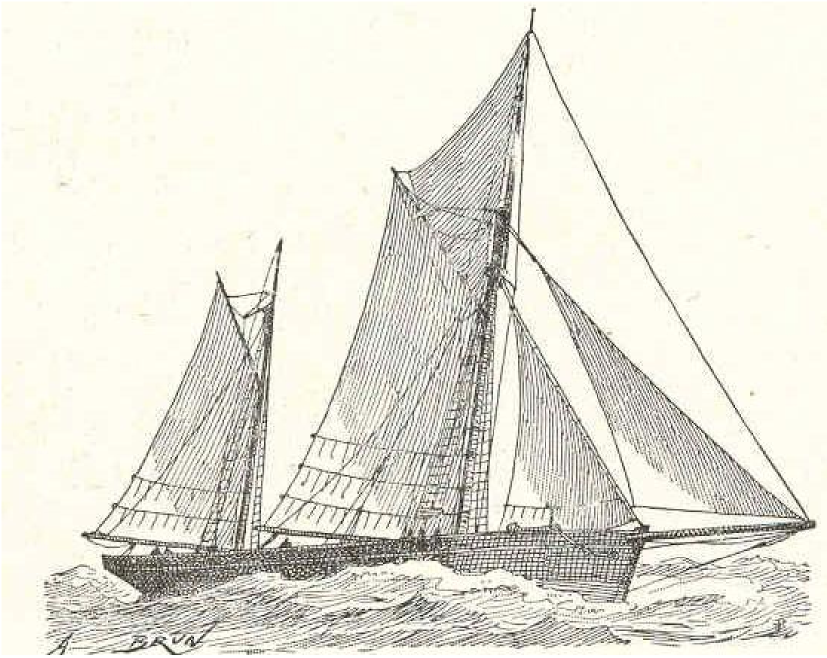
The Sail Freighter Handbook



Steven Woods

This handbook is not a comprehensive guide to Sail Freight operations, but simply a collection of experience gained recently during the Sail Freight Revival. It is hoped that this guide will aid in understanding the functioning of sail freight operations, but relies on perspective sail freight operators to be experienced sailors. The advice in this work does not constitute an exhaustive or direct set of procedures, but points the way to developing your own.

No part of this manual can be used directly without adaptation to local circumstances, and does not constitute legal, business, investment, or financial advice.

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Introduction And Scope

This small book isn't designed to be a complete manual of everything you need to know about Sail Freight: That would be a volume of several gross register tons, and completely unreadable. Instead, this is designed as an introductory How-To of the practical elements of Sail Freight. Once you have started to understand the regulations, practicalities, and the basics of navigation, this volume will begin to be useful. Hopefully, this is the tool you read between understanding the theory and buying a boat, to clear up the otherwise difficult portions of making a sail freight business function.

When looking at Sail Freight, just knowing how to sail isn't enough. You have to know how to get cargo back and forth to the docks, how to recruit cargos, be your own broker, and more. Understanding Coast Guard and state regulations is critical, alongside many other practical concerns you'll find mentioned in this booklet. This tool is designed to help guide you through the practical decisions necessary to be successful, and isn't going to help you learn to sail, or handle cargo, or other challenges. While this may point out gaps which need to be filled in your knowledge, it is hoped that closing those gaps before you begin will save a lot of headache, money, and (possibly) lives, in the long term.

Sail Freight has many nuances, and needs to be considered carefully before you undertake the project. However, it is still eminently do-able, and has been done for over 5,000 years all around the globe. If it were truly difficult, that would have never been the case. We can all take heart in that fact at least as we endeavor to make the world just a little bit better with each project we put in motion.

This booklet is designed primarily for those interested in coastal and inland sail freight, as opposed to transoceanic trade. As a result, things like Customs Regulations, STCW, and other requirements are not treated here. Further, this is aimed at a "Mosquito Fleet" audience and the small vessel sector. Large vessels and international trade bring with them a far more complex set of concerns which are difficult to treat succinctly and in many cases require professional legal advise which a mere booklet could never begin to provide. If you are interested in ships greater than 100 Gross Register Tons and/or crossing international borders, this manual will be far less useful than for those looking at small vessels on relatively local routes.

That being said, there are common concerns to all sail freight endeavors which span all ship sizes and all trade: finding cargo, stowing cargo, last-mile transport, and how to encourage the use of sail freight all qualify, among other topics. Anyone interested in Sail Freight may find these chapters helpful.

If, after reading this manual, you have a clear plan and a ship to put into service, it will have served its purpose. We hope it clears the way to a larger fleet of sail freighters by making obstacles predictable, avoidable, and success more attainable by compiling the lessons learned thus far in the Sail Freight Revival of the 21st century.

What Is Sail Freight?

It seems like the first question to answer is "What the hell are you talking about?!" So, here's the best definition of Sail Freight (interchangeable with the Current European term "Sail Cargo") I've come up with so far:

Sail Freight is the ecologically motivated maritime movement of cargo by primarily wind power with little, if any, engine use.

This allows for a lot of leeway in terms of engine use strategies, boat design, sail types, and other elements, but leaves as a prerequisite a motivation to address the climate crisis. Sail Freight excludes wind assisted propulsion which is aimed solely or primarily at regulatory compliance and saving money on fuel, but is inclusive of most every effort to address climate change through the use of working sail.

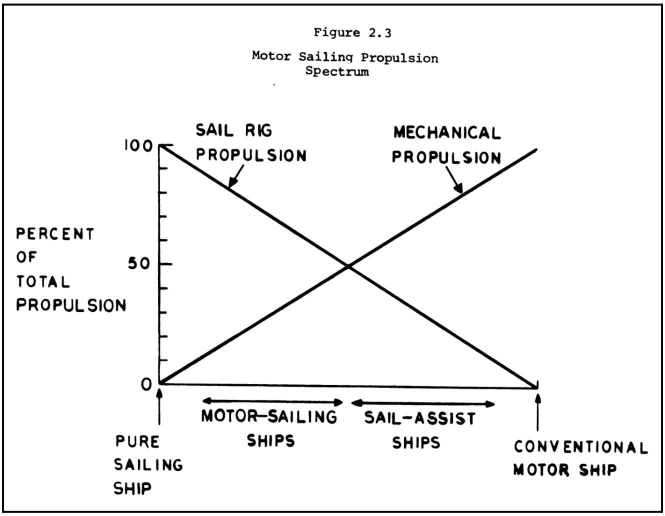


Figure 2.3 Motor Sailing Propulsion Spectrum [1]

[1] Wind Ship Development Corporation, *Wind Propulsion For Ships Of The American Merchant Marine.* Norwell, MA: WSDC, 1981. Pp II-5

As you can see from the above image, taken from *Wind Propulsion For Ships of the American Merchant Marine,* Wind Propulsion is scoped along a spectrum, from pure (engineless) sailing vessels to motor ships, but Sail Freight only covers vessels which are classified as Sailing vessels or Motor-Sailers. Marking out the difference between Wind Propulsion, WindShips, Wind Assisted Propulsion, amd Sail Freight is best done with the help of this adapted trinity diagram below.

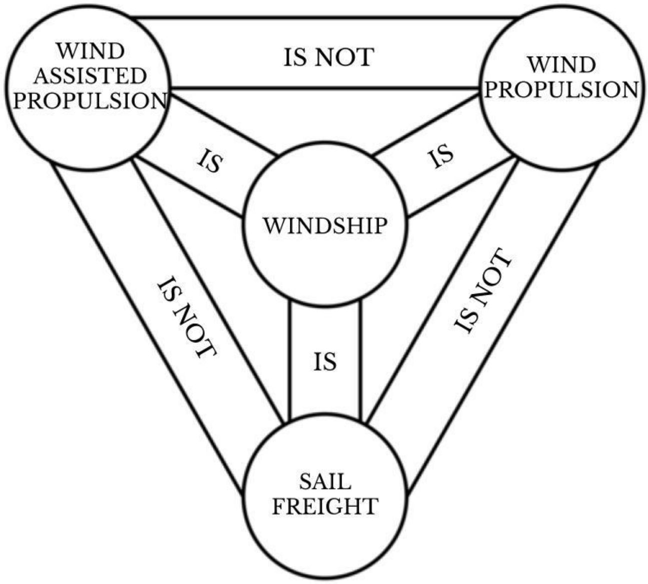


Image Based on: "Trinity Shield Template" AnonMoos, CC BY-SA 4.0 via Wikimedia Commons.

Any ship which uses any wind propulsion at all is a windship, but the others are all distinct forms of the movement based around their basic motivations, implementations, engine-use strategies, and other factors. For our purposes here, Sail Freight is that part of the Windship movement which relied almost entirely on wind propulsion, is ecologically motivated, and generally (though not exclusively) uses the most restrictive of engine use strategies.

Sail Freight is useful for adapting to the climate crisis due to a very high fuel efficiency and very small inputs. At their simplest, sail freighters can be made of wood, canvas, and cordage, with little metal and no power aside from human muscle, though any modern sail freighter is more likely to be made of steel and use advanced sailcloth technologies. In terms of efficiency, even small sail freighters of 10 tons CDWT can be up to 25% more fuel efficient than rail transport, and the longer the run the more fuel efficient sail freight becomes.

The other advantage to sail freight is its minimal infrastructure requirements. As will be covered later, all a properly designed sail freighter needs is deep enough water to move, and a place to tie up to. This can even be a soft spot on a beach which can be landed at just short of high tide, in some places. Lightering, the use of smaller boats to ferry goods ashore from a vessel at anchor, requires even less infrastructure. Sail Freighters need no support in the form of constantly-wearing roads, rails, bridges, tires, and brakes, with all the supporting equipment, resources, and factories those require.

Of course, Sail Freight cannot answer all transportation problems: Boats are remarkably bad at traveling overland, and sailing vessels are not fast. This means anywhere landlocked needs alternate arrangements, and some cargos such as fresh fruits will need to seek faster transport methods. However, Sail Freight has an important role to play in the carbon-constrained transportation systems of the future, taking cargo away from congested systems and taking advantage of its high efficiency wherever practicable to save fuel and energy reserves for where they are absolutely necessary.

Sail Freight is fundamentally an Appropriate Technology, and one which can be implemented immediately and with little research and development. As described by E.F. Schumacher, Intermediate Technologies aren't a retreat into the past, but instead pick up historical technologies where they left off a century or so ago and start from there into new territory using knowledge we have gained since these technologies declined. This really is exploration of new technologies and combinations of technologies which has never been attempted before.[2]

Sail Freight, along with dozens of other intermediate technologies, can be used right away to address the most pressing needs of our time in the Great Transition away from Fossil Fuels. With this definition in hand, we will move along to the rest of the concerns this manual is focused on. The more in-depth theory behind all this is covered by the reading suggestions below.

FURTHER READING:

Cutcher, Nicola. "Winds of Trade: Passage to Zero-Emission Shipping." *American Journal of Economics and Sociology* 79, no. 3 (2020): 967-979. doi:10.1111/ajes.12331.

De Decker, Kris. "How to Run the Economy on the Weather." *Low Tech Magazine* September 2017. www.lowtechmagazine.com/2017/09/how-to-run-the-economy-on-the-weather.html.

Christiaan De Beukelaer "Tack to the future: is wind propulsion an ecomodernist or degrowth way to decarbonise maritime cargo transport?" *Climate Policy,* 22:3, 310-319, DOI: 10.1080/14693062.2021.1989362

Andrew Willner. "A New Age Of Sail..." Mongabay, March 2021. https://news.mongabay.com/2021/03/new-age-of-sail-looks-to-slash-massive-maritime-carbon-emissions/

[2] Ernst Friedrich Schumacher, *Small is Beautiful: A Study of Economics as if People Mattered* (New York, NY: Abacus, 1978). Pp 179.

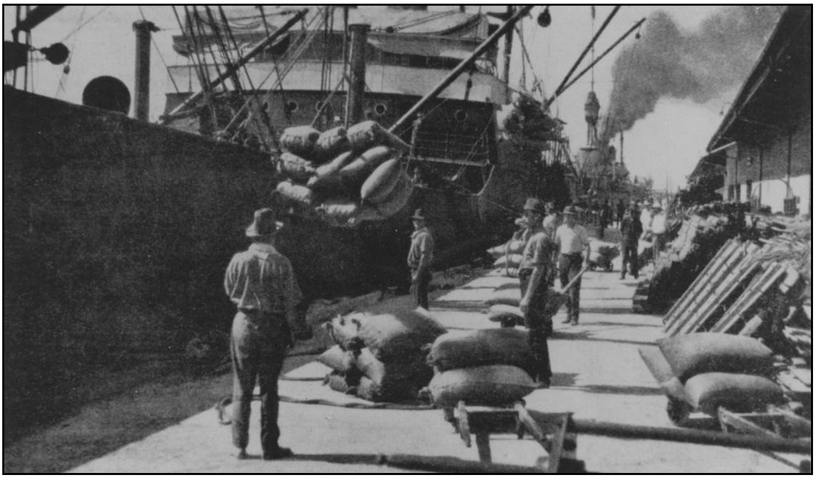
Types Of Cargo

Understanding the types of cargo currently in use around the world is important to fitting your sail freighter into the transportation system which already exists, instead of trying to build one from nothing. Different industries and scales of operation require different kinds of cargo, and the appropriate equipment to handle them. Further, your rig will need to be able to handle the type of cargo, meaning stays and shrouds in the correct places, booms and gaffs out of the way, and other concerns which will need to be verified before your vessel is chosen and a type of cargo adopted.

Containerized cargo is the international standard for long range and large volumes of manufactured goods and some raw materials. These steel boxes of standardized sizes (the most common being 20 and 40 foot long containers) can be stacked, locked together at their corners, and easily shifted from rail to trucks to ships, and back. Once cargo is packed into a container, only the container itself needs to be moved, saving enormous amounts of time and labor. Despite these advantages, containerized cargo is heavy, and requires specialized cranes and equipment to handle, making it better suited to larger vessels than those treated in this work. That said, having the capability to handle containers is a useful function to build into a sail freighter if some of the ports on their route can handle them with shore gear. There are existing designs for small sail freighters capable of taking on containerized cargo, covered in the chapter on existing vessel designs.

Bulk Cargo includes cargo like coal, grains, sand, gravel, cement, and other things wich can simple be dumped into a hold and shoveled out later. While these are the general categories at the moment, it is not always the best idea for windjammers to take on loose bulk cargo without installing temporary bulkheads to stop it from shifting when sailing up wind or in other circumstances when heel nagles are increased. Poor loading of bulk grain cargo was likely at fault in the sinking of *Pamir* in 1957, when a cargo of grain from Brazil was stowed loose, instead of in bags as had been traditionally been done in windjammers to that point. However, Schooner *Wyoming* loaded coal loose her entire career, and did not suffer for it.

Breakbulk or General Cargo is what was traditionally loaded before containerization: Sacks, bales, boxes, barrels, and crates of cargo, stowed carefully into the holds of ships in their individual packages. The illustration below of a steamer loading cargo in Australia a century ago shows a number of cargos all of this type being handled by ship's gear on the quayside. As a general rule, most sail freighters now are general cargo ships, especially smaller vessels and those intending to use undeveloped shore facilities such as existing marinas and small harbors.



Tanker Cargo is mostly liquids, though for small vessels tank containers are frequently used instead of designing the ship entirely as a tanker. Unlike general cargo ships, which can be made container-capable but use principally breakbulk loadings, tanker vessels can only take tanker cargos such as oil, water, or other liquids. Some tankers are also specialized to take pressurized gasses as cargo, but again this will be all the vessel can take, to the exclusion of all other cargos. For Sail Freighters, a containerization capability will be more

[3] Image: Loading cargo into the hold of the ship, Cairns, ca. 1921. State Library of Queensland, Australia. Public Domain, Via Wikimedia Commons.

favorable for these types of cargo, as the container can be removed with the tank full of liquid, and then the ships is again a general cargo vessel without further modification.

