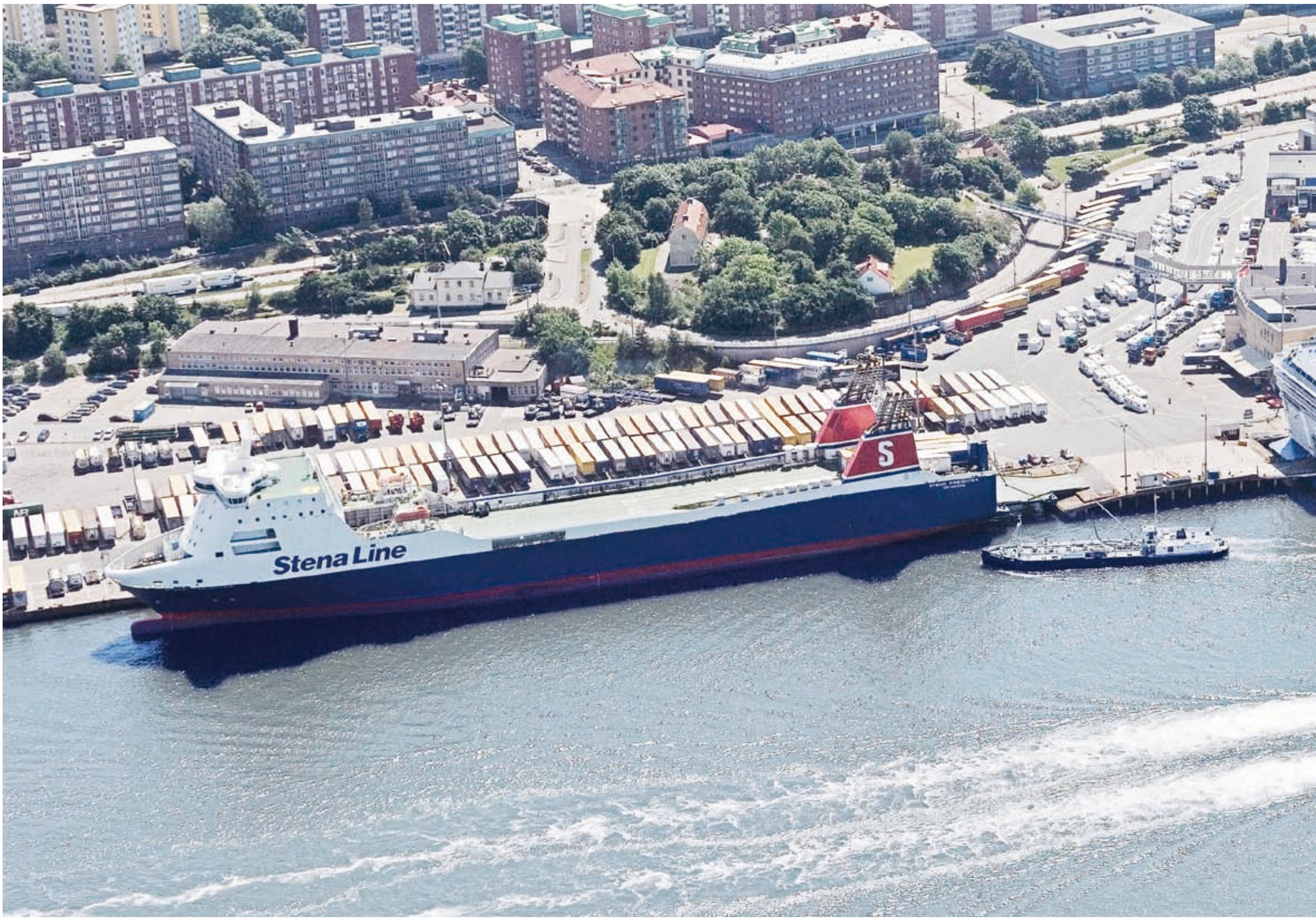


Shore-to-ship power

ABB's turnkey solution is effectively reducing portside emissions

KNUT MARQUART, TON HAASDIJK, GB FERRARI, RALPH SCHMIDHALTER – In the shipping industry, harbor areas have been identified as a prime candidate for enabling significant emissions reductions. With this in mind, port authorities, ship-owners, industry suppliers and regulators are now focusing on the decade-old technology known as shore-to-ship power, for which universal electrical standards are on the verge of being ratified by IEEE, ISO and the IEC. Onshore power supply allows commercial ships calling at ports to turn off their diesel engines and tap into cleaner energy sources. Having successfully delivered the world's first shore-to-ship power connection to the port of Gothenburg, Sweden in 2000, ABB has not only the technologies but also the experience required to make the complete connection, onboard and onshore.

