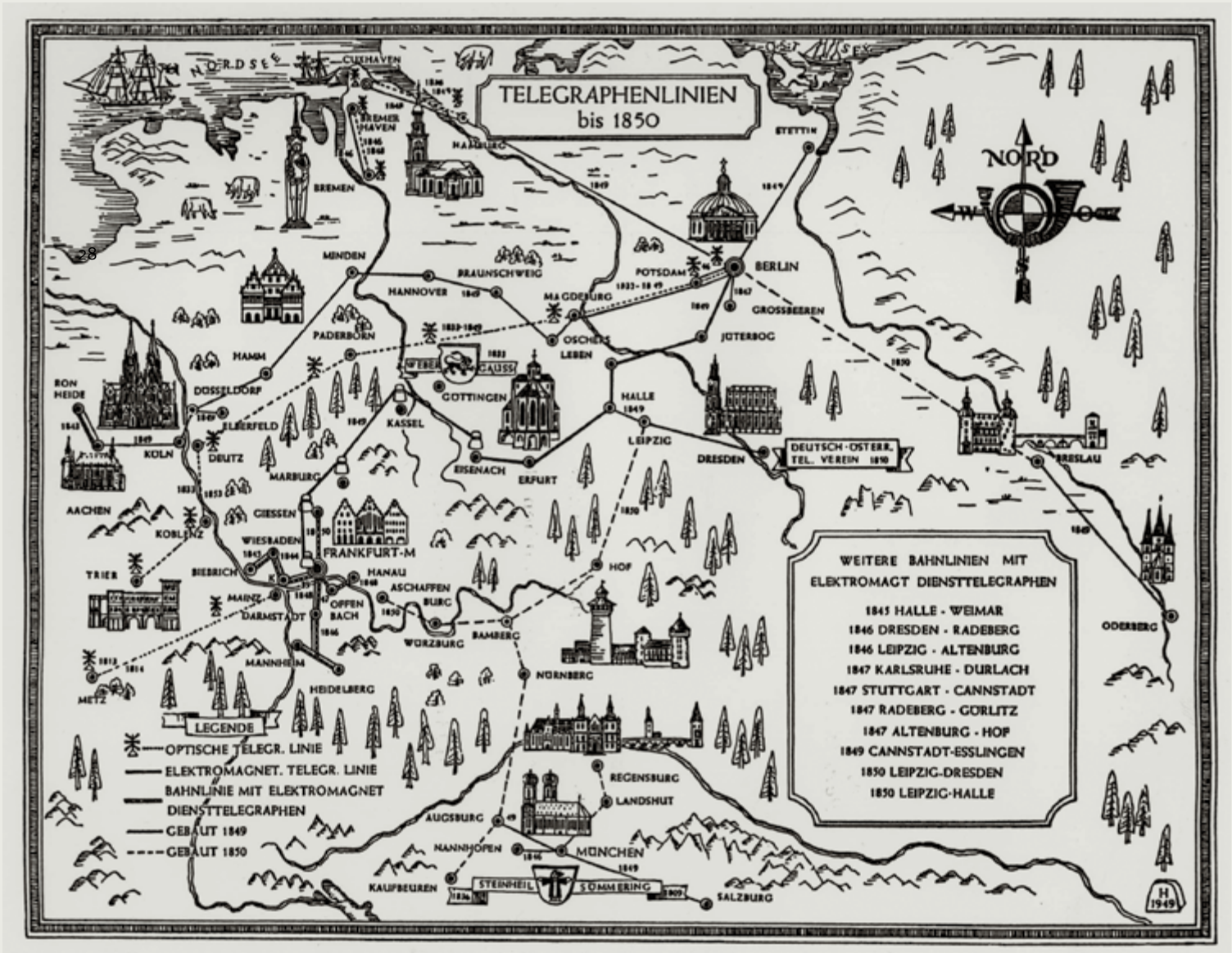
One year later, in 1848, the young start-up won a contract to build Europe's first long-distance telegraph line. Extending largely underground from Berlin to Frankfurt am Main, the 670-kilometer link went into operation in February 1849. in March, the Frankfurt Parliament elected the Prussian King Friedrich Wilhelm IV German Emperor. However, democratic efforts failed after the monarch rejected the crown. Thanks to the new communications technology, the news from Frankfurt am Main reached Berlin in just one hour.

Innovative tech entrepreneurs

As Werner had predicted in his early bout of optimism, the company, now known as Siemens & Halske, quickly became the market leader in telegraph construction. The partners, however, continued to drive innovation and new products in every field of electrical engineering. Siemens & Halske's product range soon included electrical alarms that made rail traffic safer, fire alarms, water meters, and early electromedical equipment.

They also continued to refine their electrical telegraphy business. One fundamental advantage in building entire telegraph lines proved to be the use of gutta-percha, a rubber-like substance obtained from the tree of the same name. By seamlessly coating telegraph wires with this material in specially developed presses, the company could ensure long-lasting protection, something not previously possible. This gave Siemens a head start in long-distance telegraphy.

In spite of its spectacular success within the very first years of its founding, Siemens & Halske's position was still fragile at this early stage. In 1851, the head of the Prussian Telegraph Administration, Friedrich Nottebohm, canceled all government orders for Siemens & Halske because damage to the gutta-percha insulation had caused disruptions in the company's telegraph lines. Now Siemens paid the price for being a monopoly supplier to the government: This status had largely insulated the company from business cycles, but it also placed it at the mercy of just a few major customers. The resulting crisis pushed Siemens to the verge of ruin.



Overview of telegraph connections in Germany, 1850

An early focus on business abroad

This motivated Siemens to act as an international player, earlier and with greater focus than almost any other company of the day. Early ventures in England and Russia expanded the company's reach and made it a pioneer of multinational entrepreneurship from its very earliest days.

A special feature of Siemens' turn toward the world market was the establishment of a family network based in Europe's major metropolises. Well into the 1880s, this network was rooted in a loyal and highly successful – though not always conflict-free – "band of brothers" that Werner von Siemens set up with his brothers Wilhelm and Carl.

Werner's brother Wilhelm – later Sir William – settled in London in the mid-1840s as Werner's close confidant and advisor. Britain was the mother country of economic and technical transformation, and this is where the ambitious young engineer marketed Werner's inventions before finally opening the **first foreign branch office** of Siemens & Halske in London in 1850, only three years after Werner had founded his start-up in Berlin. The London office would lead to the establishment of Siemens, Halske & Co. in 1858 and Siemens Brothers in 1865.

While William was busy in London, Werner opened up new possibilities in Russia until he handed over leadership of the projects in St. Petersburg to his brother Carl. Carl was only 24 years old at the time – but he proved to be extremely capable. Under his leadership, Siemens & Halske built up a telegraph network across Russia that extended over 9,000 kilometers by 1855.

"In my youth I dreamed of founding a world business like that of Fugger which would offer power and respect in the world, both to me and to my descendants."
Werner von Siemens, 1887

Carl von Siemens, 1865

William Siemens, ca. 1860

The company also involved itself in other markets across Europe. In this period of rapid growth, risk came with the territory. A real test came in the summer of 1857 with the first attempt to lay a submarine cable in the Mediterranean, across a segment between the south coast of Sardinia and Bône (now Annaba) in northeast Algeria.

Werner von Siemens was on-site during much of the project. It was fraught with extraordinary difficulties. Techniques for cable-laying were still immature and had to be optimized – in real time and on the high seas.

In the end, it worked, and more daring ventures followed, including the 1859 cable-laying expedition under the Red Sea from Suez in Egypt to Bombay in India, and an 1864 project to cross the Mediterranean between Cartagena, Spain, and the coastal Algerian city of Oran.

Werner was willing to take risks, and some of these pioneering projects did involve high-loss setbacks. Johann Georg Halske was less and less inclined to embark on risky ventures of this kind. He withdrew from the company in 1866.

The courtyard at the cable plant in Woolwich, England, ca. 1890

A telegraph office in St. Petersburg, 1878

"We owe it mainly to [Carl's] energy and ability that the Russian business now grew so rapidly and to such proportions."
Werner von Siemens, 1892

Growing business in Russia

Meanwhile, **Russia** increasingly became a central part of the company's business. Tsar Nicholas I was making efforts to modernize his country, which lagged behind other major European powers industrially. Werner von Siemens seized the opportunity, personally conducting the negotiations on several trips to Russia during 1852 and 1853. In October 1853, cable-laying operations gained an extra boost from the outbreak of the Crimean War, which resulted in a sudden surge in the Russian military's need for electric telegraph lines.

The first major order was to build a telegraph line from Warsaw to the Prusso-Russian border. In 1854, after just three months of construction, the 1,000-kilometer line from St. Petersburg to Warsaw opened for operation.

Other jobs followed. The work took Siemens from Helsinki and Tallinn all the way to Odessa and Sevastopol on the Black Sea. The projects often faced unusual challenges, ranging from extreme climate conditions to the logistical puzzles of carrying equipment and materials across nearly impassable terrain. By 1855, Siemens & Halske had laid a telegraph network across some 9,000 kilometers of Russian territory.

During this period, the Russian business far overshadowed operations at the Berlin home office, at times accounting for nearly 90 percent of revenue. In 1856, some two-thirds of all Siemens & Halske employees were working in the Russian Empire.

A major part of the Russian business consisted of twelve continuous years of "remonte" contracts for maintaining the installations in the czarist empire. A sophisticated monitoring system enabled the company to offer the service of ensuring that the lines remained functional; it took little time to resolve malfunctions.

At the same time, however, new orders began waning beginning in 1855 under Nicholas' successor, Tsar Alexander II. Carl von Siemens, who had headed the St. Petersburg offices, ultimately left for London, where he spent several years running the English business. In 1880 he returned to St. Petersburg to pursue a new project: electrifying the country. One of the largest illumination projects of the era was lighting the Winter Palace with 12,000 incandescent lamps in January 1887. Tsar Alexander III was delighted.

A contemporary picture of production activity at Siemens & Halske's new plant on Markgrafenstrasse in Berlin (wood engraving by Angerer and Göschel, Vienna), 1886

"A global enterprise à la Rothschild"

Siemens & Halske's efforts to expand did not always succeed. Carl von Siemens' first branch office outside Germany, in Paris, had to be given up in 1852, after only a few months. But Siemens' outposts in London and St. Petersburg had permanently transformed the company into a European enterprise, headquartered at the Berlin home office, where planning and production were carried out. In 1863, Werner von Siemens sketched out an even broader vision of a multinational business. The Siemens brothers' company should evolve into a lasting enterprise

> "which might later, under our boys' management, become an enterprise of world standing comparable to the Rothschilds', etc., and earn our name respect in the world. For this great plan, each individual – if he thinks it a good one – must be willing to make personal sacrifices!"[4]

Comparing Siemens & Halske to the Rothschild banking family was quite audacious, less than 20 years after its founding, and given that Siemens still had only about 500 employees.

The Indo-European telegraph line and the transatlantic cable

Two spectacular projects in the 1860s and 1870s demonstrated that there was something to the Siemens brothers' ambitions. In the spring of 1868, work began on building the **Indo-European telegraph line**, which ran from London to Calcutta in Britain's largest colony, India. The idea was to drastically curtail the time needed to send messages; overland mail at this point took some 44 days.

Traversing various sovereign territories was not just a practical problem of building the so-called Indoline. It was also a political balancing act that called for adroit negotiations with the Persian and Russian governments and extensive logistical preparation. Siemens took charge of the segment from Thorn in West Prussia to Tehran, the Persian capital, some 4,600 kilometers away. And, in a major feat, it set up almost 70,000 telegraph poles in remote regions and often nearly impassible terrain.

All the greater the sensation, then, when on April 12, 1870, William Siemens demonstrated to an astonished London public that a dispatch had traveled a total of 11,000 kilometers to arrive in Calcutta just 28 minutes later – instead of well over 40 days, as had been the case before. The telegraph line remained in service until 1931 – and in Iran, into the 1960s; some of the telegraph poles were still standing in Georgia in the 1990s.

Officials of the Indo-European telegraph line in Tehran, 1868

Next page:
Indo-European telegraph line, 1867–1870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The cable steamer *Faraday*, 1874

Siemens then turned its entrepreneurial energies westward, where **transatlantic cable connections** between Europe and the burgeoning North American economy were opening up new opportunities for communication. Instead of sending mail by ship, which took weeks or even months, messages were to be sent within a matter of hours.

But the project involved nearly incalculable risks: American monopolist Cyrus Field was throwing every resource at his disposal into the competition he was spearheading, and cable-laying technology was still in its infancy.

William Siemens himself designed an oceangoing cable steamer, the 108-meter *Faraday*, which could carry more than 2,700 kilometers of cable. It set sail on its first Atlantic voyage in May 1874.

The process of laying cable from the southwestern coast of Ireland to the easternmost tip of Newfoundland, and later down the US coast to New Hampshire, was a saga marked by cable breaks, storms, and sabotage. Just one example: At one point, a broken cable had to be retrieved from a depth of more than 4,700 meters off the Irish coast.

Despite all obstacles, the connection between Newfoundland and Ireland went into operation on September 15, 1875 – an entrepreneurial triumph that earned the Siemens name lasting prestige, especially in the USA.

By the end of the 19th century, the company had laid nine more cables across the Atlantic. Siemens had come a long way since Werner had filed the patent application for his pointer telegraph in 1847. The company was now a leader in the revolution of communications technology that laid the groundwork for later globalization.

"The realization of this [transatlantic] project is almost an existential question for us. We won't be respected as a cable business until we have completed a cable to America."
Carl von Siemens, 1872

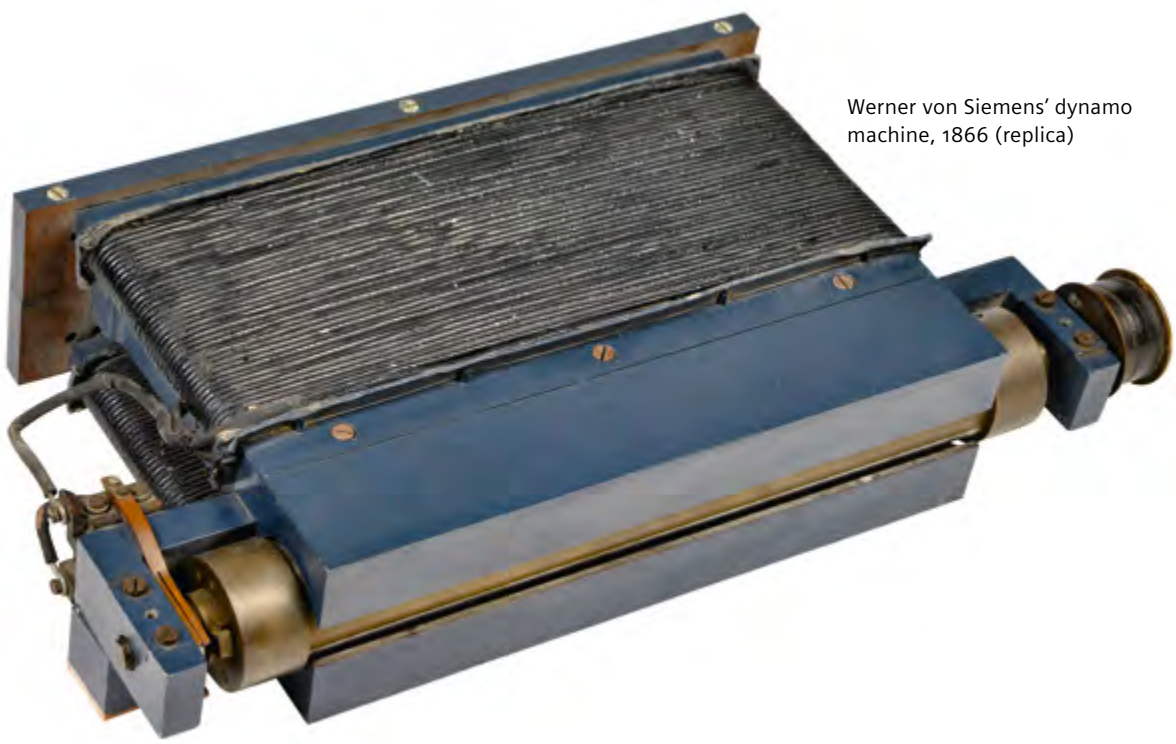
The dynamo machine and the birth of energy technology

Despite these successes, Siemens did not see electric telegraphy as its business. The company had a wider perspective: Its business was the application of electricity. As early as 1847, Werner had noted that "electro-magnetism is still scientifically and technologically entirely vacant ground, and capable of uncommon expansion. [...] I feel quite called upon to help it earn the reputation it deserves."[5]

Some 20 years later, Werner presented a new innovation. It was his most significant one: the discovery of the dynamo-electric principle and its application in the **dynamo machine**.

This new idea involved the possibility of converting mechanical energy into electrical energy by way of a generator, in this way making it available for permanent use – with no need for storage and no interruptions. As in the case of the pointer telegraph, the invention of the dynamo machine is not attributable to Werner von Siemens alone. But it was he who realized its practical, economic application in the new field of heavy-current technology.

So far, research and development at Siemens had been conducted in Werner's improvised "experimentation room." In 1867, Siemens & Halske set up its first independent design



Werner von Siemens' dynamo machine, 1866 (replica)

office, to be followed by a physical-chemical laboratory in 1873. This was the birth of the company's independent research and development departments. These were dedicated to systematically applying scientific methods, to turning scientific findings into technology – the backbone of Siemens' work.

The dynamo machine proved to have almost limitless **possible applications** – and not just in industry, but in people's everyday lives too. In cities in Germany and elsewhere, electricity was coming onto the scene in production, communications, lighting, and transportation systems. Electricity also made its first inroads, soon to be unstoppable, into private homes, transforming the lives of an increasing number of ordinary citizens.

Siemens now ventured beyond the light-current electric business and found new ways of applying electricity that opened up astonishing growth surges, especially in the 1880s and 1890s. This was the "expansion of electromagnetism" that Werner had anticipated as early as the 1840s. Now the knowledge of the practical utilization of electrical engineering was really coming into its own.

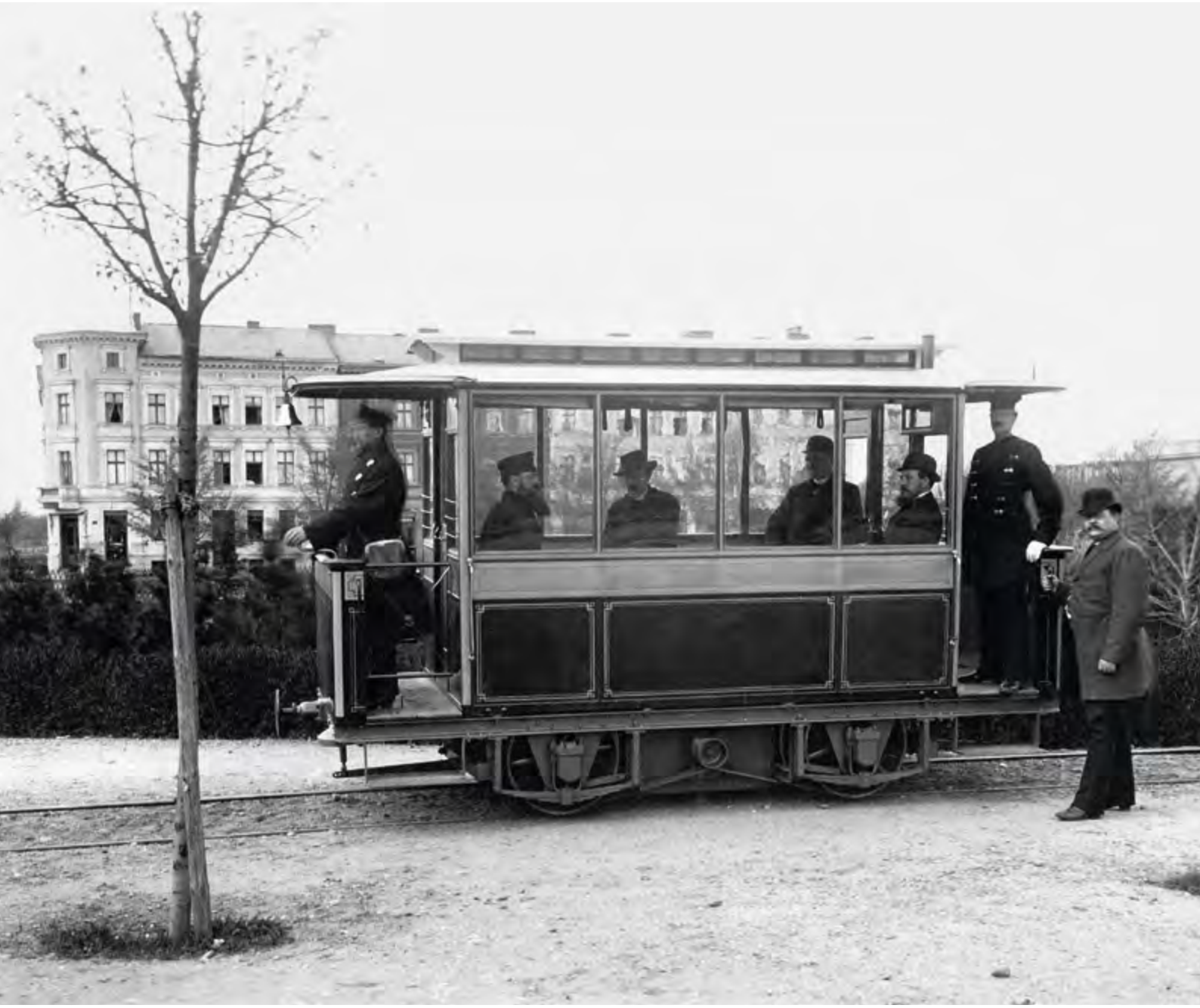
One especially promising area of application for the new field was electric lighting. Even though Werner von Siemens was reluctant at first ("We are not a lighting company, we are manufacturers"[6]) and the orders were modest initially, electric lighting was immensely superior to previous techniques.

Streetlights on Potsdamer Platz in Berlin, 1884 (painting by Carl Saltzmann)

The differential arc lamp that was invented by Siemens & Halske in 1878 and later replaced by incandescent lamps, made it possible to distribute light. Instead of individual, generator-powered light sources, it now became possible for the first time to build complete lighting systems.

In March 1879, some 250 guests admired the electric lighting at the Siemens villa in Charlottenburg. But this was just a prelude.

Orders followed for theaters and railroad stations and for additional lighting projects both in and beyond Berlin. An especially high-profile development was the 1882 streetlighting of Leipziger Strasse and Potsdamer Platz in the German capital. The triumph of electric lighting was unstoppable. It marked the beginning of a complete change in many people's everyday lives – initially in their workplaces, and later in their homes as well.

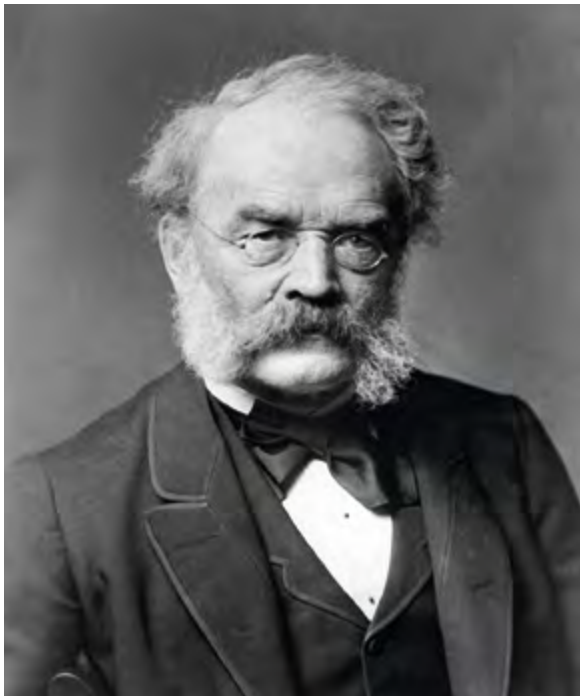


World's first electric streetcar presented by
Siemens & Halske in Lichterfelde, 1881

A second important field to emerge was the use of electric motors in locomotives and streetcars. On May 31, 1879, at the Berlin Industrial Exposition, Siemens astonished visitors by presenting the world's **first electrically powered railway**.

On May 12, 1881, there was another premiere: The world's **first electric streetcar system** went into operation, initially on a 2.5-kilometer route in the Berlin suburb of Gross-Lichterfelde. Significantly faster and cheaper than a horse-drawn tram, it was soon being used by thousands of passengers on regular lines.

In 1887, Siemens took part in building Europe's first major electric streetcar line, in Budapest, which expanded into a transportation network covering some 60 kilometers. Other cities also adopted the new principle of an underground electric power supply.



Werner von Siemens, 1885

Not all of Werner von Siemens' ambitious projects came to fruition. His plans for an electric elevated railway in Berlin, for instance, met with little enthusiasm. After residents near the planned line protested and the city government expressed reservations, the idea had to be abandoned. All the same, the era of electrified public rail transportation had begun; the horse-drawn tram and steam locomotive were becoming a thing of the past, and attention turned to developing modern high-speed trains.

"Our electric railway is causing a stir here. In fact, it is working better than expected. For a few hours each day, 1,000 passengers pay 20 pfennigs a ride to benefit a charity. Each train carries 20 to 25 people. The speed is about the same as a horse-drawn railway. Now something can be built on this!"
Werner von Siemens, 1879

Siemens & Halske also stayed on top of the times in its original field of telecommunications technology. Under a contract for the German Postal and Telegraph Administration, the company worked to expand Germany's underground telegraph network, starting in the second half of the 1870s.

At the same time, a "telephone fever" had rampaged through the USA and spread to Germany. Alexander Graham Bell's invention of the first technologically mature telephone created a new market. In 1877, Siemens began producing imitative versions; the very next year, it came out with its own improved design. In the mid-1880s the number of telephone connections began to rise sharply. More and more private homes signed up for this new device that had improved the basic idea of the telegraph – instantaneous telecommunication – and in the course of the 20th century turned it into a piece of consumer technology.

