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The Great Lakes-St. Lawrence Seaway Navigation System: Options for Growth

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Summary

Congress faces infrastructure funding decisions that would support shipping on the Great Lakes and St. Lawrence Seaway (GLSLS). In the Water Resources Development Act of 2016 (H.R. 5303, S. 2848), Congress may decide whether to permanently allocate 10% of certain harbor maintenance funds both to small ports and to Great Lakes ports. On the horizon are debates over construction of a second lock at Sault Ste. Marie, MI, and a second Great Lakes heavy icebreaker vessel. These projects would likely cost several hundred million dollars and take several years to complete.

These funding decisions come at a time when the GLSLS's traffic base is eroding. There are reasons to think this trend will continue. It is largely the result of technological changes in manufacturing and transportation, as well as the globalization of production—factors unrelated to Great Lakes infrastructure funding:

- Most steel is now manufactured from scrap metal, which is moved by truck and railroad, rather than from iron ore shipped by vessel in the Great Lakes region.
- Dedicated single-cargo "unit" trains have helped the railroads compete with vessels in carrying dry bulk goods such as grain and coal. Shippers of high-value goods (including containerized cargo) are deterred from using the GLSLS by winter closure and locks that slow transit.
- Export demand for North American grain now comes mainly from Asia. The grain moves to Pacific or Gulf Coast ports rather than through the GLSLS.
- The boom in domestic production of unconventional oil and gas has increased demand for vessel transport on certain U.S. waterways, but the GLSLS has been unaffected.

These developments are major obstacles to efforts by the St. Lawrence Seaway Development Corporation, the U.S. government agency that shares responsibility for administering the seaway, to increase traffic on the GLSLS system.

Operation and maintenance of the system's locks and the dredging necessary to maintain the mandated 27-foot channel depth at Great Lakes ports are funded from the Harbor Maintenance Tax, which is predominantly paid by shippers using coastal ports, not Great Lakes ports. Coastal ports, especially those experiencing steady increases in cargo volume, wish to retain more of the cargo taxes they generate for their own infrastructure needs, raising questions about the future source of federal support for the GLSLS.

Congress could return to funding the GLSLS system with lock tolls instead of annual appropriations as was the case prior to 1986, but Congress expressed no interest when this was last proposed in 2006. It is too early to tell whether public-private partnership provisions enacted in the Water Resources Reform and Development Act of 2014 might be pursued with respect to the GLSLS. The most promising strategy for attracting shippers to the GLSLS is to reduce users' costs relative to the costs of shipping by truck, rail, or pipeline.

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Congress faces infrastructure funding decisions that would support shipping on the Great Lakes and St. Lawrence Seaway (GLSLS). In the Water Resources Development Act of 2016 (H.R. 5303, S. 2848), Congress may decide whether to permanently allocate 10% of certain harbor maintenance funds both to small ports and to Great Lakes ports as proposed in the Senate-passed version of the bill (S. 2848, sections 2010 and 2018).[1] Also on the horizon is a debate over construction of a spare, parallel lock at Sault Ste. Marie, MI, to provide redundancy in case the existing lock should need to close for emergency repairs.[2] Some Members of Congress also seek funding for the construction of a second Coast Guard heavy icebreaker vessel for the Great Lakes.[3] A new lock and a new icebreaker would likely cost several hundred million dollars and take several years to construct.

These funding decisions concerning the GLSLS come at a time when the system's traffic base is eroding. There are reasons to think this trend will continue. It is largely the result of technological changes in manufacturing and transportation, as well as the globalization of production—factors beyond the scope of infrastructure funding. Moreover, federal funds for harbor maintenance are derived from cargo taxes predominantly paid by shippers using coastal ports, not Great Lakes ports. Coastal ports, especially those experiencing steady increases in cargo volume, wish to retain more of the cargo taxes they generate for their own infrastructure needs.[4] In light of these pending funding decisions, this report examines in more detail the reasons for the GLSLS system's cargo decline, prospects for attracting more cargo, and current and alternative approaches to financing the system's capital needs.

Background

The GLSLS system from the Gulf of St. Lawrence to Duluth, MN, is 2,300 nautical miles. It takes a ship six to seven days to sail from Montreal to Duluth or Chicago. There are two distinct categories of vessel traffic on the system: intra-lakes trade, and transits between the Great Lakes and the St. Lawrence Seaway.

The Great Lakes Navigation System

Except for Lake Erie, most of the Great Lakes are hundreds of feet deep and are easily navigable by any vessel that can pass through the seaway. Lake Erie's mean natural depth is around 50 feet, although the western end of the lake is much shallower. All of the cargo ports on the Great Lakes require periodic dredging to maintain a 27-foot depth. The top 10 U.S. ports on the lakes handle

[1] For further information on these bills, see CRS Insight IN10510, *Water Resources Development Act of 2016: Army Corps of Engineers Provisions in H.R. 5303 and S. 2848*, by (name redacted). Under current law, these set asides will expire after FY2024. The set asides were established in the Water Resources Reform and Development Act of 2014 (P.L. 113-121).

[2] Melissa Nann Burke, "Army Corps Gets $1.35 Million to Study Upgrade for Soo Locks," *Detroit News*, November 16, 2015.

[3] The Coast Guard Authorization Act of 2015 (P.L. 114-120) authorized the Coast Guard to fund the design of a Great Lakes icebreaker in FY2016 and FY2017.

[4] For further information on harbor maintenance taxes and funding, see CRS Report R43222, *Harbor Maintenance Finance and Funding*, by (name redacted)

70% of U.S. cargo, but there are over 30 ports handling cargo and over 100 ports the federal government regularly dredges to maintain depths.

The 75-mile-long St. Marys River, which flows from Lake Superior to Lake Huron, forms an important connecting channel within the Great Lakes. Navigation on the river passes through the parallel locks at Sault Ste. Marie (the "Soo Locks") (**Figure 1**), operated and maintained by the U.S. Army Corps of Engineers. There are four U.S. locks at this site and a much smaller Canadian lock used by recreational craft. The Poe Lock is the largest and the most relevant to cargo ships. Two of the smaller U.S. locks are currently closed and could potentially become the site of a parallel lock to the Poe. The locks are toll free and are closed from January 15 to March 25 of each year due to ice and downtime needed for lock maintenance.

Three other channels combine to allow passage between Lakes Huron and Erie. The St. Clair River is 40 miles long, the channel through Lake St. Clair is 18 miles, and the Detroit River is 31 miles. All of the connecting channels and the locks are maintained to a depth of 27 feet.

