Appendix G

Assessment of Short-Sea Shipping Options for Domestic Applications

December 23, 2009

Prepared for:
Dr. Paul Rispin,
Office of Naval Research (ONR),
875 North Randolph Street, Room 273
Arlington, VA 22203-1995

Prepared by:
Bahar Barami, Ph.D., Intermodal Infrastructure Security and Operations, RVT-51
Michael Dyer, Engineer, Infrastructure and Facility Engineering, RVT-63
Volpe National Transportation Systems Center
Research and Innovative Technology Administration (RITA)
US Department of Transportation
55 Broadway
Cambridge, MA 02142
In partial fulfillment of the requirements for the
Reimbursable Agreement (RA)-VH99
Agile Ports and Terminal Systems

List of Tables

List of Figures

Preface

This report has been prepared for Dr. Paul Rispin, Office of Naval Research (ONR), as part of the research conducted by the Volpe Center in collaboration with the Center for Commercial Deployment of Transportation Technologies (CCDoTT). The report, originally submitted in a Draft form on June 30, 2009, was intended to build on the multi-year research conducted at the Volpe Center and the CCDoTT on Agile Port Systems and High-Speed Ship technologies to assess the feasibility of dual-use deployment of the vessels. The project activities included the demonstration of the feasibility of domestic container feeder ports for a transportation and logistics system based on a generic short sea vessel focusing on the West Coast operations for both domestic and international traffic.

This report has been prepared by the Dr. Bahar Barami, Intermodal Infrastructure Security and Operations (RVT-51) and Mr. Mike Dyer, Infrastructure and Facility Engineering (RVT-63). Dr. Paul Rispin has authorized granting of a clearance for the report to be distributed to the members of the Committee on Marine Transportation System (CMTS) and the Integrated Action Team (IAT) for conducting and Assessment of the MTS. This revised version of the draft report reflects comments received from the ONR project sponsors, comments sent on September 10, 2009 by Tanya Rawson, Port and Intermodal Security Division, Department of Homeland Security, and comments sent by James Pugh, MARAD, on September 22, 2009. Rod Cook, Chief, Intermodal Infrastructure Security and Operations Division, provided peer review comments and quality control input.

Purpose and Study Scope

The purpose of this study is to conduct a high-level analysis of markets for dual-use vessels with potential military and commercial applications. The study conducts an assessment of the challenges and opportunities for SSS operations in the U.S. coastal and inland waterways for the Office of Naval Research (ONR.) The emphasis will be on identifying the infrastructure capacity constraints, vessel size, type and performance requirements, and the prospects for deployment of dual-use SSS vessels to meet military and civilian requirements for goods movement and logistics operations.

One of the studies evaluated the feasibility of deploying dual-use High-Speed Trimaran and other ONR vessel technologies to meet the military and civilian supply chain service requirements for efficient door-to-door container service. Another project, funded through the CCDoTT FY07-08 program was designed to be a study on “East Coast Marine Transportation System Development based on High-Speed Trimaran (HST) for 140 53-Foot Trailers” to assess the market potential for SSS operations to connect the ports of New Bedford and Fall River to Port Canaveral, Florida.

This report will develop a broader context for the deployment of these dual-use technologies by creating an analytical framework for the infrastructure, operational, vessel, and economic requirements of viable and efficient SSS operations in the U.S., in the following section:

> Section 1.0 will review the SSS concepts and definitions and the institutional forces in the U.S. governing the short sea operations in the context of the domestic marine infrastructure and transportation markets;
>
> Section 2.0 will review the existing SSS practices, operations and freight corridors in the U.S.;
>
> Section 3.0 will review SSS market conditions and service requirements, the factor favoring SSS, and potential corridors based on estimated cargo volume and service requirements;
>
> Section 4.0 will describe vessel types and performance in the U.S.;
>
> Section 5.0 will document the cost components of SSS vessel construction and operations and review research findings on impacts on freight capacity, energy use, and emissions;
>
> Section 6.0 will address challenges to market growth, opportunities for service improvement, and policy options to promote SSS as a national transportation strategy.

Section 1.0 Short Sea Shipping in the U.S.: Infrastructure and Cargo Characteristics

1.1 Concepts and Definitions

The term short sea shipping (SSS), commonly defined as "commercial waterborne transportation that does not transit an ocean," [1] refers to waterborne transportation of commercial freight between domestic ports using inland and intracoastal waterways. Today, a new term, Marine Highways, has been introduced to refer to this mode of transport.

SSS is not a new mode of transporting goods. The practice dates back to early maritime commercial practices when merchant vessels were small in cargo capacity and sailed within sight of the coastline, moving cargo from one seaport to another. The mariners faced natural hazards and threats to vessel safety, and had to follow sailing schedules dictated by the condition of wind and tides. [2]

In the U.S. the historical context for SSS has been framed around the concept of maritime laws and referred to by names such as "coastal trade," "cabotage shipping," "inland shipping", and "Jones Act service." In fact, "cabotage shipping" has historically been used interchangeably with "coastal shipping" and in many applications the two terms define the SSS concept.

Because of this historical context, two distinct definitions of the scope of SSS currently exist in the U.S.: one that limits the scope to coastal shipping, and a broader one encompassing the entire scope of the coastal and inland waterways.

The narrow perspective on the size of the SSS market limits the market only to the U.S. coastal traffic. According to this perspective, the distinction between coastal and riverine/brown-water shipping is crucial as far as the intent of the Jones Act is concerned. To be true to the spirit of the Jones Act, the advocates of this perspective maintain, only coastal shipping has utility for military power projection; riverine vessels have limited military utility because shallow water barges are incapable of transporting cargo to the combat theater abroad. Because this limitation would thwart the rationale offered for the legislative protection of the Jones Act, the proponents of this school of thought exclude not only riverine barges that are incapable of sailing coastal routes, they also exclude domestic cargo routes for which no rail or highway alternative exists and can only move by sea (e.g., Alaska or Hawai'i). [3] Relying on this premise, several recent studies conducted on the feasibility of expanded SSS service in the U.S. have excluded shallow-, inland-, and brown-water operations that rely on tug-barge operations.

---

[1] MARAD, http://www.marad.dot.gov/marinehighways

[2] Gary A. Lombardo, "Short Sea Shipping: Practices, Opportunities and Challenges," May 2004.

[3] This perspective is promoted by the researchers at the Institute of Global Maritime Studies (IGMS), in *America's Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security*, September 2008.

The broader scope for SSS includes riverine, shallow water, and Great Lakes routes, encompassing both existing markets and future market niches. According to this perspective, the relevant infrastructure boundaries of SSS operations are both the blue-water coastal waterways as well as non-deep sea segments of the freight infrastructure. These infrastructure segments are complementary to intermodal truck and rail transport and potentially support an integrated model of domestic freight traffic flows. In this report, the term SSS is used in the broad sense to encompass coastal, inland rivers, and the Great Lakes shipping.

Early Institutional Forces Governing U.S. Coastal Shipping

In the 19^{th} century, coastal shipping was the dominant mode of transporting domestic and foreign trade goods in the U.S. In 1817, Congress passed the “cabotage law” barring foreign-flagged ships from engaging in American coastal trade. The geographic reach of this cabotage legislation was extensive and was eventually broadened to include trade between the Atlantic and Pacific coasts and among non-contiguous parts of Puerto Rico, Alaska, and Hawai’i.

In 1860, coastal shipping engaged far more ships and crews than did traffic for overseas trade. In terms of tonnage, the volume of coastal trade equaled the tonnage carried in foreign trade, as reported in a recent report by the Institute for Global Maritime Studies (IGMS) entitled *America’s Deep Blue Highway*. [4] According to the IGMS report, coastal shipping remained competitive, even though by mid 19^{th} century turnpikes had greatly improved and railroads were firmly in place. Because builders of the nation’s railroad gave first priority to laying tracks westward rather than north/south along the Atlantic seaboard, the continued dominance of Atlantic coastal trade was sustained. Coastal trade remained prosperous well into the 1860s, when “Coaster” ships were used to serve the new manufacturing industries, carrying textiles from New England cities to customers up and down the Atlantic coast and into the Gulf as far as New Orleans, returning with items such as raw cotton and coal to meet the region’s demand for raw material input and fuel. In 1830, New York was the nation’s leading port, followed by Philadelphia, Baltimore, Boston, New Orleans, and Charleston. Smaller ports along the coastal area served as “feeders” to these larger hubs. These “feeder ports” served as transshipment centers for both domestic and overseas traffic.

Ship building as an industry peaked in the mid-19^{th} century. After 1865, American yards could no longer compete with foreign-built shipyards and the industry went into a sharp decline. However, coastal shipping thwarted competition from railroad for a bit longer because of prohibitions against railroads acquiring steamship operators. The Merchant Marine Act of 1920 and the related statutes, commonly known as the Jones Act, decreed that vessels used to transport cargo and passenger to U.S. ports be owned by U.S. citizens, be built in US ship yards and crewed by U.S. citizens. The passage of the Act coincided with a period in the nation’s transportation history in the 1920 associated with improved roads and introduction of new cargo truck transport mode in competition with SSS.

---

[4] Institute for Global Maritime Studies, *America’s Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security*, September 2008, http://www.igms.org; the study reports that in 1860, coastal trade carried some 2,644,000 tons of cargo compared to 2,545,000 tons carried in foreign trade.

1-2 Waterway Infrastructure and Facilities

The types of SSS services provided in the U.S. are strictly governed by waterway facility depth, type of cargo carried, and location in the water transportation network for moving goods and people referred to as the U.S. maritime transportation system (MTS). The U.S. MTS consists of 26,000 miles of navigable inland and intracoastal waterways, including 11,000 miles of commercially active inland waterway navigable channels and 2,342 miles of Great Lakes and St. Lawrence Seaway. [5] These waterways consist of 9,584 "commercial facilities" in the Atlantic, Gulf, and Pacific coasts, Great Lakes, and Inland waterways, each categorized according to channel depth and usage (Cargo, Passenger service, and Unused):

- A total of 5,066 of the U.S. waterway facilities are deepwater facilities, where deepwater is defined as those with greater than 12 feet in depth. (Exceptions to this classification are the 14- to 15-foot portions of the Columbia and Snake rivers that are classified as shallow water.)

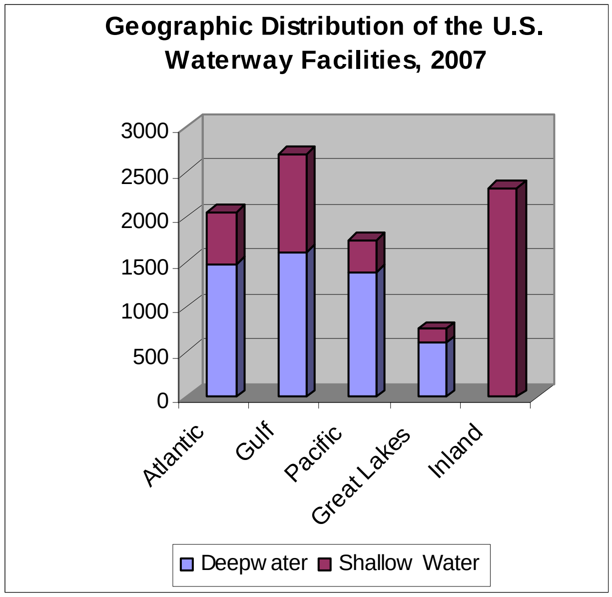
- A total of 4,518 of the U.S. waterway facilities are shallow water facilities, including the entire inland waterways facilities.

The geographic distribution of the nation's 9,584 deepwater and shallow water facilities by region shows that deepwater facilities are fairly evenly distribution among the coastal and Gulf ports, with the inland waterways exclusively classified as shallow-water facilities, as outlined below and in Figure 1. Altogether, 21 percent of the facilities are located on the Atlantic Coast, 18 percent on the Pacific Coast, 24 percent on the inland rivers, 29 percent on the Gulf Coast, and 8 percent on the Great Lakes:

- Atlantic Coast - 1,473 deepwater and 587 shallow water facilities
- Gulf Coast - 1,606 deepwater and 1,093 shallow water facilities
- Pacific Coast - 1,387 deepwater and 363 shallow water facilities
- Great Lakes - 600 deepwater and 154 shallow water facilities
- Inland river system - 2,321 shallow water facilities.[6]

[5] Office of Freight Management and Operations, Freight Facts and Figures, 2007, FHWA, USDOT.
[6] Based on data from USACE, U.S. Waterway System – *Transportation Facts*, 2007. Note that there are deep water facilities on the inland waterway system as well, but the source does not identify them.

Figure 1 - U.S. Waterway Facilities by Geographic Region, 2007



Source: Volpe Center-generated chart based on USACE, "The U.S. Waterway System – *Transportation Facts*", Navigation Data Center, December 2007

Two key points underscore the vast number of waterway facilities in the U.S., many of which have deepwater channels: Neither adequate channel depth nor access to waterway facilities in a region necessarily lead to active commercial use. Of the 5,066 deepwater terminals in the U.S., only a fraction – approximately 300 terminals (or 6 percent) – handles significant volumes of commercial traffic. About half of these 300 deepwater terminals are identified as "selected" by the Waterborne Commerce Report. These selected terminals handle more than 1,000,000 tons of cargo annually. Of these, there are approximately 55 ports that handle more than 10,000,000 tons annually, and have a channel depth of over 40 feet. In all, only about half of all waterway facilities (5,279) are currently used for commercial cargo carriage. The remaining facilities are either used for passenger transportation (3,319 facilities) or are "unused" (986 facilities.) [7]

1-3 Domestic Commercial Cargo Traffic

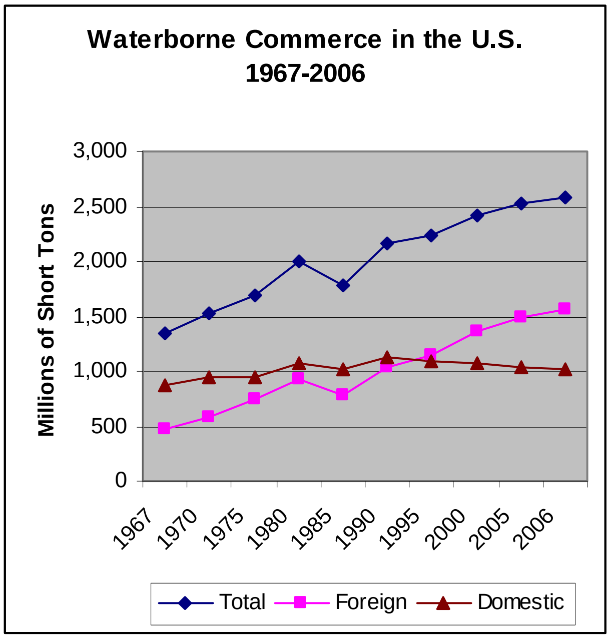
Unlike the 19th century shipping conditions, when a larger share of the nation's cargo tonnage was carried in domestic coastal traffic than in ocean-borne foreign trade, the volume of cargo carried for domestic trade today accounts for less than 40 percent of the total cargo volume. Today, foreign trade accounts for sixty two percent of the marine transportation shipments (1.6 billion short tons) and domestic trade for the remaining 38 percent (1 billion short tons).

The volume of commercial cargo shipped today through the marine transportation system (MTS) – with shipments amounting to 2.6 billion short tons of commercial freight – has

[7] USACE, The U.S. Waterway System – Transportation Facts", Navigation Data Center, December 2007; http://www.iwr.usace.army.mil/NDC/factcard/fc07/factcard.pdf

grown twofold (from 1.3 billion tons) since 1967. The tonnage of goods transported for domestic waterborne trade grew moderately until the 1980s, from 871 million tons to about 1 billion tons (an 18 percent growth for the entire period,) but has since remained stagnant. In contrast, the foreign waterborne commerce has grown from 466 million tons to 1.6 billion tons, a growth of 236 percent over the past four decades. Until 1993, domestic tonnage exceeded foreign trade tonnage by as much as a factor of 2. Subsequent to the rapid growth in the foreign-trade component of the U.S. waterborne commerce in the 1990s, a reversal in the relative shares of domestic and foreign trade cargo has occurred. [8] Since 1994, the foreign trade component of the waterborne commerce has outpaced the domestic component by 50% (Figure 2.)

Figure 2 - Waterborne Commerce of the United States



Source: Volpe Center-generated chart based on USACE, *Waterborne Commerce of the US,* Calendar Year 2006, Part 5, National Summaries.

The distribution of the 1 billion tons of freight carried each year for domestic trade among the U.S. waterway segments is as follows:

- Inland rivers carry over 60% of the tonnage (622 million tons);
- Domestic ocean/coastwise, Gulf and St. Lawrence Seaway facilities carry less than a third of the volume (267 million tons); and the
- Great Lakes carry the remaining 11 percent (115 million tons).

Shares of the coastal, inland rivers and the Great Lakes traffic of the nation's domestic freight transportation have been moving on a downward slope. In the inland waterways, most of the waterborne transportation takes place on the Mississippi. Channel depth restrictions and the presence of locks and dams in the Upper Mississippi, Illinois, and Ohio

[8] Waterborne Commerce of the United States, Calendar Year 2006, Part 5 – National Summaries, IWR, USACE, Release date: 07/04/2008.

Rivers have restricted throughput for some of the facilities. Because of these infrastructure constraints, the types of vessels used to carry cargo on these waterways have effectively been restricted to tugs and barges. [9] Because barges have traditionally carried low-value goods at low speeds, the conventional expectations of the SSS growth potential in the U.S. have been for a low-growth scenario.

Compared to over-the-road truck transportation, water transportation carriers receive only a fraction of the total domestic freight revenues, less than 2 percent of the value of the domestic freight carried in the lower 48 states. By tonnage, however, domestic waterborne shipping account for larger shares of the national cargo volume, depending on how the shares are calculated. The data indicate the following distribution of freight shipments by value, tonnage, and ton miles for domestic shallow water and deep-water facilities. [10]

Table 1 – SSS Freight Traffic by Value, Tonnage, and Ton-miles

Marine Facility Type	Value (% U.S. Cargo Shipments)	Tons (% U.S. Tonnage Carried)	Ton Miles (% U.S. Ton Miles)
Shallow Draft	0.7	3.9	6.7
Great Lakes	-	0.3	0.4
Deep Draft	0.4	1.6	1.8
Total Waterborne	1.1	5.8	9.0

Source: *Bureau of Transportation Statistics*, U.S. DOT; the figures exclude wet bulk shipments and water traffic on the nation's inland waterways.

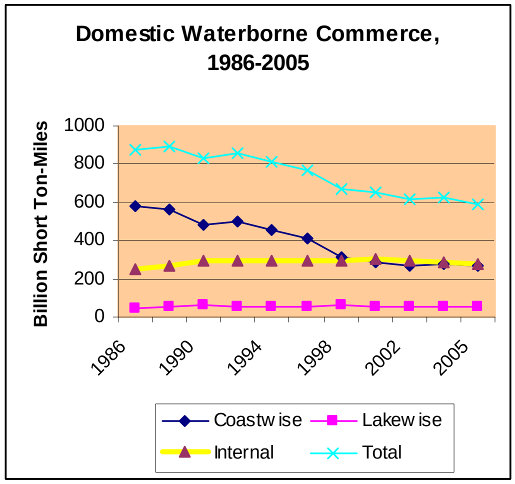
The second factor contributing to the low levels of revenue generated in domestic waterborne markets is the continuing decline in the ton-miles or cargo carried on domestic waterways. As noted above in reference to the trends depicted in Figure 2, the tonnage carried on MTS has remained stable around 1 billion tons in the past decade; whereas the length of shipments has declined steadily. The average length of coastwise shipments declined from 1,496 miles in 1960 to 1,269 in 2004. Lower waterborne ton miles of freight not only reduce the level of revenues generated in the service, they also reduce the break-even distance at which domestic water transport becomes a viable option. The total ton miles of domestic waterborne traffic (on coastal, Great Lakes, and inland waterways) declined from 873 billion ton-miles to 591 billion ton-miles between 1986 and 2005 (Figure 3.)

---

[9] Of the 25,000 miles of navigable inland waterways and intra-coastal/coastal channels, 12,000 miles of the navigable inland waterways capable of handling commercial traffic; there are over 1800 shallow water terminals with channel depth of 14 feet or less (1,748 on the Mississippi River system, and 64 on Columbia/Snake River.)

[10] "Shipment Characteristics by Mode of Transport for the United States," US Department of Transportation Bureau of Transportation Statistics, available from http://www.bts.gov/publications/commodity_flow_survey/2002/united_states/html/table_01_b.html.

Figure 3 - Trends in Domestic Waterborne Commerce Ton-Miles, 1986-2005



Source: Volpe generated chart based on data from USACE, *Waterborne Commerce of the U.S.* Calendar Year 2005, Part 5, National Summaries, Table 1-9

The flat domestic cargo tonnage volumes, coupled with the declining ton-miles in water transportation, have created an underlying structural condition in the U.S. that has shifted freight transportation traffic away from the waterborne mode. The dampening effect of this structural condition on the U.S. SSS market share has been worsened by the influence of three related market forces: a) the growing demand for expedited truck service for moving high value, just-in-time shipments to regional distribution centers for inventory replenishment; b) emergence of major East-West large-volume, high-density rail corridors for the movement of imported goods; and the c) emergence of truck-dominated transshipment networks of inland distribution and consolidation centers in the major port regions. On balance, these factors have further dampened the growth of markets for domestic water transportation, though many economic and policy factors have begun to shift the balance in favor of SSS, as addressed in Section 3.0 and 5.0.

Section 2.0 Existing SSS Practices and Operations

The Maritime Administration (MARAD) has defined the existing SSS corridors and carriers in the U.S. as part of the agency's description of the Marine Highway (MH) Program. Note that the scope of this study goes beyond the MARAD MH program. MARAD has pointed out that the MH program is for containers, trailers and rail cars only, and that no bulk cargoes are included. MARAD has also pointed out that the scope of the MH program also extends to the offshore foreign trades, such as Canada and Mexico. In this study, the scope of SSS operations includes present and potential future bulk movements of cargo. [11]

Section 2-1 describes the corridors defines by MARAD. Section 2-2 describes the carriers currently serving the SSS markets.

