

Nautical Solarpunk - A Resource for Solarpunk Writers and Artists

I've been reading up on modern sail ships and asking questions while working on some solarpunk sailing artwork. At this point, I think I have gathered enough information that it might be useful to someone else.

So if you want to include ships in your solarpunk story (even just mentioned in the background) or you're looking for references for some artwork, take a look. I'm very much not an expert, but I've been pestering some of them, and collecting examples from the internet and doing my best to organize it. Hopefully this by-laymen-for-laymen approach will help make it accessible without leading you astray.

One thing to note up front: there's a ton of variety here. Historical nautical terminology is remarkably chaotic - probably because most of it predates manufacturing practices that involved standardization. Highlights include the fact that ships can be classified based on size, sail plan, rigging, hull type, how they're used, some combination thereof, or whether they have a figurehead or not. Modern sail-based freight shipping is still very new and I get the impression that the industry as a whole is sort of picking up old ideas and new ones and trying them in different combinations to see what fits. There are very few finished examples underway out in the world and I'm not sure we'll know what designs are the absolute best for which use cases until a lot more ships have been launched and put to work.

That said, I think we're definitely going to see a resurgence of sail and it seems like there's a decent amount of interest and enthusiasm in the industry, even if many are understandably nervous about making huge changes when those changes involve incredibly expensive ships.

Why sail?

It's the original zero-carbon (-ish, they deforested huge amounts of land and destroyed entire habitats to build ships back when) shipping and transportation system. We had the technology to move cargo and passengers using the wind to directly do most of the work, and we have the technology (metal hulls, automated rigging, satellite navigation systems, radio, etc) to do it much more safely than our ancestors could. Even if a shipping company isn't motivated by regulations or pure environmental reasons, oil will get more expensive eventually and that will cut into the profitability of giant motor vessels.

How shipping might change:

Modern day shipping is extremely cheap but only when you limit the metrics you track to money. When you account for the pollution, the waste, it gets a lot harder to justify. A huge part of keeping modern day cargo shipping cheap is using the absolute worst fuel (bunker fuel, tar-like stuff left over after distilling and cracking petroleum, which is contaminated with everything the fuel they were actually making couldn't include), as soon as they hit international waters.

I think a solarpunk society is one that cares about externalities.

I genuinely like the optimization and logistical advantage of using standardized, stackable shipping containers which fit on ships, trucks, and trains without the need to load and unload the cargoes by hand at each transition in their journey. That's great stuff, no complaints.

What I wonder about is if the cost efficiency brought by combining containerization with ever-more-massive, bunker-fuel-burning ships has caused other problems. We ship cargo all over the world but much of the time, we do it because it's so cheap to do so. Many of those containers are full of cheap tat that ends up in landfills after one use or no use at all. We ship raw material from one continent to process it on another, we ship that material to another so it can be shaped into parts, which are shipped away for partial assembly on another continent, and then again for final assembly. Is that efficient? It's cost efficient. But we burn terrible amounts of fuel each time we do it, and we do it for so many things.

When you read through the handful of real sail ships operating today, a theme becomes somewhat clear - these early (for profit) ones at least are primarily transporting the same high-value or location-specific cargoes sail ships were carrying a hundred years or more ago. Wines, champagnes, and other liquors, raw coffee, raw cocoa, luxury goods like that. This is partly because they need to justify the up-front cost of standing up a whole new kind of shipping, because they're often slower, and because there are already crew shortages even before getting into the specialized skillsets related to sailing by wind. So they're currently prioritizing the kind of specialty products (that only grow in certain climates or need special skills or reputation to produce) that exist in one place with markets in others, where they can markup for greener shipping. As they expand, the range of products will no doubt expand as well - cargo ships used to carry all kinds of stuff. But even with massive fleets (to make up for the fact that it'll be hard to make single ships as big as we have now for reasons I'll get to) we probably won't see shipping done as cheap as it is today. Generally I think this lines up well with solarpunk principles like building to your local environment using local materials, manufacturing things locally, and building them to last and to be repairable. Shipping would fit the things that have to come from somewhere else.