Traditional sailing rigs can be made compatible with containerized, bulk, and tanker cargo, but need to be thought through to ensure the ship will be able to work effectively. Tanker designs will need to have cranes and hoses which will be operable without interfering with the shrouds and rigging. Container designs will rely on lifting containers directly out of holds, straight up, meaning booms, gaffs, running and standing rigging must be set up to accommodate this. General Cargo is likely the proper target for most (not all) small sail freighters in the early stages of the revival, because it requires the smallest amount of cargo handling gear and specialized shore support. If you plan on using small harbors, plan on having a general cargo vessel. Historically, these are the most common type of sailing cargo vessels built, as they were also the most versatile.

Hazardous Cargo comes in all forms, and requires specialized licenses for handling and transporting it. It is generally not a good idea to take on hazardous cargos of any type without a highly trained crew and a good insurance policy.

Cargo which moves well by sail historically included anything which did not depend on rapid delivery for quality: Bricks, stone, cement, lumber, grains, ice, coal, textiles, petroleum, metal ores, and similar cargo were what kept windjammers employed from the mid 19th to the mid 20th century. For shorter coastal trade, the crgo inventories grew, to include vegetables, beer, meats, dairy, fish, and most other foods, though many were processed and preserved before shipment. Wines and beers could be conditioned on ships, such as Madeira wine and India Pale Ales. Depending on the distance involved, almost anything can be shipped by sail in one form or another. However, it is worth mentioning that most small sail freighters are unlikely to have the energy storage and generation capacities for refrigerated or frozen goods stowage.

Lean towards high-value cargo where possible. These cargos, such as wine, olive oils, ciders, coffee, chocolate, and other similar items gain relatively less from being shipped by a more expensive method than a comparatively cheap product. These can then bear the brunt of your operating expenses with higher cargo charges, while steadier bulk cargos such as malt, flour, and other goods provide a steadier amount of cargo to fill the holds. This is the model used by Schooner *Apollonia* with its circuit, and it has proven successful for two seasons. For transoceanic operations, the importation of hard alcohol is also high-value cargo which can generate significant income.

There is a lot of marketing value to be had from Sail Freight for boutique goods, foods, and services. This should be part of negotiations for cargo, and be used to advantage where possible in squaring the ship's books.

FURTHER READING:

James Buckley. *The Business of Shipping*. 8th Ed. Centerville: Cornell Maritime Press, 2008

Levinson, Marc. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger - Second Edition with a New Chapter by the Author*. REV-Revised, 2. Princeton University Press, 2016. https://doi.org/10.2307/j.ctvcszztg.

UNCTAD *Review Of Maritime Transport 2021* Geneva: UN, 2021. https://unctad.org/system/files/official-document/rmt2021_en_0.pdf

Coastal Versus Transoceanic Sail Freight

There are two major schools of Sail Freight: Transoceanic, international trade on the high seas, and coastal trade, normally in one region. Both have r=merits, and are different endeavors requiring substantially different skillsets and equipment. While this short treatment won't be exhaustive, it should be enough to give you an idea of the major differences and where you are most likely able to fit yourself in.

Differences in skill between the two trades are one of the first things to point out. While coastal trade can normally be done with navigation by landmarks and other aids, transoceanic trade requires celestial navigation skills and equipment. Further, coastal sailors are not required to have as high a level of certification in lifesaving and firefighting aboard ship, as assistance isn't too far away. This is a very different situation in the middle of the ocean with no other ships in visual range.

Differences in regulation apply because of these differences in required skill. Crew aboard ships crossing international boundaries will need to be credentialed mariners, and most will need STCW certificates (Standards of Training and Certification for Watchkeeping) under international law. Captains will need to have Ocean Licenses, instead of Near-Coastal or Inland tickets, and more lifesaving equipment will be required on oceangoing vessels.

Differences in ships will be seen as well. While larger ships will almost always be more economically viable for any route, for international scale of trade, a large container-capable ship is preferable. For coastal trade, small vessels carrying only a few tons can be viable, given the correct circumstances and local environment. Oceangoing ships can afford to have deep drafts, square rigs, and other features not amenable to the necessity for coastal traders to be nimble, able to sail very close on the wind, and access small, sometime underdeveloped anchorages and harbors. Differences in cargos will also be seen, with small coastal vessels tending to be general cargo types, while oceanic trade will heavily favor containers due to the need for intermodal compatibility with rail and road transport.

Differences in carbon gains are also evident. Coastal trade displaces trucks and trains, which are much more carbon intensive forms of transport than even conventional motor ships. While a sail freighter crossing the atlantic with cargo from New York to Hamburg is certainly better than a container ship, it must still reach large economies of scale to significantly reduce carbon emissions. When replacing a truck which gets only 30 ton-miles per gallon of fuel, a sail freighter makes much more difference by displacing not only the truck, but the traffic congestion which wastes fuel and energy in every major city around the world.

Coastal trade was a historic training ground for sailors who moved on to the transoceanic shipping trade. A natural progression for rebuilding the Cræft knowledge of working sail starts with a proliferation of coastal fleets in smaller vessels, then builds to a large competent group of sailors who gain more experience offshore and rebuild the long-range sailing networks of a century ago. This also gets the highest carbon gains, and trains mariners who could step to the side into the windjamming fishing and passenger fleets which are likely to proliferate again when fuel costs rise significantly. These other types of working sail will also need sailors and captains, though likely at a slightly later date than the cargo fleet.

FURTHER READING:

United States Department of Commerce. *Distances between United States Ports.* 13th ed. Washington DC: US Department of Commerce, 2019. http://nauticalcharts.noaa.gov/publications/docs/distances.pdf

National Geospatial-Intelligence Agency. *Publications 151: Distances between Ports.* 11th ed. Bethesda, MD: National Geospatial-Intelligence Agency, 2001. https://msi.nga.mil/Publications/DBP

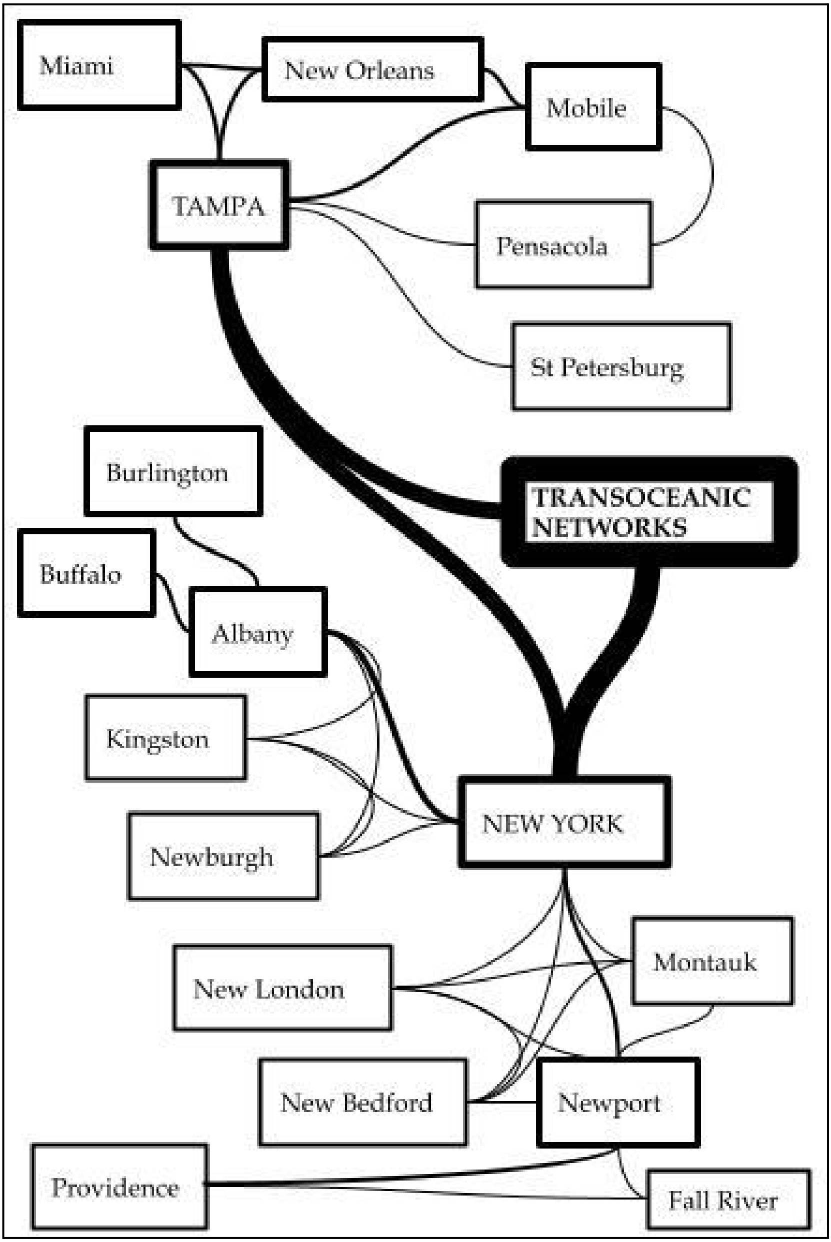
Tramping Versus Packet Service

There are two major types of service that Sail Freighters will likely take on, Tramping and Packet services. Tramping is the classic picking up a cargo for anywhere, then finding another when you've arrived, while Packets usually run on a rough schedule between two or more ports. To have these two types of trade make more sense as part of the overall transportation system and patterns, some explanation is in order.

There are several types of Trade Networks, running from linear, where one item goes from point A to point B in essentially one leg, and is used at point B. The other is a Hub-&-Spoke, or Star type trade network. In a star network, large amounts of cargo arrive at a central port from outside, and are then broken out into smaller cargos for shipment on to smaller ports in the surrounding area. Then, there are linear connections between stars. The illustration on the following page outlines this pattern to a degree, and will be referred back to from time to time for lending clarity to the description.

The illustration shows a trade network, and its trunk and star connections asa logical map. Tampa and New York are the major Hubs, and then each has a small star off it, including some independent smaller hubs. One subordinate star off of New York, for example, is Newport, which has its own connections to Fall River, New Bedford, and Providence, for example. The thickness of the connecting arc in the diagram indicates the volume of trade, and the route any cargo might take can be traced from one connection to another.

Tramping along this diagram might look something like this: A sail freighter named the *Tramp* picks up a cargo of wine in France, and sails for New York, entering from the "Transoceanic Networks" box. This cargo is dropped off, and the *Tramp* then sails in ballast for Albany to pick up a cargo of Widgets™ for Tampa. The *Tramp* sails through New York to Tampa, and delivers the cargo, then picks up 30,000 pounds of bananas for Boston. This picking up and dropping off cargos for anywhere on the map as they are available is Tramping.


Miami
New Orleans
Mobile
TAMPA
Pensacola
St Petersburg
Burlington
TRANSOCEANIC NETWORKS
Buffalo
Albany
Kingston
NEW YORK
Newburgh
New London
Montauk
New Bedford
Newport
Providence
Fall River

Tramping has its advantages, but some disadvantages as well. There is like to t be considerable time spent in ballast and not making any money. Further, there is no real way to schedule cargos ahead for a sail freighter as there is no way to strictly schedule the ship's arrivals and departures. As a result, it may not be possible to get enough cargo together in a year to pay the ship's bills, and intensity of use is the only thing which keeps most tramp ships in business: They almost never stay in port for longer than the time required for loading and discharging cargo. Many previous sail freight companies which attempted tramping, especially during the oil crisis era, were unsuccessful due to just this problem.

Packet Service is a different idea altogether. In a packet service, the ship sails predictably on a predetermined and repeated route. This could be between only two ports, such as Tampa and New York on the diagram, or two dozen, depending on the local situation. In a normal Star-Type Trading Network, you would have a few sets of packets, such as a New York-Tampa packet with a very large vessel, and others off those hubs. Tampa may have a Pensacola-Mobile-New Orleans packet, for example, along with a Miami Packet. Deliveries going from Pensacola to Miami would be brought to Tampa by the packet, then be transferred to the Miami packet for delivery there. Similarly, New York may have a handful of packets off that hub, such as Albany-Kingston-Newburgh (substantially that of Schooner *Apollonia*), New London-New Bedford-Newport-Montauk, and a sub-packet from Newport to Fall River and Providence.

These packets would all cooperate using the larger hub ports for passing cargo between these circuits, and there may be one or more vessels on each circuit. These circuits need not be simply local affairs, though, as packet services used to run between major cities as a transoceanic connection with fast ships for mail and high-priority cargos. London-New York was a route established by the mid 18th century, and in use until the end of the age of sail.

The advantage to a packet route for a small sail freighter is that there will be relatively reliable cargos, and relationships can be built with customers in each stop along the circuit. These can be used to establish a steady and sustainable base of cargo to carry and pay the ship's bills, and smaller cargos and deliveries can be added along the circuit as needed. Then, as that grows, the ship will be full and economically sustainable. The relatively predictable nature of the delivery times and locations will build goodwill and recognition, as with Schooner *Apollonia* in the Hudson River Valley and New York Harbor. This is essentially impossible to pull off with a tramp.

Tramping and Packet Service can be combined if done carefully. If, for example, there is only a monthly circuit which leaves a two week window available every month, tramping cargos could be taken during that time. So long as the packet service remains reliable, the two will not interfere and the ship can be used more intensively, and thus keep itself solvent. Such combinations may also allow the ship to expand their range and create the opportunity for other packet routes off one of their normal ports. However, the packet service should be considered the more favorable and important service during the early stages of the Sail Freight Revival.

FURTHER READING:

James Buckley. *The Business of Shipping*. 8th Ed. Centerville: Cornell Maritime Press, 2008

Ownership & Business Models

There are many types of ownership models available for Sail Freighters which aren't the typical shipowning corporation. While this structure works just fine in some cases, it isn't always the full picture, and it can be useful to know about some of these precedents. Combining these in various new combinations which fit your circumstances will take some thought and likely some legal advise, but will be worth the effort. It is important to understand, however, that thee ownership and business models are not the same as finance, and should be separated from that in this context. Your ship's finances are going to be something this work cannot really touch, and will have to be organized from the bottom up based on your business model and local circumstances.

Some of the following models are very similar to each other, and can overlap with finance to some degree (the sale or granting of stock shares, for example,) but are all unique. Some combine elements of others in a more useful way, which might be helpful in some jurisdictions.

Probably the simplest form of ownership and business model, though rarely the most successful in its simplest form, would be the Sole Proprietorship or Owner-Captain model, likely with a corporation of LLC structure involved. This simply forms a corporation which wons the boat, owned wholly by the captain (or a small number of stockholders) and operates the vessel. These seem to have principally been tramp vessels in the past few sail revivals, and haven't been remarkably successful as such. Those on packet routes seem to do better.

Another model is that of the Farmer's Ships of the Åland Islands of Finland in the 19th to 20th century. In these small vessels, a band of farmers would hire a shipwright and donate their labor and a share of the materials needed to build the vessel under the guidance of the shipwright. Then, each would have a share in the vessel's cargo capacity and revenues when exporting their farm produce and firewood, normally to Stockholm. These vessels were also normally crewed by their owners, and captained by one of them who was most experienced, or best credentialed as the circumstance calls for. In a modern context, this might work for an uninspected cargo vessel built on the model of the Vermont Sail Freight Project's *Ceres* for use by a group of farmers. This should involve a corporation to own the ship, with a share given in return for labor and supplies, and the profits from that operation returning to he shareholders and maintaining the boat. This can reduce the amount of capital needed to start as well.

Similarly, Crew Cooperatives can be used, where a captain and crew pool resources to cooperatively purchase or build a vessel and share in the company equally. In this case they may not have a right to part of the cargo space each voyage, as with the Farmer's Ships model, but they will each have an equal vote in the running of the ship and the returns on the investment. Where crew retention is expected to be very high, this model will work well.

Community Supported Shipping Is somewhere between the first and second models. This would be where either a captain-owner or crew cooperative owned vessel sold shares in the cargo capacity to local producers who need shipping capacity for a fixed price. For example, $1000 per Net Register Ton per year would entitle the holder to fill 100 cubic feet of cargo space every voyage for the flat fee of $1000 at the beginning of the season. This can be combined with other models to some degree if not all cargo space is sold, allowing for space for small packet cargos in addition to the regular subscriptions. This is very similar to and based off of the Community Supported Agriculture movement, which helps farmers secure predictable income regardless of the outcome of the harvest each year.

