Background information

Shore-to-ship power
Dock-side power reduces emissions

The shipping industry is facing increasing scrutiny when it comes to emissions, especially while in port. The solution at an increasing number of ports is to switch from onboard generation to grid power delivered right to the quay.

Over 90 percent of the world's goods are transported by sea, and as trade grows with the global economy, so too does the volume of goods being shipped. That means more ships making more voyages, burning more fuel, which in turn means more emissions.

Overall, shipping is a highly efficient means of transporting cargo with lower CO_2 emissions per ton-kilometer than trucking and far lower emissions than air transport. Still, the industry is estimated to account for around 4 percent of all CO_2 emissions globally (compared to 2 percent for aviation). Shipping also accounts for 10 to 15 percent of all emissions of nitrogen oxides (NOx) and 4 to 6 percent of sulfur oxides (SOx), which are tied to smog and acid rain, respectively.

A study conducted by the port of Long Beach, California, found that ships berthed at the port released on average 13 tons of NOx per day. That is equivalent to the daily NOx emissions of nearly 250,000 cars, according to estimates of auto emissions from the US Environmental Protection Agency.

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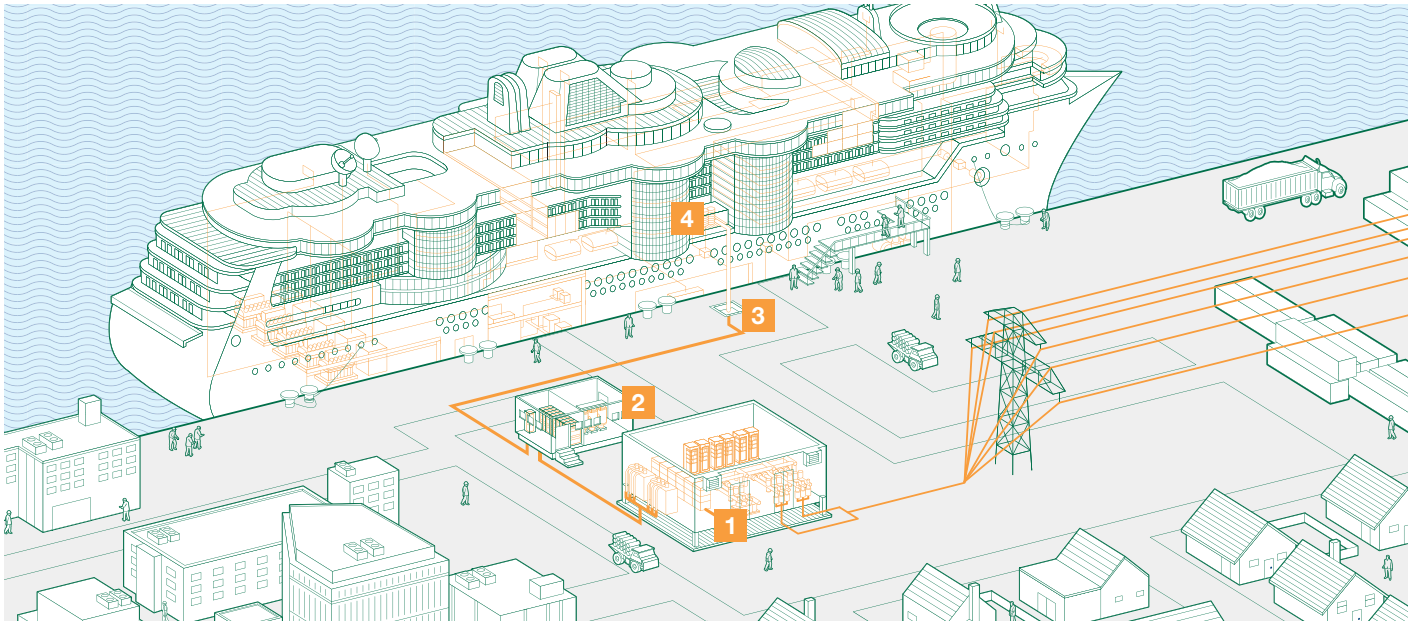

[1] Substation
[2] Frequency converters
[3] Berth terminal
[4] Power electronics

There are also significant health impacts associated with ship emissions, mostly due to air quality issues in the communities surrounding large ports. One study conducted in 2007 put the total societal cost of ship emissions at $255 billion per year.

A plug at the dock

As arresting as these figures may be, there is now an answer to the challenge of mitigating ship emissions while in port: AMP or alternative maritime power.

