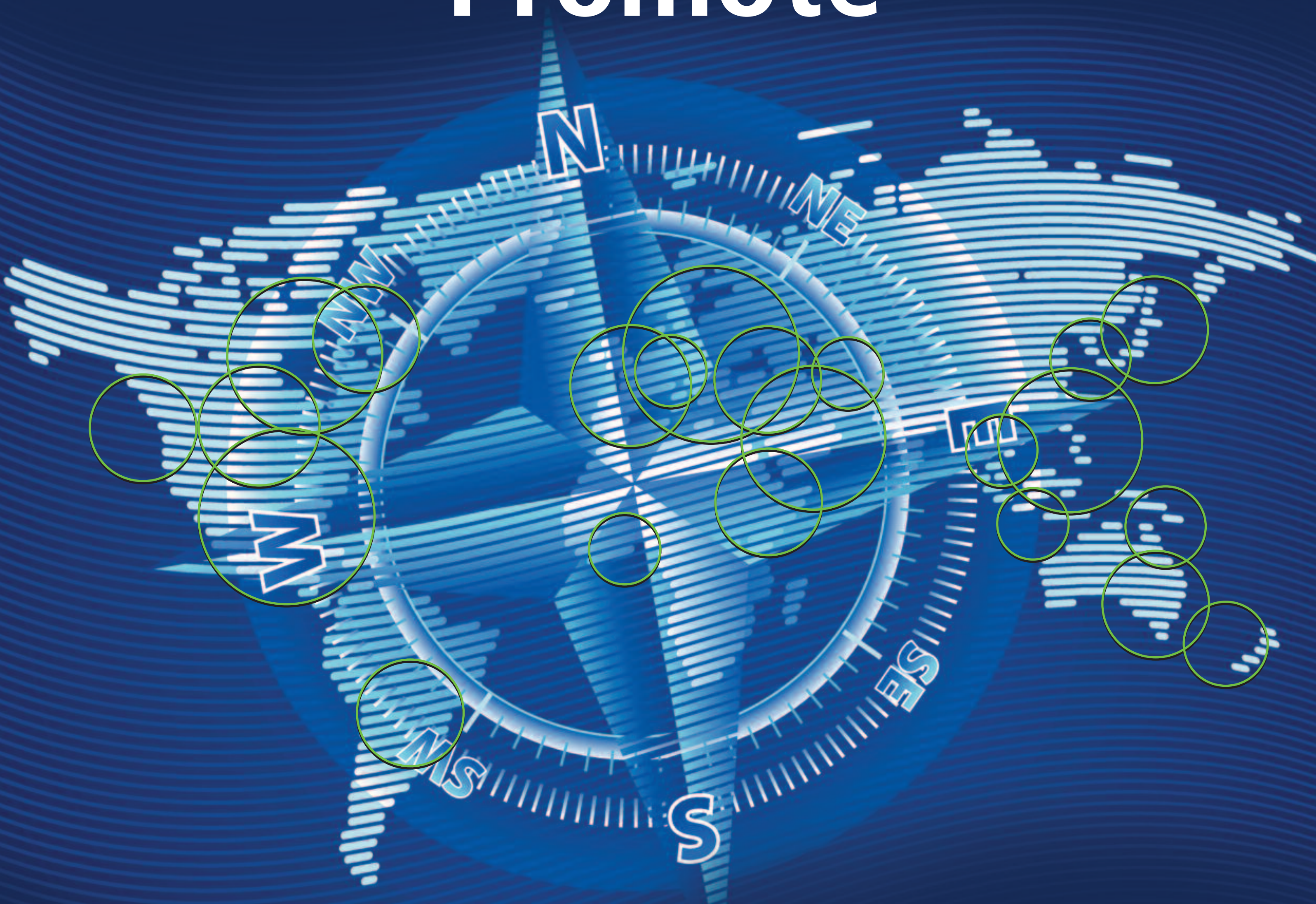
Define, Defend *and* Promote



The Need to Differentiate Short Sea Shipping from International Shipping in the Application and Development of IMO Conventions and National Regulations and Policies

Prepared for the CSL Group – September 2013

Research and Traffic Group
www.rtg.ca

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About the Study Authors

The report *Define, Defend & Promote: The Need to Differentiate Short Sea Shipping from International Shipping in the Application and Development of IMO Conventions and National Regulations and Policies* was commissioned and produced in collaboration with CSL Group. Transportation consultants Research and Traffic Group conducted the research and analysis presented in this study. IMEAS Corp. made contributions to, and edited, the final report.

CSL Group

The CSL Group is the world's largest owner and operator of self-unloading vessels. Headquartered in Montreal with divisions based in the United States, the United Kingdom, Norway, Singapore and Australia, CSL delivers more than 70 million tonnes of cargo annually for customers in the construction, steel, energy and agri-food sectors.

Research and Traffic Group

For more than two decades, Research and Traffic Group has provided advice and assistance to clients, and undertaken important studies in transportation.

Gordon English (B.Sc., M.B.A., P. Eng.) has been a partner since 1999, and an active associate since 1994, leading projects focused on energy, safety and techno-economic feasibility evaluations. Mr. English has more than 37 years' experience conducting transportation-related research. He previously worked as the Director of Research for the Canadian Transportation Safety Board Act Review Commission and in various positions at the Canadian Institute of Guided Ground Transport at Queen's University.

David C. Hackston (B. Comm, B. Arts, FCILT) has been a partner since 1988, assisting clients with analyses related to rail transportation, intermodal and Great Lakes-Seaway issues. He has more than 40 years' experience in the transportation sector, including providing the *Canada Transportation Act Review* with expert advice on rail freight and passenger issues. He previously served with the Canadian Transport Commission as Executive Director, Traffic and Tariffs, advising on rates and public interest issues for rail, motor vehicle and marine. This followed a nine-year career at CP Rail.

James Frost, (MA, MBA, CMC) has been an Associate for 5 years and has over 30 years of experience in the North American marine sector. He has been President of MariNova Consulting Ltd. since 1995 and prior to that, managed a container feeder/transhipment service operating between the traditional trading links of Halifax and Boston, and was marketing manager for a large ferry company operating on Canada's East Coast.

IMESA Group

As founder and President of IMESA, **Gary Croot** has over 25 years of experience in the fields of marine safety, environmental protection, and international regulatory compliance and enforcement. He retired from the U.S. Coast Guard in 2011 as Chief of the Environmental Standards Division where he developed a wide variety of environmental regulations including ballast water management, control of marine debris, and dry cargo residue. He also administered the Coast Guard's innovative Shipboard Technology Evaluation Program (STEP), which has facilitated the development and installation of effective ballast water treatment technologies. Gary led and participated in numerous Congressional briefings focusing on the intricacies of ballast water regulation and legislation and served on joint panels with representatives of the U.S. EPA's Office of Water.

Executive **Summary**

As this report demonstrates, short sea shipping (SSS) requires an internationally accepted "**definition**" and a sizable segment of the world's fleet of shipping vessels needs to be strongly "**defended**" and "**promoted**" in the international regulatory arena and within adopting IMO Member national regulations.

Vessels engaged in short sea shipping are an important component of the global fleet. Analysis by Research and Traffic Group (RTG) estimates that the worldwide SSS fleet contains close to **16,000 vessels** with a combined deadweight tonnage **(DWT) of 77 million tonnes**.

Short sea shipping makes a significant socio-economic contribution to many nations. Promoting SSS trade contributes to the social good, by supporting a transportation mode that is safer in terms of injuries and fatalities and produces lower emissions than land modes. The economic value of SSS is also considerable in many countries in North America, Europe and the Far East, creating large numbers of direct and indirect jobs, and generating significant tax revenue for governments.

There is currently no clear advocate for the various SSS trades at the International Maritime Organization (IMO) or within the International Chamber of Shipping (ICS), and issues specifically affecting SSS are typically handled on an ad hoc basis. The trans-oceanic trades, on the other hand, are strongly represented at the global level and well-organized around key issues. Consequently, international maritime conventions best represent the interests of the ocean-going trades and frequently produce negative impacts for short sea shipping.

There is currently no clear advocate for the various SSS trades at the International Maritime Organization …

As detailed within this report, such is the case for two recent environmental IMO Conventions: the proposed Ballast Water Management Convention and parts of Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL) — the components dealing with Emission Control Areas (ECAs) and the technical components of the Energy Efficiency Design Index (EEDI).

Although these conventions are well-intentioned, aimed as they are at reducing the environmental impact of shipping, they threaten the interests of short sea shipping and are creating risks that could shift trade away from SSS to the rail and truck modes.

The unconsidered consequences of these conventions are negative to the environment in that they promote a negative modal shift to land transportation. They have come about in part because there is no mechanism at the IMO to analyze the impacts of impending regulations on the SSS sector, in order to advise member delegations before adoption.

Recommendations

1. DEFINE: IMO should establish a common definition of Short Sea Shipping.

In order to better focus and consolidate the interests of SSS globally, a widely accepted and broadly inclusive definition must be adopted …

Several countries and regions throughout the world have established their own unique — and sometimes geo-political — definitions of short sea shipping. In order to better focus and consolidate the interests of SSS globally, a widely accepted and broadly inclusive definition must be adopted — one that encompasses all aspects of SSS, and that would be acceptable to national and international governing bodies. While typically, short sea shipping primarily competes with road and rail, not all instances of SSS meet this absolute definition due to present infrastructure. Therefore, the definition should be broader as the same socio-economic benefits exist prior to the road and rail sectors being induced to set up for these additional tonnes. The following definition is recommended:

> **Short sea shipping (SSS) is defined as the commercial shipment of cargo or passengers by domestic and international maritime transport. In general, this subsector of marine transportation operates in coastal and inland waterways, does not cross an ocean and often competes with road and rail networks.**

While this definition may be inconsistent with some entities' definitions that seek to broadly expand geo-political boundaries (e.g., U.S. Marine Highways and the EC Shortsea Shipping Network), or with nations with particular interest in any one trading segment (container shipping, for example), it is consistent with the broad intent of SSS and with existing international conventions such as the SOLAS and Loadline Conventions.

2. DEFEND: IMO Member Administrations should establish a mechanism, either a new Sub-Committee or a Working Group within an existing Sub-Committee, to evaluate and make recommendations for the protection of the Short Sea Shipping sector, prior to adopting International Conventions that include the sector. The Sub-Committee or Working group should work with the SSS industry to identify the disproportionate and hidden impacts of Conventions on the industry.