The motor-to-wind spectrum:

I think it's safe to say that almost any ship is going to be some kind of hybrid between motor vessel and sailing vessel. What ratio of wind to other energy (electricity, biodiesel, hydrogen, bunker fuel) is up to you. I will say there's potential for a timeline here, starting with the majority being modern-day cargo ships with sails bolted on saving around 20% of their fuel, and transitioning towards more numerous, smaller ships using more and more wind, until the bulk of the fleet is primarily-sail ships with auxiliary motors or engines for maneuvering in port and dealing with emergencies. And chances are good that ships from all over that spectrum will be sailing at the same time.

So what does modern-day shipping look like?

We should cover the current landscape a little so you know what the new stuff is competing with or building on.

Most of the sites I've read break cargo ships into a few big categories:

Container ships:

These are apparently the most common and probably for good reason. The convenience and efficiency of shipping containers allows for some real benefits. Cargo can be packed into a 20', 40' and 45' long container, transported by truck or train to a port, loaded onto a ship, transported to another continent, lifted onto trains and trucks and not actually unpacked until it reaches its destination. When the alternative is people physically carrying stuff onto the ship and packing it into the hold, and carrying it out and packing it into a truck, you can see where there'd be some advantages. (Palatalized cargo is a sort of great middle ground that allows for better weight distribution in the hold (you want the heaviest stuff near the bottom so the ship is stable) and can be loaded very similarly to how containers are (you move the entire pallet, so it doesn't get unpacked until it reaches its destination) but that's not super relevant at the moment.)

The big modern container ships can transport 85 TEUs (twenty equivalent units) to 15,000+ depending on their size. So far the biggest primarily-sail design I can find can haul 100 TEU containers.

Putting sails on these is kind of difficult because they use the deck for cargo space and will have cranes loading and unloading containers whenever they're in port. Apparently this isn't as big an issue as I expected, but it's still something to keep in mind, especially if there's tons of rigging involved in the design of the sails.

There's a ton of designs out there for adding big easy-to-use sails and kites to existing container ships in order to boost their efficiency and cut fuel use somewhat. They're in use now and have some good info if you're looking for hard numbers. I haven't really covered them in these notes much.

I find container sailships to be the most interesting (something about the mix of old and new, and the fact that containers make the ship's purpose visually clear) so I've got a bunch of examples of them below.

Roll-on roll-off ships:

These ships are used to transport wheeled cargo, things like private cars, industrial vehicles, buses, trucks, construction equipment, excavators, etc. They usually have a huge door in the side or stern and the vehicles can directly roll on and off the vessel. They seem to be a popular choice for full-sail cargo ships because they don't need to worry as much about keeping the decks clear for loading and unloading. How well they'll fit in a solarpunk world is up to you – some vehicles and wheeled equipment will undoubtedly have to be transported overseas but whether there'll be enough to justify this class of ship is up to you. Neoline is a good primarily-sail example of this type, Norsepower is a more traditional primarily-fuel version.

Dry Bulk Carriers:

These transport solid non-packaged loose dry cargo in bulk quantities. Think wheat/grain, chemicals for fertilizer, cement, wheat, sugar, coal, iron ore etc. Some of the last sail vessels in operation were bulk carriers, like the Flying P-Liners, some of which were still transporting nitrates in the 1950s. Most of the modern sailships listed below seem to do at least some of this.

Tankers:

These ships transport large amount of liquid cargoes like petroleum products (oil, gas), chemicals, wine, juice, etc. in bulk. They are probably a good fit for a wider range of sail types since they don't need to worry as much about keeping the decks clear for loading and unloading.

Reefer ships:

(Short for refrigerator) they're designed to transport frozen/temperature-controlled cargoes, mainly in refrigerated containers. Food and perishable goods (fruits, vegetables, meat, fish...). I don't have much info on these (except that I think a lot of the container examples should apply). I do suspect these would be one of the most challenging as they'll need a lot of power onboard.

Considerations for sailing cargo vessels:

This info is mostly pulled from some excellent comments provided by the folks on the Naval Architecture subreddit, especially Open_Ad1920.

This is a simplified summary, there are definitely details I left out that you can find over there.

What kind of sails do you need?

The most obvious (to most of us) difference between motor vessels and sail vessels is the huge masts and sails on top. For cargo vessels, they seem like they should pose huge issues for cranes in the ports (in the case of containerized shipping) but apparently this isn't as much of an issue with larger and more modern crane designs as I would have expected. The modern cranes lift their booms to allow tall structures past, then lower them to the working position. Apparently they already work right up alongside tall structures on modern cargo ships so masts should be similar.