2-1 Current SSS Service Corridors

MARAD has identified about 40 marine highway coastal, intracoastal, and inland freight services and 500 marine highway passenger services throughout the United States, including services provided to and from Canada, as depicted in Figure 4. [12]

Figure 4 – SSS Corridors Identified by MARAD

Source: http://www.marad.dot.gov

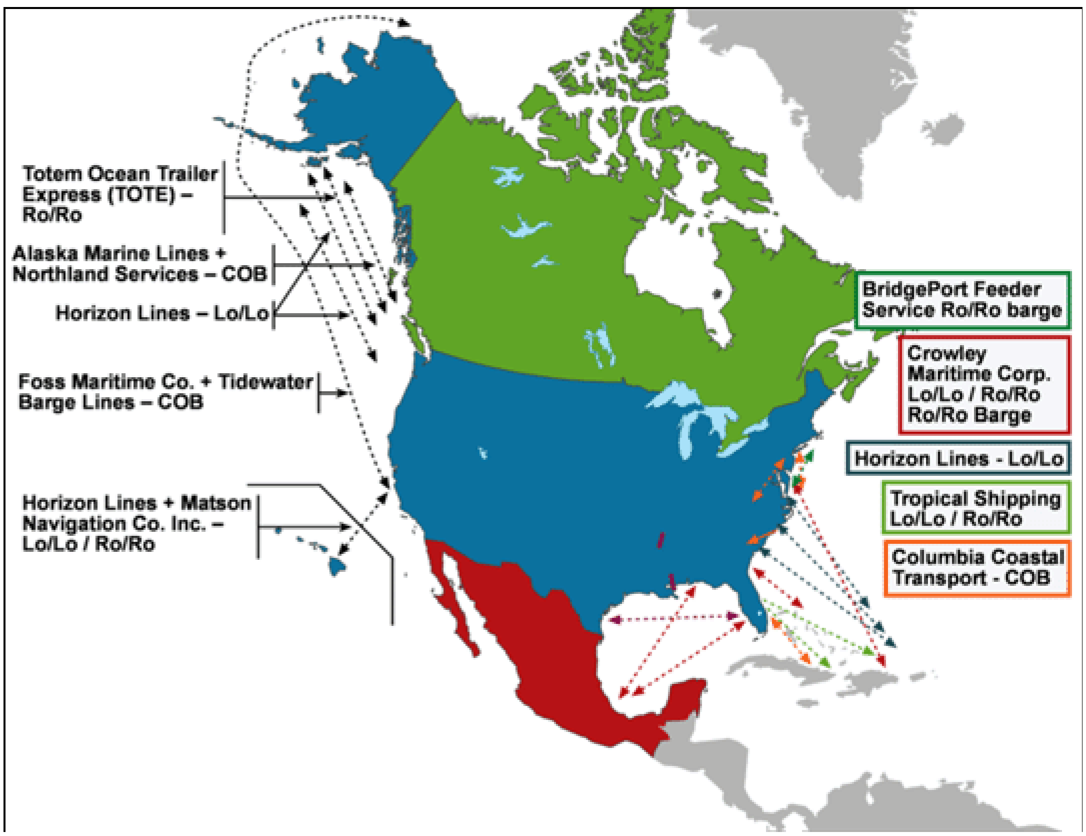
[11] Mr. James Pugh, MARAD, in comments sent on September 22, 2009, has pointed out that "Certainly, there are bulk movements in short sea services, but they are not part of the Marine Highways program."
[12] shttp://www.marad.dot.gov/documents/Marine_Highway_Program_brochure_(final.pdf

The SSS/Marine Highway services identified by MARAD are defined as cargo and passenger services provided on the following vessel types:

- Sea-going tug & barge vessels;
- Riverine tug & barge combinations;
- Intermodal operations involving container-on-barge (COB), and roll-on, roll-off (RoRo);
- Ferry services.

Figure 5 depicts major corridors for SSS service in North America.

Figure 5 – Major SSS Corridors and Services in North America



Source: http://www.marad.dot.gov

Note that some of the services identified by MARAD may no longer be operational. Table 2 summarizes the existing SSS/Marine Highway Corridors as identified by MARAD.

Table 2– Current SSS Corridors, Carriers, Vessel Types, and Service Frequency

Corridor	Carrier	Vessel Type	Frequency
East Coast			
New York – Boston	Columbia Coastal Transport	COB	Weekly
Orient Point, NY- New London, CT	*Cross Sound Ferry Service*	Ferry Service (Passenger, vehicle & trailer)	2 ferries 7 times daily
Norfolk – Baltimore	Columbia Coastal Transport	COB	Weekly
Norfolk - Richmond	*James River Barge Line/* "*64 Express*"	COB and RoRo	Weekly
Elizabeth, NJ - San Juan, PR	Horizon Lines	Container, Reefer, hazmat	Weekly
Jacksonville (& the U.S. West Coast)	Trailer Bridge	COB, RoRo	3 weekly sailings
Port Everglades, FL – Puerto Rico	Crowley Maritime	COB, RoRo, (45ft drybulk, 40 ft Reefer)	
Gulf Intracoastal Waterway			
Houston - Pascagoula	Osprey Lines	Container	Weekly
Houston – Brownsville/"Houston–Brownsville Barge Express Service"	Richardson Marine/Schaefer Stevedoring	Container	Biweekly service
Houston - Puerto Rico	Horizon Lines	Container, Reefer & Hazmat	every fourteen days
Brownsville - Port Manatee	Sea Bridge Freight	COB (600 TEU barge)/general/ break bulk service)	a four-day scheduled service
America's Heartland: Inland Waterways (The Mississippi, Ohio, and Missouri, Rivers up to the Great Lakes)			
New Orleans-Memphis	Osprey Lines	COB	Weekly

(Table continued on the following page)

Table 2 (Continued)
Current SSS Corridors, Carriers, Vessel Types, and Service Frequency

Corridor	Carrier	Vessel Type	Frequency
West Coast and Alaska Service			
Tacoma - Anchorage – Kodiak-Dutch Harbor	Horizon Lines	Container/ Specialized Cargo	Weekly
Tacoma - Anchorage – Kodiak	Horizon Lines	Container/ Specialized cargo	Two Weekly Services
Tacoma - Anchorage	TOTEM Ocean Trailers	Container, RoRo	Two Weekly Services
Pacific Northwest- Hawaii	Matson Navigation	Container Reefer, Special cargo	Weekly Service
Tacoma – Oakland – Honolulu	Horizon Lines	Container	Two Weekly Services
Dutch Harbor – Ketchikan	Alaskan Marine Highways System	Ferry, passenger/ car	
Tacoma-Oakland-Honolulu	Horizon Lines	Container	3 weekly
Los Angeles-Honolulu-Oakland (California-Hawaii Express	Horizon Lines	Container	2 roundtrip sailings
Tacoma-Oakland-Honolulu-Guam	Horizon Lines	Container	Weekly
Oakland-Honolulu	Matson Navigation	Container, Specialized cargo, Reefers	2 weekly
Oakland-Long-Beach-Honolulu	Matson Navigation	COB, Specialized cargo, Reefers	Weekly
Los Angeles-Honolulu (Mid-Week Express)	Horizon Lines	Container	Weekly
PNW-Hawaii	Matson Navigation	Container, Reefer, Specialized cargo	Weekly
Great Lakes			
Detroit-Windsor	Detroit Windsor Truck Ferry	Hazmat, Passenger/Truck	Daily
Ontario-Montreal	McKeil Marine	COB	
Manitowaoc-Ludington	Lake Michigan Car Ferry	Passenger/truck/ General cargo Ferry	Twice Daily
Interlake Services	Various Carriers	Various Cargo	Various

Source: http://www.marad.dot.gov/ships_shipping_landing_page/mhi_home/mhp_map/mhp_ec-n_map/mhp_ec-n_map.htm

Figure 6 - East Coast Region – North-South Corridor Map

Figure 7 - East Coast Region – South Corridor Map

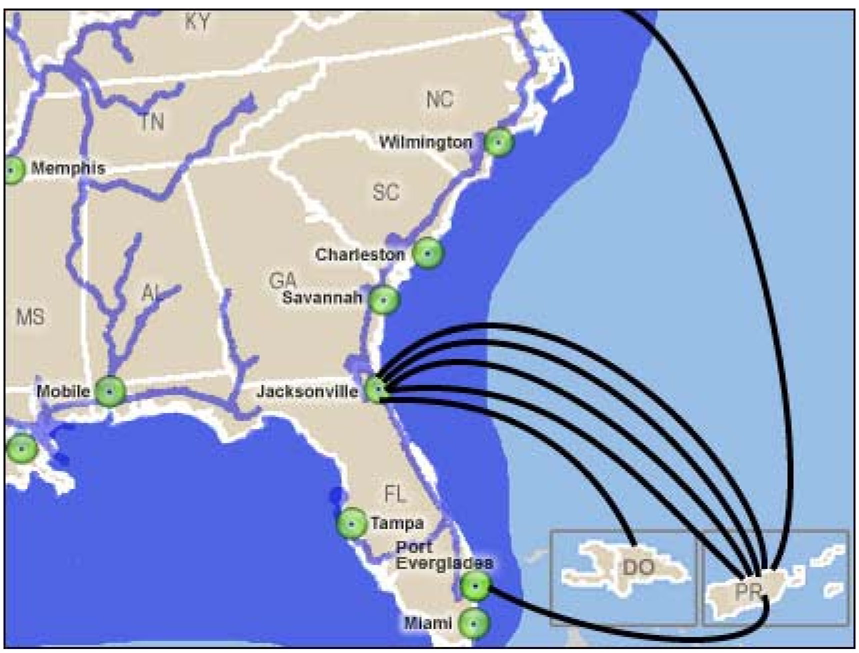
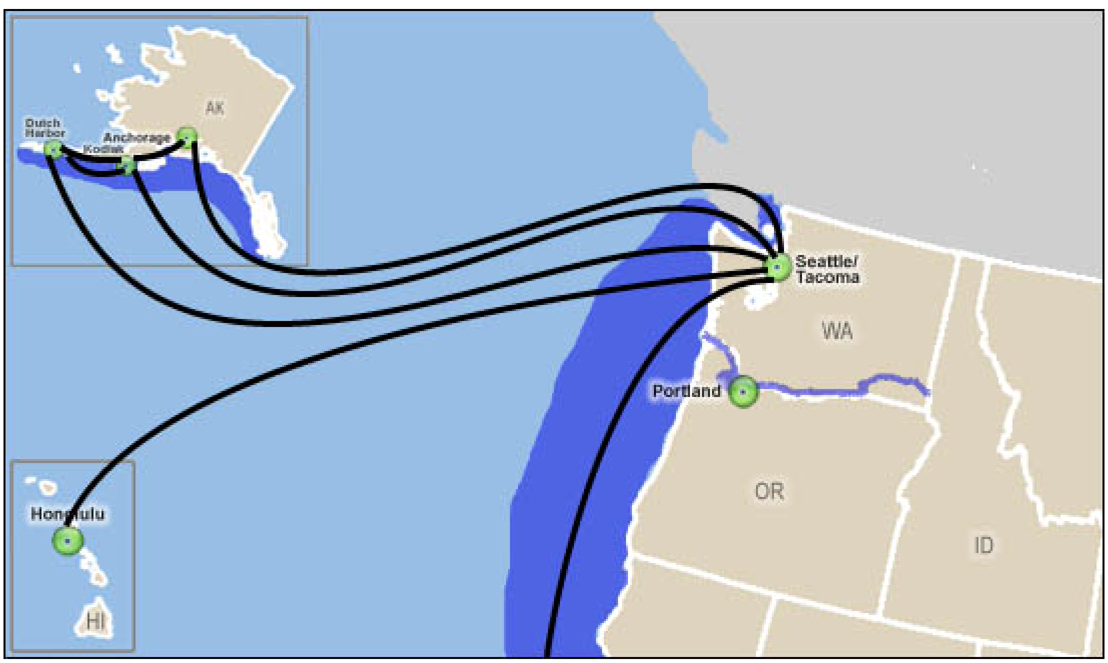


Figure 8 - Gulf Coast and America's Heartland Corridors Map

Figure 9 - West Coast Region - North Corridor Map



Source: http://www.marad.dot.gov/ships_shipping_landing_page/mhi_home/mhp_map/mhp_ec-s_map/mhp_ec-s_map.htm

Figure 10 - West Coast Region - South Corridor Map

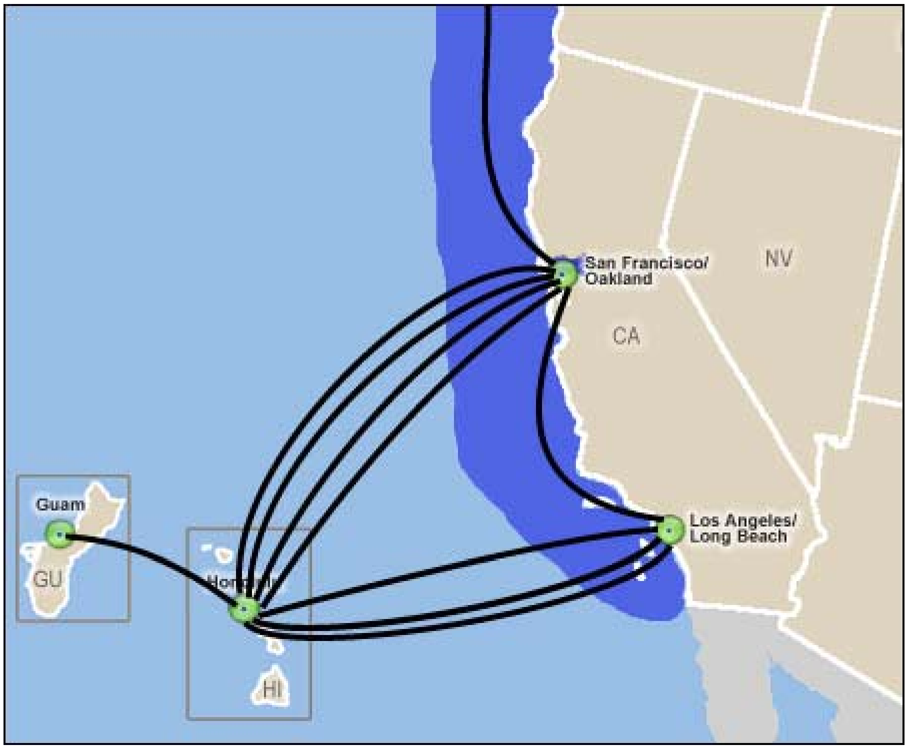
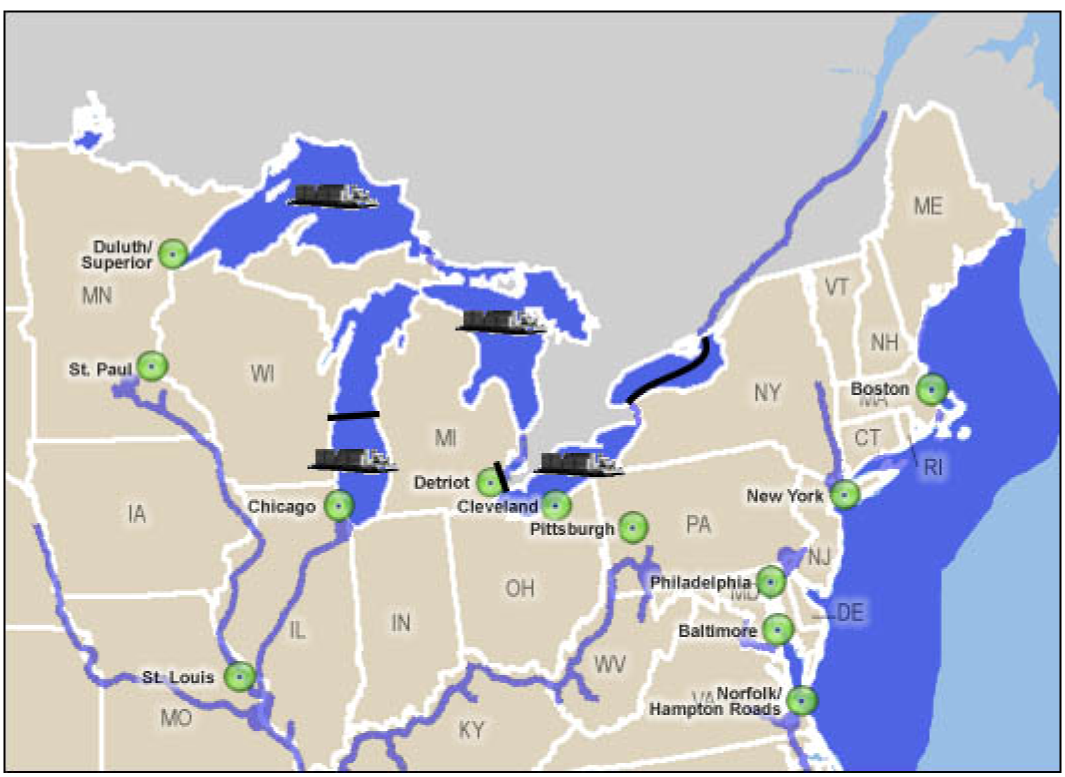


Figure 11 - Great Lakes Map



2-2 Current SSS Markets and Carriers

The existing SSS corridors and carriers identified by MARAD's Marine Highway Program are summarized in Table 3.

Table 3 – Current Inventory of SSS Operators by Vessel Type and Corridor

Carrier	Vessels	Service Region/Corridor
Alaskan Marine Line	RoRo	Alaska
Bridgeport Feeder Service	RoRo	Bridgeport, CT
Cross Sound Ferry Service	Passenger/Vehicle Ferry	Orient Point NY to New London, CT
Columbia Coastal	Container-on-barge (COB)	NY-Boston, Norfolk-Baltimore
Crowley Maritime	COB, RoRo, Reefer, HM	Port Everglades, Puerto Rico
Detroit-Windsor Truck Ferry	HM, Truck Ferry	Great Lakes
Foss Maritime	Self-propelled, COB	Pacific West Coast, Columbia/Snake Rivers
Horizon Lines	Container, Reefer, HM	Honolulu- Los Ángeles, Elizabeth, NJ-San Juan, Houston-Puerto Rico
James River Barge Lines	COB, RoRo	Route 64 Norfolk-Richmond
Matson Navigation	COB, Oversized Cargo	Pacific North West
Osprey Lines/Sea Trader	Self propelled LoLo Containership, COB	Houston-Pascagoula; New Orleans-Memphis
Overseas Shipbuilding Group (OSG)	Self-propelled Handysize Tank ships, ATB	East, West, Gulf Coasts, Alaska
Richmond Marine	Barge Express	Houston-Brownsville
Sea Bridge	COB, Break-bulk	Brownsville-Port Manatee
Sea Point	COB	New Orleans-Memphis
Tidewater	Bulk, Break-bulk	Columbia, Snake Rivers
Totem Ocean Trailer Express (TOTE)	Orca Class Self-propelled RoRo	Anchorage-Tacoma
Trailer Bridge	RoRo, LoLo	Jacksonville and Pacific Coast

Three distinct SSS service markets are reflected in the SSS services summarized in Table 3 above:

a) Inland tug-barge transport for domestic shipments (including ATB);
b) Coastal/Great Lakes services for domestic shipments with self-propelled vessels, fast ferries or COB; and
c) Feeder service to ocean carriers primarily on self-propelled vessel service.

Each of the service classes fall into discrete market segments with fairly clear regional and geographic boundaries and different vessel-service requirements, equipment need, and pricing. Service characteristics of each market segments, however, are often blurred and represent overlapping services. For instance, feeder services and coastal services overlap in that they use similar self-propelled vessels for feedering, transshipment, and lightering services, while many COB services conducted in coastal areas may or may not qualify to be classed as feedering.

2-2-1 Inland Waterway Markets: Tug-Barge, COB and ATB Service

Of the total 1 billion tons of domestic freight transported by water, about 60 percent is transported on the in inland rivers. Tug-barge is the service traditionally used for inland river transport. Of the remaining domestic waterborne freight, about a third is carried on the coastal waterways and the intracoastal Gulf routes. The Great Lakes carry the remaining 10 percent of the domestic waterborne traffic.

The fleet of vessels serving the domestic waterborne trade is comprised of about 28,000 dry bulk barges, 4,200 liquid tank barges, and 4,560 tug-tow boats. The service, conducted at a speed of about 5-7 knot on dry bulk hopper barges and liquid tank barges, has been predominantly for low-value, bulk commodities such as coal, minerals, petroleum, and grains.

2-2-2 Coastal/Great Lakes Markets: Self-Propelled RoRo, COB, Fast Ferry

This market is characterized as potential high-density domestic commodity markets that could support large volume of truckloads on RoRo. With the emergence of newly containerized bulk commodities, container-on-barge (COB) service is also a growing vessel type for this market segment. Competition for SSS operators comes from rail carload and intermodal trailer service and long-haul trucking service. Some examples of SSS services in this market include the following classes of service:

- Self-propelled tanker fleets distributing domestic liquid bulk cargo and providing lightering service;
- Self-propelled and COB/ATB vessels for domestic delivery of dry bulk cargo;
- Fast Ferries, RoRo, and COB service for Great Lakes.

Modernization of traditional tug-barge transport began about 30 years ago with introduction of the domestic COB service in the U.S. COB operations began along the Atlantic Coast range and on the Columbia River System in the Pacific Northwest, when international containerization had reached a critical mass and pushed intermodal operations beyond the deep water ports. Only a handful of the COB operations that began in 1975 has survived to date, with many businesses changing ownership structure. Of the 15 COB firms that began operations 30 years ago, the Alabama COB Feasibility study identified only five as still in operation, as follows: [13]

- Columbia Coastal (New Jersey-based); offering Coastal COB service;
- Osprey Lines, LLC. (Texas-based); offering Inland COB service;
- Tidewater Marine (Washington-based); offering Inland COB service;
- Foss Maritime (Oregon-based); offering Inland COB service;
- ACBL (Indiana-based); offering Inland COB.

[13] Reeves and Associates, “Analysis of the Potential Markets for Short Sea Shipping Services ove the Ports of Fall River and New Bedford,” prepared for the Massachusetts Department of Business and Technology and Seaport Advisory Council, March 29, 2006.

The above list of COB carriers does not include other SSS operators operating feeder service with small containerships/LoLo vessels, RoRo vessels and ferries, described in this section. The following is an overview of the SSS services that have been provided in the past or are currently in effect.

Columbia Coastal Transport

Columbia Coastal Transport provides COB service on the Atlantic coast, from Portland, Maine to Miami, as well as several Gulf and Caribbean ports. On the Norfolk to Baltimore route, according to MARAD, the service currently moves 1,800 containers per week by barge. [14] The Columbia Coastal fleet of COB has capacities of 450 to 912 TEUs (5,300 to 10,267 tons), including some refrigeration service (Figure 12.) [15]

Figure 12 – Columbia Coastal Transport Barge Tow

Source: Columbia Coastal Transport website.

