How do you get ever more people to their destinations ever more quickly?

With efficient railway electrification solutions: innovative, economical and eco-friendly

Answers for mobility.
More people, more challenges, one solution: Complete mobility.
Demographic change, urbanization and climate change: these global trends are determining the way we live today and tomorrow. And the world population is not only growing, it’s also getting older. By 2050 approximately 9.2 billion people will need food, accommodation and care. Efficient transportation and logistic offers based on our innovative electrification solutions will play an important role meeting these challenges.

The Siemens environmental portfolio
Siemens has set itself the task of providing sound answers to such daunting challenges. With the world’s largest corporate environmental portfolio, an environmental research budget of, so far, around one billion euros and around 14,000 “green” patents, we are doing our part to coming to grips with these global challenges. In 2009 alone, we helped customers in all parts of the world to reduce their CO₂ emissions by a grand total of 210 million tonnes.

The “Complete mobility.” approach
It is Siemens’ goal to sustain the competitiveness of our cities and growth of our industrial centers. We are therefore pursuing our “Complete mobility.” approach to create integrated transportation and logistics solutions for the safe, economical and environmentally friendly transport of people and goods. Siemens has all the expertise needed to provide everything from infrastructure systems for road and rail to rolling stock, from airport logistics to postal automation. Major components of “Complete mobility.” include efficient solutions for rail-based transportation systems for cities and metropolitan areas and for connecting major cities and countries. Rely on our comprehensive portfolio of turnkey solutions, rolling stock, control and safety systems, as well as railway electrification equipment.

Your benefit: our versatility
Our vision is the creation of solutions to 21st century transportation problems – solutions that not only inspire but are also sustainable, innovative and attractive. We can achieve this with technical competence, utmost product quality and a highly diversified portfolio and with the advantages of a versatile and financially strong partner who has international presence and vast experience. So, profit from the synergies within our company and from the know-how of the technological leader in road and rail applications.
Our strength: innovations for the future
Continuous research and development and well-founded expert knowledge are the foundation on which Siemens stands. Collaborative projects with universities and research institutes as well as over 31,000 employees in R&D activities make sure every day that we practice the enthusiasm for innovation we preach.

In fiscal 2009 alone, Siemens employees made 7,700 inventions.

**Technology needs development**
Siemens maintains 176 R&D sites in 30 countries around the world. The result is more than 56,000 active patents and an encyclopedic fund of knowledge. Rely on the experience of a technology partner whose innovations have decisively advanced the development of railway electrification systems! We make an important contribution to maintaining mobility with our flexible, reliable railway electrification systems.

**Siemens set milestones in railway electrification**
- **1879** First electric railway
- **1889** First electric tram with a pantograph
- **1905** First catenary system
- **1957** First silicone rectifier for supplying power to DC railways
- **1988** World record railway speed of 406.9 km/h set with a standard overhead contact line
- **1994** First fully digital protection equipment for the traction power supply
- **2001** First static energy storage system for mass transit
- **2002** First overhead contact line system certified for high speed
- **2008** Hybrid energy storage system for tram operation without contact lines
- **2010** First modular, multilevel direct converter in the AC traction power supply
Efficient railway electrification – the very basis of rail travel
Railway electrification frequently confronts planners, erectors and operators with extremely complex challenges. Customized systems are required that fit easily and harmoniously into a larger infrastructure – systems from Siemens.

**Rely on our expertise**

We have a simple formula for successful railway electrification: combine our comprehensive knowledge of underground and above-ground construction, of mechanical, electrical and electronic engineering, and of telecommunications with customized software (simulated operations). The big advantage for you is that we can run through and evaluate almost any scenario before you choose a particular alternative. To cope with the complexity of the subject matter we developed, validated and verified many of the simulation programs ourselves, such as tools for calculating not only electrical and mechanical but also static and dynamic loads. They are complemented, of course, by standard CAD tools. Rely on our specialists to support you in every implementation phase of your project.

**Engineering excellence**

The task of our engineering is to work out the basic system requirements and to develop potential solutions for meeting them. We analyze the fundamental requirements: such as the power supply system, the desired running speeds, the spacing of substations, the composition of the contact line, climatic conditions, route-related requirements and much more. On this basis, we create a detailed solution for the traction power supply and contact line. Of course, we also take other general conditions into account, such as the power utilities’ requirements regarding feedback on the network, and local environmental protection regulations (electromagnetic compatibility, transformer-related noise, CO₂ emissions, etc.).

---

**Geographical requirements**
- Climatic
- Topography

**Standards**
- Local
- International

**Electrical safety**
- Operators
- Passengers, pedestrians
- Protection of installations

**Availability**
- Security of supply
- Redundancy

**Economy (LCC)**
- Investment
- Operation
- Maintenance

**Energy saving**

**Environmental compatibility**
- Electrical and magnetic fields
- Noise emissions
- Climate (CO₂)

**Railway electrification**

**Requirements of power utilities**
- System interactions
- Peak loads
- Measurement and protection

**Transportation performance**
- Vehicles
- Timetable

**Rail automation**
- Signaling
- Control systems

**Line requirements**
- Stations
- Technical buildings
- Tunnels
- Viaducts
- Crossings
Your added value: a complete package tailored to your needs
The performance can only be good if the quality is good – and that throughout the entire project cycle and beyond. We therefore offer a range of services that extends all the way from initial consultation to in-service maintenance. Rely on a full-service package offering the highest standard of quality.