With ABB's shore-to-ship power connection, a large cruise ship can cut fuel consumption by up to 20 metric tons and reduce CO_2 emissions by 60 metric tons during a 10-hour stay in port.

Over 90 percent of the world's goods are transported by sea, and although shipping is a highly efficient means of transporting cargo with lower CO_2 emissions than trucking and far lower emissions than air transport, the industry is still responsible for around 4 percent of all global CO_2 emissions (aviation accounts for 2 percent). With ABB's shore-to-ship power connection [1], a large cruise ship can cut fuel consumption by up to 20 metric tons and reduce CO_2 emissions by 60 metric tons during a 10-hour stay in port – equivalent to the total annual emissions of 25 European cars. It is no surprise then that interest in shore-to-ship power is growing, not only for environmental but also for economical reasons. With a shore-based power connection, a ship is able to turn off its engines without interrupting its port services, such as loading and unloading, hotelling or any other activities that consume power at berth. The connection and disconnection of the ship takes as little as 15 minutes, and administration of power supply and consumption is handled by the port operator.

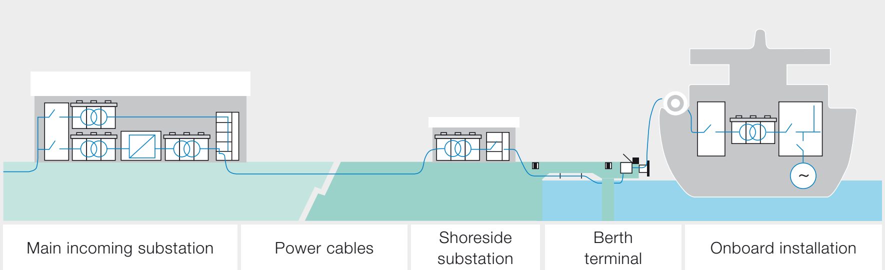
Establishing a shore-to-ship power connection necessitates investment by both shipowners and port authorities or terminal operators in the form of either a retrofit of existing assets or construction of new ones → 1. The ship needs an additional electrical switchboard, cables connecting it to the ship's main switchboard, and, in many cases, a step-down transformer. The port requires a substation with breakers and disconnectors, an automated earthing switch, a transformer, protection equipment such as transformer and feeder protection relays, communications equipment to link ship and shore, and in most cases a frequency converter to adapt the frequency of electricity from the local grid to match that of each vessel. Further, a cable-management system is needed for either the port or the ship.

Such technology is readily available, and given the emission reductions implicit in onshore power as well as the technology's imminent standardization, the solution is gaining attention. It is increasingly appearing in regulations and discussions in the European Union, the United States and within the United Nations' organization for maritime policy, the IMO. EU directive 2005/33/EG, which went into effect January 1, 2010, exempted ships using shore-based electricity from a rule requiring use of reduced sulfur-containing marine fuels while in port. In the United States, legislation proceeds state by state; California, a regulatory forerunner, has begun to require shoreside electricity connection for some ship types. At the IMO level, new restrictions on the allowable sulfur content in fuels improves the economical case for onshore power, without explicitly mandating or supporting it.

Footnote

1 Shore-to-ship power is also known as cold ironing, onshore power supply, alternative maritime power (AMP), or shore connection, among others.

1 Overview of a shore-to-ship power connection



Onshore power supply is a well-established technology → 2, which is already available at several ports, including those in the United States, Belgium, China, Canada, Germany, Sweden, Finland and the Netherlands. With a new set of global shoreside electricity standards on the verge of ratification, the practice is expected to rapidly expand for all major types of ships and ports worldwide.

Regulations point to onshore power

As regulators realize that pollution stemming from the shipping industry is having a major impact on public health as well as costs, they have increased their attention on this industry. Since at least the late 1980s, the IMO has focused on how to reduce the environmental impact of shipping (oil spill prevention has a much longer history). National, city and port authorities are also initiating regulation of emissions generated by ships.