Their privately owned and operated tug-and-barge firm began operating the Albany Express Barge service in 2003, as part of an initiative to help alleviate port capacity problems at the Port Authority New York/New Jersey (PANY/NJ) and relieve congestion on crowded roadways in the New York City area. This service moved containerized cargo up and down the Hudson River between the PANYNJ and the Port of Albany and was part of a proposed Port Inland Distribution Network (PIDN) that would include multiple rail and short sea shipping services between the PANY/NJ in the south and the Port of Albany in the north (approx. 150 miles). The service received a public subsidy to allow the service to charge a rate 10 percent below the truck rate to compensate for the slower speed of moving containers by barge. The regional planning groups had hoped that within 15 years some 18 percent of the containerized cargo could move into and out of the PANY/NY by barge. However, even with a discount, the cargo volumes did not meet expectations during the operational period, and the twice-weekly Albany Express service has since been terminated.

Detroit-Windsor Truck Ferry

The Detroit-Windsor truck ferry has been operating since 1990 as a freight ferry on the Detroit River, carrying hazardous materials, oversized/overweight cargo (e.g., house trailers and industrial equipment), and some time sensitive shipments on a barge. The company operates a scheduled service on a reservation basis. During the 20-minute crossing, the

[14] As reported in the MARAD Marine Highway video, reporting that the carrier moves the equivalent of 3 lanes of traffic 8 miles long, at 1/8th of the fuel consumption of trucks.

[15] Columbia Coastal transport website, http://www.columbia-coastal.com/CCTransport_New_Site_1_2004/index10B.html.

driver of the trailer stays with the load and then drives off. The carrier has carved out a niche market in the corridor because both the Ambassador Bridge and the Detroit-Windsor Tunnel have banned transport of hazardous materials. [16] Figure 13 shows the Detroit Windsor Truck Ferry.

Figure 13 – Detroit Windsor Truck Ferry

Source: http://www.truckferry.com/

New England Fast Ferry

New England Fast Ferry operates passenger service, with some limited cargo capacity, between New Bedford and Nantucket/Martha's Vineyard, Massachusetts. The company is considering starting up a New Jersey-New Bedford RoRo cargo service with medium-speed vessels with catamaran-hull design. The new service is planning truck-competitive operations with overnight bypass of congested New York area through scheduled departures from New Jersey at 8 pm, arriving in New Bedford 5:00 pm the next morning. Two catamaran vessels are under consideration: a 260-foot RoRo with a 24 trailer capacity at a cost of $25 million, or a 320-ft RoRo with a 42-trailer capacity at a cost of $30 million. [17] The company is envisioning a port-to-port, next morning container service at a rate of $350 per trailer. Key to holding operating costs would be using the crew to load and discharge the trailers, rather than relying on more costly port labor. The service is still at the planning stage, looking for "cornerstone" contract with a major trucking company to provide base cargo volume. [18]

OSG Self-propelled Tanker Fleets Distributing Domestic Liquid Bulk Cargo and Providing Lightering Service

Overseas Shipbuilding Group (OSG) is an example of a carrier delivering bulk liquid products for domestic commerce. OSG owns and operates 35 Jones Act tank vessels, consisting of "Handysize" (40,000 to 50,000 deadweight tons) tank ships and Articulated Tug-Barge (ATBs) in all four U.S. coastwise markets: Gulf, west coast, east coast, and the

---

[16] NYU Rudin Center and Rutgers University, Bi-State Domestic Freight Ferries Study, prepared by Allison de Cerreno, Martin Robins, Pippa Woods, Anne Strauss-Wieder, Ryan Yeung, September 2006.
[17] Note that these vessel cost estimates include lower-cost used and rehabilitated vessels.
[18] Reeves and Associates, "Analysis of the Potential Markets for Short Sea Shipping Services ove the Ports of Fall River and New Bedford," prepared for the Massachusetts Department of Business and Technology and Seaport Advisory Council, March 29, 2006.

Alaska North Slope. The ATBs' cargo capacities range from 25,000 to 54,000 deadweight tons. OSG is phasing out its older tank vessels and replacing them with state-of-the-art double hull tonnage, including twelve Veteran Class MT-46 Jones Act product tankers being built at the Aker Philadelphia Shipyard, as mandated by the Oil Pollution Act of 1990 (OPA 90).[19] The OSG ATB fleet has cargo capacities similar to those of the Handysize tankers. These ATB units serve as both refined petroleum product carriers and crude oil lightering vessels at U.S. ports where very large crude carriers (VLCC) use shuttle service to transfer cargo to smaller ships offshore, because depth restrictions at approaches to the terminals prevent them from offloading directly at the port. Figure 14 shows a new OSG ATB tugboat under construction.

Figure 14 – OSG ATB Tug, under construction

Source: OSG website.

Osprey Lines Self-propelled and COB Vessel Service in Gulf-Coast Markets for Liquid, Drybulk and Break-bulk Cargo

Osprey Lines, LLC started business in 2000 as a spinoff from Maersk's acquisition of Sea-Land to provide U.S. flag container feeder service to transport import containers in the Gulf Coast region. The service initially focused on COB operations between New Orleans and Houston, and then expanded into domestic service on the *Sea Trader* self-propelled lift on-lift off (LoLo) containerships. The Sea Trader was a 13.5-knot, 286-foot-long, 248 TEU (124 FEU) U.S. flag containership converted from an offshore service vessel (OSV) capable of carrying 2,500 tons of cargo for both international and domestic containers. [20] The vessel

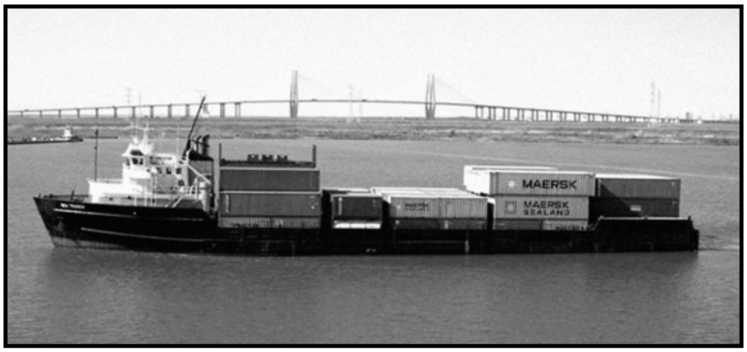
---

[19] http://www.osg.com/ks_usflag.htm

[20] Reeves and Associates, "Analysis of the Potential Markets for Short Sea Shipping Services ove the Ports of Fall River and New Bedford," prepared for the Massachusetts Department of Business and Technology and Seaport Advisory Council, March 29, 2006.

operated on a 7-day cycle around the Gulf of Mexico, using boom cranes to load and discharge containers, transporting finished manufactured goods and building supplies to and from ports in Houston, New Orleans, Tampa, and other cities.[21] The 13.5-knot speed of the *Sea Trader* made the move about half the time of a tug-and-barge service. The faster speed allowed Osprey to compete with trucking along the Houston-Tampa routes because of the truckers' difficulty of finding drivers and the undesirability of the route for truckers (a long-distance route that required multiple transit days and had no backhaul loads.) Declining rail service in the corridor, and capacity shortage at the Port of Houston due to large influxes of international cargo also contributed to the initial success of the Sea Trader service that shift some traffic to Osprey. (Figure 15)

Figure 15 - Sea Trader, Osprey Line



Source: GAO Report, 2005.

Though initially the service attracted enough business to cover most of its operating expenses and offer truck competitive prices, the service had operated below full capacity. [22] Osprey Line has since discontinued the *Sea Trader* service, but continues to provide weekly COB and LoLo container on barge service with scheduled services[23] (Figure 15), on its American Heartland Corridor service via the Mississippi River from the Gulf Intracoastal (Houston, Lake Charles, New Orleans, Mobile, and Pascagoula) to Memphis and Chicago. (Figure 16)

[21] A 7-day cycle means that the vessel returns to its port of origin every 7 days. A shipper moving goods from Houston to Tampa, for example could make one shipment every 7 days on this service.
[22] GAO, "Freight Transportation: Short Sea Shipping Option Shows Importance of Systematic Approach to Public Investment Decisions," July 2005.
[23] Kirby Marine purchased majority holding in Osprey. Osprey's founder formed a new Coach Line, and is planning on purchases of four new 125 FEU, 13.5 know containerships to operate on the coastal and Gulf markets.

Figure 16 - LoLo Barge at Pier, Osprey Line

Source: Osprey Line website.

Trailer Bridge

Trailer Bridge has provided LoLo and RoRo container on barge (COB) services between mainland coastal ports of New York and Jacksonville and Puerto Rico, and services to the West Coast. The company operated the "Atlantic Highway" COB service between Port Newark and Jacksonville in 1999 with a transit time of 3 days. Among the corridor shippers were General Motors with shipments of auto parts to and from San Juan, and paper and pulp shipments of forest products and lumber. The service had to be terminated when a hurricane delayed the barges carrying the ToysRUS shipments, leading to the loss of the account. Contributing to the service vulnerabilities were the high costs of the Port of Newark longshoremen. *Trailer Bridge* also operates the Triple Stack Box Carriers® service on the West Coast, with a fleet of triple-deck RoRo vessels. *Trailer Bridge*, the first carrier to offer a fleet of LoLo vessels built for 53 foot containers, offers integrated service with Pacer doublestack trains, providing through bill-of-lading to Southern California in 12 days from San Juan and to Northern California/the Pacific Northwest in 16 days (from San Juan).

Totem Ocean Trailer Express, Inc. (TOTE)

TOTE, a privately owned company, began operating a fleet of 600 RoRo trailer cargo ships in Alaska in 1975 between the Ports of Anchorage and Tacoma, Washington. The service has stayed consistently profitable and truck competitive. TOTE provides a short-sea service between two U.S. ports with Jones Act ships, operating on a "blue water" route of over 1,400 nautical miles with challenging conditions, in what is essentially an island service, that is, cargo carriage to a site virtually lacking access via surface transportation.

The most modern ships in the TOTE fleet are the Orca class vessels with the following attributes: Length: 839-feet; Beam: 118-feet; Service Speed: 24 knots; Capacity: 600 FEU containers plus 220 vehicles served by 13 internal ramps. The ships have fuel-efficient diesel-electric plants with twin engines for navigation and propulsion system redundancy. There are also numerous environmental protective features such as double hull fuel compartments and a fresh water ballast system that does not discharge to the ocean.[24] The hull is designed with high freeboard and a flared bow for operation in rough seas. (Figure 17)

Figure 17 - TOTE Orca-Class Self-Propelled Ship.

Source: TOTE website.

2-2-3 Coastal Container Feeder-Service on Self-Propelled Vessels

Feeder service is commonly defined as the movement of the container by sea along the same coastline for the purpose of providing container service between major deepwater "mega-ports" and the region's secondary and tertiary ports. A key characteristic of the feeder service is that coastal markets are served by small self-propelled containerships that transport imported containers from Tier 1 international gateways to regional or Tier 2 ports close to inland destination. [25]

Feeder services are often associated with the need for specialized vessels and ship designs for coastal traffic to move containers from major import ports to smaller regional ports. Part of the reason is that strong currents along the Pacific Coast lanes preclude operations by push-pull tug barge operations. However, many of the self-propelled feeder services that have been planned or initiated in the past have not yet been implemented on a large scale. For a feeder port service to succeed, the domestic marine leg of the import containers needs to be coordinated with the schedules of the international deep-sea liner services from Asian and European ports to the Tier 1 U.S. ports. Another barrier to greater expansion of feeder service on the West Coast is the relatively high cost of cargo handling which give trucking operations an edge over marine transport, as evident from the account of why feeder services have not been sustainable. Below are some examples of the current efforts in feeder service.

Matson Navigation and Horizon Lines Feeder Container Services

Matson Navigation and Horizon Lines are the only two container feeder shipping lines MARAD has identified in the U.S. These shipping lines operate only on the West Coast markets, with neither operating feeder services in mainland U.S. ports. Matson began operating the Pacific route service in the 19th century in 1882, and later initiated container service between the U.S. Mainland-Hawaii, claiming some 70 percent of market share.

[24] Totem Ocean Trailer Express, Inc. website, http://www.totemocean.com/default.htm.
[25] Tami Porter, "U.S. Container Feeder Network: Status Update," Horizon Lines, Inc., Presentation at the Journal of Commerce Marine Highway Conference, Jacksonville, Florida, April 2, 2009.

Between 1994 and 1999 Matson ran a single surplus 2,100-TEU container vessel on a weekly service between the Los-Angeles-Seattle and Los-Angeles-Vancouver lanes, a service that has since been discontinued. [26] Matson also took delivery of two 2,400-TEU containerships at the cost of $100 million from the Kvaerner/Aker Shipyard in Philadelphia for serving international feeder service, empty-container repositioning, and domestic routes, but this service too was discontinued in 1999 due to poor financial performance. The service failed primarily due to the high stevedoring costs. The company gained a key account with Anheuser Busch for domestic short-sea delivery but found it difficult to work out the detailed performance arrangements or work out partnership agreements with trucking companies who saw the service as a threat. [27]

Horizon Lines has operated some container services between Hawaii and Los Angeles in the past and is planning feeder services for moving import containers for Maersk, Evergreen, or Hanjin Shipping. As of this date, however, the feeder services have not started. Horizon has maintained that a Coastwise Container Feeder Network will serve as a safety valve for relieving pressure at the nation's "Gateway Corridor" ports, but that the recent economic downturn has delayed the carrier's plans to begin service. At a recent conference, Horizon's director of terminal operations stressed the need for government action in support of the Title XI ship building financing, elimination of the HMT for domestic container moves, and development of a National Port Development Plan. [28]

James River Barge and Norfolk-Richmond Feeder Cargo Service

The James River Barge Line initiated the Norfolk-Richmond "*64 Express*" tug-barge COB service on December 1, 2008 with weekly tug-tow feeder service between Richmond and Hampton Roads, using a hopper barge and pusher tug. The barge travels once weekly between the cities, carrying up to 128 20-foot containers. The service moves containers arriving at the deepwater port of Norfolk inland to Richmond on the river. (The company motto is: "We've brought the ports of Hampton Roads 100 miles west!") From Richmond, the service moves cargo back to Norfolk for shipment overseas.[29] The service is described as essentially a trucking service on the water that provides seamless door-to-door container service. The company relies on partnerships with trucking companies throughout central Virginia and offers rates that are competitive with all truck rates. The 64 Express sails Sunday at 1400 each week from Portsmouth Marine Terminal and 1700 from Norfolk International Terminal for Richmond; with cargo arriving in Richmond at 1000 on Monday, with door-to-door cargo delivery option available to shippers.

Sea Point, LLC

The Sea Point service is an example of SSS feeder service for dealing with container imbalance and the need for empty container repositioning. The service, however, no longer

---

[26] http://www.matson.com/matnav/about_us/index.html

[27] Reeves and Associates, "Analysis of the Potential Markets for Short Sea Shipping Services ove the Ports of Fall River and New Bedford," prepared for the Massachusetts Department of Business and Technology and Seaport Advisory Council, March 29, 2006.

[28] Tami Porter, Horizon Lines Inc., Presentation at the Journal of Commerce Marine Highway Conference, Jacksonville, Florida, April 2, 2009.

[29] 64 Express website, http://www.64express.com/home.aspx.

exists. [30]Sea Point service was developed as a container transshipment terminal in Venice, Louisiana, with plans to provide an alternative to west coast ports. Through these feeder operations, containers move into south Louisiana and are transshipped on COB to "Middle America"(defined on their route map to include the Gulf Coast and the Mississippi River basin.) The Sea Point business plan consisted of offering the shipper a tradeoff between the savings on inland transportation costs using barges and the added time required for "all water transit".[31] The Port of Baton Rouge had promoted COB service as the preferred alternative for container movements to the Gulf and Midwest states. [32]

West Coast Corridor Feeder Service Prospects

Unlike the East Coast, the prospects for a viable feeder service on the West Coast have been considered dim by some because of labor issues, and lack of port density and minimal freight volumes along the north-south cargo routes. A recent study conducted at the University of Southern California (USC) study has concluded that a RoRo feeder services on the West Coast would be a viable option and possibly instrumental in alleviating congestion at the three "mega-ports" of Los Angeles-Long Beach (LA/LB), San Francisco-Oakland, and Seattle-Tacoma. The study evaluated opportunities for re-directing empty container flows to secondary ports, and for feedering and transloading the movement of international containers to and from the manufacturing areas on the U.S.-Mexico border. The study evaluated the type of maritime and port operation best suited for these market segments, and determined that RoRo SSS vessels are most suitable for initial operations. This study also argued in favor of the establishment of regional port systems to provide an appropriate institutional apparatus for the coordination of public and private investments in SSS. [33] The study found the feeder port concept feasible for RoRo services that require the movement of container-on-chassis/tractor-trailers. Because RoRo service can move the local export and import containers and international empty boxes within the regional port transload system, terminal-handling costs are avoided since they require only loading and unloading ramps. The study identified significant congestion and air quality benefits from a feeder port system compared to the current pricing strategies implemented for relieving port congestion (e.g., PierPass fees charged trucking services for peak hour container pickup.) Pricing measures such as PierPass have the effect of *shifting traffic in time.* The impact of a feeder service, the study concluded, would be to *shift traffic in place* by strengthening container handling capacity at smaller ports such as San Diego, Port Hueneme, Stockton, and Sacramento in California and ports of Portland and Vancouver in Oregon. Figure 18 depicts the envisioned West Coast feeder port service.

[30] As pointed out by Mr. James Pugh, MARAD, in comments sent on September 22, 2009.
[31] Sea Point website, http://sea-point.net/container/.
[32] Port of Baton Rouge website, http://www.portgbr.com/content.php?display=container.
[33] Le-Griffin and Moore, "Potential Impact of Short Sea Shipping in the Southern California Region", University of Southern California (USC), Department of Civil and Environmental Engineering, Research Project Report, METRANS Project 65-A0047, February, 2006.

Figure 18 – Envisioned West Coast SSS Feeder Service Corridor

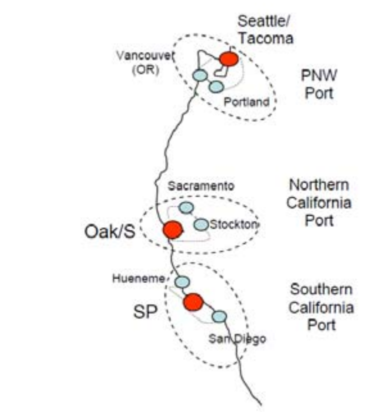


Figure 4. West Coast Regional Port Systems

Source: Le-Griffin and Moore, USC, February, 2006.

To summarize, Section 2-1 described the existing SSS markets, as identified by MARAD in five key corridors served by about 16 carriers. Section 2-2 identified 3 prototype SSS markets: Inland Tug-Barge markets, Coastal/Great Lakes RoRo and Fast Ferry markets, and the Coastal Feeder Network, showing that:

- The traditional tug-barge service and new ATBs serve an important niche market for low-margin, low priority shipments, and that they should remain a core market for SSS service;

- The Coastal and Great Lakes services need to be augmented by the service of a more robust self-propelled fleet of vessels for RoRo, LoLo, and break-bulk service; this segment has not been able to be sustained given the high costs of stevedoring services, short shipment distances that make competition with the trucks more difficult, and absence of mass cargo volumes;

- The Coastal container feeder markets have yet to be developed; they offer the greatest potential for incremental improvements in serving congested and capacity constrained coastal corridors for delivery of import containers.

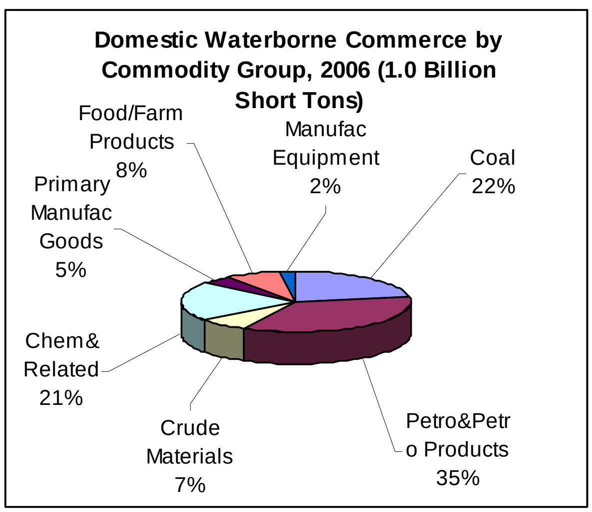
To assess the extent to which SSS services in these markets are potentially sustainable, and to identify the factors that would make SSS a viable alternative for moving freight, accurate cost and operational data are needed. Many of the companies that in the past have been active are no longer in business, partly because of the current economic downturn. Operational data are currently lacking, partly because of the privately- held nature of the businesses. Sections 3 through 5 will attempt to provide a better understanding of the economic performance of these SSS operations.

Section 3.0 Market Conditions, Service Requirements and Potential Market Size for Viable SSS Service

3-1 Baseline Commodity Market Characteristics

The composition of the domestic cargo shipped in the U.S. waterborne commerce is markedly different from the composition of cargo shipped in international trade. The U.S. domestic waterborne cargo trade is largely dominated by dry and liquid bulk products. Eighty five percent of the 1 billion tons of cargo shipped for domestic waterborne commerce in 2006 was coal, bulk petroleum, crude materials and chemicals (Figure 19). These products are transported in dry- or liquid-bulk form in self-propelled tankers, tank barges pulled by tugs, and in dry-bulk barges. Only about 15 percent of the domestic waterborne cargo – food products and manufactured equipment – is currently suitable for containerization. Figure 19 shows the breakdown of the domestic waterborne trade by commodity class.

Figure 19 – Domestic Waterborne Commerce by Commodity Group



Volpe generated chart based on IWR, USACE data.

Adversely influencing the size of the domestic markets for waterborne trade are two interrelated factors: the low value of the bulk cargo carried and the short distances shipped. Together, these two factors explain why the share of waterborne domestic cargo transported in the U.S. is so small.

Bulk commodities have lower per-unit cargo value than containerized cargo. Since shipping charges are ad-valorem, domestic bulk commodities, dry or wet, have traditionally claimed a small share of the transportation revenues. This condition has been further exacerbated when coupled with large volumes of empty containers shipped by water, and increasingly shorter shipment distances. Together these factors further stifle the growth of markets for waterborne domestic cargo transportation.

