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# An environmentally friendly, economical power supply for berthed ships

SIHARBOR shore connection power supply system

Answers for infrastructure and cities.

# Clean power supply for ships

Seaports are particularly important for global trade and economic development. More than 90 percent of the global trade flow is transported across the world's seas and oceans. This poses a special challenge for environmental protection, since the loading and unloading of ships is associated with considerable emissions. And because ports are usually located in densely populated urban areas, thousands of people are affected.

Did you know that over a period of about eight hours a berthed cruise ship (12 MVA) generates:

- as much NO<sub>x</sub> emission as 10,000 cars (1.2 t) and
- as much PM (particulate matter) as 6,000 cars (30 kg) approximately within the same period?

## Ship's emissions harm the environment

The main source of emissions are the diesel generators supplying power to the ships' systems – for example for lighting, navigation and communication equipment. This causes heavy air pollution. To remedy this problem, standards have been specified at the local, national and international levels. There are two ways to meet these standards: either power generation on board using low-emission fuels, or connection to a shore connection power supply system. The onshore solution has proven to be more sustainable, and more economical too.

## Shore connection power supply: A successful model

An effective, clean and straightforward solution: The installation of more than 100 shore connection power supply systems worldwide speaks for itself. A WPCI survey even reveals that more than two thirds of seaports are planning or developing a shore connection power supply system in the next ten years.\*

## Environmental pollution by ships' emissions globally

- 2% of all CO<sub>2</sub> emissions
- 15% of all nitrogen oxide emissions
- 6% of all sulphur oxide emissions

*(Source: United Nations Statistics Division, Indicators for the Millennium Development Goals)*



# Measures for improving quality of life

Numerous regulations and measures have been introduced worldwide with the aim of significantly reducing emissions from ships in ports and substantially improving the quality of life in port environments.

## European environment protection in ports

EU Directive 2005/33/EG, which has been in force since January 1, 2010, limits the maximum sulfur content of fuels used for vessels that moor for more than two hours in EU ports to 0.10 percent by weight.

In addition, the shore connection power supply system is backed by several different organizations. The European Commission has also declared itself in favor of this solution in its Recommendation 2006/339/EC, and funding for shore connection power supply projects is being provided to an increasing extent.

## Emission control areas worldwide

The International Maritime Organization (IMO) has approved binding measures to improve the operational energy efficiency of ships. However, the IMO is also concentrating on measures to counter other pollutants such as sulfur oxide and nitrogen oxide gases or particulate matter.

Annex VI to the MARPOL 73/78 Convention, which became effective in May 2005, sets limit values for the emission of sulfur and nitrogen oxides (NO<sub>x</sub> und SO<sub>x</sub>) by ships' diesel engines. Even stricter conditions are in force for the so-called Emission Control Areas (ECA) of the USA, Europe and Baltic. Within the control areas



for sulfur emissions (SECA), the sulfur content of marine fuels in maritime traffic must not exceed 1.00% m/m (percent by mass); effective as of January 1, 2015, a figure of 0.10% m/m will apply. Outside the SECAs, a sulfur content of up to 3.50% m/m is permissible, which will be lowered to 0.50% m/m as beginning January 1, 2020.

The introduction of nitrogen emission control areas (NECA) for the North Sea and Baltic is currently under consideration. Strict limit values for nitrogen oxide and particulate matter emissions have applied for the coastal regions of North America since August 1, 2012, and these are to be extended to include further areas of the American coast as of January 1, 2014.



**The SIHARBOR system offers numerous advantages:**

- Fast and simple connections to the vessel via a cable management system (CMS) without slip rings
- Cascading power modules cover your individual power requirement
- Saving of additionally qualified personnel for the shore connection
- Control of the complete shore connection power supply system from on board the ship



**Shipowners and shipyards profit from SIHARBOR:**

- Safe and reliable power supply
- Financially attractive option in view of rising fuel prices
- Lower maintenance costs
- Up to 10% lower harbor dues

# SIHARBOR: Highly flexible for every situation

With the SIHARBOR shore connection power supply system, Siemens offers a modular concept for the onshore power grid and the ship's grid. It is optimally adaptable to the different requirements of port operators, shipowners, shipyards and power supply companies.

## SIHARBOR for every power requirement

SIHARBOR covers every power requirement with its power modules. It can be installed in any port, regardless of the berth topology and the type of power supply. The smart system is also suitable for all types of ships.