Nearly all segments of the maritime industry are represented at the IMO by non-governmental organization (NGO) participants. At MEPC-64, there were no fewer than 15 such organizations representing nearly all facets of shipowners and operators. However, none of these organizations purport to solely represent the interests of SSS operators. While it is very important to ensure SSS interests are adequately represented by member administrations, it is equally important for SSS to have its own voice at the IMO. Until such an entity exists, various NGOs with SSS members and administrations with SSS interests should carefully balance these needs prior to the adoption of policies and conventions.

3. DEFEND: A mechanism must be developed within the International Chamber of Shipping (ICS) and/or within an exclusive Non-Governmental Organization, to ensure the interests of Short Sea Shipping are represented at the IMO, exclusive of Administration representation.

As outlined above, the impacts of international conventions — and often the more expansive national implementing regulations for those conventions — have a significant, disproportionate effect on short sea shipping. Thus, SSS organizations must identify agencies within their national administrations that are involved in policy development and convention negotiation, and educate the decision-makers on the socio-economic impacts of the SSS industry. Additionally, they must provide factual input and communicate the likely impacts of existing conventions; conventions that have not yet come into force; and proposed conventions and amendments (along with their national implementing laws and regulations) on the SSS industry. Likewise, federal administrations must be willing to engage SSS interests; make a concerted effort to better understand the impacts of the SSS industry; and understand the impacts of conventions and regulations on the SSS industry.

SSS organizations must identify agencies within their national administrations that are involved in policy development and convention negotiation, and educate the decision-makers on the socio-economic impacts of the SSS industry.

4. DEFEND: Short Sea Shipping nations should adopt as policy a defence of domestic Short Sea Shipping interests when adopting International Marine Conventions and in subsequent adoption of National Regulations.

In addition to recognizing the disproportionate impacts of international conventions on short sea shipping, administrations and the IMO must fully appreciate and value the public good associated with the continued development of short sea shipping as an integral part of a nation's domestic and international trade policies. To that end, the SSS industry, both regionally and globally, needs to develop quantified data and undertake analyses of the socio-economic impacts of unintended mode shifts from existing vessel routes to road and rail that could result from adoption of IMO policies. These include potential domestic policy disparities across competing modes in the SSS jurisdiction, and undesirable public impacts of unintended mode shifts (e.g., on employment, infrastructure maintenance costs, taxation revenues, transport injuries and fatalities, GHG and local CAC air emissions). While the IMO needs to encourage nations to adopt international conventions, it also needs to allow nations to modify the enabling regulations as applied to SSS operators, such that a fair and equitable representation of public good is realized.

5. PROMOTE: Short Sea Shipping nations must be clearly identified and targeted by SSS national shipping associations. Clear, concise and up-to-date information on the full socio-economic benefits — including public safety, reduced highway congestion, economic value and environmental footprint — must be fully evaluated and appreciated by political decision-makers and public advocacy groups.

Overall, there is a scarcity of reliable data for the short sea shipping segment of the transportation industry. Thus, many national governments do not have an appreciation for the socio-economic impacts of SSS on their countries or regions. As a distinct example, until the Canadian St. Lawrence Seaway Management Corporation and the U.S. St. Lawrence Seaway Development Corporation jointly sponsored an economic report for the North American Great Lakes region, there was no reliable data upon which governments could rely to make policy decisions. The resulting study reported that the Great Lakes-St. Lawrence Seaway maritime transportation system was responsible for producing 227,000 direct, induced and indirect jobs for the region with a business revenue impact of $35 billion. In addition, Great Lakes-Seaway shipping has a wider related impact on jobs, income and tax with the shippers (mining companies, farmers, manufacturers etc.) and supporting industries that move cargo through the marine terminals. Related jobs totalled 477,593 with a related business revenue impact of CDN$119 billion. SSS industry leaders need to advocate aggressively to local, national, regional and international decision-makers who are in a position to effect change.

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1 Introduction to Short Sea Shipping

1.1 Objective and Purpose

The objective of this report is to provide an in-depth analysis of short sea shipping (SSS) throughout the world, with a particular emphasis on North America. It compares SSS with traditional trans-oceanic shipping to demonstrate the significant differences between these two shipping trading routes and the resulting disparity in the application of international conventions and regulations. The purpose of the report is to provide information to decision-makers and vessel owners to help effect change in the international regulatory scheme, as it relates to vessels engaged in SSS.

Since the focus is on the effects of international conventions on SSS, segments of the SSS trading routes that are not directly captured under international conventions are not included in the datasets.[1]

For example, although the U.S. inland rivers tug and barge fleet is an important SSS component, it is not represented in this report. Instead, the focus is on ships, which do fall under the regulations of international maritime conventions.

1.2 Background and Terminology

Short sea and/or domestic shipping have been around for centuries and have been an integral part of many countries' domestic transportation strategies. Short sea shipping has a rich history in the North American Great Lakes, as well as in coastal European trade and in the Far East, including Australia. While some international conventions — such as the International Convention for the Safety of Life at Sea (SOLAS), some Annexes of the International Convention for the Prevention of Pollution from Ships (known as MARPOL, from "marine pollution") and the International Loadline Convention — make specific allowances for vessels engaged in near-shore, coastal or domestic shipping trading routes, others do not adequately address the unique aspects of SSS. Additionally, the SSS definition is often confined to the intermodality of container traffic; as shown throughout this report, SSS includes the transportation of a variety of goods and people on a wide range of vessels. If change is to be accomplished in the international arena

1 Although many provisions of international conventions do not directly apply to some segments of the SSS fleet, the domestic regulatory implementation of conventions frequently does apply. Such is the case for the North American Emission Control Area (ECA). However, currently, the converse is true for the Ballast Water Management Convention. The U.S. implementing regulations for ballast water management exempt vessels that do not transit outside the ECA boundary line (i.e., non-seagoing vessels).

with respect to SSS, it will be important to first, identify a basic understanding of the similarities and differences in SSS globally, and develop a clear definition or description to ensure all vessels engaged in SSS are appropriately captured.

1.2.1 European Commission

In its report on short sea shipping (European Commission, 1999), the European Commission defined short sea shipping as "the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe." Confusing the issue, the European Shortsea Network includes a multimodal or intermodal facet to its description of SSS, with an emphasis on containerized cargo. Additionally, the EC incorporates all member countries within its definition (including Iceland), irrespective of whether the voyage is trans-oceanic. As a result, the European public's perception of SSS may be more restrictive from a trade perspective, yet more expansive from a geographic perspective, than in other parts of the world.

1.2.2 U.S. Department of Transportation Maritime Administration (MARAD)

The term "Marine Highway" has become somewhat synonymous with short sea shipping in the U.S.; yet, there are significant differences. "Marine Highway" refers to specific coastal or inland waterways that have been designated by the Maritime Administration (MARAD) of the U.S. Department of Transportation (DOT) as having the potential to relieve landside congestion — as a means to encourage expansion of U.S. commercial shipping on that waterway. Similar to the EC's inclusion of Iceland in its definition, the U.S. has included Hawaii and Puerto Rico — both of which include non-coastal voyages — in the definition of Marine Highway, presumably for political or economic reasons. However, MARAD has defined SSS as coast-wise waterborne transportation of freight and/or passengers by navigable waterways without crossing an ocean. Thus, although a significant majority of waterways and routes captured by the Marine Highway Program are also SSS routes, there are notable differences.

1.2.3 Transport Canada

On its website, Transport Canada defines SSS — in the context of North American operations — as a multimodal concept involving the marine transportation of passengers and goods that does not cross oceans and takes place within and among Canada, the United States and Mexico.

1.2.4 Recommended Definition

While it is undeniable that short sea shipping and intermodal transportation are inexorably linked, it is important not to limit the definition of SSS to intermodal or multimodal operations. While a more broad and inclusive definition may initially cause some confusion, a hybridization of the definitions widely accepted throughout the world should help consolidate and focus the unique regional aspects of SSS. We therefore recommend adopting the following definition of short sea shipping:

Short sea shipping (SSS) is defined as the commercial shipment of cargo or passengers by domestic and international maritime transport. In general, this subsector of marine transportation operates in coastal and inland waterways, does not cross an ocean and often is in competition with road and rail networks.

This definition would encompass North America's Great Lakes and coastal operations and much of the continent's international coastal operations. However, Research and Traffic Group (RTG) notes that many policy makers have a different perception, being highly influenced by the European Shortsea Network's definition that is focused on "intermodal transport" and "usually involving containers," and the inclusion of non-coastal partners (such as Iceland), as well as MARAD's Marine Highway Program. The proposed definition is also more consistent with the definitions and intent of the International Loadline Convention and SOLAS than with the EC's or MARAD's more geographically expansive definitions.

We also recommend that the SSS industry clearly note this proposed definition in every presentation it makes and dissuade other marine organizations from creating and/or using alternate definitions of the SSS term. This definition has broad, global application and does not employ artificial (political) geographic boundaries. Hereinafter, the term short sea shipping will be defined as above. Additionally, it is important to note that regardless of the definition employed, SSS trade often competes directly with land modes of transportation, such as rail and truck, which are regulated differently than SSS. This is in stark contrast to trans-oceanic shipping — in which shipping companies compete against one another for trade, but where international regulations affect all competitors more or less equally.

1.3 Public Perceptions of the Maritime Industry

Traditionally, the maritime shipping industry has not done a good job of self-promotion, particularly when compared to modes of land-based transportation, such as rail and truck. While those transportation industries often have had extensive mass media promotional campaigns, the maritime shipping industry had remained primarily silent. As a result, the general public — particularly in North America — had a poor understanding and appreciation of the value of maritime shipping.

1.3.1 Data and Information Gaps

Contributing to the public perception of the maritime industry was a scarcity of reliable data and information regarding many aspects of commercial shipping, particularly as it applies to the Great Lakes. In addition to contributing to an incomplete understanding of the value of maritime shipping on the part of the public, these data and information gaps can also have significant negative effects on lawmakers and regulators at all levels.

1.3.2 Recent Initiatives

Realizing these shortcomings, the Great Lakes maritime industry, through the Chamber of Marine Commerce, commissioned two studies to demonstrate the tremendous social and economic impacts of the the short sea shipping industries in Canada and the United States:

- *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*; and
- *Environmental and Social Impacts of Marine Transport in the Great Lakes-St. Lawrence Seaway Region*

These comprehensive studies clearly demonstrate the importance of maritime trade — and short sea shipping, in particular — to the economies and social structure on both sides of the border. These studies have received widespread distribution and interest among the media and in the local, provincial, state and federal governments in Canada and the U.S., and their results are routinely quoted as a matter of record.

In an effort to better project a positive image of maritime shipping, the Marine Delivers program was also launched.