3-2 Requirements for Viable SSS Service

Shippers and carriers have different requirements for a viable freight service. Research findings suggest that for a carrier, the primary requirement for a sustainable service is a minimum volume commitment; for a shipper, the primary requirement for using a service is reliability. A feedback loop or vicious cycle might be at the heart of much of the performance gap today: lack of service reliability for a SSS carrier may often be tied to the lack of volume commitment. [34]

Shipper Service Requirements

For the shipper, the critical service requirement for committing any level of cargo to SSS carriers is service reliability, followed by cost and transit time. A study on the feasibility of a container-on-barge (COB) movement of cargo within the freight corridor served by the Port of Mobile and the inland waterway system for the Alabama Freight Mobility program indicated that shippers give the reliability of the shipment arrival the highest priority (with 48 percent considering it the highest priority), followed by cost (a high priority for 37 percent of the survey respondents) and transit times (high priority for 15 percent of respondents.) The study found that longer transit times are not necessarily detrimental to SSS markets and concluded with the following statement:

> "Alternative modes need not be faster or cheaper; they can be competitive if they are reliable." [35]

Service unreliability has traditionally been caused by a combination of three factors prevailing in tug-barge service: unpredictable service hours arising from weather-related vulnerabilities and seasonality of service, lack of scheduled services because of lack of volume commitment, and inherent delays caused by the difficulty of controlling the tug-barge combination coupled with the need to switch gears when entering the harbor. The Alabama Freight Mobility Study described some of these root causes of service unreliability in tug-barge operations: [36]

a) Weather delays are often caused by uncertainties of towing a barge in a heavy storm; towed barges must often wait for seas to subside before crossing, particularly when hazardous materials and petroleum products are carried.

b) Difficulty of controlling towed barges in congested waterways and the frequent need for helper tugs in port add to service unreliability; tug-barge tows face delays because they have to wait to cross the harbor entrance; once in the harbor they face further delays because they must switch from towing gear to pushing gear;

---

[34] *"Alabama Freight Mobility Study, Phase I: Business Perspectives on the Feasibility of Container-on-Barge Service,"* April 9, 2007.

[35] *"Alabama Freight Mobility Study, Phase I: Business Perspectives on the Feasibility of Container-on-Barge Service,"* Prepared for the Coalition of Alabama Waterway Association, prepared by Hanson Professional Services, Inc., Nashville, Tennessee, April 9, 2007.

[36] "The Articulated Tug/Barge – AT/B: The History and State of the Art," Robert P. Hill, President, Ocean gtug & Barge Engineering Corp. Undated.

c) Tug-barge vessels' variable operating schedules pose an inherent conflict with the growing shift of the business model for petroleum terminal operations to supply delivery methods centered on reduced inventory holdings and demand for on-time delivery of replenishment products.

This perception has reinforced the belief that because SSS service cannot compete with trucking in transit times, then the only market niche for this service is the low-cost, low-priority bulk shipments. There is evidence suggesting that this perception is not supported by what we know about the minimum service requirements of the carriers and shippers, and how they can be reconciled.

Carrier Requirements for Market Entry

Success factors for surviving in the COB business include the ability to achieve economies of scale to satisfy specific markets and waterway operational constraints, and achieve a reasonable balance of service reliability and cost performance. The Alabama COB Feasibility study identified the following success factors for COB SSS operations:

- Bundling of services and prices to stay competitive with rail and trucking carriers. This includes the ability to bundle land-side operations, terminal equipment, and stevedoring services into their price since these charges are too complex for the customers to deal with separately (particularly since these costs are highly visible and could potentially create competitive disadvantage if not bundled properly.)

- Enabling customers to leverage COB by using it as part of an intermodal end-to-end service with the same bill of lading (BOL), with emphasis on demonstrating measures of "equivalency of performance" with rail and truck service;

For traditional tug-barge service, the primary requirement for the entrance of a carrier in a corridor is minimum volume commitment. Carriers need a minimum critical mass that would allow them to enjoy modest scale economies. Service unreliability is often related to the absence of a regular service schedule because the barge service has not obtained the minimum volume commitment to allow the service to be sustained on a regular basis, as the Alabama COB study has pointed out. This is because barge service is conducted under two operational conditions:

a) "*Unit Tows*" in which barges and tows are assigned for the purpose of uninterrupted move from a single origin-destination port pair. This service format, prevalent in the liquid bulk petroleum and chemical processing industry, follows relatively reliable and predictable schedules;

b) "*Line-Haul Service*" for moving dry cargo, in which a tug is assigned to a route, and a number of barges are assigned to utilize the tug's available capacity. This service relies on a "first come, first serve" arrangement with no predictable schedule. When traffic volume is low, barges in the line-haul arrangement are "tramped" to secure

[37]

Lack of volume commitment in a corridor, a commitment a carrier needs in order to achieve economies of scale in serving the corridor, often leads to service reliability problems which in turn become a self-fulfilling prophesy, perpetuating the vicious cycle of the initial lack of volume commitment.

The Alabama Feasibility Study concluded that carriers desiring to enter the market for COB tug-barge operations encounter two key impediments: a) they depend on mass volume commitments, and b) they need to move faster to maintain their market share. Because towed barges are essentially low-cost, slow-speed conveyances, as shipping markets become more competitive, they can maintain their market share only if they move faster because they cannot lower their already low rates any further. [38]

Commodity Market Requirements Favoring SSS Service

Tug-barge vessels are particularly suited to meet a unique requirement of shippers of bulk commodities. The Alabama COB study found that when shippers or logistics managers select their mode of transport they take into account the cargo weight, dimension, and other handling requirements. [39] Many bulk commodities are heavy and "*weigh out before they bulk out*." The study team conducted a survey of shippers in the Alabama and Port of Mobile catchment area and found that a combination of the cargo weight and bulk determines the optimal mode and conveyance. Cargo can be loaded to a container's maximum capacity in two ways:

a) Fully loading the container by volume so that the container "*cubes out*"; or

b) Loading the container to its capacity by weight, so that it "*weighs out*" before it cubes out.

Most commonly shipped commodities on tug-barge service are heavy-weight products and hazardous materials that *weigh out* before they *cube out* a container. For dense and heavy cargo, the container cannot be loaded to its maximum capacity because it would exceed the structural limits of the box or the legal limits of the vehicle on the road. Approximately 45 percent of the shippers *weigh out* before the volumetric capacity of the container is reached, the Alabama COB feasibility study found. The report pointed out that this cargo attribute represents a significant advantage for COB operations over trucking for overweight loads. Shippers pay for the use of a container whether or not they can fill it up. Offering a COB service will allow 45 percent of the shippers to load to a weight higher than the limits imposed by the highway size and weight limits. Two common types of inland barges, designed to meet the waterway limits imposed by locks and waterway depth and dimensions, are available to meet these commodity needs:

---

[37] *"Alabama Freight Mobility Study, Phase I: Business Perspectives on the Feasibility of Container-on-Barge Service,"* Prepared for the Coalition of Alabama Waterway Association, prepared by Hanson Professional Services, Inc., Nashville, Tennessee, April 9, 2007.
[38] *Alabama Freight Mobility Study*, April 2007.
[39] *Alabama Freight Mobility Study*, April 2007.

a) Hopper barges (195 feet long and 35 feet wide, carrying 1,500 tons of bulk cargo in waterways 9 feet deep;) and

b) Liquid tank barges (195 feet long and 35 feet wide, carrying 10,000 barrels of liquid.)

The core commodities that are primary candidates for moving on inland waterways, as identified in Section 3-1, have a high *volume-to-value ratio*, consisting of commodities such as coal, petroleum, construction materials, grains, fertilizers, chemicals, and minerals. The tug-barge operators that carry these commodities enjoy economies of scale in this market and compete with railroads for market share. Competition from inland waterway operations has benefited the shippers and the environment in many regions as tug-barge operations not only keep the rail rates low, but also consume less fuel and generate lower emissions.

3-3 SSS Corridors Designations According to Potential Market Size

A recent study conducted for the U.S. DOT identified four key potential short-sea corridors in the U.S. These designated corridors are characterized by their potential for high volumes of traffic, balance of directional flows, prospective port locations outside of major congestion areas, and geographic diversity. The corridors were identified by Global Insight based on the parameters of a cost model developed to estimate corridor-level market penetration rates, terminal costs, distribution costs, and end-to-end line-haul and drayage costs to potential corridor shippers and carriers. The cost model developed a business case based on the catchment area of a 250-mile port hinterland at each end of the SSS corridor. The SSS market penetration rate was calculated based on the assumption that as the distance from the port location grows the benefit from diversion of cargo from highway declines. In this respect, in addition to cargo volumes, port geography and competition from existing rail and truck modes for door-to-door service represented critical factors in the estimated market size for SSS. The study identified the following four corridors:

- *Gulf to Atlantic Coast Corridor* – between the ports of Beaumont, TX and Camden, NJ;
- *Atlantic Coast Corridor* – between the ports of Port Canaveral, FL and New Haven, CT;
- *Pacific Coast Corridor* – between the ports of San Diego and Oakland, CA and Astoria, Oregon;
- *Great Lakes Corridor* – between the ports of Milwaukee, WI and Muskegon, MI.[40]

Market Size and Cost Parameters for each Corridor

As noted above, in making modal choices for shipping cargo from locations A to B, shippers make tradeoffs among several cost- and service- performance criteria. One tradeoff is between delivery speed and price as shippers trade off low transit times for a lower rate. The Global Insight's economic model estimated market penetration for SSS by balancing equipment utilization (to reflect carrier discounting in order to fill available vessel capacity) with reasonable modal shares for intermodal moves. Considering corridor-level traffic

[40] Global Insight, "Four Corridor Case Studies of Short-Sea Shipping Services: Short-Sea Shipping Business Case Analysis", submitted to the U.S. DOT, Office of the Secretary, in association with Reeve & Associates, August 15, 2006.

volumes, density and direction, market penetration rates for SSS were assumed at 12 percent to 25 percent of the target corridor freight volume, based on estimated freight volumes obtained from the Federal Highway Administration (FHWA) Freight Analysis Framework (FAF) database.

The relevant costs for SSS operations included direct vessel operating costs (vessel movement and crew costs, maintenance costs, and fuel and consumables); capital costs; and costs associated with trailer/container loading/unloading. Non-vessel operating costs included port/stevedoring charges and terminal costs, equipment leasing/purchase costs, drayage costs, sales/administration overhead, and the Harbor Maintenance Tax (HMT) charges. Also included were the costs associated with repositioning the container/trailers, costs in which rail and truck carriers have an advantage because of greater latitude in finding backhaul loads. The study also compared "best-in-class" SSS costs with representative "status quo" carrier costs. Trucking costs included driver wages, trailer/tractor costs, fuel, tire, oil, insurance costs, and tolls.

Vessel types included in the Global Insight study were assumed as follows:

- Self-propelled RoRo and LoLo vessels were assumed to be available for moving trailers and container vessels in all corridors; (with the exception of the Great Lakes where only RoRo vessels were considered (to account for the short steaming distance across Lake Michigan and the subsequent premium on minimizing port time for trailer ferry service.)

- Vessel capacities were assumed to be limited to 1,200 TEU LoLo containerships (600 FEU containers or capacity for carrying 500 trailer loads with a mix of sizes); and RoRo vessels were assumed to have a 400-trailer capacity on the Gulf Coast-Atlantic Coast Corridor and the Pacific Corridor. For the Atlantic Coast corridor, vessels modeled were 200 TEU LoLo container vessels and 140-trailer RoRo vessels to reflect the relatively high levels of freight density and service frequency requirements of the corridor.

- Crew sizes of 12 for the larger coastal vessels and 10 for smaller vessels were assumed. This assumed that new manning agreements would be in effect with the Sea Farers Union with respect to the USCG manning requirements for self-propelled vessel operating along the contiguous coast of the United States.

- Average vessel speed of 25 knots was assumed for the coastal corridors and 20 knot for the Great Lakes. These relatively high speeds (compared to the lower tug-barge speeds of under-10-knots in inland waterways) were assumed in order to offer "truck-competitive" transit times.

- Vessel capital costs were assumed lower than prices currently charged by U.S. shipyards.

Comparing the regional costs and transit times for the three alternative modes are Tables 4 and 5.

Table 4 – Regional Cost and Transit Time Comparisons for Door-to-Door Delivery of a 40-Ft Container

Corridor	Truck		Rail Intermodal		SSS	
	Costs	Transit time (hours)	Cost	Transit time (hours)	Costs	Transit time (hours)
Atlantic	$1,881	54.5	$1,070	60.5	$1,045	70.0
Gulf/Atlantic	$2,405	67.5	$1,286	86.0	$1,314	111.0
Pacific Coast (San Diego – Astoria)	$1,757	56.0	$1,014	62.0	$1,184	115.0
Great Lakes	$599	9.5	NA	NA	$467	7.5

Source: Global Insight, "Four Corridor Case Studies of Short-Sea Shipping Services: Short-Sea Shipping Business Case Analysis", August 15, 2006.

Table 5 - Total Shipper Costs per Mile and Percent Differential with Respect to Truck

Cost Components	Truck	Rail	SSS (Status Quo)	SSS (Best in Class)
Gulf/North Atlantic				
Shipper Costs/mile	$1.77	$1.06	$1.13	$1.03
% Differential	-	-40%	-36%	-42%
South Atlantic-North Atlantic				
Shipper Costs/mile	$1.73	$1.09	$1.12	$1.00
% Differential	-	-37%	-35%	-42%
Pacific Coast, San Diego, CA-Astoria, OR				
Shipper Costs/mile	$1.58	$1.01	$1.29	$1.14
% Differential		-36%	-18%	-28%
Pacific Coast, Oakland-Astoria				
Shipper Costs/mile	$1.59	$1.35	$0.95	$0.86
% Differential	-	-15%	-40%	-46%
Pacific Coast, Oakland-San Diego				
Shipper Costs/mile	$1.56	$1.90	$1.93	$1.75
% Differential	-	+22%	+22%	+12%
Great Lakes				
Shipper Costs/mile	$1.51	NA	$1.32	$1.24
% Differential	-	NA	-12%	-18%

Source: Global Insight, "Four Corridor Case Studies of Short-Sea Shipping Services: Short-Sea Shipping Business Case Analysis", August 15, 2006.

To summarize, assessment of the corridor market potential and the relative cost distribution for each mode's "value-chain" in the Global Insight study found the following for each corridor:

- ☐ In the *Gulf/North Atlantics Coast Corridor*, SSS provides the lowest cost to the shippers when compared to per-mile costs for the highway mode (based on highway- and not nautical-miles), though at significantly greater transit times. [41] Providing significant scale

[41] This is due to the longer distance that a vessel has to travel between Beaumont, Texas and Camden, New Jersey, since it has to steam around Key West before heading North or West. The choice of Camden for the destination port was based on its large hinterland, but the location adds 3.5 hours to the travel time.

economies within the corridor are the large volumes of chemicals and petroleum and heavy loads of crude minerals and raw materials, the core commodities for SSS market. The hazardous nature of the cargo and the typical loads that exceed highway weight and size limits and/or cause excessive pavement wear & tear, and therefore higher costs for truck shippers provide the needed volume commitments to support reliable SSS service schedules. (Table 6)

Table 6 – Comparison of Truck, Rail, and SSS Service (Gulf to Atlantic Coast Corridor)

Performance	Truck	Rail	SSS (Status Quo)	SSS (Best-in- Class"
Total Miles (Door-to-Door)	1,470	1,699	2,091	2,091
Transit Hours (Door-to-Door)	67.5	86.0	111.0	111.0
Carrier Cost per Highway Mile ($)	$1.64	$0.87	$099	$0.89
Operating Margin	10%	30%	10%	10%
Shipper Cost per Highway Mile *	$1.77	$1.06	$1.13	$1.03
Differential: SSS Shipper Costs Compared to Truck Shipper Costs**	-	-40%	-36%	-42%

Source: Global Insight, "Four Corridor Case Studies of Short-Sea Shipping Services: Short-Sea Shipping Business Case Analysis", submitted to the U.S. DOT, Office of the Secretary, in association with Reeve & Associates, August 15, 2006.

* Shipper costs include any "markup" or profit margin added to the carrier's costs, as well as incremental inventory carrying costs incurred by slower transit times of rail and SSS service options, plus the HMT fee for SSS paid by the shipper.

** The "Differential" is calculated as the ratio of the shipper costs for trucking service to shipper costs for rail and SSS service.

- ☐ In the *Atlantic Corridor (South Atlantic to North*, SSS economics represent a significant advantage over truck transportation, and a modest advantage over rail (Table 7.)

Table 7 - Cost of Moving a 40-foot Container in the Atlantic Corridor (North Atlantic to South Atlantic)

Cost Components	Trucking	Rail Intermodal	SSS (Best-in-Class)
Line haul	$1,796	$544	$426
Drayage (origin)		$211	$219
Terminal (origin)		$52	$65
Terminal (destination)		$52	$65
Drayage (destination)		$211	$219
Equipment		$46	$51
Repositioning	$85		
Total cost	$1,881	$1,070	$1,045
Transit Time	54.4 hours	60.5 hours	70.0 hours

Source: Global Insight, "Four Corridor Case Studies of Short-Sea Shipping Services: Short-Sea Shipping Business Case Analysis", submitted to the U.S. DOT, Office of the Secretary, in association with Reeve & Associates, August 15, 2006.

- ☐ In the *South Pacific Corridor*, Global Insight analysis showed mixed results. Inclusion of Oakland as a point in the corridor improved capacity utilization but had the drawback of higher costs of marine terminal stevedoring services (costs that can be as much as 50% higher than the Gulf and Atlantic Coast corridors.) The study considered these higher terminal costs as the “deal breaker” for SSS on the Pacific Coast.

- ☐ In the *Great Lakes Corridor***,** the model results showed that SSS is superior to trucking in both transit times and cost, assuming service frequency of 2 daily services in each direction. (Port pairs of Milwaukee, WI and Muskegon, MI connect two primary interstate networks (I-94 and I-90 in WI and I-96 in MI).

Key conclusions about the conditions that make SSS commercially viable include:

- The corridor is commercially viable when the cargo markets have enough density to enable relatively larger vessels that provide scale economies to operate. These scale economies would lower per trip operating and capital costs and would allow high enough service frequency to be truck competitive.

- SSS service is commercially viable and competitive with ground alternative on a door-to-door basis when the vessel capital and crew costs and marine terminal stevedoring expenses are reasonable (i.e., achieved at “*best in class*” levels.) This parity is achieved in three of the four corridors. Pacific Coast is less competitive because of high terminal costs.

- SSS is particularly competitive for heavy loads and hazardous shipments that generally move over the road.

- When SSS provides a more direct port-to-port routing and/or avoids areas of traffic bottleneck and urban congestion it can be highly competitive in both transit times and costs, as in the Great Lakes Corridor.

To summarize, Section 3.0 identified the shipper and carrier requirements for service cost, speed and reliability, and developed operating cost estimates for SSS operations based on operational scenarios developed for four freight corridors. The Corridor designation and market sizing study indicate that with the exception of one segment in the West Coast (the Oakland-San Diego Corridor) all corridors could potentially support a viable SSS operation in some segments, with shipper costs lower than alternative truck costs at rates between 12 to 40 percent.

Section 4.0 Vessels and their Relative Performance

Feasibility and sustainability of a reliable SSS service within any freight corridor within the U.S. is closely linked to the cargo markets served in the corridor, the geography of the region and its port system, and the available vessels and lift equipment. This section provides information on the SSS vessel cost structure by describing the spectrum of vessel types suitable for SSS service, including conventional tug-tow combinations, tankers and self-propelled commercial and military ships and ferries for serving coastal (blue-water) and riverine (brown-water) freight markets.

Generally two broad classes of vessels are used for non deep-sea shipping: self-propelled vessels and tug-barge combinations. Tug-Barge combinations are currently the dominant vessel types for SSS service, including Articulated Tug-Barges (ATB) that operate at relatively low speeds (often less than 10 knots per hour.) Self-propelled vessels include ships that carry containers (lift on-lift-off or LoLo ships), trailers (roll on-roll-off, or RoRo ships), small petroleum tankers that serve as "lightering ships" for larger oil tankers, and ships that carry barges (called Lighter (Barge) Aboard Ship or LASH vessels). These vessels are constructed in a variety of speed and hull types for civilian and military purposes. [42]

Table 8 shows the current inventory of the Jones Act compliant U.S.-flag fleet of approximately 37,000 vessels, consisting primarily of dry bulk and liquid barges. Some publications have put the size of the fleet to 39,000. [43] Note that not all the U.S. Flag vessels operate in the domestic coastal trade or on inland waterways.

Table 8 – Number of Jones Act Compliant Self-Propelled and Barge Vessels with Potential Application for SSS Service

US Flag Vessels (County of Registry)	# of Jones Act Vessels
Self Propelled Tankers	95
Self-Propelled Freight Ships (Container, Dry-bulk, RoRo, General Cargo)	200
Tug/Tow boats	4,560
Dry Bulk Barges	28,000
Liquid Bulk barges	4,200
Total Jones Act Fleet	**37,055**

Source: MARAD, based on data from the United States Army Corps of Engineers.

4-1 Self-Propelled U.S. Flag Vessels

Self-propelled vessels suitable for SSS service in the U.S. are relatively small in numbers (a fleet size of fewer than 300) and range of capabilities. The following sections describe the currently active or potential fleet for coastal and/or inland SSS operations.

[42] Mr. James Pugh, MARAD, in an e-mail sent on September 22, 2009, has pointed out that the MH program has not identified any LASH operations.
[43] Maritime Cabotage, Annual Report, 2007, and the Jones Act Report, November 2007.

Self-Propelled Tank Ships

In 2007, the tank vessels serving the U.S. coastal trade included crude tankers (also called crude carriers), product tankers, and tank-barges, including Articulated Tank Barges or ATB (Table 9.) ATBs are classified as non-self-propelled tug-barge combinations, as described in Section 4-2.

Table 9 – Jones Act Compliant Self-Propelled Tank Ship and Non-Self-Propelled ATB Vessels in Domestic Commerce, 2007

Type	Fleet	DWT	Metric Tons (Million)	Ton Miles (Billion)	Average Miles per Shipment
Self-Propelled Crude Tankers	13	2,068	27.8	44.9	1,615
Self-Propelled Product Tankers	44	1,909	35.6	44.7	1,256
Tank Barges/ATB	116	2,045	67.4	30.1	447
Total	173	6,022	130.8	119.7	915

Source: MARAD, *Coastal Tank Vessel Market Snapshot*, 2007, Office of Policy and Plans, August 2008, Tables 1 and 3.