Where masts pose a problem is with going under bridges. Bridges often block ports and rivers where sail ships would like to enter. Most all of our modern bridge and port infrastructure was built in the days after tall ships had been replaced by steam and motor vessels, but that means there are trillions of dollars worth of port infrastructure that would be blocked to anything with a mast.

This has been a major motivator for folding mast designs. Some sails are better suited to folding masts than others, so consider the routes and ports your ship would likely see, and whether it would need to get past bridges. Consider bridge height, the height of the mast normally associated with your ship height, and whether the mast needs to fold. If it does, consider which sails are well-suited to doing so.

- Several modern/proposed designs like the Windcoop or Neoliner use rigid sails on masts that can apparently fold down.
- Of the more traditional designs, junk rigs / Chinese lug sails / fully battened lug sails seem to be the best candidate for a folding mast and are apparently pretty easy to use. Hasler & McLeod for more info. They may use curved battens that flip to orient the curve towards the tack in order to make close-hauled upwind performance comparable to that of a bermuda rig. If you need to understand those terms in order to write your story at the correct level of detail, you

probably either know them already or are about to dive in to the world of nautical terminology, in which case best of luck! Lots more info here.

- Lateen or “crab claw” varieties fold fine. Unfortunately they’re not very efficient upwind.
- I’m told a bermuda main sail with in-boom furling is also conceivably compatible with a folding mast but that hasn’t been done yet.

Water draft/how deep is the ship below the waterline?

Water draft is another major consideration for port entry. Ports and rivers are shallower than the open ocean and sailing vessels with reasonably good performance will have a deeper draft than an equivalent motor vessel. This is for two reasons that I think basically sum up to ‘preventing the sails from tipping the ship over’ and ‘preventing the wind from pushing the ship sideways’:

- Ballast weight – the lower they can hang the ballast, the lower the vessel’s center of gravity. This makes it more stable against the tendency of the sails to pull it over onto its side.
- The protruding part under the hull acts as a wing in the water, producing horizontal lift. This counteracts the sideways component of the forces generated by the sails when traveling upwind, or even perpendicular to the wind. Having this makes the ship safer by helping prevent it from getting pushed onto shores, rocks, and reefs by unfavorable winds. This extra lateral area is going to stick out way under the hull for hydrodynamic reasons.

To allow them to enter these ports, modern sail ships might use lifting keels or have a flatter bottom, no keel fin, with daggerboards to provide that control while being able to lift up and cross into shallower water.

How tippy is it?

Motor vessels can make do with a higher center of gravity and much lower angle of vanishing stability (AVS). This is the point at which the vessel will capsize and stay inverted, thus sinking it. That’s because they don’t have sails making it easy for the wind to tip them. Sailing ships tend to lean more while underway, so they can’t pile containers as high.

Containers also don’t allow for the cargo to be packed quite as densely, or apportioned particularly well within the vessel from heavy to light as you go upwards compared to other systems. You just get what you get. Heavier containers can be placed lower, but the overall packaging density is less so the center of gravity still ends up higher than with more piecemeal loading methods. Palletization is a good compromise that can still load a sizable vessel in acceptable time. So while there’s a bunch of interesting container sailboat designs, I think we probably won’t see something equivalent to the absolutely massive cargo ships transporting thousands of containers.

However, this is another place where folding masts can help – being able reef the sails and tip them down during bad weather provides additional stability/safety so the ship can be loaded to a higher center of gravity.

Examples:

This is a list of new, operating, and proposed sailship designs. I’m going to sort them from less-traditional to more-traditional as determined by me (a person who learned most of this terminology a

week ago). There are a lot of traditional sailboat designs seeing a resurgence, with various modernizations ranging from basic stuff like metal hulls, on-board motors, and modern navigation and communication equipment, to fancier stuff like automated sails on rotating masts.

The Windcoop container ship – this one has heavily-automated sails with very little rigging, making it easier to load and unload cargo. It can haul 100 TEUs which is the highest number I've found so far. It appears to have been designed by the same folks who drew up this one <https://www.dykstra-na.nl/designs/wasp-ecoliner/> which would have used dynarig sails. At time of writing, neither has been revealed or launched.