> **Marine Delivers is a bi-national industry collaboration created to demonstrate the positive economic and environmental benefits, safety, energy efficiency and sustainability of shipping on the Great Lakes Seaway System. The primary mission of the Marine Delivers communication program is to provide responsible, timely, consistent and relevant information to help shape a positive image of the Great Lakes-St. Lawrence Seaway maritime industry.**

Other regions and countries have also sought to encourage a better public understanding of the importance of SSS to their region. In their paper, Drs. Bendall and Brooks (Bendall & Brooks, 2010) evaluate the commercial and regulatory landscape in Australia and propose regulatory measures that would encourage a shift from land modes, such as truck or rail, to short sea shipping. Such a proposed shift would lessen highway and rail congestion, potentially reduce shipping costs and decrease air emissions.

1.4 Size and Composition of the Global Short Sea Shipping Fleet

The following estimates the size of the global shipping fleet by region.

1.4.1 Size Estimation for the Global SSS Fleet

As noted above, the paucity of information and databases related to the maritime industry, combined with differing definitions of “short sea shipping”, “coastal”, “inland”, and “domestic” fleets, makes it challenging to produce a numeric estimation of the global SSS fleet.

In working on this phase of the project, RTG researched various sources of information to gain insight on the importance of short sea shipping and inland waterways transport around the world. The most complete data available were found to be those published by the International Transport Forum (ITF), a body established by the Organisation for

Economic Cooperation and Development (OECD). The most complete data found were for 2008 — later data were absent for several countries listed for 2008 — and later years' data would also reflect the impact of the economic downturn that commenced in 2008.

Appendix A contains a full description of the methodology that RTG used to develop estimates for the global short sea shipping fleet, as well as a brief characterization of the various unique SSS fleets throughout the world. The following is a synopsis of that process.

To estimate the size of the world fleet involved in SSS, RTG made an extract of vessels from the 2012 version of the Lloyds/Fairplay Vessel Registration Database, using the following criteria:

- All vessels flagged in countries with cabotage protection (e.g., Canada, U.S., Japan, Australia), excluding large vessels (over 45,000 deadweight tonnage [DWT] or 1,500 twenty-foot equivalent units [TEU])[2].
- In all other countries, smaller vessels as defined below:
  - tankers, roll-on/roll-off (Ro-Ro) and general cargo < 125m.;
  - bulkers < 150 m.; and
  - containerships < 1500 TEU.

The results of this extract are summarized in Table 1. **The estimated size of the global SSS fleet is close to 16,000 vessels with a combined DWT of 77 million tonnes**.

Table 1: Estimated Size of the Coastal/SSS Fleet (excluding barges)

Flag	Count/DWT	Vessel Type				
		Bulk and SU	Tanker	General and Ro-Ro	Container	Total
Canada	Count Total DWT	73 2,362,251	103 842,450	48 163,645	2 16,657	226 3,385,003
U.S.*	Count Total DWT	54 2,107,208	24 1,022,726	- -	29 2,096,931	107 5,226,865
Japan	Count Total DWT	308 802,457	411 517,436	656 741,253	14 25,998	1,389 2,087,144
Australia	Count Total DWT	8 216,750	8 46,193	23 229,033	- -	39 491,976
All other/ smaller vessels**	Number Total DWT	648 8,144,403	3,466 9,588,034	8,087 26,797,119	1,810 21,376,528	14,011 65,906,084
Grand Total	**Number** **Total DWT**	**1,091** **13,633,069**	**4,012** **12,016,839**	**8,814** **27,931,050**	**1,855** **23,516,114**	**15,772** **77,097,072**

Source: Derived from the Lloyds/Fairplay Vessel Registration Database

* U.S. are U.S. flagged and U.S. company-owned vessels, with containerships limited to those < 1,500 TEU capacity.
** All other countries' smaller vessel criteria are: tankers, Ro-Ro and general cargo < 125m.; bulkers < 150 m.; and containerships < 1500 TEU.

2 While 45,000 DWT would include vessels in ocean trade, it is believed that the cabotage restrictions imposed by these countries would not make it economical to use domestically registered vessels in ocean service.

1.4.2 Composition and Characterization of the Global SSS Fleet

The data in Table 1 do not show the diversity of vessels employed in the various trades. For example, the inland waterways of Europe are home to a large number of small vessels employed in the transport of manufactured goods and other containerized cargo, as well as being important suppliers to heavy industry, such as iron and steel. Transport on Europe's inland waterways has similarities to transport on the Great Lakes, except that there is a major difference in the size of vessels employed and the conditions under which they operate. It is also interesting to note that the variety of powered barges on the inland waterways of Europe includes tankers, bulkers and general cargo vessels (see Figure 1). The Baltic also has some similarities to the Great Lakes, in that the large markets are located in the South, while the resource-producing countries are located in the North.

Figure 1: Traffic on the Rhine (left) and Bulk Transport on the Moselle[4] (right)

Source: RTG

It is worth noting the similar dependence of traffic on the steel industry on both the Moselle and on the Great Lakes. Many of the barges plying the Moselle from Northern France to the Ruhr carry coal and iron ore, the raw materials required in steelmaking. In earlier work, RTG has noted and commented on the essential relationship between carriage of iron ore and coal to the steel mills around the Great Lakes and the economic well-being of these mills. For example, while the steel mills in Hamilton and Nanticoke have rail service, none of these mills has the current capability to receive raw materials by rail — and, while rail unloading facilities could be added, the costs of using this mode would probably far exceed those of the current bimodal routes[3] now used. The same could be said for the steel mills and thermal electric plants on the U.S. side of the Lakes, which are currently receiving iron ore and coal by the rail-lake route. At the least, alternative-mode routing provides competition and helps to keep down the prices of delivered raw material.

3 Ore is railed from the mine directly to processing facilities at loading ports and vessels carry the cargo directly to steel mills.

4 According to the Encyclopedia Britannica online edition, the Moselle can handle barges of up to 1500 tonnes between Metz (France) and Koblenz (Germany) where it runs into the Rhine.

2 Economic Benefits of Short Sea Shipping

The following describes the important economic contributions of short sea shipping.

2.1 North American Great Lakes

Millions of tonnes of traffic move on the Great Lakes-St. Lawrence Seaway System each year. This includes overseas import-export traffic that is mostly loaded/unloaded at St. Lawrence River ports but also some traffic into the Great Lakes (e.g., raw steel) and out of the Lakes (e.g., grain). Due to the cabotage laws of both countries, virtually all of the traffic that is carried between two points in North America is carried by either Canadian or U.S. flag vessels. Intra-Lakes traffic is the domain of the domestic Canadian and U.S. laker fleets. Combined, they handle approximately 150 million tonnes of freight annually. Traffic between two points in the United States is reserved for U.S.-flag vessels, while traffic between two points in Canada is reserved for Canadian-flag vessels — unless an exemption is obtained pursuant to the *Coasting Trade Act*.

Without the Canadian Great Lakes fleet and the Seaway, it would not be economically possible to deliver iron ore from Quebec/Labrador to Canadian and U.S. steel mills along the Lakes.

The Great Lakes fleets haul enormous volumes of coal and iron ore to the steel mills, and coal to the thermal generating stations located along the Lakes. They also carry large volumes of aggregate, both fluxing limestone and construction-grade aggregate. The existing rail system would be hard pressed at best to carry these volumes — and in some cases, rail-loading capability is not available at origin (e.g., Meldrum Bay), or receiving facilities are not in place at destination (e.g., steel mills in Hamilton). Without the Canadian Great Lakes fleet and the Seaway, it would not be economically possible to deliver iron ore from Quebec/Labrador to Canadian and U.S. steel mills along the Lakes.

Accordingly, the importance of the Great Lakes fleets to industry in the Great Lakes-Seaway System cannot be underestimated. In 2011, Martin and Associates was commissioned to undertake a study into *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*.

In 2010, 322.1 million tonnes of freight were handled at ports on the Great Lakes-Seaway System in Canada and the United States. Martin estimated that this equated to 226,833 jobs and total economic activity of CDN$34.6 billion.[5] Direct, induced and indirect taxes paid to federal, state/provincial and local authorities were CDN$4.7 billion.[6]

5 Martin Associates, *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*, October 18, 2011, p.28 and p.31.

6 Ibid, p.31

In addition, Great Lakes-Seaway shipping has a wider related impact in terms of jobs, income and tax with the shippers (mining companies, farmers, manufacturers, etc.) and supporting industries that move cargo through the marine terminals. These impacts are classified as related because the firms using the ports can — and in some cases do — use other ports outside the Great Lakes-St. Lawrence Seaway System. The study estimated that the Great Lakes-Seaway System was responsible for 477,593 related jobs, with a related business revenue impact of CDN$119.0 billion. Related personal income impacts were estimated at CDN$23.4 billion, while state/provincial and local taxes were CDN$2.5 billion and federal taxes were CDN$4.8 billion.[7] Of these totals, approximately 92% of the jobs, income and taxes were generated as a result of SSS activities.

Appendix B provides specific data and tables from the Martin Associates report — detailing the impacts of short sea shipping on the Great Lakes-Seaway System regarding jobs created; volumes of cargoes handled; and taxes and income generated in both Canada and the U.S.

The EU is the largest trading bloc in the world and 2% of its GDP comes from the maritime cluster, representing 350,000 jobs.

2.2 Europe

Research Traffic Group was not able to find detailed data on the economic benefits of short sea shipping trading routes in Europe. Perhaps other studies might be better suited to quantify these benefits in the European context.

The shipping industry is critical to the welfare of the European economy. According to the European Commission (EC), about 90% of the world's trade and the same percentage of European Union (EU) external trade are carried by sea. About 18% of world tonnage is registered under various EU flags and 33% of the world fleet is controlled by EU shipping companies (equal to 8,700 and 12,200 ships, respectively). The EU is the largest trading bloc in the world and 2% of its GDP comes from the maritime cluster, representing 350,000 jobs.[8] The cluster is particularly significant in Denmark; with a population of just 5 million people, over 100,000 people — or 2% of the nation's population — earn their living in the shipping sector.[9]

Surprisingly, given the emphasis on modal shift in Europe, and contradictory to some other suggestions, the relative share of short sea shipping and inland transportation has declined since 1995. Both rail and sea have seen losses to road over that period. Road has seen its share of the transportation market increase by 10.7% over the period, while inland and SSS modes have decreased by a total of 19.4% over the same period. Short sea shipping does, however, account for a larger percentage of EU-27 (EU members excluding Croatia) shipping than does deep sea shipping. This pattern is especially prevalent in countries such as Sweden and Finland.[10]

7 Ibid, pp. 85-86.

8 Jonathan Scheele, "An EU Perspective", presentation to 2nd European Shortsea Congress, Liverpool, 2009.

9 "The Danish Maritime Cluster: An Agenda for Growth", Danish Maritime Authority, 2006.

