

SIEMENS

Ingenuity for life



Destination: Smart Rail Electrification

The Smart Grid – Constant Energy in a World of Constant Change

[siemens.com/rail-electrification](https://www.siemens.com/rail-electrification)

Welcome to the future of our energy systems

We're living in a world that's constantly changing ...

Our world is changing. Economies on every continent are growing with unheard-of dynamism. More and more people are living in urban areas. Demands on logistics and mobility are continuing to increase. These changes are giving rise to new challenges, especially the need to use resources more and more efficiently. To deal with these developments and help shape a prosperous future, we need reliable, powerful, and sustainable infrastructures – intelligent infrastructures.

... where energy meets intelligence ...

Energy systems around the world are also changing. Infrastructures need to be expanded or built from scratch. Energy customers are placing increasingly stringent demands on a stable and economically and ecologically efficient power supply. Grid operators, industrial and supply companies, municipal utilities, energy providers, and rail operators all have to confront these challenges. The answer is intelligent infrastructure: smart grids. These are a crucial – and possibly decisive – element in the energy supply system of the future.

... and power networks become smart grids.

Siemens is the ideal partner for this transformation. It has the most experience and a comprehensive Smart Grid portfolio that covers the entire spectrum of products and solutions specifically for smarter energy infrastructures. This opens up unforeseen opportunities to keep energy systems stable, make them easier to plan and efficient to expand, to develop new business models, and to optimize the exchange and procurement of energy. Not only do our solutions include the necessary products and IT systems: Most importantly, our customers can also count on our domain-specific expertise in the complete optimization of individual systems.

This combination of system knowledge, products, and IT systems optimized for their applications is the key to the reliable, economical infrastructure networks of the future – and a solid foundation for future growth. Together with customers and partners, Siemens is turning the smart grid vision into a reality.



The mobility challenge: transport for every location

The percentage of the population living in cities is steadily rising. Sixty percent of the world's population will live in urban areas by the year 2030. Global passenger transport is continuing to grow as well: By 2030, experts forecast an annual growth of about 1.6 percent.

For freight traffic, too, an annual growth of 2.5 percent is expected. These developments imply a huge need for investments: Expenditures on urban mobility will triple by 2050. To deal with these trends over the long term, we need solutions for intelligent and efficient rail electrification.



Smart cities need ...

Urbanization and globalization, climate and demographic change: The mega-trends of the current age are creating major challenges for rail-guided transportation systems all over the world.

Twenty-first century developments are leading to rapid increases in the logistical demands on rail-based passenger and freight traffic. There is an urgent need for intelligent and efficient solutions that will guarantee reliable, long-term mass transit and main-line railways in a highly dynamic environment. Without efficient, powerful transport systems, it would be impossible to organize a high-functioning major city that would appeal to residents and investors alike.

In the area of rail electrification in particular, there are fundamental questions about the efficiency and effectiveness of existing and new traction power supply systems. How good are the connections between rail networks and distribution systems? How extensively are control-center technologies and grid process-control technologies networked? Is the level of automation in existing structures sufficient, or are energy management systems needed in order to deal with the challenges of the future? Are IT systems powerful enough and compatible with current developments?



... intelligent rail systems

Since the first electric railway was introduced in 1879, Siemens has been a driver of innovation and a technological leader in rail electrification. The company sees the electrification of rail transportation as one component of a new, smart network environment. In a world that is growing more and more complex, especially in terms of energy infrastructure, everything is connected with everything else and is dependent on a range of factors.

Siemens is the only provider in the industry that can offer a complete portfolio of innovative solutions, systems, and products for traction power supply, contact lines and network-control technology for the rail transport of the future.

From consulting and financing to system design, implementation, and after-sales service, Siemens implements projects throughout the world – always tailored to the rail operator's individual needs.

Siemens rail electrification systems are the first choice for three reasons: They offer the world's leading technology, complete system solutions, and the ability to embed them in smart grids and the intelligent infrastructures of the future.

Electrification solutions ...



Siemens is the perfect partner for customized, reliable electrification solutions for mass transit and main-line railways. Comprehensive skills, personal commitment, and many years of experience enable Siemens to create solutions based on tried proven products that for decades have set the standard in terms of technology, value for the money, and long-term quality. The result are reliable traction power supply and overhead contact line systems that are winners in every respect.