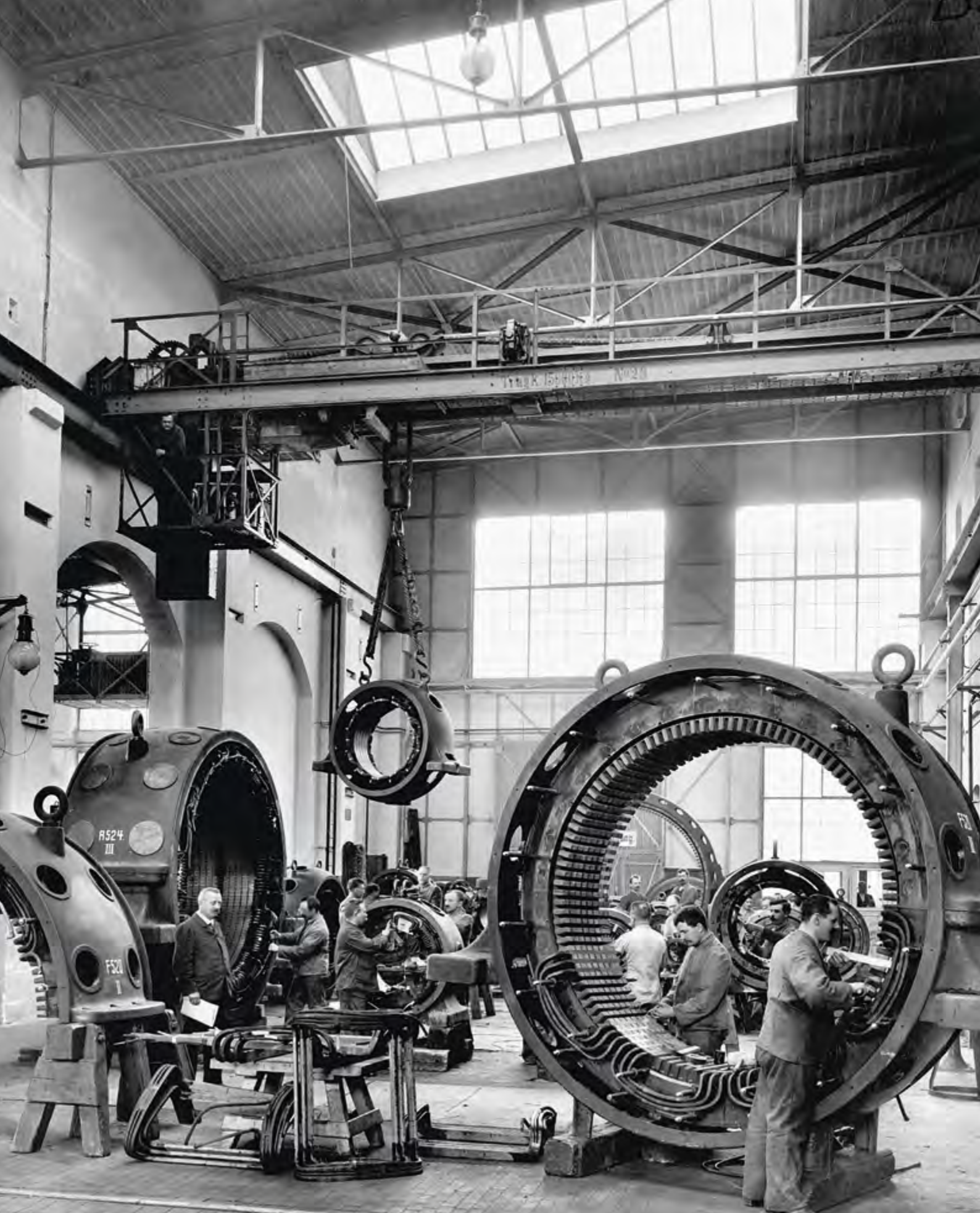
Werner von Siemens died on December 6, 1892, a few days after his 76th birthday. He survived in contemporary memory as a revered and popular pioneer in the electrical industry. In Siemens & Halske, he left behind a family firm that had grown to some 6,500 employees. This was thanks to the combination of inventive spirit and entrepreneurial vision, the willingness to take risks, and the firmness of purpose that he had embodied. Werner von Siemens' devotion to the family firm and his focus on technical progress and the general benefit – rather than a single-minded focus on maximizing profit – became deeply ingrained in the company's DNA.

Right: A view of the courtyard of the factory at Markgrafenstrasse 94 in Berlin, ca. 1875

1880–1914

Transition to an electrical conglomerate

The period between the end of the 19th century and the beginning of World War I was one of booming economic trends for Siemens. Under the management of the family's second generation, and especially through an expansion in the heavy-current sector, the company transitioned into a large corporation. But it also had to prepare itself, through structural reforms and new strategies, against rising competition.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Wilhelm von Siemens, ca. 1895

Arnold von Siemens, ca. 1880

The second generation of entrepreneurs

After 1895, Germany – like many other European industrialized nations – entered a period of what seemed to be almost unlimited growth. This was the golden age for a number of large corporations, most of them organized as stock companies.

For Siemens, the arrival of this dynamic era of intensive industrialization coincided with a shift in generations. Early in 1890, barely three years before his death, Werner von Siemens had transformed Siemens & Halske – originally a simple general partnership – into a limited partnership. As a limited partner, he still held the reins in many business decisions. On the other hand he opened the way for his eldest sons from his first marriage, Arnold and Wilhelm, to join his brother Carl in taking over responsibility for business as partners in the company. Although the company had grown significantly more complex, keeping management in the hands of the family continued to be a success.

Wilhelm, however, was aware that only organizational reforms and professional management would safeguard Siemens for the future as a unified firm. "Up to now we have kept our 35 million shares of S&H together," he noted in 1902, "and I will dedicate my whole life's work to this policy, so that the younger generation will at least have a chance."[7]

Social policies

Wilhelm von Siemens also felt an obligation to expand his predecessors' corporate social policies. From the very start, this had been a core component of Siemens & Halske's corporate culture.

One key feature was the Pension, Widows', and Orphans' Fund, which traced its origins back to the support funds for factory and office workers. The pension fund's founding in 1872 had been a pioneering social achievement. And, starting in 1908, the company began investing in a comprehensive healthcare system, including its own company health insurance fund, together with internal

The school for apprentices at the Nuremberg plant of Siemens-Schuckertwerke, founded in 1903, ca. 1908

training opportunities, for instance by founding its own **vocational school** in 1906.

These social benefits were based in part on a "patriarchal" principle of care that had been shaped by Werner von Siemens. But they also helped retain employees at Siemens & Halske and kept staff turnover low. **Social programs** were considered a suitable way of reinforcing employees' identification with the company, and of largely immunizing them against socialist influences.

It was "not just humanity alone, but a substantial amount of healthy egotism that moved us to form the fund," said Werner von Siemens in 1875, explaining his motivation. "The fund makes people feel a lasting bond with the factory; the harmful fluctuation of workers has thus decreased significantly[.]"[8]

Competition from AEG

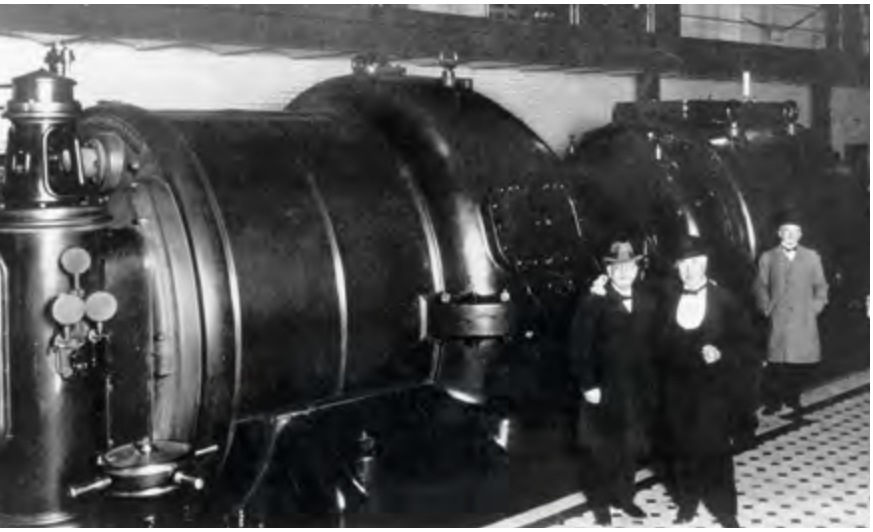
On the economic front, however, it became clear that something had to change. Siemens & Halske could no longer be certain of its unchallenged monopoly as a pioneer in electrical engineering. From the 1880s onward, the company found itself confronted by an ambitious newcomer – initially underestimated – that would become its toughest rival across several decades: the Deutsche Edison-Gesellschaft für angewandte Elektrizität (DEG), founded by Emil Rathenau in Berlin in 1883 and known from 1887 onward as Allgemeine Elektricitäts-Gesellschaft (AEG).

Although Siemens had recognized the potential of electric lighting, it was Rathenau who procured the patent rights to the incandescent lamp invented by Thomas Alva Edison in the USA. Despite early cooperation agreements and even a stake in its rival's capital, Siemens was unable to slow the skyrocketing rise of AEG.

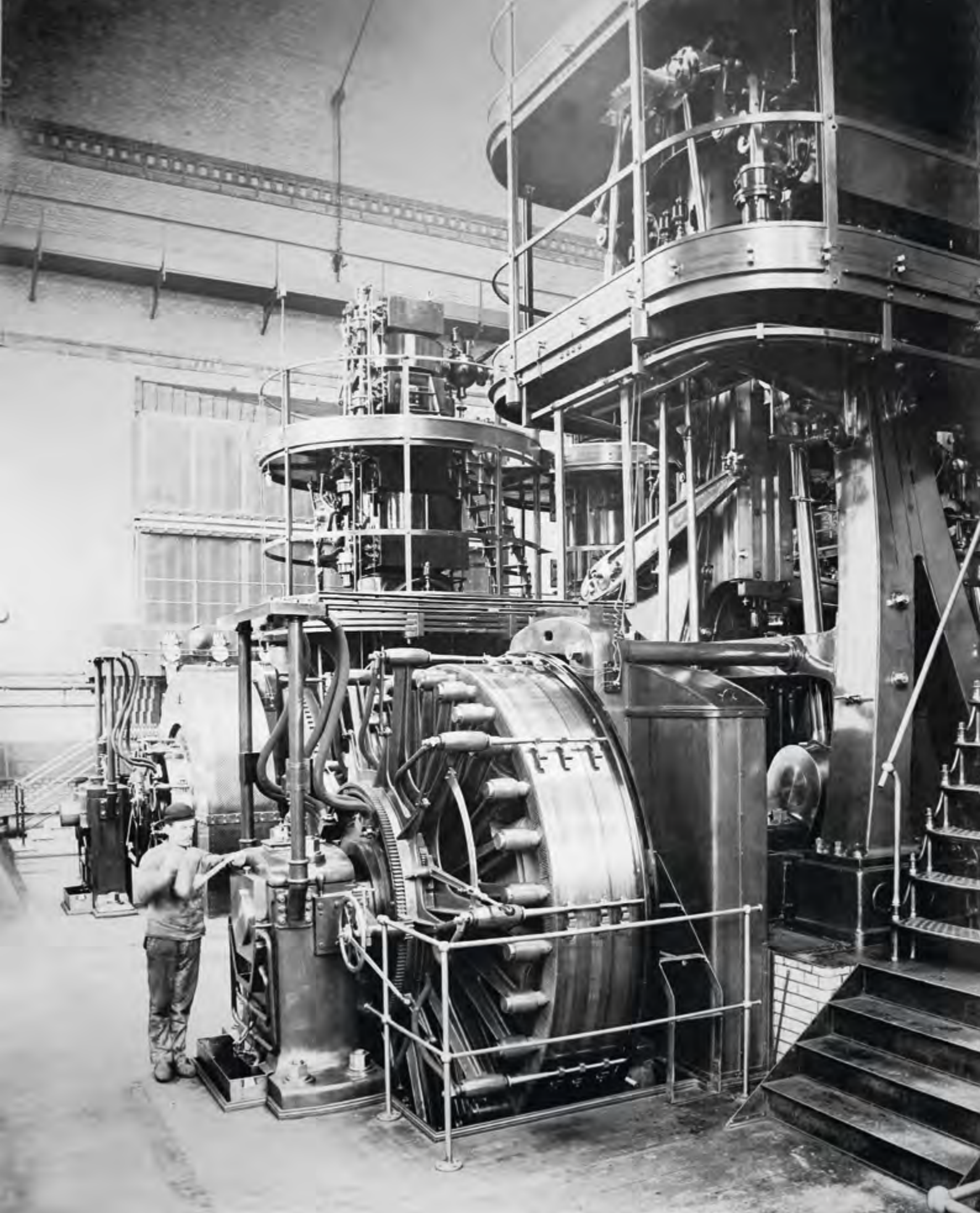
AEG's large-scale incandescent lamp production and accelerated power plant construction quickly turned the new competitor into a force to be reckoned with. While Werner von Siemens had regretted as early as 1882 that the "fine days of an absence of competition [were] basically past,"[9] by the end of 1888, Carl von Siemens was foreseeing a struggle with AEG that would leave "both sides bloodied."[10] Wilhelm von Siemens, who made no secret of his personal aversion to Rathenau, even went so far as to charge the competitor with having the aim of "controlling everything capitalistically, and namely finishing off S&H."[11]

Rathenau was a new species of manager, less bound by tradition, family, and research. He also did not hesitate to engage in aggressive business practices, focusing corporate policy on purely business administration principles. On top of that, capital investments by banks – especially Deutsche Bank – gave AEG the leeway to get into the expensive "venture" business, which combined selling both electrical equipment and electric power. Using its own companies for financing and operations, the firm was able to offer cities and towns

Emil Rathenau and Thomas Alva Edison visiting a Berlin power plant, 1911



Right: Direct current generators from Siemens & Halske at the Mauerstrasse power plant of Berliner Electricitäts-Werke, 1886



complete packages that included not only the planning and construction, but also the operation of electric streetcar systems, lighting systems, and power plants.

Just as Werner von Siemens had anticipated in the 1840s, electrification was unstoppable. One consequence of growing electricity consumption was that in the second half of the 1890s, the number of electricity plants in Germany more than quadrupled to 774. By 1907, two-thirds of all large and medium-size cities had an electric power plant.

Compared to AEG, Siemens & Halske – a family firm that operated under financial autonomy, with a rather limited clientele of government agencies and state companies such as the Postal Service and railway – began to lag behind. By 1898, AEG had become Germany's highest-revenue electrical equipment company. Other rising companies in the same field also began taking more and more of Siemens' market share.

"[In 1897] the company S&H stock corporation was founded. On July 2 the Supervisory Board held its first meeting (the only members: Uncle Carl, Arnold, Werner [Carl's son], myself)."
Wilhelm von Siemens, 1897

Conversion to a stock company and the "electrocrisis"

Amid this precarious situation, Wilhelm von Siemens began to take vigorous action. He pushed to jettison the company's preference for keeping a distance from capital markets and to pursue plans that his uncle Carl had once encouraged in vain:

> "In electric light, we'll only be able to achieve big things if very significant amounts of capital are available to us. Otherwise we'll be reduced to mere manufacturers, and we'll have to fight the competition, which is growing all the time."[12]

Consequently, on July 3, 1897, retroactive to August 1, 1896, Siemens & Halske adopted the modernized form of an Aktiengesellschaft (AG) – a **stock corporation**. All 35 million marks of the share capital remained in family hands. The staffing of the supervisory board with Carl von Siemens, his son Werner, and his nephews Wilhelm and Arnold signaled that family control continued. Arnold would succeed Carl von Siemens as Chairman of the supervisory Board in 1904. One unusual institution that had been created the year before was the position of a "Delegate of the Supervisory Board," which enabled Wilhelm von Siemens to hold extensive powers as a kind of super CEO. This restructuring gave Siemens &

First share of Siemens & Halske Aktiengesellschaft, 1897

Halske AG more financial leeway and enabled it to go on the offensive when competing with AEG and others.

There was little time for the company to catch its breath. The superheated competition from mushrooming new electrical equipment companies, along with surplus capacity and ruinous competition on price, led to a huge slump from 1900 to 1903. Some companies were pulled into a recessive undertow, lost their independence, or collapsed altogether. Siemens emerged from this "electrocrisis" comparatively unscathed, thanks to its broad product range, good export opportunities, and circumspect corporate policies. AEG also defied disaster. From this point on, the two corporations would largely have the market to themselves.

Siemens-Schuckertwerke is founded

One more liberating step was needed to permanently avert the threat of AEG dominance: the founding of **Siemens-Schuckertwerke GmbH** in March 1903. Elektrizitäts-Aktiengesellschaft vorm. Schuckert & Co. (EAG), once a precision-mechanical workshop in Nuremberg, had grown to become one of Siemens' most important competitors in electric power plant and streetcar system construction, but had been severely impacted by the crisis. Wilhelm von Siemens was able to merge the heavy-current departments of Siemens and Schuckert into a highly efficient company in the heavy-current sector. From this point on, for more than 60 years, the House of Siemens would have two parent companies under its roof, each handling its own share of the work: Siemens & Halske AG was responsible for the light-current aspects – telecommunications equipment and systems of every kind, such as telephones, telegraphs, radio equipment, and signaling equipment. And Siemens-Schuckertwerke GmbH (transformed into a stock corporation in 1927) made generators, motors, transformers and switchgear, lighting systems, home appliances, and cables. By integrating additional financing companies, Siemens & Halske took on a mixed format as a company engaged in both manufacturing and investment. It came to view itself as a technical holding company, while Siemens-Schuckertwerke became a financing and holding company. On this basis, Siemens was able to take on the construction of entire rail, power plant, and industrial systems, which quickly came to represent the lion's share of revenues.

This strategic refocusing enabled Siemens to recover from its relative loss of standing, but it did not relieve it of the need to compete against AEG. Nevertheless, these two giants in the business cooperated occasionally. One of the most important of the joint ventures founded by AEG and Siemens came in 1903, with the "Gesellschaft für drahtlose Telegraphie mbH – System Telefunken" (the Company for Wireless Telegraphy, Limited – Telefunken System). Telefunken, as it was commonly known, advanced radio and telecommunications technology for military and colonial purposes and improved options in marine radio communications. After 1918, Telefunken laid the groundwork for radio broadcasting as a consumer technology.

Generator production at the Nuremberg plant of Siemens-Schuckertwerke, ca. 1914

Siemensstadt

Siemens was based in Berlin, and this meant quick access to important customers such as the Postal Service, railway, and military. By about 1900, the city itself was widely admired as an "Electropolis," a model city of electrification. It was also the center in Germany for the electrical industry.

Berlin's status as a mecca for science was another invaluable advantage for the knowledge-based production of what were then termed the new industries: electrical engineering and chemical. Siemens was very closely associated with technical and scientific institutions such as the Reich Patent Office, the Technical University in Charlottenburg, the Imperial Physical-Technical Institute – of which Werner von Siemens was a patron – and the Kaiser Wilhelm Society for the Promotion of Science. These also provided the company with a rich recruitment source for qualified young engineers and scientists. Berlin offered ideal conditions for Siemens.

But the city also created problems for the company. There wasn't enough space. The growth in Siemens' business had resulted in an almost ceaseless search for new sites and spaces. The Berlin workforce tripled between 1895 and 1900 alone, growing from 4,000 to 12,000 workers. Factory installations took up more and more space. Siemens needed a long-term solution and decided to set up its own industrial site in the Berlin environs.

A view of Siemensstadt, 1910

In 1897, Siemens acquired 21 hectares in Spandau, west of the city. The area was isolated and desolate. But it offered enough space for expansion and for concentrating all factories in one place. The location became the starting point for a new city, independently developed and systematically designed as an industrial and residential town. In 1914, this new part of town was officially named **Siemensstadt** – Siemens City.

Staff of the Chemical Laboratory in the Central Research Laboratory of Siemens & Halske and Siemens-Schuckertwerke in Siemensstadt, 1924

"[…] the task of a company's top management is to watch and give the necessary directives so that a healthy, fruitful evolution of technology takes place in the firm, new advances are attempted, and fields that have lagged somewhat behind receive new impetus."

Wilhelm von Siemens, cited from Richard Fellinger, 1920

Siemensstadt began to come alive in August 1899, when production began at the Kabelwerk (cable plant) on the Spree River. Some six years later, all the light-current production from the Berliner Werk (Berlin plant) was relocated to the new Wernerwerk in Siemensstadt, an immense "factory palace" with twelve interior courtyards. Production of large generators and motors was moved from the Charlottenburger Werk (Charlottenburg plant) to the new **Dynamowerk** (Dynamo works).

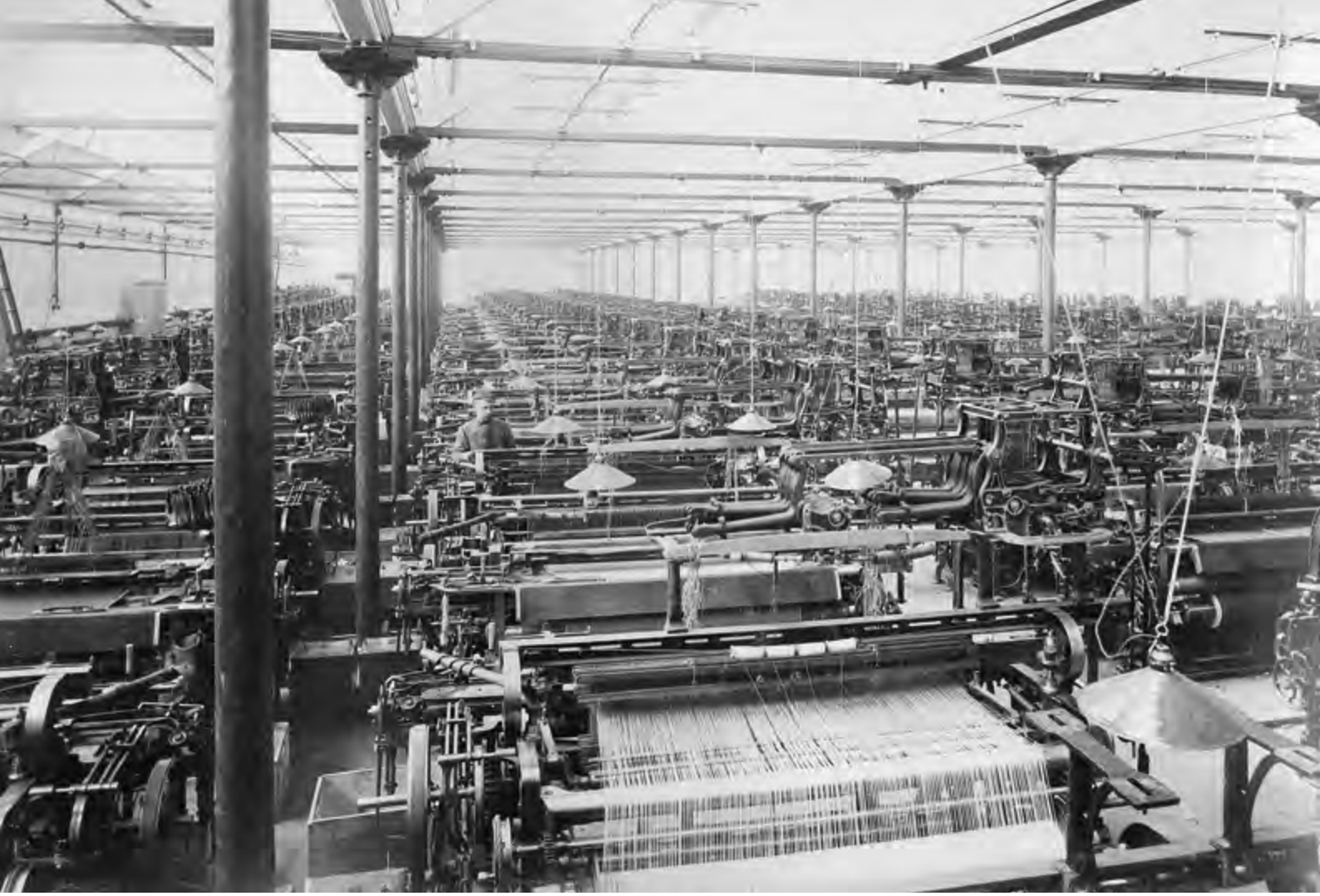
All new structures – inseparably linked with the names of Siemens' two chief architects, Karl Janisch and Hans Hertlein – focused on efficient, rationalized, flexible production.

For Siemens, a research-heavy company, integrating **research and development** into the newly developed town was of central importance. In 1906, the company started to set up its first central laboratory, known as "Charlotte," in Siemensstadt.

The next big step up to an integrated corporate facility for physical, chemical, and technical basic research came with the Research Laboratory of Siemens & Halske AG and Siemens-Schuckertwerke GmbH, which went fully into operation in 1922.

The Corporate Office for Scientific-Technical Research Work, founded in 1919, pooled the individual laboratories' research findings, thus providing a complement to the large laboratory's work.

But Siemensstadt was not intended merely as a place of work. Residential settlements and infrastructure, including a train station and electric streetcars, were equally a part of "Siemensstadt." By the time war broke out in 1914, Siemensstadt had turned into a large residential and industrial complex outside the gates of Berlin, a development that had no parallel anywhere in the world.



Spinning room of the first Siemens electrified spinning mill in Saxony, 1895

High-speed trains, electric cars, and telephones

Electrification continued to spread throughout society. This was also reflected in Siemens' client base. It was no longer just a matter of government agencies and large industrial customers. Electrification affected small businesses, craftsmen, and, increasingly on a mass scale, private homes.

Beginning in the late 1880s, the energy-equipment business profited from a significant technical paradigm change: In a lively debate among the experts, partisans of the already widespread direct-current system faced off against advocates of alternating current. Wilhelm von Siemens was among the driving forces that bet on alternating current, in which voltage could easily be increased by transformers for transport, and then reduced to the necessary level when it reached the consumer. This made it possible to transmit high-voltage electricity significantly more efficiently and cost-effectively across longer distances.

Siemens proved that the new technology was ready for use. The company systematically expanded the power supply in remote areas and made the spread of electricity to ever-larger regions an important mainstay of its business.