10 SKEMA Coordination Action, "Sustainable Knowledge Platform for the European Maritime and Logistics Industry", W.P. no. 2, May 2011.

While the North American Great Lakes-Seaway SSS market is comprised predominantly of bulk carriers, the European market is more balanced — with bulk liquid cargoes comprising approximately half of the tonnage; dry bulk comprising less than one quarter; and the remaining tonnage split between Ro-Ro, container and general cargo. Additional information on the breakdown of cargoes is contained in Appendix B. Figure 2 illustrates the relative shares of each type of SSS in Europe.

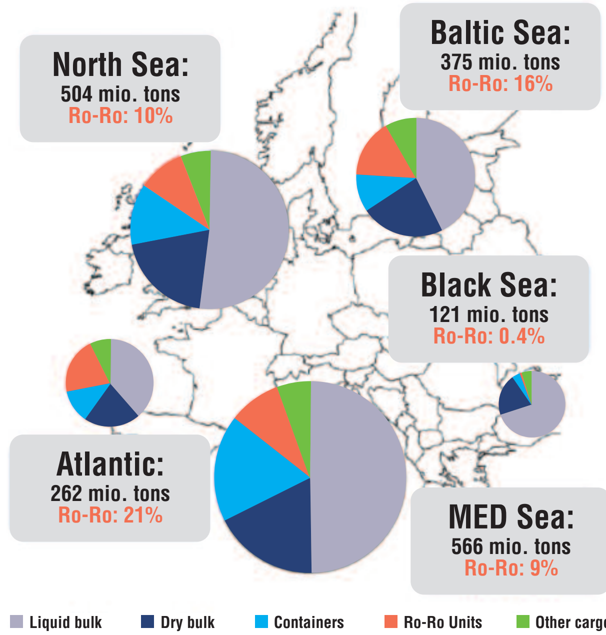


Figure 2: Total SSS in 2009: 1.68 billion tons (Eurostat)

2.3 Australia

In Australia, the focus is more on bulk shipping than other sectors.[11] The country has a long coastline of 37,000 nautical miles; when its islands are included, this increases to 60,000. Almost 99% of the country's international trade moves by water, but only 26% of domestic cargo is moved by coastal shipping, a decrease of 44% over 20 years.

As Bendall and Brooks point out, the number of vessels in the Australian coastal trading fleet has been declining for some time. In 1996, this fleet had 75 ships; by 2006, the number had declined to 46 and just two years later, the fleet included only 35 vessels. Of these, 21 were bulk ships and there were few licensed Australian- or foreign-registered container vessels in the country's coasting trades. As the number of Australian ships in coastal trade has declined, so has their market share in terms of cargo tonne-km. In 1984, SSS held a 43% market share but by 2001, that share had decreased to 28%. Partly as a result of the liberalization of cabotage requirements, SSS has been able to retain/regain its 28% market share as of 2010.[12] Additionally, unlicensed foreign-registered vessels may trade along the Australian coast under special permit. These vessels carried 15 million tonnes of cargo in 2008 — 95% of which were dry and liquid bulk cargoes.

… the number of vessels in the Australian coastal trading fleet has been declining for some time. In 1996, this fleet had 75 ships; by 2006, the number had declined to 46 and just two years later, the fleet included only 35 vessels.

There is a belief that coastal shipping is competitive in Australia only in corridors exceeding 2,200 road km, while for distances under 1,500 km, road transport will dominate.[13] Existing domestic shipping trades include:

- Bass Strait trade — containers, trailers, break bulk;
- Mainland inter-state containers — east–west using international container vessels or domestic, when available;
- Remote area and other domestic non-bulk trades;
- Domestic bulk and break bulk trades — cement, gypsum, bauxite, alumina, iron ore, petroleum products, iron and steel products.

These trades and associated mode shares are illustrated in the map of Australia in Figure 3.

11 This section is largely based on Helen B. Bendall and Mary R. Brooks, "Short sea shipping: Lessons for or from Australia, Institute of Transport and Logistics Studies, University of Sydney, Working Paper ITLS-WP-10-12, June 2010.

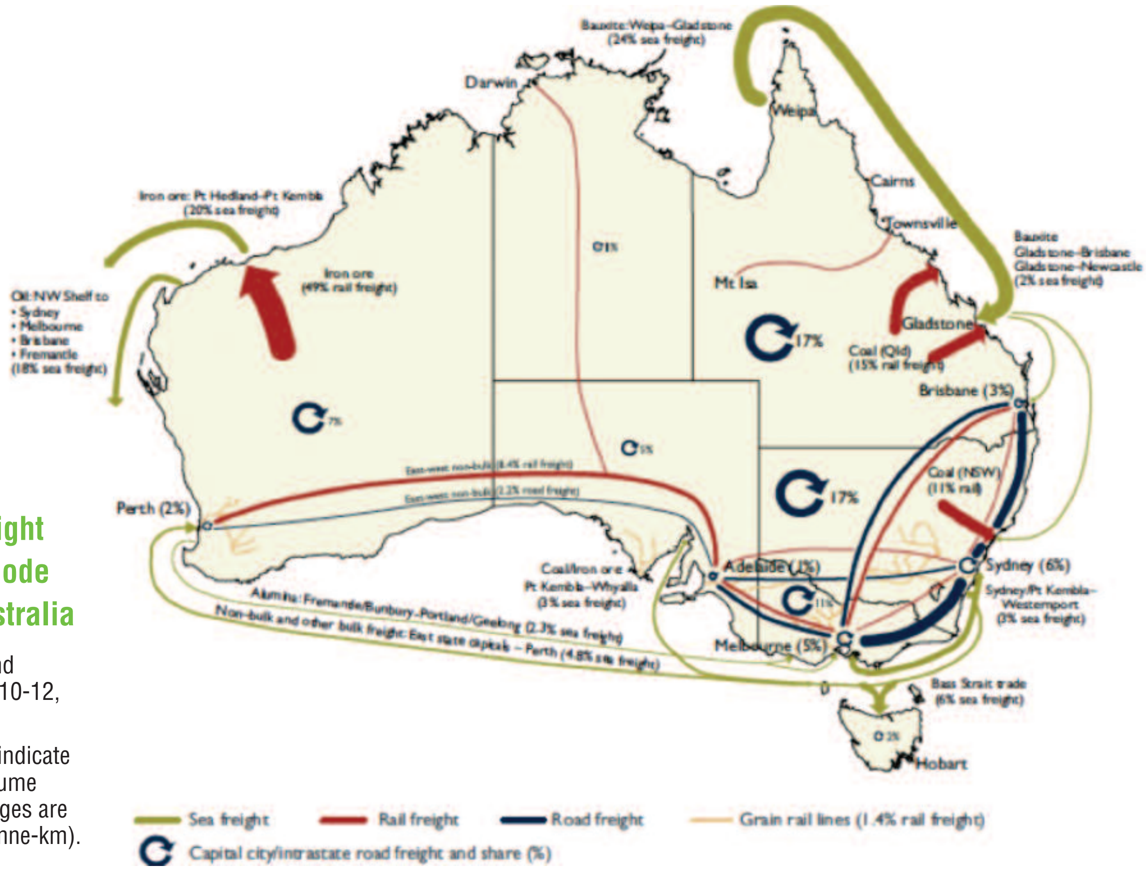
12 Meyrick and Associates, "International and Domestic Shipping and Ports Study", Australian Marine Group, 2007, p. 101; Brooks and Bendell op.cit.; Australian Shipowners Association, "Sea Transport Efficiency and greenhouse Gas Emissions, p. 1.

13 Mary R. Brooks, Sean M. Puckett, David A. Hensher and Adrian Sammons, "Understanding mode choice decisions: A study of Australian freight shippers", Institute of Transport and Logistics Studies, University of Sydney, Working Paper ITLS-WP-11-20, October 2010.

Figure 3: Principal Freight Trades and Mode Shares in Australia

Source: Bendell and Brooks, ITLS-WP-10-12, June 2010.

Note: Line widths indicate relative freight volume (tonnes); percentages are mode share (%-tonne-km).



Similar to the Canadian and U.S. Great Lakes experience, the bulk trades in Australia are often part of an integrated supply chain "involving raw materials supply and distribution of intermediate products or final products from production facilities to regional storage facilities."[14] Similar to Europe and North America, the marine mode is more competitive within longer corridors, particularly east–west. A 2007 study suggested the following cargoes are most likely to be shifted to land modes:

- Low-value commodities;
- Heavy and hazardous cargoes;
- Commodities that are not time-sensitive; and
- Commodities that originate or have a final destination close to ports.

Conversely, the following cargoes are less likely to shift from land modes to ship:

- Cargoes requiring just-in-time deliveries;
- Reefer cargo; and
- Manufactured goods moving to and from distant inland origins and destinations.

Another factor affecting domestic shipping in Australia is crew costs. For a small coastal vessel, these costs will represent an additional 10–15% of the total voyage costs when compared to a foreign-flagged, foreign-crewed vessel — and for a handysize ship, crew costs will be an additional 5–6%. The manning cost for an Australian-manned licensed vessel is about 38% of the daily operating cost versus 13% for its foreign counterpart.

14 Meyrick and Associates, p. 128.

Nonetheless, in a recent study of Australian shipping, Meyrick and Associates expressed the belief that short sea shipping has some potential, if it offers service that is similar to rail, but at a lower price — and that door-to-door partnerships should be developed for container and trailer services. In their view, using foreign vessels for domestic shipping is too volatile, as those vessels frequently enter and leave the market according to international shipping conditions.

2.4 Japan

Brooks points out that Japan's cabotage market is closed to all but Japanese-flag vessels. This sector carried 35.9% of Japanese domestic cargo in 2006.[15] The transportation of basic industrial materials is more heavily reliant on shipping than is general freight, of which only 14.3% moves by marine mode. Japan's SSS sector has seen significant consolidation but 80% of the vessels are 500 gross register tonnage (grt) or smaller.

Japan's cabotage market is closed to all but Japanese-flag vessels. This sector carried 35.9% of Japanese domestic cargo in 2006.

According to the APEC Transportation Working Group:

> "The Japanese short sea shipping network comprehensively covers all around the country from the north to the south in a 3000 km range. The network involves 23 routes, 48 operators, 101 ships, 112 ports and 196 sailings per week. The majority of ships operated by the SSS in Japan are Ro-Ro, ferry and conventional boats. The size and the capacity of them are moderate and handy to accommodate local niche cargo demand. Therefore, most of the ports called by the SSS are relatively smaller ports in local areas even though some routes call bigger ones like the Port of Tokyo. Most of the container ports are located in the proximity to the greater metropolitan areas."[16]

15 Mary R. Brooks, "Liberalization in Maritime Transport: A Paper for the Leipzig Forum", May 26-29, 2009.

16 APEC Transportation Working Group and Inha University, "*Short Sea Shipping Study: A Report On Successful SSS Models That Can Improve Ports' Efficiency And Security While Reducing Congestion, Fuel Costs, And Pollution*", October 2007.