Currently, there is no law or rule requiring ships at port to connect to an onshore power supply, but standardization may well lead to increased adoption of onshore power technologies.

Regulations in Europe

In Northern Europe, mapping of global emissions began on a large scale in the 1970s. As a result of these studies, initial efforts to reduce emissions-based public health threats such as acid rain focused on land-based emissions sources. In the 1980s, the focus thus became power plants and automobile and truck traffic. However, as the studies showed higher levels of deposition of pollutants in coastal areas and along major sea lanes like the English Channel than could be accounted for by known polluters, it became clear that ships in international transit were responsible for a considerable amount of pollution. Sweden and Norway brought these studies to the attention of the IMO in 1988. Almost 10 years later, the IMO's convention (MARPOL Annex VI), which limits the amount of pollutants in marine fuels, won acceptance. This convention went into effect in 2005.

The EU has taken steps toward reducing emissions from ships in tandem with the IMO. When the EU was developing a strategy to deal with shipping-related pollution in 2001 and 2002, the potential for onshore power supply was already being discussed. This resulted in a directive requiring all ships berthed in EU ports to use marine fuels with a maximum sulfur content of 0.1 percent, with few exceptions – one was an exemption for ships using power from shore.

The EU has opted to pursue a policy that does not favor any particular kind of abatement technology, but rather reaches for overarching goals. In the case of shipping emissions, EU legislation has prioritized cutting emissions that immediately impact health in areas close to ports or major shipping lanes, but has taken a regional perspective. The lasting and widespread effects of acidification and particulate pollution also drove legislation. (Emission of CO_2 has not been in focus with respect to shipping, as CO_2 emissions have only a slight impact on local health compared with particulate emissions.) The issue has been addressed by the EU and the IMO, particularly with respect to a carbon emissions trading system, but there are no definitive outcomes as of yet.

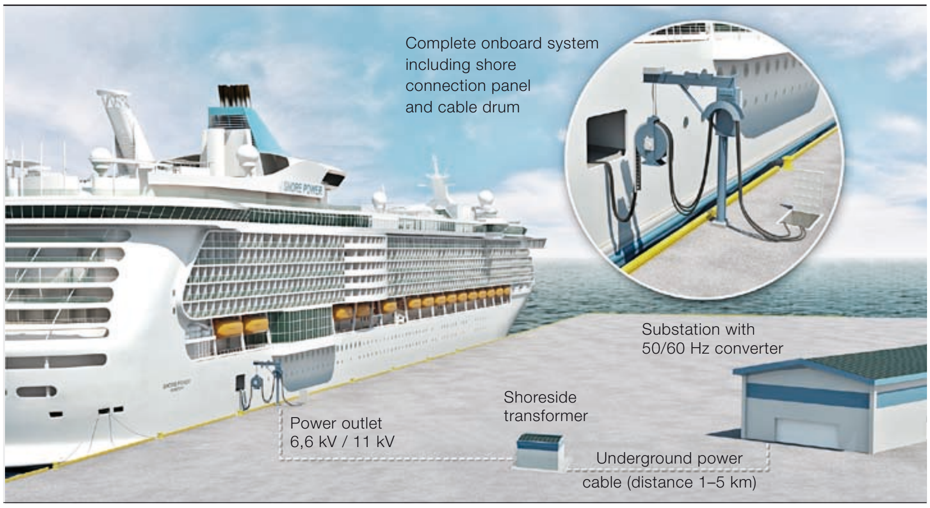
> The environmental profile of electricity generated by power plants on land versus ships' diesel engines running on bunker fuels is one of the main advantages of shore-based power.

Regulations in the United States

Compared with the EU, the Environmental Protection Agency (EPA) of the state of California has gone much farther toward stipulating shore-based power supply to docked ships, although it provides for alternative technologies. The EPA requires container ships, passenger ships and refrigerated cargo ships to either turn off their auxiliary engines for most of their stay in a Californian port and connect to another power source (eg, grid-based), or use other control techniques that achieve the same emissions reduction.