## SIPLINK for every grid

In international maritime traffic, around 75 percent of all ships are equipped with 60 Hz systems. However, most countries operate their power supply grids with 50 Hz – only 25 percent of countries have 60 Hz systems. With SIPLINK, all combinations of 50 Hz and 60 Hz networks can be covered with all voltage ranges commonly used in the shipping industry.

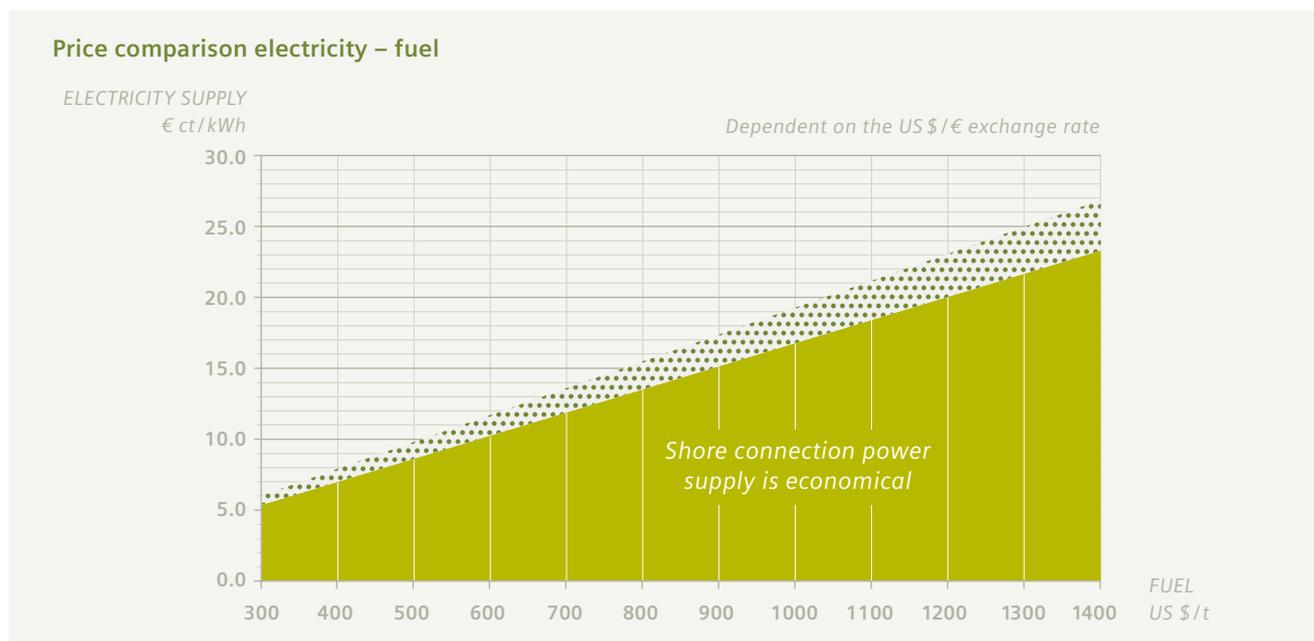
## Cable management system for quick connections

The cable management system operates without slip rings (with the exception of container ships), resulting in fast, simple and flexible shore-to-ship connection, and without the need for additionally qualified personnel. SIHARBOR limits the short-circuit power, thereby preventing overloading of the on-shore grid and the plug-in connection on the medium-voltage side. International standards IEC/ISO/IEEE 80005 and IEC 62613-2 are fulfilled without restriction. The shore connection to the ship is controlled completely from on board the ship.



# SIHARBOR: Cost savings in every respect

Invest in the SIHARBOR shore connection power supply system and you can expect considerable cost savings. The Siemens solution for the shore connection power supply for ships in port is not only environmentally friendly, but exceptionally economical as well.



### Reduced raw material costs

Demand for fuel will increase globally in the future, and low-sulfur fuels are mandatorily prescribed in the ECAs effective from 2015. But measurable savings can be achieved with the shore connection power supply.

### Lower maintenance costs

Maintenance costs for diesel generators are estimated at about 5 US dollars per MWh. The savings potential per ship mounts up to as much as 100,000 US dollars annually, making this a very worthwhile investment.

### Lower harbor dues

Ports encourage the use of shore connection power supply systems with attractive discounts on the harbor dues on the basis of the Environmental Ship Index (ESI)\*.

\*The Environmental Ship Index (ESI) developed by the WPCI for sea-going vessels is based on the NO<sub>x</sub>, SO<sub>x</sub>, PM and CO<sub>2</sub> emission of ships and classifies ships according to their environmental performance.