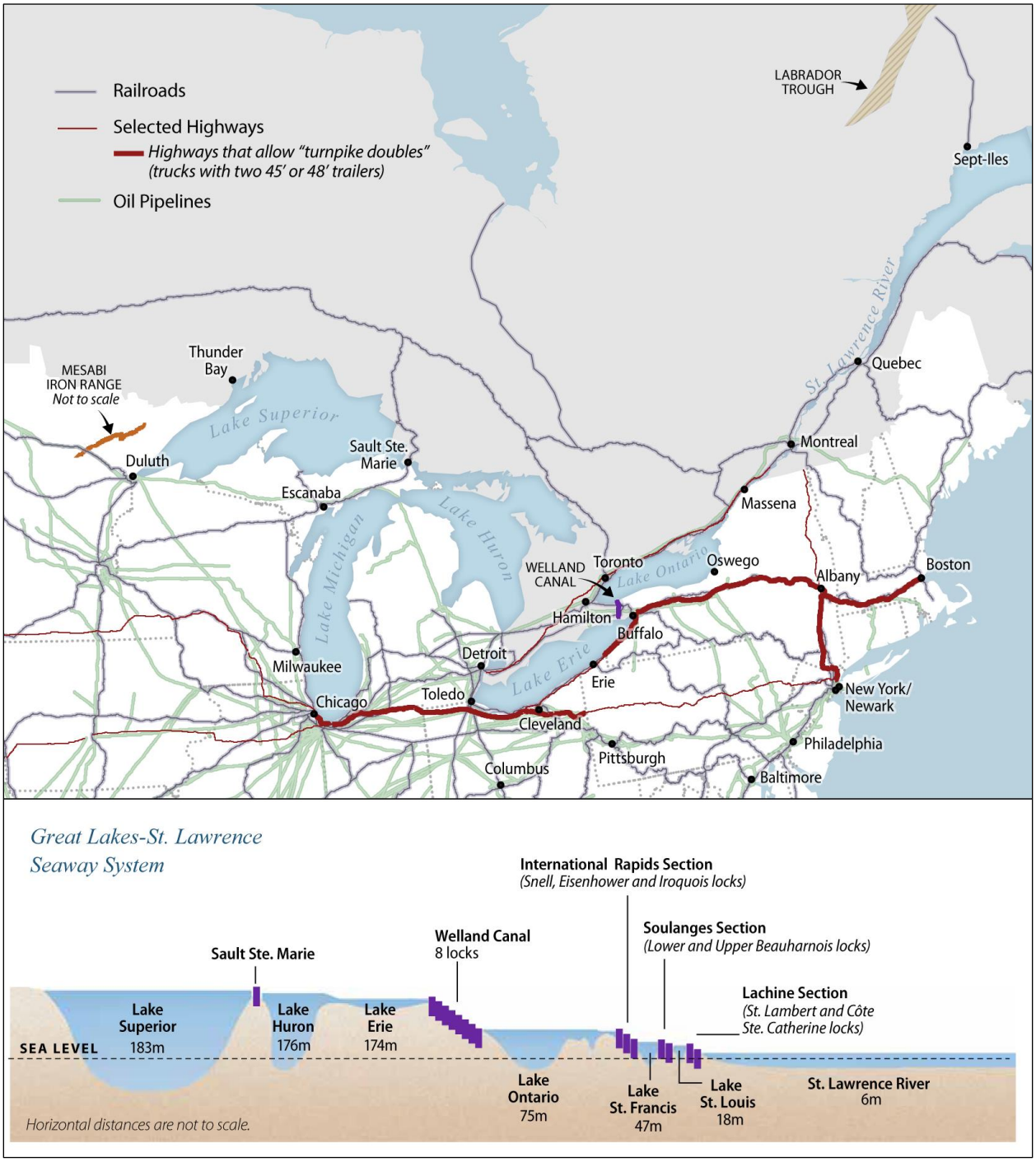
The St. Lawrence Seaway

The St. Lawrence Seaway extends from Montreal through the Welland Canal in Ontario, Canada, to the eastern portion of Lake Erie. The Welland Canal is 27 miles long with eight locks that allow ships to bypass Niagara Falls. The Montreal to Lake Ontario (MLO) portion of the seaway consists of a 27-foot-deep dredged channel and seven locks. Five of the locks are operated by the St. Lawrence Seaway Management Corporation (SLSMC) on behalf of the Canadian government, and two are operated by the St. Lawrence Seaway Development Corporation, an agency within the U.S. Department of Transportation with a staff of 130. The MLO portion of the seaway includes dams to create reservoirs that deepen the river for navigation. The SLSMC also operates and maintains the Welland Canal.

The seaway opened in 1959. Prior to its navigation improvements, the St. Lawrence River had a navigable depth of 14 feet and handled few large ships.[5] The Welland Canal already existed. The canal's lock dimensions were last increased by Canada in 1932. Those dimensions became the design standard for the new locks to be built on the MLO section. Seaway construction increased the canal's depth by two feet, but the size of the locks was not changed. It takes a ship 12 hours to transit the Welland Canal. The seaway is closed in winter, from the last days of December to around the third week of March.

[5] The 14-foot channel depth was largely the result of Canadian investments.

Figure 1. Transportation Networks in the Great Lakes Region



Source: CRS, using St. Lawrence Seaway Management Corporation diagram (bottom) and GIS data (top).

Motivations for Building the Seaway

The origins of the St. Lawrence Seaway project are relevant to its financing and the traffic base of the GLSLS. Canada had urged construction of the seaway since the early 1900s. In the United States, opposition from eastern ports and railroads, together with the estimated cost of the project (about 2% of the federal budget at the time), prevented approval. The political climate changed in the 1940s when it was thought that high-grade iron ore in the Mesabi Iron Range of northeastern Minnesota and the Marquette Iron Range of the Upper Peninsula of Michigan might soon be depleted. This iron ore supplied steel mills located along the Great Lakes. There was discussion that the mills might need to be relocated to access iron ore from South America. However, it was found that a deposit of iron ore newly discovered on the Labrador/Quebec border could replace Mesabi ore if the St. Lawrence River were improved for navigation. Winter closure of the seaway was not regarded as a hindrance because iron ore rock contains moisture and would freeze into a solid block in the hull of a ship, making it impossible to ship in winter. Construction of the mining facilities began in 1950.

U.S. opposition to the seaway project due to cost concerns was subdued by two agreements between the United States and Canada. One provided that tolls would be charged on the seaway to recoup the construction costs. This was a significant departure from long-standing U.S. federal waterway policy that provided toll-free navigation channels. Tolling also weakened the railroads' argument that their privately financed systems, with rights of way subject to property taxes, would be competing with a seaway heavily subsidized with public funds. The other agreement provided that New York State would fund the hydropower portion of the seaway project, which accounted for about four-fifths of the total cost. Hydropower plants were to be constructed at Niagara Falls, NY, and at the falls near Massena, NY, with power shared equally between the state of New York and Ontario. New York had long had an interest in more fully developing the hydropower opportunities at these locations. The Administration of President Dwight D. Eisenhower was against developing federally owned power facilities; allowing New York to build the hydropower plants resolved this issue.

The Eisenhower Administration's campaign for the project also helped overcome political opposition. The Administration promoted the project as necessary to strengthen national security by facilitating closer economic ties with Europe. The seaway was seen as a conduit for international trade. Couching the seaway in these terms made it more difficult for railroads and East Coast ports to oppose the project, because they might appear to be putting their self-interest above the national interest.

Today, U.S. steel mills on the Great Lakes obtain almost all of their iron ore from the Mesabi deposit, which does not require transport through the seaway; only about 5% of their ore supply is shipped through the seaway from mines in Canada. The Mesabi deposit also supplies more iron ore to Canadian steel mills on the Great Lakes than do the Labrador mines. Almost all of the iron ore produced from the Labrador mines is exported overseas when the global price environment supports it, and thus is not shipped on the seaway.

Soon after Congress approved construction of the seaway in May 1954, two technological developments, one in mining and the other in shipping, undercut the United States' rationale for the project. Iron ore was first pelletized on a commercial scale in 1955. Pelletization allowed low-grade iron ore (taconite), which was (and is) abundant in the Mesabi Range, to be processed into high-grade iron ore. The pellets, about the size of a quarter, are often preferred to iron ore rock as feedstock in steel mills. Pellets can be shipped in freezing conditions because they contain no moisture.

The other technological change started on April 26, 1956, when what could be called the first containership sailed from Newark, NJ, to Houston, TX, carrying 58 truck trailers on its deck. Its journey is said to have touched off the "container revolution," described as one of the most fundamental and far-reaching advances in the history of shipping. The intermodal container has dramatically facilitated global trade by lowering shipping costs. The ease with which containers can be transferred between ships and land modes (the first container shipping line was named "Sea-Land") makes it practical for vessel operators to avoid ports requiring a time-consuming transit through a long, confined waterway. The Interstate Highway System, authorized on June 29, 1956, would facilitate sea-to-land transfers, which are now referred to as intermodal shipping.

Seaway Traffic

The seaway is still of primary benefit to Canada, whose domestic commerce accounts for 40% of total tonnage and whose overseas traffic accounts for another 16%. Trade between the United States and Canada accounts for 34% of seaway tonnage. U.S. overseas trade through the seaway, 3.5 million tons in 2015, is equivalent to that which is handled by about the 88th busiest port in the United States. Contrary to President Eisenhower's vision of the seaway as an important route for U.S. overseas trade, the waterway accounts for less than 0.5% of U.S. overseas waterborne trade.

Table 1. St. Lawrence Seaway Tonnage, 2015

Trade Lane	Tons	Share of Seaway Total	Leading Commodities (by weight)
Canada to Canada	15,871,709	40%	Wheat, iron ore, limestone
United States to United States	30,985	0%	Limestone
Canada to United States	5,348,734	13%	Iron ore, cement
United States to Canada	8,501,858	21%	Coal, coke, iron ore
Overseas to United States	2,268,644	6%	Iron and steel products
United States to Overseas	1,617,831	4%	Wheat, soybeans
Overseas to Canada	2,613,782	7%	Iron and steel products, chemicals, sugar
Canada to Overseas	3,711,611	9%	Wheat, soybeans, canola
Total Tonnage	39,965,153		

Source: St. Lawrence Seaway Management Corporation (with conversion of metric tons to short tons).

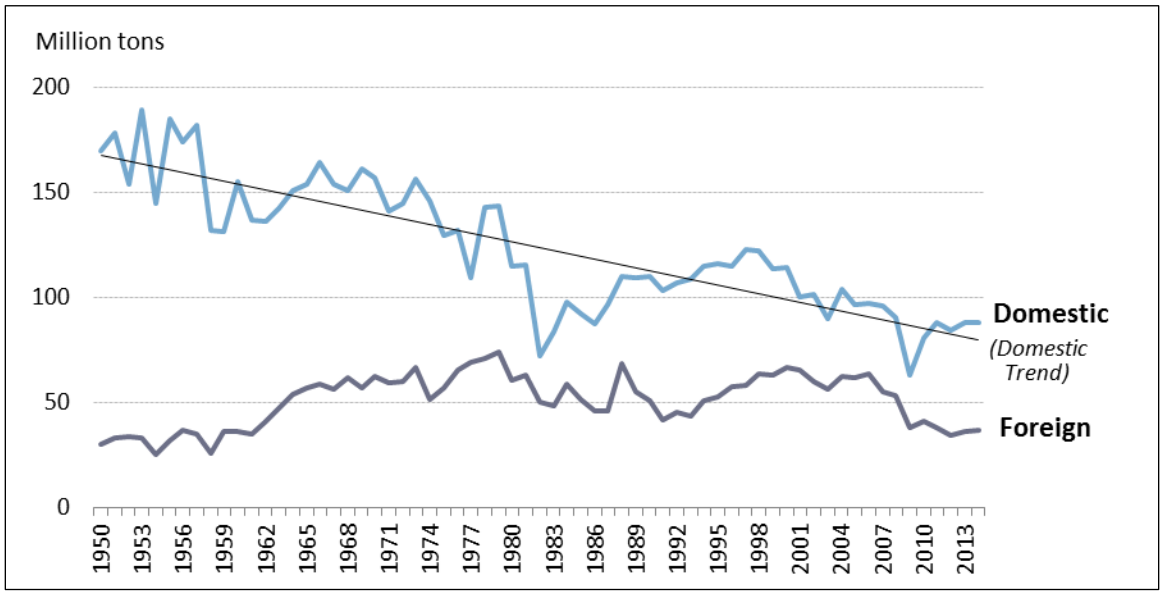
As **Table 1** indicates, most of the tonnage on the seaway consists of bulk commodities such as wheat and coal. Iron and steel products, which are imported, are the highest-value commodity shipped in large quantity. About 85% of the cargo handled by U.S. ports on the Great Lakes is moving to or from other Great Lakes ports and therefore does not use the seaway.[6] Thus, for most U.S. ports, the business generated by the seaway represents a small share of their traffic base. The exceptions are the Port of Oswego, NY, at over 50%, and the Port of Toledo, OH, at about 32%. At the adjoining Ports of Superior, WI, and Duluth, MN, which ship out mostly iron ore, about 17% of outbound tonnage passes through the seaway to reach Canadian steel mills.