Initially, this regulation only applied to a few vessel types, and within fleets that call at Californian ports 25 or more times per year. Effective January 1, 2010, any ship that could connect to shore-based power and was part of an affected fleet would have to use shore power if it was available at the port and was compatible with the ship's equipment. The requirement for 2014 does away with the loopholes for ships not ready for shore power and sets a 50 percent fleet-wide maximum limit to power generated by auxiliary engines while docked. In 2017, 70 percent of a fleet's port visits must be shore-power visits and engine power generated by the ships must be reduced by 70 percent; in 2020, these numbers increase to 80 percent.

The regulatory developments in the IMO, the EU and the state of California are being followed closely by other jurisdictions, such as other American states and countries in Asia. Generally, it is expected that regulatory authorities will set increasingly strict rules for emissions from ships in port, increase taxes on sources of pollution and make exemptions for onshore power connections, opening the door to companies such as ABB that can supply the complete shore-to-ship power solution.



Evaluating the benefits

For port authorities and shipowners, the merits of shore-to-ship power supply versus the competing emissions-abatement technologies are debatable. The operational profile of the ship also has a big impact – eg, a ferry calling in a port every day is quite different from a container vessel calling in a port once a month. Thus, it is difficult for investors to calculate long-term return on investment as the regulatory picture changes. Fluctuations in the price of marine bunker fuels [2] compared with shore-based electricity also influence calculations.

The environmental profile of electricity generated by power plants on land versus ships' diesel engines running on bunker fuels is one of the main advantages of shore-based power. Generally, when power production can be reduced to as few producers as possible, these producers can be more easily and efficiently optimized to reduce environmental impact.

Another argument for shore-to-ship power is the advantage of jurisdiction. With onshore power arrangements, regulators can deal with the specific, local problem of pollution with a specific, local response. Efforts to capture emissions from auxiliary diesel engines can be used throughout a ship's operations worldwide, but it takes away any scope of action by local or regional authorities.

For ports, the ability to supply power to ships at berth enables them to establish a more efficient and powerful overall electrical supply as a utility. The use of state-of-the-art frequency converters can provide both a stabilizing effect on the local grid and an improved power factor. Effectively, this means the local power system experiences lower losses.

Onshore power supply has an additional advantage over other emissions abatement technologies in that it reduces both noise and vibration in port areas. This is a benefit to merchant mariners, passengers and crews, port workers and the surrounding community of ports, particularly large ones. Some ports have encountered growth constraints related to their environmental permits, as their operations' emissions, noise or vibration levels have become too high.

Finally, shore-to-ship power is easily scalable; infrastructure investments are sustainable over decades with long-term revenues and relatively little maintenance. For each new port that invests in shore connections, the cumulative value of the technology increases by a factor, as more and more ships and sailing schedules are impacted.

Arguments against shore-to-ship power are related to the provenance of the shore-based power, the costs of investing in infrastructure, safety and efficiency concerns in port operations, and the need to use technologies that also influence emissions when a ship is at sail.

Onshore power supply has an additional advantage over other emissions abatement technologies in that it reduces both noise and vibration in port areas.

Studies have shown that switching from ship-based diesel power generation to onshore coal-powered electricity has a limited environmental benefit (with increases in particulate matter and, potentially, sulfur oxides), while other forms of power have a more considerable benefit; renewable energy sources, in particular, improve port operators' environmental footprint.

The costs of investing in shore-based power infrastructure are considerable, and a template for how governments, port or terminal operators and shipowners share these costs has not yet been established. At the port of Gothenburg, for example, a ship charterer that was determined to improve the environmental profile of its supply chain invested in the infrastructure. At the Port of Long Beach and Port of Los Angeles, which are owned by the local government, port infrastructure is financed by taxpayer dollars. However, as the cost of emissions and the regulations that prevent them increase, more and more funds will be made available from both private and public sources.

Safety and efficiency concerns in port operations are also very important. Container terminals, with large rolling gantry cranes, present challenges in terms of cable placement and shoreside infrastructure. In ports, space is at a premium. Additionally, both port authorities and shipowners are concerned with the possibility of injuries or deaths related to power connection. The introduction of strict shore connection standards and technical solutions that allow smooth dockside operations and safe cable handling should allay these concerns.

Footnote

2 Marine bunker fuel is any fuel used onboard a ship.

3 ABB shore-to-ship power connections have already been installed on a variety of vessels, including oil tankers, container ships and cruise ships.