Neoliner – cosmetically similar to Windcoop (I think, anyways), this is a roll-on roll-off cargo ship with heavily automated sails which can fold down to go under bridges. This has also not launched yet.

The Anemos, an 81-meter 'Phoenix' class ship (I can't find an equivalent historical type) with a thousand-ton capacity and some automation on the sails. It's currently transporting cognac, champagne, coffee, and other high-value cargoes.

The SV Juren AE a 48-meter cargo vessel with an Indosail-Sailing Rig and a 300-ton capacity. It looks much more like modern ships to me, and has an interesting frame rig on the structure near the stern covered in solar panels. A few other ships have used the Indosail rig, including one of Greenpeace's Rainbow Warrior Ships (I think the one the french didn't blow up?).

The Harryproa (and any other cargo proa designs). These use hull designs borrowed from the outrigger sailing canoes of the Pacific Islands. Made from fiberglass using simple, modular molds, they're intended to be easy to build and repair. One hull is intended to transport up to 10 tonnes of cargo in modular containers, while the other holds the crew quarters and ferry seating space for 25 passengers. It has a built-in tender (small boat) for reaching areas the main ship can't, and for powering the main ship when it needs it. This may also be a good candidate for the river boat section below. <https://www.harryproa.com/>

The Iliens, a sail catamaran with a 68-passenger capacity traveling along the coast between Quiberon and Belle-Île in France. <https://en.rochefortterre-tourisme.bzh/offers/iliens-la-navette-qui-met-les-voiles-quiberon-en-4652240/>

|Grain de Sail II, a 24-meter, metal-hulled clipper ship with a 350 ton capacity, transporting wines, raw coffee and cocoa following the trade winds. It looks somewhat more traditional in the rigging to me. <https://graindesail-overseas.com/grain-de-sail-ii>

<https://gosailcargo.com/ships.html> A list of designs for somewhat traditional (I think) sailboats designed to transport shipping containers, starting with a clipper and working down to small boats. I really appreciate the diagrams they provide with each ship description and feature list. I don't think any of these have been built yet but they're based on historical designs. I didn't notice any mention of being able to lower the masts, but some other tall ships, like the USCG training vessel Eagle (a three-masted barque), have upper mast sections that can be lowered to squeeze under modern bridges so that might be an option.

|The SV Kwai for an example of a motor vessel retrofitted with fairly traditional sails. This allowed it to visit ports that weren't considered profitable for motor vessels. A reuse-focused solarpunk society might make a lot of similar retrofits.

|Sailcargo – a company operating a small fleet of wood-hulled schooners. They have a fair number of photos to use as references, including some clever solar panel placement.

Tres Hombres – about as traditional-looking as it gets – an engineless, wood-hulled brigantine made in the 1940s transporting rum, cocoa, coffee and olive oil.

Vega – (a looks like either a galleass or a cutter?) built in 1892 and formerly used to transport limestone, bricks, pig iron and cement, it is still in use today, transporting free school and health supplies to remote islands in eastern Indonesia and to East Timor. More info here:

<https://www.hrmm.org/history-blog/sail-freighter-friday-galleass-vega-1892-present>

This is far from an exhaustive list, if you know of a cool ship or design I should include by all means let me know and I'll add it!

River Sailboats

Here's a few examples (real or proposed) which would operate on large rivers like the Hudson, hauling cargoes or passengers. (Here's a neat worldbuilding idea I found in the IWSA Small Windships Publication – the term 'Sail Freight' is apparently more common in the US while Sail Cargo is more common in Europe – both terms seem to have gained popularity independently, but in the US it was mostly in the context of rivers and coasts while in Europe it seems to be more about ocean cargo. It wouldn't be unreasonable for sail freight to come to mean transporting cargo on rivers (competing with trucks and trains) while sail cargo ends up referring to the ocean.)

Schooner:

<https://www.scenichudson.org/viewfinder/carbon-neutral-shipping-on-the-hudson/>

Sloop:

<https://www.clearwater.org/the-sloop/history-and-specifications/>

Gaff yawl:

<https://gosailcargo.com/secret-40.html> – hauling a single shipping container or a modular 'bus' passenger compartment.