3

National and Regional Policy Initiatives

3.1 United States

In the United States, the U.S. Maritime Administration (MARAD) has been promoting short sea shipping for at least a decade. In 2003, the U.S. signed a Memorandum of Co-operation with Canada and Mexico, and has hosted a number of conferences on the topic. The centerpiece of MARAD's SSS initiatives is the Marine Highway Program, which is illustrated in Figure 4 (although, as previously stated, some geographic aspects of the Marine Highway Program conflict with the proposed SSS definition).

Much study has taken place, but little investment has been made in new short sea services. MARAD has even had new ships designed — but has not offered assistance to get them built.

One new service that offered some hope was established by American Feeder Lines in June 2011. It envisioned a short sea hub-and-spoke feeder system along the U.S. East Coast, similar to those emanating from Hamburg into the Baltic. The company proposed eventually building U.S. vessels and circulated a prospectus to obtain funding. While awaiting the results of this campaign, it decided to commence service with a foreign-flag feeder, operating between Halifax-Boston and Portland. Unfortunately, despite receiving funding from both the Halifax Port Authority and the province of Nova Scotia, the service did not reach sustainable volumes and ceased operations in May 2012. The *Journal of Commerce* noted that the "Marine Highway Suffer[ed] a Blowout" when this service ceased operating.

In 2003, the U.S. signed a Memorandum of Co-operation with Canada and Mexico, and has hosted a number of conferences on the topic [of short sea shipping].

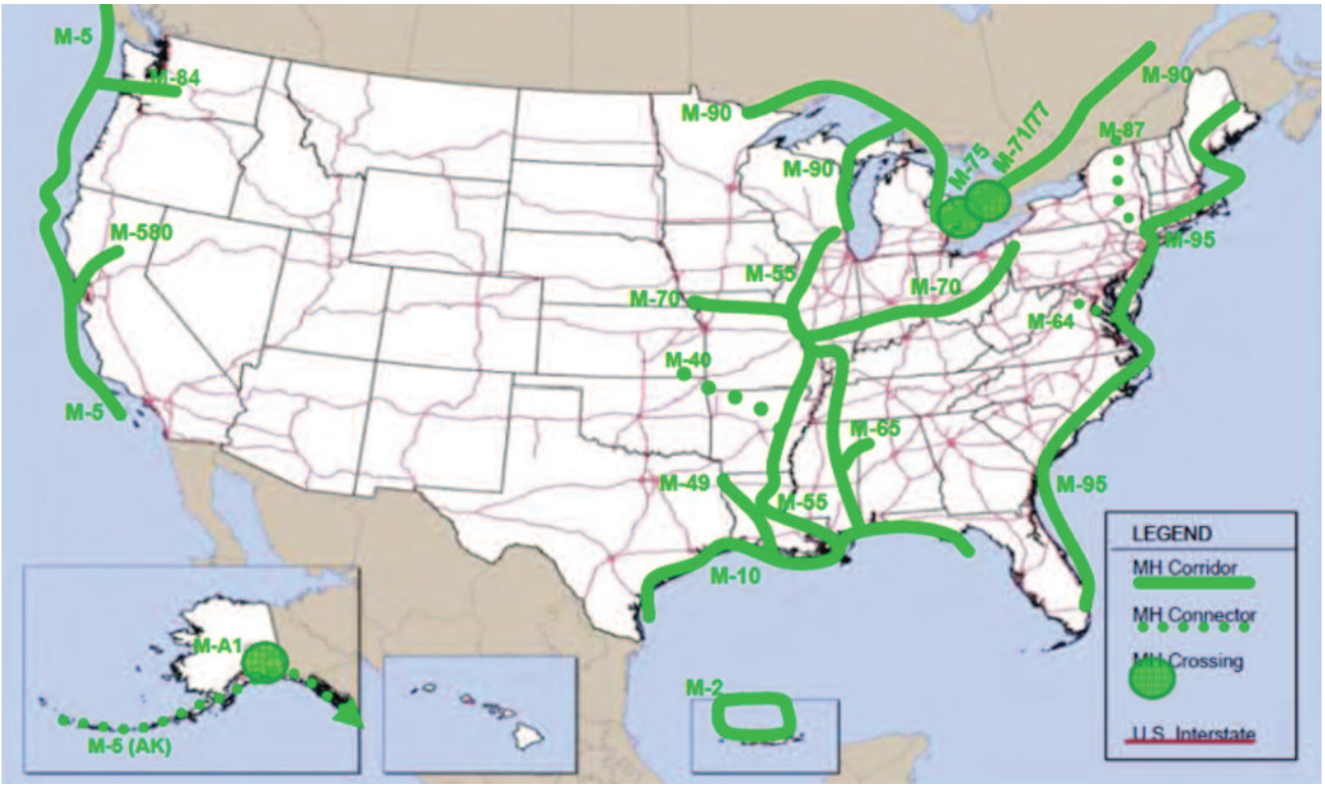


Figure 4:
Shipping Corridors Identified in the U.S. *Marine Highway Program*

Source: U.S. DOT Maritime Administration, *Presentation to the 4th Annual European Shortsea Congress*

Note: The green highlights on the map were offset in the original MARAD figure.

While some hurdles to the development of SSS in the U.S. are related to domestic tax and regulatory issues, the following two aspects are applicable to any country:

1) additional handling costs at transfer points; and
2) the image of shipping as slow and unreliable.

3.2 Canada

Canada's efforts to promote short sea shipping have been in lock-step with the U.S. …

Canada's efforts to promote short sea shipping have been in lock-step with the U.S. — with considerable study but little investment in actual services. In 2003, the federal government commissioned a number of regional background studies and hosted a series of workshops across the country. This created a lot of interest in the SSS concept among port authorities and shipowners. This interest led to additional study and a few fledgling attempts to start new services, most notably between Hamilton and Montreal/Sept-Îles. McKeil Marine's service to Sept-Îles is the longest-lived of the new services. New research in 2008 led Transport Canada to ask for proposals for new infrastructure funding related to SSS and many ports responded. (Most of the studies, however, suggested that infrastructure was not the key need but rather, a funding program to get new services established was required).[17] On the West Coast, similar studies did reveal a need for infrastructure investment and a call for proposals was issued, which resulted in several projects being funded.

17 CPCS Transcom, "Eastern Canada Hub-and-Spoke Study", Transport Canada, 2008.

In the meantime, the Department of Finance has removed the 25% duty on foreign-built vessels, thus eliminating what many observers considered to be a major barrier to entry and investment in short sea services in Canada. The laker industry has responded with a spate of new vessel orders and RTG understands that Oceanex (Canada's biggest short sea operator by the European Shortsea Network's definition of SSS) has also placed an order for a new Ro-Ro vessel in Germany.

3.3 Europe

Europe has been very aggressive regarding modal shift — from road to both sea and rail. It has used a series of programs to heavily promote short sea shipping for over a dozen years. Significant initiatives to support and encourage the development of SSS have taken place, including the establishment of Shortsea Promotion Centres in all EU member states. Europe's long-term goal is to promote SSS as a viable alternative to road haulage, since SSS produces fewer polluting emissions than any other mode of transport and fewer deaths per passenger carried than other modes. The European Commission (EC) describes a strategic vision whereby "maritime transport becomes a fully integrated component of door-to-door intermodal transport services, and a major contributor to sustainability, cohesion, and competitiveness."[18]

The European Commission (EC) describes a strategic vision whereby "maritime transport becomes a fully integrated component of door-to-door intermodal transport services, and a major contributor to sustainability, cohesion, and competitiveness."

The EC has enacted several programs in support of this vision. The first program was the Pilot Actions for Combined Transport (PACT), which ran from 1992 to 2000. It financed 167 intermodal programs, mostly after 1997. This program was succeeded in 2002 by Marco Polo I, which had total funding of €102 million and a broader objective to enhance intermodality. Marco Polo II, which started in 2007 with a budget of €450 million for the period of 2007 to 2013, permitted the participation of "close third countries having a common border with the European Union or with a coastline on a closed or semi-closed sea neighbouring the European Union." Five "actions" are supported under Marco Polo II:

1. modal shift actions, which shift cargo from road to rail or SSS;
2. catalyst actions, which will promote innovative ways to remove barriers for intermodal transportation;
3. motorways of the sea, which will achieve door-door service;
4. traffic avoidance actions, which will reduce the demand for freight transportation; and
5. common learning actions, which will enhance knowledge in the freight logistics sector.

Examples of the type of modal-shift actions funded are:

- aid to start-up services;
- a subsidy of €2 per 500 tonne-km shifted; and
- a subsidy of up to 35% of eligible costs.

18 *Short Sea Shipping: A Transport Success Story*, European Commission, brochure, 2003, http://www.shortsea.pl/onas/shortsea.pdf.

In 2009, 101 proposals were received, of which 32 were selected for funding and 69 rejected. A good example of a newly funded service is a proposal by Grimaldi and Louis Dreyfus Line to establish a "motorways-of-the-sea" service between the Atlantic coasts of France and Spain, from Gijon to Nantes. The proponents received €4.2 million.

Some of the Marco Polo II "actions" are very similar to aspects of the U.S. Marine Highway Program. While the funding is designed to help spur growth in SSS and provide initial capital resources for vessel owners, some pundits argue that it distorts the market and unfairly funds competitors, while others, especially in the UK and Ireland, bemoan the lack of projects funded in their markets.

4

Comparison between Short Sea Shipping and Trans-oceanic Shipping

Obviously, there are significant differences between sea-going vessels and their SSS counterparts. These unique differences are often underevaluated or misinterpreted when discussing maritime trade as a transportation mode.

4.1 Voyage Duration

While most trans-oceanic voyages range in duration from several days to a month or more, SSS voyages may range in duration from only a few hours to less than a week. In other words, the longest SSS voyages are normally shorter than the shortest trans-oceanic voyages. While this statement seems rather intuitive, some of the resulting ramifications may not be as readily apparent.

… the longest SSS voyages are normally shorter than the shortest trans-oceanic voyages.