As a result, more and more buildings, even entire residential districts, were being lit using electricity. With this new technology, Siemens generalized the benefits of electrification. It was no longer just for early adopters. Instead, it increasingly became a normal part of everyday life.

In mobility, streetcar systems had largely transitioned to electric power by the turn of the century. Siemens also started to build subway systems. Following construction of the first subway – in **Budapest in 1896** – an 11-kilometer elevated and underground railway line in Berlin linked the Friedrichshain district in the east to the suburb of Charlottenburg in the west in 1902. Just one year later, 29 million passengers were using the line.

A few years prior, Siemens had already started working on **high-speed trains**. With significant contributions from the engineer Walter Reichel, the Studiengesellschaft für elektrische Schnellbahnen (the Research Association for High-Speed Electric Railways) began conducting trial runs in 1899 on a 23-kilometer route south of Berlin. Two self-propelled cars reached a record speed of 210 kilometers an hour – a spectacular demonstration of their superiority over any steam locomotive.

But when it came to building electric automobiles, Siemens was too far ahead of its time. Unlike the combustion-engine cars started with a hand crank, the electric cars that Siemens-Schuckertwerke began building in 1905–06 were emission-free and noiseless. But their low-power, heavy batteries made them unviable.

The first "sub-pavement railway" – i. e., subway – on the European continent, built by Siemens & Halske in Budapest, 1896

A segment of the Berlin elevated and underground rail line at the Görlitz Station, 1902

There was also no future for a new hybrid system, or later for the wholly gasoline-fueled "Protos" car – because in 1925 less expensive models made in the USA began crowding into the German market. The time for electrifying car transportation would not arrive for another 100 years.

In telephone technology, the company had to keep pace, through advancing networking and automation, with the steadily rising number of telephone connections and local municipal networks.

In Berlin alone, the number of telephone connections skyrocketed from merely 48 in 1881 to 130,000 in 1900. Siemens technology played a central role in this "online" boom.

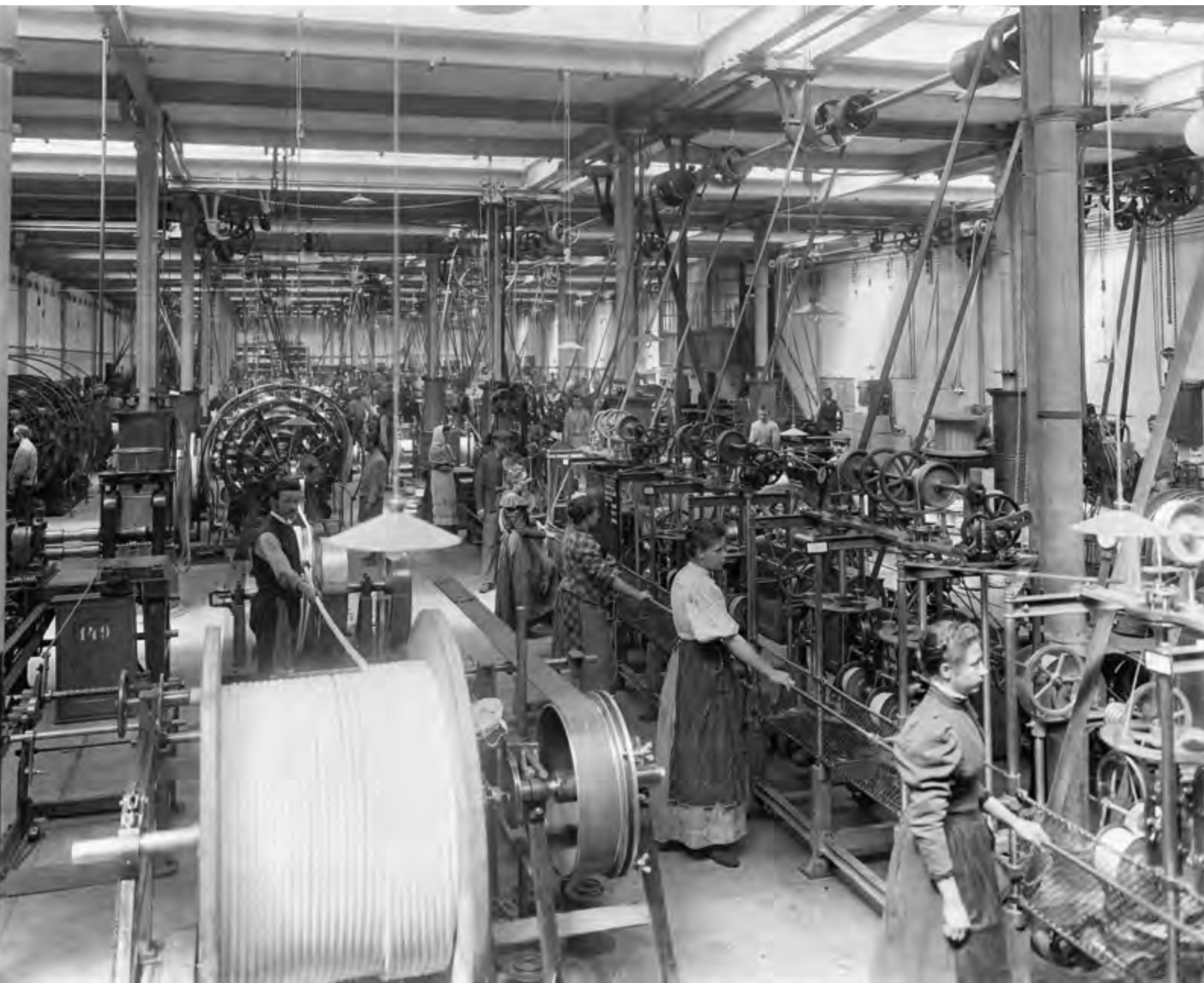
A main challenge was to dispense with the laborious manual switching of calls, and to automate the process. For this, Siemens worked on refining an automated dialing system already in use in the USA, and in 1909 set up a central telephone office in the Schwabing district of Munich – for the first time in Germany. This opened the path for telephony on a mass scale.

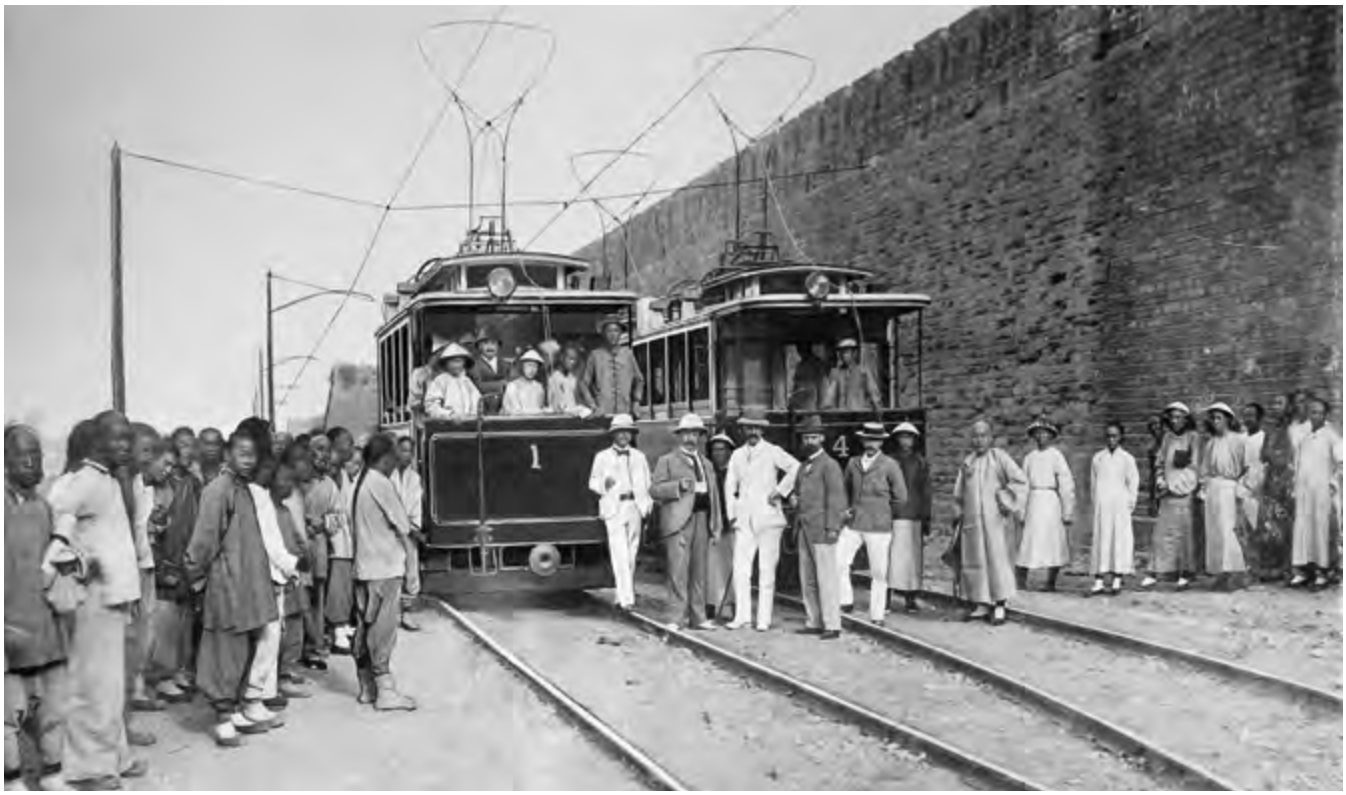
Protos cars being built at the Berlin automotive plant, 1913

Central Telephone Office II in Berlin-Moabit, 1906

In parallel, Siemens was also a pioneer in building long-distance telephone connections. In 1906, it laid a telephone cable across Lake Constance, from Friedrichshafen in Germany to Romanshorn in nearby Switzerland. In 1913, work began on Germany's first long-distance telephone cable, the 600-kilometer Rheinlandkabel between Berlin and Cologne, with the last segment being connected in 1922. In addition, an international cable project by Siemens Brothers & Co. opened up direct telephone communication between Paris and London in 1910. The telephone became a World Wide Web.

View into the production of the cable plant of the
Österreichische Siemens-Schuckertwerke in Vienna-Leopoldau, 1912





China's first electric streetcar built by Siemens & Halske in Beijing, 1899

International operations

Production continued and to some extent was expanded at the company's English and Russian sites, which had been established in the early days. The cable works in Woolwich were joined in 1903 by a machine and transformer factory in Stafford, a town located between London and Manchester. In 1906, this would become the heavy-current firm Siemens Brothers Dynamo Works Ltd.

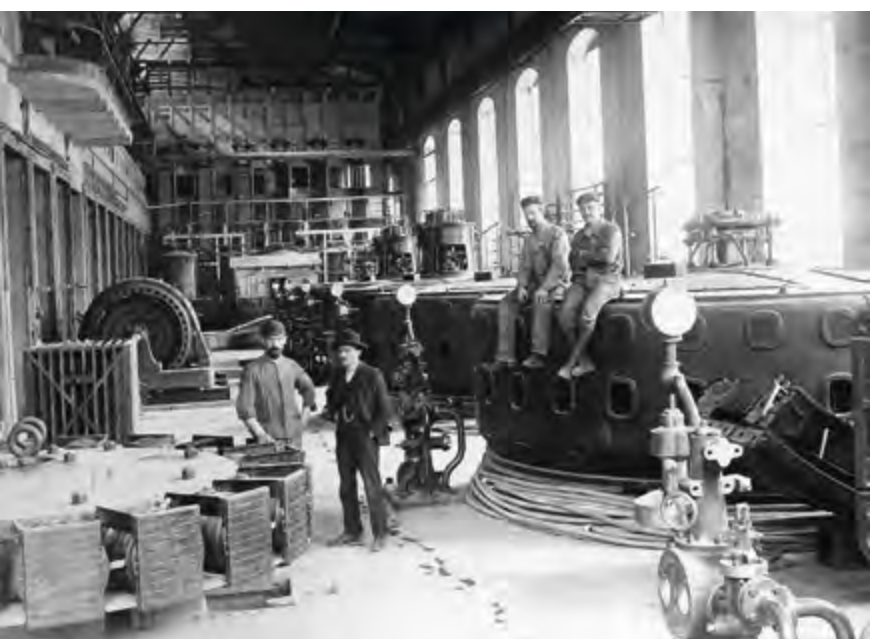
In St. Petersburg, the company built its own cable plant and a factory for dynamos and electric motors. Similar to the German parent companies, Siemens segregated its light-current and heavy-current operations here into two separate stock companies. This enabled the company to take part in the Russian Empire's lucrative venture business that combined street lighting, power plant construction, and streetcar line construction.

Siemens also made a wealth of different products in other parts of the world. From 1908 onward, the Central Overseas Administration coordinated the work of branch offices and technical offices in Asia, Central America, and South America.

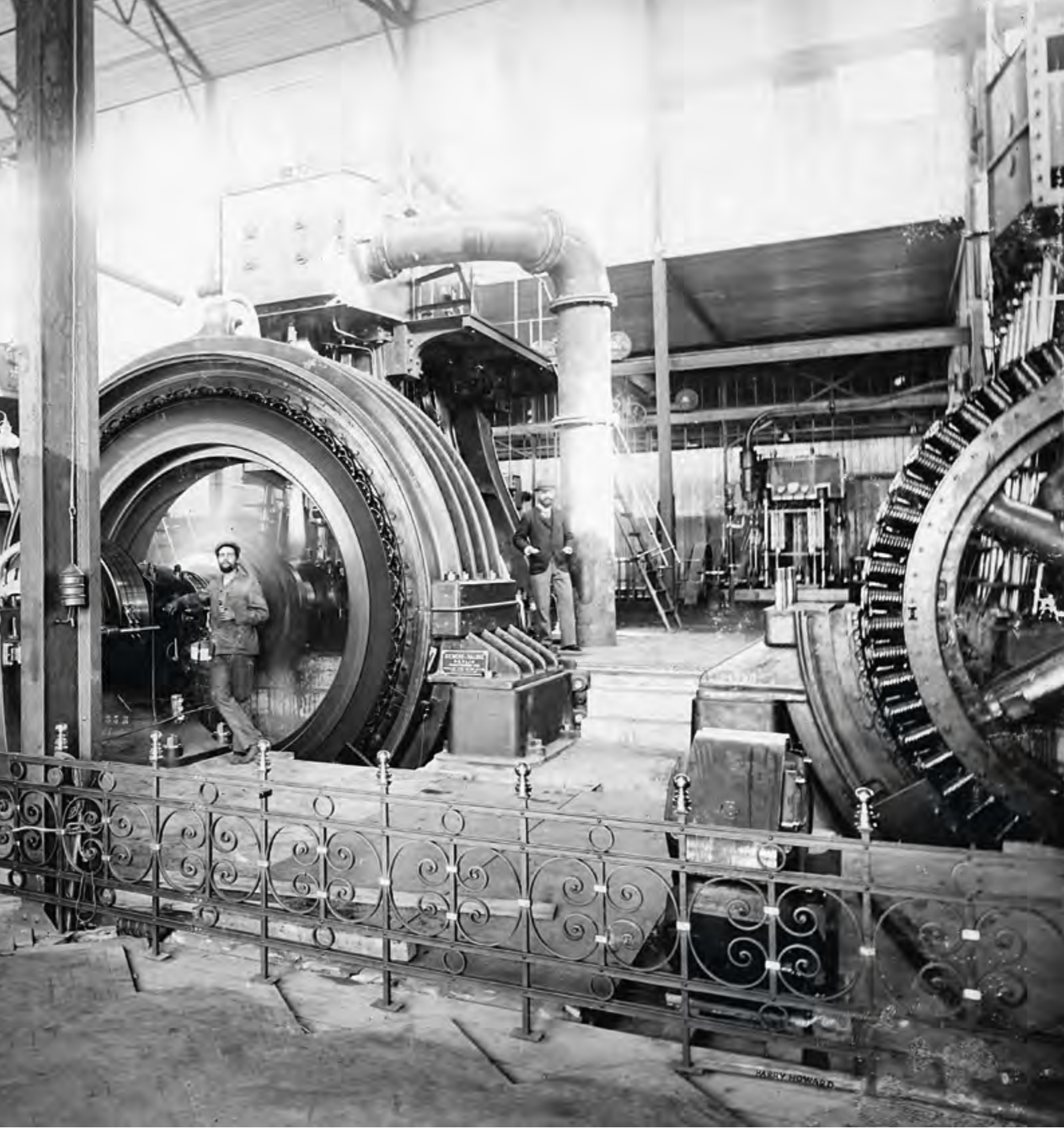
One of the most significant orders was for Mexico's highest-capacity hydroelectric plant of its time, on the Necaxa River. This facility, still in operation today, was built between 1903 and 1905 to supply electricity to **Mexico City**.

The company's first major railway project in East Asia was the construction of an electric overland streetcar system in 1899 in China. This connected the imperial capital of Beijing to the Ma Chia Pu railroad station, 3 kilometers away.

Late in the 19th century, Siemens also gained a foothold in Africa. The opening of the Siemens & Halske South African Agency in 1895 was followed two years later by the commissioning of South Africa's first public electric power plant, near **Johannesburg**. The plant supplied much of the rising demand for electricity for the growing city and for the later capital Pretoria and the gold mines in the Witwatersrand mountains.



A view of the machine shed at the Necaxa hydroelectric plant, 1905



Machine room of the Brakpan coal-fired power plant near Johannesburg, 1897

Getting into the USA

Business operations also began in the **USA**, though they would not come to full fruition until decades later. There was never any question that company policy would include North America. But in spite of the successful transatlantic cable-laying venture of 1875, involvement remained limited, mainly because of differences of opinion between Siemens & Halske in Berlin and Siemens Brothers in London.

Siemens entered the scene with a serious time lag behind American electrical equipment makers. In 1892, the Siemens & Halske Electric Company of America opened in Chicago. With its dynamos and electrical railroad equipment, the company intended to compete with US market leader General Electric, but it proved to be an "American tragedy."[13]

President and shareholder Otto Meysenburg and Plant Manager Alfred Berliner, dispatched from Berlin, disagreed on issues of management and their respective powers, and the entire project was in financial trouble within just one year.

To this was added the difficulty of communicating and coordinating between Berlin and Chicago. To top it all off, the factory building burned down in 1894. That signaled the end of the US company. To maintain a foothold in the USA, Siemens & Halske and Siemens-Schuckertwerke set up a joint office in New York in 1908, headed by physicist Karl Georg Frank. His staff prepared market analyses and encouraged the exchange of information with the leading US companies in the electrical sector.

There were several reasons why it would take quite some time before Siemens could gain a significant market share in the USA. When it first attempted to enter the market in 1892, the ideal moment had passed – American companies had already caught up on their technology lag by themselves. On top of that, the country's protectionist economic policy, with high tariffs and rigid patent laws, posed a significant barrier.

All in all, two different business cultures were colliding. Siemens, with its high-tech, high-quality, specialized electrical products, was facing customers who were looking more for low-priced, mass-produced goods. The German equipment and machines, Karl Georg Frank complained, were "not as sturdy and foolproof" as the American ones, and there was "too much emphasis on external fittings, [...] durability, and solidity."[14]

A partial view of Siemens & Halske Electric Company of America, Chicago Works, 1892

All the same, by the end of the industrial age's first surge of globalization, Siemens & Halske and Siemens-Schuckertwerke had become global players; 24,000 of the total workforce of 57,000 employees were working in countries other than Germany.

On the eve of World War I, Germany's electrical industry accounted for one-third of the world's electrical goods production and had taken a seemingly irreversible lead. Siemens and AEG alone accounted for three-quarters of German production. With ten independent companies – in England, Russia, Austria-Hungary, France, Belgium, and Spain – and 168 agencies, branch offices, sales offices, and technical offices in a total of 149 countries, it seemed as though nothing could shake Siemens' firm foothold in the world market.

1914–1945

War, democracy, and dictatorship

For Siemens, as for everyone else in the world, the era between the start of World War I and the end of World War II was an "age of extremes."[15] The company – headed from 1919 to 1941 by Carl Friedrich von Siemens – initially consolidated its position and recovered its market status, before eventually suffering the profound impacts of the Great Depression, the rearmament economy, and ultimately the war economy under the National Socialist dictatorship.


SIEMENS-
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Siemens in World War I

The outbreak of World War I in 1914 took the German electrical industry by surprise. As for so many, it had catastrophic consequences for Siemens as well. The government intervened deeply in private production and enlisted companies to deliver war matériel.

Siemens extended its production to include armaments and other products alien to its normal field of operations. Its broad range of electrical equipment had to be cut back substantially. The scarcity of raw materials such as copper, aluminum, and rubber was countered by affiliating individual companies.

As a globally active electrical engineering company, Siemens suffered severely from the destruction of international trade and the loss of the global network that it had been building up for decades. Many foreign subsidiaries and branch offices were expropriated or placed in trusteeship. The loss of most of its foreign possessions, including patent rights, stripped Siemens of nearly 40 percent of its assets with a single stroke.

Carl Friedrich von Siemens and the unity of the House of Siemens

The interwar period coincided with the intra-family succession of **Carl Friedrich von Siemens** as head of the firm. As Head of the House of Siemens, the youngest son from the company founder's second marriage, significantly influenced company policies for more than 20 years and preserved the unity of the House of Siemens against the centrifugal forces brought to bear by the diversity of the individual companies within the group. A decisive step in this direction was the integration of Siemens-Schuckertwerke into the House of Siemens in 1939. In this way, Carl Friedrich von Siemens achieved the unity of the entire company that had been sought for a long time, and which was to be finally completed in 1966 with the founding of Siemens AG.

Carl Friedrich von Siemens, 1924

Outside his own company, Carl Friedrich rose to the top of leading organizations and associations and became one of the most influential business leaders of the Weimar Republic.

Airplane production at Siemens-Schuckertwerke's Nuremberg plant, 1916

A meeting of the Board of Directors of the Deutsche Reichsbahn-Gesellschaft. At the head of the table, Carl Friedrich von Siemens, 1928

Products – technologies – rationalization

Following the era of basic innovations, the focus in the 1920s and early 1930s turned to optimizing existing products and technologies and opening up new areas of application.

The rising demand for electric power for industrial and home use made it necessary to expand existing power grids and extend the range of power delivery with increasingly high voltages. Oil-filled high-voltage cables developed by Siemens came into use for power transmission. Specialized switchgear, transformers, and insulators ensured safe control. In 1927, the acquisition of the turbine plant in Mülheim an der Ruhr made Siemens the leading producer of high-performance, high-pressure steam turbines.

Laying a 100-kV oil-filled cable in Nuremberg, 1931

Machine room of Berlin's large-scale power plant (Grosskraftwerk West), 1931

Innovations in transportation technology focused on cost-effectiveness, safety and speed. One outstanding example is the E 44 electric locomotive, which went into service in 1930. It served on both freight and passenger routes for half a century and completely eclipsed conventional coal- and diesel-fueled locomotives.

Most spectacularly, the “Hamburg Flyer, a diesel-electric fast locomotive, set new standards for speed. From 1933 onward, it covered the route between Berlin and Hamburg in just 138 minutes – a record that stood until 1997.

In road traffic, which was becoming increasingly motorized, the first automatic electric traffic light took on the task – something we take for granted today – of controlling traffic flow and preventing accidents. Siemens installed the system in 1924 in a traffic tower more than 8 meters tall at the center of Potsdamer Platz in Berlin, one of most congested intersections in Europe at that time.

Passenger and freight electric locomotive E 44, 1933

In communications, the telephone business outdistanced all other Siemens & Halske operations. Vacuum-tube amplifiers improved signal transmission, making the telephone network available to more and more people. Dialed telephony, which was already advancing in local networks, now came into use for long-distance calls as well.

At the same time, Siemens' traditional core business in telegraphy was still significant, and began expanding in 1928 to handle teletype. For decades, governments as well as companies took advantage of this ability to transmit text in seconds, until this "telex" method was replaced by fax and e-mail. Siemens also developed and marketed telegraph systems that could transmit pictures over long distances. Newspapers in particular made extensive use of this new technology.

Siemens traffic light system at Potsdamer Platz, ca. 1936

Advertisements for Siemens home appliances, 1939

Electrification had also been transforming private homes increasingly, but starting in the 1920s, Siemens and other electrical appliance companies brought this to the next level with a new category of products. Household appliances such as washing machines, laundry spinners, vacuum cleaners, and refrigerators ushered in a new age.

The vacuum cleaner – from the first dust removal pump (1906) to the first home vacuum cleaner (1924), the whispering Super canister vacuum cleaner (1931), and the Siemens Protos Rapid, the first handheld vacuum cleaner (1935) – is a good example of how these appliances became increasingly smaller and easier to handle until they became completely mainstream.

These developments were accompanied by strategies for rationalization. Carl Friedrich von Siemens himself was one of the leading figures in a nationwide movement for setting industry standards. He played a leading role in the Reichskuratorium für Wirtschaftlichkeit (Reich Board for Economic Efficiency), founded specifically for this purpose in 1921. Beginning in 1925, Siemens took on a pioneering role and converted production and assembly, transportation and storage to assembly line systems. Standardized components, harmonized organizational structures, and optimized working processes cut costs at Siemens, saved time, and thus increased profitability. Administrative departments were reformed as well – standardization was likewise introduced in offices, accounting, and controlling.