The concept of AMP, also known as shore-to-ship power, high-voltage shore connection (HVSC) or by its historical maritime term “cold ironing,” is simple. Instead of running diesel generators on board, ships draw power from a connection right at the quay. For ferries and other roll-on roll-off vessels, this might amount to one or two megawatts (MW), but large container ships can use as much as 6 MW while in port and cruise ships up to 15 MW. That’s enough power to serve more than 25,000 average homes in Europe.

Given the large increase in power required to serve docked ships, the local grid connection to the port must usually be upgraded and this will include the addition of a substation. A new substation can be as much as 10 km away, which is important since quayside space is at a premium.
The equipment required at the quay can be housed in a container-sized enclosure, and can even be mobile.

AMP systems are made up of components that are long established in other power applications: transformers to shift voltage levels, circuit breakers to protect electrical equipment, frequency converters to allow power to be supplied to ships

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from different regions, etc. The technology is not new, and is thus already proven.

On board the cable handling system and the various elements of the connection panel (circuit breakers, relays, cable connections, etc.) can be retrofitted to existing vessels, even while the ship is in service. Many shipbuilders now incorporate AMP capability into their designs or leave room for it to be added later.

An AMP-equipped ship docking at a similarly equipped port can switch to shore-based power in as little as five minutes upon arrival.

Benefits

The environmental benefits of AMP are compelling. The World Port Climate Initiative (WPCI) estimates that a ship using power from shore instead of onboard diesel engines will generate 50 percent less CO_2, assuming the average fuel mix for European power. Even electricity derived entirely from coal-fired plants would yield a 30 percent reduction in CO_2 emissions. An all-renewable supply would cut CO_2 emissions almost entirely.

In terms of SOx emissions (gases/compounds associated with acid rain), the benefits depend largely on the type of fuel being used by the ship's auxiliary generators.

Low-sulfur fuel (0.1 percent) is roughly on par with shoreside power in terms of SOx emissions whereas using AMP instead of generators using conventional fuel, yields a 96 percent reduction in SOx emissions. However, low-sulfur fuel is also more expensive. Smog-inducing NOx emissions are greatly reduced using AMP regardless of fuel. Assuming the average EU-25 fuel mix used in power generation, a ship receiving power from shore will produce just 3 percent of the NOx emissions it would using onboard generators.

Market drivers: regulation and standards

The world's first AMP system was installed by ABB at the Swedish port of Gothenburg in 2000. Since then, the technology has been applied in ports up and down the Pacific coast of North America as well as in Germany, Sweden, Finland and Holland.

Regulations enacted in Europe and locally in North America have made shore-to-ship power a more attractive option or an outright requirement for ship operators, and this is largely responsible for the development of the AMP market to date. Other ports will likely follow suit. However, one major obstacle to further adoption of AMP has been the lack of an international standard for shore-to-ship connections.

That is about to change. Three major organizations—the IEC, IEEE and ISO—have jointly published a draft standard for AMP connections that is expected to be finalized by the end of 2010. With that standard in place, port operators and ship owners alike will have a far greater level of confidence in making investments in AMP.

Consistency on a technical level is also important because, currently, fuel cost savings alone do not make a business case for a ship operator to convert an existing vessel to receive power from shore. So, regulation will continue to be the primary driver for AMP investment. There are other benefits, however. Vibration and noise associated with the operation of auxiliary engines on board creates an environment that is less hospitable for workers, but is also unpleasant for nearby residents. That can make it difficult for ports to expand their operations.

Market outlook

ABB estimates the potential market for AMP, including both onboard and onshore systems, to be $15 billion over the next five to 10 years. If more stringent regulations for CO_2 and "traditional" pollutants like NOx and SOx are enacted, that will provide an even stronger incentive for AMP.

The market, however, is already prepared to adopt this technology. A WPCI study of 53 ports worldwide found that among reasons given for not pursuing AMP, "difficulty convincing ship owner/port owner" was the lowest ranked response.

ABB's role

ABB has been an active participant in the standards development process, and has pioneered AMP in the field. The company's groundbreaking project at Gothenburg in 2000 has received two awards for environmental excellence: the Clean Marine Award given by the EU in 2004 and the Clean Seas Award given by Lloyd's List in 2008.

As of August 2010, ABB has retrofitted 20 vessels for AMP, including cargo ships and cruise liners. Indeed, the company addresses both onboard and port-side requirements, and offers turnkey AMP solutions for both sides of the connection.

Having both electric power systems and marine automation squarely within its core competency, ABB is uniquely positioned to serve a global AMP market that is poised for significant growth.