Expertise and dialog

Its international presence and expert knowledge of local conditions and the unique features of different markets allow Siemens to implement projects swiftly throughout the world while keeping the transport channels to a minimum. The most appropriate electrification solution is worked out in a process of consulting interviews, including flexible financing plans, in close collaboration with authorities, government offices, and commercial banks around the world. Contacts in project management and engineering with sound expert knowledge monitor the projects during the ongoing stages of planning and implementation. Once a system is complete, Siemens also provides support for all the subsequent administrative and technical tasks.

Construction and statics

During the construction phase, Siemens creates the necessary system and assembly drawings, including parts lists, with maximum precision. Any special constructions desired, like special assemblies or fixing components (for example in buildings, bridges or tunnels) are designed in a second stage. Likewise, the static calculations require the utmost care in order to ensure the stability of the overhead contact line systems under all conditions of use. This involves evaluating the ground surveys, the site itself, and building reports, always with the goal of achieving the ideal combination of function, value for the money, and safety.

Outstanding hardware

Siemens manufactures for the global market and guarantees uncompromising quality – materials and products must stand up to the toughest conditions: from a freezing cold of -45°C to 98 percent humidity in the tropics, and from sandstorms in the desert to salt-water mist on the coast. The mechanical and electrical functions of all systems are reviewed and successfully tested under the conditions found at the locations where they will be used.



... for mass transit and main-line railways

Excellent engineering

Between the design and the commissioning of a system lies excellent engineering that is precisely adapted to suit the system design requirements. Siemens' partners benefit from comprehensive expertise and the unique "global execution footprint" offered by Siemens engineers. In parallel, Siemens takes on the job of designing the necessary buildings and managing all the building activities, followed by the electrical and mechanical design work. Engineering the interfaces ensures that all components can be harmoniously integrated into the overall system.

Perfect project management

Professional project management helps achieve the right balance between time, cost, and quality. End-to-end documentation of all activities and objectives highlights any opportunities for savings and development, simulates and evaluates the effects of different potential solutions on life cycle costs, and prevents errors by applying standardized work procedures. This is how Siemens is already implementing systems that satisfy the demands of the future.

Service and training

Even after commissioning a system, Siemens is still there for its partners: for example, by providing employee training and introductions to the features of the new plant. Siemens is also a reliable partner when it comes to the subsequent maintenance of your plant. The rigorous professional development of Siemens employees and its constructive collaboration with all its customers ensure maximum quality standards on a lasting basis.

The right tool ...

Siemens uses its own expert software tools to implement every project. Additional services offered include detailed calculations and system simulations, so that every customer gets the best possible advice at every stage of the project.

Every network has its own peculiarities

System design and calculations for rail electrification is one of Siemens' core competencies. The more detailed and thorough the analysis and evaluation of all important project data, the longer the service life of the completed system, and the better value it will provide. We've been building our experience and these system skills for as long as the company has been in existence, and they are all the more necessary today, when we consider the new and dynamic demands on supply networks in particular. This is what sets us apart from the competition.

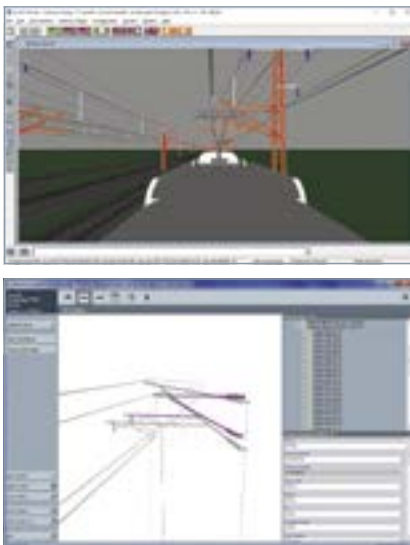
Our experience feeds into our innovative simulation, analysis, and customization tools to help us make qualified system decisions: from optimizing ride dynamics to considering the limiting conditions imposed by energy providers on power quality and system perturbations, for example. This knowledge enables Siemens to combine IT, electrical engineering, and mechanics to create an outstanding system in terms of its quality, reliability, and optimized power consumption.