An assembly line for Siemens vacuum cleaners, 1930

"We can no longer limit ourselves to what progress we can make within our most familiar area of operation; we must find connections between the various branches of technical life..."
Carl Friedrich von Siemens, 1920

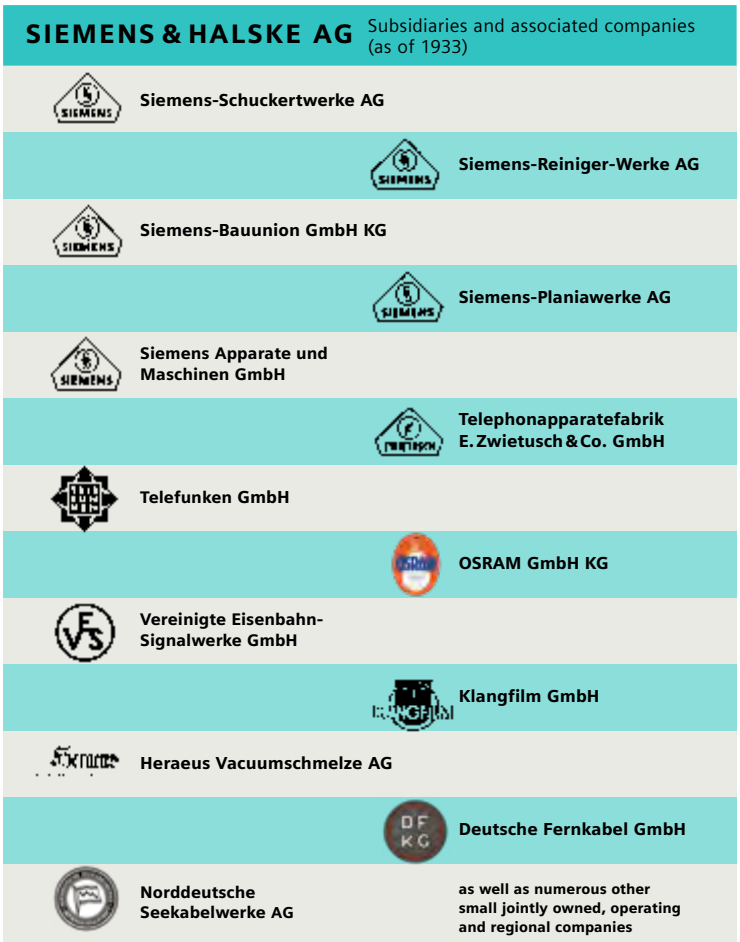
Affiliates and subsidiaries

The push for organizational modernization was also intended to strengthen the unity of the House of Siemens. This acknowledged the growing importance of cooperative ventures, affiliates, and independent subsidiaries, which posed challenges for the efficient management of the corporation as a whole.

Siemens & Halske retained an ownership interest in Telefunken (founded in 1903) until 1941, preparing the way for the Weimar Republic's flourishing radio culture. The economic potential of media such as film and phonograph records was further enlarged with Telefunken's investment in Klangfilm GmbH (1928), Telefunken-Platte GmbH (1932), and Deutsche Grammophon-Gesellschaft (1937). Telefunken also cooperated in the early baby steps of television technology, first used at the 1936 Olympics.

The longest-lived joint venture of Siemens and AEG, launched in 1919–20, was OSRAM GmbH KG. This Berlin light bulb manufacturer, in which Siemens continued to hold an ownership interest until 2017, evolved into the largest European company of its kind. OSRAM bulbs were used in headlights for cars, in making and showing movies, in illuminated advertisements, and as photographer's lamps. They were also used in homes.

Television camera "Olympia Kanone" (Olympic canon), 1936

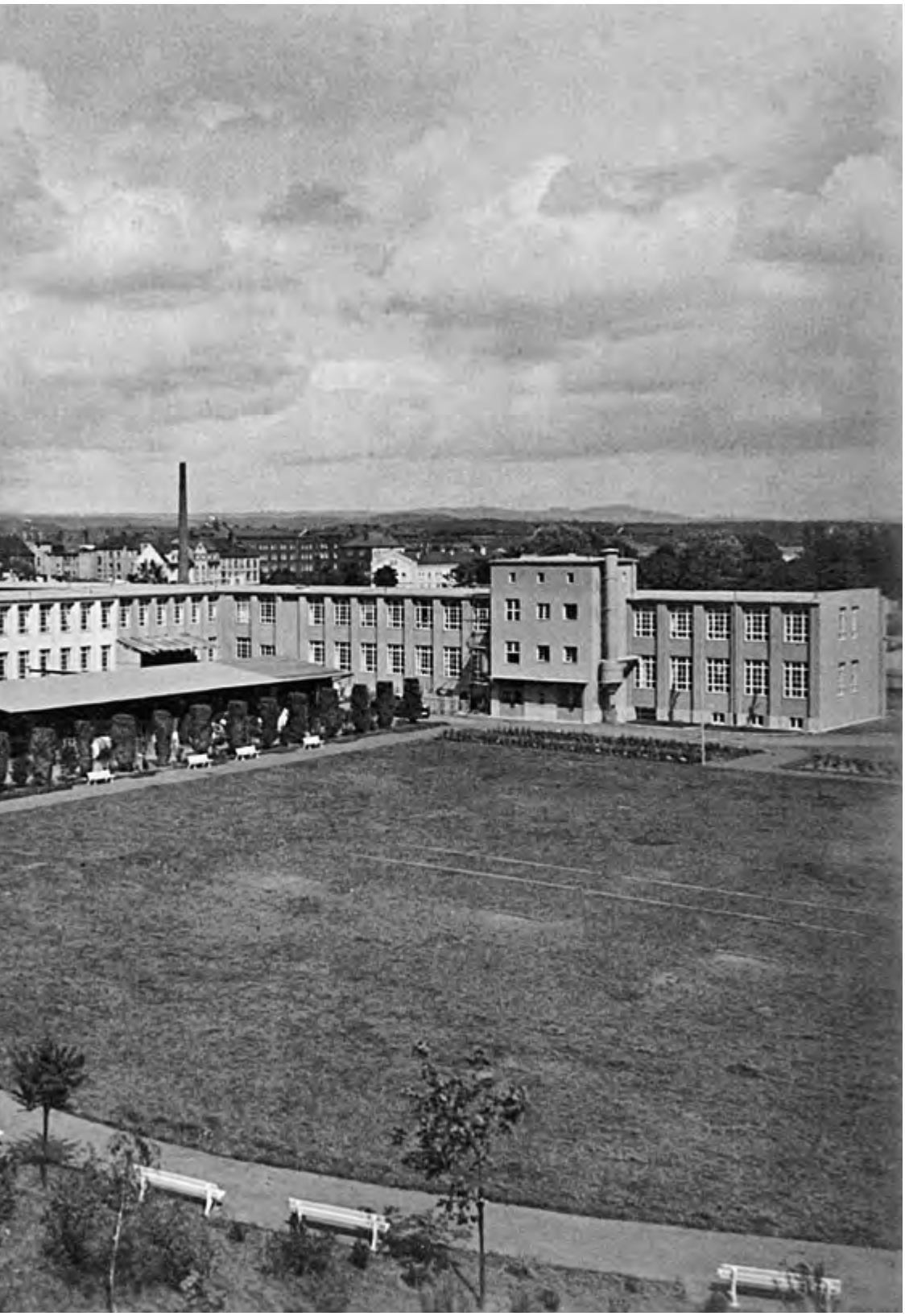


Siemens & Halske AG affiliates and subsidiaries as of 1933

The founding of **Siemens-Reiniger-Werke AG** (SRW) in 1933 pooled the strengths of Siemens medical technology with two former competitors in the medical technology sector for the first time. The unified company was quickly regarded as the world's largest company specializing in electromedicine. It owed that reputation not least of all to the many innovative products that it brought out, meeting with great demand both in Germany and abroad. These included the Siemens X-Ray Sphere, which offered greater safety from radiation and contact. Mobile and user-friendly, it could simply be plugged into a wall outlet. Many thousands of units were sold between 1934 and 1974, and the x-ray sphere achieved almost iconic status as a result of its extravagant design. The "Pantix" rotating anode tube was developed in SRW's plant in Rudolstadt. It was ready for the market in 1933 and likewise became a worldwide best seller. Modern X-ray tubes are still based on the principle of the Pantix tube even today. Countries other than Germany accounted for more than 60 percent of revenue by 1936, and Siemens-Reiniger-Werke had offices all over the world.

X-Ray Sphere manufacturing at
Siemens-Reiniger-Werke AG in Erlangen, 1940

A Pantix rotating anode tube, 1933



The Siemens-Reiniger-Werke plant in Erlangen after its expansion in the 1930s. Photo from 1948

The completion of Siemensstadt

The company also made use of its own construction capabilities at Siemensstadt itself, where construction and expansion work was largely completed by the early 1930s. It now included Europe's **first industrial high-rise**, designed by Siemens architect Hans Hertlein. Between 1915 and 1951, Hertlein, as head of the company's construction department, designed buildings and installations at Siemensstadt and at several other company sites. His rationalistic, modern industrial architecture – his specific "Siemens style" – is characterized by the integration of technical functionality and aesthetically sophisticated designs.

The overall picture of Siemensstadt was also defined by forward-looking residential settlements. The apartments, intended as housing for some of the staff, were a significant component of Siemens' corporate social-benefits policy. The first rental units at the Nonnendamm settlement, as it was known, were completed in 1905. The early 1920s brought a

The Heimat (home) settlement on Quellweg, 1931

A view of Siemensstadt, 1931

breakthrough in reform-minded residential construction concepts. By 1939, several settlements had been built for company employees, with more than 2,000 rental apartments and 121 individually owned homes with modern designs. There were also numerous social and leisure facilities. After 1945, Siemens would continue this line of activities by building tens of thousands of company apartments at various sites.

One high point for the overall layout of the Electrocity, as Siemensstadt was also known, was the opening of the Siemensbahn in 1929. The **commuter train rail** built by the company in public-private partnership ran through the entire site and carried thousands of employees to their jobs. This marked a highlight of 30 years of urban infrastructure construction in this previously isolated area.

Tapping back into export markets

By the mid-1920s, Siemens had caught up with its prewar production levels.

But the war's disruption of world trade and of traditional business relationships continued to impact the company far into the Weimar era. Growth was further slowed by reparation requirements, inflation, and political turmoil.

The question arose whether it would be worthwhile for Siemens to expend resources on returning to export markets. Competitors had gained ground abroad, and many countries had also been developing electrical industries of their own. Carl Friedrich von Siemens, however, advocated for the decision to venture back into international competition. He did

Motor production in Cornellá, 1920

End of the workday at the Cornellá plant in Spain, 1925

not believe in ideas of economic isolation and national self-sufficiency that were gaining currency at the time.

The global economy, he believed, was a "closely knit fabric, from which one cannot remove a number of threads without severely compromising the viability of the whole."[16] The "era of national isolation" was over, he emphasized in 1931: "We must realize that in today's world we have become dependent on one another."[17]

Siemens' share of total German electrical equipment exports had still not caught up in total to pre-World War I levels. Yet, the company gradually regained its international character. In 1936 it had 16 manufacturing plants abroad, 14 of which in Europe. In 1939, the company had nearly 200 business offices abroad, about half of them in Europe, and more than 20,000 of its 183,000 employees were working in countries other than Germany.

An overview of Siemens business offices, agencies, and factories, 1930

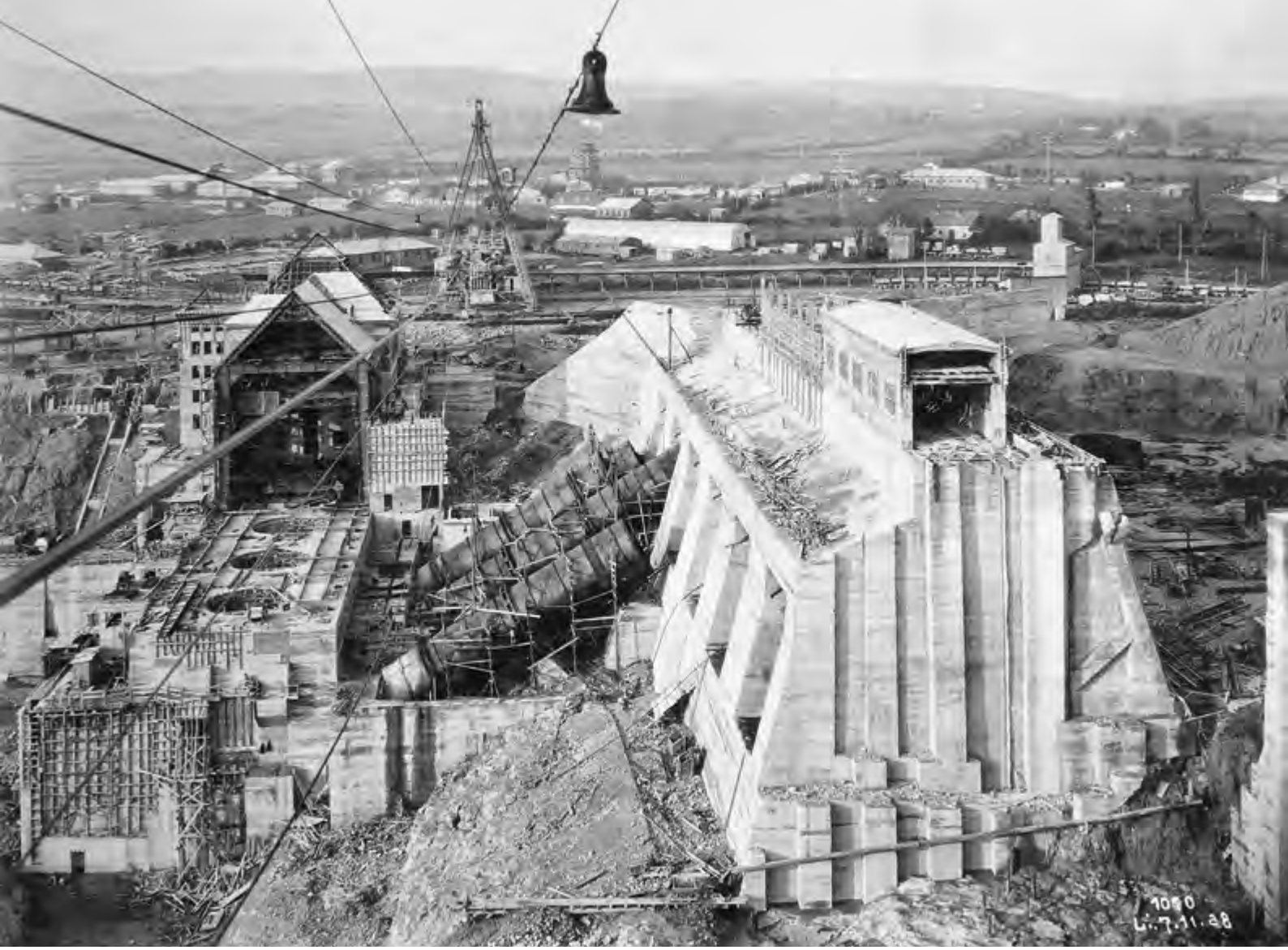
MENS-SCHUCKERTWERKE A-G

tungen und Fabriken •

Access to the US market remained difficult for Siemens. Prospects in Asia were more promising, especially in Japan. The Siemens-Schuckert Denki Kabushiki Kaisha commercial office in Tokyo traced its origins to the first Siemens office on the continent, opened in 1887. And as early as 1907, Siemens-Schuckertwerke had handled construction of the country's largest hydroelectric plant, on the Katsuragawa River in Komahashi, which supplied power to Tokyo. Now the business connections with Furukawa & Co., which dated back to the 1880s, really paid off. The two companies' joint venture, Fusi Denki Seizo KK, enabled Siemens to make an entry into the Japanese market for heavy-current products in 1923, and later the market for light-current and medical-technology products as well.

Siemens' connections with China extended even farther back, to 1872 – making it a jubilee of 150 years there this year. The technical

Showroom on the ground floor of the Siemens office in Shanghai, 1936



The Ardnacrusha hydroelectric plant on the Shannon – building the generator hall and dam, 1928

office that had operated in Shanghai since 1904, giving rise to Siemens China Co. in 1914, became the nucleus in the 1930s for the company's largest international subsidiary outside Europe.

Turning to a very different latitude, Siemens-Schuckertwerke received an order in 1925 that overshadowed many others. This was for a **large hydroelectric power plant** to be built at Ardnacrusha, north of Limerick in the Irish Free State – today the Republic of Ireland – on the lower course of the Shannon River.

The new plant would supply most of the Irish Free State with electric power for the first time. The ambitious project posed enormous challenges. Tons of construction machinery and materials, shipped from Germany to Ireland by steamer, were used in excavating millions of cubic meters of earth. Construction of the power plant itself was followed by the construction of a 3,400-kilometer power grid. The inauguration of the Shannon Scheme in 1929 made it possible to supply electricity to businesses and homes in every part of the Free State.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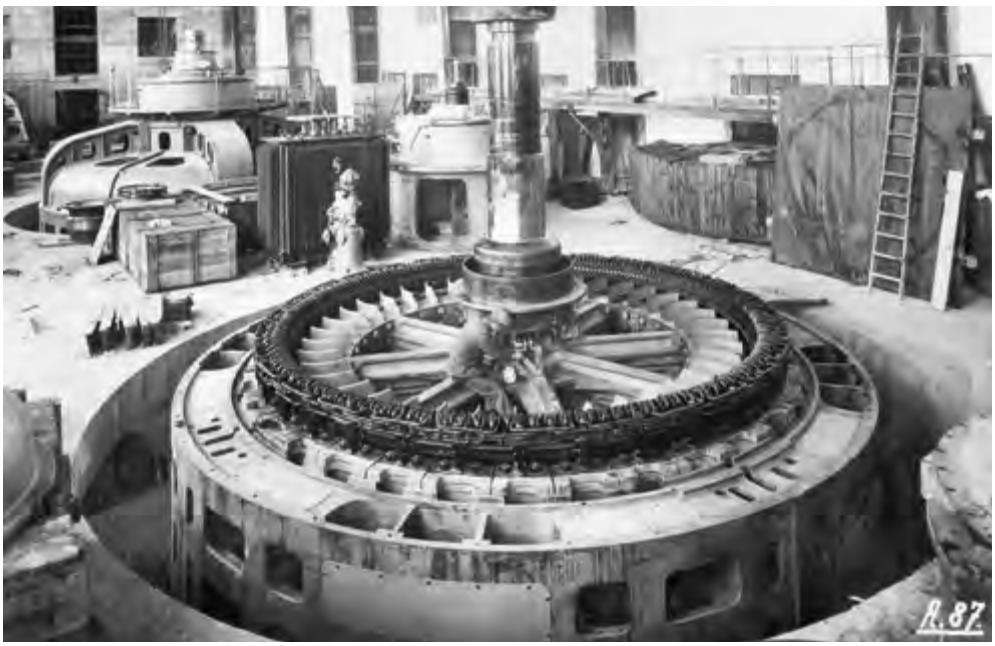
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Building the Ardnacrusha hydroelectric plant on the Shannon

Top: Building the surge tank, 1928

Left: Inserting a generator rotor, 1932

Right: Installing a generator rotor, 1932

War production at Krainburg (today Kranj) in Slovenia, ca. 1940

"It grieves me deeply to have to dismiss employees who have faithfully served my House for decades, due solely to their origin. Even though I employ more than 100,000 people, today Germany is ruled by a mob of political adventurers who no longer leave me the power to make decisions in my own House as I see fit. Things have gone so far that, if I were to oppose them for the sake of a few, it would threaten the existence of the entire House of Siemens."

Carl Friedrich von Siemens, early 1930s

Global economic crisis

Following a five-year "golden age" of the Weimar Republic, the Great Depression hit in October 1929, clouding the outlook for Siemens. Whole economies and countless companies were thrown into the abyss of a fatal global economic crisis that would not bottom out until 1932. Mass unemployment, a severe slump in industrial production, and a drastic shrinkage of the global market ensued.Siemens, too, had to switch to crisis mode.

From 1929 to 1933, total revenues of the House of Siemens shrank from 820 million Reichsmarks (RM) to 330 million. In spite of programs to subsidize shortened work schedules, as well as wage and salary cuts, layoffs became unavoidable. By 1932, the workforce had dwindled from 138,000 to around 75,000 employees. This was truly catastrophic.

"This is the first time our company [...] has had to proceed with such extensive dismissals," Carl Friedrich lamented to Chancellor Heinrich Brüning in July 1930. "Until now we had been proud that any employee who was diligent and had worked well in practice for a few years could feel assured of a position for life. That was also one of our company's strengths."[18]

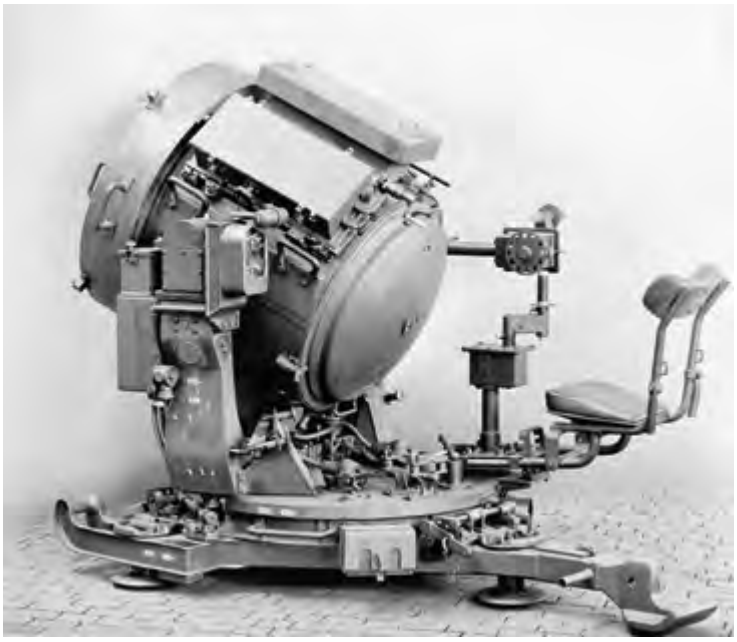
Rearmament economy under National Socialism

The National Socialists' rise to power in January 1933 represented a radical disruption that also resulted in a reshaping of the entire economy. This was an ambivalent development for many companies. On the one hand, government programs to spur the economy sped up an economic recovery already under way. Full employment was achieved by 1936. On the other hand, the economy was subjected to government control on a scale it had never experienced in Germany. The regime regulated worker allocations, investment decisions, and management of raw materials. These control measures aimed to make Germany economically self-sufficient and ready for war.

This ambivalence was evident at Siemens as well. By 1935–36, revenue was returning to pre-Depression levels, initially at Siemens & Halske and later at Siemens-Schuckertwerke as well. In 1939, with 187,000 employees, the company had re-consolidated its lead as the world's largest electrical company and the world's fourth-largest corporation of any kind. In terms of armaments production, Siemens had deliberately continued work in this line during the Weimar era. From 1933 onward it was a shareholder and joint founder of Mefo (Metallurgische Forschungsgesellschaft m.b.H.), and therefore participated in financing for rearmament (which was initially kept secret, as a violation of the Treaty of Versailles). But now more and more orders came in from military authorities to supply the Army, the Navy, and the Merchant Marine. As early as 1933–34, these orders represented 18 percent of the volume at Siemens & Halske, and by 1936 they accounted for about one-fifth of total new orders at Siemens-Schuckertwerke.

Like other companies in heavy industry, Siemens operated within a tense context of tight binds, economic incentives, and the surviving openings for entrepreneurial freedom. It was part of corporate management's responsibility to explore the remaining leeway for action. Carl Friedrich von Siemens, the Head of the House of Siemens and a liberal defender of the achievements of a republican democracy, took a distanced position toward the dictatorial system and the National Socialist tyranny. Even the government's authoritarian interventions in the economic sphere and its striving for national self-sufficiency ran contrary to his nature. After all, he was a businessman, and these were diametrically opposed to his ideas of fruitful international networks. Yet in 1938 he no longer felt he was in a position "to make decisions as I wish in my own house" without "putting the survival of the entire House of Siemens at risk."[19]
A few months before his death in 1941, Carl Friedrich von Siemens resigned himself to the conclusion that:

> "Today, work no longer brings any joy or satisfaction. One who was proud that his own work was dedicated to a task that sought to serve the growth and progress of the human race can only see with a mourning heart that the success of that work has now served solely to benefit destruction."[20]



An antiaircraft "flak" searchlight, 1940

Relocation plant porcelain factory Neuhaus, 1941

World War II

The outbreak of World War II in September 1939 brought even more government control and intervention in business operations. Beginning in 1942, armament efforts picked up once again, and war manufacturing encroached on civilian production.

Government demands, including for telecommunications equipment, transformers, motors, and generators, pushed the company to the limits of its capacity, while shortages of skilled workers and raw materials, transportation difficulties, and rigid secrecy regulations posed additional constraints. To protect itself against air raids and to facilitate transports, Siemens decentralized its production operations in Berlin. By the turn of the year from 1944 to 1945, nearly 400 widely scattered contingency and relocation plants had been set up across Germany.

Finally, Siemens was among the large group of companies that made use of foreign workers and forced laborers. Beginning in the autumn of 1940, these workers were used at almost every plant. Initially, these were individuals hired regularly as foreign civilian workers and Jews forced into service by the authorities. But as the war advanced, the workers' ranks came to include prisoners of war, workers and forced laborers from occupied territories (especially the Soviet Union),

and prisoners from concentration camps. At least 80,000[21] women and men were put to work for the Siemens parent companies or subsidiaries like Siemens-Bauunion.

In 1942, Siemens & Halske relocated part of its production of electric switches, telephones, radios, and measuring equipment to Ravensbrück, some 90 kilometers north of Berlin. In specially built production halls, up to 3,000 prisoners from the women's concentration camp in Ravensbrück had to perform precision-mechanical work.

From 1943 onward, satellite concentration camps were built near existing or recently relocated Siemens operations. They housed prisoners, mainly from the Auschwitz, Buchenwald, Flossenbürg, and Gross-Rosen camps, who labored at the Siemens sites.

At Siemensstadt as well, from 1940 onward, foreign workers, some of them forced laborers, were quartered in barracks in Haselhorst. During the last year of the war, part of the site that had been destroyed in an air raid was rebuilt and run by the SS as a satellite

A forced laborer at Berlin-Siemensstadt, 1943

concentration camp, housing more than 2,000 prisoners from the Sachsenhausen and **Ravensbrück** camps under degrading conditions while they were forced to work for Siemens-Schuckertwerke.

In In September 1944, a few months before both the war and the Nazi dictatorship ended, Siemens had grown into a sprawling complex of companies with 246,500[22] employees. Revenue and profits had developed while adjusting to the dictatorship's terms, and had been based during the war years on a massive use of forced labor.