Well advised by experts
We are at home in our customers’ markets. Thanks to our international presence, we can process projects quickly and minimize transport distances. We are also extremely familiar with local regulations and know the special features of your market and your requirements – be they for mass transit or main line services, for AC or DC traction power supplies. That’s the basis that enables us to advise you individually. We analyze the actual status together with you and work out the best possible electrification solution for the given infrastructure, topography and climate. We believe that good consultation includes an appropriate financing concept. We draw up flexible proposals for you in close collaboration with public authorities, government offices and commercial banks all over the world.

Excellent project management
Professional project management and the right balance between time, cost and quality. That is our key to success. Equally important are experience, know-how, and transparency provided by the seamless documentation of all measures and goals. That is how we uncover potentials for savings and development, simulate and evaluate the effect of various solution approaches on life cycle costs, and avoid errors by using standardized work steps. Our efficient project management lays the foundations for systems that already meet tomorrow’s requirements today.

It’s the engineering that counts!
Between the drafting and the commissioning of your system is excellent engineering work that is provided by experienced professionals. We bring together the components of your traction power supply, station control system and contact line and adapt them to meet the specific requirements of the system design. Based on the latest R&D results from the relevant Siemens Divisions, our extensive know-how is combined with our ability to draw the right conclusions from the calculations of our IT tools and assures you that the result satisfies your requirements perfectly. Profit from our engineers’ broad expertise – knowledge that ranges from in-depth analyses of protection issues and the dimensioning of static converters to system comparisons and human safety specifications.

There is no end to service
In our opinion, a project is far from finished when it is commissioned. That’s why we remain your partner when it comes to training your personnel and introducing them to the features of the new system. We are also your expert partner for maintenance matters. We consistently promote the further technical education of our own personnel and constructive relationships with our customers in order to maintain our standard of quality. And to give our customers the high degree of reliability that they need.
Engineering for more power – designed for efficiency and safety
**Sustainable, economical systems**

Innovative simulation and optimization programs help us to design your system cost-effectively and according to your needs. This ranges from optimizing train dynamics to accounting for the limitations imposed by the power utility regarding, for example, voltage quality and feedback on his network. We apply this knowledge to our design to combine electronic, electrical and mechanical components in order to form a system that sets itself apart through quality, reliability and reduced power consumption.

**Professional configuration**

Using our own Sicat® Master configuration tool, we generate load analyses, layout diagrams and profiles, record track data and optimize span lengths. In line with the specifications of the system design we then select the switchgear, transformers, converters, protection and control equipment, trackside facilities and energy storage systems. At the same time, we design the necessary buildings and define the constructional measures and related requirements. This is followed by the layout of the electrical and mechanical equipment. We engineer the interfaces so that all components match each other harmoniously and are integrated into one turnkey system.

**You can rely on tested components**

When it comes to designing railway electrification systems, the top priorities are absolute safety for people and property and protection of the customer’s investment. Therefore, our components are thoroughly tested under real-life conditions before they are used. In order to ensure optimal protection for the personnel and electrical equipment, we also create a grounding concept and examine the electromagnetic compatibility of the planned system. These principles lay the foundation on which we can offer quality products that give you the highest possible standard of safety.
Perfect systems: quality knows no limits
Modern contact line systems, traction power supplies and control systems form the heart of rail-based mobility. Wherever trains are running on electrified routes, reliability plays a crucial role. The consistently high quality of all products and systems means that, here again, the name of Siemens stands for sustainable solutions – on all five continents.

Efficient supply
Traction power systems provide the power for urban mass transit services, tramways, light rail systems and main line railways. No matter whether the application calls for high or medium voltage, transformers, rectifiers, substation controllers or SCADA systems – we have perfected solutions in our portfolio which will ensure that your rail operations remain economically efficient in the future. There is, for example, the Vicos RSC network control system which integrates a wide range of SCADA applications into a control and monitoring system. Its modular structure makes it open to the future and expandable at any time. It also offers not only a detailed overview of the system’s operational status, but also the options of actively managing the power consumption in the system and stabilizing operational processes by means of fault and maintenance management.

Reliability is a question of definition
The design of the contact line system also depends upon precise identification of the basic conditions through simulation of a range of scenarios. We then define your individual contact line system according to project specifications and the results of the feasibility analysis. This also includes specifying the required wires and tension forces. We use the Sicat Dynamic analysis tool to simulate the traversing characteristics – i.e. the interaction between catenary and pantograph – under realistic conditions in order to verify that the quality meets your pantograph passage requirements.

Perfection in detail
We use Sicat Master to create detailed contact line diagrams indicating the positions of poles, catenaries and traction power cables. These diagrams also usually include the grounding system and salient topographical features around the track. The positions and types of foundations as well as the types of poles are designated in a list of poles and foundations generated by the special Sicat MatLog IT tool. The circuit diagrams of the electrically separable zones of the contact line system are worked out on the basis of reliability, feed and operational control concepts. Finally, the entire system is recorded with all relevant data in “as built” documentation.

A solid foundation: design and stress analyses
In the design phase, we first create the necessary system and assembly drawings, as well as the bills of materials, with a high degree of precision. In a second step, we draft the special designs – such as special assemblies and mounting fixtures (e.g. in structures, on bridges or in tunnels). The stress analyses likewise demand utmost care in order to ensure that the contact line systems remain stable under all operating conditions. This includes the evaluation of soil studies and expert assessments of the foundation soil and structures. For, after all, we are committed to providing you with a perfect combination of functionality, economy and safety.
Convincing performances: our references
Best material
Precisely because we produce for the world market, we have to use materials that make our products resistant to the harshest conditions: from bitterly cold temperatures down to –45 °C to 98 percent air humidity in the tropics, from sandstorms in the desert to salt spray on the coast. With us, you can rest assured that the mechanical and electrical functions of our systems have been checked and successfully tested under the actual conditions at the installation site.