Increasing energy efficiency:
Optimized traction power supply in mass transit systems
Electrification solutions that pay

Safeguarding mobility is one of the big challenges in our society. To ensure our mobility in future, we need networked transportation and information systems. And we will only meet these mobility requirements through efficient coordination and perfect meshing of all modes of transportation.

This is why Siemens – with its “Complete mobility” approach – is offering integrated transportation and logistics solutions for safe, cost-effective and environment-friendly passenger and freight services. For Siemens has the necessary competence to provide everything from infrastructure systems for railways and roadways to solutions for rolling stock, airport logistics and postal automation.

Key elements of “Complete mobility” are efficient solutions for rail-based transportation systems for cities and population centers and for connecting large cities and countries.
Thanks to our defined and holistic process, we ensure transparency and clarity in each phase of a project. In three steps, we help you to analyze your needs, plan your individual configuration and then concretely implement your tailor-made electrification solution.
Providing advice and finance: A good starting basis for growth

Our highly competent engineers and partners provide you with advice on all aspects of planning and system configuration from the very beginning. With our global network of innovation, we not only look beyond the known in the area of technology know-how but also closely examine local needs through our on-the-spot experts who are located all over the world. On an international level, this enables flexible analysis of the actual situation compared to what is in fact required. We consult with you closely to define the general parameters of the project as early as the first consulting session. To this end, we draw up an individual financing concept that is tailored to your situation and developed in close cooperation with official authorities, government offices and commercial banks all over the world.

Data acquisition: The value added is in the details

Irrespective of whether the infrastructure, topography or climate is concerned, our experts collect your data where they actually exist. In doing so, they make use of data that is already available. However, it is frequently necessary to obtain new data as well in order to reliably evaluate the viability of a planned project. We carry out specific software-supported analyses on site, the results of which are incorporated as important parameters in the project simulation.
**Awards**

The project management staff of Siemens has received several awards for outstanding project work.

- **German Project Management Award 2005** for Metro Kaohsiung, Taiwan
- **International Project Management Award 2005** for MTRA Bangkok, Thailand
- **International Project Management Award 2006** for HSL-Zuid, Netherlands

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**First planning unit:**

**Laying the foundations for decisions**

With our Sitras® Sidytrac simulation tool, we generate crucial advantages that work out to your benefit. In an early phase of cooperation, you decide on the quality of the solution and the continuation of the project. On the basis of the acquired data, we draw up an initial project outline that allows alternatives at any time and thus creates a solid basis for a concrete offer to be made to you.
Efficient railway electrification systems are the result of exact planning. Long before work is started on site, we simulate your individual project under realistic conditions on the computer. This saves you from any surprises and allows us to take all contingencies into consideration.

Planning means: knowing what the result will be

We always consider a project from a holistic point of view. Our experts plan your traction power supply system embedded in a larger context. On the basis of the data obtained and taking into account your special needs, we incorporate the relevant infrastructural parameters into the simulation of your system from the very beginning. As regards energy efficiency, the potential for savings can thus be determined as early as the first stages of calculation. This guarantees optimal engineering of your individual configuration and cuts back on the use of resources.

Sitras Sidytrac: A little less, if you please?

Sitras Sidytrac is a simulation software that enables us to carry out an exact power-system calculation with train operation simulation for your particular project. In addition, workflows are standardized and automated, as a result of which sources of error can be reduced and efficiency considerably increased. And regardless of whether you need a completely new system concept or simply want to know your existing system’s potential for improvement. The software calculates your individual configuration and even goes a step further: due to the optimization of power consumption, power recovery behavior and energy-saving potential, your resulting traction power supply system is not only exemplary in terms of ecology but also has the side effect of substantially reduced lifecycle costs.

Additionally the following aspects of your system can be simulated and planned with Sitras Sidytrac:
• The electromagnetic compatibility of your planned installation or the parts of the installation to be upgraded
• An earthing concept that guarantees optimum protection for people and electrical equipment
• The system interactions and voltage quality based on the analysis of
  – system interactions due to harmonics,
  – three-phase current imbalance with single-phase loads,
  – voltage fluctuations and flicker and
  – resonance performance of line sections under realistic service conditions
Concrete planning procedure: 
Energy efficiency in three steps

Sitra Sidytrac has a three-part program structure composed of input block, calculation block and output block. The input block is used to process the line data, the timetable, the vehicle data and the data of the electrical power supply system.

The calculation block is the heart of Sitra Sidytrac. First of all, the speed profile program calculates the location of the vehicles in the power supply network and the power they consume and deliver. These electrical loads are then incorporated in the static network and, on this basis, the dynamic electrical network is calculated. In a second step, the electrical load flow is determined, the values of which are then incorporated in the speed profile.

In the output block, the electrical data for the detailed design of the main components are finally evaluated. The results are then shown in the form of predefined lists and graphics and are stored in a database.

Planning example: Potential for savings thanks to energy storage units

Due to the storage of braking energy by means of stationary energy storage units, the vehicle’s primary energy demand can be reduced by up to 30%.
The energy efficiency of railway electrification is mainly measured in terms of its energy saving potential. Siemens possesses a pathbreaking range of products with the latest technologies for high environment-compatibility and greater economic efficiency. Once integrated in your system, our products enrich your electrification solution in respect of its ecological aspect.