[6] U.S. Army Corps of Engineers, *Waterborne Commerce Statistics.*

The board that set the seaway's initial tolls estimated that tonnage would climb to 50 million tons per year by 1968 and plateau at that amount thereafter. That estimate proved low. Tonnage peaked in the early 1980s at around 80 million tons per year thanks to a temporary spike in grain exports. After the United States embargoed grain to the former Soviet Union in response to its invasion of Afghanistan, Canada increased its grain exports to the Soviet Union, a large part of which were loaded at Thunder Bay, Ontario, and shipped through the seaway. Since then, annual tonnage has steadily declined to its present level of between 35 million and 40 million tons, roughly the same as during the first years of the seaway's operation in the 1960s (see the "Foreign" line in **Figure 2**).

Figure 2. Annual U.S. Tonnage on the Great Lakes

(million short tons)



Source: U.S. Army Corps of Engineers, *Waterborne Commerce Statistics*.

Note: Foreign includes overseas and Canada.

Since the mid-1980s, demand for North American grain has come mainly from Asia; most U.S. exports move to Pacific ports by rail or to New Orleans by barge. The decline of eastbound grain exports through the seaway has been detrimental to westbound shipments of iron ore from Labrador because the ore was often shipped aboard bulk ships returning empty after carrying grain overseas.

Great Lakes Traffic Is Dependent on the Steel Industry

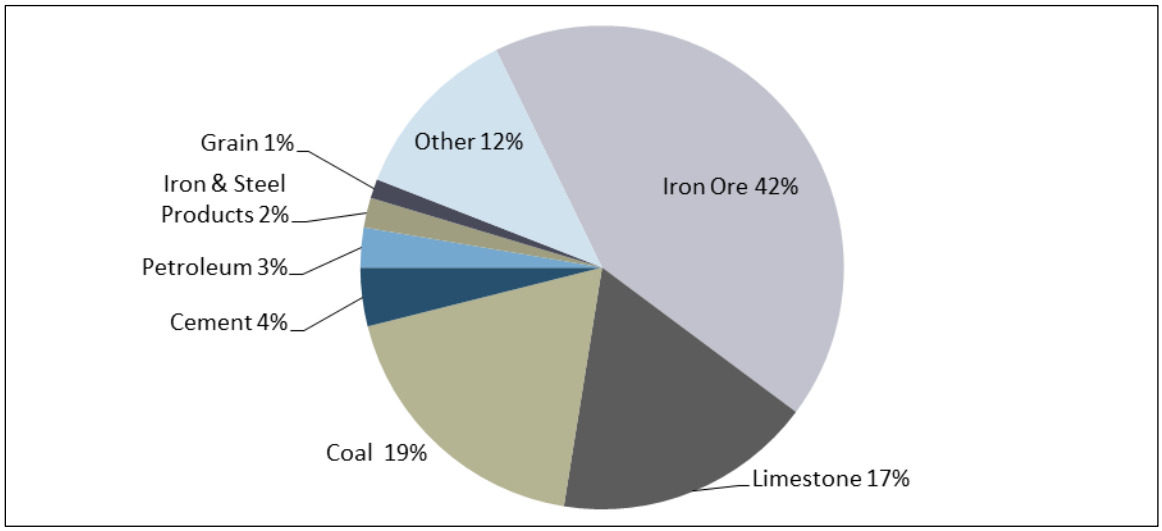
Although seaway tonnage has declined, it has fallen proportionately less than tonnage on the Great Lakes (**Figure 2**). U.S. domestic cargo volume within the Great Lakes today is half of what it was in the 1950s and 1960s, declining from about 160 million tons to 85 million tons (see the "Domestic" line in the figure).[7] By comparison, tonnage at the Port of New York and New Jersey has increased nearly 50% since the early 1960s.

[7] U.S. Army Corps of Engineers, *Waterborne Commerce Statistics.*

The decline of domestic cargo on the Great Lakes is largely a result of changes in the steel industry. Steel manufacturing—particularly the movement of iron ore, limestone (used as a purifying agent in making steel), and coal (burned in blast furnaces to produce coke for steelmaking)—has been the mainstay of shipping on the Great Lakes and through the seaway (see **Figure 3**). Steel mills that use iron ore are clustered around Chicago, Detroit, and Cleveland in the United States and in Quebec City; Montreal; and Hamilton, Ontario, in Canada.

Figure 3. U.S. Cargoes on the Great Lakes and Seaway

Percent of total tonnage, 2014



Source: U.S. Army Corps of Engineers, *Waterborne Commerce Statistics*.

Changes in steelmaking have greatly reduced the need to ship iron ore and metallurgical coal, including on the Great Lakes and the seaway. Almost two-thirds of U.S. production now is derived from scrap metal melted in so-called mini-mills rather than from iron ore processed in integrated mills. The production of steel in mini-mills does not require coke, eliminating the need for metallurgical coal.

The sources of scrap metal are widely scattered and, therefore, it is shipped overwhelmingly by truck and rail. The steel mills that produce steel from scrap are also widely dispersed. Thus, ships and the GLSLS are largely irrelevant to the mini-mills. The largest customers of the traditional, integrated mills that use iron ore as their feedstock are auto manufacturers, but auto manufacturing has moved away from the Upper Midwest to the South and Southeast, as well as Mexico, reducing demand for this type of steel production in the Great Lakes region.[8] Manufacturers of auto-related parts, like tires, have also moved away from the Great Lakes, further reducing potential seaway volume. On the other hand, as **Table 2** indicates, globalization of steel manufacturing has increased steel imports through the seaway. While U.S. steel exports also have increased, none are exported through the seaway.

[8] For a map of North American steel mills, distinguishing traditional mills from mini-mills, see http://www.steel.org/making-steel/where-its-made.aspx.

Table 2. U.S. Steel Industry, 1950s and Today

	1953	2015
U.S. Steel Production	112 million tons	107 million tons
U.S. Steel Production in Great Lakes	80%	52%
Rest of World Steel Production	147 million tons	1,559 million tons
U.S. Production/World Production	43%	5%
U.S. Imports/U.S. Production	2%	36%
U.S. Iron Ore Production	107 million tons	43 million tons
U.S. Steel Produced from Scrap	7 million tons	67 million tons
U.S. Exports	3 million tons	11 million tons

Source: American Iron and Steel Institute and U.S. Geological Survey, *Mineral Commodity Summaries*.

Note: Steel production includes raw steel and pig iron.

Several steel rolling mills and steel processing plants are being built or were recently built on U.S. waterways. None of them is on the Great Lakes.[9] Announcements indicated that year-round availability of water transportation and location with respect to customers were important factors in siting decisions. These announcements suggest that the availability of the GLSLS is not sufficiently attractive to induce such manufacturers to settle in the Great Lakes region.

The Jones Act

The Jones Act is a factor in U.S. domestic shipping on the Great Lakes. This law requires that vessels transporting cargo or passengers between any two U.S. ports be U.S. built, U.S. owned, and crewed mostly by U.S. citizens.[10] The law is intended to protect the domestic maritime industry, but critics charge it significantly reduces the price competitiveness of domestic shipping compared to truck, rail, and pipeline transport.[11]

The domestic build requirement may be particularly relevant because U.S.-built ships are said to be three to five times more expensive than similar foreign-built ships. The cost of a U.S.-built ship may discourage market entry and fleet renewal by existing carriers. The U.S. fleet of 1,000-foot freighters, the largest ships operating on the Great Lakes, was built between 1972 and 1981.[12] The second-largest class of ships, around 700 feet in length, is older, with some of the vessels having originally been built in the 1940s or 1950s; a number of these were rebuilt in the 1970s. Canada's fleet of GLSLS freighters was of similar age to the U.S. 1,000-foot fleet until recently. In 2010, Canada repealed a 25% tariff on foreign-built ships. Since then the two largest carriers have replaced their fleets with 22 new ships built in foreign yards.[13] According to the

[9] See http://www.siteselection.com; http://www.areadevelopment.com.

[10] The Jones Act requirements are codified at Title 46, *U.S. Code*, chapters 81, 121, and 551.

[11] See, for instance, the comments filed by the Ad Hoc Committee for U.S. Maritime Transportation System Regulatory Reform, November 29, 2013, https://www.regulations.gov/document?D=MARAD-2013-0101-0045.

[12] Lake Carriers Association, *2016 Statistical Annual Report*, http://www.lcaships.com/wp-content/uploads/2016/04/VESSEL-ROSTERS-PART-II-Max-Capacity2.pdf.

[13] Algoma Central Corp., "Fleet Renewal," http://www.algonet.com/; Canada Steamship Lines, "Fleet Renewal," https://www.cslships.com/en/canada-steamship-lines.

U.S. Lake Carriers Association, ships operating in freshwater can have longer lives than oceangoing vessels, whose economic life is about 20 years. Much of the U.S. Great Lakes fleet has been exempted from the stricter air emission standards that other ships operating in U.S. waters have been required to meet since 2015.[14]

Shipping Hurdles on the GLSLS

Winter closure of the seaway and the Soo Locks and the GLSLS system's intricate navigation requirements are likely two features that are holding back its development. The size of the locks may not be as much of a hindrance as is often asserted.