According to the MARAD Fleet Report on the inventory and traffic volumes for coastal tank vessels, the volume of trade carried on crude carriers and product tankers, measured by metric tons carried, declined moderately between 2002 and 2007, while the volume of trade on tank barges stayed relatively stable. MARAD has reported that new tank vessels are more productive than the older vessels they have replaced because they require less maintenance and dry-docking time. New tankers also have 2 to 3 times more pumping capacity (and less time required for load per discharge) than older tankers. Figure 20 shows a Self-propelled Lube Oil Barge with the following characteristics: 46,000 deadweight tons, 183 meters long, 33.2 meters in breadth, 12.2 meters draft, service speed 15 knots, cargo pumps at 3,600 meters^3/hour (15,800 gpm).

Figure 20 - *Overseas Houston Self- Propelled Tank Barge*

Source: Professional Mariner website, https://www.professionalmariner.com

MARAD has attributed the decline in the self-propelled product- and crude-tanker trades largely to "import substitution" in the petroleum trades. In 2007, imports accounted for 65 percent of U.S. consumption of petroleum products, up from 58 percent five years previously. The inventory of tank barges, however, grew by 52 vessels between 2002 and 2007, to a total of 116 (99 of which were double-hull bottoms.) The relative growth in the tank-barge fleet and tonnage trade, according to the MARAD report, reflects the steadily growing markets for domestic oil and petroleum products, and the fact that tank barges complement imports by redistributing products in the intra-coastal trades. MARAD has identified three service markets for the U.S. tanker fleet: [44]

- Crude tankers serving the Alaska and West Coast crude oil trades;
- Product tankers serving the coastal and inter-coastal petroleum products and chemical trades, but also supplementing crude carriers in the Alaska/West Coast crude oil trade;
- Tank barges and ATBs moving petroleum products and chemicals in the coastal and short-sea haul (Gulf inter-coastal to South Atlantic) trades.

MARAD has pointed out that the transition to double-hull tank bottoms has also been a factor in the growth in the tank-barge fleet, reporting that the year-end 2007 orders for double-hull tank barges and product tankers were at record levels and exceeded the existing 25-year old single-hull fleets. MARAD has cautioned that given the expected upgrade and expansion of the coastal product tanker and tank barge fleet, tank vessel operators "will face a significant risk of underutilized vessels and reduced earnings." [45] Recent shipbuilding activity for the U.S. short sea trade has been focused on tank ships, including the following tank ships built in the U.S. shipyards:

- Aker Philadelphia Shipyard has built 3 new 46,000 deadweight ton (dwt) double-hulled product tankers for Overseas Ship-Holding Group (OSG), leading a class of 16 vessels (Figure 14).
- General Dynamics Nassco has built the *Golden State*, leading a class of nine 49,000 dwt ton product tankers for U.S. SSS operations.
- Atlantic Marine has completed assembly of three 42,400-dwt product carriers with twin-screw diesel electric propulsion as part of a modular construction process involving several partners, for AHL Shipping. [46]

Self-Propelled RoRo, LoLo, LASH, and Feeder Ships

Fleet data on the number of Roll-on/Roll-off (RoRo) and Lift on/Lift-off (LoLo) ships in U.S. Flag vessels indicate that there are about 40 RoRo vessels and 75 LoLo containerships. MARAD fleet data suggest that the U.S. flag RoRo vessels have been growing in numbers (from 32 in 2001 to 40 in 2005), while the containership fleet has declined slightly (from 78 to 75). It is not known how many of these Jones Act vessels operate in domestic SSS operations. Totem Express is an example of a successful deployment of self-propelled U.S. flag ships for domestic service.

[44] MARAD, *Coastal Tank Vessel Market Snapshot*, 2007, Office of Policy and Plans, August 2008.
[45] MARAD, *Coastal Tank Vessel Market Snapshot*, 2007, Office of Policy and Plans, August 2008, p. 8.
[46] https://www.professionalmariner.com, December 2008.

Lakers are examples of self-propelled bulk cargo vessels designed specially for the Great Lakes. The vast majority of the Lakers are self-unloading dry bulk carriers, allowing the cargo to be released through hatches that feed a conveyor belt running along the bottoms of the ship. The configuration allows vessels to unload at a rate of up to 1,000 metric tons per hour without the need for shoreside personnel or equipment. Has a fleet of 13 American Fleet 1,000 feet (300 meter) Lakers that operate on the GLDLS. Single longest route is Port of Duluth-Superior down as far as Lake Erie Canal. Lakers carry iron ore and coal for domestic steel production, transport coal for electricity, and move limestone for cement production. Because the upper lake ships operate exclusively on freshwater, they experience less corrosion and enjoy life spans of up to 50 years, compared to 25 years for ocean going ships. The size of the Lakers prevents them from transiting Welland Canal so they operate only in the upper four Great Lakes. [47]

RoRo Feeder Ships are a variation of a feeder containership used to convey vehicles or other large cargo. In a RoRo ship containers are placed on wheeled conveyors that are driven aboard the ship through cargo hold doors in the sides and stern of the ship, then the containers are moved by ramps and elevators to their places in the cargo hold. The driver's cab is detached from the conveyor and driven back on shore. The container and conveyor remain on board to be unloaded at their destination.

Lighter (Barge) Aboard Ship (LASH) Vessels represent a higher-speed version of the containership. On LASH vessels, barges (lighters) loaded with cargo are hoisted on board the 800-feet long vessel by a crane on board the ship and stored in cargo holds. The host vessel could be a break bulk ship on which the barge is directly loaded. The advantage of LASH vessels is that they can be moved easily ashore or transported up rivers in areas that lack marine facilities. Barge-carrying ships provide a new transport capability that may influence military logistics in ports and over undeveloped beaches. To explore military applications of these new 'floating containers,' DOD has conducted demonstration studies where LASH barges were used to perform a variety of sea tests at Coronado, California. The tests related to barge towing, handling and maneuvering, barge marshalling (clustering) at sea, cargo handling from barges at sea, and helicopter/ barge interaction. The tests demonstrated that cargo barges from commercial barge-carrying ships can be handled and unloaded by the amphibious forces.

The U.S. Maritime Security Program (MSP) maintains a modern U.S.-flag fleet providing military access to vessels and vessel capacity. As of October 1, 2008, the MSP fleet consisted of the following 13 carriers and 59 U.S. flat vessels:

1. American International Shipping, LLC (1 RO/RO vessel)
2. APL Marine Services, Ltd. (9 containerships)
3. Central Gulf Lines, Inc. (4 RO/RO vessels)
4. Farrell Lines Inc. (2 RO/RO and 3 containerships)
5. Fidelio Limited Partnership (7 RO/RO vessels)
6. Hapag-Lloyd USA, LLC (5 Geared Container vessels)

[47] *GLSLS Study: Final Report*, Prepared for Transport Canada, USACE, USDOT, St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish & Wildlife, Fall 2007.

7. Liberty Global Logistics (1 RO/RO vessel)
8. Maersk Line, Ltd. (17 containerships and 2 Geared container vessels)
9. Marmar Tanker LLC (1 tanker)
10. Luxmar Tanker LLC (1 tanker)
11. Patriot Shipping LLC (1 Heavy Lift)
12. Patriot Titan LLC (1 Heavy Lift vessel)
13. Waterman Steamship Corp. (2 RO/RO, 2 Geared Container vessels.)

Commercial High-Speed Catamaran Multi-Hull Vessels

Many different types of commercial multi-hull and high-speed vessels have been developed in the past thirty years, mostly in the passenger trade, whether as ferries or as excursion vessels (e.g., whale watching, eco-tours). Catamarans have dominated this class and grown in size and capacity, accompanied by advances in power plants, propulsion units (i.e., water jets as an alternative to propellers), ride control, and navigation. Hull and superstructure construction of these craft are nearly universally of aluminum. The largest catamarans topped out at about 110 meters in length in the late 1990s and remain there today.

Incat, a 112 meter diesel-powered high speed catamaran is an example of the current evolution of the type. It has an 800 passenger/355 cars capacity (total deadweight of 1,380 tons), with a 38 to 47 knots service speed and 36,000 KW (48,000 hp) power. For the U.S. Jones Act markets, the *Alakai,* owned and operated by Hawaii Super Ferry Inc., operated between Oahu and Maui, with a capacity of 866 passengers and 282 cars built by Austal USA (Mobile, AL). The service speed was 35 knots from four marine diesels rated at 8,177 KW (10,966 hp) each, a total of 32,710 KW (43,864 hp).[48] Hawaii Super Ferry is no longer in operation.[49] Figure shows the Austal Alakai Supeferry, 107 meters long, 23.8 meters in breadth, 3.6 meters draft.

Figure 21 - Austal *Alakai Superferry*

Source: Austal website, http://www.austal.com/files/delivery/DS_HawaiiSuperferry.pdf.

[48] Austal website, http://www.austal.com/files/delivery/DS_HawaiiSuperferry.pdf.
[49] Tanya Rawson, DHS, in an e-mail dated September 10, 2009, pointed out that Hawaii Super Ferry stopped operations in March 2009 and entered bankruptcy proceedings in July 2009.

Fast Freighters (or Fast Ferries) are self propelled vessels that use powerful engines with higher fuel consumption to operate at high speeds. Examples are the auto and truck ferries in service New England and the Great Lakes. Typical fast ferries use 20 times more fuel per TEU per mile than containerships. The GLSLS study on new vessel technologies concluded that the most promising waterborne vessel technologies are small and large 20-knot containerships that can carry both international and domestic containers. [50]

Partial Air Cushion Supper Catamaran (PACSCAT) is a new technology at the design stage considered for operation on the Great Lakes/St. Lawrence Seaway (GLSLS). The vessel is designed as a "surface-effect ship", i.e., a vessel that uses an air cushion to partially lift itself out of the water. The prototype has been developed for operation on the GLSLS to reduce the draft of the vessel as well as its wake. At lower speeds, water displacement mode is in effect; at higher speed the vessels raises itself out of the water, an improvement achieved at the cost of higher fuel consumption.[51]

Military High Speed Multi-Hull RoRo, Trimaran, and LMSR Vessels

The U.S. military has leased the RoRo HSV-X1 (*Joint Venture*, jointly developed by the Army, Navy, Marines, and Coast Guard) and TSV-1X (*Spearhead*, developed by the Army), Incat 96-meter and 98-meter wave-piercing catamarans, respectively, and run them through multi-year trials to evaluate their performance and help define future operational roles. These vessels were also used in service for sustainment deliveries of Army prepositioned stocks and troop transport. The U.S. military has entered into similar leasing and test and evaluation programs with Austal, including the *West Pac Express* (Marines) and JHSV (Army and Navy). The *West Pac Express* is a RoRo vessel with 2,500 square meters of vehicle deck space and seating for 900 troops. The JHSV (635 deadweight tons, 103 meters long) is also a RoRo vessel, with 2,500 square meters of vehicle deck space and seating for 900 troops (see Figure 22). [52]

---

[50] *GLSLS Study: Final Report*, Prepared for Transport Canada, USACE, USDOT, St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish & Wildlife, Fall 2007.

[51] *GLSLS Study: Final Report*, Prepared for Transport Canada, USACE, USDOT, St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish & Wildlife, Fall 2007.

[52] Volpe Center, "Theater Support Vessel (TSV) Evaluation", for the U.S. Army Tank-automotive & Armaments Command, November 2007. The leases on the HSV-X1 and TSV-1X were not renewed, in part because of significant critical systems problems identified during ocean crossings. An analysis by the Volpe Center for the U.S. Army Tank-automotive & Armaments Command recommended against renewing the TSV-1X lease, noting the failure of the superstructure vibration/dampening system and subsequent misalignment of he superstructure (deckhouse) with the hull, air supply, exhaust, and quality problems for the main engines and the ship service diesel generators, and unacceptably long parts delivery and repair times.

Figure 22 - Austal JHSV

Source: Austal website, http://www.austal.com/index.

Military Multi-Hull High-Speed Trailership (HSTT-180) is another potential vessel for SSS not yet proven feasible for commercial domestic operations. The HSTT-180 is a vessel intended for dual-use with a dual powering arrangement for two service speeds and modified military configuration that includes a spare deck over the top cargo deck for additional cargo area for light weight materiel. Its principal characteristics are: 181 meters in length, 32 meters beam, and 8 meters draft; commercial deadweight of 2,000 tons, and cargo area of 2,680 square meters.[53] The Center for the Commercial Deployment of Transportation Technologies (CCDoTT) is conducting research for ONR on HSTT-180. The HSTT-180 power plant consists of four marine diesel engines with a total power of 32,000 KW (43,000 hp) installed in the center and wing hulls and two gas turbines of 36,000 KW (48,000 hp) both installed in the center hull. The designers identify service speeds of 26 knots using the three diesel engines and 40 knots using all four engines. The HSTT designers have identified 40 knots as a service speed in both military and commercial modes of operation.

Cost comparisons of the High Speed Trimaran Trailership HSTT-180 vis-à-vis traditional tug-barge in studies conducted by CCDoTT were conducted for the U.S. west coast SSS services on several routes of various lengths. For the large 27-knot RoRo container ship, they found that a Los Angeles -to-San Francisco service would cost $1,341 to $1,783 per container compared with an average truck cost of $950 paid by shippers ($2.78/mile). The study estimated that the largest contributors to the total cost (accounting for approximately 80 percent of the total per trailer cost) were the fuel, drayage, and stevedoring components of costs associated with handling containers twice in port. [54] Herbert Engineering and SAIC investigated the economics of container shipments on the Trimaran Trailership HSTT-180 and found that the freight rate per mile ranged between $2.75 and $3.85 per trailer-equivalent highway mile), based on the assumption of a 26-knot service speed from four diesel engines (32 MW). [55] Figure 23 shows Incat HSV (Swift), 627 deadweight tons, 98 meters long, 27 meters in breadth, 3.4 meters draft.

[53] Vom Saal et al, Dual-Use Short Sea Shipping Trimaran Trailership HSTT-180", Marine Technology, v. 42, number 3, July 2005.
[54] CCDoTT, "Operational Development of Short Sea Shipping to Serve the Pacific Coast", Cooperative Agreement No. N00014-04-2-0003, Agile Port and High Speed Ship Technologies, July 2008.
[55] Vom Saal et al, Marine Technology, July 2005.

Figure 23 - Figure 23 Incat HSV-2 (*Swift*)

Source: Military Sealift Command Ship Inventory website,
http://www.msc.navy.mil/inventory/ships.asp?ship=163&type=HighSpeedVessel.

Strategic deployment of military vessels is currently carried out by the fleet of Large Medium Speed Roll-On-Roll-Off (LMSR) ships and commercial RoRo vessels. The LMSR is part of the Navy's Military Sealift Command (MSC) which provides ocean transportation for DOD cargo and U.S. forces around the world. More than 70 strategic sealift ships transport military equipment, supplies and petroleum to support U.S. forces overseas. Sealift capacity has grown primarily by replacing smaller, aging ships with new large-capacity, medium-speed roll-on/roll-off ships. The LMSRs provide the platforms for the Army's afloat prepositioning program and add significant square footage to the surge fleet. In addition, the Marine Corps is adding 3 additional RO/RO ships to the service's Maritime Prepositioning Ships program, bringing the total to 16.

4-2 U.S Fleet of Tug-Barge Vessels

A fleet of conventional tug-barge combinations dominates the U.S. waterborne traffic for domestic commercial traffic. The typical inland tow, e.g., those operating on the Mississippi River, is a tugboat connected to a raft of barges by wires, with the barges – up to 35 in number – themselves connected to each other in a tow by wires. As noted in Section 4-1, there are currently about 28,000 barges and 4,560 tug boats in use in the U.S. As far as federal safety and regulatory requirements are concerned, a tug is a full-class ocean vessel that meets the national and international maritime standards for operating in coastal areas. These safety regulations also require a tug escort for tankers carrying petroleum oils, pursuant to 46 CFR regulations. As far as the USCG manning requirements are concerned, some types of tugs are treated differently from self-propelled vessels, and require a smaller crew size, as described below. Figure 24 shows a hopper barge loaded with containers.

Figure 24 - Hopper Barge Loaded with Containers

Source: Bautch, Doris (Great Lakes Region Director, MARAD), presentation to meeting of the Society of Naval Architects and Marine Engineers, "Heartland Intermodal Partnership", January 27, 2005

More advanced versions of the tug-barge combination are two generations of tug-barge vessels, Integrated Tug-Barge (ITB) and Articulated Tug-Barge (ATB), designed to eliminate the tow line and achieve better efficiency and control in ocean conditions, as described below.

Integrated Tug-Barge (ITB)

Integrated Tug-Barge (ITB), a combination of tug and barge vessels characterized by a rigid connection between the two vessels, has been around since the late 1800s. The modern version of ITB, in service since the 1950s, was the first design evolution to marry the tug and the barge and eliminate the long tow lines ("hawse") in common use for long range barge movements in coastal waters. The components of an ITB are typically connected together rigidly by many steel cables/wires, with the intent of operating as a single hydrodynamic body. The advantages of this arrangement relative to the tug-tow – less wave-making resistance of a virtual single vessel and better directional control of the barge by the tug – have been known by naval architects for over 100 years.

The design of an ITB was conceived in such a way that allows the vessel to operate in one mode only, i.e., as a tug pushing a barge, and does not have the ability to separate and tow under differing sea conditions. The Coast Guard treats ITBs as self-propelled vessels and has created regulations to address their safety issues and manning requirements, raising the vessels' construction and operating costs. Because of the higher constructions and manning costs, and for reasons related to maintenance difficulties with the wire connections, no new ITBs have been constructed in the U.S. since the 1980s.[56]

Articulated Tug-Barge (ATB)

Articulated Tug Barge (ATB) is a vessel that allows tug and the barge to operate independently as a tug and tow together or separately with other vessels. The existing fleet of ATBs in the U.S. consists primarily of large, 10,000+ DTW tank barges with hinge-like

[56] Hill, "The Articulated Tug/barge - AT/B, The History and State of the Art, undated, http://www.oceantugbarge.com/PDF/history.pdf.

connections between the tug and the barge. These connections increase the stability, speed, and maneuverability of the tug-barge unit compared to traditional units, as described in the following segment.

Currently there are about 166 Jones Act ATBs in the U.S. fleet, 99 of which are double-hulled. The modern ATBs have improved significantly on the performance of ITB and have addressed some of the tug-barge disadvantages. New ATBs have proven superior in performance to traditional tug-barge combinations and move about 20 percent faster.

The ATB, first conceptualized by naval architect Edwin Fletcher in the early 1970’s, is a single-degree-of-freedom system involving large transverse pins connecting the tug’s bow and barge’s stern. This arrangement enables the ATB to function hydrodynamically much like a self-propelled ship and reduces wave-induced hull loads and stresses in both tug and barge by allowing them to rotate freely relative to each other about the transverse axis. ATBs are now growing in size and number in the United States, particularly in the bulk oil trade.

ATB’s more sophisticated design helps it to better combine the economics of tugboat and barge operation with the speed and weather-reliability of a ship, mainly through optimized hydrodynamic flow for the connected units. This results in service speeds up to 13 knots for barges in bulk cargo services and up to 15 knots in RoRo or container services, compared with the typical 7-knot speed of a tug-tow.[57]

ATB vessels have emerged as the unintended beneficiaries of the differential treatment of tug-barge and self-propelled vessels. The growth in the ATB vessel market in the recent years has in turn contributed to the improved prospects for SSS operations in the U.S. As noted above, an ATB is an assembly of a tug and a barge that stays coupled through specially-designed machinery at most times but can be decoupled. ATBs are thus regulated as tugs and barges and not as ships, face lower operating costs, and have smaller crew requirements than self-propelled ships with the same voyage, service, cargo and capacity. ATBs have other inherent operating advantages such as higher flexibility and safety, and can be cheaper to operate than standard tug & barge, but they are also more efficient and less costly to operate than tug-barge groupings such as ITBs that are classified as ships.

The differential treatment of non-self-propelled vessels has benefited the prospects for expansion of SSS service because of the superior performance of ATBs compared to traditional tug-barge combinations. Though on the grounds of economic efficiency the criticism of the Federal regulations for differential treatment of self-propelled and tug-barge vessels is valid, it should be noted that because of the superior efficiency of ATBs compared to conventional tug-barge combinations, the SSS markets have benefited significantly from availability of lower-cost and reasonably efficient ATBs, even if they are not as fast and fuel efficient than self propelled ships. With the growing diversity of SSS markets in the U.S., the hope is that faster and more fuel-efficient self-propelled vessels will enter the market and expand the choices available to users.

The Crowley Maritime Intercon System is a good example of an ATB with articulated connection between the tug and barge consisting of a pair of port and starboard rams in the

[57] Ibid.

hull structure of the tug. The end of each ram is geared to engage a vertical rack of teeth on the barge notch wall at a chosen height allowing for choices of draft for both units (depending on loading and sea conditions). This establishes the transverse horizontal axis allowing independent pitching motions of the tug and the barge. Crowley has described the advantages of the articulated (or 'hinged') connection system between the tug and barge in its ATB system an important feature for allowing relative movement about the transverse axis and independent pitching motion of the tug and barge. This feature, not previously available with an ITB, has greatly reduced structural loads and stresses at the point of connection and reduced the excessive load on the barge hull that wave-induced motions generate. Crowley Maritime has also identified several other advantages:

- Improved reliability/safety over towed barges;
- Improved operating efficiency over towed barges and tankers;
- Lower capital cost compared to new tankers;
- Faster construction cycle, as ATB's can be delivered in a fraction of the time compared to new-build tankers;[58]
- Good directional stability for new barges; and
- Many safety features similar to those found on modern tank ships.