Sitras Sidytrac

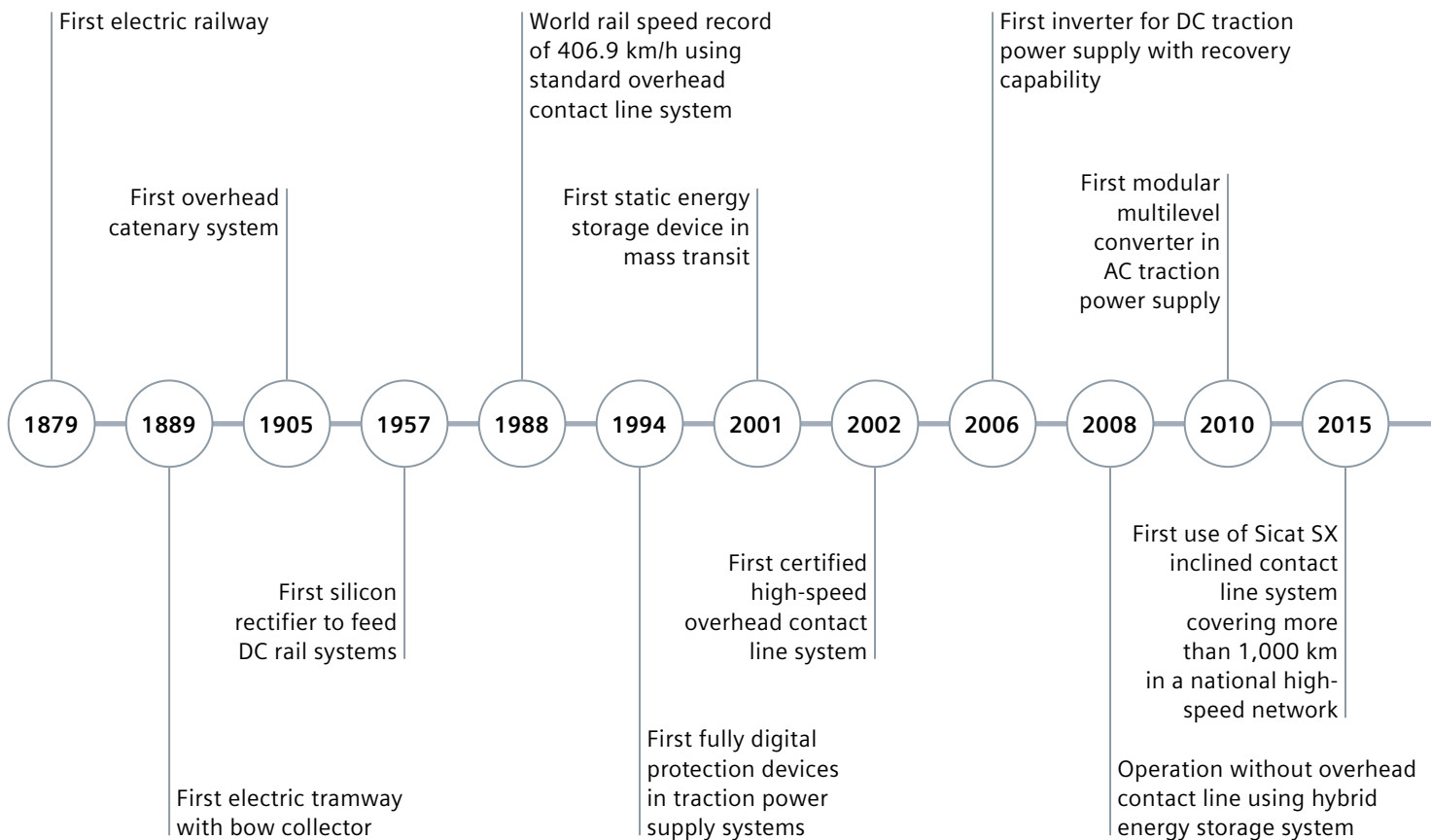
With its powerful simulation tool Sitras® Sidytrac, Siemens can offer its partners comprehensive network calculations, including informative rail transport simulations. The calculations are all based on route, vehicle, network, and timetable data, so new and existing traction power supply systems can be compared, configured, and performance-tested under realistic conditions. Sitras Sidytrac now also makes it possible to model energy storage devices, renewables, and the use of inverters. The more calculations, the easier it is to guarantee operational safety. This tool and the accompanying services have been available to selected customers since 2015. The influence of electromagnetic fields also cannot be ignored.

Sicat Master and Sicat Candrop Pro

Siemens uses the Sicat® Master engineering tool to perform load analyses and draft detailed site and contact line plans with lists of poles and catenary systems, as well as traction power line routing. Additional profiles are used to perform calculations for earthing systems, record rail data, and optimize ranges. The Sicat SX inclined catenary system is designed to minimize investment costs, and it is calculated in full using Sicat Candrop Pro to enable all the components to be prefabricated. This simplifies the assembly work and follows our principle of "hang and fit."



... for every job



Control systems and power management

Traction power systems ensure the power supply for long-distance and local passenger services, for tramways, light-rail, and standard-gauge rail systems. For continuous system management and potential future plant modifications, Siemens offers a broad range of refined IT solutions for rail operators. These applications will ensure that rail power systems will remain economical in the future.