4.1.1 Near-coastal Voyages

Since, by their definition, SSS voyages are restricted to coastal or inland routes, this means that these vessels typically remain in pilotage waters or — at a minimum — spend a significantly higher proportion of their voyages in pilotage waters as compared to sea-going vessels. In some cases — such as the North American Great Lakes — this mandates that all navigation officers have pilotage endorsements for the waters in which they normally operate. For other regions, this may necessitate the hiring of a local pilot, which can add significantly to the cost of a voyage.

Additionally, since vessels engaged in short sea shipping dock more frequently than their ocean-going counterparts, and often operate in restricted waters, they are required to maneuver more frequently. Thus, while ocean-going ships may rely heavily on tug assistance for maneuvering within a harbor and docking to a facility, SSS vessels must be more maneuverable to avoid the need for constant tug assistance. As a result, while main propulsion plants on ocean-going vessels may be designed to maximize efficiency for periods of long steaming, the main propulsion, auxiliary power and steering gears on SSS vessels are often configured substantially differently to address their unique needs.

The North American Emission Control Area (ECA), with its 200-nautical mile outer boundary, has a much greater impact on SSS operations than on ocean-going vessels.

4.1.2 Emission Control Areas (ECAs)

The North American Emission Control Area (ECA), with its 200-nautical mile outer boundary, has a much greater impact on SSS operations than on ocean-going vessels. On a typical trans-oceanic voyage, a vessel will spend less than 5% of its voyage in the North American ECA. In almost all cases, vessels engaged in SSS will spend 100% of their voyages within the ECA. Therefore, the cost of compliance with the North American ECA (as a result of switching from intermediate fuel oil [IFO] to marine diesel oil [MDO]) will be approximately 20 times higher for SSS vessels than the cost of compliance for trans-oceanic vessels. The same dynamic occurs in the Baltic Sea and North Sea ECAs. As more and more countries and regions evaluate and implement ECAs, the effects on SSS will increase. (Additional information regarding this inequity is discussed in section 6.2.)

4.2 Cabotage Requirements

With the notable exception of the EU countries, many of the countries with vibrant SSS sectors also have aggressive cabotage laws to protect their domestic fleets from foreign competition. Although there has been some recent relaxation of cabotage laws in Canada and Australia, in most cases, domestic shipping in Canada, the U.S., Australia, Japan and China is restricted to vessels that are flagged, crewed (and often built) in their own countries. While cabotage laws protect the domestic flags from foreign competition, the aforementioned countries generally have significantly higher-than-normal wages for vessel crews (when compared to ocean-going counterparts) and often must meet more rigorous manning, qualification and inspection standards.

4.3 Design Differences

Since, by the nature of their operations, vessels engaged in SSS often operate in inland waters, they often encounter restrictions unique to that trading route. For example:

- Draft restrictions — Rivers and lakes may have fluctuating water levels, which result in less than optimum cargo loading levels. Even under optimum circumstances, water depth is often a limiting factor in many SSS routes.
- Height restrictions — Inland rivers and lakes are more likely to have overhead restrictions resulting from bridges, high-tension wires and other obstructions.
- Length and breadth restrictions — Waterways may restrict the length and breadth of vessels due to the presence of locks or other obstructions to navigation, such as narrow drawbridge openings.

Since vessels engaged in SSS make more frequent port calls, it is often imperative that they minimize cargo loading and discharge times. As a result — particularly in the bulk cargo industry in the Great Lakes — these vessels may be fitted with self-unloading equipment and high-capacity ballast pumps. These features not only add to the initial cost of the vessel but also require additional power generation during cargo operations.

4.4 Modal Competition

With almost no exception, vendors wishing to move cargoes across the ocean have no choice other than trans-oceanic maritime shipping. Thus, development and uniform implementation of international maritime conventions affects all shippers relatively equally. To further ensure a level playing field, nearly all IMO Conventions contain a "no more favorable treatment" clause, to ensure that even the vessels of non-signatory countries must meet the same level of compliance within these Conventions' provisions. As a result, there is no competitive imbalance created by the implementation of maritime conventions in trans-oceanic shipping. In other words, all competitors that are vying for trans-oceanic cargoes are forced to play on a level (regulatory) playing field.

Conversely, short sea shipping frequently competes directly or indirectly with rail, truck and pipeline as a means of moving cargo. The same international conventions that help level the trans-oceanic playing field often apply to vessels engaged in SSS, as well. Obviously, these international maritime conventions have no applicability to land transportation modes. This means that the owners of SSS vessels must bear the increased costs associated with convention compliance, while their land-side counterparts do not. As a result, instead of leveling the playing field, maritime conventions can frequently tilt the balance in favor of land modes, which frequently do not have to comply with standards that are as stringent. Research and Traffic Group (RTG) estimates that up to 20% of some SSS trades in North America might shift to rail or truck, due to the MARPOL Annex VI (ECA) requirements, alone. As is demonstrated in Section 6.2, this will have significant, negative economic, environmental and safety impacts.

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5

Modal Comparison of Environmental Impacts

The mode comparison study undertaken for the Chamber of Marine Commerce (CMC) involved a like-for-like comparison of the Great Lakes-Seaway fleet's impacts compared with those of the two ground modes, if they carried the same Great Lakes-Seaway cargo.[19] The study findings are illustrated in this section under three subheadings:

- Air emissions;
- Congestion relief; and
- Noise footprint.

5.1 Air Emissions

Criteria Air Contaminants (CAC) emissions include: all oxides of nitrogen (NO_X), particulate matter (PM), carbon monoxide (CO), sulfur oxides (predominantly SO_2),[20] and volatile organic compounds/hydro-carbons (VOCs/HCs). Recent regulations have defined the emissions of HCs to consider only non-methane hydrocarbons (NMHCs). Sulfur oxides are being addressed via fuel regulations or scrubber requirements, while all other CACs are addressed with engine regulations. The focus of regulatory initiatives has been on NO_X emissions and particulate matter (PM). Thus, much of the data on expected technology improvements is focused on NO_X and PM, with less information on other CAC emissions.

5.1.1 Seaway-size Fleet Comparison

The post-renewal scenario is based on each mode's upcoming regulatory changes being met and each mode's fleet being renewed.

In the CMC-commissioned study, the resulting findings for the Canadian and Seaway-sized international fleets operating on the Great Lakes-Seaway System are illustrated separately for the adjusted-2010 case and for the post-renewal scenario in pairs of bar charts in Appendix C. The post-renewal scenario is based on each mode's upcoming regulatory changes being met and each mode's fleet being renewed. The comparison reflects the fact that the renewal of the marine fleet has been delayed relative to the ground modes, due to regulatory constraints. Canada's removal of the 25% import duty

19 Research and Traffic Group, *Environmental and Social Impacts of Marine Transport in the Great Lakes-St. Lawrence Seaway Region)*, Chamber of Marine Commerce, July, 2012.

20 Sulfur oxides are being addressed via fuel regulations or, alternatively, through the use of scrubber technologies, rather than engine regulations.

on foreign-built vessels will stimulate modernization of the marine fleet. All modes can make improvements but the Seaway-size fleet, being older, has more potential for improvement.

Cargo transportation via Seaway-size vessel — in terms of cargo tonne-km per liter of fuel — is significantly more energy efficient than rail or truck. Based on the 2010 data, existing Seaway-size vessels are 24% more efficient than rail and 531% more efficient than truck. Said another way, a Seaway-size vessel can carry an equal cargo load 24% farther than rail and 531% farther than truck. For the post-renewal scenario, the Seaway-size fleet will be able to move cargo 74% farther (or is 74% more efficient) than rail and 704% farther (or is 704% more efficient) than truck.

In addition to being far more energy efficient, Seaway-size vessels emit fewer greenhouse gases (GHGs) than either rail or truck.

In addition to being far more energy efficient, Seaway-size vessels emit fewer greenhouse gases (GHGs) than either rail or truck. For example, in 2010, the GHG intensity of rail was 1.2 times higher and for truck, was 5.5 times higher than for the Seaway-size fleet. In the post-renewal scenario, the difference is even more striking: rail is 1.7 times higher and truck 7.1 times higher than the Seaway-size fleet. For the post-renewal scenario for all modes, marine is the lowest emitter of SO_X and NO_X and second to rail in particulate matter (PM).

The post-renewal SO_X and PM charts are based on 100% use of ultra-low sulfur marine diesel oil (MDO) in propulsion and auxiliary engines.

5.1.2 CSL's International Fleet Comparison

Canada Steamship Lines (CSL) did a coastal comparison with its Panamax coastal fleet and the results were as follows. The post-renewal comparison for the international fleet assumes a 10% efficiency improvement, which is consistent with the assumption made for international vessels in the CMC study. The efficiency comparison of the three modes under the post-renewal scenario for each mode is illustrated in Figure C12 in Appendix C. Post renewal of all modes, the more efficient marine fleet will be able to move cargo 109% farther (i.e., is 109% more efficient) than rail and 1,071% farther (or about 11 times farther and 1,071% more efficient) than truck. The East Coast fleet is more efficient than the West Coast fleet, largely because of the former's lower ballast ratio, and both fleets are more efficient than the Seaway-size fleet due to vessel size/design and longer trip distances.

As with the Seaway-size fleet, the CSL international fleet also emits far less greenhouse gases (GHG) than either truck or rail. The GHG intensity of rail is 2 times higher and for truck, is 11.2 times higher than the East Coast fleet in 2010 — and rail is 2 times higher and truck 8.5 times higher than the East Coast fleet in the post-renewal scenario.

The West Coast fleet has lower "near-land equivalent" emission intensities than the East Coast fleet because the West coast fleet uses auxiliary diesel generators on MDO fuel, while the East Coast fleet uses power take-off generators from the main engine using IFO fuel.

5.2 Congestion Relief

The freight ground modes contribute to congestion delays for the general public — trucks, via direct sharing of infrastructure, and rail, through delays at highway-rail grade crossings. The per-vessel capacity of the Great Lakes-Seaway fleet is significantly higher than the two ground modes. As indicated in Figure 5, one Seaway-max vessel is equivalent to 301 railcars and 963 trucks.

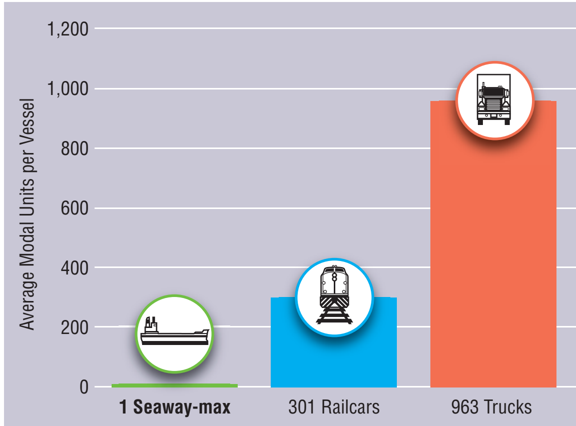


Figure 5: Capacity per Seaway-max Vessel

Source: RTG analysis

One Poe-max vessel (1,000 footer) carrying 56,260 tonnes (62,000 tons) and passing under the Ambassador Bridge between Windsor and Detroit is the equivalent of 2,340 trucks at a nominal 26.5 ton (24.1 tonne) load passing over the bridge — enough to fill a traffic lane for 50 km (30 miles) back from the border inspection booths.