ATB vessels are available as "lightering ships" for liquid bulk transport. "Lightering operations" involving delivery of partial loads from large crude oil tankers too heavy for entry in the harbor or for transporting petroleum products from refineries to markets have emerged as growing markets. The growing demand for ATB in SSS lightering service is being met by newly built ATBs and Handy-sized tank ships, as inventoried Section 4-1. The new fleet of ATB liquid bulk tank barges has grown larger in size and capacity and has improved transit times and safety and environmental protection features relative to towed barges. ATBs also have capital- and operating-cost advantages relative to tank ships, advantages that compensate for their slower speeds. In fact, the larger new liquid bulk ATBs are approaching and even in some cases exceeding the specifications of modern Handy-sized tank ships in cargo capacity, speed, and pumping rates. Although tank ships have advantages in range, speed, and operational capability for blue-water operations, ATB vessels can perform very well for dedicated SSS operations in the future. ATBs now coming into service are nearly all built for the liquid bulk trade, and are not suitable for alternate use as container carriers because of the pumping gear and other fixed appurtenances on deck. Fleet construction data show that none of the current container-on-barge (COB) services, either active or proposed, involves the use of ATBs. Future entrance of ATBs for COB operations would significantly increase operating speeds and reduce transit times and would be likely to offer new opportunities for improved COB service performance. Figure 25 shows a "Deck" barge loaded with containers.

[58] Crowley Marine website, http://www.crowley.com/petroleum-chemical-transportation/atb-advantages.asp

Figure 25 - "Deck" Barge Loaded with Containers

Source: MARAD, January 27, 2005

Section 5.0 SSS Costs: Direct Construction and Operation Costs Versus Avoided Costs of Alternative Modes

This section reviews the performance and operational parameters of the existing as well as evolving vessel systems, their construction and operating costs, the avoided external costs of highway trucking, and estimates of their potential impacts.

5-1 Vessel Construction and Operating Cost for SSS

Capital and operating costs for several prototype SSS vessels have been estimated by Global Insight. Table 10 shows the range of capital and operating cost for five prototype containerships and RoRo vessels of different size and operating capabilities. The capital costs range between $38 million to $90 million for speeds of about 25 knows. Daily operating costs range between $12,000 and $21,000.

Table 10 – Estimated Construction and Operating Costs for Representative SSS Vessels

Cost Components	**Containerships**		**RoRo Vessels**		
	500 TEU	**200 TEU**	**350 Trailer**	**140 Trailer**	**200 Trailer Ferry**
Capital Costs ($Million)	$80	$38	$90	$44	$50
Speed (Knots)	25	25	25	25	20
Crew size	12	10	12	10	8
Vessel Expenses					
Crew Costs/Day	$7,500	$6,500	$7,500	$6,500	$5,000
Maintenance Costs/Day	$1,750	$875	$1,750	$875	$1,000
Consumables	$1,000	$600	$1,000	$600	$600
Insurance & Other Costs	$1,250	$625	$1,250	$625	$700
Subtotal Costs/Day	$11,500	$8,600	$11,500	$8,600	$7,300
Depreciation*	$8,767	$4,164	$9,863	$4,822	$5,479
Total Expense/Day	$20,267	$12,764	$21,363	$13,422	$12,779

Source: Global Insight, based on Reeves and Associates estimates; p. 38
* Assumes straight-line depreciation over vessel life of 25 year.

Data in Table 10 are based on direct construction and operating costs involved in moving freight within a corridor. There are economic models that have estimated the Required Freight Rate (RFR) for each mode, trucking, rail, and SSS. For SSS carriers to compete successfully against the other mode, they have to charge a rate at or above their RFR in order to break even. In addition to RFR, available economic models estimate the direct costs borne by the private shippers or carriers as well as the *external costs* of conducting that freight move, i.e., the costs not paid by the users. For purposes of economic analysis, the direct operating costs of SSS should be compared with the *avoided costs* of moving cargo on the highway by alternative modes on truck or rail. The *avoided costs* include external costs of congestion, emission, and safety costs, and also reduced or avoided costs of future infrastructure expansion. Section 5-2 reviews available estimates of the RFR for SSS services. Section 5-3 reviews the *avoided external costs* of highway congestion, fuel use and emission – *per- trip* and *per-mile* – when SSS services are used for moving freight as an alternative to trucking. Section 5-4 describes the impacts of SSS in terms of avoided future costs of infrastructure expansion.

5-2 Estimating Required Freight Rate (RFR) for SSS

Researchers at the U.S. Merchant Marine Academy have developed a cost model to determine the required freight rate (RFR) that the SSS operator must charge to break even. Lombardo and colleagues developed the model based on the prevailing national freight rates for moving a standard overland RoRo by truck, and equivalent SSS vessel operating costs for moving a single RoRo ship carrying 80 trailers. Based on the findings of cost model, the RFR for moving a truckload was estimated at about $1.25 per statute miles. The cost model also estimated the RFR for SSS and assumed that for SSS to be sustainable the RFR must be lower than this standard $1.25 rate per statute mile. [59]

The model calculated the RFR for SSS as a function of operating speed (allowed to vary between 5 knots and 40 knots), route lengths (allowed to vary between 200 and 800 nautical miles) and minimum cargo volume (assumed at 80 trailers per load.) The model found that meeting the minimum volume requirement is often key to sustainable service and that market share and profitability usually go together. Lombardo and colleagues concluded that the RFR of $1.25 per statute mile would be economically viable for SSS operations assuming that a single RoRo would have a minimum load to fill up 80 tractor trailers, with operating speed falling in the range of 15-20 knots. They found that RFR curves were extremely flat near the minima, i.e., the diseconomies of marginally faster operating speeds are not particularly punishing in terms of imposing additional costs (e.g., fuel cost associated with higher speeds), concluding that: "The minimum RFR rises more slowly than route length, indicating that the cost advantage of SSS increases on longer routes." This improvement in economy is only limited by the feasible limits of how much freight SSS service could carry how far. However, due to the geography of the U.S. East, Gulf, and West coasts, the study found, SSS services cannot be implemented over routes much longer than 800 nautical miles. Table 11 shows the calculated total RFR rates for end-to-end SSS cargo delivery, RFR per nautical mile, and the optimal operating speed assuming an 80-trailer RoRo vessel.

---

[59] Lombardo, Gary A., Robert F. Mulligan, and Change Q. Guan, U.S. *Short Sea Shipping: Prospects and Opportunities,* U.S. Merchant Marine Academy, prepared for Short Sea Shipping Cooperative (SCOOP), November 1, 2004.

Table 11 – Optimal SSS Speed and RFR rates for different Route Lengths

Route Length (Nautical Mile)	End-to-End RFR for SSS	RFR per Nautical Mile	Optimal Operating Speed
200	256	1.3	18
250	286	1.14	18
300	307	1.02	18
350	327	0.94	19
400	348	0.87	19
450	368	0.82	19
500	388	0.78	19
550	409	0.74	19
600	429	0.72	19
650	450	0.69	20
700	470	0.67	20
750	490	0.65	20
800	510	0.64	20

Lombardo, Gary A., Robert F. Mulligan, and Change Q. Guan, U.S. *Short Sea Shipping: Prospects and Opportunities*, U.S. Merchant Marine Academy, prepared for Short Sea Shipping Cooperative (COOP), November 1, 2004.
(Note: 1 nautical mile=1.15 statue mile; 1 statute mile = 0.868 nautical mile.)

The Lombardo research team concluded:

- RoRo vessels offer the best prospects for serving truck competitive SSS markets as they have faster port turnaround times and have traditionally attracted higher-value freight paying higher prices for service;

- Overcoming low freight volumes that would allow carriers to achieve scale economies and deep-seated expectation of unreliable service may be difficult and may detract from opportunities to gain market share;

- Vessel construction costs can be lowered once economies of scale are achieved;

- RoRo cost savings can be significant if they avoid terminal handling costs (which may increase the RFR by as much as 20%);

- The key shortcoming of the RoRo concept is that a hefty 30% of the weight and volume capacity has to be devoted to carrying the tractor-trailer cabs; even containerize tractor trailers (on chassis) can never be packed as densely as on a containership.

- RFR per nautical mile compares roughly with the cost per statute miles charged by truckers. SSS should not see to undercut interstate trucking or railroads beyond the minimum amount necessary to assure full capacity on each SSS trip. SSS should then take advantage of their significantly lower costs to operate at a higher profit margin.

- For SSS operations to be successful, strategic alliances with truck and rail carriers are essential.

5-3 Estimating Avoided External Costs of Highway Trucking

Not all the costs of moving a cargo container from the point of cargo-origination to the destination port are internalized costs paid by private-sector shippers or commercial carriers. In the process of producing a transportation service, there are "negative externalities" that are generated, but are not paid for by the direct beneficiaries of the transaction, the shippers, and carriers. A negative externality can be defined as the costs of producing and distributing a shipment (or alternatively, consuming a product or receiving a freight service) that are not borne by the product's producers or consumers. Negative externalities of freight movement include network congestion and maintenance costs not paid for by the user through user fees or higher private costs; air and noise pollution costs; unpaid-for accident costs; infrastructure wear and tear from heavy truck use (not covered by diesel taxes); and inefficient fuel consumption.

A study by the Short-Sea Shipping Cooperative (SCOOP) conducted in 2004 estimated the private (internalized) and external costs of moving a 40-foot container for two origin-destination points: Boston to New York, and New York to Miami (Table 12). [60] For the New York to Boston route, the study simulated the costs and performance for a modified Fast Craft Ferry with a speed of 22 knots and capacity of 66 trailers. [61] The study findings indicated that SSS movement of cargo generated significant savings in external costs of moving a freight container. More specifically, diverting a container unit destined to move from New York to Boston from highway mode to coastal ferry amounted to a saving $131 in external cost for a one-way truck trip or $0.56 per truck mile. Diverting a truck from moving a load from New York to Miami from highway to SSS would save $398 in external costs, a saving of $0.32 per highway mile.

Table 12 – A Comparison of Private and Public/External Costs of Moving a 40-foot Freight Container in Two Corridors

Private and External Costs of Moving a 40-Foot Container	Boston to New York City	New York City To Miami
Private Costs/Trip	$500	$1,460
External Costs/Trip	$131.2	$398.2
External Costs as % of Private Costs	26.2%	27.3%
External Costs per mile	$0.58	$0.32

Source: University of New Orleans, National Ports and Waterways Institute, "The Public Benefits of the Short-Sea Intermodal System," Prepared for the Short Sea Cooperative Program (SCOOP), November 2004.

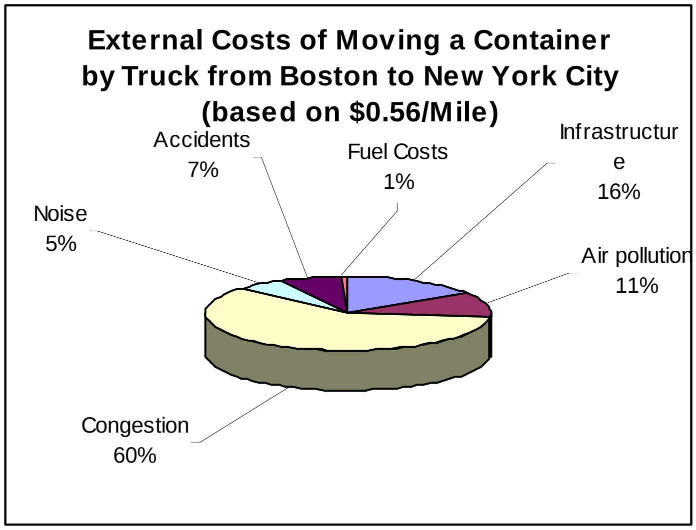
The additional $131 or $398 in external costs, accrued on top $500 and $1,460 truck rates, paid by private beneficiaries for delivery of a 40-foot container (from Boston to New York or from New York to Miami) by truck, represents the unpaid-for costs of air and noise

[60] University of New Orleans, National Ports and Waterways Institute (NPWI), "The Public Benefits of the Short-Sea Intermodal System," Prepared for the Short Sea Cooperative Program (SCOOP), November 2004.

[61] The vessel design and cost assumptions were based on the National Ports and Waterways Institute (NPWI) model estimates.

pollution, accidents, highway congestion and infrastructure maintenance. This means that the true cost of the container shipments are $631 and $1,858, and not $500 and $1,460, and that between 26-27 percent of ($0.58 and $0.32 per mile) of the full costs are not paid for by the shipper (Figure 26). Table 12 shows the components of the $0.58 per-mile external costs of moving a container from Boston to New York.

Figure 26 – Components of the External Costs of Moving a Container from Boston to New York



Source: University of New Orleans, National Ports and Waterways Institute, "The Public Benefits of the Short-Sea Intermodal System," Prepared for the Short Sea Cooperative Program (SCOOP), November 2004.

Below, the components of the external costs of shipping a container from Boston to New York City by truck, as calculated by the University of New Orleans SCOOP study and augmented by other research findings, are described.

Avoided Costs of Urban Congestion

External costs of congestions not borne by the direct users (i.e., costs not paid for through the private time costs of delays), measured as a function of the time of day, truck route, and peak-hour traffic at representative segment of the Interstate Highway 95, are estimated at $0.34 per mile applied to the 225-mile segment, amounting to a congestion cost of $77.08 per trip. External costs of highway congestion further translate to future highway capacity constraints, as described in Section 5-4.

Avoided Costs of Highway Accidents and Spills

Based on the total network costs for all vehicles, the FHWA Highway Cost Allocation Study (HCAS) estimates the external costs of accidents that are not borne by the users of the highway system at about 9 cents per vehicle miles travelled on urban highways. For combination trucks, the HCAS estimated the external costs of accidents at 6.9 cents per mile. The SCOOP study assumed the external accident costs to be lower, at 3.1 cents per mile for rural segments of the corridor and 0.9 cents for the urban segments, amounting to $14.94 in external accidents costs for the 225-mile Boston to New York trip.

Reduced risk of spills and incidents involving hazardous materials (hazmat) during water transportation is another advantage of expanding SSS service. Spill statistics have indicated that SSS operations involve fewer spills and risks of incidents involving hazardous materials, even though SSS operations and inland tows and tug-barges are major carries of bulk oil and petroleum products. These spills and incidents involve private costs as well as external, uncompensated safety and property losses. Among the private benefits (avoided costs) accrued to shippers for moving hazmat by water are lower insurance rates because of the security benefits of moving hazardous materials by barge away from high density population areas. [62]

A 2007 Texas Transportation Study (TTI) study, using the USCG reported spill incidents, reported the rates of spill, spill volume, and gallons spilled per million ton miles for truck, rail, and inland towing (Table 13.)

Table 13 – Modal Comparison of Oil and Hazardous Materials Spill rates

Mode	4-Year Averages (2001-2004)		
	# Spills	Spill Volume (gallons)	Gallons Spilled per million ton miles
Truck	161	674,622	6.1
Rail	29	286,776	3.9
Inland Towing	6	117,645	3.6

Source: Texas Transportation Institute, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*, December 2007.

Avoided Costs of Emissions and Air Pollution

The SCOOP study estimated the air pollution costs for urban areas at $0.0557 per mile, amounting to $12.53 for the 225-mile trip. The study did not identify the pollutants measured in that estimate.

Other estimates of the volume emissions are available based on emission models that calculate freight vehicle emissions based on the amount of fuel used to carry a standard volume of freight by each mode. DOT data show that one gallon of diesel fuel used by a typical tug-barge on domestic freight movement carries one ton of freight 514 miles, compared to 202 miles carried by rail and 59 miles carried by truck. Table 14 compares the fuel usage and pounds of emission generated in tug-barge operations with comparable trucking and rail operations.

[62] Based on the report of the PANY/NJ about the anticipated benefits of the Albany Barge Express program.

Table 14 – Fuel Usage and Emission Levels for Truck, Rail, and Tug-Barge Modes

Mode	Ton miles of Freight Carried per Gallon of Diesel Fuel	Pounds of Emission per Ton Mile		
		Hydrocarbons (HC)	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)
Truck	59	0.0063	0.0190	0.1017
Rail	202	0.0046	0.0064	0.0183
Tug-Barge	514	0.0009	0.0020	0.0053

Source: USDOT data reported in Alabama Freight Mobility Study, April 19, 2007

Emission estimates by other studies have been measured as grams of pollutant emission generated by each of the three modes, are shown in Table 15.

Table 15 – TTI Estimates of Emissions per Ton Mile of Cargo Moved

Mode	Grams of Emission per Ton-Mile			
	HC	CO	NOx	PM
Truck	0.020	0.136	0.732	0.018
Rail	0.024	0.064	0.654	0.016
Tug-Barge	0.017	0.046	0.469	0.011

Source: Texas Transportation Institute, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public,* December 2007.

Greenhouse gas emission, as measured by carbon dioxide (CO2) emission can also be substantially lower in some port areas. The International Chamber of Shipping and International Shipping Federation have documented the relative emission-saving potential from shipping cargo on four alternative transport modes: air, trucking, rail, and barge (Table 16).

Table 16 - CO2 Emissions for Alternative Modes

Mode	CO2 Grams per Ton-Kilometers
Air freight 747-400 1,200 km flight	540
Heavy Truck with Trailer	50
Marine Cargo Vessel 2000-8000dwt	21
Marine Cargo Vessel over 8000 dwt	15

Source: Texas Transportation Institute, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*, December 2007.

Current research indicates that natural gas, compared to diesel fuel, reduces emissions of NOx by about 80%, carbon dioxide by roughly 20%, carbon monoxide by approximately 75%, benzene by over 95%, and VOC by over 30%[63]. For a time during 2008, some viewed

[63] Calculations based on interview of Alexandre Eykerma, Wärtsilä; and James J. Winebrake et al, "Energy Use and Emissions from Marine Vessels: A Total Fuel Life Cycle Approach," Journal of the Air and Waste Management Association, Vol. 57, January 2007, pp. 105-109.

natural gas as a viable fuel choice for marine propulsion because it was cheaper than marine diesel fuel, the price of which at some point spiked at over $4 per gallon. However, the price advantage has disappeared, at least for the time being; it should be noted that the natural gas market is also subject to volatility and that the relative cost advantage may shift back and forth between these two fuels over time.

While some past investigations of natural gas propulsion have identified design, safety, and operational barriers, there are nonetheless many ferries now fueled by natural gas, stored in compressed form. One example of a ferry operating on compressed natural gas (CNG) is the *M.V. Virginia*, built by Tidewater Regional Transient Ferry, powered by a CNG system with a Caterpillar 300-hp. spark ignited engine.[64]

The U.S. EPA now addresses emissions from marine engines as "non-road" or "off-road" diesel engines through regulation of both fuel content and emission limits. In May 2004, EPA finalized new requirements for non-road diesel fuel that took effect in 2007, to decrease the allowable levels of sulfur in fuel used in marine vessels by 99 percent. These fuel improvements are likely to increase the expected environmental and public health benefits due to particulate matter reductions from new and existing engines.[65]

Avoided Noise Costs

Based on the rates estimated by the FHWA cost model from the Highway Performance Monitoring System (HPMS) database, the noise costs per truck trip in urban and rural sectors are estimated at the mid range (from a range of 4.5 cents to 0.48 cents per mile) amounting to $5.64 for the New York-Boston transit.

Avoided External Costs of Infrastructure Repair Not Paid for by User Fees

The user fees paid by heavy trucks do not fully cover the additional of pavement repair. Based on the FHWA Highway Cost Allocation Studies (HCAS), the infrastructure costs per mile depend on the vehicle type/size and the class of highway segment travelled (urban versus rural.) HCAS estimates indicate that repair and maintenance costs for urban segments are 3 to 4 times higher than rural segments, because of the more elaborate nature of the urban highway structures and greater disruption and traffic delays generated. The estimated unpaid-for infrastructure-repair costs per one-way truck trip from Boston to New York are 20.52 cents. The user fees paid by 5-Axle Combination trucks traveling on urban interstates for diesel fuel taxes, vehicle excise taxes, tire taxes, and the Heavy Vehicle User Tax (HVUT) for pavement repair add up to 7.4 cents per mile. The total Federal costs for repair and maintenance of the urban highway segments amount to 21.1 cents per mile. The difference between what the heavy truck users of the urban infrastructure segments pay and the federal costs represents a public burden of 13.8 cents per mile. The differential is equivalent to a public subsidy of 13.8 cents per mile to the trucking sector for the Boston-New York shipment.

---

[64] Brett and Wolff, LLC website, http://www.brettandwolffllc.com/ngmvessels.html.
[65] Ibid.

5-4 Estimating Reduced Costs of Meeting Future Highway Capacity Needs

Better utilization of the vast capacity of the nation's coastal and inland waterways for domestic shipping is tantamount to significantly reducing the nation's future needs for highway capacity expansion. Several studies reviewed in this section have estimated the costs of expanding the highway network, estimated to cost between $103 billion to $155 billion per year in the several decades.

Resources needed to pay for highway capacity expansion are becoming increasingly scarce, particularly with rising highway capacity constraints on several key arteries in coastal areas, most notably the I-5 (Pacific), I-95 (Atlantic), and I-10 (Gulf) corridors. Urban planners in large cities such as New York and Los Angeles question whether building new infrastructure will solve these capacity constraints, reasoning that both rail and highway networks serving the nation's coastlines are at or beyond capacity and their expansion could be achieved only at exorbitant costs. [66]

In 2008, the Society of Civil Engineers estimated that improving the nation's surface transportation infrastructure would require $155.5 billion annually. The IGMS report concluded that the total price tag to shore up this failing system would reach over a trillion dollars and that "we cannot pave our way out of this challenge." [67]

A 2007 report by the National Cooperative Highway Research Program (NCHRP) has reported that to meet the performance needs of the existing interstate highway system, an additional 173,000 lane miles of capacity will need to be added to the existing 210,000 lane miles of the Interstate System. Meeting these capacity-needs requires a total expenditure of $103 billion per year over the next 30 years, with a 30-year total of $3.1 trillion. Two major components on the NCHRP highway improvement study are the Freight Logistics Network Improvement Program and the Metropolitan Mobility Program. Meeting the Freight Logistics Network's improvement needs would require building additional 68,600 miles of capacity, at annual costs of $27 billion, or $835 million over the next 30 years. Meeting the Metropolitan Mobility Program would require adding 73,000 lane miles of capacity, at the annual cost of $71 billion, with outlays of $2.2 trillion over the 30-year period. [68] Adequate resources have not been available to pay for these freight and metropolitan mobility programs, both closely related to the nation's needs for expanding the critical freight infrastructure. [69] A targeted SSS program geared to utilizing the existing marine transportation capacity for domestic shipping would be an efficient solution to this resource shortfall.

---

[66] Institute for Global Maritime Studies in cooperation with the Fletcher School of Law and Diplomacy, Tufts University, "America's Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security," September 2008.
[67] Institute for Global Maritime Studies in cooperation with the Fletcher School of Law and Diplomacy, Tufts University, "America's Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security," September 2008.
[68] National Cooperative Highway Research Program(NCHRP), Future Options for the National System of Interstate and Defense Highways, Task 10 Final Report, Prepared by PB Consultant, Inc. and Cambridge Systematics, Inc., May 2007.
[69] FHWA, *Estimated Cost of Freight Involved in Highway Bottlenecks – Final Report*, Nov. 12, 2008.