Customer Cooperatives would be another option for an ownership and management system. In a customer cooperative, a group of customers, likely food stores, farmers, breweries, malthouses, mills, bakeries, vineyards, and so on all decide they want to have a sail freighter in operation, and form a cooperative that owns and operates the ship. The cooperative then charges the members a membership fee which in turn pays for the ship, its maintenance, and hires crew to sail and manage the vessel. This could be successful where the demand for sail freight is present, but no one person or organization has the financial resources to start the project, and the retention of democratic local control is desired.

The business model you select will need to be compatible with the form of ownership established. Tramping and Packet Service are explained elsewhere, but for most circumstances a packet service will be preferable. For the best chance of success, simply adding the boat to existing trade relationships is the easiest way to go, as no new relationships need to be made between each end of the transaction: The vehicle is all that changes. Finding one or two businesses who are significant shippers in the area, sich as a large malthouse, orchard, mill, or perhaps a large-volume coffee roaster, then carrying cargo with the ship to their customers who are near the water is a good way to start. If your ship is owned cooperatively, there is a principle of “Cooperation Among Cooperatives” and so integrating such a vessel into a food cooperatives food supply chain may be appreciated, and would use existing relationships.

Starting from scratch and creating a new trade relationship on both ends will be very difficult, and seems to have been only rarely successful in previous sail freight revivals. Creating new relationships should be encouraged, but as an auxiliary to the steady business which will keep the ship floating in black as opposed to red ink in the long run.

FURTHER READING:

Elizabeth Henderson and Robyn Van En, *Sharing the Harvest: A Citizen's Guide to Community Supported Agriculture*, Revised ed. White River Junction: Chelsea Green, 2007.

Georg Kahre, *The Last Tall Ships: Gustaf Erikson and the Aland Sailing Fleets 1872-1947.* Basil Greenhill, Ed. London: Conway Maritime Press, 1990

Small Vessel Selection

Selecting a vessel for sail freight isn't exactly easy. There are a lot of complicating factors, and all of them must be accounted for based on the conditions likely to be encountered. As always, a packet route is easiest to plan, because the most restrictive harbor for each element can be chosen to give the appropriate constraint.

Draft is the most important for most harbors. If the ship's draft is too deep, it cannot enter small harbors, and a shallow draft is preferable in many cases to a deep draft. By using small harbors inaccessible to other ships a sail freighter cn carve out a business for themselves where other ships cannot, and so Draft should be a concern for all sail freight enterprises.

Air Draft is the reverse of Draft, meaning the distance from the waterline to the top of the highest element of the ship. For many sail freighters, this can be a concern because bridges, wires, or other obstructions may be present along the route and restrict the height available for use. This may encourage the use of bald-headed rigs, and other adaptations to keeping the height of masts to a minimum. In places where there is no air draft restriction, this will of course be unimportant. Tramps will need to be especially aware of this for all harbors they may consider serving.

Engines and their use are an important consideration for sail freighters. As was observed a century ago in Reisenberg's *Standard Seamanship For The Merchant Marine*:

> The coming sailing vessel of the future, however, is the auxiliary; no matter what her rig may be. A vessel fitted with crude oil engines, placed aft for convenience, offers a decided advantage to navigators and one that is beginning to be appreciated. Internal combustion engines take up a certain amount of hold space, to be sure, but the advantage gained through being able to make headway in all kinds of weather should not be

> undervalued. When a dead beat to windward is encountered, instead of sailing 500 miles to make 250, all that is necessary is to start the engines and plow ahead into the wind's eye. Again, in light airs, the engines can be used to advantage in decreasing the port-to-port time. If the vessel should happen to be dismasted, the engines are there to be called into service. If anchored near a lee shore with no chance of ratcheting off- Start the engines.[4]

With engine options currently including Diesel, Electric, Hydrogen Fuel-Cell, and possibly gasoline for a small enough boat, there are a lot of considerations. Diesel is likely the least expensive, and can be paired with biodiesel for a low carbon footprint. They are also reliable, easily maintained, and can be repaired almost anywhere. Fuel is available worldwide for both diesel and gasoline engines, which will be a concern for tramps.

Electric engines are very simple and extremely low maintenance, but must be paired with batteries of some sort. They may be difficult to service in many locations, but are quite reliable. Hydrogen fuel cells can suffer from all these flaws, as well as also being expensive and highly specialized.

Hybrid options exist for propulsion which combine diesel, electric, and even hydrogen systems, but are expensive and can add unnecessary complexity. As with other systems, they may be workable and highly successful, but should be considered carefully before adoption.

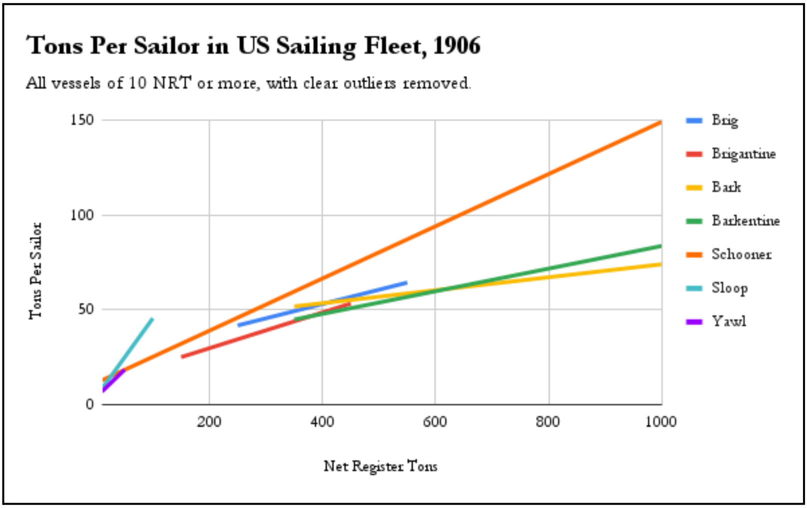
Energy Storage is important whether it is in the form of batteries, compressed gas, or liquid fuels. While lead acid batteries can double as fixed ballast, their weight will subtract from cargo capacity, but they are also safer than lithium, generally speaking. Electric systems also have the advantage of solar capabilities and underway

[4] Felix Riesenberg, *Standard Seamanship For The Merchant Service* 2nd ed. (New York: D. Van Norstrand, 1936) pp 17.

prop regeneration for charging, which incur neither fees nor carbon emissions. On the other hand, they can take a significant amount of time to recharge by these means or by shore power, which is a vulnerability for any situation where port time is to be kept short. It would be wise to have a backup generator for an electric vessel.

Liquid fuels such as diesel and biodiesel are stable, commonly available, and these two are interchangeable with each other without modification. Gasoline and alcohol are more hazardous aboard ships and should be carefully considered before adoption. Compressed gas shares many of these concerns. Be certain no matter what you decide to use that the fuel and services for the engine are available along your route.

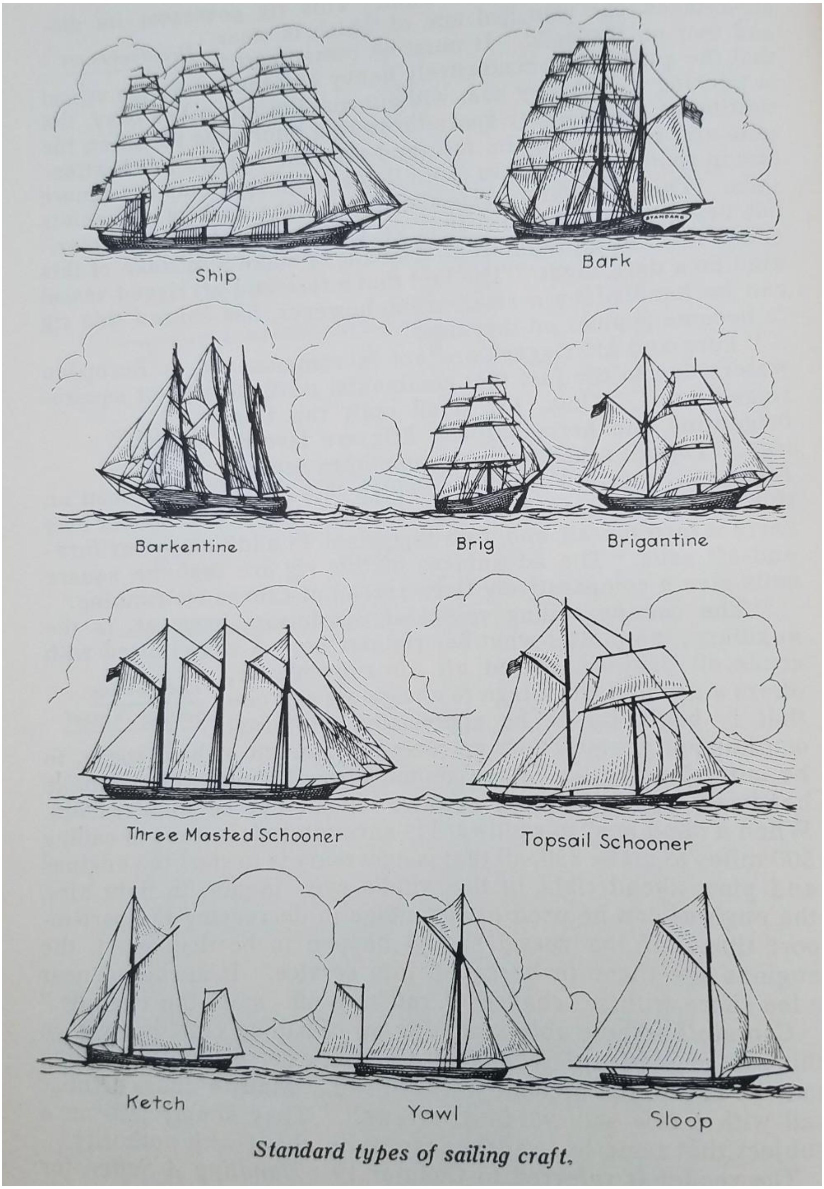
Rigs are also important because of their effect on crew efficiency. Since labor is the main operational cost for a sail freighter, rig efficiency rig is especially important, and measured in Tons Per Sailor. This chart was calculated from information on the 1906 US merchant fleet's sailing vessels, and favors Schooners of any size.



[5]

[5] Data taken from: US Bureau of Navigation, *Thirty Eighth Annual List of Merchant Vessels of the United States*. Washington, DC: Government Printing Office, 1906. https://books.google.com/books?id=QsdBAQAAMAAJ

Also See Woods, "Sail Freight Revival" Pp 60 for more information.



Standard types of sailing craft.[6]

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[6] Above Figure taken from Felix Riesenberg, *Standard Seamanship For The Merchant Service*. (New York: D. Van Norstrand, 1922) pp 18.

Rigs, keeping in the traditional sail sense as this is what makes the most sense in the small vessel fleet, are worth considering for more than just their labor efficiency. Square sails, as rigged on the classic clipper ships of the mid 19th century, are good for downwind sailing, and terrible for sailing on the wind. For any trade-wind route, square rigs such as brigs, barques, and ships are favorable, but not in most other circumstances. They are also very crew intensive and thus unlikely to be economic in a small vessel environment.

Fore-&-Aft rigs, such as schooners, sloops, and ketches, are classic all-round rigs which are both crew efficient and can also sail close to the wind. With the addition of a few square sails, such as with brigantines or barkentines, only a small expansion of crew strength is needed to greatly improve downwind capabilities.

Regardless of the rig chosen, it will need to be suited to local wind conditions and the skills of the operators. Fore-&-Aft rigs are far easier to use and train crew on, and thus are likely to be more common in the early stages of the sail freight revival. Choosing any rig other than Sloop, Schooner, or Ketch should be carefully considered and the benefits weighed before final adoption.

Automation or mechanization of rig components such as the installation of (possibly powered) halyard winches can also reduce crew requirements. There is no reason a crew needs to be overly large just to handle lines when mechanical assistance is available and inexpensive. The vast majority of modern small sail freighters can take advantage of electric anchor winches, mechanical halyard and sheet winches, and a suite of other innovations from the sail racing world and the last decades of working sail with far less expense than hiring more crew every season.

Tonnage is measured in different ways for small vessels, but for licensing and regulatory compliance, Gross Register Tons of 100 cubic feet each are the important measurement. As covered below, captain's licenses are denominated in Gross Register Tons (GRT), as are some port fees. Cargo Deadweight Tonnage (CDWT) is the weight of cargo which can be carried, and is one of the more important things to know about your sail freighter, as it dictates how much cargo you can carry in terms of weight. Net Register Tonnage is GRT less the space taken up with crew accommodations and machinery space, CDWT and NRT together give you your cargo weight and volume maximums. For regulatory purposes, Gross Register Tons will be the important number, while cargo movement will be more concerned with CDWT. The objective would be to have a maximum NRT and CDWT for a given GRT in a sail freighter design if started from drawings, to allow for the maximum cargo capacity in a fixed hull volume.

Regulatory compliance requirements for vessel length and tonnage varies. Ships over 65 feet require a far more intensive inspection than those 64’11” and shorter, making this an easier category for new sail freighters in the US. Under current USCG regulations, any cargo vessel under 40 feet and 15 GRT qualifies as an uninspected cargo vessel, so long as it carries less than 15 tons of non-hazardous cargo at a time, and need only be registered with the Coast Guard. In all cases, the first step when uncertainty about the requirements for a vessel arise is to contact the nearest Coast Guard office and ask the questions there. For all vessels trading between US Ports, the vessel must be Jones Act compliant (see later chapter on Pertinent US Regulations).

The origin of your sail freighter is worth consideration as well. New builds have proven successful in the past for small vessels, even those built and run by amateurs, such as was seen with the Vermont Sail Freight Project’s *Ceres* in 2013-2014. While *Ceres* was fiberglass-covered plywood, other materials are possible and more favorable: Steel is the preferred material for durability, ease of maintenance, and longevity, but is a higher capital investment. If a mass-production run of small craft, especially Uninspected Cargo Vessel types was going to be made, Fiberglass hulls would be inexpensive and fast to manufacture in large numbers. Traditional wood construction would also work for any size boat, but will require more maintenance and a very high initial investment.

Retrofitting existing vessels of various sizes is also an option. Motor cargo vessels up to about 300 GRT have been retrofitted with fore and aft rigs successfully in Fiji during the last oil crisis, and the SV *Kwai* in the Marshall Islands is a currently-operating example. Converting a leisure vessel to cargo use is possible, and simply using an existing sailing vessel designed for long range cruising, such as the Schooner *Apollonia*, which has space for cargo which can be adapted. Retrofits and restorations for large vessels may be more economic than new construction, but the number of vessels which can be refit into serviceable sail freighters is limited. New build vessels will have to be constructed at some point, and will generally speaking be better equipped for their job than retrofits.

Licenses and Captaincy requirements must be met for any vessel, sail freighter or not, which is in commercial use. Before putting the investment into a sail freighter, be certain you can secure the necessary personnel to operate it, with the license of the required tonnages and including an auxiliary sail endorsement. Not all captains are allowed to be master of a sailing vessel under Coast Guard regulations, and the difference between inland, Great Lakes, near-coastal, and ocean licenses needs to be understood as well. For uninspected cargo vessels, there is no formal captaincy requirement, and no licensed personnel are strictly necessary, but having master mariners on the crew will likely go a long way toward reducing insurance bills. There is more on this topic under the heading of "Crew Training and Experience."

Other local circumstances will effect your vessel. For example, if you are not crossing state lines, you may not need to be a Coast Guard Registered Vessel, as may be the case for small sail freighters around Hawaii or along the Great Lakes, which might be able to register only with their State and save some overhead and inspection concerns, but this is not guaranteed and should be cleared with the Coast Guard and competent legal counsel before going into operation.