In a queuing situation with stopped vehicles, one truck length is equivalent to 4.67 passenger-vehicle lengths. While the trucks have dedicated lanes and inspection booths, the length of the truck lanes could accommodate 4.67 passenger vehicles per truck and due to the nature of queuing delays, the queue will occasionally back up past the dedicated lanes into mixed traffic lanes. The capacity-utilization equivalent units of one Poe-max vessel at a highway border-crossing inspection station are illustrated in Figure 6.

The traffic moved by the Great Lakes-Seaway fleet in 2010 would require 7.1 million additional truck trips. Delay to other traffic is imposed by each additional vehicle. If the hypothetical shift of Great Lakes-Seaway traffic to the highway mode involved 20% urban freeways, the incremental cost of delays to other vehicles would be in the range of \$346 million to \$380 million per year. The present value of this incremental cost would be \$5.6 billion to \$6.1 billion over a 24-year time period, assuming a 2.5% annual rate of growth in traffic.

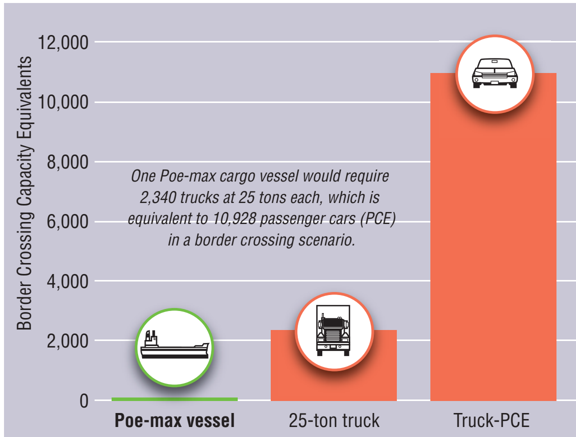


Figure 6: Border Crossing Inspection Queues Traffic Equivalents

Source: RTG analysis

Traffic shifts to rail would lead to delays to the public at highway-rail grade crossings.

The estimated cost of incremental delays at highway-railway grade crossings associated with shifting Great Lakes-Seaway traffic to rail was \$46 million a year. The present value of this cost would be \$750 million over a 24-year time period, assuming a 2.5% annual rate of growth in traffic.

5.3 Noise Footprint

Each mode's noise footprint was assessed on the basis of the area that is exposed to "severe" noise — where severe noise is a day/night weighted average of noise exposure. Both the existing footprint and the incremental footprint that would result from adding the Great Lakes-Seaway traffic were calculated. Truck's noise was associated with wheel and engine noise from motion. Rail's noise was associated with both noise from motion and noise from air horns blown at highway grade crossings. Marine's noise was associated with air horns blown when vessels meet and when mooring lines are dropped. The resulting noise footprints of the three modes are illustrated in Figure 7.

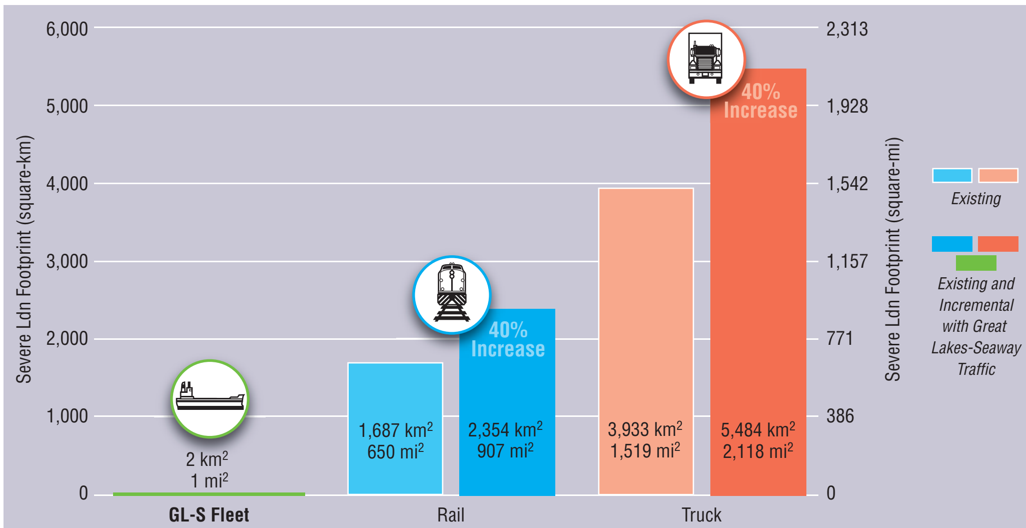


Figure 7: Modal Noise Footprints (Existing and Incremental with Great Lakes-Seaway Traffic)

Source: RTG analysis

6

Inequities with International (IMO) Conventions

The International Maritime Organization (IMO) has recently introduced a number of initiatives that could have a profound impact on coastal and short sea shipping operators around the world, including in Canada. IMO recommendations related to the Energy Efficient Design Index (EEDI) and Emission Control Areas (ECAs), in particular, affect the entire marine community but have a different and much more significant effect on coastal and SSS operators than on operators of ocean fleets.

The mission of the IMO is to promote safe, secure, environmentally sound, efficient and sustainable shipping through international cooperation. Operators of ocean-going vessels share similar interests when it comes to most IMO recommendations. On the other hand — while all nations have an interest in reducing marine's environmental impacts, both the technical and cost-effectiveness of the supporting measures can be quite different for ocean-going and coastal/short sea shipping operators. Additionally, the consequences for domestic fleets are often not adequately considered in the IMO's deliberations. This section demonstrates the differences between domestic and international fleets and highlights the disparities that have evolved with recent IMO environmental initiatives.

Sections 6.2 and 6.3 highlight the differences between SSS and ocean shipping as it most affects the relative cost of two recent environmental initiatives of the IMO. The first initiative is related to reduction of sulfur emissions and other criteria air contaminants (CAC) through the adoption of Emission Control Areas (ECAs). The second is a GHG-reduction initiative via an Energy Efficient Design Index (EEDI) — which requires that the defined EEDI baseline value be met for newly built vessels after 2013 — and improvements of 10%, 20% and 30% below the baseline EEDI for vessels newly built in/after 2015, 2020 and 2025, respectively.

6.1 Ballast Water Management Convention

The purpose of the International Convention for the Control and Management of Ships Ballast Water & Sediments, known commonly as the Ballast Water Management (BWM) Convention, is to "prevent, minimize and ultimately eliminate the risks to the environment, human health, property and resources arising from the transfer of Harmful Aquatic Organisms and Pathogens through the control and management of ship's ballast water and sediments." (International Maritime Organization, 2004). Key to the language of the BWM Convention is the term "risk." The drafters of the Convention correctly recognized that the establishment of a universal ballast water discharge standard (BWDS) was the most appropriate and effective way to reduce the risk of translocation of non-indigenous species (NIS), globally. However, they also recognized that there may be certain low-risk situations that negate the need for treating ballast water, as well as the need for alternative methods for reducing the risk. As a result, Article 3.2 (b), (c), and (d) exempts vessels that operate only in waters under the jurisdiction of a Party and on the high seas; Regulation A-4.1 specifically addresses the issue of low-risk voyages between specified ports or locations; and Regulation B-3.7 addresses other methods of ballast water management that may be considered. Conversely, Article 2.3 and Regulation C-1.1 allow for additional (more stringent) requirements if a Party believes such requirements are necessary to adequately protect the environment from NIS. In all cases, a risk assessment is required to justify the imposition of any of these regulations. Additionally, Article 13.3 encourages Parties that share an enclosed sea to develop regional agreements consistent with the Convention.

The aforementioned allowances (Article 3.2, Regulation A-4, and Regulation 13.3) appear to provide significant relief to vessels engaged in short sea shipping. However, as with many IMO Conventions and/or international initiatives, although these provisions appear to provide alternatives to strict compliance with the BWDS and the installation of a ballast water management system, the actual implementation mechanism is cumbersome. Since the Convention language is vague regarding the risk assessment required, it will likely fall to the vessel owners to develop the risk assessment in accordance with the G7 performance guidelines of the BWM Convention. As a result, shipowners could expend significant capital resources developing risk assessments to justify exemptions in accordance with Article 3.2 and Regulation A-4 — with no assurance that the Party (or Parties) would accept the conclusions and recommendations of the risk assessment. The development of international, regional agreements between Parties is often a very slow and painstaking process, which would not likely be completed until well after the implementation dates of the Convention. Finally, these provisions require both/all countries affected to be signatories to the Convention. Often, this is not the case. For example, in the North American scenario, Canada is a signatory, but it is unlikely that the U.S. will ratify the Convention in the near future. Thus, these mechanisms — cumbersome as they may be — will likely not be available to vessel owners interested in pursuing them.

Further exacerbating compliance are the design and operating profiles of vessels engaged in short sea shipping. While the design of SSS vessels varies widely throughout the world, the challenges faced by these vessels are perhaps best exemplified by SSS vessels operating in the North American Great Lakes-St. Lawrence Seaway System.

These vessels are challenged not only by the unique physical environment of the System, but also by the unique operating profiles of most of the vessels. The Great Lakes-Seaway environment is characterized by very cold, fresh water. Unlike many "fresh" water environments, the salinity of the Great Lakes is less than 0.1 practical salinity unit (PSU). This means that any of the ballast water discharge standards (BWMSs) that require Cl-ions from the ambient water cannot operate, unless an alternative source of ions can be provided. Additionally, in many areas of the Great Lakes, mean water temperature is below 10°C for 8 months of the year, and below 5°C for 5 months of the year. As a result, BWMSs that use active substances and require those substances to decay before being released may not be appropriate — due to the very slow decay rates resulting from the cold water temperatures. Most vessels engaged in short sea shipping on the Great Lakes-Seaway System have voyages with very short durations — some as short as a few hours but rarely longer than six days — further exacerbating the active-substance decay problem.