For recreation, these could be cool to include: [https://en.m.wikipedia.org/wiki/Moth_\(dinghy\)](https://en.m.wikipedia.org/wiki/Moth_(dinghy))

The Eriemax canal barge <https://www.shipshares.com/Eriemax%20Final%20Report.pdf>

Known for its somewhat chaotic looking collection of sails, the junk-rigged schooner Summer Wind does tours of Baltimore harbour

Like the ships, these smaller watercraft will likely need some kind of motor for tight maneuvering, emergencies, lack of wind, and to work as their primary power in some canals (similar to the old sail-driven canal barges (sailboats intended to lift dagger boards and drop masts when they get to the canal but able to operate as sailboats outside it). Perhaps these could even operate as trolley boats using overhead wires for power when they get to the canal so they wouldn't require dense onboard energy storage.

Other Wind-Based Propulsion Technologies:

Sails are cool but maybe you want something more futuristic or visually iconic. For that you may want vertical turbine/windmill ships, kites, or Flettner rotorships.

These are all working technologies which have seen use IRL, but at this time, as far as I know, none of them are being used as the primary propulsion for the vessels they've been added to. There may be physics limitations that prevent them from ever being more than an auxiliary propulsion, I'm not sure.

I left these off the list originally because I was focusing on vessels which could operate primarily by wind rather than relying on an onboard power source like hydrogen, oil, or batteries. But if your setting is rich with clean energy (or you're writing in the messy transition to a more solarpunk world) then these have a few advantages over more traditional sails (which are probably why they've seen earlier adoption in modern-day shipping): they're easier to use and they require less change in how the ship operates compared to sails. They require fewer changes in design (meaning they can keep building massive container ships on basically the same blueprints). Ships using these will sail more like a modern cargo motor vessel so they're more of a drop-in upgrade rather than a major overhaul in design and operation.

Perhaps your ships stop while underway at charging platforms powered by offshore wind or fuel up on hydrogen generated cleanly using electrolysis, or fill up in port as they would now. Or maybe they still burn oil. With that in mind, these alternative systems may save fuel/energy or allow the vessels to extend their range with fewer stops.

Vertical Turbine Ships / Windmill ships:

These ships use huge vertical wind turbines to turn the propeller. This can be through mechanical transmission (think huge drive shaft) or electrical transmission (generator→battery→motor). I suspect electrical systems will be lossier but they do allow for storing the power to use later. They're still figuring out the best designs/configurations, but Savonius turbines seem common at the moment. The big advantage here is they don't change how the ship operates too much – and that they're somewhat out of the way of the cargo. Most can tip down to go under bridges.

Rotorships

Rotorships use Flettner rotors (huge vertical spinning cylinders with disc end plates) and the Magnus effect to create some kind of sail effect. Lift is generated at right angles to the wind, to drive the ship forwards. I think spin speed is used for control but I'm not certain.

In order for these rotors to function as sails, they need to be spinning, so the ship needs another propulsion source for generating that movement (though doing so takes less energy than moving the ship with a conventional propeller).

Similar to windmill ships, these tall narrow rotors are more or less out of the way of normal cargo operations, and can usually tip down to avoid bridges.

Kites

Anyone who has seen *Waterworld* will recognize the power of launching a kite to pull their vessel. The big advantage (to modern cargo operators) is obvious here: the ship is essentially unchanged,

everything operates as usual until they launch the kite, and they can say they're wind powered and 'green'.

The actual advantage over sails is that windspeed increases with height, allowing kites to develop more thrust than a conventional sail. Winds are also steadier and less turbulent higher up. But unlike sails, a kite cannot stay in position when there is no wind, and must be recovered and re-launched.

Current kite rigs can be sailed within 50 degrees of the wind, meaning they tack to go upwind, like a ship with sails. Kites can be adjusted manually or by an automated system.

Battery ships?

Electric ships are looking much more practical than I would have expected – getting there seems to involve reexamining how we use ships, as well as adjusting to use battery tech that makes sense for ships (as opposed to cars) <https://austinvernon.site/blog/batteryships.html>

Edit: There's a very interesting write up in cleantechnica which describes a process of electrifying first the ports, then inland and coastal shipping. This plan would use huge, swappable battery modules, which fit standardized dimensions similar to shipping containers. These can be lifted on and off the ships using the same cranes they use for all their other cargo, and can be charged in port. Other ships could be charged while waiting for cargo to be loaded/unloaded.