For the total period of National Socialism, it must be assumed that the individuals in charge as management held a wide range of attitudes and beliefs about the regime. While concern about the company's survival may have dominated, tactical and strategic considerations also played a role, and opportunities for profit were seized. Firm ethical and moral reservations were countered in other cases by an inner commitment to the Nazi regime. What is unquestionable is that the years 1933 to 1945 as a whole cast a dark shadow over the history of Siemens.

Forced laborer at Berlin-Siemensstadt, 1943

1945–1966

Rebuilding during the “economic miracle” era

The postwar era posed existential challenges for Siemens, but also offered undreamed-of opportunities to rise again. Conditions of political geography and the economy left the company’s future more uncertain than ever before, until the economic boom of the 1950s and 1960s – both in West Germany and internationally – restored it to its position as one of the pacesetters in the electrical industry.

The immediate postwar years

The war had devastated the company's infrastructure. In Berlin, heavy air raids destroyed about half of the **buildings and factory installations at Siemensstadt**. The plants had to cease work on April 20, 1945. As Soviet troops occupied the capital of the German Reich five days later, members of the Red Army dismantled thousands of machines, installations, and instruments, carried off valuable laboratory and design documents, and cleared out remaining inventories.

During the improvised reopening of operations at Siemensstadt on September 8, 1945, amid rubble and burnt-out shells of buildings, little was left that would inform someone as to the company that once stood there. The employees, initially numbering 14,000, carried out repair and cleanup operations, and put the town's transportation, lighting, and energy systems back into commission. Once it became possible to make the first simple articles of electrical equipment, production

The Wernerwerk II, severely damaged by air raids, Berlin-Siemensstadt, 1944

Hall complex of the metal plant in Berlin-Gartenfeld after the dismantling of the rolling mill, summer 1945

loops were gradually restarted at the central Berlin plants. By 1952, most of the war damage to the industrial buildings had been repaired.

The future was still deeply uncertain for Siemens. The 1947 centenary went unnoticed as the focus shifted to ensuring the company's survival. Luckily, Siemensstadt, unlike the sites of competitor AEG, was situated entirely in what later became the British Sector of Berlin. Still, numerous production units and contingency plants in eastern territories were confiscated, together with their equipment and machines. Plants in Saxony and Thuringia, in particular, were lost to expropriation and nationalization. The total financial loss from dismantling and worldwide confiscation, together with the loss of securities, bank balances, and patents, came to nearly 2.6 billion Reichsmarks – four-fifths of the company's assets.

On top of that, the revered unity of the House of Siemens was in danger of permanent destruction. The US government, in particular, was irritated by all the company's cartel, syndicate, and trust structures. It started working on breaking up large corporations in Germany with more than 10,000 employees – which it characterized as monopolistic – as in the case of chemical giant IG Farben. Ultimately, the change in the Western powers' policies toward Germany, as they began to evolve in 1946, and their rupture with the USSR, kept such plans from being carried out.

Siemens-Schuckertwerke's equipment plant office in Berlin-Siemensstadt, dismantled by Soviet troops, 1945

Resumption of production at the Schaltwerk in Berlin-Siemensstadt, 1945

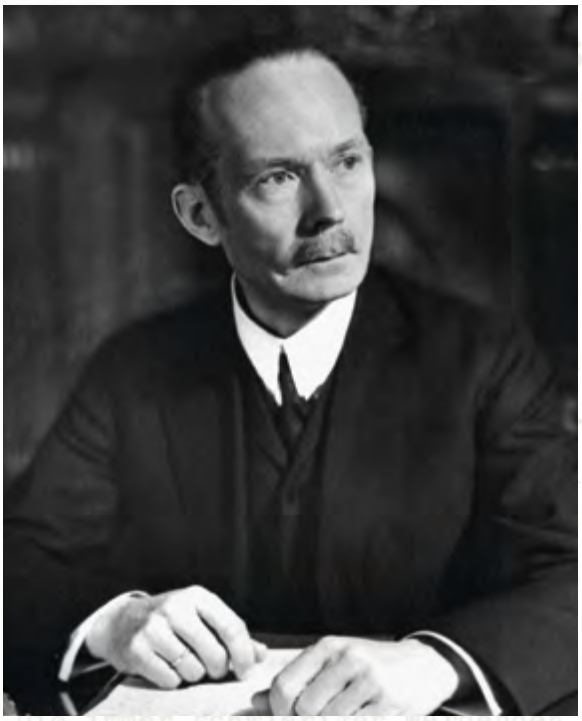
A fresh start in West Germany

All of this caused immense pressure for Siemens management, whose ranks had already been decimated by the consequences of the war. Both Chairmen of the Management Boards, Heinrich von Buol and Rudolf Bingel, were detained by Soviet forces and did not survive beyond 1945. The head of the House of Siemens, Hermann von Siemens, had been arrested for a time by the Americans in June 1945 and was interned once again for an unforeseeable term at the end of November.

Left in charge was Ernst von Siemens, the son of Carl Friedrich von Siemens. Born in 1903, he had been with the company since 1929, and joined the managing boards in 1943. Immediately after the war's end, it was he who pursued the overall interests of the House of Siemens from a base in Munich.

Mere months before, the company had been prescient enough to **relocate large parts of its operations** to the Allied Occupation Zones in West Germany. Three sites were shortlisted as possible headquarter locations: Munich, Erlangen, and Mülheim an der Ruhr.

Parts of the company were already located there, and showed promise for expansion: in Munich, Isaria-Zählerwerke AG, a maker of telephone systems acquired in 1927; in Erlangen, Siemens-Reiniger-Werke, and in Mülheim, at the heart of West German heavy



Hermann von Siemens, ca. 1950

Ernst von Siemens, 1956

industry, construction of steam turbines and generators.

A move to West Germany might have made sense at that time, but it was highly controversial. Internal debates raged between generally older traditionalists and a younger, more progressive generation. Ernst von Siemens took the side of the progressives, warning against "sentimentality and misunderstood tradition."[23]

> "Everything about tradition argued for Berlin as the location. But what is tradition? It is all too often confused with habit. In this case, we had to create something new from the spirit of the old. Berlin's isolated location disqualified it as a site for the company's headquarters – the decision was hard, but given the state of things, it was unavoidable."[24]

At a meeting of both boards in Starnberg (a lakeside town near Munich) on April 1, 1949, the corporate headquarters of Siemens & Halske were moved to Munich, and those of Siemens-Schuckertwerke were moved to Erlangen. The agreement would later be known as the Peace of Starnberg. At the same time, the organizational principles of the House of Siemens that had been practiced since 1903 were reconfirmed: Research and development, project planning, and sales for both companies would operate separately, while joint central departments were created for administration. Hermann von Siemens, who had been released from internment in January 1948, returned to head both companies' supervisory boards.

Siemens-Schuckertwerke headquarters in Erlangen, 1953

"... A number of storms have thundered over us, wars and economic crises that have left other companies crushed. Each time we have emerged perhaps somewhat leaner, but tougher, and now once again, here we stand with many scars, but sturdy muscles, and a will to accomplish our tasks steadfastly in an economy founded on the division of labor."

Hermann von Siemens, 1949

The Siemens & Halske location on Hofmannstrasse in Munich, 1964

Foundation for a comeback

Siemens' comeback came swiftly, thanks to the new German Federal Republic's Wirtschaftswunder, a period of economic prosperity set off by a currency reform and American financial aid that lasted over 20 years.

Industrial companies like Siemens were perfectly situated to take advantage of this boom. The company's workforce, revenue, and profits skyrocketed, and not even the recession of 1966 and 1967 could dull the shine. Expansion became the new norm, and **new buildings** were erected and new business operations initiated all over Germany.

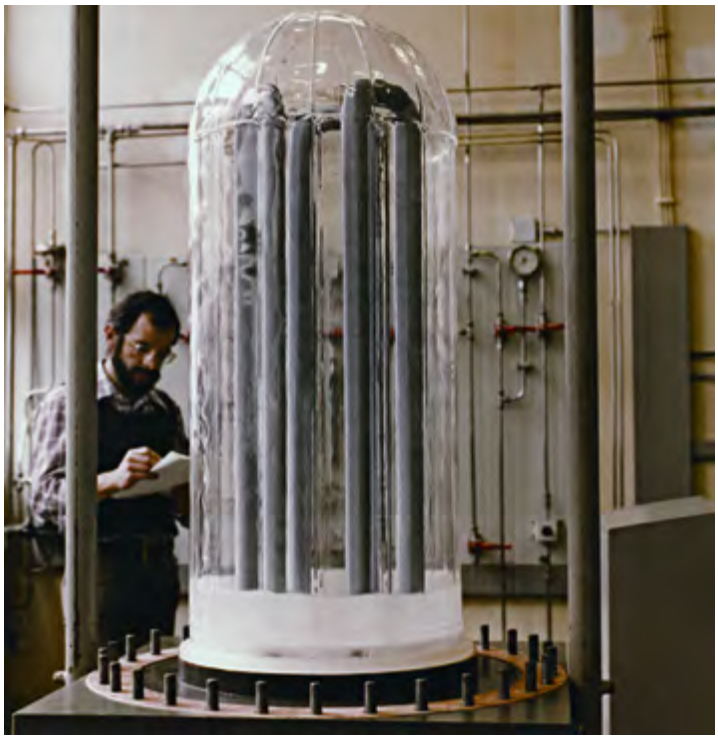
There was one area where Siemens needed to catch up: research and development. The international competition had pulled ahead during the war. Even after, industrial research and development activities were controlled, restricted, or even entirely banned by the Allies. It took until 1955 for Siemens to start back in earnest, with a Siemens & Halske telecommunications laboratory in Munich. In 1965, Siemens Schuckertwerke followed suit

Relay production at Siemens & Halske in Bruchsal, 1956

"In today's economy, outbidding other companies with increasingly modern technology has become the most effective form of competition. Competing in the area of research is much more important than competing on price. Only large companies can succeed in this "laboratory competition."

Ernst von Siemens, 1965

Aerial photo of the research center in Erlangen, 1965



Making ultrapure silicon using the floating zone method and adding a photosensitive coating to a wafer, 1976

by opening Europe's largest private research center in Erlangen, focused on heavy-current technology, especially nuclear power.

After Siemens AG was formed, the two parent companies' research facilities were combined organizationally in 1969, and R&D activities took an increasingly application-oriented approach. Early in the 1970s, Siemens AG concentrated its research and development activities for data and telecommunications technology, with significant investments, at another new site – in Munich-Neuperlach.

A particularly conspicuous early success of postwar research at Siemens was the development of the floating zone method for producing ultrapure silicon, achieved in 1953 at Siemens-Schuckertwerke's semiconductor laboratory in Pretzfeld. The discovery would pave the way for the production of semiconductor components like diodes, transistors, and memory chips.

Control room at Germany's first research reactor, the FR-2 in Karlsruhe, 1961

Products and innovations during the "economic miracle" years

Siemens now had the ability to think long-term, and focus on its core fields in electrical engineering. Siemens & Halske delivered such products as railway signaling devices and telecommunications equipment for public clients. The fast-growing demand for electrical equipment in industry also yielded new orders. The rapid rise in energy consumption was reflected in the construction of power plants. In 1955, Siemens-Schuckertwerke got into reactor development, advancing the process of practical application of nuclear energy.

At the same time, private homes showed a growing desire for consumer goods. Most of all, having a home equipped with electrical appliances became one of the key symbols of the Federal Republic's rising prosperity and of its social market economy. Siemens began

a race to catch up with competing electrical product manufacturers, who had dominated the market up to now. Siemens' devices would set themselves apart with their increasingly sophisticated technological refinements, convenient automated functions, and safety devices. In 1953, Siemens introduced the first infrared-heated oven onto the market; the company's first dishwasher came along in 1964. The fully automated Siwamat washing machine that arrived the next year was the first to combine wash, rinse, and spin functions in a single appliance. In 1957, Siemens pooled the development, production, and sale of its entire line of home appliance products – together with radios and television sets – at its Munich subsidiary Siemens-Electrogeräte AG. Finally, in 1967, the joint venture Bosch-Siemens-Hausgeräte GmbH brought a breakthrough to rationalized, modernized mass production.

An ad for Siemens appliances, 1961

A milling machine with the SINUMERIK electronic control system, 1967

With the last of the postwar restrictions and reporting obligations ending, Siemens set its course in the direction of another pivotal future technology: “information processing” – what we today call data processing. This opened the way for a revolutionary innovation whose direct connection with semiconductor and microelectronics technology would come to play a key role in a great many other areas in which the company operated.

Research started as early as 1942. At the Berlin Wernerwerk for Radio Technology, work was done at that time on what were known as crystal diodes. In the early 1950s, at Munich’s Wernerwerk for Telegraph and Signal Technology, Siemens began developing integrated circuits, the foundation for microelectronics. And as early as 1956, preparations were made for series production of the 2002-type digital computer. The first unit of this kind was delivered in 1959, after a successful presentation at the Hannover Messe trade show. The first digital computers were used initially in science, and later for mass data processing, enabling companies as well as government agencies to save time. Automation technology, which was becoming indispensable for every production process, also benefited from these new ideas. In 1958, Siemens began a worldwide triumph with the **SIMATIC** system, supplemented in

An automated lathe with SIMATIC components from the Pittler company, Langen, 1959

1960 with the **SINUMERIK** machine tool controller. The two systems stood out for their novel control elements. Constantly improving, enhanced versions of these remain in use today wherever there is a need to effectively and reliably automate industrial systems.

This move into microelectronics was bold, even for Siemens. It was venturing into an extremely dynamic, research-intensive, and high-cost field. New generations of increasingly powerful yet more compact data-processing systems had to be put on the market in faster and faster succession. At the same time, the dominance of the United States, especially office machine maker IBM, had to be effectively countered. Siemens' solution for this was to sign international cooperation agreements. The company's first successes in semiconductor production were based on know-how that Siemens-Schuckertwerke had gained in 1954 by renewing its agreements with Westinghouse. Another partner, from 1964 to 1971, was the Radio Corporation of America (RCA) in New York. A further transnational joint venture, which lasted from 1973 to 1975, was Unidata – an alliance between Compagnie Internationale pour l'Informatique, Philips, and Siemens that also had political support, with the aim of building up a competitive European IT industry.

SIMATIC component, 1959

Siemens' involvement in data technology required stamina. The business would not develop into a profitable line until the late 1970s, and it could not crack IBM's worldwide supremacy. But in West Germany, Siemens held its own amid intense competition and rising market concentration, and by the

An examination with the Vidoson, 1967

mid-1960s had become the only producer of medium-size and large computer systems.

The “economic miracle” was also becoming apparent in **medical technology**, one of Siemens’ roots. In response to the broad need for medical care among large segments of the population, the Allies had already given Siemens-Reiniger-Werke in Erlangen permission to resume production as early as the end of May 1945. The internationally respected specialist in electromedical technology was ready to go into action; by 1948 it was already producing “technology for health” again under largely normal conditions.

One field where the ensuing developmental work opened up new opportunities was cardiology. The Angiograph, introduced in 1950, made it possible to trace a catheter on a fluoroscopic screen as it made its way through the blood vessels into the heart. About three year later, a material testing device from Siemens, newly optimized for medicine, made it possible for the first time to display cardiac activity non-invasively, using ultrasound. This was the beginning of echocardiography. And the world's first fully implantable cardiac pacemaker, developed by Siemens in 1958, improved therapy for heart disease.

Alongside the new developments in cardiology, research and development at Siemens-Reiniger-Werke gave rise to a great many other innovations in the 1950s and 1960s. One example was a milestone in oncology set by the “Betatron” electron accelerator, based on Siemens-Schuckertwerke research from the 1930s. It generated very “hard” X-rays that could reach even deep-seated tumors. In the early 1960s, the company advanced its developments in ultrasound technology, leading to the invention of the “Vidoson,” the world’s first ultrasound unit for real-time procedures, making it possible to watch movements inside the body as they happened. From 1967 onward, this technique also made prenatal care easier: the Vidoson could be used to examine expectant mothers without exposing them to ionizing radiation.

Queen Elizabeth (the "Queen Mum") observes the Betatron at the International Congress of Radiology in London, 1950

Treatment with the Betatron, 1956

A Siemens Service car in Bangkok, Thailand, 1967

Return to the world market

The medical business is yet another example of the revival of Siemens' international focus. Even before 1945, this business had generated large portions of its revenue abroad; by the mid-1960s, international sales had again risen to nearly 70 percent. From 1951 onward, Siemens-Reiniger-Werke relied on a successful partnership with the Dutch Philips Group.

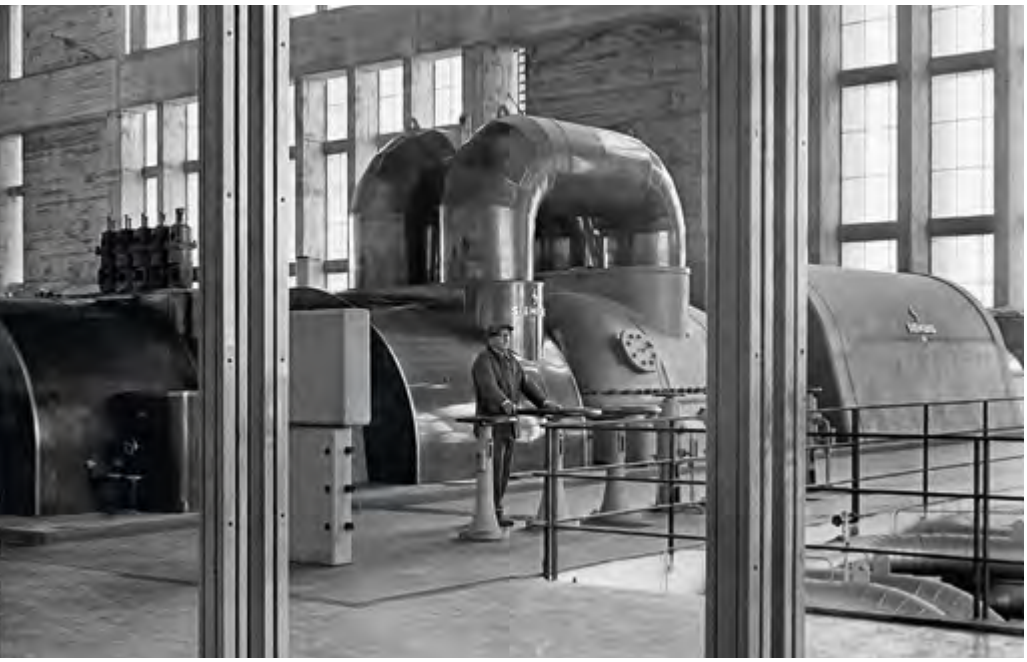
The international market had suffered greatly immediately after the war. Siemens subsidiaries and agencies in other countries had been expropriated and liquidated, and the company had lost assets, land, patents, name rights, and trademark rights. Restrictions on contacts and travel severely limited its leeway for action. Until 1947, the Allies prohibited any independent foreign trade in the Western Occupation Zones. Where the parent companies' share of exports in 1935–36 had still been 13.6 percent, exports in 1947–48, at 1.6 percent, had almost dried up.

For the second time in its history, Siemens was faced with the question of whether a new beginning of its global business operations

had any prospect of success. In internal debates, some voices loudly advocated limiting operations to the domestic market. Instead, a forward-looking strategy, championed in particular by Ernst von Siemens, won out: Recovering international sites would be given the same priority as domestic consolidation.

The recovery would be achieved by relying on outside agencies to start. However, carefully focused steps would be needed before the company could resume building and operating high-quality electrical installations and production facilities. Once the rigid restrictions on foreign trade were eased and then lifted, Siemens began buying back its former branches. It also reentered its former international markets through investments and cooperation agreements. In countless negotiations, the company recovered its former naming and trademark rights. In parallel, Siemens set up new companies. Between 1952 and 1962 alone, these efforts gave rise to sales and production companies, agencies, and outposts in 30 countries. Organizationally, from 1952 onward, the parent companies' agency relations were reorganized in a Zentralverwaltung Ausland (common international division).

Siemens teleprinter in a travel agency in Calcutta, 1960



Machine room in the San Nicolás power plant in Argentina, 1956

There were good opportunities to revitalize the international business through large-volume international projects for power generation and distribution systems as well as the demand for transportation and communications infrastructure. Siemens initially focused on the markets in Western and Northern Europe, the Mediterranean, and the Middle East. A breakthrough in the US market would follow with the internationalization surge of the 1970s. That lent all the more importance to a 1951 contract to build a steam power plant at San Nicolás in Argentina. As head of a consortium, Siemens-Schuckertwerke handled the general planning and the delivery of electrical equipment for the 300-megawatt plant on the Paraná River. This facility provided regional electric service from 1956 onward, also supplying electricity to the nation's capital of Buenos Aires, some 250 kilometers to the southeast. As the largest major export order for West German industry since 1945, it represented a significant reference project for Siemens in the South American region. In 1957, Siemens-Schuckertwerke received the biggest single contract in its history to date. It took part in building a steelworks in Rourkela, in the northern part of the Indian state of Orissa (today Odisha). This made Siemens a player in one of the largest German developmental aid projects of the era.

Amid the altered global conditions of the Cold War, Siemens did not initially regain its earlier status among the world's leading exporters of electrical equipment. Nevertheless, by the early 1960s, the value of exports already exceeded one billion DM. Twenty years after the war ended, one-fifth of Germany's electrical equipment exports came from Siemens; the company ranked ninth worldwide among the largest corporations in the sector. The rebuilding phase after World War II was complete.

Aerial photo of the San Nicolás power plant in Argentina, 1956

"If we achieved considerable success on the foreign markets, that was possible only because, after the collapse, we were once again able to rise to the top class technically and were also in a position to offer our technically high-quality products at competitive prices."
Hermann von Siemens, 1956

1966–1989

Diversification and internationalization

The postwar boom years were followed by an era of global turmoil. Organizational reforms strengthened Siemens, enabling it to weather the looming economic crises. But it had to face more competition in increasingly liberalized European and international markets.


SIEMENS

The founding of Siemens AG, 1966

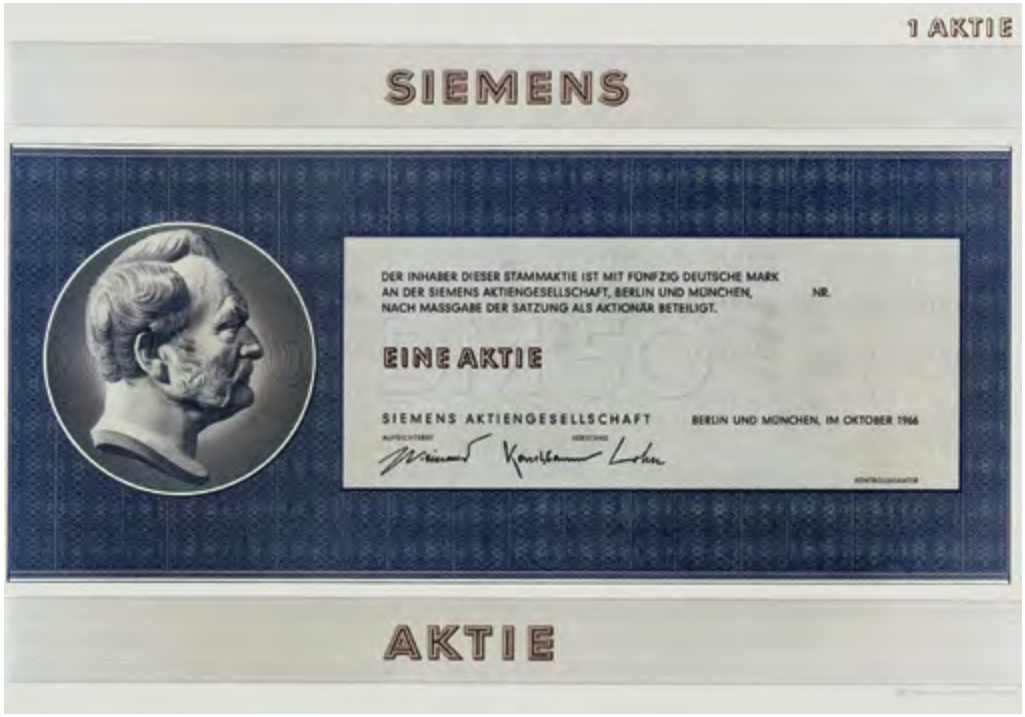
In the second half of the 1960s, the company girded itself for the future by **founding Siemens AG** and reorganizing its corporate structure. Back in 1939, when Siemens & Halske integrated the heavy-current department, Carl Friedrich von Siemens had already set his sights on forming a corporation that was fully unified. The events of the war and the subsequent reconstruction work delayed his ideas, but in the end, his son Ernst carried them out.

In the meantime, electrical engineering had become a matter of highly complex structures that no longer fit the classic distinction between heavy-current and light-current equipment. In measuring, control, and instrumentation technology especially, overlaps and expensive parallel developments occurred between Siemens & Halske and Siemens-Schuckertwerke. It was also becoming more difficult to create holistic system solutions with a greater customer orientation.

Finally, the institution of the Head of the House, so steeped in family tradition, ran up against its limits. The expanding international corporation had outgrown the carapace of the former family firm. From the early 1920s to 1966, the workforce had more than tripled – from 78,600 to 257,000. It further became clear that, following the retirement of Ernst von Siemens, at the age of more than 60, no member of the family would take over the double chair of the two parent companies' supervisory boards. An additional outside push came from the amended terms to which German stock corporations were subjected under a new Stock Corporations Act, which took effect in 1966. These would have forced the company to make new internal contractual arrangements and left it exposed to fiscal burdens.

The members of the managing boards and supervisory boards decided on a far-reaching solution that would continue in its basic form for almost 50 years. On October 1, 1966, Siemens & Halske AG, Siemens-Schuckertwerke AG, and Siemens-Reiniger-Werke AG had been merged to form Siemens AG, headquartered in Berlin and Munich. Its management was initially placed in the hands of a three-member Presidential Committee, with Ernst von Siemens remaining as the Head of the Supervisory Board until 1971. This step completed a carefully planned transformation

"In the future there will only be one parent company called Siemens Aktiengesellschaft. Combining the parent companies into one unit realizes the idea that had long been entertained of safeguarding coherence and continuity in the leadership of the large company."
Ernst von Siemens, 1966



A share of Siemens AG, 1966

into the legal form of a modern, manager-led, transparently structured stock corporation – to a certain extent mirroring the successful intergenerational handovers of corporate management in 1890, in the aftermath of World War I, and in the 1940s.