Efficiency you can grasp

With braking energy into the future? Modern technologies in the area of traction engineering considerably improve the traction system of rail vehicles and thus reduce energy consumption enormously. The energy storage units of the Sitras family are the heart of your custom-made electrification system. They save energy in daily use by storing the braking energy that is released and thus make a decisive contribution to the reduction of lifecycle costs as well.

Energy-efficient systems:
Three products for tailor-made solutions

Siemens can offer you three components that ensure the energy efficiency of your system in different ways. When performing the preparatory calculations, our engineers consult with you to determine the best possible energy saving product for your individual mass transit system.

Sitras TCI inverter:
More current for stops along the line

The Sitras TCI inverter makes it possible to transfer the braking energy into the higher-level medium-voltage power system. Large distances can be overcome easily so that even very remote loads can be supplied with the necessary power. Since the medium-voltage power system is capable of absorbing the recovered brake energy, the design of the braking resistors on the vehicles are also optimized – which means weight savings. Substations can also be retrofitted with a standby Sitras TCI inverter to make them capable of handling recovered energy. The robust and reliable thyristor technology ensures optimal energy transmission.

Moreover, parameterization, control and diagnosis can be carried out by means of a standardized communication interface independently of the location.

Sitras SES:
Energy saving potential that can be relied on

The Sitras SES stationary energy storage unit creates optimum preconditions for energy recovery in mass transit systems. The Sitras SES can store and emit energy extremely quickly, thus enabling a complete exchange of energy between vehicles. Besides that, the primary energy requirement is reduced by up to 30% without any influence on transport capacity. This is ensured by the central part of the energy storage unit which works on the basis of double-layer capacitors. The Sitras SES works in two modes:
• As a voltage stabilizer, it maintains a constantly high degree of charging and only releases energy when the system voltage falls below a predefined limit.
• In the energy saving mode, it absorbs energy recovered during braking and stores it so that it can be released later for acceleration purposes.

Sitras MES/HES:
Saving energy simply by driving

The Sitras MES and Sitras HES mobile energy storage units add a mobility factor to the proven technology of braking energy recovery. Electric and diesel-electric vehicles can easily be retrofitted with the systems.
The Sitras HES hybrid concept even goes one step further by combining the advantages of storage technology with the possibilities of a traction battery. Mass transit systems without an overhead contact line are thus possible and not only reduce energy costs, energy consumption and CO₂ emissions but can also be integrated into every urban environment almost without being noticed.

**Continuous optimization:**
Lifecycle under the microscope

Our work is by no means over when your mass transit project has been implemented. After commissioning, we continue to provide support for your system, subjecting the measured data and configurations to ongoing checks. Rationally based improvements can therefore be carried out at any time, assuring you that your mass transit system will operate efficiently for many years.

Saving energy globally: If all DC railway systems worldwide used energy storage systems or inverters, CO₂ emissions could theoretically be reduced by up to 11.6 million metric tons.

Which roughly correspond to the CO₂ emissions of a central European city with one million people.
In use worldwide

Our railway electrification systems receive praise in all parts of the world. Systems that have been planned and built on the basis of our electrification process are being operated successfully all over the globe. The reference list on the right shows just a small selection of the projects we have handled and illustrates our wide range of services in the area of DC traction power supplies.

Metro de Madrid SA
Madrid, Spain

In Madrid, two stationary Sitras SES energy storage units with double-layer capacitor technology ensure stable voltage conditions along railway routes. Simultaneous acceleration of several trains is no longer a problem in the Spanish capital.

Scope of services: Two turnkey systems, including engineering, manufacture, installation and commissioning

Operating since: July and November 2003

Main components: Double-layer capacitor bank, converter, control system, connection unit

Supply voltage: 750 V

Mode: Voltage stabilization
Kölner Verkehrs-Betriebe AG
Cologne, Germany

From April 2001 to January 2003, Kölner Verkehrs-Betriebe AG tested a prototype of an SES stationary storage unit with double-layer capacitor technology. The result convinced the customer’s experts. Only one year later, four energy storage systems were purchased and put into operation.

**Scope of services:** Five turnkey systems, including engineering, manufacture, installation and commissioning

**Operating since:** April 2001, July 2003, October 2004, June and October 2006

**Main components:** Double-layer capacitor bank, converter, control system, connection unit

**Supply voltage:** 750 V

**Modes:** Energy saving, voltage stabilization

Beijing Metro
Beijing, China

Beijing, the host city of the Olympics, has been using the energy saving power and stabilizing capacity of four Sitras SES stationary energy storage units since February 2007. They are being used at a total of four installations.

**Scope of services:** Four turnkey systems, including engineering, manufacture, installation and commissioning

**Operating since:** February 2007

**Main components:** Double-layer capacitor bank, converter, control system, connection unit

**Supply voltage:** 750 V

**Mode:** Voltage stabilization

Bayerische Zugspitzbahn Bergbahn AG
Zugspitze, Germany

The installed Sitras TCI inverter has transformed the braking applications for vehicles operating on Germany’s highest mountain. Part of the braking energy created by vehicles traveling downhill used to be dissipated at the brake resistor but can now be fed into the customer’s own medium-voltage ring.

**Scope of services:** Turnkey system, including engineering, manufacture, installation and commissioning

**Operating since:** May 2007

**Main components:** B6 thyristor bridge, autotransformer, control electronics

**Supply voltage:** 1,500 V

**Mode:** Voltage stabilization
The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.