The Sitras RSC grid control system, for example, integrates a wide variety of SCADA applications in a control and monitoring system. It is future-proof and can be expanded at any time, thanks to its modular construction. In addition to a comprehensive overview of system operating status, Siemens also offers the opportunity to actively manage both energy consumption and energy flows within the system.

Sitras iEMS provides a full-value energy management system that can independently perform optimizing tasks using rule-based load management. It can also forward rule-based suggestions to the operator and thereby offer rapid troubleshooting when operational support is needed, in exceptional situations in particular.

Optimal rail electrification on every continent ...



... and under all possible conditions

Metro Lima, Peru

Peru's capital Lima is a city of nine million inhabitants, the sixth-largest city in South America. It is very densely populated, with 3,000 people per square kilometer. Lima Metro's 35-kilometer-long Line 1 has 27 passenger stations and is a modern, fast, and safe means of transport that brings the city both social and economic benefits, as well as environmental protection: Lima's annual CO₂ emissions have been reduced by more than 32,000 metric tons. With a transport volume of roughly 228,000 passengers every hour, the line covers a total of 11 urban districts and cuts unproductive travel time by more than two-thirds for large parts of the population. The entire route, which would previously have taken three hours by car or bus, can now be completed in 54 minutes. For this electrification project, Siemens was contracted to provide the planning, delivery, installation, and commissioning of eight 1.5-kV DC traction power supply substations and 22 km of overhead contact line systems for the main line, plus another 7.4 km for two shops and yards. The project also included the electric Scada system and two high-voltage 60/20 kVA substations.



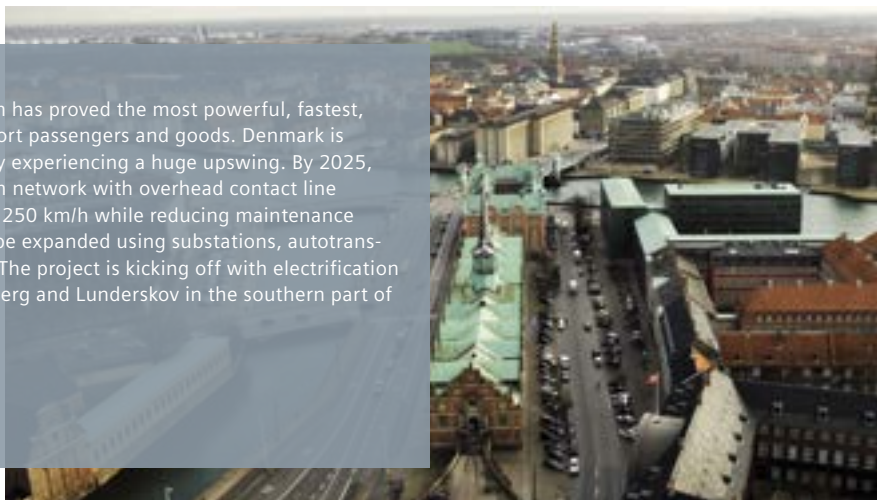
Metro Riyadh, Saudi Arabia

Riyadh, the capital of Saudi Arabia, is currently planning the world's most extensive underground rail network: six lines with a total length of 175 km. Siemens has been tasked with supplying the entire turnkey system for two driverless metro lines for the city. The metro network is one of the long-term solutions that the city is adopting to deal with its transport problems, which are partly the result of rapid population growth: Since 1990 its population has doubled to more than five million. Siemens is equipping Lines 1 (Blue Line) and 2 (Red Line) of the six-line system with Inspiro trains, and is also responsible for the electrification and the signaling and communications systems needed for driverless operation. The project includes project management, signaling, power supply, communications, and rolling stock.



Electrification program, Denmark

Around the world, electric train transportation has proved the most powerful, fastest, and most environment-friendly way to transport passengers and goods. Denmark is one place where rail electrification is currently experiencing a huge upswing. By 2025, Siemens will equip nine sections of the Danish network with overhead contact line systems (2 x 25 kV), enabling speeds of up to 250 km/h while reducing maintenance expenses. The power supply system will also be expanded using substations, autotransformer stations, and remote control systems. The project is kicking off with electrification of the 57-kilometer-long stretch between Esbjerg and Lunderskov in the southern part of the country.



Siemens AG

Mobility Division
Otto-Hahn-Ring 6
81739 Munich
Germany

E-mail: electrification.mobility@siemens.com
www.siemens.com/mobility

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