# SIHARBOR: Very worthwhile for port operators

The use of electrical shore connection systems reduces CO<sub>2</sub> emission by an average of 50 percent referred to the EU average for shoreside power generation. But other forms of environmental pollution can also be reduced significantly with this system.

## Lower emissions

Power generation in on-shore power plants is less harmful to the environment, and these plants are usually situated in less heavily populated areas. This is a major advantage compared with on-board power generation, since the people living in the densely populated areas around ports are constantly subjected to emissions from the ship's diesel engines.

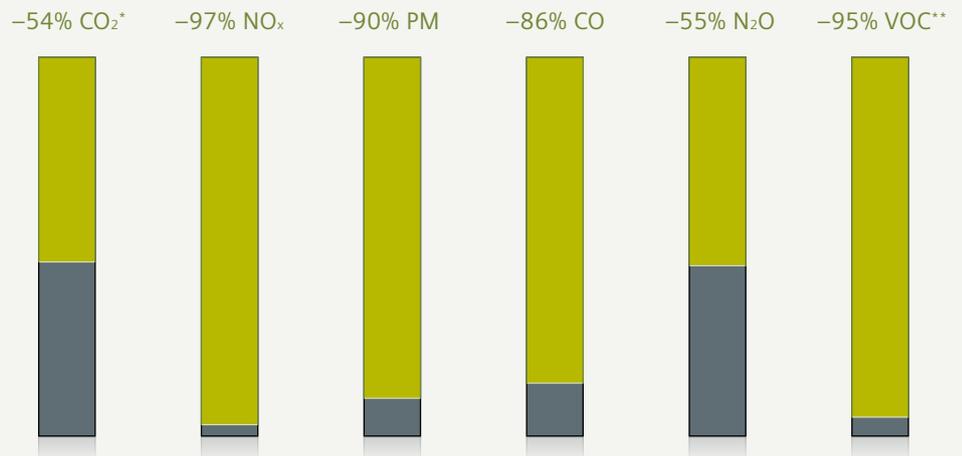
## No noise or vibrations

Diesel generators on ships generate considerable noise pollution with levels of up to 120 dB attained close to the engines. As a result, local residents frequently complain about the noise and low-frequency vibrations which are produced by the generator diesel engines and also transmitted over long distances. The solution is an electrical shore connection that operates completely without diesel-driven generators.

The shore connection power supply is the clear winner in a comparison with power generation by means of diesel generators.

If the power generated on shore is obtained entirely from renewable energy sources, all types of emission can be reduced by 100%.

### Reduction of emissions through shore connection power supply



\*45% with modern diesel engines

\*\* Volatile organic compounds or carbonaceous substances

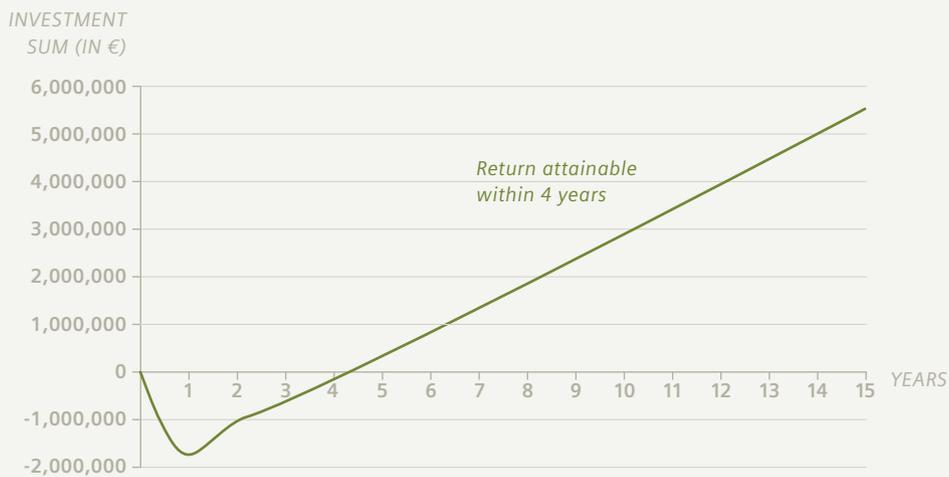
### Seaports rely on SIHARBOR:

- Environmentally friendly power supply for ships with low emission pollution
- Minimal operating costs
- Development of new business fields through power supply for ships
- Less pollution by noise and vibrations in the ports and the immediate vicinity



### High return on investment for your port

Calculation of the return on investment (ROI) for the shore connection power supply for ships in ports



### Parameters for calculating the ROI:

- Investment sum
- Interest rate
- Utilization of berthing capacity
- Amount of power supplied
- Power costs from the power supply company
- Power selling price to ships

# SIHARBOR: All-in-one with proven components

The standardized, modular connection system offers a coordinated concept with components for shore connection power supply.

