Green is the New Black

In response to demands to reduce emissions, the shipping industry is reconsidering wind power

By Lydia Mullan

In addition to cutting a fine figure, *Tres Hombres* is one of the most ecofriendly vessels on the high seas

PHOTO COURTESY OF PIERRE FROMENTIN, FAIRTRANSPORT

There is perhaps no area of human endeavor that has shaped the modern world as much as trade and transport. Think of the vast network of indigenous trading routes crisscrossing the Americas, Asia's Silk Road and the clipper ship routes round Cape Horn. Here in the United States, the country's biggest cities, including New York, Los Angeles and Miami, were not only all established as seaports, but remain influential centers for culture and commerce today.

The shipping industry, though, has a dirty secret. Despite being far and away the most efficient means of transporting everything from cars to shipping containers filled with electronics or running shoes, it's still a major source of pollution.

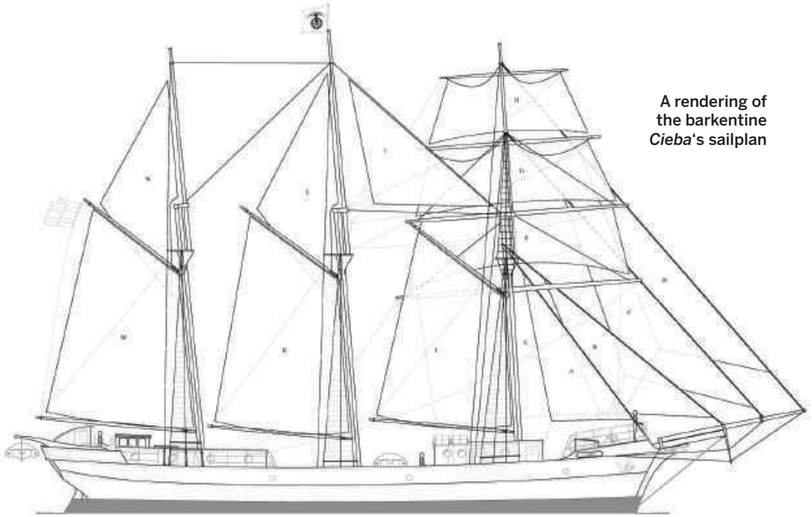
According to the *Third IMO Greenhouse Gas Study 2014*—an effort commissioned by the International Maritime Organization (IMO) to study the industry's role in climate change—the world's commercial vessels collectively burn around two billion barrels of heavy fuel oil per year. The heavy fuel oil (HFO), or bunker fuel, used by most ships is also a highly contaminated byproduct of crude oil processing. As a result, in addition to being burned in great quantity, it's also extraordinarily toxic. An especially damaging contaminant in bunker fuel is sulfur, which contributes to acid rain and the acidification of the oceans.

In 2016 the IMO responded to this problem by requiring all commercial shipping to reduce sulfur emissions beginning January 1, 2020. Options include switching over to "Very Low Sulfur Fuel Oil" (VLSFO), continuing to use "Intermediate Fuel Oil" (IFO) but with scrubbers to clean emissions, or switching to propulsion systems that use liquified natural gas (LNG). This has left companies with some tough decisions.

According to Anja Roennfeldt, senior vice-president at Global Ocean Freight Trade Management, Schenker AG, "The difference between VLSFO and IFO was $250 to $300 per ton at the time of the switch, and carriers needed to start using the compliant fuel several weeks before the official start date to clean the engines," so new VLSFO systems and their fuel were costly. However, installing scrubbers to continue using cheaper fuel is also both expensive and time consuming—costing around $10 million and taking up to three months—and an entirely new system for LNG isn't cheap or fast either. Even then, it's not as simple as crunching the numbers.

"While we have been under the impression that liquefied natural gas may be the 'cleanest' option, there is contradicting information about this," Roennfeldt says. "The same goes for the VLSFO; the concentration of black carbon seems to be much higher and thus is actually much more impactful to the ocean than heavy fuel oil with higher water contents. It's very confusing."

Ceiba is being built at a carbon-neutral yard in Costa Rica



A rendering of the barkentine *Ceiba*'s sailplan

PHOTO AT LEFT AND SAILPLAN COURTESY OF **SAILCARGO INC**; PHOTO AT RIGHT COURTESY OF **SKYSAILS**

So what else can be done to "green up" an industry that has roughly the same carbon footprint as Germany? As any sailor with solar panels or a wind generator knows, the output of these devices can leave something to be desired. But, of course, harvesting and converting energy to electrcity is not the only way to move a boat. There are also sails, the same things that powered international trade for millennia. The result has been the dawning of a new "Age of Sail," with companies all over the world now offering various approaches to wind-powered cargo shipping, including classics, retrofits and all-new designs.

The Classics

Whether it's historic ships pressed back into service or purpose-built replicas, there are now a surprising number of companies using square-riggers, schooners and ketches to transport goods both around Europe and across the Atlantic.