The Siemens family was still associated with the company, with some of its members serving in its governing bodies. Peter von Siemens, the founder's great-grandson and previously a member of the managing board of Siemens-Schuckertwerke, succeeded his uncle Ernst as Chairman of the supervisory board between 1971 and 1981. His son, Peter C. von Siemens, worked for Siemens for nearly 50 years, including as a member of the managing board from 1987 to 1993 and then of the supervisory board until 2008. Since 2015, the supervisory board has once again had a member of the founding family in Nathalie von Siemens, the great-great-granddaughter of Werner von Siemens.

Ernst von Siemens viewed the new organizational form as a guarantor of "coherence and continuity in management" and of the successful management of future challenges.

> "If our company – while still respecting the tradition that has made us so great – can make the necessary changes without undue delay, then I have no doubt that we will also be able to master the great challenges that we will face in the future."[25]

The organizational reform of 1969

Unification of the company was followed by a small reform to make the business more flexible. Effective October 1, 1969, the company was structured into six Groups that operated largely autonomously and with their own areas of responsibility: the well-established Telecommunications Group (formerly Siemens & Halske) and the Power Engineering and Electrical Installations Groups (formerly Siemens-Schuckertwerke), as well as Medical Engineering (formerly Siemens-Reiniger-Werke), plus two new Groups: Components and Data Systems. Five central departments performing corporate functions – Business Administration, Finance, Personnel, Technology, and Sales and Marketing – were intended to ensure efficient coordination among all Groups and to keep business policy as consistent as possible. There were also 14 West German and 38 international offices and subsidiaries.

Siemens AG now had a unified structure and a clearer profile. Smaller, more flexible units enabled it to respond faster to changes and to adapt to the needs of an ever-broader clientele. The reform principles were laid down in writing in the Grundordnung (Basic Corporate Principles) of 1969, which would remain valid for the next 20 years. Its aim was to strengthen the workforce's identification with the corporate policy guidelines.

GROUPS

B
Components Group

Divisions
Semiconductor Devices
Passive Devices
Electron Tubes

Departments
Commercial Management

Manufacturing Plants
Berlin
Heidenheim
Munich
Regensburg
Málaga SPAIN
Porto Alegre BRAZIL
Pretoria SOUTH AFRICA
Sabugo PORTUGAL
Sulmona ITALY
Vienna AUSTRIA

D
Data Systems Group

Divisions
Data Processing
Telegraph and Data Communications
Railway Signaling Systems
Signaling Equipment

Departments
Central Laboratories
Manufacturing Engineering
Commerical Management

Manufacturing Plants
Augsburg
Berlin
Braunschweig
Munich
Evora PORTUGAL
Lanklaar BELGIUM
Melbourne AUSTRALIA
Pretoria SOUTH AFRICA

E
Power Eningeering Group

Divisions
Power Generation and Distribution
Industry
Instrumentation and Process Engineering
Transportation and Laboratory Equipment

Departments
Manufacturing Plants
Joint Technical Projects
Commercial Management

Manufacturing Plants
Amberg
Bad Neustadt on Saale
Berlin
Bremen
Cham
Karlsruhe
Munich
Nuremberg
Wesel
Würzburg

Regional Offices

Berlin
Bremen
Dortmund
Düsseldorf
Essen
Frankfurt
Hamburg
Hanover
Cologne
Mannheim
Munich
Nuremberg
Saarbrücken
Stuttgart

Organizational structure of Siemens AG, 1969

Andheri INDIA
Bogotá COLOMBIA
Buenos Aires ARGENTINA
Cavenago ITALY
Cornellá SPAIN
Eskilstuna SWEDEN
Kalwa INDIA
Karachi PAKISTAN
Melbourne AUSTRALIA
Mexico City MEXICO
Rosslyn SOUTH AFRICA
Sabugo PORTUGAL
São Paulo BRAZIL
Trondheim NORWAY
Vienna AUSTRIA

I
Electrical Installations Group

Divisions
Installation Equipment and Air-Conditioning Systems
Wiring Material and Lighting Engineering
Power Cables and Insulated Wires
Electricity Meters and Automotive Electrical Equipment

Departments
Commerical Management

Manufacturing Plants
Berlin
Coburg
Neustadt near Coburg
Regensburg
Cornellá SPAIN
Mudanya TURKEY
São Paulo BRAZIL
Trondheim NORWAY
Vienna AUSTRIA

M
Medical Engineering Group

Divisions
Radiological
Electromedical
Electro-Acoustical
Dental

Departments
Development
Manufacturing Engineering
Sales and Marketing
Commercial Management

Manufacturing Plants
Bensheim
Erlangen
Kemnath
Mumbai INDIA
Madrid SPAIN
Milan ITALY
Paris FRANCE
Stockholm SWEDEN
Vienna AUSTRIA

N
Telecommunications Group

Divisions
Telephone and Switching
Long-Range Communications
Communications Cable Engineering

Departments
Central Laboratories
Commercial Management

Manufacturing Plants
Berlin
Bocholt
Bruchsal
Gladbeck
Munich
Speyer
Buenos Aires ARGENTINA
Helsinki FINLAND
Istanbul TURKEY
Melbourne AUSTRALIA
Mudanya TURKEY
Oostkamp BELGIUM
Pretoria SOUTH AFRICA
Rosslyn SOUTH AFRICA
São Paulo BRAZIL
Salonika GREECE
Vienna AUSTRIA
Zurich SWITZERLAND

Foreign Subsidiaries

AFGHANISTAN
ALGERIA
ARGENTINA
AUSTRALIA
AUSTRIA
BELGIUM/LUXEMBOURG
BRAZIL
CANADA
CENTRAL AMERICA
COLOMBIA
DENMARK
ETHIOPIA
FINLAND
FRANCE
GREAT BRITAIN
GREECE
INDIA
INDONESIA
IRAN
IRELAND
ITALY
JAPAN
KENYA
MEXICO
MOROCCO
THE NETHERLANDS
NORWAY
PAKISTAN
PERU
PORTUGAL
SOUTH AFRICA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
URUGUAY
USA
VENEZUELA

CENTRAL DEPARTMENTS

ZB Business Administration

Departments
Planning
Accounting
Organization, Central Purchasing
Internal Auditing

ZF Finance

Departments
Financing
Financial Statements
Administration of Subsidiaries and Affiliates
Legal Matters
Tax Matters

ZP Personnel

Departments
Personnel Policy
Social Policy

ZT Technology

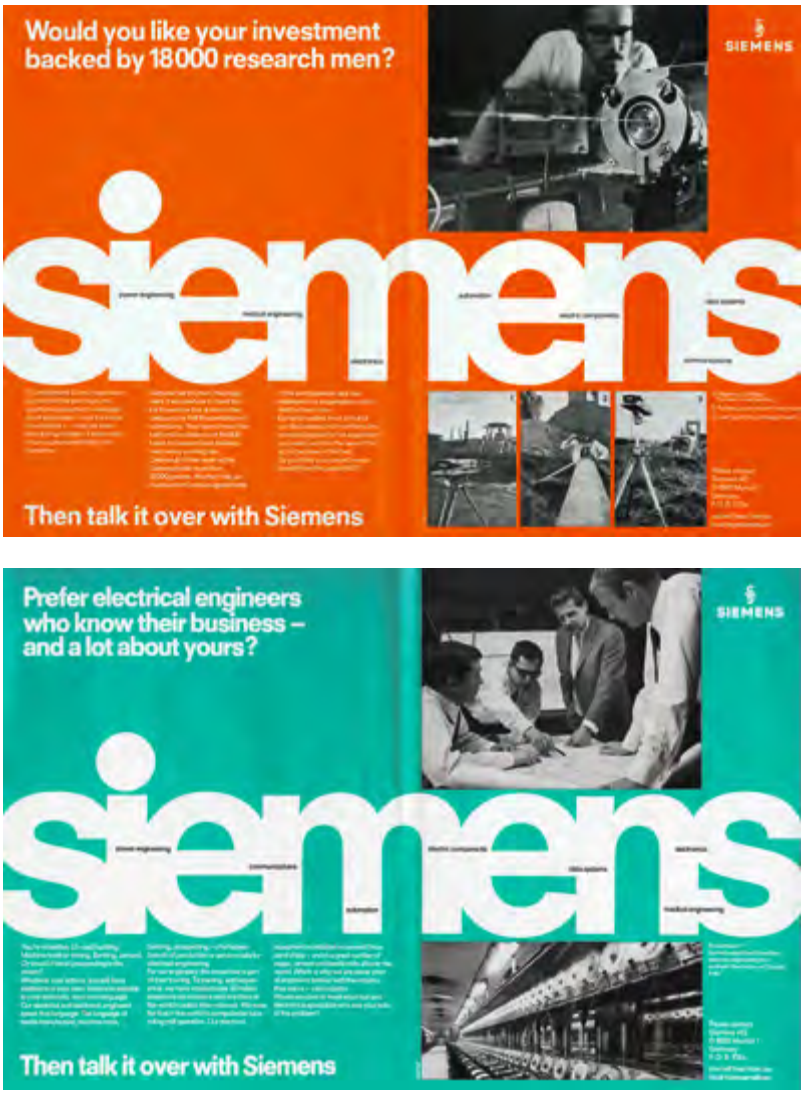
Departments
Research and Development
Manufacturing Engineering
Contracts and Patents
Construction

ZV Sales and Marketing

Departments
Marketing
Regional Offices Administration
Foreign Operations
Eastern Markets
Advertising and Design

Advertising themes for the "this is Siemens" image campaign, 1969/70

The company signaled its departure from the postwar era in its external image as well. The individual company brands were replaced by an umbrella Siemens brand and a uniformly designed corporate identity. More professional corporate communications and progressive advertising campaigns prepared by the Advertising and Design Department, formed in 1969, helped the company establish a more modern image.



Siemens advertisements for international markets, 1970

Internally, Siemens upgraded the employees' stake in the company's success. The company's employee investment and bonus system had long been a part of its employee benefits policy and corporate culture, extending all the way back to 1858. From the beginning, it has served in part to help employees build assets and to create additional performance incentives. Beyond that, Siemens has issued **employee shares** at a preferred price since 1969. In the program's first year alone, almost one-quarter of the workforce in Germany took advantage of the offer, acquiring a total of 135,725 shares[26]. As is shown by the employee investment level, which reached 70 percent for the first time in 1989, the employee share program has grown into an attractive, popular part of the company's support for building wealth. In the fall of 2021, nearly 190,000 employees held shares of Siemens and Siemens Healthineers.

Investment policy at the end of the postwar boom

As change accelerated in the electrical industry, development costs rose, and innovation cycles shrank. Siemens now reformed its previously rather cautious investment policy. Ultimately, the cost savings and synergies it was aiming for could only be achieved with more extensive acquisitions, investments, and cooperation agreements. In addition to the formation of Bosch-Siemens Hausgeräte GmbH in 1967, the establishment of two joint ventures was especially important: Kraftwerk Union AG (KWU) and Transformatoren Union AG (TU).

Cover page of a Transformatoren Union image brochure, 1969

To keep pace with the steadily rising energy demand from industry and homes, power plant capacity had to be constantly increased. But developing the necessary high-capacity power plants and large-scale turbines, generators, and transformers required massive amounts of investment. Competition from the USA and the United Kingdom was fierce. Amid this situation, the two German market leaders, Siemens and AEG, once again pooled their capacities. On April 1, 1969, they founded KWU, headquartered in Mülheim an der Ruhr, and TU, based in Stuttgart. KWU combined the two electrical equipment companies' activities in conventional and nuclear power plants, while TU handled the joint development and production of large and medium-size transformers and steam turbines, as well as their sales.

This was the start of what would be the last chapter in the nearly 100 years of shared history of Siemens and AEG. Though AEG's sales had climbed substantially at first, by the mid-1970s, the company was reeling. Unsuccessful business strategies, management errors, and deficits in administrative structures now took their toll. The nuclear power business had also proved to be a financial disaster for this historic firm. Fighting for survival, AEG sold its stakes in KWU and TU to Siemens. In 1976, Siemens had acquired AEG's interest in their joint venture OSRAM; in 1978, it acquired AEG's shares held by the US firm General Electric.[27] But none of these steps could save AEG from breakup and liquidation. Its name was deleted from the Commercial Register in 1996.

Cover page of a Kraftwerk Union image brochure, 1969

The economic picture as a whole was also looking much different. Even at the time of the Siemens restructuring, the long-lasting postwar boom was already showing signs of coming to an end. In the autumn of 1973, the dramatic increase in oil prices and the associated rising cost of the industrialized countries' most important energy source triggered economic shock waves. The situation deteriorated into a severe recession, with growing unemployment, rising inflation, collapses of production, and insolvencies. A second crisis in oil prices afflicted the economy in 1979–80.

The crisis also brought an unforeseen slowing of Siemens AG's dynamic business performance. Even though business volume continued to rise, return on sales declined. In 1980–81, earnings slumped by more than one-third from the 1977–78 level. The business path through the 1980s was full of ups and downs; now the management's agenda was dominated by consolidation efforts and steps to increase productivity.

Turning to Europe and international markets

Internationally, Siemens was still focused on reacquiring its previously confiscated companies. After more than two decades of tireless effort, the company achieved that goal in 1971. One decade later, Siemens owned 141 factory installations in 37 countries, and around one-third of its total workforce was employed abroad. More and more research and development had also been resettled directly at international sites since the 1970s. The rising level of exports was an unmistakable sign of the company's increasingly global nature: In fiscal 1974–75, for the first time, nearly half its revenue was generated outside Germany.

It was no surprise that a large share of exports, 57 percent, went to Western Europe. Back in 1892, Werner von Siemens had already had the vision of "clearing away all intra-European customs barriers [...] that restrict sales territory, make fabrication more expensive, and

Production at the Haripur telephone factory in Pakistan, 1967

Wiring of telephone systems in the Siemens Ruta 8 factory in Buenos Aires, 1966

reduce competitiveness in the world market."[28] And 75 years later, the founding of the European Economic Community made this vision a reality. It inaugurated the process of European integration, creating never-before-seen political, social, and economic leeway on the continent. In the rising common European market, cross-border traffic in merchandise, capital, and services came to be taken for granted. The disappearance of customs barriers offered companies new opportunities to expand business.

Signs of further fundamental changes were emerging for the electrical industry. After 1960, German products' share of worldwide electrical exports were heading downhill. Meanwhile, Japan's share of electrical and electronic exports had quintupled from 1958 to 1968, overtaking Germany's in 1978. The Asian Tigers – South Korea, Taiwan, Hong Kong, and Singapore – were growing into powerful competitors as well. Low wages and mass production gave them crucial cost advantages.

Coil winding in the Siemens factory Ruta 8 in Buenos Aires, 1966

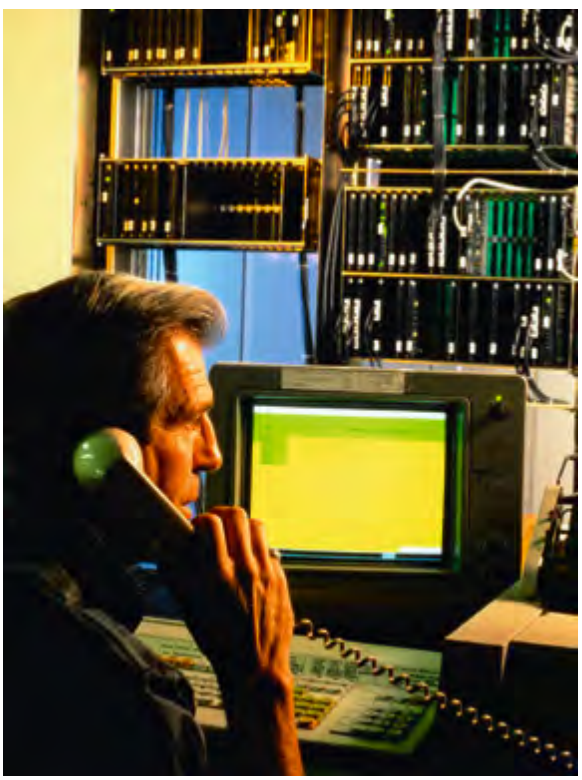
But Siemens benefited here too. It was the Asia-Pacific region itself that had evolved into the company's second-largest market abroad, exceeded only by Europe. Over the coming decades, the company would focus more and more attention on this especially promising growth region.

Unique growth potential in the electrical market and the power plant sector remained to be tapped in the People's Republic of China, the world's most populous country. China opened to the West in the 1970s, initiating economic reforms without entirely eliminating its planned-economy structures. After some initial large orders, Siemens opened an agency office in Beijing, the capital, in 1982. Three years later, the signing of a broad master agreement brought the breakthrough for a long-term collaboration with Chinese industry, and for transfers of technology and know-how. In this way, Siemens was able to gain a foothold in China.

Experts from the People's Republic of China learn about computerized control technology for power distribution switchgear, 1985

The Siemens presentation at the Electrical Engineering and Electronics exposition in Shanghai, 1978

A new era was also dawning in relations with the USA. Growing from a New York office that had opened in 1952 as a contact point for investors, Siemens had resumed its efforts in the postwar era to set up business relationships. By 1970, revenue had reached a solid 100 million DM. But despite a revived connection with Westinghouse and additional licensing and cooperation agreements, business volume lagged well behind the potential that the attractive US market had to offer. Only 1.4 percent of all US electrical imports came from Siemens, and the company generated only 0.1 percent of its consolidated revenue in the USA.



Deployment of the EWSD digital switching system at the telephone operating company Ohio Bell, 1988

Under President and Chief Executive Officer Bernhard Plettner, a shift in awareness was happening globally. First, the liberalization and deregulation of global economic and trading structures, the rise of novel options for communication and transportation, and the company's own growing financial and technology potential opened up new possibilities. Second, as trading prices drove up the price of exports, the company was compelled into a "flight forward." Siemens dared to cross the Atlantic yet again, making massive investments in production and sales operations there. That was the only way to make production processes more cost-effective and shorten delivery times significantly.

In 1970, all US activities were combined in a holding company, Siemens Corporation, in Iselin, New Jersey. The first landmark of the new business policy was the 1973 acquisition of Computest Corporation, a relatively small manufacturer of automated testing equipment. This was followed by dozens more acquisitions, company formations, and joint ventures, as

well as contracts for exchanging patents, licenses, and know-how. Allis-Chalmers Manufacturing Company in Milwaukee – the third-largest supplier in the US heavy-current segment – became the most important partner. In 1978, the two companies formed a joint subsidiary, Siemens-Allis Inc., which produced generators, transformers, motors, and switchgear. Siemens medical technology, the high-quality, long-life-cycle products of which had made it the company's highest-volume line in the US business, expanded with additional production sites. In the core electrical engineering segment of communications, the company had, by 1994, become the third-largest vendor of public telephone switching systems.

Thanks to the transformation process, by the early 1980s, Siemens was present in every major segment of the world's largest market for electrical goods. Nevertheless, differences in management methods and in employee and customer attitudes, along with country-specific differences in technical product features, impeded the transition to profitability.

Siemens communication systems for the American market, 1986

"The US is an inevitable part of our journey. Our [...] activities in the United States will [...] be a touchstone for our effectiveness and adaptability."
Paul Dax, 1974

The HVDC transmission starting point: the Songo current conversion station near the Cahora Bassa power plant, 1975

Large-scale projects were still the bread and butter of Siemens AG, especially massive power plants. The extraordinary technical challenges included the hydroelectric plant at the Cahora Bassa Dam on the lower Zambezi in northern Mozambique, commissioned in 1975. Here, a corporate consortium headed by Siemens built one of the highest-capacity power plant systems in southern Africa. It was intended to supply electricity via overhead lines, at the lowest possible cost, to the Johannesburg metropolitan region, 1,420 kilometers away in neighboring South Africa. One technical prerequisite for the project was high-voltage DC (HVDC) transmission, which Siemens had been helping to develop since the 1930s. Using modern semiconductor technology, alternating current was converted to high-voltage direct current, and back again, reducing line losses significantly and making it possible to transmit power even across national borders. Despite interruptions in

operations that sometimes lasted for years – due to war, civil war, and sabotage – the power plant remained able to do its job. It was fully modernized by Siemens in the years between 2017 and 2020. In 2006, most of the shares were transferred to Mozambique, and since then the country has been using the energy itself for industrialization and to supply power to rural areas.

In South America, Siemens joined a power plant project of superlatives in 1978. At Itaipú on the Paraná River, on the border between Brazil and Paraguay, the world's largest hydroelectric plant up to that time was under construction as a joint project between the two countries. It was not completed until 1991. The components supplied by Siemens included five enormous generators built at its own plant in São Paulo and transformers that weighed tons. Most of the electricity generated since then has gone to Brazil, but the plant also covers three-quarters of Paraguay's electricity needs.

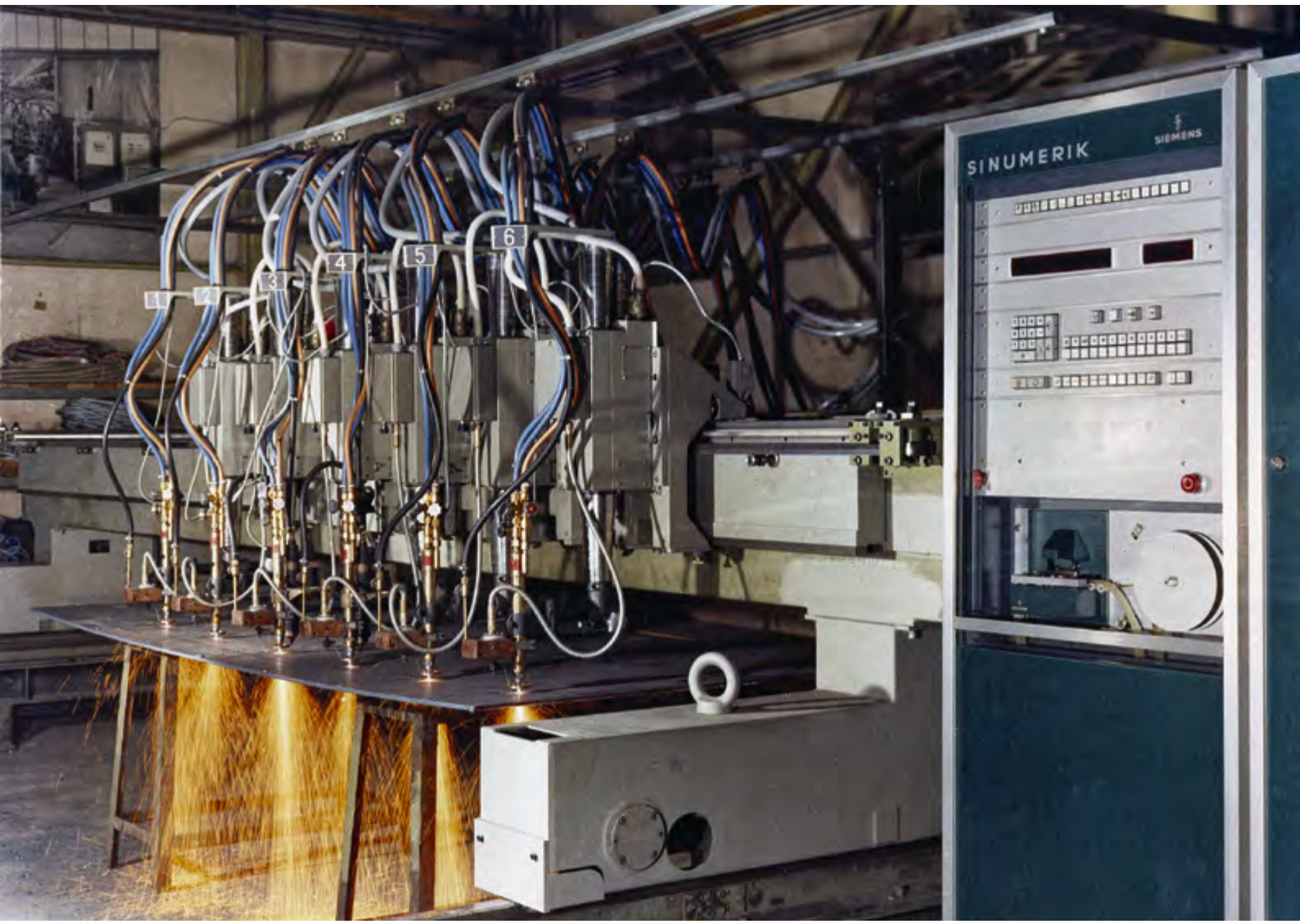
These two power plants, the origins of which date from the 1970s, also came in for their share of criticism. Hydroelectric power, though relatively clean, could not be generated without considerable interference with the natural environment, and in the case of the Itaipú plant, it also meant resettling indigenous populations.

Assembling a generator in the machine building at Itaipú, the world's largest hydroelectric plant, 1983

Electronic and digital innovations

In general, power plant technology and electric power grids remained the chief emphasis in the Siemens portfolio – utilizing hydroelectric power by way of pumped storage plants, as well as generating power in thermal power plants and combined-cycle plants. On top of that, from 1958 onward, all nuclear power plants in West Germany were built by Siemens and AEG, and later KWU. Modern switchgear and transmission systems ensured increasingly safe, low-loss power distribution. Yet despite all the continuity, Siemens was turning away to some degree from the corporate guidelines to which it had held fast for decades and which were laid down explicitly in the revised Basic Corporate Principles of 1971. The traditional restriction to electrical engineering remained the company's guiding star. But the chance of serving every field of electrical engineering had permanently receded beyond reach. Realistically, what the company needed to do now was to concentrate on profitable electrical and electrical-equipment lines of business, most importantly those with a promising future, together with a corresponding severe pruning of the business portfolio.

The earth station at Raisting in Upper Bavaria, 1964



SINUMERIK 580 CNC track control on a flame-cutting machine, 1973

This changed nothing about Siemens' omnipresence in energy supply, communications, mobility, medical technology, and a great many other fields. The catalog still covered tens of thousands of products, including various switching components and techniques for automating production processes, electromechanical products, and safety equipment for shipping and aviation.