#### Optimum matching:

##### SIPLINK converter

SIPLINK (Siemens Multifunctional Power Link) enables ship's grids and local power grids to be connected electrically despite different frequencies.

#### Flexible routing:

##### Cable management system (CMS)

The cable management systems for different ship types can be positioned on the quay and automatically compensate for the tidal range. All shoreside cable management systems operate without slip rings; these can lead to malfunctions due to the aggressive operating conditions in seaports. The complete system can be controlled from the ship.

#### Ease of connection:

##### Plug-in connectors

The shore connection power supply is connected via reliable plug-in connectors with integrated connecting sockets for fiber-optic cables. Plugs and outlets for the shore connection power supply are manufactured in compliance with IEC 62613-2 for 6.6 kV and 11 kV transfer voltage – the suitable voltage range for ships with  $\geq 300$  kW power demand.

#### Connection safety:

##### Transformers

Converter transformers provide the SIPLINK connection to the onshore power grid. The ship facing onshore transformer electrically isolates the ship's power grid from the onshore power grids, as stipulated in IEC 80005-1.

#### Reliable temperature control:

##### Cooling system

The SIPLINK system is water-cooled. The heat exchanger is designed either as a water/air exchanger (outdoor installation) or as a water/water exchanger, depending on the application. Noise protection requirements are also taken into account.

#### Suitable design:

##### Switchgear

The switchgear systems can be either air-insulated or gas-insulated. Gas-insulated switchgear systems are preferred for ease of maintenance and space reasons.



**Exact control:**

**Human-machine interface systems**

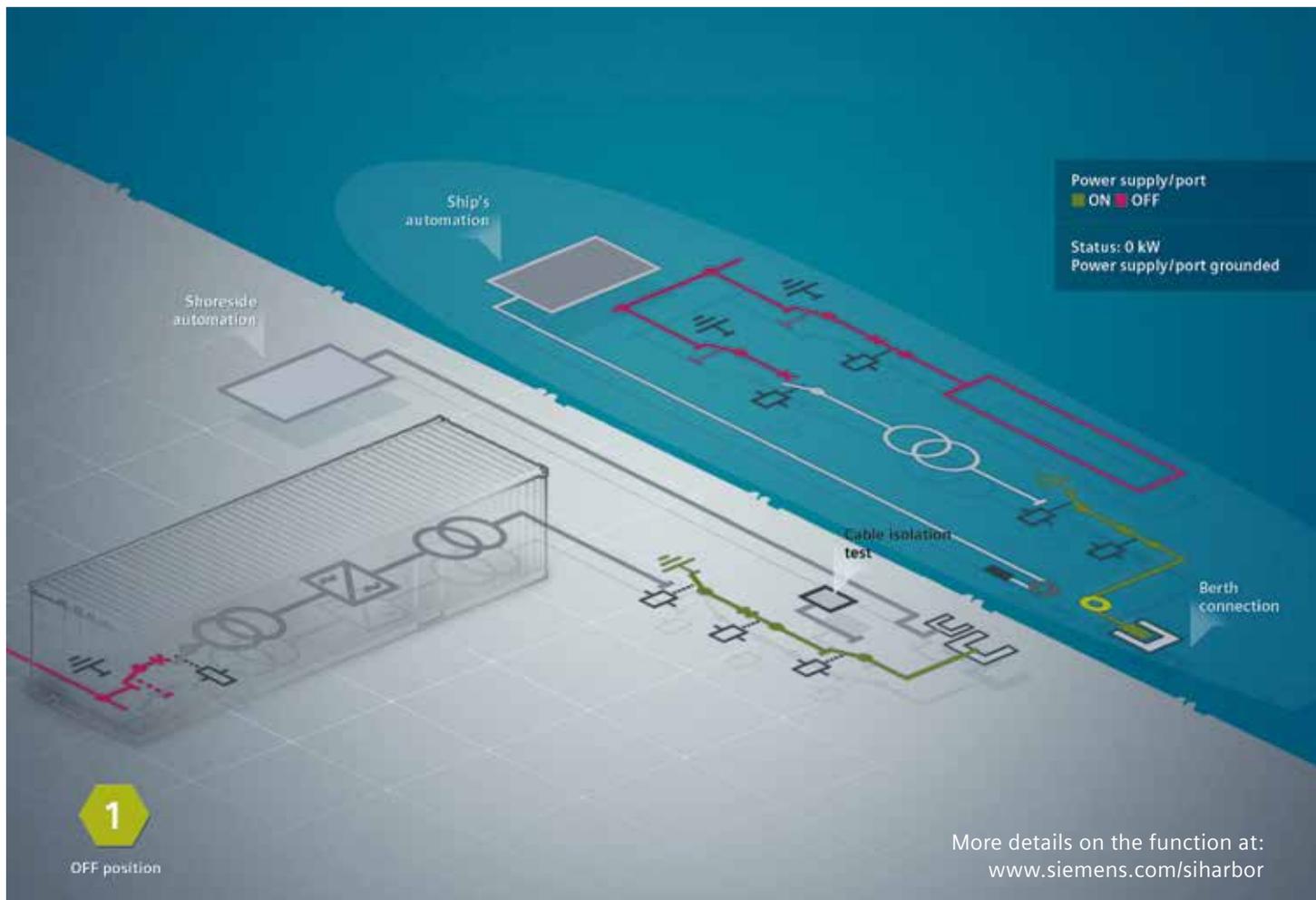
The components of the SIPLINK system are equipped with a local control unit with operating and diagnostics options. A master SIMATIC S7 controller with operator panel monitors the state of the system centrally and displays all operator, alarm and fault data. All data can be transferred to master control systems via standardized bus systems.