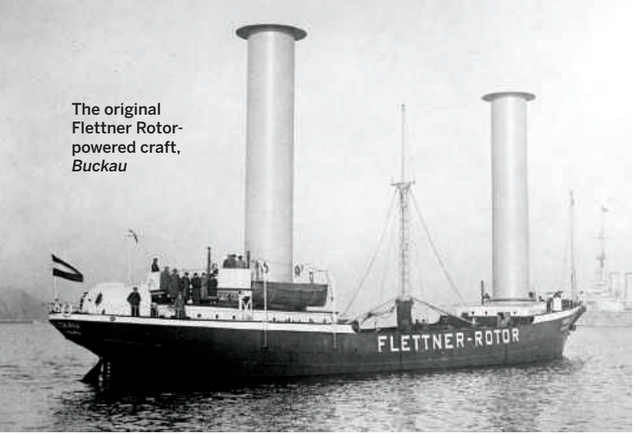
The barkentine *Ceiba*, for example, is an entirely carbon-neutral ship currently in-build with Sailcargo Inc (sailcargo.org). "Construction of wooden ships reached its peak around 1900-1920, and this is the time period that our style of building is from," says director and founder Danielle Doggett. "Our aim is to demonstrate that a for-profit company can be regenerative from inception. By making conscious decisions about where and how we're sourcing our materials, we can record all of the data and make a comprehensive report on the entire process, and hopefully set a precedent for construction projects of all kinds in the future, not limited to just wooden shipbuilding."

Wing kites, like this one from SkySails, are gaining momentum

Ceiba is being built in Costa Rica, where wood can be locally sourced and trees replanted. The materials and sourcing are at the heart of this project. "Consider any fiberglass vessel… working with fiberglass can be detrimental to human health and can cause lasting adverse effects in addition to short-term skin irritation," Doggett says. "When the waste is not properly disposed of in receptacles managed by the government or other waste management companies (creating dependency), it causes damage to the surrounding environment. When you begin to look at the cradle-to-grave consequences of a material, you begin to see the issues that surround it."

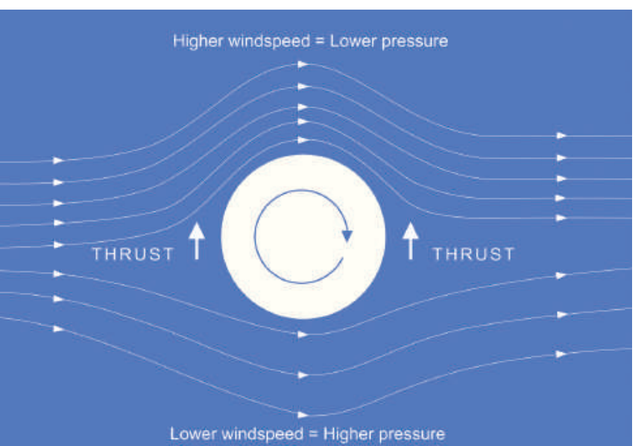
Square-rigged on her foremast and fore-and-aft rigged on her main and mizzen, *Ceiba* was designed by Naval architect Pepijn van Schaik and is an evolution of the coastal trading schooner *Ingrid*, built on Finland's Åland Islands. With a length on deck of 116ft, she will draw 14ft and carry up to 250 tons of cargo in in her 12,360ft^2 hold. In addition to her sails, *Ceiba* will be equipped with an electric motor and a combination of solar panels and wind turbines for auxiliary propulsion and close-quarters maneuvering.

By contrast, Andreas Lackner, Jorne Langelaan and Arjen van der Veen of Holland's Fairtransport Holding decided to use an existing hull as the starting point for their 91ft brigan-



The original Flettner Rotor-powered craft, *Buckau*

Modern designs are sttrikingly similar to the original



Flettner Rotors take advantage of the Magnus effect in order to "sail" without a sail. When the cylinder spins around an axis at an angle to the wind, the cylinder is deflected or pushed toward the low-pressure side

tine *Tres Hombres* (fairtransport.eu). "*Tres Hombres* was converted from a WWII motorship into an engineless sailing cargo ship and ambassador for emission-free trading and shipping," Lackner explains. "One hundred and fifty people from all continents took part in the restoration, spending 160,000 working hours over 2.5 years." This same outpouring of support has also helped them expand their small fleet to include the wooden ketch *Nordlys*, built in 1873, the oldest working cargo ship.

Fairtransport carries a variety of goods, including coffee, wine, chocolate, olive oil and rum, many of which can be purchased directly through the company's website. The company also accepts paying passengers, or trainees. *Tres Hombres*, which can carry a full 40 tons of cargo in her holds, has crossed the Atlantic a dozen times. *Nordlys*, which carries around 25 tons of cargo, restricts her passage to European waters.

"What we do, we can do for hundreds of years, without damaging ecosystems or anybody's health," says Lackner. "What else would you call sustainable?"