Lastly, Ship's Gear for cargo handling should be considered. Depending on the type of cargo you will be handling, different types of cranes, lifts, blocks, and other gear will be desirable or absolutely necessary to loading and unloading your cargo. Be certain this will be possible before committing to a ship's design, only to later find you cannot take important cargo types due to a lack of reliable equipment onboard and ashore.

A more or less optimal small sail freighter for packet routes is different from one designed for tramping. For a coastal tramp, assuming a 50 GRT license is in play, a 64 foot ketch or schooner of about 30 tons CDWT with a Hybrid Diesel Electric system would make the most sense. All systems and fuels can be maintained anywhere, and are reliable across the board, while the 3 power options can be balanced to ensure the safety and profitability of the ship. On a packet route with good services and shore power at known intervals, an electric auxiliary version of the same vessel would make sense, or a diesel auxiliary setup if shore power and services are not available for electric systems. As with all other aspects of a sail freighter, these should be weighed carefully during the vessel selection phase of operational planning.

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Engine Use Strategies

The vast majority of modern Sail Freighters are going to have a motor, so deciding how you are going to use it is a critical portion of your operational plan and carbon impact. While there's a lot of options for types of engines and energy storage systems, covered in the last chapter, no matter which you have you will be applying it somehow. That's your Engine Use Strategy.

Generally Speaking, these are the major classes of engine use strategies, from least to most engine-intensive:

1. Not Having an Engine.
2. Emergency and Docking use.
3. Minimum Speed.
4. Schedule Keeping.
5. Economic Optimization.
6. Motor-Sailing.

In this chapter, we will also go over a few other types of engine and energy use strategies specific to certain environments, such as estuaries, but first we'll get these basic strategies out of the way.

1. Not Having An Engine.

Not having an engine, i.e. having a pure sailing vessel, is of course the simplest and least engine-intensive strategy out there: You can't use an engine even if you wanted one. However, this comes with a lot of risks, such as lee shores, which were the reason so many historic vessels were wrecked and crews injured or killed. Depending on your level of skill and environment, this may be an acceptable risk, but for the majority of sail freighters, it won't be.

2. Emergency And Docking Use.

Emergency and Docking Use is the next most intensive strategy. By limiting the use of engines to avoiding hazards and getting into or out of dock, the engine stays off most of the time, and this also opens the option of docks which are not suitable for sailing on and off. The Schooner *Apollonia* uses this strategy, and despite her frequent stops uses the engine less than 4.5% of her underway time, most tramp operations will likely use their engines less due to longer routes. This is likely to become one of the most common engine use strategies across the sail freight movement, as it ensures the safety of the vessel and crew, while causing a very small climate impact.

3. Minimum Speed Strategies.

Minimum Speed strategies are pretty simple in practice. The ship sets a desired minimum speed, and when the wind is not sufficient to meet it, the engine gets turned on. Frequently this involves motor-sailing as a way to use as little fuel as possible for the desired speed, but can also involve shifting entirely to engines if te wind is against the direction of travel.

This has some advantages for certain routes and cargoes. For cargos which need to reach a destination by a certain time, such as fresh foods and critical supplies, this lets sail freighters still participate in the market, and can still result in significant fuel savings on favorable routes. For example, on some routes the engine may only be used to cross the Doldrums, as the speed on either side of them is higher than the desired minimum. Reducing a voyage's duration by these means can be very useful for a ship on tramping routes as it allows for scheduling and more voyages per year.

4. Schedule Keeping.

Schedule Keeping engine use strategies are similar to minimum speed uses, but more intensive: For example, a minimum speed voyage may still sail to windward in some cases, because time can be made under sail at the minimum speed. While minimum speeds are good for tramping, schedule-keeping is good for packets.

A packet vessel which chooses to sail on favorable legs of a circuit, then travel under motor only on the upwind sections, with a bit of motor-sailing on the favorable bits to save some fuel is using a schedule-keeping strategy. This is what was adopted by retrofitted vessels in Fiji during the last oil crisis, with some significant success, but a lot of motor-sailing. Overall, they saved around 30% on fuel, but if they had traveled under sail alone for about 10% of their routes, could have saved as much as 60% on fuel.

Depending on how tight a schedule you set, there might not be much need for motoring within what is technically a variant of this engine use strategy, but it is generally taken to mean motor use to keep an otherwise impossible schedule.

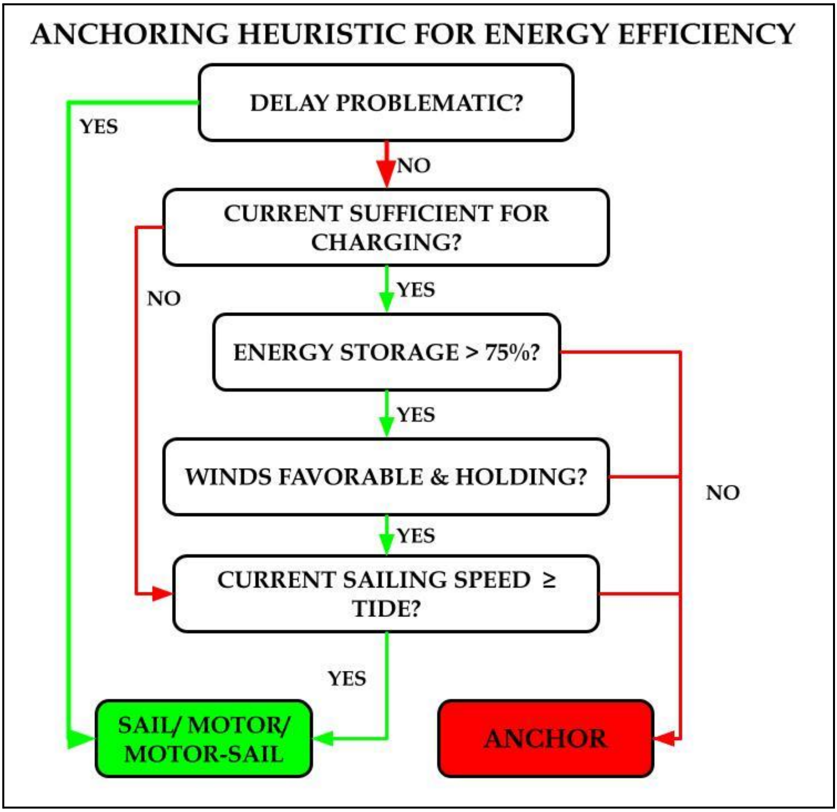
5. Economic Optimization.

Economic optimization is a strategy where the most cargo and revenue is sought, and if fuel is cheap, you motor at high speed, and you sail when it is expensive. This is one of the least Sail-Freight type engine use strategies, and is really only listed for reference. If you're using fuel on a sail freighter, under the definition at the front of the manual you're likely worried more about ecological than economical outcomes of your vessel's operations. However, if you're equipped with an electric engine which you're recharging under sail, this is a valid choice. However, you'll be straying further and further into the realm of Wind Assisted Ship Propulsion (WASP) the more motor you employ.

6. Motor-Sailing.

Motor-Sailing as an engine use strategy is thoroughly within the bounds of WASP as opposed to Sail Freight, as the sails become an auxiliary to the motor, and are used only about half the time at most. That being said, motor-sailing is a highly useful technique, as it can reduce the amount of fuel needed for a given motoring task. Any time there's slightly favorable winds and another engine use strategy would call for motoring, motor-sailing can be used, with the caveat that motor-sailing moves the apparent wind up about one point of sail (for example, from a broad to a beam reach).

There are other ways to manage energy as well as engine use strategy, depending on your environment. For example, the combined use of tides and anchors can allow a windjammer to avoid using the engine and give the crew additional rest while traversing estuaries or other tidal regions. If this is built into the schedule, that will not impede scheduling. For ships with electric engines and underway regeneration from the props, the use of the tide when it is going against the direction of travel can be a time to recharge batteries if there's sufficient current. A diagrammatic heuristic for this technique is given below, assuming electric engines with prop regeneration.



Regardless of engine use strategy, a vessel needs to be safe and well handled to make anything like a successful cargo run. Managing energy, in this context, doesn't really care how the energy is stored: Liquid or solid fuel, electric batteries, compressed gas, or otherwise. Energy reserves on small vessels will be limited, and must be stewarded appropriately. If you have a battery reserve which can only provide two hours of full throttle use, it would be unwise to try to adopt a minimum-speed strategy, for example. Vessel design, rig, and environmental factors will likely ba a major factor when deciding on an engine use strategy.

For tramping vessels, there is little you can plan for in advance, as cargos and destinations will be varied. As a result, wind and water conditions will also be quite variable, and may or may not be favorable. In this case, depending on the demands of your cargo and the capabilities of your ship, you might find yourself changing your engine use patterns every voyage. For packet vessels, this will be less of a concern, as the dedication to a single route means there will be generally predictable winds and a generally predictable schedule.

When developing your engine use strategy, make sure to take into account your ship's capabilities and the demands of your route. Once a strategy is chosen, more budgeting can be done to figure out how much fuel, battery, or other storage you will need on board and how that effects your cargo capacity and other operations.

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Crew Training & Experience

Crew training and experience for Sail Freight is going to be an important element of the sail freight revival, because the Cræft knowledge of working sail effectively died out in the overdeveloped world over 70 years ago. That living tradition and its intangible knowledge about cargo handling, sail handling, and dozens of other aspects of sail freight work will need to be re-learned from the fragments of knowledge left to us in books, photographs, artifacts, and other records which have yet to be combed through in hundreds of archives and libraries around the world. Some things, however, are universal and will be required for all working sailors and ship's officers. We'll start with these and work up to the more complex and specialized skills.

First Aid certification should be required for all Windjammer sailors, as sailing vessels are inherently dangerous environments, and the time required to get outside help will be far longer than on land. CPR should also be considered as a priority for all crew members as a precaution while underway. This standard is not sailing specific, but should still be held to as the training is inexpensive and widely available.

Minimum standards for sailing competence in domestic coastal trade will be relatively minimal, especially in uninspected cargo vessels. Basic Keelboat Certification through recreational bodies such as US Sailing, American Sailing Association, and other such bodies should be considered a prerequisite for any working sailor. These courses give the student a good familiarity with boats and the water, and good line-handling skills, along with basic knowledge of handling a sailing vessel with a Fore-&-Aft rig.

In addition to this basic requirement, experience on sailing vessels should be expected of sailors. Basic Competence can be trained easily, but a more experienced hand will improve the operation of the ship significantly. Those with tall ship experience on similar rigs and vessels should be desirable crew, especially when paired with higher certifications such as Master's, Mate's, or STCW certifications.

Captain's Tickets of the appropriate tonnage with an Auxiliary Sail endorsement will be absolutely necessary for any vessel larger than the uninspected cargo vessel category. Depending on what the Coast Guard determines the vessel's crew requirement to be, other credentialed mariners will also be any time the vessel leaves the docks. For all these endorsements and licenses, sea time is required, as well as drug testing, medical certificates, first aid training, and CPR certification. Able Bodied Sailors (AB) with Sail endorsements, Aux-Sail endorsed Mates, and other specialized personnel may also be required, and generally need to have the same types of medical and drug testing clearances as captains.

Crews crossing International borders will need to have the appropriate mariner's credentials, and be STCW trained where necessary. This additional amount of training will increase the pay required to hire and retain sailors, but brings a large amount of skill to the ship and should be considered as a desirable certification for any Sail Freighter crew members.

Cargo Handling Experience is a good idea for all Sail Freighter crew members to learn. Poor cargo stowage has led to the sinking of many ships and killing a lot of sailors. While some modern manuals will be available and should be studied, the basic principles of stowage for basic cargos is to not let them shift, and keep the weight as low and close to the keel as possible. Improper cargo stowage on a sailing vessel can result in loss of stability when sailing upwind, capsize, loss of righting angle, and any number of other problems. There are historic manuals on stowage for different cargos which can be referenced as a general guide, but for breakbulk cargo plenty of dunnage will be needed, as will strapping and the use of lines to secure cargo in place. Maintaining trim (level along the vessel's length) and balance (preventing list) in cargo stowage will need to be carefully considered alongside the load's packing into place.

Crews and captains also need to understand that these ships will be relatively slow, handle sluggishly compared to leisure boats, and are not meant for sport. Leisure sailors moving to working sail should understand that these vessels may seem underpowered, but they're designed that way to make them safer working ships in all conditions. Stability and simplicity are highly desirable traits in working vessels; speed and sharp handling are secondary to these.

Training Programs aboard small sail freighters should be encouraged. While many of the transoceanic sail freighters have passenger programs and do some training for many people per voyage, even a single internship or Novice position on a small vessel could be a significant help to the sail freight movement. At a minimum, all vessels (and the crew members themselves) should keep track of sea time and be certain to push for each opportunity to upgrade crew from uncredentialed mariners to any certification they're eligible for. In many cases this might be Mate's tickets, AB-Sail, or other certifications, and eventually Master's or Captain's licenses after a season or two of work, and this can create a pool of working-sail skilled hands to pull the movement forward.

PROPOSED BASIC CREW TRAINING PROGRAM:

The following program outline is by no means formalized, but has been designed to cover the basic skills and competencies necessary for sail freighter sailors. Any qualifications in excess of these, such as STCW Basic Training, can be used as replacements. It is expected that a formalized sail freighter training program will take many years to fully develop, but the following is proposed as an initial outline. Locally developed training should be outlined, detailed, and preferably published under a CC BY-SA 4.0 License to be distributed to the fleet for refinement and implementation.

1. First Aid Training.
2. CPR Training.
3. Basic Keelboat Certification Course.
4. Fire Extinguisher Training.
5. Basic Cargo Handling:
    - A. Block and tackle.
    - B. Use of barrel slings, cargo nets, and other tools.
    - C. Basic cargo stowage.

D. Cargo handling safety.

6. Quayside Operation Basics:
    A. Basic cargo bicycle operations.
    B. Cargo organization and staging.
    C. Use of shore gear/cranes.
    D. Basic portage tools and skills.

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Finding Cargo

In many cases, cargo won't come seeking out your sail freighter: You'll have to go get it, and figure out how to make the whole operation work. For this, a ship broker is important, but in these early stages of the Sail Freight Revival most sail freighters will need to be their own agents, as well as sailors and dockers. This will be a critical part of planning, and should be worked extensively before embarking on other legs of the planning operation.

This chapter will deal principally with packet routes, as Tramps will never fully realize a steady stream of cargo, and constantly be on the hunt for the next paying gig. Packet routes, however, have the chance to build lasting, mutually beneficial relationships and use them over the long term to ensure a steady flow of cargo and revenue to keep the ship afloat.

The simplest way to find cargo is to add your ship into an existing trade relationship. For example, if there are several breweries along a stretch of navigable water, as well as a malthouse which supplies them, inserting the ship into this already-existing trade is an ideal move. This has been successfully done by Schooner *Apollonia*, and represents the bulk of their trade. Other cargos taken on by *Apollonia* include hot sauce, maple syrup, flour, logs, soap, books, coffee, pillows, yarn, vegetables, fruit, cider, rock salt, beer, and wine.

The general advise seems to be that you should look for lasting cargos, not the short-term cash-grab cargo. For cash-grab cargo, it is fine to take it on if it is on your way, but taking it at the expense of the lasting relationships you can build for steady cargo is a risk. Steady cargos will keep your boat in business, unsteady cargos will not.

One method tried by Schooner *Apollonia* was a CSA style "Boat Box" of selected goods in a shoe box which could be purchased on a subscription model. These contain 3-4 items each cargo run, and can be picked up at the dock or from designated partner businesses on shore. The ship buys the items to include, and sets up the boxes, making a small profit, but uses this to increase the amount of cargo moved, and get a wider audience involved. This will ultimately increase the demand for sail freight goods. A similar arrangement has been made with a cidery for a subscription set of bottles shipped monthly on the *Apollonia*, and both seem to have been moderately successful.

Shoreside support is an important element of the Boat Box project, and should be arranged beforehand if a similar model is attended. This allows subscribers to pick up their box at a designated business, such as the Hudson River Maritime Museum in Kingston, NY, if they arrive after the *Apollonia* has departed the docks. CSA boxes from farms along a route would have a very similar administration, being picked up at one port and delivered at another, though this would best be done with non-perishable goods where possible due to the unsteady nature of sail freight scheduling: Honey, pickles, preserves, jellies, jams, and dry goods would all work well for this type of model.