Winter Closure

Because the seaway and Great Lakes connecting channels are freshwater and shallow, they freeze sooner and harder than many saltwater harbors at higher latitudes. The advantages of a "warm water" port are significant; ship owners may prefer to avoid ice, strong winds, and icy precipitation, all of which can interfere with navigation and cargo handling and can throw vessels off schedule.

During the seaway's winter closure, shippers are expected to shift to rail transportation to East Coast ports. While this may seem a workable solution, it may not be financially practical. Rail carriers would much prefer a customer providing a steady flow of cargo year-round rather than just seasonally; if a customer needs the locomotive power, rail cars, and track capacity for only three months, the railroad must find other customers who need nine months of service to avoid its capital sitting idle. Under these circumstances, a plausible strategy for the railroad would be to negotiate a rate that induces the shipper to switch to the railroad year-round for multiple years and forgo use of the seaway. In other words, the recommended winter alternative may not be as simple as it appears and points to why the seaway's climate is a serious impediment to its utility.

The Seaway's Lock Dimensions

The decision to accept the dimensions of the 1932 Welland Canal locks as the standard for the new seaway was criticized as "making the Seaway obsolete even before it opened,"[15] because ship sizes, then as now, were continually being increased. The width of the locks is more of a constraint than their length: the locks are wide enough to accommodate only about 6% of the world fleet of dry bulk vessels, ships that carry cargoes such as wheat and iron ore. For tankers, the width of the locks would allow passage of about 20% of the world fleet, and for liquefied natural gas carriers, 5% of the world fleet.[16]

Shipping economics dictates that the longer the voyage, the bigger the ship, and vice versa. Ships achieve economies of scale while at sea but diseconomies when they are in port. For example, fuel and crew costs per unit of cargo decrease as cargo loads increase, but the larger ships necessary to carry bigger loads take longer to load and unload, so port costs increase. However, the longer the voyage, the more days the ship spends at sea compared to the number of days in port. On shorter voyages, ships spend a larger portion of their total time in port. Thus loading and

[14] 77 *Federal Register* 2472, January 18, 2012.

[15] "Sinking Treasure," *Milwaukee-Wisconsin Journal Sentinel*, October 30, 2005.

[16] *Clarksons Bulk Carrier Register, Clarksons Tanker Register, Clarksons Gas Carrier Register* (London: Clarkson Research Services Ltd., 2016).

unloading time becomes more important. As explained above, the seaway was primarily designed for vessels on short voyages within the Great Lakes or eastern Canada. The size of the locks is not impeding this trade. Overseas trade via the seaway is primarily with Europe, Africa's West Coast, or the East Coast of South America. These are also relatively short voyages. The largest ships in the world fleet operate between northern Europe and Asia, across the Pacific Ocean, or around South Africa; they do not serve the seaway region.

Within the Great Lakes system, the size of vessels is limited by a lock not administered in conjunction with the seaway: the Poe Lock at Sault St. Marie, MI.[17] Minnesota iron ore moving to U.S. steel mills on the Great Lakes passes through the Soo Lock. The lock was expanded in 1968 to accommodate vessels carrying up to 70,000 tons of iron ore; in contrast, the largest ore carriers that operate on the seaway can carry 33,000 tons. Cliffs Natural Resources, the owner of mines in the Mesabi Range, recently sold its interest in mines in the Labrador Trough. Its strategy is to focus on supplying steel mills within the Great Lakes with ore from Minnesota.[18] It believes this market can be isolated from the global market, which has seen a dramatic drop in the price of iron ore. The company has stated that it benefits from the comparatively small size of the locks in the seaway. On its website, the company states, "Cliffs is also well-protected from imported pellets, as the logistical costs to bring pellets through the St. Lawrence Seaway are incredibly burdensome."[19]

Two Strategies for Marketing the GLSLS

While acknowledging the limitations of the GLSLS discussed above, one can identify two strategies for potentially attracting more cargo to the system. One strategy would be to convince shippers that currently ship by rail or truck on routes that parallel the Great Lakes or seaway that shipping by water is a better alternative.[20] A second strategy would be to encourage industrial sectors that require waterborne shipping to locate new plants or expand existing plants on the Great Lakes rather than on some other waterway. The St. Lawrence Seaway Development Corporation (SLSDC) is pursuing both strategies; the first it calls the "Highway H_2O" strategy, the second it calls the "Opportunity Belt" strategy. However, the 2015 annual report of one of the largest carriers states that it expects limited opportunity for growth on the GLSLS and therefore is looking to non-North American markets in order to grow its business.[21]

The "Highway H_2O" Strategy

The assumption behind the Highway H_2O strategy is that there are a significant number of shippers that do not realize that a parallel waterborne route offers a better way (for shippers, "better" overwhelmingly means cheaper, and secondarily means more reliable and faster) to ship their goods. This seems unlikely. In a market economy, the success and profitability of shippers,

[17] There are actually four parallel locks at this site; only the largest is discussed here.

[18] Speech by Lourenco Goncalves, Chairman, President, and CEO of Cliffs Natural Resources, Inc., World Steel Dynamics Conference, New York City, June 13-15, 2016; Cliffs Natural Resources, *2015 Annual Report*, p. 49, http://www.cliffsnaturalresources.com/English/investors/financial-information/financial-highlights/default.aspx.

[19] Cliffs Natural Resources, "Our Strategy," http://www.cliffsnaturalresources.com/.

[20] Pipeline shippers are not a viable audience because they have invested sunk costs in building the pipeline and/or are committed to long-term (15-20 year) contracts to utilize the pipeline.

[21] Algoma Central Corp., *2015 Annual Report*, p. 6, http://www.algonet.com/wp-content/uploads/2016/03/2015-Algoma-Central-Annual-Report.pdf.

and even more so of the carriers and logistics providers they hire, are based on finding the most efficient transportation methods. Globalization has required U.S. producers to reduce costs and improve reliability in the sourcing of materials and the distribution of their products.

Since the 1980s, freight transportation has evolved into "business logistics" and "supply-chain management," terms indicating a holistic approach to a firm's production, transportation, and storage functions.[22] A new sector has arisen in the shipping industry called "Third-Party Logistics Providers" (3PLs). These are firms that specialize in "reengineering" a producer's inbound and outbound transportation and inventory management with the promise of significantly reducing costs. With computers, "logistics companies now have the overview data to design the most efficient movement of materials through the production process to final delivery of the product."[23] This holistic approach has brought about practices such as "just-in-time" delivery (which the auto industry originated) and "demand-pull" logistics, methods for lowering a firm's inventory carrying costs. Stockpiling three months' inventory in anticipation of the seaway's winter closure is the antithesis of these strategies.

Within large companies, the job performance of logisticians, operations personnel, and supply chain managers is measured, in part, by their ability to bring about cost savings in their company's distribution network. It seems implausible that firms that ship significant volumes of goods have overlooked the Great Lakes and seaway as a better alternative.[24] Moreover, there has been a trend for shippers to reduce the numbers of transportation carriers they hire while developing deeper relationships with the carriers they retain to reduce empty vehicle miles and ensure they will have equipment available even when demand peaks. Trucking firms refer to these relationships as "dedicated service." These closer relationships between shippers and carriers may make shippers less willing to experiment with other arrangements.

The Container Shipping Conundrum

The Highway H_2O strategy apparently focuses on marketing to shippers of containerized freight, as shippers of bulk commodities are already very familiar with the seaway. But there are substantial obstacles to attracting container vessels to the seaway:

- Containerships sail on regular schedules, calling at a series of ports to discharge and load containers. Because the vessels are very expensive to build, the interest cost on a vessel's mortgage makes the two-week transit from Montreal to inland ports and back again unattractive to ship owners. Such a service is unattractive to shippers as well, as they can often ship cargo by truck or rail to coastal ports more quickly and at lower cost. Moreover, containerships operate most efficiently by calling at only a few ports with large amounts of cargo rather than loading small numbers of containers at many locations. Almost all newer containerships exceed the dimensions of the seaway locks. Hence, while

[22] John J. Coyle, Robert A. Novack, and Brian J. Gibson, et al., "Transportation: Critical Link in the Supply Chain," in *Transportation: A Supply Chain Perspective*, 7th ed. (Mason, OH: South-Western Cengage Learning, 2011), pp. 17-23.

[23] William D. Middleton, George M. Smerk, and Roberta L. Diehl, *Encyclopedia of North American Railroads* (Bloomington, IN: Indian Univ. Press, 2007), p. 554.

[24] For further discussion of obstacles to short sea container shipping, see archived CRS Report R41590, *Can Marine Highways Deliver?*, by (name redacted); GAO, *Freight Transportation: Short Sea Shipping Option Shows Importance of Systematic Approach to Public Investment Decisions*, GAO-05-768, July 29, 2005; Transportation Research Board, *North American Marine Highways*, NCHRP Report No. 5, 2010.

considerable containership traffic is handled at Montreal, none of the ports further inland receive regular containership calls.