<https://cleantechnica.com/2025/05/24/beyond-the-harbor-electrifying-short-sea-routes-and-hybridizing-blue-water-shipping/>

For river boats, there's a very cool project trying to convert the fleet of diesel motor canoes used in the Ecuadorian Amazon to solar/battery driven electric systems:

<https://www.nytimes.com/2025/06/23/world/americas/electric-boats-ecuadorian-amazon.html> (sorry I don't have a guest link).

Other Solarpunk Ship Stuff:

Other types of vessel

This post is mostly about cargo but there's a ton of sail-based passenger stuff out there. I've gathered a few examples and will add more as I find new ones:

A company called Star Clipper is operating three tall ship cruise ships, Star Flyer, Star Clipper, and Royal Clipper. These look like older style clipper ships to me so they might actually be using mostly wind. They seem to be very much operating in the cruise ship format, probably with some associated issues, but they demonstrate that passenger liners could still be viable (and can be quite comfortable) if a change in pace of life or available resources reduces the number of airplanes for that kind of travel.

Seacloud, another sail-based cruise ship

A company called WindStar Cruises also operates a series of cruise-ship-sized 'motor sailing yachts.' These have sails but I don't think these actually rely much on wind, at best I suspect they're closer to the cargo ships with rotary sails bolted on to save some fuel. One of the naval architects on reddit seemed to confirm this.

There are also smaller crafts such as the 38-meter Schooner Mary Day which can carry 28 passengers. This may be duplicate with the schooner example from the Hudson above, but it still represents the potential for sail-based water buses on both rivers and coasts.

River and harbour cleanup boats like Mr. Trash Wheel (even if you hope a more solarpunk society would have less plastic trash, storms and floods can wash all kinds of non-trash stuff into the rivers).

There's also the scaled-up version of those (though stopping plastic in the rivers appear to still be the critical part)

Magazines and publications with lots of good info:

The IWSA Small Windships Publication has tons of info on the sub-500GT range of smaller vessels including more info on most of the ships from the examples section (so it would have been really convenient if that was the first thing I found!). You can get a downloadable version here. Developments of Note lists a bunch of goo ships starting on page 10 and Sources for Vessel Plans on page 71 are especially useful but it's all cool stuff.

Journal of Merchant Ship Wind Energy - another industry magazine with all kinds of information you might need.

Wind Propulsion for Ships of the American Merchant Marine (an older resource I haven't read yet but am including for completeness).

Cool sails!:

<https://www.boatdesign.net/threads/the-design-of-soft-wing-sails-for-cruising.49425/>

Dynarig sails if you want ultra-modern sailboats and ships (the entire mast rotates)

All the info you could want on the Indosail Rig

https://www.junkrigassociation.org/photo_gallery

Whale Safety

Whales are sometimes hit by ships (they sleep just below the surface and don't know where human shipping lanes are). Some hulls are more dangerous to them than others. Ships with steep, sharp prows and bulbous bows are especially dangerous for whales. If you search for ship hulls and whale safety, you'll find an unfortunate number of photographs of dead whales draped over those bulbs.

One suggestion is to follow some cargo ferry designs and design the prow of the ship so it's more traditional, angled forward so the deck is further forward than where the hull meets the waterline, with no bulb below the surface, and a much more rounded/blunt bowstem. This design will likely lose some performance benefits while underway but if it hits a whale I guess it's more likely to sort of dunk them rather than to slam into them like an axe.

There are also ongoing attempts to map our whale activity and to ensure that human crews are both aware of their presence and actually making efforts to avoid them, but if you're looking for visuals this might be worth considering.

Lists of current projects:

This event has a decent list of current modern sail ships, from basically-modern-cargo-ships-with-

sails-bolted-on to completely modernized 90-100% wind driven ships, to largely historical designs still in use.

<https://www.wind-ship.org/archived-site/membership/> This organization lists its members, many of whom are related in some way to modern sailing vessels. Lots of good examples.

As I said up front, I'm not an expert. If you notice any errors, omissions, or just have a cool link to add, by all means let me know!

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