Developments everywhere were replacing conventional technology with electronic and ultimately digital alternatives. In the communications sector, Siemens was even a pioneer in satellite-supported data transmission as early as 1963, when it took part in building the Raisting earth station – Germany's first satellite station – under a contract from the federal Postal Service. In 1974, computer-controlled

switching technology achieved a breakthrough in the form of the Electronic Digital Switching System. Siemens first applied this innovation at a testing facility in Munich. It was also able for the first time to combine communications and data technology for a broader user base, with the Electronic Worldwide Switch Digital (EWSD) digital switching system, launched in 1980 and sold worldwide. The company carried this digital quantum leap toward digital communications even further in 1984, with the Hicom system, adaptable to varying customer needs. ISDN connections now enabled subscribers, with no additional switching steps, to use the telephone not only for voice communications, but also to transmit texts, graphics, and other data.

Hicom system, 1984

In transportation, the development of the Indusi train safety system had come to be used in 8,000 traction vehicles by 1973. This control system for liner trains, operated from stations and control rooms of Deutsche Bundesbahn, offered new ways of making trains safer even as speeds increased. Siemens technology also sped up procedures in rail switchyards and signal towers by switching to automated and computer-controlled systems.

A new era in long-distance rail travel began in 1991 with the newly conceived high-speed **Inter-City Express (ICE)**. This new train helped the Deutsche Bundesbahn achieve undreamed-of appeal, with significantly shorter travel times, greater passenger capacity, and comfort features. Siemens had already played a leading role in outfitting the power car of the ICE's predecessor, the InterCityExperimental, with electrical and electronic equipment. It had also helped develop and produce the successor models, with their optimized operating and safety equipment, greater flexibility, and lower power consumption.

Four generations of the ICE (l. to r.): ICE 1 to ICE 4, 2016

One particularly technically ambitious project in the early 1970s was the Transrapid magnetic levitation (maglev) train. During a first test stage, Siemens conducted endurance runs of the Magnetic Cushion Express on a round track in Erlangen. But this system never came into regular use in Germany. In China, on the other hand, the Transrapid today connects Shanghai with Pudong Airport, 30 kilometers away.

Siemens' first magnetic resonance system, the MAGNETOM, 1983

In medicine, computed tomography (CT) began opening up pioneering opportunities in the mid-1970s. Even at this early date, CT was significantly faster, less stressful, and more precise than any other procedure for examining the brain. The technique's free of superimposition slice images displayed the interior of the body layer by layer, for instance enabling the physician to precisely locate tumors or internal injuries.

Siemens' first CT head scanner, known as the Siretom, went on the market in 1975. After three years of development, in September 1977 Siemens released its first full-body CT unit, the SOMATOM. This leap from head CT to a full-body scanner was the first in a long succession of technical milestones. Computed tomography continued to advance with revolutionary inventions that significantly expanded its potential applications.

A new level in soft-tissue diagnostics came with nuclear spin tomography. Known today as magnetic resonance tomography (MRT), this technique works with strong magnetic fields. Siemens introduced its first MRT system, the MAGNETOM, into clinical practice in 1983. MRT systems can generate three-dimensional slice images of tissues and organs that offer higher contrast than with other imaging techniques, without any radiation exposure at all.

A Siretom CT head scanner, 1975

The decision to pursue microelectronics

Possibly the most influential factor for Siemens' future during this period was the decision to invest massively in catching up with the world's leaders in microelectronics. The company's activities in this segment traced their origins to developments in semiconductor technology that Siemens had concentrated at the Wernerwerk for Components in Munich back in 1954. In 1959, the Regensburg site began additional work on making passive components such as capacitors and resistors, and later, semiconductor components such as diodes and transistors.

But Siemens remained wary of an involvement in the no-holds-barred global competition to develop memory chips. Early in 1983, those in charge decided to get out of this finance-heavy, risky business – and shifted strategy again before the year was out.

Under President and CEO Karlheinz Kaske, who had been in office since 1981, Siemens kicked off in February 1984 what was known

as the **MEGA Project** – getting into chip production, whose scope outshone many past projects. With extremely ambitious technical goals and timetables in mind, the company set promptly to work on its plans, with unparalleled financial investments totaling 2.7 billion DM. Within two years, it had hired some 600 engineers – around one-quarter of all the electrical engineering graduates in Germany. Both development and production were organized in parallel and interlinked in innovative ways to boost and accelerate working processes. Even as work began on developing a 1-megabit chip at the Munich-Perlach Research Center, by October 1984 the cornerstone was already being laid for a new semiconductor plant in Regensburg. A way around foreseeable delays was found in 1985 with a license agreement with Japan's Toshiba Corporation. Because of both the financial expense and the development work involved, in subsequent years as well, the project could

Chip production at Siemens, ca. 1980

The Munich-Perlach site, 1987

be conducted only through intercompany cooperation.

Even an espionage attack by the East German State Security Service did not impede Siemens. In December 1987, series production began in Regensburg on the 1-megabit chip. By the time production was halted in 1996, the plant had put out 278 million chips. Meanwhile, Siemens had set its sights on the next level: At the end of 1989, the 4-megabit chip reached maturity for production. In 1993, the company shipped the 16-megabit chip, developed jointly with US competitor IBM, and the 64-megabit chip followed the next year. In 1995, partners Siemens, IBM, and Toshiba presented a 256-megabit chip that was far superior to competing products in both size and speed.

Semiconductor technology, in particular, demonstrated how thoroughly research and development had established itself as a key component of Siemens AG. Between 1968 and 1996 alone, total research expenditures rose from around 600 million DM to more than 7.3 billion DM. By fiscal year 2021, the figure was 4.9 billion euros. In connection with the MEGA project, expenditures soared to more than 11 percent of Siemens' total revenue. The number of employees in R&D rose by more than a third between 2010 and 2021, from more than 30,000 to about 42,500.

As the 1980s drew to a close, Siemens had unmistakably entered into a new phase of its history, against the backdrop of a global change in economic structures. In 1991, the workforce would reach a new record level, with more than 413,000 employees. Nevertheless, the company could not rest on its laurels as an international technological pacesetter. Siemens had to compete in an increasingly deregulated world market, while electrical engineering was under constant pressure to prove its ability to innovate.

Karl Heinz Beckurts was a pioneer in digitalization at Siemens, and was among the earliest managers to recognize the significance of information technology and microelectronics for the company's business. As head of the corporate research and development unit, he initiated Siemens' successful catch-up effort in microelectronics with the MEGA Project. Beckurts and his driver Eckhard Groppler were killed in a bombing by the Red Army Faction in Munich on July 9, 1986.

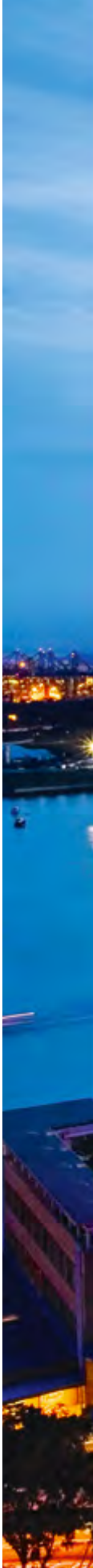
Experimenting with simulation software at Siemens for controlling a robot arm, 1987

"Microelectronics and software technologies will remain the driving forces for innovation in the 1990s. The scope and speed of technological change will result in a surge in upfront investments for capital expenditures and for research and development."
Karlheinz Kaske, 1989

1989–2022

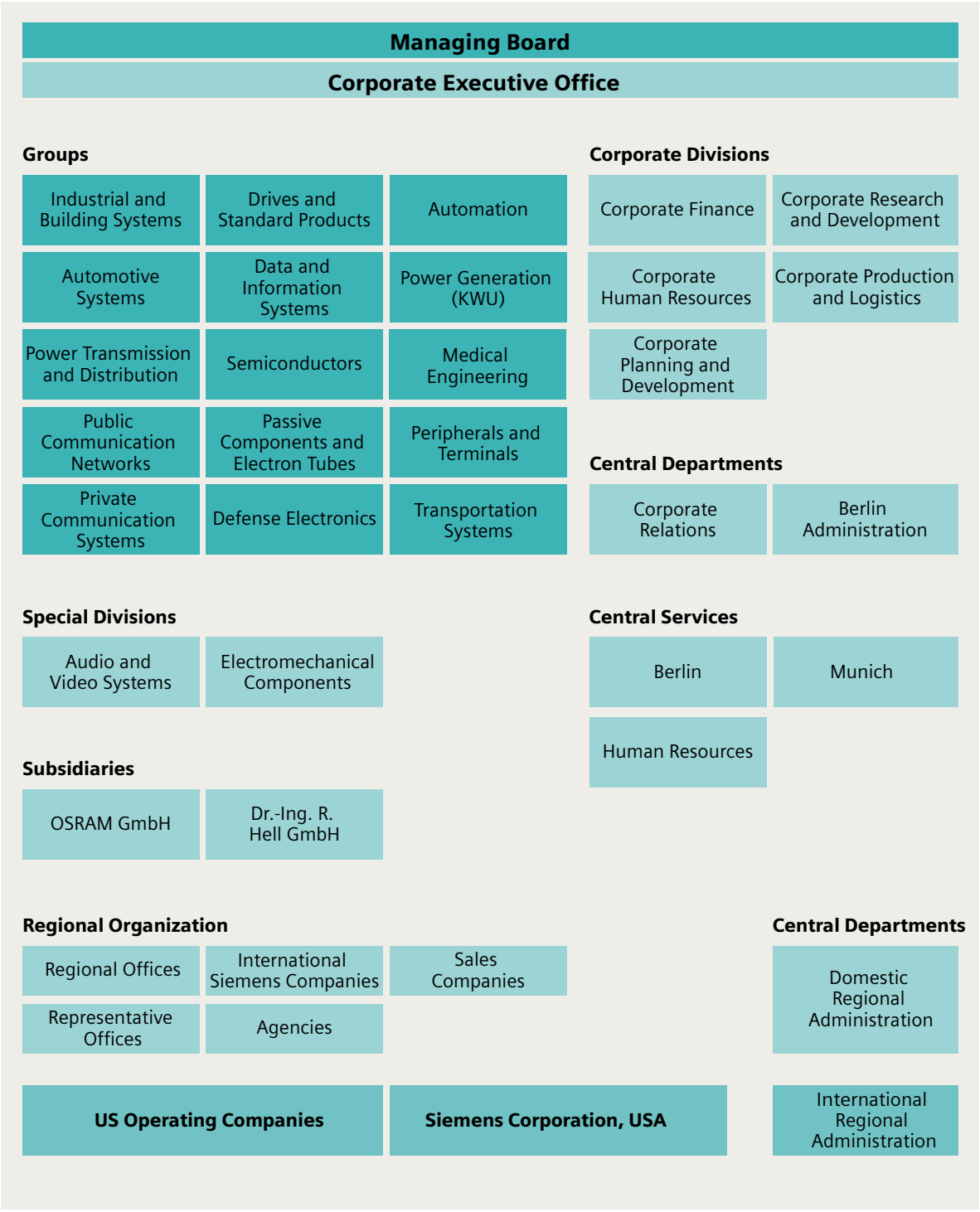
Digitalization and globalization

Dynamically advancing globalization and the digitalization of all aspects of life after 1989 transformed Siemens from an international electrical engineering company into a focused technology company. Developments during these years brought a close succession of structural reforms and strategic realignment.



1989–90 – A new organization and German reunification

Twenty years after its founding and reorganization, Siemens AG reformed its organization once again at the end of the 1980s. Market liberalization had fundamentally altered the basic conditions. Instead of long-term business relationships with mostly state-owned companies, there were connections with new customers with different needs. Products had to be put on the market faster and more economically than ever before. The company lacked the flexibility and efficiency it needed for the purpose. Despite the reorganization and the combination of multiple companies under Siemens AG back in 1966–69, the structure was still shaped by the former core companies Siemens & Halske, Siemens-Schuckertwerke and Siemens-Reiniger-Werke. To make Siemens both less bureaucratic and more transparent, as of October 1, 1989, a new structure went into effect, along the lines of a US corporation. The eight large Groups were reorganized into 15 smaller units; several central departments, central offices, and Corporate Services took over cross-unit tasks and services for the entire company. Regionally, the branches in Germany and the legally autonomous companies elsewhere were assigned greater entrepreneurial responsibility. A smaller corporate executive committee replaced the former corporate board as the company's top managing body. Flatter hierarchies shortened decision-making channels. From now on, Siemens would be able to operate in closer contact with its markets, and focus its corporate policies more directly on what its customers wanted.



Siemens organization chart, 1989

Soon after this reorganization, the peaceful revolution in the German Democratic Republic – "East Germany" – led to the Berlin Wall being torn down on November 9, 1989, and on October 3, 1990, German reunification ended decades of political partition of the country into two different states. This historic moment unexpectedly opened up new investment opportunities for many West German companies, including Siemens AG. Siemens returned to many locations where, until the 1940s, it had traditionally maintained business offices and production sites with tens of thousands of employees. Many of these sites had been expropriated after the founding of the German Democratic Republic in 1949, and the Siemens plants had been converted to state-owned enterprises known as **"Volkseigene Betriebe" (VEBs)**. Now Siemens acquired 15 former VEBs from the trust agency in charge of privatization – including in Rostock, Leipzig, Chemnitz, Görlitz, and Dresden – and in October 1992 it integrated them as parts of the full corporation. With billions in investments as well as schooling programs and multiple levels of vocational training, from 1990 onward Siemens was one of the largest industrial investors in East Germany. The business potential was massive. The region had a great need to catch up in power supply systems, transportation and communications infrastructures, and industry.

Trainees at the Rostock training center, 1992

Siemens turbine factory in Görlitz, 2004

Under the banner of a globalized economy

As the Cold War ended and the countries of the former Eastern Bloc opened their economies, additional prospects opened up for Siemens as well. Although the "Eastern Treaties" with the German Democratic Republic, the Soviet Union, Poland, and socialist Czechoslovakia during the first half of the 1970s had made technical and economic exchanges easier, orders from the Eastern European countries and their planned economies had remained at relatively low levels for decades. Now a new era dawned for expansion into these markets for electrical equipment. Siemens focused particularly on joint ventures in the Soviet Union and its successor states, where Siemens & Halske had first gained a business foothold more than 140 years earlier. For the biggest order in 2011 Siemens and the Russian Sinara Group took on responsibility for building 1,200 regional multi-unit trains for about 2 billion euros, the biggest order in the region to date. These trains remained in use all over the geographically largest country in the world. This changed in 2022 when the company decided to withdraw from Russia, following its attack on Ukraine in February 2022.

After 1989, globalization enveloped the entire world, with a major impact on both the electrical industry and Siemens itself. The economic hallmarks of globalization were a rise in global exports and especially the rapid growth in companies' direct investments in foreign markets. Even for a global player like Siemens, with its long history of multinational orientation, this development proceeded at a breathtaking pace. Where the corporation was still generating 46 percent of its revenue in Germany in 1990–91, ten years later the figure was only 22 percent; in 2021 it was 18 percent. Indeed, in 2021, of the total of 303,000 employees, 217,000 – almost 72 percent – were working outside Germany.

The European market maintained its major significance for Siemens. The founding of the European Union in 1992, and the gradual implementation of economic and currency unification with the establishment of a common internal market and the introduction of the euro as a community currency, created a new level of economic freedom of movement from 1999 onward. Siemens generated around

A successful knowledge transfer in a globalizing world: Beginning in 1990, Siemens Matsushita Components started producing tantalum chip capacitors in Heidenheim for the European market

30 percent of its revenue in Europe – at the beginning of the 1990s, 2000s, and today. But especially in Europe's leading industrialized nations, France and the United Kingdom, deeply ingrained market regulations initially hampered expansion on any larger scale. One of Siemens' most significant acquisitions here, at the end of 1989, was the acquisition of the diversified electronics maker Plessey Company, a process that dragged on for a total of 12 months altogether. The company was acquired jointly with General Electric for a purchase price of about 2 billion pounds sterling.

Mobile phones made in Shanghai and making computed tomography units, 1993/94

The most dynamic business proved to be in China. Within a few decades the country had risen to become an economic heavyweight. By 2020 it was already delivering almost 29 percent of all of Europe's electrical imports. The number of joint ventures that Siemens founded in China, in communications, energy, and automation, and in drive, switching, and installation equipment, had climbed to more than 50 by 2001 alone. In Shanghai, Siemens developed a strong presence in the Chinese market by cooperating for two decades in one of the megacity's most important infrastructure projects – the construction of a new subway system. The company was a partner in every aspect of the project, from the start of construction on the first metro line in 1989 to the Pearl Line in 2002. In 2021, the company's involvement in the People's Republic added up to 51 subsidiaries and 10 associates and joint ventures. That same year, Siemens generated about 8.2 billion euros in China – 13 percent of its global revenue.

In the USA, the most important single regional market, Siemens was finally able to gain a foothold following the turn of the millennium. In 2001, business volume at Siemens Corporation and its subsidiaries exceeded revenue from Germany for the first time. Twenty years later almost 22 percent of Siemens' global revenue came from the USA. A number of major initiatives, strategic cooperation agreements, and joint ventures, as well as extensive acquisitions of specialty

companies, made Siemens the country's largest foreign investor at times. In 2015, Texas-based Dresser-Rand, one of the world's leading suppliers of equipment for the oil and gas industry, was taken over for a purchase price of 7.8 billion dollars – one of the largest acquisitions in Siemens history. Siemens became the market leader in the mobility sector with urban train and streetcar projects for a number of American cities. The most significant order was for 175 lightweight, low-power-consumption urban rail cars to be used in San Francisco. A new listing on the New York Stock Exchange as of March 12, 2001, failed to bring the expected further surge in US business, and the stock was delisted in 2014 – a choice in which Siemens was following the example of other companies, since most of its stock was traded in Germany and via over-the-counter electronic platforms. A further advantage of the withdrawal was that the company's financial reporting could return to simpler, more efficient forms.

Siemens stock is launched on the New York Stock Exchange, 2001

A short time later, between 2015 and 2018, Siemens carried out a project on a historic scale in Egypt that would modernize the energy landscape of the country. As part of one of the biggest single orders in its 168-year history up to that point, the company built three gas-fueled power plants and twelve wind farms, with a contract value of around 8 billion euros. Now that the last phase of construction has been completed, the facility is able to supply power to as many as 40 million people.

In 2021, an even bigger contract was awarded in Egypt. This project is to provide a **modern transportation system** and create up to 40,000 local jobs. The project: "Suez Canal on rails," with ultramodern high-speed trains covering approximately 2,000 kilometers, connecting Egypt's population centers of Alexandria on the Mediterranean and the Red Sea with each other and with the future capital that has been under construction east of Cairo since 2015.

A combined-cycle power plant in Egypt, 2017

The reorganization of Siemens AG from the 1990s on

In October 1992, Heinrich von Pierer took office as President and CEO. His tenure marked the start of a number of internal corporate programs at Siemens aimed at reducing complexity.

The first milestone was the 1993 implementation of the "time optimized processes" ("top") program, based on three pillars: productivity, innovation, and growth. This was intended to encourage the organizational interlinking of the corporation's various units, and to flatten hierarchies. To make the company more flexible and customer-oriented, more responsibility was assigned to smaller teams and individual employees. Productivity measures were aimed at being faster, better and cheaper on the market. Both the increase in the annual numbers of reports of inventions and patents, and the growth of the targeted Asia-Pacific and North American regions were viewed internally as successes of the "top" program.

But 1997, the "annus horribilis," made it painfully clear to Siemens that further steps would be needed to cut costs and ensure competitiveness. While Southeast Asia suffered a severe economic crisis, the company was burdened with problems and sales shrinkage in railway and power plant technology and in the mobile telephone and semiconductor businesses. In quick response, in July 1998 Siemens introduced the "10-Point Program." It pursued a systematic focus on the core business and associated acquisitions. At the

CFO Joachim Neubürger and President and CEO Heinrich von Pierer announcing the 10-Point Program, 1998

An ad motif for the "Siemens answers" campaign that began in October 2007

same time, the company exited from the semiconductor business. Internal reporting and controlling processes were upgraded; accounting was revised and made more transparent in preparation for being listed on the exchange in the USA in 2001. Ultimately, Siemens was able to increase revenue and earnings significantly.

Siemens AG continued to be reconfigured under Klaus Kleinfeld, who succeeded von Pierer as President and CEO in January 2005. In his very first year in office, he introduced the "Fit4More" working program, which entailed extensive shifts in the portfolio. Kleinfeld's strategy focused on two global megatrends: demographic change and urbanization. From these, Siemens determined that energy, infrastructure, and healthcare would be the key fields of application for the future. The company intensified its involvement in industrial automation, energy technology, and medical technology, sold its loss-making mobile telephone division, and spun off the business with communications networks. This was necessary because, for several years, Siemens misread technological developments in telecommunications, such as the trend toward transmitting voice over the internet (VoIP). In 2007, Siemens also divested its successful Siemens VDO Automotive parts unit to Continental AG.

The Compliance Affair, 2006 to 2008

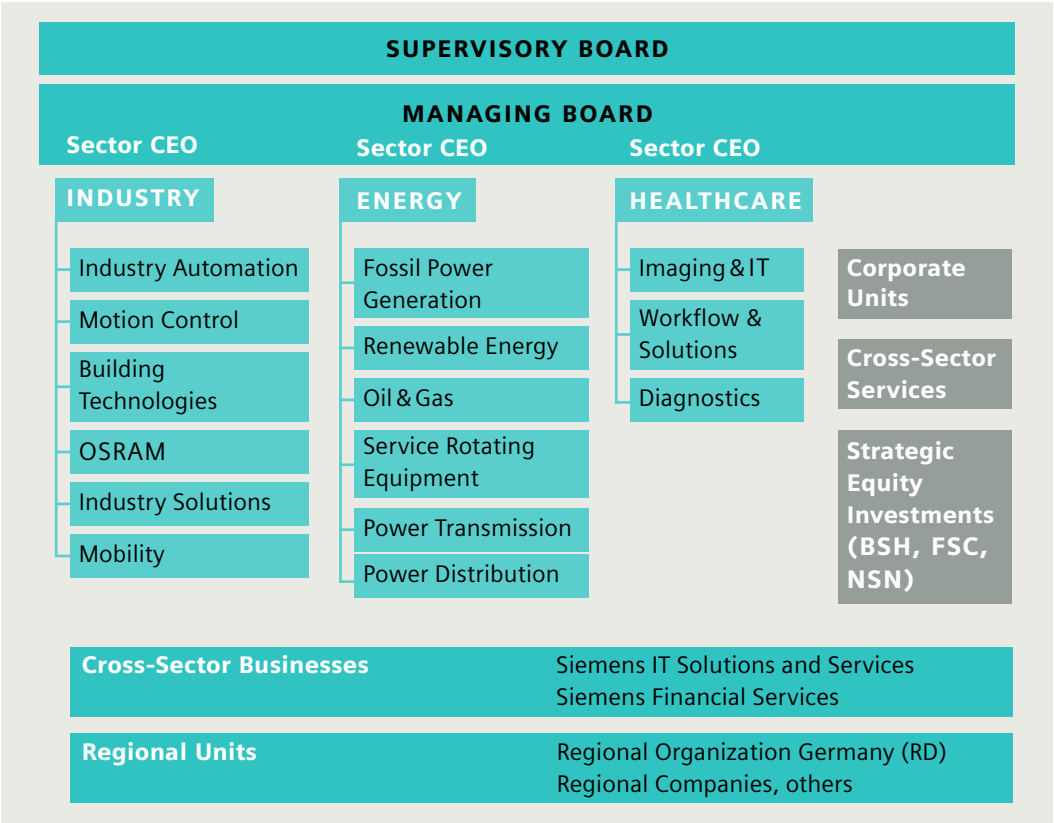
At the end of 2006, a corruption affair plunged Siemens into its most harrowing crisis since 1945. Searches by the Munich Public Prosecutor's Office at numerous company sites on November 15 that year were the starting point for investigations that shook the company to its foundations. Siemens attracted scrutiny from the authorities in the USA as well, and in view of the rigid regulations in force there, the company's survival was at risk. The charges ranged from slush funds, embezzlement, and kickbacks to tax evasion, bribery, and corruption. Broad parts of the company were involved – even though an in-house compliance system had been introduced in the early 1990s. Ultimately, the sum revealed in the investigations came to some 1.3 billion euros.

When legal proceedings in Munich and Washington concluded in December 2008, Siemens had been able to avert scenarios that would have meant its collapse. Nevertheless, the total for fines, back taxes, and outside attorneys' fees came to 2.5 billion euros.

The Siemens Supervisory Board appoints Peter Löscher as new CEO. L. to r.:
Heinrich Hiesinger, Ralf Heckmann, Gerhard Cromme, Berthold Huber, Peter Löscher, 2007

One hundred and thirty employees had to leave their positions, and the consequences even extended to top management: In April 2007, Supervisory Board Chairman Heinrich von Pierer resigned; he was followed by President and CEO Klaus Kleinfeld at the end of July. The new Head of the Supervisory Board was Gerhard Cromme, an old hand at compliance who had led the project to draft the rules of good corporate governance for German industry.

The Compliance Affair had damaged Siemens AG's reputation and spread grave uncertainty among the team. To restore respect and trust, Siemens installed an up-to-date, all-inclusive compliance system that also became a benchmark for other companies. A key component of its internal controlling structures was the "Compliance Help Desk," set up in the summer of 2007. This provided orientation for employees and disseminated information about conduct in compliance with the law and regulations. Effective October 1, 2007, a separate position for Law and Compliance was also established on the Managing Board.