A 2006 University of Southern California study has suggested that the political will to pay for the cost of expanding surface transportation capacity may no longer exist, and that new capacity would "certainly fail to noticeably alleviate congestion problems," because they would generate "new trips" rather than relieve congestion or expand capacity sufficient to meet future trade growth. The authors asked: "Faced with an absence of sufficient political will to develop additional carrying capacity on the region's surface transportation system, along with the potential tripling of container volume that will be handled at the region's ports by 2030, how can the region cope with the inevitable shortfall in surface transportation infrastructure while seeking to sustain regional economic competitiveness?" [70]

SSS has the potential to significantly mitigate capacity shortage on the nation's freight rail network and reduce the size of the expenditures on maintenance and construction of highway and railroad infrastructure. This claim has been validated by calculations of the equivalent carrying capacity for alternative freight modes. For instance, the 2007 TTI study has reported the following equivalencies:

> *Cargo Capacity of a single 15-barge tow is equivalent of 2 unit-trains and 1,050 53' semi-trailer trucks.* [71]

This estimate is based on the following assumptions about the standard units of capacity for three alternative modes: (Table 17)

Table 17 – Equivalency Units for SSS, Rail, and Truck

Mode	Standard Cargo Capacity	Units needed to Carry 1,750 Tons of Dry Cargo	Units needed to carry 27,500barrles of Liquid Cargo
Highway, 53' Semi Truck Trailer	25 tons	70	144
Rail, Bulk Car	110 tons	16	46
Barge, Dry Bulk	1,750 tons	1	
Barge, Liquid Bulk	27,500 barrels		1

Source: Texas Transportation Institute, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public,* December 2007

Other studies have made similar assumptions about the equivalency of SSS shipments and comparable rail and truck modes. Table 18, developed by Hanson Professional Services, establishes equivalencies with respect to the comparable freight network capacity for three modes, allowing an equivalency comparison for the carrying capacity of a single barge or a typical 15-barge tow with the average rail and highway truck capacity to move a standard load of freight. Note that the TTI and Hanson equivalencies are not identical because they

[70] Le-Griffin and Moore, USC Department of Civil and Environmental Engineering, "Potential Impact of Short Sea Shipping in the Southern California Region", Research Project Report, METRANS Project 65-A0047, February, 2006.
[71] Source: Texas Transportation Institute, *A Modal Comparison of Domestic Freight Transportation Effects on the General Public,* December 2007.

are based on different assumptions about the typical size of a barge, truck, or rail conveyance.

Table 18 – Equivalency Units for Carrying Capacity of Barge Tows and Alternative Highway and Rail Modes

SSS Alternative	Equivalent Units
1 Barge	15 Jumbo Rail Hoppers 58 Large Semi Trailer Truck
1-15-Barge Tow	2.25 Unit-train rail cars 870 Large Semi Trailer Truck

Source: Hanson Professional Services, Inc. "Kentucky Freight Transportation Conference, 2007", Frankfort, Kentucky, May 15, 2007.

Other capacity equivalencies with respect to alternative highway, rail, and water modes for moving freight are documented in Table 19.

Table 19 – Capacity Equivalency for Alternative Cargo Conveyance Modes

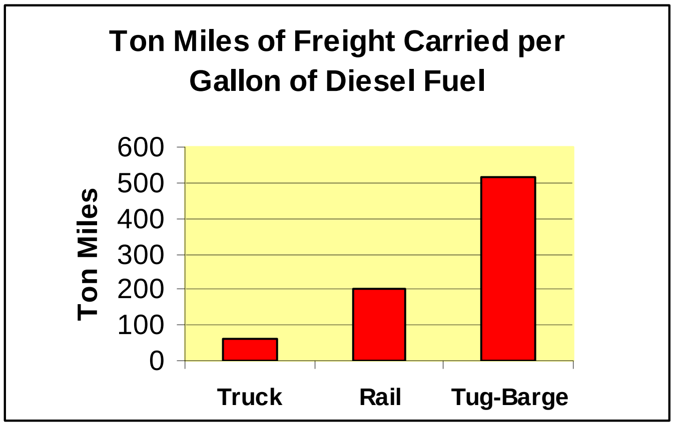
Vessel type	Cargo Capacity
1 Barge	1,500 tons 52,500 bushels 453,600 gallons
1 15-Barge Tow	22,500 tons 878,500 bushels 6,804,000 gallons
1 Jumbo Rail Hopper	100 tons 3,500 bushels 30,240 gallons
A 100-Car Train	10,500 tons 35,000 bushels 3,024,000 gallons
A Large Semi Truck Trailer	26 tons 910 bushels 7,865 gallons

Source: Hanson Professional Services, Inc. "Kentucky Freight Transportation Conference, 2007", Frankfort, Kentucky, May 15, 2007.

5-5 Estimating the Potential to Reduce Fossil Fuel Consumption

SSS vessels are more fuel-efficient since a single marine propulsion system replaces multiple truck engines needed to move the same volume of cargo. As Table 19 above showed, based on the DOT estimates, an average tug-barge combination carries 1 ton of freight 514 miles on a single gallon of diesel fuel, compared to 202 miles carried on a rail car and 59 miles carried by truck (Figure 27)

Figure 27 – Modal Comparison of Ton Miles of Freight Carried per Gallon of Fuel



Source: USDOT Estimates

Share of fuel in a truck's total operating cost is much higher than rail or barge. An estimated 46 percent of a truck's operating cost is fuel, compared to 35 percent for rail and 18 percent for a container-on-barge operation.[72] Note that any estimate of fuel usage is highly sensitive to assumptions about the tonnage carried in a typical load and the particular model used to estimate fuel use. For instance, the 2007 TTI study cited above used the EPA data from the MOBILE6 model to estimate trucking emission data. For rail emissions, TTI used the Surface Transportation Board (STB) and the Security and Exchange Commission (SEC) data, and for marine fuel efficiency the study used data obtained from the Tennessee Valley Authority fuel consumption model. Based on these input data, TTI estimated that an average inland tug-barge carries 576 ton-miles per gallon of fuel, compared to 413 ton-miles carried per gallon of fuel used by a railcar, and 155 ton miles per gallon of fuel used by a truck. These estimates showed far higher rates for ton-miles of freight for rail and truck than the DOT data, but comparable figures for tug-barge vessels. [73]

5-6 Estimating the Benefits from Improved Driver and Crew Productivity

With respect to labor productivity, several metrics indicate significant advantages of a single barge over a truck carrying freight. A small crew (e.g., an average size barge crew of 10) operating a 15-barge tow can move 22,500 tons of freight; the same load when moved by truck trailers (assuming an average truckload of 26 tons) would require the labor of 865 single truck-trailer drivers.

SSS offers the potential to alleviate some of the current labor shortages problems in the trucking industry as well as the capacity shortages for railroads. Because SSS operations

[72] Transportation Economics & Management Systems, Inc., (TEMS), *Impact of High Oil Prices on Freight Transportation: Modal Shift Potential in Five Corridors, Technical Report,* Prepared for MARAD, USDOT, October 2008.
[73] C. James Kruse et al, A Modal Comparison of Domestic Freight Transportation Effects on the General Public, Texas Transportation Institute, December 2007; http://tti.tamu.edu/documents/TTI-2007-5.pdf

often need to be conducted in tandem with line-haul or local drayage trucks, the service not only improves labor productivity and relieves driver shortage pressures in the trucking industry; it can also facilitate the drivers' compliance with the trucking Hours of Service (HOS) regulations. The prevailing HOS rules, coupled with newly enforced immigration and Commercial Driver Licensing (CDL) rules and the Transportation Worker Identification and Credential (TWIC) regulatory requirements have compounded the driver shortage and the so-called "quality of life" issues that have worked against driver retention for long-haul truck drivers, and present compelling arguments in favor of promoting SSS as a key component of a national freight network. [74]

[74] Mark Yonge has referred to the "Perfect Storm" in freight transportation for trucking industry that in addition to driver shortage, new HOS and TWIC rules includes new EPA rules for Ultra Low Sulfur Diesel (USLD) and an aging truck fleet.

Section 6.0 – SSS Challenges, Opportunities, and Policy Options

This section concludes the assessment of SSS options for operation in the U.S. freight markets by evaluating the actual or perceived impediments to expanded market penetration and proposing several policy options.

Section 6-1 reviews the issues relating potential impediments to expanded SSS markets and operations:

- 6-1-1 Adverse impacts of the regulatory restrictions effecting efficient choice of self-propelled vessels;
- 6-1-2 Potential cost impacts of the Harbor Maintenance Tax (HMT), the Jones Act, and the USCG vessel manning requirements;
- 6-1-3 Absence of an efficient pricing mechanism to account for external costs of freight movement;
- 6-1-4 Challenges arising from the absence of a feeder port system; and
- 6-1-5 Challenges arising from the failure to integrate the domestic waterborne infrastructure with the nation's freight network.

Section 6-2 reviews the opportunities and policy options available for promoting SSS in the U.S. by recommending:

6-2-1 Support for design and construction of small self-propelled feeder vessels;

6-2-2 Support for exemption of SSS moves from the HMT;

6-2-3 Promotion of pricing strategies compensating SSS carriers for the environmental and congestion mitigation benefits;

6-2-4 Promotion of feeder ports and inland distribution centers for transshipment of cargo containers (with focus on lessons-learned from the European Union experience);

6-2-5 Deployment of advanced technologies which improve efficiency of the domestic marine shipping and integrate the mode into the national freight system.

6-1 Potential Impediments to Expanded SSS Operation

In general, SSS markets have not grown to efficient market size to achieve scale economies because of the regulatory, pricing, and network-related barriers outlined below.

6-1-1 The Jones Act and the USCG Manning Requirements have Impeded the Deployment Self-Propelled Vessels

Federal regulations guiding the design, operation and manning of vessels for domestic use have generated unintended consequences for domestic navigation safety and efficiency. Federal regulations guiding construction and crewing standards may have stifled the development of markets for construction of higher performance self-propelled ships, led to sub-optimal use of advanced ship technology, and encouraged excessive reliance on tug-barge vessels.

Current federal regulations give a preferential treatment to tug-barge combinations to the detriment of self-propelled vessels. Differential manning is often a key factor in the choice between self-propelled and tug-barge combinations. The USCG applies crew size determination rules on the basis of the size of the vessel's propulsion unit. As a consequence of these manning requirements, an ATB requires a crew of 10 persons, while a tanker of the same capacity would require a crew size of 20. This is because crew standards are based on the size of the vessel's propulsion engine and not its carrying capacity and other performance requirements and risks. The tug is treated as a small vessel with lower crew requirements (the size of the barge is not relevant to crew size determination) whereas a tanker with a capacity similar to ATB combination is treated as a large ship. The labor cost advantages can thus favor ATBs over self-propelled ships with similar construction costs despite ATBs' disadvantages in maneuverability and reliability.

Some observers have maintained that the differential treatment afforded the tug-barge combination vessels has led to inefficient choice of vessels for SSS because self-propelled ships have higher fuel efficiency and better maneuverability than tug-barge vessels and ATBs. This view has been expressed in a recent IHS Global Insight report on the regulatory advantages enjoyed by ATBs in manning, concluding that the outcome has been poor design choices by shipbuilder. They maintain that current manning requirements have raised the operating costs of more efficient self-propelled vessels. Because of the high costs of the more efficient self-propelled vessels, the IHS report concludes: "Current crewing laws are not optimal from the standpoint of commerce. They distort ship choice and cause the market to choose less efficient ships were it not for the crewing regulation." [75] In general, these industry observers have maintained that federal programs in support of shipbuilding for the domestic Jones Ac fleet may adversely affect domestic marine transport, because the protection afforded through the cabotage regime might generate a backlash from the differential treatment of the domestic and foreign-trade sectors and adversely impact efforts to promote SSS for domestic cargo movement. [76]

Higher construction costs for the U.S. flag fleets are another potential impediment to the growth in SSS markets. Because of these higher vessel purchase costs, businesses may find it harder to start and sustain a SSS operation. Many SSS stakeholders have maintained that the Jones Act adversely affects SSS operations because it increases the startup costs since ships built in the U.S. tend to be more expensive than those constructed abroad. The Merchant Marine Act of 1920 (46 U.S.C. App. § 883), commonly known as the Jones Act, requires that vessels used to transport cargo and passenger to U.S. ports be owned by U.S. citizens, be built in US ship yards, and that at lease 75 percent of the crew be U.S. citizens. Industry advocacy groups such as the Coastwise Coalition have recommended removing this significant disincentive to coastal waterborne traffic. [77]

[75] IHS Global Insight, IHS Global Insight, Inc., An Evaluation of Maritime Policy in Meeting the Commercial and Security Needs of the United States, Prepared for the USDOT, MARAD, January 7, 2009.
[76] IHS Global Insight, January 7, 2009.
[77] *Coastwise Coalition*, Paul Bea, pbea@phbpa.com and http://www.maritimeadvisors.com

Other industry experts, however, have maintained that given the long operating life of a ship, these higher costs would add little to the cost of each trip. A July 2005 GAO report asked one SSS operator whether the Jones Act requirements for the vessels to be U.S.-built were a potential obstacle to expanding service, given that U.S. construction costs may be more expensive than foreign-built vessels. The operator responded that these requirements did not pose a burden, but that the USCG crewing requirements that mandate unnecessarily large crews for SSS operations increase the costs significantly. [78]

6-1-2 Harbor Maintenance Tax (HMT) Raises the Costs of Shipping a Container by Water

Harbor Maintenance Tax (HMT), a general *ad valorem* tax on the cargo value (0.125 percent) levied on the value of all waterborne cargo loaded or unloaded at a port, is imposed by §26 U.S.C. 4461 and 19 C.F.R. §24.24. The tax is paid by the shipper or the product importer. Exports have been exempted by the Supreme Court ruling from paying the tax. Cargo entering at ports in Alaska, Hawaii, and Puerto Rico is also exempt from the fee. For domestic shipments, the fee is levied at only one port – either the port of departure or the port of entry, but not both – and it does not normally apply to movements along the inland waterways as long as the ship moving the goods is subject to the Inland Waterways Fuel Tax (19 C.F.R. §24.24 (C0 (5) and 25 U.S.C. § 4042. [79]

An import container that is offloaded at a port and again loaded on a marine vessel for the inland leg of the journey is charged the HMT twice. The HMT adversely impacts growth in SSS operations because the fee, imposed on each leg of the movement of an import container, taxes the same load twice: once at the arrival port and again at the inland destination port when unloaded for domestic distribution or feedering. The HMT discourages SSS since equivalent truck transportation of a load does not involve similar fees.

The fee is intended to pay for harbor dredging. Containers account for much of the revenue generated given the higher value of cargo shipped in containers, even though the tax applies to both containerized and bulk cargo. The proceeds of the HMT go into the Harbor Maintenance Trust Fund (HMTF), which is used to reimburse the cost of maintenance dredging of federal channels and to cover operations of the St. Lawrence Seaway Development Corporation. Industry experts have maintained that HMT may not be the best method of financing waterway improvements because currently HMTF is taking in much more revenue than is being appropriated, with a growing balance of about $3 billion. [80] Devising a more efficient system for charging user fees and congestion pricing would be a good alternative to the existing HMT fee system.

---

[78] GAO, "Freight Transportation: Short Sea Shipping Option Shows Importance of Systematic Approach to Public Investment Decisions," July 2005, GAO-05-768

[79] GAO, July 2005.

[80] Other potentially more efficient methods of pricing container shipments to pay for container processing costs are the charges imposed by West Coast container ports for congestion pricing by charging fees per container during peak hours, e.g., the PierPass fee system at the ports of Los Angeles/Long Beach.

6-1-3 Challenges Arising from the Failure to Account for External Costs Moving Freight

Absence of an efficient pricing mechanism for paying for freight movement adversely impacts the growth of SSS markets, as outlined in Sections 5-2, 5-3, and 5-4. The external costs of moving a container by truck about 200 miles on the interstate highway system from Boston to New York, for instance, would generate $131 per trip in unpaid-for external costs in addition to the $500 paid for by the shipper. These external costs represent the additional costs of highway congestion, air and noise pollution, accidents, and infrastructure maintenance costs not paid for through fees, tolls, gasoline taxes, excise taxes and heavy truck user fees.

6-1-4 Challenges Arising from Lack of a Feeder Port System

Currently there is no viable feeder port system in the U.S. operating within a well-integrated, interconnected network. In the marine shipping industry, "feedering" is defined as the practice of using smaller self-propelled ships for local or coastal transport to carry bulk cargo or containers to and from ports not scheduled to be called by the ocean vessels serving international trade, and to connect smaller ports to major ocean ports. [81] In its 2006 *Report to Congress,* MARAD pointed out that there is a scarcity of small feeder vessels and SSS services in the U.S., and attributed the growing channel capacity constraints and the inability of the existing infrastructure to meet the vessel draft needs to this deficiency. The report noted that the average size of containerships calling at U.S. ports is 17 percent larger than the size of vessels calling at ports elsewhere in the world. The size of an average feeder ship is less than 3,000 TEU, compared to the 6,000-plus TEU vessels routinely calling on coastal ports. The report explained that one reason for the larger average size of the vessels calling at U.S. ports is the absence of a robust feeder port system in the U.S. In Europe and Asia, the *Report to Congress* point out, SSS services rely in smaller feeder vessel to handle most of the intra-European and intra-Asian trade. [82]

6-1-5 Challenges Arising from the Failure to Integrate SSS in the Nation's Freight Infrastructure

The nation's vast inland waterway system is not integrated with the nation's intermodal freight system. In a 2005 feasibility study prepared by the University of Virginia the study team explored alternative means for augmenting transportation capacity and the Inland Waterways Intermodal Transportation System to alleviate capacity shortfalls and highway congestion facing the US intermodal system. The report noted that the Inland River Container Services are underutilized resources because they are not fully integrated with the intermodal system, thus depriving the nation of the potential benefits of a low-cost and efficient transportation mode. [83]

Lack of integration of the inland waterway system is further exacerbated because adequate access infrastructure for the cargo terminals serving inland waterway traffic is not available. This gap has created significant competitive barriers to the development of a viable SSS for

---

[81] P&O Nedlloyd 2005, quoted in Yonge, 2007

[82] Maritime Administration, *Annual Report to Congress*, Fiscal Year 2006.

[83] "Inland Waterways Intermodal Transportation System Design and Feasibility Analysis" prepared by the University of Virginia for MARAD in May 2005

moving containers as well as bulk and break bulk cargo. The existing infrastructure is equipped primarily for moving bulk commodities, which currently accounts for most of the cargo volume moving by barge on the inland waterways. Access infrastructure and container lift equipment are not in place for handling more containerized cargo onto the inland waterway system. Building wharves, container marshalling areas, high capacity cranes and other container handling equipment, and providing access connectors to the inland transportation network will be essential if SSS service is to be expanded.

6-2 Opportunities and Recommended Policy Options

The review of the research finings on the feasibility of SSS for domestic shipping points to several key policy options. In concluding the study's findings, this report recommends the following five strategic initiatives:

a. An initiative to support the design and construction of small self-propelled vessels to serve as feeder ships would close the existing gap in the U.S.-flag fleet of medium speed vessels with low operating costs;

b. Exempting import containers from double payment of the HMT would remove one of the disincentives for domestic water shipments;

c. Environmental benefits of SSS provide a compelling argument in favor of a policy of full-cost pricing in the form of a tax rebate to low-emission vessels and SSS alternatives to highway trucks to reflect the differential external costs of moving freight;

d. A policy of promoting the development of an efficient system of feeder ports and transshipment hubs would bolster the growth in SSS and augment its infrastructure capacity and environmental benefits; Lessons learned from the success of the European Union in SSS could be highly valuable;

e. Promoting the deployment of advanced navigation and communications technologies would greatly facilitate cost effective SSS operations.

6-2-1 Supporting the Design and Construction of More Efficient Self-Propelled Vessels

Several industry experts have pointed out that SSS must reduce excessive reliance on the barge-tow and articulated tug-barge (ATB) vessels and expand the fleet of medium-speed small ships in order to effectively compete in the freight markets. The speed of such ships would not need to be 25 or 30 knots per hour, as some high-speed ship designs would suggest. A speed range of 18- to 20-knots would be adequate for competing, as the U.S. Merchant Marine Study has indicated.[84] A self-propelled ship with the speed of 15 knots would be adequate for meeting the speed requirements for moving a domestic cargo container. As one industry expert has put it, a medium speed ship moving at 15 knots per

[84] Lombardo, Gary A., Robert F. Mulligan, and Change Q. Guan, U.S. *Short Sea Shipping: Prospects and Opportunities*, U.S. Merchant Marine Academy, prepared for Short Sea Shipping Cooperative (SCOOP), November 1, 2004.

hour could deliver the same container 500 miles away in about 1.5 days (less than 34 hours) considering that an average truck that is subject to the HOS rules drives 500 miles per day. The small size of the vessel would also enable it to match the crew size advantages of ABTs. [85]As noted in Section 5, the design could incorporate some of the features of ATBs to benefits from lower crewing requirements.

Medium-speed speed small ships will also grow more competitive with trucking as oil prices rise. As oil prices rise, operating costs go up as well. Rising speed tend to raise fuel consumption and operating costs at an exponential rate. It has been estimated that in the past 15 years the average speed of the world marine vessel fleet has grown from 20 knots to 29 knots. This 45 percent increase in speed has been associated with the doubling of the fuel consumption per unit of cargo (a 100 percent increase.) [86] It is reasonable to assume that as oil prices rise, shippers may find it easier to trade off higher-speed freight modes for lower operating costs.

Other SSS studies have concluded that the current inventory of tug-barge vessels may represent a class of service vessels too slow to compete effectively for capturing a significant share of existing road and rail traffic. The have suggested that support for construction of higher speed ships, perhaps in the 20-knot range, would be effective in promoting SSS for a broader range of cargo and would close the existing gap in the small medium-speed vessels with low operating costs. [87]

6-2-2 Removing the Disincentives for Domestic Marine Shipping by Exempting Import Containers from Double Payment of the HMT

Efforts to seek a waiver of the HMT imposed on import containers shipped by water for domestic distribution continue. This exemption would remove the adverse impact of HMT on domestic water shipments as it taxes the same load twice, whereas the equivalent truck transportation of a load does not involve similar fees.

