Increasing energy efficiency

Optimized traction power supply in mass transit systems
Electrification solutions that pay

Safeguarding mobility is one of the big challenges facing our society today. To ensure our mobility in future, we need networked transport and information systems. But we will only be able to meet these mobility requirements through efficient coordination and perfect meshing of all modes of transport.

This is why Siemens – with its “Complete mobility” approach – is offering integrated transport 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 transport systems for cities and population centres and for connecting large cities and countries.
A HOLISTIC ELECTRIFICATION PROCESS

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.
Siemens is one of world’s leading suppliers of innovative railway electrification systems. The design and calculation of installations are among our core areas of competence. System know-how and the latest IT tools enable us to achieve a precise definition of your particular needs.

**Profitable analyses**

It’s good that we’re so calculating. After all, the complex requirements involved in the creation of an economically efficient and stable electrification system call for an in-depth analysis. Our experts work with the latest software modules and apply the experience they have gained from decades devoted to the development of such solutions worldwide.

**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 our own field of technology know-how but also have local needs closely examined by our worldwide network of on-the-spot experts. This enables a flexible variance analysis to be obtained on an international level. We consult with you closely to define the general parameters of the project right from the very 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 local authorities, government offices and commercial banks all over the world.
Data acquisition:
The value added is in the details
Irrespective of the infrastructure, topography or climate, our experts collect your data straight from the actual source. In doing so, they are making 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, the results of which are incorporated as important parameters in the project simulation.

First planning unit:
Laying the foundations for decisions
With our Sitras® Sidytrac software tool, our experts 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.

The result:
The right solution for the job in hand
Our extensive system know-how is based on the latest results from research and development by the relevant sections within Siemens as well as on our ability to draw the right conclusions from the calculations performed by our IT tools. These factors combine to ensure an optimal result ideally suited to satisfy your requirements.

Sample calculation:
Payback period
The energy saved with Sitras TCI can give a return on investment in just three years.
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 is 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 ensures a configuration that is both individual and easy on 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, which means sources of error can be reduced and efficiency increased considerably. And that is 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 behaviour and energy-saving potential, your resulting traction power supply system is not only exemplary in terms of ecology but also offers the beneficial side effect of substantially reduced lifecycle costs.

The following additional 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 network reaction and voltage quality based on the analysis of
  - system interactions due to harmonics
  - three-phase imbalance because of single-phase railway loads
  - voltage fluctuations and flicker
  - resonance behaviour of line sections under realistic operating conditions.

Concrete planning procedure: Energy efficiency in three steps

Sitras Sidytrac wins over customers with its 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 Sitras Sidytrac. First of all, the speed profile program calculates the location of the vehicles in the power supply network as well as the power they consume and deliver. These electrical loads are then incorporated in the static network and provide the basis for calculation of the dynamic electrical network. Then, the system determines the electrical load flow and incorporates the values in the speed profile.

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

Planning example: Energy storage units tap saving potential

The storage of braking energy by stationary energy storage units enables the primary energy demand of a rail vehicle to be reduced by as much as 30%.
The energy efficiency of railway electrification is mainly measured in terms of its energy saving potential. Siemens possesses a path-breaking range of products with the latest technologies for high environment-compatibility and greater economic efficiency. Once integrated in your system, our products enrich the ecological attribute of your electrification solution.

**Efficiency you can grasp**

With braking energy into the future? Modern technologies in the area of traction engineering considerably improve the drive 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 storage 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 consumers can be supplied with the necessary power. Since the medium-voltage power system is capable of absorbing the recovered brake energy at any time, the design of the braking resistors on the vehicles is 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 independent of the location.
Saving energy globally: If all the DC railway systems in the world used energy storage systems or inverters, CO₂ emissions could theoretically be reduced by as much as 11.6 million tonnes.

This figure roughly corresponds to the CO₂ emissions of a central European city with one million people.
In use worldwide

The energy efficiency of railway electrification is mainly measured in terms of its energy saving potential. Siemens possesses a path-breaking range of products with the latest technologies for high environment-compatibility and greater economic efficiency. Once integrated in your system, our products enrich the ecological attribute of your electrification solution.
Kölner Verkehrs-Betriebe AG
Cologne, Germany

From April 2001 to January 2003, Kölner Verkehrs-Betriebe tested a prototype of a Sitras SES stationary energy 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: Four turnkey systems, including engineering, manufacture, installation and commissioning


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

Supply voltage: 750 V

Modes: Energy saving, voltage stabilization

Metro de Madrid SA
Madrid, Spain

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

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

Commissioned: 2003

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

Supply voltage: 750 V

Mode: 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. The stationary energy storage units are being used at a total of four installations.

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

Commissioned: 2007

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

Supply voltage: 750 V

Mode: Energy saving
Since 2007 VAG in Nuremberg has been able to rely on the energy saving potential and stabilizing capability of Sitras SES stationary energy storage units.

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

**Commissioned:** 2007, 2011

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

**Supply voltage:** 750 V

**Mode:** Energy saving

Since 2010, a Sitras SES stationary energy storage unit has been making sure that braking energy is absorbed, stored and released for acceleration purposes.

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

**Commissioned:** 2010

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

**Supply voltage:** 600 V

**Mode:** Energy saving

The Toronto Transit Commission has placed its trust in a Sitras SES stationary energy storage unit to reduce the primary energy demand of its vehicles and increase the reliability of its system.

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

**Commissioned:** 2011

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

**Supply voltage:** 600 V

**Mode:** Energy saving
### 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 travelling 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

**Commissioned:** 2007

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

**Supply voltage:** 1,500 V

**Mode:** Energy recovery for optimized power distribution

### Metro Transportes do Sul S.A. (MTS)
Lisbon, Portugal

This hybrid energy storage system has been in operation for passenger services since 2008. And it has proved a great success – the vehicle is able to run without an overhead contact line on gradients of up to 2.6% and saves energy.

**Scope of services:** Engineering, manufacture, installation and commissioning

**Commissioned:** 2008

**Main components:** Hybrid energy storage system – consisting of a mobile energy storage unit and traction battery

**Supply voltage:** 750 V

**Mode:** Operation without overhead contact line

### Innsbrucker Verkehrsbetriebe und Stubaitalbahn GmbH
Innsbruck, Austria

Innsbrucker Verkehrsbetriebe has been benefitting from the energy saving potential provided by a mobile energy storage unit since 2011.

**Scope of services:** Vehicle retrofitting: energy storage unit, modification of vehicle converter and control system

**Commissioned:** 2011

**Main components:** Mobile energy storage unit, vehicle converter

**Supply voltage:** 600 V

**Mode:** Energy saving
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.