Siemens corporate structure, 2008

Reform measures from 2007 onward

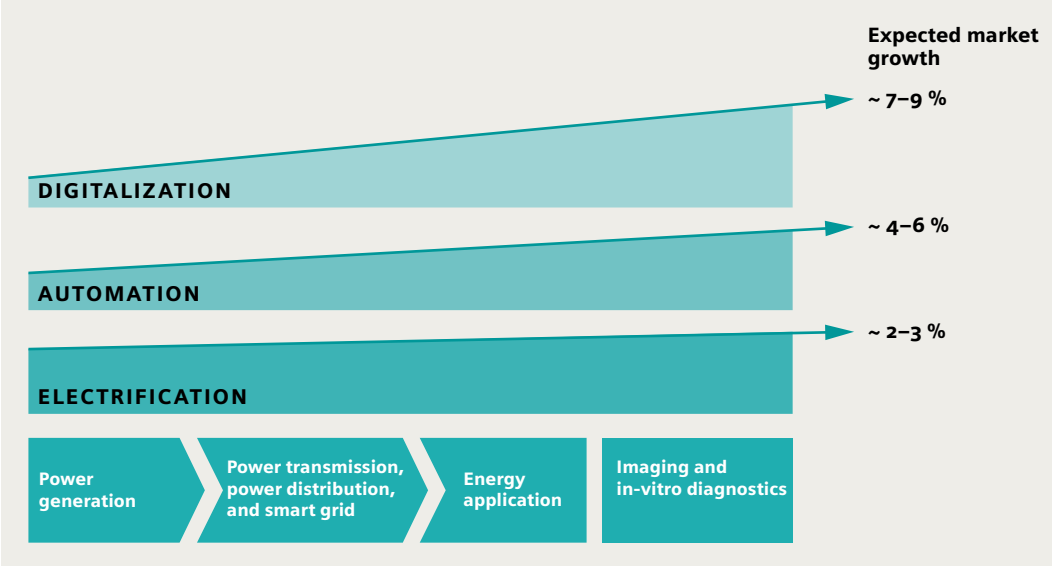
On July 1, 2007, Austrian-born Peter Löscher took over as the Head of Siemens AG – the first top executive to be recruited from outside the company. This surprising personnel decision followed a comprehensive shake-up in the managing board and the supervisory board, intended to emphasize the company's deep commitment to a lasting culture of regulatory compliance. For the first time, two women – Barbara Kux (2008) and Brigitte Ederer (2010) – were appointed to the company's top management. The introduction of the CEO principle under Löscher centralized the company into three sectors: Industry, Energy, and Healthcare. In 2011, the company created an additional sector: Infrastructure & Cities. Löscher too focused on megatrends: demographic change, urbanization, climate change, and globalization. In light of the nuclear disaster in Fukushima, Japan, in 2011, corporate management also decided to exit entirely from the nuclear power business. But profits lagged behind expectations for several quarters, sparking a rise in criticism in the company's performance.

In mid-2013, Löscher decided to leave Siemens.

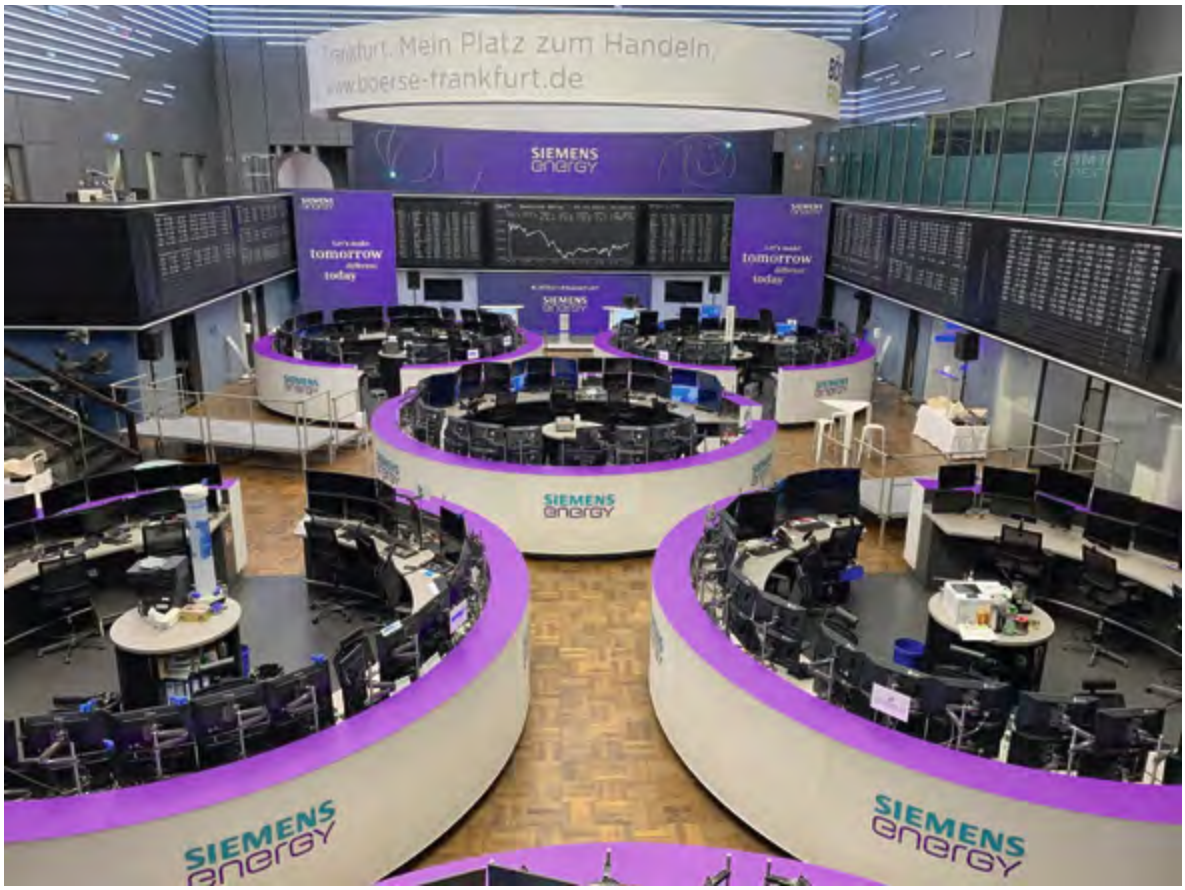
The new CEO of Siemens, Joe Kaeser, defined his own strategic course as of August 2013. Ralf Thomas played a key role as CFO alongside Kaeser and remains in this role today. The Vision 2020 strategy, presented in 2014, focused the company's business activities in the areas of electrification, automation, and digitalization, reorganizing the sectors into

smaller units called divisions. A couple of years later, Kaeser reorganized again creating operating companies in preparation for Siemens to be split into three independent corporations.

The company merged its wind power business in 2017 into the stock-listed Spanish wind turbine maker Gamesa Corporación Tecnológica, which now bears the name Siemens Gamesa Renewable Energy (SGRE), still listed on the Spanish stock exchange. In 2018, the wholly owned subsidiary Siemens Mobility GmbH was formed, with an eye to a merger with France's Alstom Group. But the merger was blocked by the European Commission in 2019. Last but not least, an extraordinary shareholders' meeting of Siemens AG on July 9, 2020, decided on a historic break: After transferring the shares of SGRE to the energy business, Siemens Energy AG was listed on the Frankfurt Stock Exchange in September 2020; Siemens AG holds a 35 percent interest.



Growth fields in the "Vision 2020" strategic program, 2014



Siemens Healthineers AG (2018) and Siemens Energy AG (2020) go public

Since the 1970s, another of the company's core concerns has been **sustainability and conservation of resources**. In 1970, Ernst von Siemens himself explicitly expressed his satisfaction that "the general public has become so much more aware of the need to protect our environment."[29] From 1990 onward, the "Business Conduct Guidelines" committed the company to "protect our environment and conserve natural resources" in production processes and products.[30] In 2008, the company presented its environmental portfolio – products and solutions that would enable customers to save significant amounts of greenhouse gases. In 2015, Siemens announced its goal of becoming climate neutral by 2030, and by 2020 it had already cut its CO2 emissions by 50 percent – a reduction of 1.2 million metric tons.

Today, a focus on ecological, sustainable criteria is part of the company's Corporate Social Responsibility. In 2000, Siemens AG published its first "Corporate Citizenship Report," documenting how it meets its social responsibilities. In June 2021, to reflect higher ambitions for environmental, societal, and governance (ESG), the company presented its **DEGREE** framework. This comprehensive sustainability approach – looking at ESG from every angle – rests on six pillars: decarbonization, conduct guided by ethical standards, responsible business practices, efficient use of resources, equal treatment and respect, ensuring employability through continuous skills development.

Cover page of a Siemens publication on environmental protection, 1971

Business strategy, development and production in an age of digitalization

In addition to globalization, digitalization became a major driving force for Siemens. The radical change spread not just to automation solutions and power generation and transmission, but also to medical and transportation technology. The era of the internet was a major disruption for business generally, but particularly for the communications segment. Content and data of all sorts could be transmitted worldwide in a flash; multimedia applications opened up almost infinite possibilities.

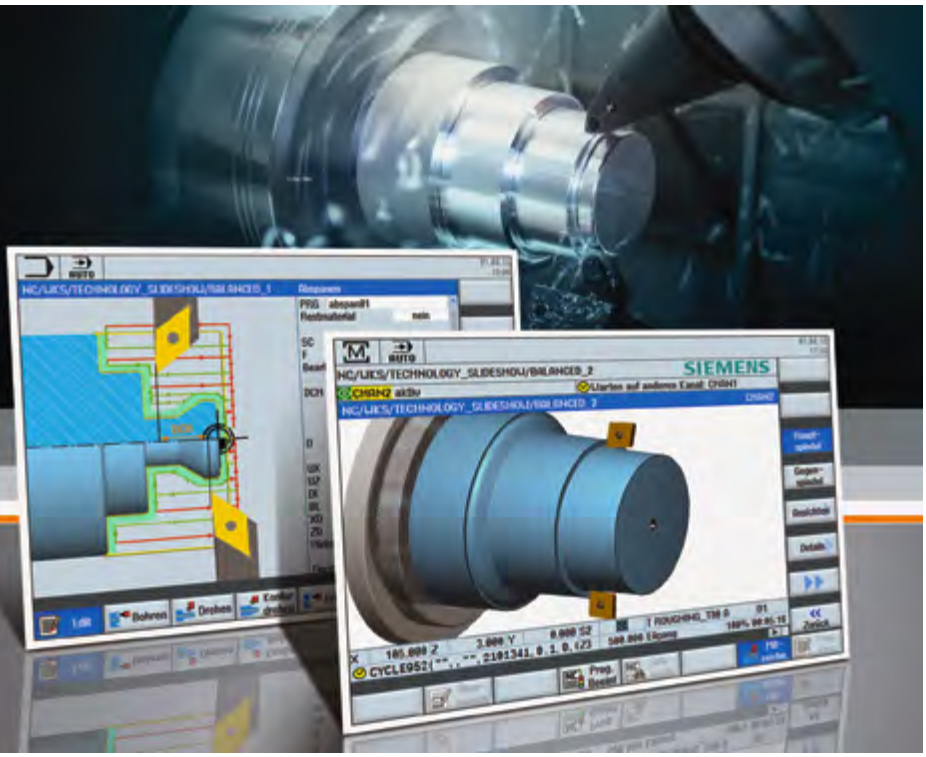
Amid this environment, not every segment of the company could count on having a future. In the fiercely competitive field of data-processing and information technology, Siemens AG took the initiative with its largest acquisitions since the end of World War II. In October 1990, it acquired a majority of the struggling Paderborn company Nixdorf Computer AG, and merged its operations into Siemens Nixdorf Informationssysteme AG (SNI), Europe's largest information technology company. But the decision was ill-fated, because technical

Siemens Nixdorf Informationssysteme AG headquarters in Munich, 1990

Computer production for Siemens Nixdorf at the Augsburg Elektronikwerk, 1992

and organizational problems piled up. On top of that, the two different corporate cultures proved hard to harmonize. Following a rehabilitation and reorganization project, SNI was broken up and integrated in 1998 into Siemens AG. Since 2009, computer technology has no longer been a part of the company.

A rollercoaster ride was also happening in semiconductor technology. Unforeseeable cyclical shifts and fluctuating business conditions left little room for longer-term planning. Chip production called for high levels of investment. Bottom line, this added up to a loss-making business, and Siemens made the decision to spin off the semiconductor business as of April 1, 1999, as Infineon Technologies AG, headquartered in Munich, with 25,000 employees. The following year, with much fanfare, Infineon saw the largest initial public offering of any German technology firm to date, before the end of the "dot-com boom" led to massive sales slumps in the semiconductor industry, accompanied by a drastic plunge in microchip prices. Step by step, Siemens AG separated from Infineon, and sold its last shares in the company in 2006.



Digital twins combine the real and virtual worlds in industry, 2020

Having recognized the opportunity to become a driving force in digitalization, in 2008, Siemens began making selective acquisitions to build up a digital portfolio of software and services. By 2022, it has invested 13.6 billion euros in companies such as UGS, Mentor Graphics, LMS, and Mendix. These acquisitions laid the foundation for the creation of the leading industrial software business of today.

With its Digital Factories business, Siemens was the first company to place its hopes in the systematic **digitalization of industry**. A breakthrough moment in our history was to understand the opportunity to make industry substantially more efficient by combining the real and digital worlds. Siemens became the frontrunner in Industry 4.0, as it emerged. Digital twins make it possible to simulate processes in the virtual world before development, production, and operation go into action in the real world. This technique enables the creation of anything from individual products to entire systems, at lower cost and in significantly shorter times. Digital Industries is now a driving force for digital transformation in the discrete and process industries as an innovation leader in industrial automation and digitalization.

Today's **Smart Infrastructure** business grew out of the Building Technologies and Energy Management divisions – low- and medium-voltage businesses. Both of these units focused on integrating technologies for metropolitan regions and their infrastructures. In 2012, Siemens opened The Crystal in London, the world's first center for sustainable urban development – and the building itself was a showcase for energy efficiency. The effort to improve sustainability, together with rising

digitalization in planning for construction and power grids, revealed new opportunities relating to energy consumption and the energy supply. Siemens solutions in smart buildings and smart grids, setting up and connecting smart, digitally networked buildings and power grids, opened up new dimensions in designing the city of tomorrow. In 2013, for instance, work began on studying the complex interconnections of energy distribution in an urban environment at the **Aspern Smart City** research project near Vienna. This new urban district is expected to be home to 25,000 people in the years to come. Some of the solutions being developed here include how to intelligently manage electric vehicles' energy demand on the power grid. This project was a taste of what was to come with the creation of a new sustainable community for **Expo 2020 in Dubai**.

In recent years, this business provided technologies to help accelerate the energy transition, for example by providing grid software to manage increasingly distributed energy resources. In 2022, Siemens welcomed a leader in cloud-based asset management software with the acquisition of Brightly. A perfect complement to Siemens' digital offerings for buildings.

The Expo fairgrounds in Dubai, 2020

The Sustainability Pavilion at the Dubai Expo (right)

The sign of Expo 2020 at the entrance of the site in Dubai (bottom)


EXPO
2020

Digital commuter train Hamburg, 2021

When it comes to the Mobility business, with transportation technology, Siemens has focused on platform concepts, which make new trains significantly easier to develop and deliver. One example is the Vectron multisystem locomotive launched in 2010, that could reach speeds of up to 200 kilometers an hour. It is one of the most successful locomotives, to date, more than 1,400 have been sold to 62 customers. This vehicle can be adapted flexibly to operators' needs, and is usable in different countries' rail systems. The Velaro, a further development of the InterCity Express (ICE) that could be configured specifically for each country, came into international use in 2002. Its successor, the Velaro Novo announced in 2018 and expected to be in service in 2023, will enable comfortable train travel that also consumes up to 30 percent less energy, thanks to its lightweight construction and improved aerodynamics. For local public transport, Siemens has developed highly automated, driverless streetcars, subways and commuter trains. Here the Métro in Lille, France, and the one at Roissy-Charles de Gaulle Airport in Paris, together with the driverless subway system in Nuremberg, offer successful examples.

Siemens has focused on digital technologies in mobility as well. In 2013, Siemens acquired Invensys Rail expanding its footprint in rail automation. In 2020, with ÖBB-Infrastructure AG Siemens introduced the first digital interlocking in the cloud which enables the virtualization of most signaling components – a technological breakthrough. The world's first entirely autonomously operable **digital commuter train** was presented in Hamburg in 2021. It is based on the pan-European stan-

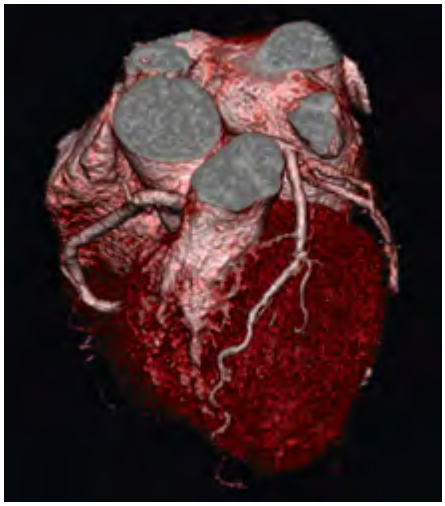
Advertisement for Siemens' entry into laboratory diagnostics, 2007

dardization of signaling and safety systems for train traffic that has been gradually implemented since the early 1990s with the European Train Control System.

In medical technology, in 2001 Siemens brought the Biograph onto the market – a hybrid system that combined computed tomography and nuclear medicine. The device can precisely image body functions, metabolic processes, and anatomical details of organs, which means it can play a key role in the early detection and treatment of diseases. And with SOMATOM Definition, which uses two X-ray tubes and detectors, Siemens greatly enhanced the performance of computed tomography while at the same time reducing radiation exposure. The unit, which has now been refined significantly further, delivers detailed scans of bone, tissue, and bodily fluids. In 2011, the Biograph mMR combined magnetic resonance tomography with nuclear medicine – a milestone in such fields as tumor diagnostics and neurology.

Beginning in 2006, the company entered into laboratory diagnostics through various acquisitions and today it is a pillar of Siemens Healthineers. One important element here is the Atellica diagnostics platform, a extremely flexible solution for clinical chemistry and immunodiagnostics.

In 2016, Siemens rebranded its healthcare business as **Siemens Healthineers** and announced its intention to become publicly listed. Its first day of trading was in March 2018. In 2021, Siemens Healthineers acquired US cancer therapy specialist Varian. This was the largest acquisition in Siemens history: 16 billion dollars. It brought the company the potential to fight cancer even better in the future – with a whole portfolio of products for imaging, laboratory diagnostics, artificial intelligence, and therapy.



CT image of the heart and coronary arteries taken with SOMATOM Definition, 2006

A focused technology company

The Telegraphen-Bauanstalt von Siemens & Halske has evolved into three companies: Siemens Healthineers, Siemens Energy, and Siemens AG.

For Siemens AG, this new chapter as a focused technology corporation began in October 2020, and the transformation has continued under Roland Busch, who took office as CEO in 2021. Busch is the latest in the company's tradition of leadership by passionate innovators. Together with an almost entirely reorganized managing board team, he is forming a focused tech company. The new strategy is focused on accelerating high value growth and empowering customers to transform the industries that form the backbone of economies. The strategy recognizes the need to stay relevant, be ready to adapt and ensure employees have the skills to thrive in times of change. The organization is guided by four strategic priorities: customer impact, technology with purpose, empowerment and a growth mindset.

Hardly any CEO has faced such serious challenges from his very first few months of office as Busch has. The COVID-19 pandemic and the Russian war of aggression in Ukraine have upended long-standing conditions and principles. Lockdowns disrupted supply chains. Materials were in short supply. Inflation, and especially energy prices, soared. The digitalization that had been pursued in-house proved to be a major advantage, for instance in managing the supply chain crisis by reallocating production swiftly as events evolved.

A core ambition is to play an active role in shaping digital transformation. The aim is to support customers and partners in generating growth that will not be at the expense of sustainability, while at the same time minimizing the company's own consumption of resources and energy. The key here will be to combine the real and digital worlds. Digitalization will bring a complete transformation in the backbone of national economies: industry, buildings and infrastructure, mobility, and healthcare.

In these times of unprecedented volatility with the need to move faster, with the emergence of a platform economy, new ways of thinking are required. For that reason, Siemens took an important step in its 2022 anniversary year. In June, Busch presented **Siemens Xcelerator**: an open, digital business platform intended to make the digital transformation simpler, faster, and scalable for customers of every size, in every sector. That will mean a fundamental change in how the business

CEO Roland Busch presents the Siemens Xcelerator, 2022

collaborates and innovates. Siemens will modularize its hardware and software portfolio, connect them with the cloud, and rely on standardized interfaces.

Siemens Xcelerator comprises three cornerstones: a portfolio of IoT-capable hardware, software, and services, a growing ecosystem of partners, and finally, a marketplace. The focus will be on cooperation – because no company can manage the digital transformation on its own.

Automated factory shopfloor (right) designed as digital twin
for the industrial metaverse (left), 2022

Shaping the industrial metaverse

The next wave of the great disruption is already rolling in: the **industrial metaverse**. Photorealistic, physics-based digital twins embedded in the industrial metaverse offer enormous potential to transform industries by providing a virtual world where people can interact and collaborate to solve real-world problems. Siemens is well positioned to shape the industrial metaverse: The company offers many of the core technologies that will define the industrial metaverse including 5G, artificial intelligence, edge computing, as well as the industry's most comprehensive, physics-based digital twin.

In line with its belief in an ecosystems approach to make the industrial metaverse possible, Siemens will work together with many partners. As a first step in this arrangement, the Siemens Xcelerator will be connected with NVIDIA's Omniverse, a 3D design platform that is to be used as a shared base for developing immersive digital twins.

In a year of unprecedented volatility, Siemens continues to stand for the values of its founder, Werner von Siemens.

Technology with purpose is the compass for innovation. And as Busch states:

> "Technology has the power to create a better future and has repeatedly played an essential role in keeping our economy and society functioning during difficult times."

Today, as in 1847, Siemens stands for transforming the everyday for a better tomorrow.

Notes

1 Werner von Siemens was raised to the hereditary nobility in 1888. For reasons of consistency his name is written Werner von Siemens for the period prior to 1888.
2 Siemens Historical Institute, Siemens-Archiv-Akte (SAA in the following) W6249, Werner von Siemens to his brother Carl, January 27, 1865.
3 SAA W1075, Werner von Siemens to his brother William, November 6, 1847.
4 Werner von Siemens to his brother Carl, November 4, 1863, cited after Bähr, Werner von Siemens, p. 252.
5 SAA W1078, Werner von Siemens to his brother William, December 20, 1847.
6 Werner von Siemens to his brother Carl, December 28, 1878, cited after Bähr, Werner von Siemens, p. 354.
7 Wilhelm von Siemens diary entry, December 26, 1902, cited after Feldenkirchen/Posner, Siemens-Entrepreneurs, p. 76.
8 Werner von Siemens to Berlin factory inspector Major Adalbert von Stülpnagel, November 19, 1875, cited after Bähr, Werner von Siemens, p. 311.
9 Werner von Siemens to his son Wilhelm, February 1882, cited after Siemens Historical Institute, Age, p. 8.
10 Carl to Werner von Siemens, December 26, 1888, cited after Siemens Historical Institute, Future, p. 70.
11 Wilhelm von Siemens diary, February 26, 1902, cited after Kocka, Siemens, p. 333.
12 Carl to Werner von Siemens, January 20, 1889, cited after Bähr, Werner von Siemens, p. 368.
13 Carl to Arnold von Siemens, August 3/15, 1894, cited after Kreutzer, Von den Anfängen, p. 85.
14 Monthly report from Karl Georg Frank, March 25, 1909, cited after Feldenkirchen, Anfänge, p. 894.
15 Eric Hobsbawm, The Age of Extremes. A History of the World, 1914–1991, Munich 1996.
16 Carl Friedrich von Siemens at an election rally for the German Democratic Party, February 13, 1921, cited after Feldenkirchen, 150 Jahre, p. 38.
17 Speech by Carl Friedrich von Siemens "The Electrical Industry and the Present Economic Situation," at Columbia University, New York, October 21, 1931, cited after Siemens Historical Institute, Future, p. 132.
18 Carl Friedrich von Siemens to Heinrich Brüning, July 31, 1930, cited after Feldenkirchen, Siemens 1918–1945, p. 228–230.
19 Carl Friedrich von Siemens, farewell words to a Jewish executive of Siemens-Bauunion, 1938, cited after Siemens, Carl Friedrich von Siemens, p. 295.
20 Carl Friedrich von Siemens to an employee, cited after Siemens, Weg II, p. 329.
21 https://press.siemens.com/global/en/pressrelease/auschwitz-liberated-70-years-ago-today-siemens-remembers-victims-national-socialism [February 23, 2022].
22 See the SHI's internal review prepared in 1998–99 from different sources on the Siemens workforce (including forced laborers), September 1944. See also the figures in Feldenkirchen, Siemens 1918–1945, table 42, p. 403, and Feldenkirchen, Siemens, p. 170.
23 "If we wish to preserve the unity of the house – and I believe that is our duty today – we cannot serve one customer from two places; inevitably, that would shortly lead to a fragmentation. […] It cannot be considered responsible to try avoiding a solution to this issue [relocating to the West] any longer. And one more point here, and with all clarity […]: The entire matter cannot (as unfortunately to some degree is happening today) become a question of prestige. The interests of the company as a whole alone must determine what happens; sentimentality and misunderstood tradition must be set aside." Ernst von Siemens to Friedrich Carl Siemens, November 9, 1946, SAA 11-75.1.
24 Ernst von Siemens, 1978, cited after Feldenkirchen/Posner, Siemens-Entrepreneurs, p. 133.
25 Ernst von Siemens addressing the Managing Board Members and Executive Directors of Siemens, February 1, 1966, cited after Siemens Historical Institute, Future, p. 197.
26 SAA 12172, Stock Issue 1970 (Employee Shares), Appendix 1, October 17, 1969.
27 The consolidated OSRAM GmbH subsequently became the world's fourth-largest maker of light bulbs and lamps.
28 Siemens, Recollections, p. 282.
29 Cited after Wiese, 50 Jahre (https://new.siemens.com/de/de/unternehmen/konzern/geschichte/stories/umweltschutz-bei-siemens.html [February 11, 2022]), interview in the Süddeutsche Zeitung, December 1970.
30 Cited after Feldenkirchen, 150 Jahre, p. 82.

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We safeguard, analyze and make available valuable written documents, photos, films and products from the 175-year history and development of Siemens and its predecessor companies.

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Siemens history on the internet:
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