The places which will most likely be looking for near-zero-carbon transport are likely to be found in the Organic and Slow Food movements, and high value cargos such as wine, beer, coffee, chocolate, alcohol, and other shelf-stable, expensive foods and goods. Those which stand to benefit from low carbon marketing of their products will also be prime candidates. Localization movements, such as the Northeast Grainshed Alliance have also proven to be good candidates for finding Sail Freight cargo. Cooperatives and other alternate-economy movements are also likely to find the idea appealing.

There is a chance that a freight forwarder may take on a sail freighter which is on a ferry or packet service and arrange cargo for you. If this is the case, then there will be a constant stream of stuff to move, and likely good pay to go with it. This will be especially difficult to arrange in the US, but has been successfully arranged in the EU. Where price competition is possible, this type of arrangement will be favorable, but that is unlikely to occur outside of service to small islands or where fuel prices are especially high. Congested large ports with small-port alternatives not accessible to larger vessels may also present a chance to employ such a model. Local circumstances will be the final arbiter of whether this type of arrangement can be made in the initial stages of the sail freight revival.

In the long run, remember that before about 1830, effectively all maritime cargo was moved by sail, and effectively everything was moved on the water. For the vast majority of cargos, it isn’t a question of whether a cargo CAN be moved on a sail freighter, so much as whether it should be. Livestock, building materials, lumber, dirt, and almost anything else can be moved by sail, as we know from nearly 5,000 years of archaeological records. You simply have to narrow down what you consider to be a good idea on your particular vessel, in your specific environment.

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Feral Trade Website: https://feraltrade.org/statement/

First & Last Mile Transport

Dealing with the Land Leg of first and last mile transport can be a challenge, and will be dictated partly by port facilities and the type of cargo carried by your sail freighter. This section is primarily geared towards a general cargo/breakbulk vessel, as containerization will add a myriad of other concerns to the list of challenges for ship to shore cargo transport.

Port Facilities (discussed elsewhere) will typically dictate the type of quayside and last mile operations you are able to undertake. If lightering from an anchorage or beaching the ship on soft sand is required, a cargo bike may be impossible to employ, for example. On the other hand, in places with good dock infrastructure, cargo bikes and trailers will be a simple means of getting cargo too and from the boat. Where good road networks exist, the use of trucks and other larger vehicles can take over this role, though balancing this with carbon intensity will be a challenge. Anything within about 2 miles can be delivered by bike without a significant challenge, as found through the operations of Schooner *Apollonia.*

"Organic Transport" is a military idea of transport assigned permanently to a unit. In sail freighters this can also be used, such as the electric-assist cargo bike and trailer used by *Apollonia* are another option for shoreside service. This type of transport is part of the ship's organization from the start, and lives aboard for use where appropriate. As almost all cargo bikes, even the long-tail types, do not take up much room onboard, they are well suited ot this role of organic transport, and will free the crew from relying entirely on shoreside services and facilities. If well planned, these organic transport options can also be low-to-no carbon vehicles to complete the delivery with as little fossil fuel use as possible. Organic Transport is worth considering for both tramp and packet vessels, and the more versatile the means, the better off a tramp operation will be. For packet services, organic transport should be based on the prevailing conditions for ports along your circuit.

Organic transport also has the advantage of being inexpensive. The capital outlay for a simple bike with a cargo rack and trailer is minimal, and gives a considerable range of movement off the quay. Its crew is drawn from the vessel's compliment, and thus incurs minimal or no additional labor expense. New or used cargo bikes with electric assist will lengthen the range of operation shoreside, but incur more expense than a simpler bike. In many cases, bike trailers can be made to serve dual purposes while working on the quay during loading and unloading of cargo, adding another advantage to their purchase.

Relying on shore-side services makes more sense for a packet than a tramp operation, as a packet route will have more predictable access to shore-side low-carbon transport such as bicycle couriers, etc. Relationships with these couriers should be cultivated early and wherever available. Integrating into these existing delivery networks will likely open up more options for other cargos which were relying on these couriers for low-carbon marketing, and another leg might be picked up by the ship. Shore-side contract services and organic transport can work well together where capacity on land is restricted or scheduling issues exist, especially if organic transport drops off deliveries at a contractor's depot for further distribution.

Information on simple load-bearing devices can be had from a number of sources, including those listed in the further reading section for this chapter. For short ranges, such as around the quay, working with very simple equipment may be favorable, but any distance more than a quarter mile should consider some type of more advanced transport.

FURTHER READING:

J. Alexander Page, "Role of Cargo Bicycles in Disaster Planning and Emergency Management" Master's Thesis. University of OR, 2014. https://scholarsbank.uoregon.edu/xmlui/bitstream/handle/1794/18475/Page_final_project_2014.pdf

Technical briefs and technical drawings of a number of options are available free of charge from Practical Action. These include briefs and drawings of wheelbarrows, bicycles, bike trailers, bike hitches, and other types of cargo bikes for specialist purposes. See their website at:

https://answers.practicalaction.org/our-resources/construction-and-transport

Modular, Open-Source cargo bike designs can be acquired from http://www.xyzcargo.com/ either free or for a small fee.

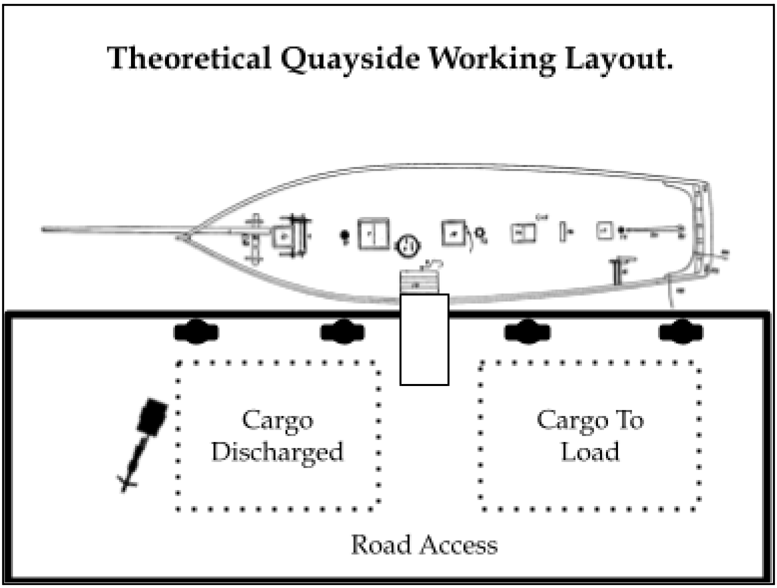
Gordon Hathway, *Low-Cost Vehicles: Options for Moving People and Goods*. London: Intermediate Technology Publications, 1985.

US Army. *FM 55-110: Transportation Port Companies Military Stevedoring* Washington: Government Printing Office, 1952. https://books.google.com/books?id=S_TjOPdR44UC

Loading & Unloading Cargo

Small sail freight operations are unlikely to have dedicated docker and stevedore crews at all the small ports they visit, and the ship's crew will have to be willing and able to do this job as well as sailing. This may change in future as more small ports are re-developed for cargo operations, but this is likely to be many years in the future. Some knowledge of quayside operations and loading procedures will be helpful, and as with most of this manual a small general cargo vessel is assumed.

Breakbulk cargo low-carbon methods or cargo handling at he quayside should emphasize simplicity and the conservation of space. While some working space to stage cargo from ship to shore and vice-versa will be necessary, having a general rule (off-loading cargo towards the bow of the ship, on-loading cargo aft of the gangway) which can be used almost anywhere will be helpful. Further breakdown of each space will be needed based on the number of deliveries involved at each stop. Organization of quayside operations is critical to making sure the correct goods go with each order.



Ship's equipment should include at least one hand truck, some levers, and extra blocks and lines to set up cranes and lifts. Hand barrows, slings, cargo nets, and slides are all seen in use in historic photographs, and can be used. Old sails are a great material to make chutes and slides from, while old lines can be converted into nets and slings. Wooden hand barrows which break down easily and store as a set of boards can be constructed easily and inexpensively out of lumberyard stock, and are useful for carrying barrels, sacks, and other goods over terrain too rough for easy access by wheeled tools. Hand Barrows can also be rigged as a temporary lifting platform or pallet depending on the cranes and other gear available.

Cargo must be stored in a way which retains stability and ensures it cannot shift while underway. Dunnage, wedges, and tie-downs are important and should not be spared, especially if weather conditions are at all uncertain or bad along the length of the voyage. Heel and trim changes from the vessel's normal state should be minimal or non-existent when loaded with cargo, with the at-rest deck relaining level. Heavier cargo should be stored lower as a general rule to keep the center of gravity low in the vessel, and either centered or balanced port and starboard. This will preserve the righting angle of the ship, which is highly important when propulsive force is applied high above the ship's center of gravity, and heeling occurs when sailing upwind.

It is worth while to take lessons in maritime cargo handling through local community colleges and other educational resources in your area if you are to be responsible for loading and handling cargo on board any sail freighter, but especially for any vessel likely to encounter heavy weather or rough seas. There are STCW Endorsement courses around cargo handling for larger vessels, and the principles involved translate to smaller ships. Any tramping or international sail freighter will need to have officers with this endorsement regardless, and others will certainly benefit from the knowledge and skills gained through these courses.

Poor cargo handling has killed a lot of sailors and sunk a lot of ships. Be certain you have loaded your ship correctly, and it remains in trim and on ballance. The Schooner *John F Leavitt* took on a load of industrial chemicals and lumber bound for Haiti on its maiden voyage, and due ot poor stowage the chemical drums leaked while in a Nor'Easter off Long Island. As a result, the donkey engine could not be started to power the ship's pumps without a high risk of igniting the chemicals, contributing directly to the vessel's sinking in January of 1980. Luckily, in this case the crew survived, after being picked up by New York Air National Guard helicopters.

Pamir stowed grain improperly in 1957, loose in the hold instead of bagged, which allowed it to shift when sailing through a hurricane. The ship heeled over 40 degrees, the cargo shifted, and the ship was unable to right itself, exposing hatch covers to waves until they were battered in and the ship sank. 80 out of 86 crew members died as a result.

These are only two of hundreds of cautionary tales which should be taken into consideration when looking at Sail Freight as a profession. Take loading and discharging operations seriously, and your ship and crew will be fine.

FURTHER READING

Dennis, Ron, and Alan Smith. *Low-Cost Load-Carrying Devices.* London: Practical Action Publishing, 1995.

Maritime New Zealand website on Vessel Stability. https://www.maritimenz.govt.nz/commercial/safety/vessel-stability/default.asp

Perez, Sergio. "Downbursts, groundings, incompetence and other hazards to 21st century merchant sailing ships" *Journal Of Merchant Ship Wind Energy.* 4 December 2021. www.jmwe.org/articles

US Army. *FM 55-110: Transportation Port Companies Military Stevedoring* Washington: Government Printing Office, 1952. https://books.google.com/books?id=S_TjOPdR44UC

Portside Considerations

Considering the available port infrastructure in your area of operations will be critical to your vessel selection process (dealt with earlier) as well as how your operation will have to handle cargo loading and unloading. Where there is reasonably well developed infrastructure, there may be no concern at all, but other places may take more extensive planning and the ability to deal with more primitive circumstances.

For small vessels, commercial marinas may be able to serve most of the needs of the ship. This has been successful for the Schooner *Apollonia* on the Hudson River, and was also reasonably successful for the Vermont Sail Freight Project in Lake Champlain and the Champlain Canal nearly a decade earlier. That said, past a certain size of ship and especially with the use of containerized cargo, more advanced and dedicated facilities and tools are required. Depending on the type of ship's gear onboard your sail freighter, you may or may not be able to get away with using undeveloped facilities with a given type of cargo, but this can only be determined once available vessels and cargos for a route are considered.

Port facilities can be grouped into three general categories for consideration here, and while this model was developed for studying the bronze age Aegean, it is still quite useful for the modern day as a means of classification or description for what we face today. The three classifications are hierarchical, but on a spectrum from Anchorages to Ports, meaning Ports are also anchorages, but not the other way around.

Anchorages, under Tartaron's classifications, are the most basic type of accommodation for shipping, and may be no more advanced than a sandy beach to pull a boat ashore on safely. The classification also covers single quays and jetties, places where lightering can be accomplished easily from anchor, or natural features which allow a ship to tie up safely.

Harbors, the middle of the spectrum, are more developed than anchorages, and a site designated for maritime trade. Harbors normally have at least limited support services, such as warehousing, shipwrights, and shore gear for handling cargo, but can still be quite small and relatively undeveloped.

Ports, on the other hand, have everything and are primarily based around maritime trade, as opposed to simply having the capability. Ports will have every possible support service, massive amounts of traffic, and have highly developed infrastructure. These are also the points normally associated with Customs offices, international and transoceanic trade, and other large scale maritime activities.[7]

Anchorages are of course the simplest option, as described above. Historically, as seen in the early 20th century photo below, these types of basically undeveloped or naturally occuring facilities can be quite useful for a properly designed vessel. They have been used from time immemorial all over the world, and many vessels were designed to use them, with flat bottoms and strong framing.


8

[7] Thomas F. Tartaron, *Maritime Networks in the Mycenaean World* (New York: Cambridge University Press, 2013). Pp 4.

[8] Unloading a collier on East Beach in the town of Cromer, UK. Unknown Photographer, 8 March 1912. Kolforn Collection, via Wikimedia Commons.

The complication from using Anchorages is the frequent lack of facilities for certain cargos. While it may be possible to tie up to a tree or rock, or sit on a tidal section of soft beach to handle cargo, if there isn't anything on the land side to work with in the way of roads and land access, it will most likely be near useless. An anchorage is extremely unlikely to have container lift capabilities, and thus will necessitate the use of bulk or breakbulk cargo. However, if you're delivering to small islands or isolated coastal settlements, this may not be an issue at all. Depending on your environment, vessel, and cargo, the use of such techniques may prove useful, even in more developed areas.

Harbors are by definition more developed than anchorages, but are short of the facilities of a full-blown port. Municipal or yachting marinas, well developed bulkheads with moorings, public docks, maritime museums, and other such places immediately come to mind. This is the type of infrastructure used by the Vermont Sail Freight Project and Schooner *Apollonia* for the most part. While still not designed to deal with containerized cargo in most cases, there is a much better chance with a Harbor that there will be supporting facilities such as shore heads, showers, and the chance to resupply the ship. In addition, there's likely to be good access to roads and cargo staging grounds such as those illustrated below. However, it is likely that there will be limited dedicated cargo infrastructure at a harbor at this early stage of the sail freight revival.

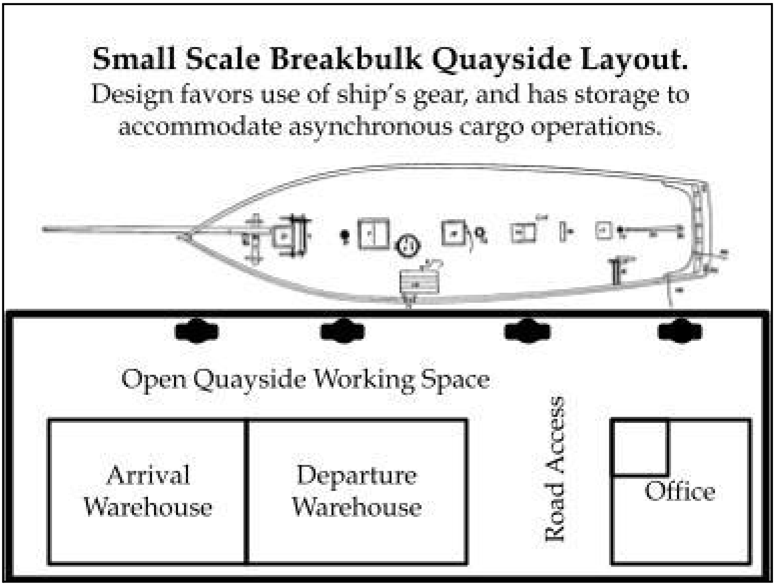
Harbors, unlike anchorages, are also likely to have some limited repair facilities. While drydocks may not be available, common parts should be, as well as services such as welding, rigging, and electrical troubleshooting. Haul-out and storage on the hard may also be available at many harbors along seasonal waterways, depending on local circumstances.