Retrofits

Of course, gaff-riggers are all well and good for carrying things like coffee and rum, but moving Mazdas or bulk cargos of cement or grain requires a different approach. Enter the retrofits, modern commercial vessels whose conventional propulsion systems have been upgraded to include some form of wind propulsion. This approach offers the benefit of being cheaper and faster to install than scrubbers or an all-new fuel system—think three days versus three months.

One intriguing approach is a wing sail, like the Seawing. This wing-like kite can be easily fitted to the bow of existing ships and is built by Airseas (airseas.com), a spinoff of Europe's aircraft builder Airbus. Looking like a giant version of the air foils use by kiteboarders, the technology can be deployed in winds from 15 to 40 knots providing fuel savings of up to 20 percent. Airseas says its fully automated kites can be retrofitted to virtually any ship in the same time it takes for a regular port-of-call. Because the Seawing deploys, flies and furls automatically, no extra crew is necessary, allowing the system to pay for itself that much more quickly.

Another company making inroads in this area is Germany's SkySails Group (skysails-marine.com). As is the case with the Seawing, SkySails deploy and manage themselves automatically, and can be built as large as 10,700ft². According to SkySails, its kite sails generate up to 25 times more energy per square foot than "conventional sail propulsion systems," in part because operating at altitude means they're catching winds that are a good deal stronger than those at sea level. "There is enormous, free wind energy potential on the high seas. With SkySails, we can cut fuel consumption of our ships in half on good days and save an average of 10 to 15 percent in fuel every year," said Gerd Wessel, managing partner of the shipping company Wessels Rederei GmbH.

Another retrofit option gaining momentum in the world of commercial shipping is the Flettner Rotor. The technology, however, is far from new. Back in the 1920s, a pair of early prototypes were retrofitted to the freighter *Buckau*, which then successfully crossed the Atlantic under "sail." However, in a time of cheap oil and few, if any environmental concern, the technology languished until recently when designers and shippers began reconsidering it as a source of sustainable propulsion.

Though they don't look much like conventional cloth or even wing sails, the spinning cylinders actually use the same basic physical principle to propel a boat as a sail does—employing the Magnus effect. Put simply, as air passes over a rotating cylinder, its speeds up on one side of the cylinder and slows down on the other, creating a pressure differential that sucks the boat forward, just like when sailing close-hauled.

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IMAGE COURTESY OF THE INTERNATIONAL WINDSHIP ASSOCIATION

New builds allow designers to reimagine what a sailboat looks like, as seen in Neoline's double sails

Several European companies, including Norsepower (norsepower.com) and Anemoi Marine Technologies (anemoimarine.com), produce Flettner Rotors that can be retrofitted to everything from bulk freighters to passenger ferries and provide fuel saving from 5 to 20 percent without changes being made to operation (such as weather routing). As is the case with kite sails, the systems are highly automated, requiring little extra crew effort. A number of commercial vessels are now equipped with Flettner Rotors, including the 800ft tanker *Maersk Pelican* and 700ft cruise ship *Viking Grace*.

New Builds

Though the number of freshly minted sailing cargo ships on the water is low, a handful of designs are in the works, employing a variety of rigs. Presumably, more will follow after these vessels have had a chance to prove themselves out in the real world.

An especially interesting player in this area is France's Neoline (neoline.eu/en), which is currently working on a ship specially designed for "clean transoceanic sea transport, at a stable price and adapted to the logistical reality and the needs of shipper." No small feat! The company's design features an unusual double-main, with two overlapping sails forward and two slightly smaller ones aft, rigged together with scaffolding. A brand sailors know well has already signed on to have its cargo transported using a Neoline vessel: Beneteau plans to send boats to the U.S. market aboard one of the ships once they're operational.

Another company with a unique new build in the works is France's TOWT (towt.eu). Founded in 2011, TOWT has historically employed an assortment of classics to transport its goods, which include things like wine, coffee and olive oil. Over the years, schooners, luggers and ketches have all been part of the fleet, plying their trade over five separate Atlantic routes. However, the company is also now working on plans for a 220ft, three-masted schooner with a projected average speed of 12 knots and a carrying capacity of 1,000 tons. Planned routes include those to Portugal, the Caribbean, Central America and West Africa, taking the company's already successful model to a whole new level.

Looking Ahead

So, what does the future of "green" shipping look like? It depends on who you ask. "It's my job to sell the concept that wind works and is a real solution for shipping. It's our member's job to sell the technology they've created to make it happen," says Gavin Allwright of the International Windships Association (wind-ship.org), a group that advocates for wind-powered shipping solutions. Classics, retrofits and new builds are all represented in the group's membership, making it an international alliance where would-be competitors come together to promote a common goal.

This diversity only makes sense, given that when it comes to reducing pollution from any industry, there is no silver bullet. Whether building the infrastructure for romantic-yet-carbon-neutral ships like *Ceiba* or creating technologies to power larger, more conventional commercial vessels, the only wrong way to cut down on emissions is not doing it. No matter what the solution (or solutions) ultimately look like, though, it's exciting to see the dawn of a new "Age of Sail."