**Space-saving construction:**

**The container station**

The system can be installed in existing equipment rooms, although the trend today is towards flexible system solutions in the form of containers or prefabricated stations including converter, switchgear and transformers. The components are preassembled and function-tested at the manufacturer. This is a space- and cost-optimized solution that simultaneously provides optimal safety, efficiency and reliability.

**Function model of the shore connection power supply for ships**



More details on the function at:  
[www.siemens.com/siharbor](http://www.siemens.com/siharbor)

# SIHARBOR: All requirements covered from a single source

With SIHARBOR you get all the advantages of a shore connection power supply, matched to your exact requirements – from a partner who can deliver everything from a single source of supply, right from the start.



- Siemens provides you with a complete solution for your shore connection power supply and assists you with planning and implementation – from the initial idea to start-up and system testing.
- Our service teams are present in 150 countries to provide rapid support.
- Siemens provides all products and services from a single source – including prefabricated substations for connection to the utility grid, medium and low voltage switchgear, cable management systems and automation system, so that no interface problems arise. All components are standardized and come from the proven Siemens portfolio.

## A single source of supply – along the entire value chain

SIHARBOR is our complete solution for the shore connection power supply of berthed ships. Thanks to our comprehensive technological expertise and global presence, we're always close to our customers – with comprehensive service and innovative products that meet all current standards.

Engineering  
topology

Project  
management

Integration

Installation  
and  
commissioning

Support

# References

**Build on our experience and expertise: From the initial idea to commissioning, SIHARBOR is the proven solution for your shore connection power supply.**

## Flensburger Schiffbaugesellschaft



### Requirements:

- Shore connection power supply for powering ships in the shipyard with different voltages (400V/50 Hz, 440V/60 Hz, 690V/60 Hz) from the 50 Hz shipyard grid
- Converter capacity 1 MVA
- No space available for installation
- Testing of on-board generators with energy feedback into the shipyard grid
- Max. acoustic pressure level 45 dB(A) at a distance of 65 m

### Solution:

- Compact and flexible container solution with complete installation of all components, erected on posts at a height of 8 m

### Result:

- Completely integrated solution from a single source of supply
- Lower emission values
- Lower pollution through noise and vibrations in the direct environment
- Safe, reliable power supply for the ships
- Energy cost saving during the generator tests

## Port of Luebeck: TransAtlantic



### Requirements:

- Shore connection power supply for the three paper ferries – TransPaper, TransPulp and TransTimber of Finnish shipping line TransAtlantic with 400 V/50 Hz power grid
- The ships are already equipped for shore connection in Finland and have a cable management system with a plug-in connector, a control unit for the coupling process and a transformer on board

### Solution:

- SIHARBOR package with 6.0 kV switchgear with complete integration of all components in a container
- Connection to the on-shore power grid at the jetty wall

### Result:

- Completely integrated solution from a single source of supply
- Lower emission values
- Lower pollution through noise and vibrations in the direct environment
- Safe, reliable power supply for the ships

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