Ports are the ultimate embodiment of a land-water interface for cargo. Almost every port will have container capabilities, warehouses and staging grounds, road and rail access, and likely extensive repair facilities. There will be deep water, good moorings, and for transoceanic sail freighters, the normal Customs and border control facilities. Major coastal cities will have these types of advanced facilities, and few other locations.

Lightering is an option for consideration when facilities are not ideal for your freighter to enter a specific area. Using a ship's boat to deliver goods by ferry to shore has a very long history. Some anchorages or harbors may be too shallow to allow a fully laden vessel into the shore, or a ship's design may prevent it from beaching to unload as depicted above. In this case, a lightering operation can solve the problems at hand, but will need a considerable amount of time to load and unload. If conditions in your area of operation require frequent lightering, it may be worth establishing permanent moorings offshore to avoid a large amount of anchoring in the area and damaging the local sea floor. Encouraging at least the installation of a floating dock with links to shore will help immensely.

The whole point of Ports, Harbors, and Anchorages is to provide an interface between land and water transportation. If there isn't a good link with a capacity comparable to the amount of cargo you need to move through the area, there's little point in using the facility. The connections need not be overly complex, depending on your cargo and customer, but unless they live and work at the dock, some sort of space for changing vehicles and working with cargo will be necessary.

All harbors should be provided with moorings and an open space on the Quay for working. Loading and unloading will need space to put things down and stage them into vehicles or warehouses depending on the situation at hand. The illustration below depicts a simple but workable design for a small vessel quayside equipped with warehousing and an office. Road and rail access should be available just below the bottom of the illustration in an ideal situation. If there are no warehouses available, and the office does not exist, the quayside depicted is still entirely workable, but less ideal. When working with limited facilities and resources, warehouses could be replaced by simple 20 or 40 foot containers dropped off at the landing. If no warehousing can be furnished at all, the last-mile system will simply have to arrange to meet the ship at the dock and complete deliveries immediately.



Warehousing is extremely important to Sail Freight, as it is essentially the means by which the only roughly scheduled means of delivery can be coupled to the timing of demand. If no warehouses are available and delivery cannot be completed as the ship discharges, then the ship itself must remain at the dock or at anchor as the warehouse, which will prevent its gainful employment. However, with sufficient warehousing, an area can be supplied on the ship's schedule and then the stored deliveries can be drawn upon as needed by the shoreside population. This keeps ships working, and reserves ensure local access to stored goods and food when ships are delayed. As a piece of infrastructure warehousing should be encouraged wherever possible, and especially in close proximity to harbors and ports.

Another consideration for ports and harbors is their normal cargo needs and wants. When selecting ports along a circuit route, ensuring they have a sufficient demand for the items you will be carrying will be important to ballance with the port infrastructure.

Even if there is less sales value, a nearby place with a better dock may be worth cultivating, instead of going to a place with higher demand for sail freighted goods, but with an underdeveloped and possibly hazardous anchorage. This can then be used to encourage the improvement of facilities at the point of higher demand.

The last concern for ports of call is compatibility with any attached last-mile transport your vessel uses. For example, last-mile cargo bike delivery relies on sufficient access to bike-able roads or paths, and the ability to land the bike without damaging or degrading its machinery. While some ports will have good infrastructure for zero-carbon last mile transport, others will not, and a plan to cope with the difference along a route will be an important part of the planning process.

FURTHER READING

Emmanuel T. Kodzia and Naima Saeed. "Increasing the attractiveness of a cruise port for cargo business: The contribution of stakeholders" *Case Studies on Transport Policy* 9:2, June 2021. 879-888 https://doi.org/10.1016/j.cstp.2021.04.008

Andrew Willner. "Rondout Riverport 2040: Parts 1&2" www.resilience.org/stories/2021-01-26/rondout-riverport-2040-part-1/

Koltz, Bruce George. "The reintroduction of sail for marine commerce: and the consequent effects upon small port economy and trade routing" Master's Thesis, University of Notre Dame, 1980. https://calhoun.nps.edu/handle/10945/19039

Pertinent US Regulations

Regulations vary across the world, and this volume was written in the US, so it will focus on US regulations here. As always, in matters of regulation and legal clearances, seek answers from competent legal council and the US Coast Guard. The following is only a general guideline of what to expect and be aware of initially.

The Jones Act is likely the most broadly applicable piece of regulation a sail freighter in the US needs to be aware of. The Jones Act, in force since 1920, requires all vessels trading between US Ports to be built in the US, Owned in the US, Flagged in the US, and crewed by at least 75% US Citizens or Nationals. This can be a significant hurdle for retrofitting vessels, as many of the boats in the US are foreign built, and not used for commercial purposes, thus exempt from the Jones act. As soon as they are converted to commercial use, they must be Jones Act Compliant. This may lead to the necessity of new-build vessels in most of the US as there are very few suitable vessels available for restoration or retrofit to cargo use.

Coast Guard Documentation for your vessels will generally allow you to operate in Federal Waters, or across state lines. Depending on the size of your vessel, you will have to pass various inspections and and meet crewing and competency requirements. For Uninspected Cargo Vessels, this will be only the submission of papers for the vessel, and will not require captain's licenses, inspections, or other compliance requirements aside from the normally expected safety equipment for all vessels.

Vessels going abroad will need to ensure they are compliant with ballast water treatment, safety equipment, STCW requirements, SOLAS requirements, and other provisions of international law which are more complex than this volume is able to treat in detail.

Crew may also need to meet regulatory compliance standards on inspected cargo vessels. Crews (or at least a certain number of them) will need Merchant Mariner Credentials and ratings as Masters, Mates, Able Seamen, or Ordinary Seamen. This requires medical certificates, drug screening, documented sea time, and other details such as first aid and CPR training. For any vessel crossing international borders, STCW (Standards of Training and Certification for Watchkeeping), basic training, lifeboat, and other certifications will be necessary, depending on tonnages and ratings involved. These need to be taken into consideration. Even for an uninspected cargo vessel where these things are not strictly required, the presence of a licensed deck officer is not a bad idea, and will likely contribute to the boat's long-term success.

TALK TO THE COAST GUARD about regulations, they're the only ones who will know them well enough to guide you properly. There are whole offices set up for this exact purpose, and asking ahead of time will save a lot of trouble later on.

FURTHER READING

John Frittelli, *Shipping Under the Jones Act: Legislative and Regulatory Background* Washington DC: Congressional Research Service, 2019.

US Coast Guard. "National Master of Self-Propelled &/Or Aux Sail Vessels of Less than 100 Grt upon Near Coastal Waters 11.428." https://www.dco.uscg.mil/Portals/9/NMC/pdfs/checklists/mcp_fm_nmc5_15_web.pdf.

Ideal Environments For Sail Freight Revivals

When looking for conditions which make Sail Freight economically viable, a few patterns stick out historically, which are different for tramping and packet routes. For tramping, the simple answer is large cargo capacity and very long distance route, as these are the most expensive in fuel for conventional ships. For packet routes and coastal trade, the situation is far more complex. However, three major circumstances seem to favor Sail Freight: Poor land transportation infrastructure, high energy prices, and a maritime-oriented culture.

Poor land transportation infrastructure can take many forms. Roads may be poor quality, or vehicles may be in short supply, and both will have the same effect. Mountainous terrain which makes for a long drive between ports and towns, but short communication by water will have a similar effect. The most obvious, however, is a complete lack of land transportation between points, as with an island.

High energy prices also make for favorable conditions to start with Sail Freight. During the Oil Crisis of the 1970s, a large amount of research on Sail Freight happened world-wide, but a particular focus was in the Pacific Island States. Due to very high fuel import prices, modest revenues, and no alternative to maritime trade, these small island states worked to bring back sailing technology with everything from pure-sailing vessels to instituting motor-sailing on retrofitted ships assigned to government subsidized inter-island packet routes to save on fuel. Anywhere labor is cheaper than fuel sail freight is likely to thrive.

The combination of the above two factors has kept traditional sailing networks of Dhows active on the East coast of Africa to this day, aided by a maritime culture which has traded in this way for thousands of years. This fleet of Dhows, likely several thousand strong, ranges from the West coast of India as far south a Madagascar, using the seasonal Monsoon winds to bring them back and forth each year.

A maritime-oriented culture is helpful for reviving sail freight because people will look to the water more often. New York, for example, despite having waterways on all sides, is generally a land-oriented culture from the City to Buffalo. Water is seen as a barrier, not as a gateway to another area. However, in a culture still conversant with the sea and sailing, such as coastal Maine, the Marshall Islands, or Hawaii, the situation is different, and people are more likely to accept the idea of maritime trade as a viable response to energy and climate change crises.

Hawaii, considering all the above, would be an ideal location to start a Sail Freight operation in the US, along with the Florida Keys and Maine coastline. Outside the US places like, Iceland, New Zealand, the Baltic States, Greece, the Philippines, Fiji, Japan, and others all come to mind as fitting the conditions above. The Caribbean and Gulf of Mexico are also likely to be a prime area for sail freight endeavors, especially on the connection between Miami and Puerto Rico. Other areas may include Ireland on coastal and packet routes to the continent, and between the UK and EU.

These conditions are joined by one other which will become ever more present as time goes on: Awareness of the Climate Crisis. The more aware an area is of the climate crisis, the more amenable it will generally be to the idea of Sail Freight as a low-to-no-carbon means of transportation. In the places most effected by the climate crisis, sail freight may prove a useful and immediately implementable tool for survival.

FURTHER READING

Biman Prasad et al., "Sustainable Sea Transport Research Programme: Toward a Research-Based Programme of Investigation for Oceania," *Journal of Pacific Studies* 33, no. 1 (2013), 78-94.

Beorne, Geoffery. *Filling the Gap: Small Inter-Island Caribbean Trading Ships and their Crews.* Cardiff, UK: Seafarers International Research Centre, 1999. https://www.wind-ship.org/en/research/

Levinson, Marc. "Freight Pain: The Rise and Fall of Globalization." *Foreign Affairs* 87:6 (2008) 133-140 www.jstor.org/stable/20699377.

Bergeson, Lloyd and Christopher Greenwald. “Sail assist developments 1979–1985.” *Journal of Wind Engineering and Industrial Aerodynamics* 19 (1985): 45-114.

Encouraging Sail Freight

There are a number of ways to encourage sail freight as it becomes viable again in the overdeveloped world. One of the simplest, of course, is to use and purchase from sail freighters and those they supply, which will keep those networks strong. Taking advantage of systems like the *Apollonia*'s Boat Boxes and Cider Club are an ideal way to show support and demonstrate that general public support for sail freight exists.

The largest changes which would favor the revival of sail freight are legislative, and should not be counted upon in the short term. That being said, pressure for these changes to increase the cost of conventional shipping by factoring in market externalities is worthwhile, and should be sought regardless. Even those outside the Sail Freight movement but working for sustainability causes will be pushing for some of these changes, which will help Sail Freight along.

Another relatively simple and immediate move is to learn to sail and find a place in the sail freight fleet. While the revival just gets started, a pool of willing sailors will be needed, and the pay may be mediocre, but a sailing vacation where you have to occasionally move some things around on the ship might be appealing to you. If it is, consider this option as a real possibility, and contact any sail freighters near you with the offer.

The ultimate move, of course, would be to launch a sail freighter of your own and directly engage in Sail Freight as a professional. This is possible for very few people, but investing in or donating to sail freighters when the opportunity presents itself is a good intermediate step.

If you are directly involved in sail freight already, collect & publish data for academic use: Fuel Use, Cargo Details (Point of Origin, Destination, Mass, Volume, How Packaged), Engine Use, Miles in Ballast, voyage times between ports, and more are all important to making the case for sail freight, and figuring out what works and what doesn't, and making the case to legislators and the public that Sail Freight is viable and important.

Appendix B: Advocacy And Policy Recommendations

Advocacy suggestions generally work from lower levels upward, but may not work in the reverse order. For example, an individual will not be able to subsidize Sail Freight on their own, but Local, State, and Federal entities can. The same applies to many legal reforms, as federal laws cannot be altered at state level. These actions are not comprehensive or exhaustive, though all of them are likely achievable in a wide variety of locations. ☛= Immediate. ☛= Mid Term.. ☛= Long Term.

INDIVIDUAL

- ☛ Invest directly in Sail Freight Operations and Research Organizations in your region.
- ☛ Purchase products shipped by sail when and where possible, and request them often.
- ☛ Encourage the creation of Community Supported Shipping initiatives where possible.
- ☛ Allow the use of private property for portage operations, boat storage, or dockage where possible along expanding sail freight routes.
- ☛ Earn certification as a sailor, captain, or other applicable rating within the Sail Freight industry.
- ☛ Build a ship and start a sail freight company.
- ☛ If you have been involved in Sail Freight, assist in putting together a handbook on starting and running a Sail Freight venture.

LOCAL

- ☛ Create and improve local infrastructure to support sail freight & multimodal transport.
- ☛ Create Grant Program for infrastructure and building ships within local area.
- ☛ Create detailed Foodshed and Material-shed maps for local and regional governments as basis of other actions.
- ☛ Create a Municipal Sail Freight Plan and incorporate sail freight and associated infrastructure into sustainability planning.
- ☛ Create local sail shipping networks and brokerages where possible, including local farms, artists, restaurants, businesses, manufacturers, and nonprofits.
- ☛ Work to make seasonal multi-owner ships for agricultural runs like those of the Åland Islanders possible through infrastructure, permitting, and locating farmer's markets at or near waterfronts.
- ☛ Create a local non-profit insurance pool for sail freight projects at reduced and reasonable rates.
- ☛ Start and host symposia or conventions to promote Sail Freight cræft, networks, and skills at local, regional, & state levels.

STATE

- ☛ Fund and implement infrastructural improvements alongside expansion of state-administrated waterways through portage systems.
- ☛ Increase taxes on all transportation fuels (Gasoline, Diesel, Natural Gas, Hydrogen, Biogas, Biodiesel, etc.).
- ☛ Place moratorium on expanding road infrastructure and new funding for roadway construction.
- ☛ Increase annual registration costs for all non-electric commercial trucks.
- ☛ Create a small-scale grant program to assist sail freight startups where markets can be created.
- ☛ Create Sail Freight category within Renewable Energy Subsidies currently on the books, and future subsidy laws.
- ☛ Create legal structures allowing for novel ownership systems.
- ☛ Create Inter-State cooperative efforts where possible to encourage coastal trade under sail. This would be well suited to the Chesapeake Bay, Gulf of Mexico, and New England Coast.

FEDERAL

- ☛ Grant Jones Act exemption for all primarily Sail Powered vessels of 1000 GRT or less.
- ☛ Implement a Weight-Distance tax on Interstate Road and Rail Transportation, with a specific exemption for waterborne transport.
- ☛ Increase taxes on transportation fuels & tires.
- ☛ Create Grant program to support Sail Training programs, Infrastructure, Sail Cargo Vessel Construction & Refit.
- ☛ Simplify captaincy certification for masters of small sail vessels under 50 GRT. A separate program may be needed for this type of limited sailing cargo captain.
- ☛ Make alterations to Uninspected Cargo Vessel regulations to allow for larger sailing ships to qualify under this heading.

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[9]Image taken from: Steven Woods. "Sail Freight Revival: Methods of calculating fleet, labor, and cargo needs for supplying cities by sail." Master's Thesis. Prescott College, 2021. Pp 94

Other initiatives can encourage Sail Freight as well. In 2022, the Hudson River Maritime Museum, The Center for Post Carbon Logistics, Schooner *Apollonia*, and the Northeast Grainshed Alliance ran the Northeast Grain Race. This was a gamification of grain delivery, with the rules below, but was designed to make any typical pickup truck non-competitive.