- The Port of New York and New Jersey is a "must call" for containerships providing service to the U.S. Northeast. Because much of the import cargo on any given ship is likely destined for the New York City region, this port is typically the first U.S. stop for vessels from Europe and often for vessels from Asia. Once a container has arrived in New York, it can reach some parts of the Great Lakes region by truck within a day and by rail in two days. In less time than it takes for a ship to transit the 27-mile Welland Canal, a truck can cover about 550 miles—a radius upon which many distribution networks are planned because of trucking's speed, convenience, and economics within this distance.[25] Moving containers by water from New York to Montreal and then through the seaway would take well over a week.
- Due to the considerable sailing distance between New York and the major ports in eastern Canada, container shipping lines typically serve New York and Canadian ports with separate "strings," or routes. Containership calls at the ports of Montreal and Halifax are far less frequent than at New York. If feeder vessels were available, carriers could use them to route containers from Canadian ports to U.S. inland points such as Detroit and Chicago. Two feeder vessel services on the seaway were attempted in recent years. Sea3, sponsored by the Hamilton, Ontario, Port Authority beginning in July 2009, offered service to Montreal and Toronto. The Great Lakes Feeder Line, initiated in July 2008, provided service from Halifax to Montreal and Great Lakes interior ports. Both were terminated after about a year of operation. No U.S. vessel operators have attempted a container feeder service on the seaway. Several such services have been introduced on other U.S. waterways with financial support from the U.S. Maritime Administration; the only one to survive, which provides container-on-barge service between Norfolk and Richmond, VA, requires state as well as federal subsidies.
- Truck and rail competition between Northeast Atlantic ports and the Midwest is intense partly because the New York Thruway, the Massachusetts and Ohio Turnpikes, and the Indiana Toll Road allow truckers to pull "turnpike doubles"—two full-sized trailers (45 feet to 48 feet in length) in tandem (see **Figure 1**). Railroads compete using railcars that allow them to stack one container upon another (double-stack), thus hauling twice the number of containers per train. Nationally, this is the most common method by which import and export containers are moved by rail (referred to as "intermodal rail"). On average, 22 to 26 intermodal trains per day travel between Chicago and the Port of New York, making it one of the busiest intermodal rail corridors in the country.[26] The number of containers transported by rail per day on this route (14,000 twenty-foot equivalent units, or TEUs)[27] is equivalent to the capacity of the largest

[25] These trucking economics make central Ohio (Columbus specifically) a key location for producers of consumer products. From this location, one can reach the greatest number of U.S. consumers for the least transportation cost. Thus, the "e-commerce" revolution could accentuate this advantage for central Ohio.

[26] "Who Does It Best?" *Trains*, November 2011, pp. 62-71.

[27] TEU refers to twenty-foot equivalent unit, a standard measure of containers. A typical 40-foot container counts as two TEUs.

containerships that call at U.S. ports. In the Great Lakes region, railroads also carry truck trailers using methods that obviate the need for expensive cranes to lift them on and off railroad flat cars. Vehicle manufacturing plants in the Great Lakes region most frequently send their exports by rail to the ports of Baltimore, Philadelphia, and Norfolk, where they are loaded aboard dedicated car-carrying ships. No such vessels operate through the St. Lawrence Seaway.

The Cleveland-Antwerp Express

In an attempt to attract containerships beyond Montreal, the Port of Cleveland is subsidizing service to Antwerp, Belgium, by chartering a multipurpose ship from a Dutch shipping line and paying for its fuel. The ship has mostly carried breakbulk and project cargoes (overly large pieces of equipment), but has also carried some containers (about 300 in 2014).[28] The service was initiated two years ago; the port hopes that it will eventually operate without public funds. So far the port has provided $11 million in subsidies.

If containerized cargo could be captured by the seaway, it would generate additional revenue for the seaway's capital needs. Tolls on containerships are likely to be higher than those on other types of vessels because containers often hold high-value cargo, and seaway tolls are based on cargo value. Closure of the seaway during winter means that only shippers that can afford to stockpile inventory for three months are likely to consider it as a supply route. Typically, these are shippers of low-value raw materials.

Truck Ferries on the Great Lakes

Similar challenges in diverting truck or rail freight to the seaway apply to the Great Lakes. However, diverting domestic truck shipments can be even more challenging than international waterborne shipments because domestic truck shippers face tighter delivery windows.

A limited number of trucks use a barge service to cross the Detroit River between Detroit and Windsor, Ontario, because the nearest bridge and tunnel both prohibit trucks carrying hazardous materials. A car and truck ferry crosses Lake Michigan between Ludington, MI, and Manitowoc, WI, between May and October.[29] Both of these ferries offer truckers substantial savings in miles. The potential for other such services is limited because most large cities on the Great Lakes are not situated in places where ferry crossings would save substantial time for truck drivers.

The "Opportunity Belt" Strategy

Firms decide which routes and modes of transportation they are going to be using when making decisions about where to locate their plants and warehouses. The characteristics of their supply chain and distribution networks are central to decisions about whether to locate near an airport, a highway interchange, a railroad, pipeline, waterway, or some combination of these. Thus, the "Opportunity Belt" strategy focuses on increasing seaway traffic from industries that tend to prefer waterborne transportation. These industries typically require individual shipments of large volumes of low-value raw materials. Because transport costs are a relatively high portion of these firms' total costs, they are an especially important consideration in location decisions. Since the

[28] U.S. Army Corps of Engineers, *Waterborne Commerce Statistics.*

[29] The vessel for this service, the Badger, was built in 1952, and its engine burns coal.

commodities have low value, stockpiling them through the winter may not significantly add to a firm's inventory carrying costs.

Manufacturers of steel (discussed above), energy products, and chemicals frequently use ships and barges.[30] Manufacturers of large, oversize equipment (such as boilers, power turbines, and windmills) are also prime candidates for waterborne transportation, although truck and rail can be competitive alternatives for these shippers as well. Heavy industries seeking to export and import products to and from northern Europe may be the most viable target audience for the seaway.

In FY2015, the SLSDC hired and stationed a representative in Cleveland to pursue the "Opportunity Belt" strategy. Many Great Lakes port authorities and city, county, regional, and state economic development agencies are also involved in efforts to attract businesses to the Great Lakes waterfront, along with state governors. The added benefit of the SLSDC in this effort by promoting the Opportunity Belt strategy is unclear.

Unit Trains Gain Share Among Bulk Shippers

Many of the shippers the SLSDC is targeting with its Opportunity Belt strategy are benefiting from a railroad innovation, the unit train. Unit trains move a single product from one origin to one destination without stopping to add or remove individual cars. The cars are unloaded without being uncoupled, and the train then returns to its origin to pick up another load. Because of their very low costs, unit trains provide strong competition to tanker ships in moving bulk liquids and to dry bulk ships in moving products such as grain and ore.

One of the first unit trains was created to supply bauxite to the Alcoa aluminum plant in Massena, NY,[31] as the St. Lawrence Seaway was being completed in 1959. At the time, Alcoa owned a fleet of over 60 ships and thus had expertise in maritime facilities. Not wanting to lose an important customer, Alcoa's railroad responded by deploying 50-car unit trains to supply the Massena plant with bauxite imported from South America through the Port of Mobile, AL.[32] Today, the plant is still supplied by unit trains, but through the Port of Baltimore. Two unit trains have a total capacity roughly equal to that of a seaway-sized ship.

The Great Lakes and St. Lawrence Seaway also face unit train competition for shipping grain and coal. Very recently, shippers elsewhere in the country began using unit trains to move steel products.[33] If that business develops, it could have serious consequences for seaway traffic.

Unconventional Energy Production Leaves GLSLS Unaffected

New sources of crude oil from the Bakken region of North Dakota, the Eagle Ford and Permian basins in Texas, and western Canada have induced new waterborne routes for shipping crude oil to U.S. and Canadian refineries, including the intracoastal waterway in Texas and Louisiana, the lower Mississippi River, the Hudson River, and along the Mid-Atlantic Coast. In recent years, no crude oil has been shipped on the Great Lakes or the seaway, although the region is home to

[30] In the Great Lakes region, the sugar refining, grain milling, glass manufacturing, and cement industries are potential seaway users as well. The forest products industry also fits this description but has not shipped on the Great Lakes in recent years.

[31] Alcoa had built a plant in Massena in 1902 (it was then named American Aluminum Co.) to take advantage of the hydropower available there.

[32] "Unit Trains Move Alumina 1,700 Miles," *Railway Age*, April 4, 1966.

[33] Eric Kulisch, "Unit Trains Increase Shipping Efficiency for Steel Producer," *American Shipper*, July 15, 2016.

seven U.S. oil refineries and several Canadian refineries. All of these refineries receive their crude oil by pipeline.[34]

Petroleum products such as gasoline and fuel oil are shipped within the Great Lakes, and Canada exports and imports petroleum products through the St. Lawrence Seaway. The United States does not. Congress recently repealed a ban on exporting crude oil, but thus far almost all of the export activity has taken place at Texas ports.[35] Thus, while the dramatic increase in the domestic production of crude oil has significantly increased tank vessel activity on some U.S. waterways, it has not affected shipping volumes on the seaway. Shipping crude oil through the seaway would likely face stiff opposition for environmental reasons.

The seaway is not part of any plans for exporting natural gas, despite the proximity of the Marcellus/Utica shale basins in Ohio, Pennsylvania, New York, and West Virginia to Great Lakes ports. To export natural gas by ship first requires that the gas be converted into liquefied natural gas (LNG), an expensive process since the gas must be cooled and kept at -260 degrees Fahrenheit. Several former U.S. LNG import terminals that became inactive due to the shale gas revolution are being converted to export terminals at costs in the range of $6 billion to $10 billion each. These former import terminals have an advantage over several new terminals also being built for exporting LNG (which have a cost of about $20 billion). Most of the terminals being converted are on the Gulf of Mexico, with one already operating in Texas.[36] The extensive natural gas pipeline network serving all LNG terminals and the ability of pipelines and southern LNG terminals to move product year round would seem to leave the seaway at a disadvantage as a route for LNG exports.