Current efforts in support of the exemption include H.R. 3319 to amend the IRS code to exempt domestic intermodal cargo containers from the HMT. The American Association of Port Authorities (AAPA) has drafted several position papers and supported legislative initiatives in support of the waiver, maintaining that only a small fraction of the HMT collection on domestic shipments comes from the intermodal cargo. After the Supreme Court found in 1998 that imposing HMT on the U.S. exports was unconstitutional, the remaining cargo base subject to the HMT consisted of imports, domestic cargo, cargo processed and fabricated at Free Trade Zones (FTZ), and cruise ships using the coastal and inland waterways. The AAPA document advocating the removal of the HMT shows that

---

[85] Comments of Mr. John Bobb, USCG, Chief, Oceans & Transportation Branch, Office of Waterways Management, Journal of Commerce Conference on Marine Highways, Jacksonville, Florida, April 1-2, 2009. Mr. Bobb suggested that the best way to meet this need would be to have a competitive grants process for design of a small ship.

[86] Transportation Economics Management Systems, Inc. (TEMS), *Impact of High Oil Prices on Freight Transportation: Mode Ship Potential in Five Corridors – Technical Report*, Prepared for MARAD, USDOT. October 2008.

[87] Institute for Global Maritime Studies, *America's Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security*, September 2008.

domestic cargo accounts for only 4.3 percent of the annual HMT revenues of over $650 million. The exemption would have negligible effects on the HMT reviews. [88]

Other advocates of exempting domestic cargo containers from the HMT have maintained that the waiver would most likely be revenue-neutral for the region, as any foregone tax revenue would be offset by funds saved in highway construction and repair as trailers are removed from the highway. [89]

6-2-3 Promoting Pricing Policies that Compensate for Lower External Costs of Marine Vessels and Bolster Environmentally Efficient SSS Operations

To bolster the environmentally friendly features of SSS, pricing policies should be pursued to take advantage of fuel efficient marine propulsion systems with lower emissions. This can be done in several ways to close the cost differential for moving cargo by water.

One approach to closing the cost differential between the highway and SSS operations would be through a rebate or subsidy program. Marine operators may be compensated with a rebate equivalent to the lower external costs of moving cargo by water. This approach has been recommended by a number of carriers and state and local agencies. For instance, at a recent Marine Highways Conference the CEO of the Columbia Coastal reported that, in most lanes, moving a container by water is more expensive. He suggested that appropriate incentives and disincentives can be applied at various levels of federal and state governments to address the cost differentials. He pointed out that the challenge for state and MPO planning is that most ports are multi-state entities and incentives such as tax credits require a federal role. He suggested that port authorities should run the subsidy program and establish the differential on the basis of the full costs of transporting a container by road versus water. The difference should translate to a federal tax credit that bridges the cost gap. [90]

The cost differential between road and water for moving a container would be reduced when large volume-thresholds for water shipments are reached and diesel prices are above $3 or $4 per gallon. The need for a subsidy would thus be reduced when such conditions prevail. The Virginia Port Authority manager of the James River Norfolk-Richmond Feeder Barge Service, for instance, found that moving a container on the Norfolk to Richmond lane is cheaper by truck when oil prices are low. The program at first proved viable when diesel prices were at $4 per gallon, but after oil prices began to drop the barge service was no longer viable. However, reaching adequate volume commitments that would allow SSS carriers to achieve economies of scale, he suggested, would enable the East Coast marine operators to run a potentially profitable and sustainable feeder service to smaller ports between New York, Savannah, and Jacksonville. [91]

---

[88] The American Association of Port Authorities, The Harbor Maintenance Tax and Congestion Relief (v.9.1.05) http://aapa.cms-plus.com/files/PDFs/HMT_Coastwise_Paper_01Sept05.pdf
[89] Reeves & Associates, "Analysis of the Potential Market for Short-Sea Shipping Services over the Ports of Fall River and New Bedford," March 29, 2006.
[90] Statement of Kevin Mack, Columbia Coastal, at a presentation at the Journal of Commerce Conference on Marine Highways, Jacksonville, Fl., April 1-2, 2009.
[91] Statement of Russell Held, Virginia Port Authority, at the Journal of Commerce Conference on Marine Highways, Jacksonville, Fl., April 1-2, 2009.

Conventional subsidy programs that close the gap in operating costs for SSS have proven ineffective, as suggested by the lessons-learned from the Port Authority New York/New Jersey (PANY/NJ) initiative in support of the Albany Express Barge Service. The failure of the initiative showed the difficulties involved in using subsidies in support of cargo operations that reduce emissions and highway congestion. For several years in the early 2000, the EPA Congestion Mitigation and Air Quality (CMAQ) grants were used to subsidize SSS operators for moving cargo inland on the Hudson River. The subsidy was paid to enable the barge operators to charge a lower per-container fee to shippers (10 percent lower than the equivalent truck costs) to compensate for the longer transit time. The Albany Express Barge was designed to operate as part of a strategy to promote diversion of containers from the highways to a Port Inland Distribution Network (PIDN) for processing the container transload operations and then shipping them on the coastal and inland waterways. The initiative, however, was not sustainable after the CMAQ funds ran out. More successful implementation of CMAQ funds have been for promoting SSS in Portland, Oregon, for the Columbia Slough Intermodal Expansion Bridge project – that connected the river to the deepwater port facility and eliminated many truck trips – and for the Port of New York Red Hook Container Barge project for the purchase and operation of a barge service that removed about 54,000 truck trips from the region's highways each year.

Actively promoting environmentally "green" features of low emission-marine fuel and engines is another approach to closing the pricing differential between marine and highway modes. Environmental advocates for the promotion of SSS have suggested that "coastal shipping must go green." Among viable options for promotion of green transportation alternatives are the emerging markets for more efficient energy consumption – e.g., promotion of alternative fuels, advanced engine design that burn natural gas or ultra low sulfur diesel, or mechanisms for turning waste heat into additional energy or filtering exhaust fumes. [92]

6-2-4 Supporting a Feeder Port System and Transshipment Hubs: Lessons Learned from Successful European Operations

The existing U.S. marine infrastructure is amenable to development of an integrated system of marine transportation infrastructure in support of the global supply chains. Development of an efficient network of small self propelled feeder vessels and fast freight ferries, together with the existing fleet of tug-barge vessels, could promote a highly efficient marine transportation system. Such as feeder network, not widely developed in the U.S. today, would facilitate the alignment of the nation's "mega ports" with an emerging system of satellite feeder ports and transshipment hubs on the East and West Coasts. Such a network of satellite ports, developed to meet the transshipment and container distribution needs of the global importers, would significantly alleviate the current highway congestion and marine port capacity pressures in the nation.

Smaller vessels used for transshipment and feedering of cargo delivered at Tier 1 coastal mega ports would efficiently utilize the smaller Tier 2 ports to mitigate port capacity and highway congestion problems. Ports such as Philadelphia, PA, Wilmington, NC, and Jacksonville, Florida, for example, are suitable feeder ports because they would be able to

[92] Institute for Global Maritime Studies (IGMS), September 2008.

relive congestion at a Tier 1 port such as ports of New York/New Jersey while continuing to fill available capacity at their own facilities. Expanding a feeder port system would not only reduce the adverse impacts of congestion at Tier 1 international ports, it would also add capacity and promote economic development in small port areas, as the CEO of Horizon Lines, a shipping company that has had difficulties in sustaining its container feeder operations on self-propelled vessels has suggested. [93]

Efficiency of practices involving the development of inland distribution centers for "transshipment" of international cargo imports, often used interchangeably with "feedering," closely hinges on the availability of small feedering vessels and SSS services. The Port Inland Distribution Network (PIDN) developed in the New York/New Jersey area, and distribution center developed in the Southern California Empire Valley, for instance, are examples of the practice of transshipping goods from one shipping line/vessel to another, or from one type of container to another. Container transshipment today often involves shipping the container on truck to a distribution center for reloading, sorting, and value-added operations. The practice has become a growing component of the strategy pursued by many vessel operators that take advantage of available ground intermodal connections to reduce the number of port calls and transship cargo to and from such a PIDN by relying on a through-bill-of-lading (BOL).

The domestic feeder connectors would provide an efficient hub & spoke network for moving international containers on their domestic leg. In the recent years, growth in marine-related hub & spoke networks has been fueled by increased vessel size that have compelled carriers to reduce the number of ports directly called. For new coastal SSS services to be viable they need to be fully integrated with the existing and emerging port networks. Furthermore, since the nation's intercity trucks and rail carriers also use the same hub & spoke models for carrying international containers, SSS services need to be closely connected to them. Such an integrated network of well connected hub & spokes to strategically located PIDN and distribution centers utilizing the coastal routes and the inland waterways would foster development of an efficient feedering network to reduce trucking emissions and urban highway congestion and improve fuel use and air quality.

Promoting a system of regional feeder ports would require coordinated operations within the region. This means that the ports would function as a system rather than as competing, disjointed entities. Such a system would allow regional infrastructure investments to be prioritized to select candidate SSS projects with maximum network benefits.

Comparing and contrasting the U.S. SSS and COB operations with those prevailing in the European Union (EU) would offer some valuable lessons. These lessons are particularly of value because the privately held nature of the tug & barge industry in the U.S. has prevented the development of reliable measures of the economic viability of SSS. EU's Marco Polo Freight Transport Program is a publicly funded initiative undertaken "to shift or avoid" a substantial part of the expected increase in international freight traffic from roads to SSS, rail, and inland waterway transport. The program, first launched in 2003, is currently

---

[93] Chuck Raymond, President and CEO of Horizon Lines, Inc. quoted in David J. Farrell, Jr. "America's Marine Highway a/k/a Short Sea Shipping: A Win-Win Proposition", 5 Benedict's Maritime Bulletin, Third/Fourth Quarter, pp. 221-226, 2007.

embarking on its second funding initiative. It provides a subsidy of €2 per 500 ton-kilometers shifted off the road, subject to conditions of viability and sustainability after receiving the five-year grants. Five types of action qualify applicants to receive the Marco Polo grant funds:

- *Modal shift* actions which provide aid to "start-up services" that are "robust but not necessarily innovative" aiming "simply to shift freight off the road;"

- *Catalyst actions* which aim to "overcome structural barriers in the market" on the condition that the projects are "highly innovative, aiming to achieve a real breakthrough;"

- *Common learning* actions, which aim to "improve cooperation and sharing of know-how", with the goal of mutual training to help "cope with an increasing complex transport and logistics market;"

- *Motorways of the sea* actions which shift freight from road to short-sea-shipping or a combination of SSS with other modes;

- *Traffic avoidance* actions aiming to integrate transport into production logistics to avoid a large percentage of road freight transport.

The EU successful experience with SSS suggests several valuable lessons-learned about the industry success factors in the EU:

- EU ports have access to small feeder vessels for distribution of incoming cargo and are "mode neutral" with respect to the choice of modes for distributing cargo;

- Unlike the U.S., the EU SSS operations are often "not exclusively freight" but are based on RoRo-Passenger vessels handling a combination of freight cars and passengers with access to captive port lift equipment for accommodating cargo;
- EU has proactive policies in place in support of fuel efficiency and low emission benefits of water transport, including full-cost pricing strategies and subsidy programs;

- EU SSS ports have 24-hour terminal operations and access to efficient navigational charts and cargo handling equipment;

- EU's high-density population centers served by large ocean ports tend to serve short voyages on the waterways, providing a market edge for SSS providers (an advantage that is augmented by Europe's relatively weak infrastructure system for highway and rail transportation and contributed to the growth of a sustainable SSS industry.)

6-2-5 Deployment of Advanced Technologies could Facilitate Cost-Effective Marine Shipping and Integrate SSS in the National Freight Network

Several advanced technologies are available today to SSS operators to allow them to navigate the waterways more efficiently and deliver their cargo faster and more reliably. One such system is a prototype automatic identification system (AIS) and vessel traffic information system developed for the Columbia River pilots for improving navigation and visibility. The TransView navigation display software system was developed by the Volpe Center to provide river pilots with the capability to display the most recent channel soundings or depth information. TransView enables the harbor pilots to visualize and navigate the mountainous terrain of the Columbia River that had made it difficult in the past for barges and river vessels to navigate deep-draft channels. Because of the obstructions in the mountainous terrain, radar technologies were rendered ineffective in situations where two large ships meet around the river bend.

The SmartLock System is another example of an advanced technology system for facilitating inland waterway navigation. SmartLock was developed and tested for the Port of Pittsburgh commission, in collaboration with Carnegie Mellon University, as a prototype system based on the same principles used for air traffic control systems. This navigation, networking, and communication system establishes links between the tow and the lock and gives the pilot of the tow greater knowledge as to his position relative to the lock. The system speeds the locking process and enables the lock operation to continue during periods of low-visibility and adverse conditions.

Another example of innovative technologies for improving inland river navigation is the River Level Reporting and Forecasting System, also known as MaxLoad. MaxLoad is a water-level forecasting tool that helps pilots and ship captains set departure times and vessel speeds to take advantage of tides and water flows to allow the vessels to be loaded to the maximum depth. Potential application of LoadMax would be to reduce the need for channel deepening in addition to enabling vessel operators to maximize their loads and avoid the unpredictability of the inland river vessel transit. [94]

The iModal system is another tool that could potentially enhance the operating efficiency of SSS by addressing the problems with the lock system on the inland waterways. The University of Virginia developed the iModal tool as a decision-support tool for supply chain management and pricing. The tool is designed to create a centralized, web accessible software system which seamlessly integrates all aspects of container-on-barge (COB) shipping with the existing intermodal system, and serves as a single point of collaboration between shippers, control towers, port authorities, terminal operators, and bridge tenders. iModal generates a Network Diagram for the five river ports in the system: St. Louis, Cincinnati, Memphis, New Orleans, and Pittsburgh serving as the major nodes or ports. Locations of rail and truck terminals are identified as hubs in the network. The spokes in this network represent the optimal combination of modes (water, rail, truck) with the optimal paths determined through algorithms based on maximum and minimum costs per ton mile

[94] Columbia River Channel Deepening Project, http://www.sei.org/columbia/background_project.html, and http://www.channeldeepending.com/docs/channelBOQA.pdf

and max weight. The system produces approximate cost of shipping 40 tons of cargo between the five cities in the network for each mode of transport showing, for instance, that to ship 40 tons of cargo between St Louis and Cincinnati it costs $2,808 by truck, $463 by rail, and $276 by barge. [95]

Introduction of low-emission vessels in some SSS routes has further augmented the mode's emission advantages. The 'Green Dolphin' a hybrid tug being built for Foss Maritime at a Rainier, Oregon shipyard is an environmentally friendly tug that will help lower some emissions and pollutants. The vessel has lower fuel and life cycle maintenance costs and allows incorporation of future energy storage improvements in battery technology and hydrogen fuel cells. In October 2007 Foss Maritime announced its vessels were switching to ultra low sulfur diesel fuel (ULSD), a move aimed at producing a significant reduction in emissions of particulate matter and carbon monoxide. Port officials in Seattle and Portland lauded Foss for taking an important step to reducing the carbon footprint in Elliott Bay, Puget Sound and the Columbia and Snake rivers.

Foss Maritime introduced the Green Dolphin as part of its participation in the Environmental Protection Agency's (EPA) SmartWay Initiative. For developing this low-emission tug, in June 2008, Foss Maritime won EPA's Clean Air Technology Award, the first time a maritime operating company has ever received the federal government's prestigious honor. Unlike other tugs, the Green Dolphin hybrid tug will rely on batteries and an active power management system to minimize engine use. When the engines are used, they will run at power levels that maximize efficiency, reversing the trend of harbor tugs that spend approximately 60 percent of their time at less efficient low power levels. Main engine emissions reductions from using the hybrid tug are expected to be in the order of 44 percent for particle emissions and nitrous oxide. Fuel consumption is expected to decrease by 20 to 30 percent with a commensurate reduction in sulfur dioxide and carbon emissions.

[95] University of Virginia, "Inland Waterways Intermodal Transportation System Design and Feasibility Analysis," May 2005.

Acronyms

ATB	Articulated Tug-Barge
BOL	Bill of Lading
BTS	Bureau of Transportation Statistics
CCDoTT	Center for Commercial Deployment of Transportation Technology
CDL	Commercial Driver Licensing
COB	Container on barge
CMAQ	Congestion Mitigation and Air Quality
CMTS	Committee on Marine Transportation System
CNG	Compressed Natural Gas
DOD	Department of Defense
DWT	Deadweight
EPA	Environmental Protection Agency
FAF	Freight Analysis Framework
FEU	Fort-foot Equivalent Unit
FHWA	Federal Highway Administration
FTZ	Free Trade Zones
GAO	Government Accountability Office
GLSLS	Great Lakes and St. Lawrence Seaway
HMTF	Harbor Maintenance Trust Fund
HMT	Harbor Maintenance Tax
HOS	Hours of Service
HPMS	Highway Performance Monitoring System
HST	High-Speed Trimaran
HSV	High-Speed Vessel
HVUT	Heavy Vehicle User Tax
ITB	Integrated Tug-Barge
IGMS	Institute for Global Maritime Studies
IWR	Institute for Waterway Research
LASH	Lighter Aboard Ship

LoLo	Lift-On Lift-Off
MARAD	Maritime Administration
MTS	Marine Transportation System
NCHRP	National Cooperative Highway Research Program
NPWI	National Ports and Waterways Institute
ONR	Office of Naval Research
OPA	Oil Pollution Act
OSG	Overseas Shipbuilding Group
OSV	Offshore Service Vessel
PANY/NJ	Port Authority New York/New Jersey
PIDN	Port Inland Distribution Network
RDC	Regional Distribution Center
RFR	Required Freight Rate
RoRo	Roll-On Roll-Off
SCOOP	Short-sea Shipping Cooperative
SEC	Security & Exchange Commission
SSS	Short-sea Shipping
STB	Surface Transportation Board
TEU	Twenty-foot Equivalent Unit
TTI	Texas Transportation Institute
TWIC	Transportation Worker Identification and Credential
ULSD	Ultra Low Sulfur Diesel
USC	University of Southern California
USCG	US Coast Guard
VLCC	Very Large Crude Carriers

References

Bureau of Transportation Statistics, "Shipment Characteristics by Mode of Transport for the United States," US Department of Transportation. http://www.bts.gov/publications/commodity_flow_survey/2002/united_states/html/table_01_b.html.

Corbett, James J., James Winebrake, and Alex E. Farrell, "Emissions Analysis of Freight Transport Comparing Land-Side and Water-Side Short Sea Routes: Development and Demonstration of a Decision Modeling Tool," Not dated.

Government Accountability Office (GAO), "Freight Transportation: Short Sea Shipping Option Shows Importance of Systematic Approach to Public Investment Decisions," July 2005, GAO-05-768.

Great Lakes Maritime Research Institute, "Tax Systems and Barriers to Great Lakes Maritime Commerce," Final Report, Randall Skalberg and James Skurla, A University of Wisconsin-Superior and University of Minnesota Duluth Consortium, October 2006.

GLSLS Study: Final Report, Prepared for Transport Canada, USACE, USDOT, St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish & Wildlife, Fall 2007.

Hill, Robert P. "The Articulated Tug/Barge – AT/B: The History and State of the Art," President, Ocean Tug & Barge Engineering Corp. Undated Document

I-95 Corridor Coalition, "Short-Sea and Coastal Shipping Options Study," Final Report, November 2005.

IHS Global Insight, Inc., *An Evaluation of Maritime Policy in Meeting the Commercial and Security Needs of the United States*, Prepared for the USDOT, MARAD, January 7, 2009.

Institute of Global Maritime Studies (IGMS), *America's Deep Blue Highway: How Coastal Shipping Could Reduce Traffic Congestion, Lower Pollution, and Bolster National Security*, study conducted in cooperation with the Fletcher School of Law and Diplomacy, Tufts University, September 2008.

Marc Levinson, "The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger," Princeton University Press, 2006.

Lombardo, Gary A., "Short Sea Shipping: Practices, Opportunities and Challenges," May 2004.

Lombardo, Gary A., Robert F. Mulligan, and Change Q. Guan, U.S. *Short Sea Shipping: Prospects and Opportunities*, U.S. Merchant Marine Academy, prepared for Short Sea Shipping Cooperative (COOP), November 1, 2004.

Malone, John, and Matthew P. Tedesco, "Short Sea Shipping (S3) Roadmap," September 30, 2007.

MARAD, *Report to Congress on the Performance of Ports and the Intermodal System*, June 2005.

MARAD, "Major North American Marine Highway Operations," America's Marine Highway Initiative; http://www.marad.dot.gov/MHI/ops/index.asp

New Jersey Department of Transportation, Portway Extensions: Concept Development Study, Volume 1, Final Report, September 2003.

National Research Council (NRC), "Paying Our Way: Estimating Marginal Social Costs of Freight Transportation" Transportation Research Board (TRB), Special Report 246: NAS Press, 1996.

New York University, Rudin Center and Rutgers University, Bi-State Domestic Freight Ferries Study, prepared by Allison de Cerreno, Martin Robins, Pippa Woods, Anne Strauss-Wieder, Ryan Yeung, September 2006.

Reeves & Associates, "Analysis of the Potential Market for Short Sea Shipping Services over the Ports of Fall River and New Bedford," prepared for the Massachusetts Department of Business and Technology and Seaport Advisory Council, March 29, 2006.

SeaBridge, "Shipper Concerns on Near Coastal Trade," Steven Flott, Chairman, SeaBridge Overseas Holdings Ltd., Marine Transportation System SSS Conference, November 5, 2003.

SCOOP (Short Sea Shipping Cooperative Program), "Short-Sea Vessel Service and Harbor Maintenance Tax," *National Ports and Waterways Institute* (NPWI), University of New Orleans, October 2005.

University of New Orleans, National Ports and Waterways Institute, "The Public Benefits of the Short-Sea Intermodal System," Prepared for the Short Sea Cooperative Program (SCOOP), November 2004.

University of Virginia, "Inland Waterways Intermodal Transportation System Design and Feasibility Analysis," May 2005.

U.S. DOT, "National Strategy to Reduce Congestion on America's Transportation Network," May 2006.

USCG and NOAA, "Real Time Tide and Current Data Systems in United States Ports: Implementation Status, Safety and Efficiency Needs Expansion Plan," A Report to Congress, July 2000.

Volpe Center, "Theater Support Vessel (TSV) Evaluation" report prepared for the U.S. Army Tank-automotive & Armaments Command, November 2007.

Waterfront Coalition, *National Marine Container Transportation System: A Call to Action*, May 2005 http://www.portmod.org/news/press/White%20Paper.htm