NORTHEAST GRAIN RACE 2022

NORTHEAST GRAIN RACE RULES:

ELIGIBILITY RULES:

1. Any vehicle or means of transportation may enter the contest. Multiple vehicles may be used in any combination over the course of the delivery, so long as all fuel use is tracked from the first point of origin to the final destination.
2. During the Month of May, participants may enter one cargo voyage per cargo category. A voyage is defined as multiple points of origin to one destination, or vice versa.
3. The shipment must originate and terminate within the Northeast; New England, New York, and New Jersey inclusive. Crossing these boundaries in transit is permitted.

VEHICLE CATEGORIES:

Vehicle categories will be divided by capacity measured in TEUs (Twenty-foot Equivalent Units) of 1200 cubic feet. This is the volumetric cargo capacity of the vehicle. There are four capacity categories:

1. Half TEU or less (101-600 Cu Ft)
2. Half to One TEU (601-1200 Cu Ft)
3. One to five TEUs (1201-6000 Cu Ft)
4. Micro Category (Up to 100 Cu Ft)

CARGO CATEGORIES:

There are five Cargo Categories, outlined below. All entries must be in a single category (i.e. no mixing distilled and traditional grains in a single entry), but one entry for each cargo category may be entered per contestant set.

1. Traditional (raw or processed grains such as flour, malt, etc.)
2. Distilled (Spirits)
3. Brewed (Beer, etc)
4. Baked (Breads, etc.)
5. Feed (grains not intended for human consumption, such as feed or spent grains)

PARTICIPATION & SCORING:

1. Each participating voyage gets one (1) point per Ton-Mile of cargo Moved.
2. Each participating voyage loses five (5) points per liter of fuel used or per 10kWh of electrical power provided from the grid. Off-Grid sources of electricity are not scored.
3. Each vehicle must submit full route and fuel use data with supporting documentation where questions are likely to arise.
4. Entries must be submitted via the Google Forms provided by 23:59:59 3 June. Final scores will be determined & verified by volunteer Judges & cannot be modified.

ADDITIONAL NOTES:

1. Multiple entries may share use of vehicles. For example, multiple entries could cooperate to hire a sailing vessel or cargo bike service for part of their voyage. In this case, the vehicle’s full fuel use

is applied to all cargos in the leg to reduce problems of weighting scores.

2. Efficiency Routing is encouraged; shortest paths are not required.

3. "Vehicles" can include non-traditional means of transport such as overhead ropeways, catapults, slides, kytes, or hot air balloons. Get creative to get a good score.

4. Any operationally justifiable fuel or distance figure will be allowed, if explained.

The Grain Race was won by Schooner *Apollonia*, but generated some interest for the other organizations. A shipment which ultimately didn't work out due to timing was planned on a schooner from Bath Maine to Boston Massachusetts carrying malt and flour as part of the grain race, involving multiple breweries and bakeries, as well as a distillery, mill, and malthouse. In the micro category, Solar Sal Boats entered with their 100% Solar powered 24 foot boat, and even used the boat's solar array to charge an electric car before making their last mile delivery in Kingston NY.

For the 2023 Northeast Grain Race, there are multiple shipments and collaborations being put together, and the event is being planed as an annual occurrence. Most likely this will involve auxiliary competitions, such as beer brew-offs using the malt moved during the race, and pretzel bake-offs with flour. If this occurs annually a few times, it simply may morph into a viable windjammer route.

There's few things more powerful for convincing someone a thing is possible than getting them to simply do it. The Grain Race takes advantage of the natural desire for friendly competition and games of chance, and applies that to sustainable transport with a focus on Sail Freight. The rules are open-source and available for modification at any point for the same or other cargos in the Northeast, or other regions. Pumpkin Perambulations, Veggie Voyages, Bread Rolls, and several other suggestions for variants of the rules have all been proposed, but not yet implemented.

Anyone in academic circles can support Sail Freight by lending their assistance to its study and execution, or to the associated issues of small port logistics, transportation systems design, port infrastructure, and so on. Incorporating sail freight into transportation studies as an assumed part of a future transportation system for coastal and inland transportation can change the conversation in academia away from a near-exclusive focus on rail and road efficiencies and the internet of things as an answer to our current peoplems.

As a last point of support, membership in organizations such as the International Windship Association can be helpful to the movement. Such advocacy organizations allow further pressure to be brought to bear on the IMO, National Governments, and others in making sure the freely available power of the wind is put back to work without undue hindrance in the transition to a sustainable economy and way of life.

FURTHER READING

Austin, David. *Pricing Freight Transport to Account for External Costs.* Washington DC: Congressional Budget Office, 2015. www.cbo.gov/sites/default/files/114th-congress-2015-2016/workingpaper/50049-Freight_Transport_Working_Paper-2.pdf.

Rules, blogs, and more information on the Northeast Grain Race can be found here: https://www.hrmm.org/ne-grain-race.html

Tomé Klock, A.C., Wallius, E. and Hamari, J. (2021), "Gamification in freight transportation: extant corpus and future agenda", *International Journal of Physical Distribution & Logistics Management*, Vol. 51 No. 7, pp. 685-710. doi.org/10.1108/IJPDLM-04-2020-0103

To aid in Academic Study of Sail Freight, you can submit information on any Sail Freight voyages you undertake to a database here: https://forms.gle/65EGur1niV3m89eH7

Wildcat Sail Freighting

There is an option available to every leisure sailor for forwarding the cause of Sail Freight, and it happens to be carrying cargo on your sailboat. If you have a sailboat, and something that needs to get from Point A to Point B, and you're willing to carry it, then you can become a member of the wildcatting sector of sail freight. This is not advised across international boundaries, but in coastal or inland waters, it should usually not be a problem for small cargos. Of course, there are restrictions: You would need a vessel qualifying as an uninspected cargo vessel, for example, if you're trading in the US, and would need to be Jones Act Compliant.

The idea of trading along the lines of social networks and informally isn't new, and is in fact the basis of the Feral Trade business. This moves generally small amounts of goods by couriers who are already heading the same way as the product, and has been remarkably successful this far. Operating since 2003, only 22 shipments out of 1270 have failed. For an informal network with no dedicated infrastructure, I'd rule that as a great success rate: Over 98.5% successful.

NECESSARY DATA FOR A CARGO BOARD:
Ship-by date; Origin; Destination; Weight; Vol.; Contents; Pay; Contact

A similar system could be developed for Sail Freight, preferably out of a central brokerage, which has yet to be established. If it were, then small cargos could be posted and accepted all over the world, possibly, for transport by small vessels on leisure runs. While this is not likely to be feasible in the short or mid term, it may have some future potential.

Until that happens, if you have a sailboat, you can be a sail freighter, but on a micro scale. When you're sailing from one end of long island sound to another, for example, why not collect some cash from your friends and carry back a bunch of wine for them? The same could be done with almost anything which might be cheap at your destination but expensive at home, and displaces the transportation which would otherwise be used. It also gets people used to the idea you can do small things with the travel you're already undertaking to make positive changes to the transportation system. It might even find you future investors in your sail freight vessel, if you play your cards correctly.

If you're a routine sailor between two sides of a waterway that's difficult to get around by car or truck, you might arrange for a brewery you know supplies a pub across the water to send a pair of kegs across with you in exchange for a six-pack during your weekend sails, which you do regardless. Maybe the local opportunity is dropping off grocery orders to camps on a local island, or something similar. Look for these opportunities near you, and you might find a micro packet route is simply waiting for a sailboat to work it.

Wildcatting does become dangerous across international borders. Anything not declared at customs properly can be considered smuggling, and this can involve serious legal ramifications for you and your boat. It's best to leave international commerce to the experts who have highly paid lawyers and very good insurance.

FURTHER READING

Feral Trade Website: https://feraltrade.org/statement/

Melotti, Robert. "Trading Under Sail – could you make a living from transporting cargo on board?" *Practical Boat Owner* February 2018. https://www.pbo.co.uk/boats/trading-under-sail-58300

Safiya Horne-Bique, *The future of the informal shipping sector in the Caribbean* Association of Caribbean States, 2017. http://www.acs-aec.org/index.php?q=transport/the-future-of-the-informal-shipping-sector-in-the-caribbean

Calculating Your Sail Freighter's Impact

Once you have a sail freighter in operation, it's worthwhile to be able to calculate your transportation service's Carbon Intensity. There's a couple ways to do this, but the international standard is to measure in grams of carbon dioxide per tonne-kilometer. The comparable US standard is Ton-Miles per Gallon of fuel used.

The US Standard is pretty simple to calculate: Take the number of tons of cargo you moved in each delivery, multiply by that by the distance in statute miles the delivery was carried, and total them as you go. This will get you your total ton-miles. Then, at the end of the season, add this all together, and divide by the total gallons of fuel you burned in the course of your cargo operations. Problem Solved! Answer Found!

Then, compare it to the US Trucking average of 72 tm/gal (104 gCO2/tkm) and see how you did. If you want to compare to particular types of trucks, there's a study linked in the further reading section which has those numbers. If comparing to Rail, the average is about 500 tm/gal, a bit harder to meet. Schooner *Apollonia*, though, had an observed efficiency of 134.6 tm/gal and a theoretical maximum efficiency with her current engine use of 626 tm/gal.

Calculating g CO2/t-km is slightly more involved, but allows for a more wide-ranging and useful comparison, especially outside the US. The calculation is somewhat similar, in that you need to get the total tonne-kilometers you carried first of all. This can be done with the same method as above, but measuring in kilometers and metric tonnes.

The next step is to know how much fuel you used over the course of your operations, preferably in liters for the fuels likely to be common in the small sail freighter fleet. These include diesel, gasoline, biodiesel, biogasoline, and LPG. Then, multiply that number of liters by the factors given in the ECTA guide on calculating carbon intensity of transport, some of which is replicated below. If you used a blend of fuels, you'll have to do each type of fuel separately and total the CO2 generated. If there's still a blend in the tank at the end of the season, this could get more than a bit complicated, but if you simply do your best, it is unlikely anyone will fault you for the attempt.

Standard g CO2/Liter For Selected Fuels[10]

Diesel:	2,900	Biodiesel:	1,900
Gasoline:	2,800	Biogasoline:	1,800
Liquified Petroleum Gas:	1,900		

Using electric engines charged from shore power will be difficult to calculate a carbon intensity for. Without knowing what fuel was used for that energy, there's little to go on, but some utilities publish their energy intensity, normally in terms of gCO2/kWh. If you know how many kilowatt hours you charged, you can at least make a generalization. In the US, the average is about 386 gCO2/kWh, while in the EU a ballpark is about 334 gCO2/kWh. There are roughly 10 kWh of energy in a liter of diesel or gasoline, for a comparison, giving about a 3,500 gCO2/liter equivalent.

Once that's done, you simply divide the grams of CO2 by the tonne-kilometers, and you have your answer. For *Apollonia* using the same methods, we have an observed carbon intensity of 56 gCO2/t-km and a theoretical value of 12 gCO2/t-km. You can see how that compares below, with average numbers taken from the same source.

Average g CO2/t-km By Mode Of Transport:[11]

Road:	62	Short Sea Shipping:	16
Rail:	22	Deep-Sea Container:	8
Barge:	31	Deep-Sea Tanker:	5

The other major way of calculating carbon intensity of cargo transport is Life Cycle Analysis, which is complex, tedious, and far more detailed than the above methods. If you wanted to find out what the approximate emissions of a specific ship would be, including the

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[10] ECTA *Guidelines for Measuring and Managing CO2 Emission from Freight Transport Operations* Brussels: European Chemical Transport Ass., 2011. Pp 5
[11] ECTA *Guidelines* Pp 12

emissions from constriction, repairs, maintenance, etc. before you build it, then Life Cycle Analysis is how it's done. However, if you're using an already-built boat, those emissions already happened, and operational figures are what become more important. While there is a carbon price for replacing sails, running rigging, and paint, it is minimal, and any vehicle involves these wear parts. Trucks need tires, brakes, lubricants, coolants, and other fluids, just as much as sail freighters need sails. The fact that sails are replaced less often and have a lower carbon impact in general than any of those truck-based wear parts is simply another point in favor of Sail Freight.

Once you do calculate your impact, it is worth publishing. Whether that be on your website, in a letter to an academic studying the topic, submission to a database, or otherwise, making this type of information widely available will help the movement spread into the mainstream of sustainability studies and discourse. If it does, there will be significantly more funding available for small ports and the types of improvements which will make sail freight easier for everyone involved.

FURTHER READING

ECTA *Guidelines for Measuring and Managing CO2 Emission from Freight Transport Operations* Brussels: ECTA., 2011. https://www.ecta.com/wp-content/uploads/2021/03/ecta-cefic-guideline-for-measuring-and-managing-co2-issue-1.pdf

NHTSA *Factors and Considerations for Establishing a Fuel Efficiency Regulatory Program for Commercial Medium- and HeavyDuty Vehicles* Washington, DC: NHTSA, 2010 www.nhtsa.gov/sites/nhtsa.gov/files/nhtsa_study_trucks.pdf

Andrew Simons *Cargo Sailing: A life cycle assessment case study.* Den Helder: EcoClipper, 2020. Available by joining the EcoClipper newsletter mailing list.

Energy Information Administration "FAQ" on g CO2/kWh in the US, also by State. www.eia.gov/tools/faqs/faq.php?id=74&t=11

Calculating Freight Rates

This chapter has been left to the end on purpose. Freight Rates are going to high in Sail Freight, there's no real way around that, and until the cost of conventional transportation rises, there is little hope of making Sail Freight an economically competitive endeavor outside specific cargos and routes. That being said, you will need to break even, or at worst minimize losses to keep a boat in the water. This will be far more important to Tramps, which have fewer options to build relationships needed for alternate business revenues.

Ideally, freight rates should cover the costs of a voyage, including the following: Fuel, labor, port fees, a share of maintenance, insurance, and a share of any other expenses. This base rate to break even is known as a Required Freight Rate, or RFR, normally given in a rate per ton.

A few things need to be known before you can quote an RFR for a shipment. The duration of the drip, the cost of labor, fuel, and so on all have to be factored in. Let's take an example based on the following information for a 64 foot ketch requiring 3 crew, equipped with an aux diesel engine:

Labor: $300/Day Per Hand	Fuel: 2 Gal/Day @ $5.00
Distance: 200 miles	Speed: 100 miles/day
Weight of Cargo: 15 Tons	Port Fees: $3/foot/day
Maintenance: $20/day	Insurance: $35/Day

This gives us the required information for this simplified example. The first thing we need to do is figure out our time-based expenses per day, which is labor, fuel, maintenance and insurance ($900+10+20+35= $965). Then we need to know how long we will be in port, which is one day, with a port fee of $192. In total, this gives us 3 days plus port fees, or ($965x3)+$192= $3,087. Divided by the weight of the cargo, this gives $205.80/Ton. Now, this might not be the only cargo you have, so if your cargo was a total of 30 tons, you could charge $102.90/Ton, as an example. Of course, you'll have to figure out your numbers such as crew pay based on your local situation.

In many cases, a rate such as the above is going to be extremely non-competitive when compared to conventional shipping of any kind. Since labor is the major cost for sail freighters, crew saving devices such as winches are a very worthwhile investment. By simply needing one less crew member, the RFR drops to $145.80 per ton on the first model with 15 tons of cargo.

The only way to know how competitive your service will be is to run the numbers and compare them to other services in your area. You may have advantages others don't, such as access across an area with congested bridges or roads, where traffic delays and high fuel costs could make you competitive on single-day sailings. This might cause you to look at being a ferry service and finding a freight forwarder to divert cargo to you from conventional transport. In another situation, it simply might be a long way around from one part of an island to a mainland harbor, and thus you can take advantage of this circumstance. For general tramping work, however, these rates will likely be high and possibly uncompetitive.