Chemical Manufacturing

The significant increase in domestic natural gas production and the resultant drop in natural gas prices have stimulated investment in U.S. chemical and plastics manufacturing, which uses natural gas for power, or as an industrial feedstock (for example, in fertilizer production). According to a chemical industry survey of new plant investments, waterways in Louisiana and Texas are likely to see the overwhelming bulk (about 80%) of new chemical plant investments,[37] although many announced investments have been postponed.

The proximity of natural gas resources in the Marcellus and Utica shale basins to the Great Lakes region could potentially benefit nearby chemical manufacturers and induce chemical shipments on the seaway. However, at the 2015 Ohio Freight Conference, a major producer and distributor of natural gas in the Marcellus and Utica shale basins described its distribution network with no mention of shipping via the seaway.[38] Last year, the company shipped all of its natural gas products from the basin by rail (60%), pipeline (30%), and truck (10%); its exports to Europe, Africa, South America, and Asia were shipped via U.S. East Coast ports.

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[34] See CRS Report R43653, *Shipping U.S. Crude Oil by Water: Vessel Flag Requirements and Safety Issues*, by (name redacted)

[35] See CRS Report R44403, *Crude Oil Exports and Related Provisions in P.L. 114-113: In Brief*, by (name redacted), (name redacted), and (name redacted)

[36] See CRS Report R42074, *U.S. Natural Gas Exports: New Opportunities, Uncertain Outcomes*, by (name redacted) et al.

[37] American Chemistry Council, *Shale Gas, Competitiveness, and New U.S. Chemical Industry Investment: An Analysis Based on Announced Projects*, May 2013, https://chemistrytoenergy.com/sites/chemistrytoenergy.com/files/shale-gas-full-study.pdf.

[38] Presentation by MarkWest Energy Partners, 2015 Ohio Freight Conference, September 15, 2015, http://www.ohiofreight.org/Garner_Rookwood.pdf.

Oversize/Project Cargo

Waterways can be useful for shipping overly large pieces of equipment. While railroads offer much higher weight limits than highways for shipping goods, railroads are restricted with respect to cargo width because little extra space is available between trains that are passing one another on parallel tracks. Several companies in the Great Lakes region ship products such as large boilers and windmill blades by water. However, oversize/project cargo, as its name suggests, is usually a "one-off" type of shipment rather than a steady stream of goods.

A recent study by the Transportation Research Board found that waterways are not price competitive for domestic shipments of oversized or overweight goods, even though state highway permitting requirements and the need to raise utility lines can cause serious delays and greatly increase the cost of shipping these goods by truck.[39] The report found that waterways are only used when moving so-called mega-size loads, products too big to move by highway or railroad. This is a critical finding that is applicable to other cargoes on the GLSLS also, suggesting that many shippers using the GLSLS do so because they have no alternative, not because they regard it as an attractive option.

Manufacturing Trends and GLSLS Prospects

One of the challenges confronting the Opportunity Belt strategy is a change in the nature of U.S. manufacturing. Whereas manufacturing was once characterized by large, integrated plants that processed natural resources into finished goods, modern manufacturing is characterized by a network of smaller plants that each perform a subset of the manufacturing process.[40] The change implies a smaller portion of U.S. manufacturing relying on waterborne transport of natural resources. As discussed in a recent report prepared for Contra Costa County, CA, which is seeking to revitalize its former industrial waterfront on Suisun Bay, "Conventional large-scale vertically integrated manufacturing operations are less common as companies seek to minimize costs and provide flexible manufacturing systems and platforms for responding to changing customer demands, technologies, and economics."[41] While traditional plants are more likely to locate at the waterfront and rely on waterborne deliveries, advanced manufacturers tend to be more time-sensitive and to rely more on truck or air shipments. This trend has obvious implications for the GLSLS.

Interestingly, a number of communities in the Great Lakes region have found their waterfronts becoming increasingly attractive for development not tied to waterborne shipping. For example, a Rochester, NY, food and beverage company recently consolidated its operations at its Lake Ontario location due to ample supplies of freshwater,[42] and data centers are settling in the region because its climate reduces the cost of keeping servers cool. Some Great Lakes harbor communities have been debating whether their future depends on reindustrialization of the waterfront or whether recreation and residential construction provides a brighter future.[43]

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[39] TRB, *Multi-State, Multimodal Oversize/Overweight Transportation*, NCHRP Report 830, 2016, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_830.pdf.

[40] For further information on changes in the characteristics of U.S. manufacturing plants, see CRS Report R41898, *Job Creation in the Manufacturing Revival*, by (name redacted).

[41] Craft Consulting Group, Cambridge Systematics, *Revitalizing Contra Costa's Northern Waterfront: How To Be Competitive In The 21St Century Global Economy*, January 2014, p. 3.

[42] Dale D. Bluss, "Water: The New Blue Economy?" *AreaDevelopment Online*, 2015 Directory, http://www.areadevelopment.com.

[43] Dennis Cauchon, "For Great Lakes, A Future With Less Industry: Push for Cleaner Waterfronts Changing Attitudes (continued...)

Capital Needs of the GLSLS

The largest potential capital project on the GLSLS, as indicated above, is the construction of a second lock parallel to the Poe Lock at Sault Ste. Marie. This project is primarily relevant to the transport of Minnesota iron ore to steel mills within the Great Lakes. The purported need for a second lock is for redundancy in case the Poe Lock must be closed for emergency repairs. The Corps of Engineers has also cited sabotage from foreign ship crews as a risk.[44] Reportedly, an unofficial cost estimate for a second lock is in the neighborhood of $600 million.[45] Plans for a second lock have been studied by the corps since the early 1980s. In a 1984 study, the Corps recommended that the project proceed, based on its forecast that tonnage through the lock would reach 134 million tons by 2010. However, actual tonnage in 2010 was only 73 million tons, barely half the corps' forecast.[46] In 2009, the corps built cofferdams at the two smaller locks so that the locks could be drained as a first step in the construction of the new lock.

Two other capital needs also would require significant funding. One is dredging of harbors and channels to maintain their depths, a continuing necessity on the Great Lakes. The other is the disposal of the many lake-bottom sediments that are contaminated. These sediments are disposed of in "confined disposal facilities" rather than dumped without containment in open water or upland. Many of the disposal facilities have reached their capacity, although new ones are planned.

The current capitalization strategy regarding St. Lawrence Seaway infrastructure emphasizes preservation and maintenance rather than significant capacity expansion. This consensus, expressed in a 2007 binational study by several U.S. and Canadian federal agencies, was achieved after studies of extending navigation capabilities through the winter and increasing the seaway's depths and lock dimensions.[47] Since that study, there have been no major efforts toward keeping the seaway open during winter months or expanding the locks. As discussed further below, past evaluations determined that these expansions were not worth the cost, economically or environmentally.

As mentioned above, the pelletization of iron ore increased pressure for winter operations because pellets do not freeze into a solid block like iron ore rock and thus can be handled and shipped in freezing temperatures. While the seaway is closed in winter, portions of the western Great Lakes are kept open for navigation with icebreakers. Iron ore pellets can be sourced from the Upper Peninsula of Michigan and shipped from Escanaba (see **Figure 1**), thus avoiding interruption due to the annual closure of the Soo Locks. In the 1970s, Congress funded demonstration projects over multiple winters to show the feasibility of extending navigation through the winter over the rest of the Great Lakes. The demonstration used air hoses designed to push warmer water to the surface, reducing the thickness of the ice, as well as deployment of more icebreakers. These experimental projects upset waterfront landowners such as coal-fired power plants because

(...continued)

Toward Longtime Employers," *USA Today*, December 4, 2007; Jeremy Nobile, "Recreation Thrives Along Waterfront," *Crain's Cleveland Business*, May 9, 2016.

[44] U.S. Army Corps of Engineers, "Great Lakes Navigation Update," February 2015, p. 16.

[45] Eric Kulisch, "Critical Great Lakes Lock Assessed for Expansion," *American Shipper*, July 26, 2016.

[46] U.S. Army Corps of Engineers, *Great Lakes Connecting Channels and Harbors*, March 1984, p. 87.

[47] Transport Canada, U.S. Army Corps of Engineers, U.S. Department of Transportation, the St. Lawrence Seaway Management Corporation, St. Lawrence Seaway Development Corporation, Environment Canada, U.S. Fish and Wildlife Service, *Great Lakes St. Lawrence Seaway Study*, Fall 2007.

broken ice interfered with their intake pipes. Other waterfront property owners complained that ice floes caused shoreline erosion and damaged piers and docks. The air bubbler system interfered with fish spawning and otherwise upset Great Lakes ecology in various ways.[48] There was concern for increased risk of fuel spills from ships and the difficulty of responding to spills in winter. The air bubblers and icebreaking missions were found to be cost prohibitive.[49]

In the early 2000s, the U.S. Army Corps of Engineers evaluated whether to deepen the seaway and Great Lakes channels and ports by another 10 feet, widen the seaway locks by 28 feet, and lengthen them by 384 feet.[50] Congress requested this study in 1999.[51] The study asserted that this expansion would have net economic benefits, but it was widely criticized for not sufficiently supporting its freight forecasts and for misunderstanding container shipping economics.[52] For instance, the corps forecasted a steady increase in tonnage even without improvements, despite the recent history of declining annual tonnage.[53] Opposition also came from environmental groups concerned about invasive species arriving aboard international ships, contaminated sediments from dredging, and reduced water levels from expanded outflow channels. Congress did not provide funds to the corps for the next step in project evaluation, a feasibility study that would have examined the costs and benefits of the project in more detail. Instead, U.S. and Canadian officials instructed the committee conducting the 2007 study referenced above to determine "how best should we use and maintain the system, *in its current physical configuration* [emphasis added]." The binational study recommended that expansion of the system not proceed. In February 2010 the Army Corps issued a supplement to its earlier study, agreeing with that recommendation.[54]

As the 2007 binational and 2010 Army Corps studies recommended, the SLSDC and SLSMC are currently in the midst of a program to ensure that the locks, and the seaway in general, are kept in a state of good repair. In FY2009, the SLSDC began a 10-year asset renewal program with an estimated total cost of $186 million. Assets being renewed include the two locks it maintains and operates on the seaway, as well as a highway bridge over the seaway, a tunnel under the locks, and a small fleet of vessels it uses to perform tasks on the seaway. The agencies also are dredging to maintain seaway depth. In FY2015, the program's seventh year, SLSDC spent about $15 million on these capital assets, roughly 40% of its budget. The SLSMC (the Canadian counterpart) is also performing a 10-year asset renewal program. In its most recent year, it spent CAD$117 million (approximately USD$94 million) on its physical assets.