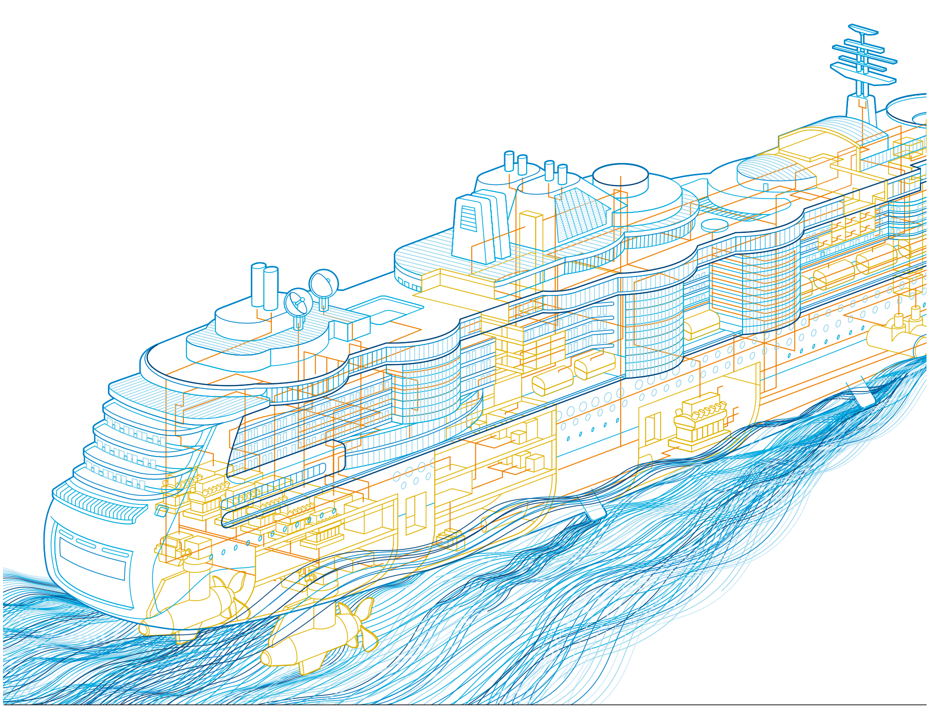


ABB has developed scalable and flexible installation solutions that meet the needs of shipowners and ports.

A shore solution

Shore-to-ship power connections have been implemented in approximately two dozen port terminals worldwide starting in 2000, and on over 100 ships ranging from cruise vessels to oil tankers and container ships → 3. Countless other port operators and shipowners are assessing an investment in the technology, on the condition that global standards for shore connection are realized.

Acceptance of and investment in shore-based power supply infrastructure has been limited due to the lack of a global standard. A public specification is already available, and this is being used by shipowners and port authorities to assess future installations. Existing technology solutions are largely built up around these specifications.

Regulatory moves by local, national and international bodies that spur adoption of shore-to-ship power supply include taxes on fossil fuels, requirements to marine fuels and stipulation of onshore power supply (or alternatives with equivalent emissions reductions).

Shore-to-ship power supply is in most instances a practical and effective means to reduce emissions in heavily used port areas. The technology is available, but its adoption is contingent upon its being available at a large number of ports, and in a large number of ships. ABB has developed scalable and flexible installation solutions that meet the needs of shipowners and ports. As part of ABB's shore-to-ship power solution, the company has engineered both shoreside and shipside connections, and is one of the few companies worldwide that has developed a reference list in this technology. Single or multiple shoreside connection points can be engineered and installed in the span of six months to one year; onboard installations can be engineered over a period of a few months and installed in the span of one week.

It is believed that a global standard will bring about a much higher level of investment in the infrastructure, thus stimulating an ever greater number of shipowners and port authorities to prepare their operations for shore-to-ship power. Already there are a growing number of portside expansion projects worldwide, and with its highly sustainable and efficient shore-to-ship power solution, ABB is fully equipped to provide the required technologies. To ensure its portside offerings are meeting the market needs, ABB continues to collaborate with customers worldwide.

A more detailed discussion of the technologies involved in ABB's shore-to-ship power will appear in the next issue of *ABB Review*.

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