Calculating packet rates can be less precise than for tramping, but should be based on days of operation and overall costs to operate. For example, if you have a one day sail between each stop, a fee table between each combination of stops might be worth while based on that amount of time, given in tons or cubic volume, whichever fits your circumstances better. If you know you have a cost of $1,157 per day (expenses above including port fees), and can carry 30 tons, the rate of $38.57 per ton (or cubic meter) per leg would be reasonable, if you always fill the hold entirely. If you figure you'll fill the hold only half full, then go for double the above, or $77.14 per stop. If the cargo is going three stops, the charge in the fist case would be $115.71 for the shipment of a full ton or cubic meter. The advantage with a packet route is that expenses can be planned beforehand in detail, so a 60 sailing day season will have a known cost to divide per leg. The challenge is then to fill the hold!

With the proper relationship building on a packet route, expenses can be kept to a minimum. Using free public docks where available or having an arrangement with a local marina (or maritime museum) for a free space to unload can reduce port fees significantly. The use of anchoring and a lighter will have substantially the same effect on port fees where practicable. Fuel expenses can be controlled through a more strict engine use strategy, to the point of elimination on electric auxiliary or engineless vessels. Insurance for small sail freighters in the early stages of the revival will likely be high, but may come down after several such vessels are in operation. Crew costs can only really be controlled by limiting the number of crew required, or taking on unpaid intern trainees, which brings other legal concerns.

You can also lower your freight rate requirements by generating other income, for example from co-branded goods with those you carry cargo for. An example might be getting a dollar for every bottle sold of wine or beer made with the supplies you move. Branded items of any sort can be mutually beneficial to everyone involved if the marketing is done well and thoughtfully. Subscriptions such as CSA-Style boxes or specific-product clubs can also create these additional streams of income aside from traditional freight rates.

Grants and subsidies are another option for supplementing your freight rates. If there are grants for carbon reduction, these can be applied for, as well as traffic decongestion grants. Academic studies are frequently funded, and this could be used to keep the ship in service for research purposes. The study of carbon intensity, infrastructural requirements, air quality effects, and traffic displacement from sail freight are all worth studying ,and local universities may have professors and grad students interested in studying these subjects. If this is the case, take advantage of that to pay part of your vessel's costs and make freight rates more affordable.

All this reflects ultimately on your business plan and system of ownership. With a well planned business model, the combination of freight rates, co-branded goods, subscriptions, grants, and other means of making money, including passenger fares if your vessel is authorized to do so. However, since freight rates are going to be an important element of sail freighting for decades to come, at least on the major trade routes, the subject has been included. James Buckley's

The Business Of Shipping has a whole chapter on the subject for tramp operations, which will be of interest to tramp operators.

It should be noted that not all ownership models need to calculate freight rates at all. A Farmer's Ship or Customer's Cooperative ship would have the expenses shared out among the users, as would be the profits from each voyage. A Community Supported Shipping operation would have the season's expenses raised before the sailing begins, and simply pay for bills as they arise. While freight may be taken on from outside the membership when there is space and freeboard available, the rate itself need not be high because costs are already covered.

FURTHER READING

Wind Ship Development Corporation, *Wind Propulsion For Ships Of The American Merchant Marine* Norwell, MA: WSDC, 1981. https://books.google.com/books/about/Wind_Propulsion_for_Ships_of_the_America.html

James Buckley. *The Business of Shipping.* 8th Ed. Centerville: Cornell Maritime Press, 2008

Minimum Recommended Reading

Anyone looking to understand the sail freight movement should set aside the time to read the following works in their entirety. Those which are harder to source will be annotated with means of getting copies where possible.

Andrus, Erik. "Vermont Sail Freight Project." Accessed 9 October, 2020. https://vermontsailfreightproject.wordpress.com/.

Ackerman-Leist, Philip. *Rebuilding the Foodshed: How to Create Local, Sustainable, and Secure Food Systems.* White River Junction: Chelsea Green Publishers, 2013.

Steven Woods. “Sail Freight Revival: Methods of calculating fleet, labor, and cargo needs for supplying cities by sail.” Master’s Thesis. Prescott College, 2021. www.researchgate.net/publication/354841970

John Frittelli, *Shipping Under the Jones Act: Legislative and Regulatory Background* Washington: Congressional Research Service, 2019. (LINK)

Andrew Willner. “Rondout Riverport 2040: Parts 1&2” www.resilience.org/stories/2021-01-26/rondout-riverport-2040-part-1/

Koltz, Bruce George. “The reintroduction of sail for marine commerce: and the consequent effects upon small port economy and trade routing” Master’s Thesis, University of Notre Dame, 1980. https://calhoun.nps.edu/handle/10945/19039

Perez, Sergio. “Downbursts, groundings, incompetence and other hazards to 21st century merchant sailing ships” *Journal Of*

Merchant Ship Wind Energy. 4 December 2021. www.jmwe.org/articles

Steven Woods and Sam Merrett “Operation of a Sail Freighter on the Hudson River: Schooner Apollonia in 2021.” *Journal of Merchant Ship Wind Energy* 2 March 2022. researchgate.net/publication/358971392

Levinson, Marc. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger - Second Edition with a New Chapter by the Author.* REV-Revised, 2. Princeton University Press, 2016. https://doi.org/10.2307/j.ctvcszztg.

De Decker, Kris. "How to Run the Economy on the Weather." *Low Tech Magazine* September 2017. www.lowtechmagazine.com/2017/09/how-to-run-the-economy-on-the-weather.html.

Christiaan De Beukelaer “Tack to the future: is wind propulsion an ecomodernist or degrowth way to decarbonise maritime cargo transport?” *Climate Policy,* 22:3, 310-319, DOI: 10.1080/14693062.2021.1989362

Wind Ship Development Corporation, *Wind Propulsion For Ships Of The American Merchant Marine* Norwell, MA: WSDC, 1981. https://books.google.com/books/about/Wind_Propulsion_for_Ships_of_the_America.html

C.J. Satchwell, “An Overview Of Wind-Assisted Propulsion For Commercial Shipping.” *Proceedings of Regional Conference on Sail-Motor Propulsion* Manila: Asian Development Bank, 1985. Available digitally (PDF) under “Further Reading” at www.hrmm.org/new-age-of-sail.html or by writing the publications desk at the Asian Development Bank.

The Sail Freighter's Reference Library

The following sources are recommended as on-board reference texts for sail freighters starting out in the trade. Links have been provided where possible to free digital editions.

Clifford W Ashley. *The Ashley Book Of Knots* Unknown, 1944. https://archive.org/details/TheAshleyBookOfKnots

James Buckley. *The Business of Shipping*. 8th Ed. Centerville: Cornell Maritime Press, 2008

Steven Woods. "Sail Freight Revival: Methods of calculating fleet, labor, and cargo needs for supplying cities by sail." Master's Thesis. Prescott College, 2021. www.researchgate.net/publication/354841970

Andrus, Erik. "Vermont Sail Freight Project." Accessed 9 October, 2020. https://vermontsailfreightproject.wordpress.com/.

Steven Woods and Sam Merrett "Operation of a Sail Freighter on the Hudson River: Schooner Apollonia in 2021." *Journal of Merchant Ship Wind Energy* 2 March 2022. www.researchgate.net/publication/358971392

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Wind Ship Development Corporation, *Wind Propulsion For Ships Of The American Merchant Marine* Norwell, MA: WSDC, 1981. https://books.google.com/books/about/Wind_Propulsion_for_Ships_of_the_America.html

Proceedings of Regional Conference on Sail-Motor Propulsion Manila: Asian Development Bank, 1985. Available digitally (PDF) under "Further Reading" at www.hrmm.org/new-age-of-sail.html or by writing the publications desk at the Asian Development Bank.

US Army. *FM 55-110: Transportation Port Companies Military Stevedoring* Washington: Government Printing Office, 1952. https://books.google.com/books?id=S_TjOPdR44UC

The Sail Freighter's Vocabulary:

Anchorage: An un- or under-developed facility for loading and discharging cargo. May only be a place to tie up to shore or drop anchor safely with no other amenities.

Breakbulk Cargo: General, non-containerized cargo, packed in sacks, rolls, barrels, crates, or other packaging. Also termed General Cargo.

Bulk Cargo: Also known as Dry Bulk Cargo, it is non-liquid cargo shipped loose, such as grains, coal, ore, etc.

CDWT: Cargo Deadweight Tonnage. The amount of cargo, by weight, which a vessel can carry. Normally measured in Short tons, or Metric Tonnes outside the US.

Containerized Cargo: Cargo packed in ISO Multimodal Shipping Containers. These units are moved with their contents in place between ships, trains, and trucks to reduce labor in transshipping.

Deadweight Tonnage: The total maximum mass of water displaced by the ship and a full cargo.

Demurrage: A charge from a ship for delays in unloading or loading of cargo. Can also be charged to the ship for being late to arrive in port, and is normally assigned a rate in the shipping contract.

Despatch: The opposite of Demurrage, a rebate to a shipper from the vessel for completing an assignment ahead of the scheduled time. Like Demurrage, this is normally specified in a shipping contract.

Docker: Dockers include Stevedores, Longshoremen, and other trades associated with the loading and unloading of cargo, and handling cargo on the docks. This includes crane operators and other specialists.

Dunnage: packing material used to stabilize and protect breakbulk cargo when loaded. Dunnage is important to maintaining the condition of cargo and preventing dangerous shifts which could endanger the ship's stability and righting angles.

FEU: Forty Foot Equivalent Unit. A unit of volume equal to that of a forty foot shipping container. Similar to, but double the volume of a TEU.

Freeboard: The amount of hull between the waterline and the deck.

General Cargo: Synonym for Breakbulk Cargo.

Gross Register Tons: A measurement of a ship's volume in tons of 100 cubic feet. Adopted under the Moorston System of ship measurement in the 19th century, and used for captaincy licensing and other regulatory matters. Does not correspond to CDWT or other types of tonnage such as displacement.

Harbor: More developed than an anchorage, a harbor has formal facilities for cargo handling and trade, but is not a center for international and large scale maritime trade.

IMO: International Maritime Organization, the UN body in charge of maritime regulation and standards.

In Ballast: To sail "In Ballast" is to sail without cargo. This is normally done only to move from the drop off point of one delivery to the pick-up point of the next. This is an undesirable state for tramping vessels due to the lack of revenue generated.

Lightering: To move cargo ashore or to a ship through the use of smaller vessels. This is frequently done in areas with undeveloped anchorages or shallow harbors which cannot allow for the mooring of large ships, but can be done at any scale.

Net Register Tons: As Gross Register Tons, but exclusive of crew and machinery spaces.

Port: A location centered around maritime trade, such as London, Copenhagen, New York, Long Beach, or Shanghai.

Sailport: A port accessible to and defined by it access to reliable winds, suited primarily to use by sailing vessels.

STCW: Standards of Training and Certification for Watchkeeping is an international standard of training for mariners on international routes, and includes lifesaving techniques, fire fighting, and other basic skills necessary for all mariners on the high seas.

Steamport: A port which is primarily accessible to motor vessels due to any combination of factors, most likely based on predominant winds and tides.

Tanker Cargo: Also known as "Liquid Bulk" cargo, this is cargo stored in tanks aboard a ship. Normally used only with tanker ships designed for only this type of cargo, it consists of oils, water, and other liquids.

TEU: Twenty Foot Equivalent Unit. A unit of volume equal to that of a twenty foot shipping container. Most commonly use standard to determining the carrying capacity of container ships.

Transshipment: The loading of cargo between ships or vehicles for further shipment to another location. This happens frequently at aggregation centers where containers form large ships are loaded into smaller ships for distribution to smaller ports.

Sources For Vessel Plans

GoSailCargo.com: The Electric Clippers. All have aux electric Engines, fore-and-aft rigs, and automation where possible. Steel Hulls, aluminum used aloft.

- ☛ 180 ft 3 Mast Schooner. 900 CDWT, 36 TEU/General cargo.
- ☛ 110 Ft Ketch. 180 CDWT, 4 TEU/General Cargo.
- ☛ 74 Ft Ketch. 40 CDWT, 1 TEU/General Cargo.
- ☛ 40 Ft Ketch. 12 CDWT, 1 TEU/General Cargo.

Tad Roberts Yacht Design: https://www.tadroberts.ca/. Steel Gaff Schooner with Aux diesel design for cargo use in two sizes.

- ☛ 60 Foot Cargo Schooner. Unknown CDWT, General Cargo.
- ☛ 52 Foot Cargo Schooner. Unknown CDWT, General Cargo.

TransTech Marine Co: ErieMax sail-electric canal and coastal cargo boat. Contact via geoff-nyc@shipshares.com for more information.

- ☛ 80 Ft Junk Schooner. 100 CDWT, 100 GRT. General Cargo.

The Greenheart Project Design: Steel Hull, Open-Source design.

- ☛ 105 Ft Modern Rig. 70 CDWT, 3 TEU/General Cargo.

OTHER/INCOMPLETE DESIGNS:

C Palmer and E.M.J Corten. "Preliminary Design Study Of Intraisland Transport Vessels For The Ha'apai Group Of Islands In The Kingdom Of Tonga." Pp 133-172 *Proceedings of Regional Conference on Sail-Motor Propulsion*. Manila: Asian Development Bank, 1985.

- ☛ 74 Ft Ketch. 20 CDWT + 50 Pax, General Cargo.

REFERENCE TABLES:

UNIT CONVERSIONS (Approximate)

DISTANCE

1 Nautical Mile (nm):	1.852 km	1.15 Statute Miles
1 Kilometer (km)	.54 nm	.62 mi
1 Statute Mile (mi)	.87 nm	1.61 km

MASS

1 short ton:	.9 Tonnes	907 kg	2000 lbs
1 Metric Tonne:	1.1 Short Tons	1000 kg	2,205 lbs

MASS-DISTANCE

1 Ton-Mile (tm)	1.46 Tonne-Km (tkm)
1 Tonne-Kilometer (tkm)	.685 Ton-Mile (tm)

TRANSPORT CARBON INTENSITY

Standard g CO2/Liter For Selected Fuels

Diesel:	2,900	Biodiesel:	1,900
Gasoline:	2,800	Biogasoline:	1,800
LPG:	1,900	Grid Electric: 350/kWh	

Average g CO2/t-km By Mode Of Transport:

Road:	62	Short Sea Shipping:	16
Rail:	22	Deep-Sea Container:	8
Barge:	31	Deep-Sea Tanker:	5

Average Ton-Miles/Gallon For Selected US Transport.

Railroad Average: 500	Trucking Average: 72
Lg Pickup Truck: 26	Sm Pickup Truck: 17
2 ½ Ton Trucks: 30	Mid-Size Box Truck: 55
Tractor Trailer: 155	Lg Straight Truck: 112

$$\frac{7{,}515.55\ g\ CO2/tkm}{Ton-Miles/Gal} = g\ CO2/tkm \text{ (Approximation)}$$

REQUIRED FREIGHT RATE FORMULA

$$\frac{\text{(Fixed Costs)+(Variable Costs)}}{\text{Tons Carried}}$$

Fixed Costs= Crew + Maintenance + Insurance + Mortgage

Variable Costs= Fuel + Port Fees + Incidentals + Etc

SEA TIME REQUIREMENTS FOR ≤100 GRT AUX SAIL LICENSE

Master, Inland: 360 Days in any waters, 180 of which under sail.
Master, Great Lakes: As Inland with 90 Days on Great Lakes.
Master, Near Coastal: 720 Days in Near Coastal Waters, 360 under sail.

Mate, Inland: 180 Days in any waters, 90 of which under sail.
Mate, Great Lakes: As Inland with 90 Days on Great Lakes.
Mate, Near Coastal: 360 Days in Near Coastal Waters, 180 under sail.

Able Seaman, Sail: 180 days under sail, and Lifeboatman Certificate.

All counted sea days must be 4 or more hours. Tonnage requirements are calculated based on sea time aboard various sizes of vessel. For more information on maritime credentials, see:
https://www.dco.uscg.mil/national_maritime_center/

NECESSARY INFORMATION FOR A CARGO BOARD

Cargo Boards can be very helpful for informal shipping networks. If you organize one, the following should be collected for every cargo:

Ship-by date; Origin; Destination; Weight; Vol.; Contents; Pay; Contact

Organizing a cargo board such as the one run by Feral Trade could be a highly effective, low resource means of assisting both professional and wildcat sail freighters throughout a region.