[48] The federal government is currently funding a program to restore Great Lakes fisheries and its ecosystem; see CRS Report R43249, *The Great Lakes Restoration Initiative: Background and Issues*, by (name redacted) .

[49] Transportation Research Board, 2016 Annual Meeting, Session 291, "Solutions and Obstacles to Revitalizing Great Lakes Goods Transportation," Washington, DC, January 11, 2016.

[50] U.S. Army Corps of Engineers, *Great Lakes Navigation System Review*, June 2002.

[51] §456 of the Water Resources Development Act of 1999 (P.L. 106-53).

[52] Lake Ontario Keeper, *Analysis: Great Lakes Navigation System Review*, July 15, 2002; Pennsylvania State University, Pennsylvania Transportation Institute, *Analysis of the Great Lakes/St. Lawrence River Navigation System's Role in U.S. Ocean Container Trade* (the report was sponsored by Save the River and Great Lakes United), August 2003.

[53] For 2015, the corps forecast for tonnage proved to be overstated by 75%; U.S. Army Corps of Engineers, *Great Lakes Navigation System Review*, June 2002, p. vi.

[54] U.S. Army Corps of Engineers, *Supplemental Reconnaissance Report: Great Lakes Navigation System Review*, February 2010, http://www.lre.usace.army.mil/Portals/69/docs/PPPM/PlanningandStudies/glnssuppreport/GLNSSuppReconMain2.pdf.

Current Financing Method on the U.S. Side

Congress appropriates about $35 million annually for the SLSDC from the Harbor Maintenance Trust Fund (HMTF). This fund also provides between $100 million and $150 million annually for the Corps of Engineers' dredging, maintenance of breakwaters and jetties, and operation of the Soo Locks. The HMTF is funded from the Harbor Maintenance Tax (HMT) on imported and domestic cargo shipped through coastal and Great Lakes ports.[55] The tax rate is $1.25 per $1,000 of cargo (i.e., 0.125% of cargo value).

This funding method greatly benefits the GLSLS because the Great Lakes and the seaway appear to generate far less HMT revenue than they receive in annual appropriations. U.S. Customs and Border Protection collects the HMT at each port but was not able to provide CRS with HMT collections by port.[56] Given the low value of cargo that is generally shipped on the GLSLS, it seems likely that HMT revenue generated by the system is a small fraction of the HMTF funding it receives. Thus, revenue received at U.S. coastal ports is likely sustaining ports in the Great Lakes-St. Lawrence Seaway system.[57]

Toll Financing on the Canadian Side

The SLSMC charges tolls at the locks it operates on the Seaway. Total toll receipts varied from CAD$63 million to CAD$72 million annually over the last three years. The SLSMC has a plan to increase tolls very slightly every year as part of an overall strategy to make the SLSMC more financially self-sufficient. The SLSMC tolling scheme consists of a relatively small charge based on the size of the vessel and higher charges based on the amount and commodity being carried. Higher-value commodities pay more per ton. For instance, the lowest fees are CAD$0.68 per ton for grain and coal, while the highest charges are CAD$2.40 per ton for steel slabs and CAD$2.65 per ton for general cargo, such as containers. The per-ton tolls are different for the locks on the Welland Canal than they are for the locks between Montreal and Lake Ontario; for some commodities they are higher, while for others they are lower. Average lockage fees amount to CAD$1.70 to CAD$1.80 per ton.[58] For a fully laden ship, this translates to CAD$40,000 to CAD$60,000 in tolls for a one-way voyage through the entire seaway, or about CAD$2,000 to CAD$4,000 per lock.[59] The agency recently implemented a reduced tolling scheme for new shippers on the seaway.

Tolls on the U.S. Side

The SLSDC originally charged tolls for passage through the two U.S. locks in order to recoup the construction costs of the seaway. By the late 1960s, it was apparent that toll revenues were insufficient to repay the construction costs. In 1970, under a provision in the Merchant Marine

[55] The tax on cargo exported through these ports was found unconstitutional in the early 1990s and is no longer collected.

[56] U.S. Customs and Border Protection, the agency that collects the HMT, did not respond to CRS requests for the amount of HMT collected at Great Lakes ports.

[57] For further information on the HMTF and its distribution among ports, see CRS Report R43222, *Harbor Maintenance Finance and Funding*, by (name redacted)

[58] A $1 per ton fee on the U.S. side would approximately cover the SLSDC's budget (2015 seaway tonnage was 36 million; SLSDC's budget is approximately $36 million).

[59] From July 1962 through the end of the 1966 navigation season, Canada suspended toll collection on the Welland Canal. This was done to fulfill a campaign promise by the Prime Minister at the time.

Act of 1970 (P.L. 91-469, Section 43), Congress forgave the SLSDC from repaying the interest on its debt (about $6 million per year, plus an accumulated interest balance of $22 million). This was thought necessary in order to prevent an increase in toll rates.

In 1982, in the Department of Transportation and Related Agencies Appropriations Act (P.L. 97-369, Section 311), Congress forgave the SLSDC from repaying its remaining $110 million debt. Congress was responding to Canada's decision to forgive the debt of the Canadian Seaway Authority and Canada's reduction in toll rates. Although the original seaway construction agreement between Canada and the United States required that the countries mutually decide toll rates,[60] a mutual decision did not occur in this case. Congress's view was that the SLSDC could not achieve enough toll revenue to pay its debt as well as reinvest in the seaway. With the debt forgiven, the SLSDC was directed to use toll revenues to operate and maintain the seaway. In 1986, Congress established the Harbor Maintenance Tax and Trust Fund in the Water Resources Development Act of 1986 (P.L. 99-662), and in 1994 the HMTF replaced tolls as the means of funding the SLSDC's costs.

Potential Effects of Higher Tolls

In its FY2006 budget request, the George W. Bush Administration proposed reinstating tolls on the two U.S. locks. The Administration projected toll revenue of $17 million per year, equal to the budget of the SLSDC at the time. The HMT would no longer have been assessed on cargo passing through the seaway. The Administration asserted that reliance on tolls would provide the SLSDC with a more flexible and stable source of funding, allowing it to function more like a private corporation. The SLSDC had found that the termination of tolls at the two U.S. locks in 1987 had no effect on shipping volumes and estimated that if those tolls were reinstated, all seaway tolls combined (including Canadian tolls) would amount to only 2% to 3% of a ship's total operating costs through the seaway. It therefore suspected, but without claiming certainty, that returning to a tolling scheme would not adversely affect tonnage through the seaway.[61] Congress expressed no interest in this proposal.

The possibility that higher tolls might drive cargo off the seaway is still a concern. User charges on potential competing waterways are minimal. Barges using the Ohio and Mississippi River system, a competitor to the Great Lakes in terms of site location for industrial plants and as an export pathway, have been assessed a fuel tax, now 29 cents per gallon, since 1978. This tax, which applies to barges using inland waterways other than the Great Lakes, generates around $100 million annually and is estimated to cover 5% to 15% of the federal government's cost of providing the inland waterway system. Thus, while the U.S. inland waterway system is no longer free to users, it is still heavily supported by public funds. The relative user fee charges on the seaway versus those on the U.S. inland waterway system are among many cost elements influencing the relative attractiveness of these waterway routes.

Financing the seaway with some kind of cargo fee, one logical way to raise funds, faces a paradox that is useful to acknowledge. Higher-value cargoes such as containerized goods or new vehicles are most capable of financing the seaway because these shippers are willing to pay more. However, these shippers are the most difficult to attract to the seaway because the higher cargo value increases the importance of transit time and the cost of stockpiling inventory for the winter. Therefore, low-value cargo shippers are most likely to use the waterway. Since a cargo tax must

[60] The 1959 Seaway Tariff of Tolls Agreement.

[61] Oral testimony of Albert Jacquez, Administrator of SLSDC, House Transportation and Infrastructure Committee, Subcommittee on Water Resources and Environment, Hearing on Water and Environment Budget, March 10, 2005.

be kept relatively low on these commodities, raising more funds requires a greater volume of cargo through the seaway. In other words, the SLSDC's strategy must be high volume, low margin. This makes the price competitiveness of the seaway route important (see last section).

Taxing Other Beneficiaries of Waterway Improvements

The possibility of raising revenue from those who benefit from waterway improvements other than shippers is often raised in the context of debates over increases in inland river user fees. Such benefits might include water quality improvements (e.g., municipal drinking water), sewage treatment, recreation on waterway pools, irrigation, cooling water for power plants, hydropower, flood prevention, or an increase in the value of land along the waterway. While often raised by barge shippers, at the federal level, Congress has not required user fees from nonnavigation beneficiaries of waterway projects.

The state of Florida has instituted a property tax to help fund one of its waterways. The Florida Inland Navigation District, a special tax district, is the principal state government entity that manages the Atlantic Intracoastal Waterway from Georgia to the Florida Keys. This is a recreational waterway. Funding is provided by a property tax in the counties that border the waterway. Over the most recent year, the tax generated $22 million; the Navigation District has an available balance of $72 million. The funds are used for dredging, and construction and maintenance of marinas and boat ramps. This year, the district expects to spend $40 million for maintenance of the waterway (mostly dredging) and $15 million for infrastructure improvements.[62]

New York State's Interest in the Seaway

As Florida demonstrates, improvements to waterways located entirely within one state can be easier to pursue since they involve only one political jurisdiction. This raises the question of New York State's interest in financially contributing to the seaway's development because the U.S. portion of the seaway is entirely within New York's borders.

As mentioned above, New York's original interest in the seaway project was primarily hydropower. The hydropower facilities are under the jurisdiction of the New York Power Authority (NYPA), a state agency, which also maintains the dams at Massena. Thus, the SLSDC has no ability to generate revenues from these hydropower facilities. Revenues from the hydropower facilities may be used to maintain a potential rival waterway, the New York State Canal System. The NYPA was recently made responsible for financing the maintenance and development of this system, which is capable of handling modern freight barges along its main stem between Albany and Buffalo and other routes. The maintenance budget for the canals is about $55 million per year plus another $30 million for debt service. Freight traffic on the canal system is currently negligible, but New York continues to promote it as a viable freight waterway. If New York were to succeed in attracting shippers back to its canal system, its toll rates could have some influence over seaway toll rates.

Public-Private Partnerships

Typically, Congress has authorized far more federal waterway construction and maintenance projects than can be executed with the funds Congress has appropriated. This has caused

[62] Florida Inland Navigation District, "Budget," http://www.aicw.org/index.jsp.

multiyear delays in getting many projects under way and a resultant impatience by shippers or local beneficiaries. In response, in the 2014 water projects authorization act,[63] Congress included provisions that potentially allow nonfederal interests (port authorities, local governments, shippers, carriers) to fund or otherwise initiate maintenance or construction projects in lieu of federal funding, but still under the approval and guidance of the Corps of Engineers. The provisions incorporated the language of separate bills (S. 566 and H.R. 1153, 113th Congress) calling for a pilot program of 15 corps projects that could be funded wholly or partly through a public-private partnership (P3).

P3s represent a significant departure from the Corps of Engineers' normal methods of completing projects. Thus far, only one project, involving flood control in North Dakota, has been initiated under the new provisions. At hearings concerning the Corps of Engineers' FY2017 budget in February 2016, some Members of Congress expressed frustration that the corps was not further along in executing P3s and had not issued any policy guidance as to how such projects would be carried out.[64] Expressing similar frustration, the House Appropriations Committee directed the corps not to initiate any additional P3 projects until it had issued a comprehensive policy.[65] Some Members of Congress view P3s as a means of funding the dredging of recreational harbors on the Great Lakes.[66]

Concession of the Seaway to a Private Operator

Turning over operations and management of the seaway to a private operator for a certain length of time is another method that might bring in private-sector capital and reduce costs. Canada offers an example. In 1998, the Canadian government transferred management of the seaway from Transport Canada, the federal department of transportation, to a not-for-profit corporation controlled by Canadian shippers and carriers that use the seaway. The corporation has a 20-year contract and is allowed to increase tolls by 2% per year. Canada settled on this arrangement after finding no private entities interested in purchasing or leasing the seaway.[67] The private management company cut the size of the Canadian seaway staff by more than half. The overall intent of the new arrangement is that the SLSMC be managed more efficiently and be more nimble in responding to rail competition. The introduction of "hands-free" locking technology, discussed below, is one result of this increased attention to competitiveness.

Improving the Price Competitiveness of GLSLS Shipping

The most promising strategy for attracting shippers to the GLSLS is for the system to offer a lower-cost alternative than the competition. An adage in the shipping industry is that "shippers are always willing to pay less for better service."

Both the U.S. and Canadian seaway corporations have measures under way that will marginally improve transit efficiency. They are installing equipment that automatically adjusts a vessel's

[63] CRS Report R43298, *Water Resources Reform and Development Act of 2014: Comparison of Select Provisions*, by (name redacted) et al.

[64] Senate Committee on Appropriations, February 28, 2016; House Transportation and Infrastructure Committee, February 24, 2016.

[65] House Energy and Water Appropriations Committee, H.Rept. 114-532, April 26, 2016, p. 61.

[66] Michael Geatz, "Rep. Miller: Provision Creating First-Ever Great Lakes Navigation System Included in WRRDA Bill, Passes House," *Targeted News Service*, October 23, 2013.

[67] "New Seaway Managers Eye Revival," *Globe and Mail*, October 12, 1998.

position in locks, negating the need for crew to handle lines. They are also installing a more refined means of measuring a ship's draft requirement, in real time, as it moves through the channel.[68] This has allowed ships to move through with up to three more inches of draft, which can translate into as much as 15% more cargo per voyage. The SLSDC could also look into recent developments in electronic navigation that may make it possible to replace physical channel markings and buoys with virtual markers using GPS, the Automatic Identification System (a ship communication and tracking system), and electronic charts. These technologies can potentially eliminate the significant cost of maintaining beacons and removing and repositioning buoys because of the winter season. The SLSDC maintains 99 lighted buoys and 112 fixed aids to navigation on the U.S. portion of the seaway. On the Great Lakes, the Coast Guard has to remove or relocate over 1,200 buoys for the winter season.

However, there are significant cost elements outside the SLSDC's control. A worldwide practice in shipping is that foreign trading ships hire a "pilot" who has local knowledge of the navigation requirements for a particular harbor or waterway. The pilot essentially captains the ship in and out of the harbor.[69] A ship navigating the entire system from the mouth of the St. Lawrence River to the Port of Duluth, MN, must hire and pay for five pilots, two of them Canadian for the eastern-most portions of the St. Lawrence River. In March 2016, the Coast Guard increased pilotage rates so that the 37 American pilots each would receive a total compensation of $326,000 per year, with 10 days off each month during the nine-month shipping season.[70] The Coast Guard determined this rate based on the compensation of Canadian pilots and its judgment as to the rate necessary to attract a sufficient number of pilots to avoid traffic delays.[71] That determination is controversial because it represents a 58% increase in pilotage rates, according to the Great Lakes Ports Association. Great Lakes ports contend that the cost of pilotage at this rate now exceeds a ship's daily operating cost in the Great Lakes and is eroding the competitiveness of the Great Lakes navigation system.[72] They argue that ships sailing on the GLSLS (west of Montreal) are competing with truck and rail modes and thus require lower costs than ships sailing to coastal ports.[73] Great Lakes ports have sued the U.S. Coast Guard, arguing its methodology for determining pilotage rates violates the Administrative Procedure Act.[74] The SLSMC is attempting to repeal the requirement that ships hire pilots on the two segments of the St. Lawrence east of Montreal. This portion of the river is much wider and deeper than the portion farther upstream and appears to pose fewer navigational restrictions. The seaway could also examine the policies of some U.S. ports that allow captains familiar with the harbor to pilot their own vessels and pay a reduced pilotage fee.

A model of how waterborne shipping can compete with railroads is demonstrated within the Great Lakes. Ships outcompete railroads in moving Mesabi iron ore to Great Lakes steel mills. This

[68] A ship's draft—its required depth—varies with changes in vessel speed and channel width.

[69] For further information on pilots, see CRS Report R44566, *The Coast Guard's Role in Safeguarding Maritime Transportation: Selected Issues*, by (name redacted)

[70] 81 *Federal Register* 11908, March 7, 2016.

[71] In 1995, Great Lakes pilotage rate-making was transferred from the Coast Guard to the SLSDC. However, some pilotage groups sued, claiming the Department of Transportation did not have the authority to make this change. After a court ruling in favor of the pilot groups, pilotage rate-making was transferred back to the Coast Guard in 1998; 63 *Federal Register* 10781, March 5, 1998.

[72] American Great Lakes Ports Association's final comments on the 2016 Great Lakes Pilotage Rate Increase, n.d., http://www.greatlakesports.org/wp-content/uploads/2016/03/FINAL-Comment-to-Docket-ID-2015-0497.pdf.

[73] "Shippers Sue Coast Guard Over 'Runaway' Great Lakes Pilotage Fees," n.d., http://www.professionalmariner.com.

[74] *American Great Lakes Ports Association et al. v. Zukunft et al.*, No. 16-1019 (D. D.C. filed May 31, 2016), http://www.joc.com/sites/default/files/u1390826/2016-05-31%20%281%29%20Complaint.pdf.

may be the only major domestic route on which ships have maintained a long-term advantage over a parallel rail service. These ships operate 24/7, as do the ports where they unload. The ships unload with no onshore assistance (no port workers); each vessel is equipped with a conveyor in the hull and on deck. Bow and stern thrusters (propellers) that can move the ships sideways eliminate the need for tugs to push them into the docks. The ships also do not require pilots because they are in domestic service. In other words, these shipping lines have control over their own costs and have scheduling flexibility similar to that of railroads.

Undoubtedly, part of the reason for the ships' advantage over rail has to do with the nature of the commodity: it is exceptional in the sheer volume needed and the density (weight) of the material. The vertical integration of these shipping operations is also important because some of the iron mines are owned by steel companies that deliver ore to their own docks, load it aboard their own ships and barges, and offload it at their own steel mills. Nevertheless, it is possible that GLSLS shipping could compete more successfully with railroads and trucks by offering similar efficiencies.

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