Many of the Great-Lakes Seaway bulkers have self-unloading equipment that reduces cargo discharge times to fewer than 12 hours. As a result, these vessels have very high ballast-pump flow rates, sometimes exceeding 15,000 m^3/hour. Due to the operation of the self-unloaders, their power generation capacity is at or near its upper limits. Thus, there is no "extra" power generation capacity to power BWMSs, which may have high power demands. This combination of challenges — very cold, fresh water; high flow rates; limited power generation; and small engine rooms — combined with the relatively low risk of inter- and intra-lake voyages — provide a persuasive argument in favor of a more liberal application of the BWM Convention for vessels engaged in Great Lakes-Seaway short sea shipping. Similar arguments undoubtedly exist for other SSS operations globally.

Many of the Great-Lakes Seaway bulkers have self-unloading equipment that reduces cargo discharge times to fewer than 12 hours.

6.2 North American Emission Control Area (ECA)

An Emission Control Area (ECA) has been adopted in North America for vessels operating within a 200-nautical mile (nm) boundary. Within the 200-nm limit, ships must use 1% sulfur fuel starting August 1, 2012 and 0.1% in 2015. Within the Great Lakes, the ECA has some modifications: the U.S. exempted steamships until 2020 and provided a grant program to re-engine these vessels, and Canada adopted a fleet averaging program, whereby the fleet makes sulfur content reductions over the period 2012 to 2020 — at which time every vessel must meet the 0.1% ECA fuel standard.

The ECA will have a greater impact on coastal and inland water fleets than on ocean fleets. The 200-nm limit represents less than 5% of a typical international voyage (10% if both ends are in ECAs and more, if making multiple stops along a coast).[21] For example, 3.3% for Kaohsiung to Los Angeles and 5.4% for Antwerp to Baltimore are in the North American ECA.

In contrast, many coastal vessels stay within the 200-nm limit for 100% of a journey. Similarly, the fuel-cost increment involved in using MDO rather than IFO fuel in the ECA is about 10 to 20 times higher for a coastal vessel than an ocean vessel. Furthermore, the coastal fleets face competition from ground modes, while ocean fleets do not. Research Traffic Group (RTG) assessed the potential mode shift that could result when

21 For example, many container vessels multi-port when on sailings to North America. For instance, an Atlantic Container Line vessel sailing from Liverpool to New York will call at Halifax, New York, Baltimore and Norfolk, before returning to New York and Halifax, and onwards to Europe. Likewise, a vessel sailing between north Europe and Montreal will enter North American waters off Newfoundland and then sail through the Straits of Belle Ile and thence to Montreal, spending significant time in the ECA.

ECA is extended into the Great Lakes.[22] It concluded that the rate increase required to cover the higher fuel costs could result in mode shifts to higher-emitting modes — some SSS trades were estimated to be susceptible to a 20% shift to trucks and other trades were susceptible to a 12% shift to rail.

While the cost and market-loss impacts are greater for the coastal fleet, the environmental impact of the coastal fleet (with main engine power below 15,000 kW) is lower than that of the large ocean vessels (with main engine power in the range of 17,378 kW for an Aframax tanker to 75,920 for an Ultra Large containership). The coastal fleet environmental impact is also much lower than the ground modes to which it could lose traffic.

Sahu and Gray[23] evaluated the dispersion of sulfur dioxide (SO_2) emissions from the largest-size vessels in the U.S. Atlantic and Pacific coastal fleets, by applying the same parameters, metrological data and CALPUFF modeling used by the Environmental Protection Agency (EPA). The authors' findings include the following:

- "SO_2 concentrations along the coasts drop off dramatically as the distance from the ship to shore increases."
- For the Eastern modeled sources, the maximum impact (highest one-hour average SO_2 concentration) for a source located 40 km from port (other than for Naragansett) is between 4% and 13% of the impact from the same source located at the port.
- For Western sources located 40 km from port (other than Vancouver), the model predicts the impact is between 2% and 6% of the impact from the same source located at the port.

With the exception of Vancouver, which was influenced by unique local circumstances, the Pacific Coast model results show that the SO_2 concentration is reduced by 97.6% within the first 40 km and an additional 2.4% reduction over the next 320 km. Similarly, the East Coast model results show that the SO_2 concentration is reduced by 93.7% within the first 40 km and an additional 6.3% reduction over the next 320 km. A 40-km ECA boundary for coastal vessels would appear to be effective in reducing SO_2, while permitting vessels to use lower-cost fuel in the normal trade lanes. The authors recommend a 50-nm (93 km) ECA boundary for coastal vessels, to allow the unique local influences at Vancouver to also be encompassed.

6.3 The Energy Efficiency Design Index (EEDI)

6.3.1 Origins of the EEDI Formula

While the EEDI formula has grown in complexity over the years, it still has at its root, the following simple ratio of performance in the provision of marine transport service:

$$EEDI = \frac{\textit{societal environmental impact}}{\textit{societal transport benefit}}$$

Where:

- environmental impact is measured in the amount of CO_2 emitted in grams (g); and
- societal transport benefit is the product of the metric ton (tonnes) of cargo capacity and distance it is carried in nautical miles (nm).

22 Research and Traffic Group, *Study of Potential Mode Shift Associated with ECA Regulations In the Great Lakes, for Canadian Shipowners*' Association, 2009.

23 Sahu, Ranajit and H. Andrew Gray, *Modeling The Air Quality Impacts Of Short-Sea Shipping Emissions and Implications For The North American Emission Control Area (ECA)*, April, 2012.

The actual formula as adopted in Chapter 4 of MARPOL Annex VI (EEDI) is illustrated in Appendix D.

The baseline performance index for recently built vessels was derived by applying the EEDI formula to Lloyds-Fairplay data on vessels (grouped into 10 different classes) that were built over the 1999–2009 period. The regression fit to the baseline data was of the form:

$$EEDI(baseline) = a(DWT)^{-c}.$$

MARPOL Annex VI (EEDI) requires that the baseline index be met by vessels that are newly built in/after 2013 and improvements of 10%, 20% and 30% in the EEDI for vessels newly built in/after 2015, 2020 and 2025, respectively. We note that while bulkers and self-unloaders are the primary vessels in the Canadian laker fleet, tankers are also part of the fleet. The derived baseline characteristic and future requirements of the EEDI for the bulk and tanker categories are shown in Figure 8.

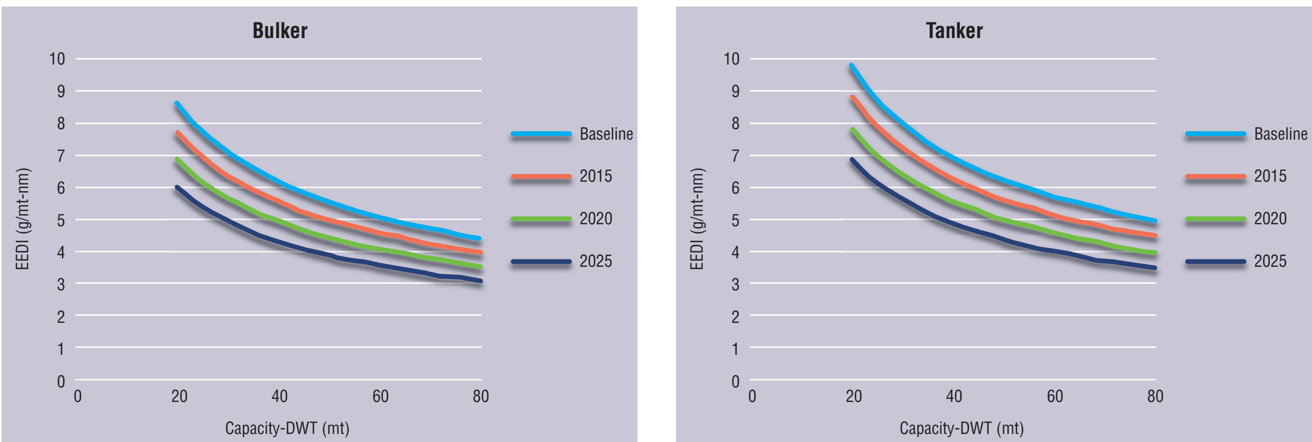


Figure 8: EEDI baseline and improvement requirements for bulkers and tankers

Source: Research and Traffic Group calculations from IMO data

6.3.2 Technical Issues in the Development of the EEDI

6.3.2.1 Unfeasible Design Constraints

There are issues of basic feasibility of design for some vessels under the EEDI. One issue related to Ro-Ro vessel classes, in particular, was raised by Pundtt and Kruger[24] of the Technical University of Hamburg-Harburg's Institute of Ship Design and Ship Safety. Their analysis revealed that the EEDI baseline formula [$EEDI(baseline) = A(DWT)^{-C}$] inherently leads to larger engines for larger vessels in some classes — and to smaller engines for larger vessels in others. More specifically, those vessel classes with a baseline "C" coefficient greater than 0.33 (e.g., tankers, bulk carriers and Ro-Ro vessels) are penalized with reduced power for increased size, while classes with a C-coefficient less than 0.33 (e.g., container ships and general cargo ships) get enhanced power with increased size under the EEDI. At a certain size threshold, the EEDI formula does not allow the power required to safely handle vessels with C-coefficients greater than 0.33.

24 Pundtt, Lennart and Stefan Kruger, *The Energy Efficiency Design Index for RoRo Vessels*, RORO Shipping Conference, Copenhagen, February, 2012.

Maneuverability is a much more important design condition for coastal vessels, which make considerably more port calls than ocean vessels and which call on tug assistance for the relatively infrequent number of port calls made.

The C-coefficient issue is not directly relevant to the Great Lakes-Seaway fleet as its size is constrained by Seaway lock dimensions. Nonetheless, the issue could raise safety-related concerns for the bulker and tanker fleets, if the 2025 target is attained via speed reduction alone — as it could result in underpowered vessels in heavy seas, late-season ice and docking operations. Maneuverability is a much more important design condition for coastal vessels, which make considerably more port calls than ocean vessels and which call on tug assistance for the relatively infrequent number of port calls made.

Pundtt and Kruger also note that the single-curve fit used to generate the EEDI baseline creates much more significant problems for small vessels than for large vessels. The source data used has a very narrow spread about the baseline curve for large vessels but a very wide spread about the curve for smaller vessels. Coastal/SSS fleets are in the size range with the most spread. It is very unlikely that a ship designer would design a vessel that is twice as fuel-intensive as another vessel of the same capacity, without having a specific constraint for the application for which that vessel was designed. Pundtt and Kruger make a comparison of recently built Ro-Ro vessels within the EEDI baseline database. They note that the most efficient design does not pass the EEDI, while the least efficient design does pass (but just barely). This anomaly is a consequence of the efficient ship being designed for a high-speed service, while the inefficient design was built for a low-speed service. They believe it is inappropriate to compare these two distinct vessels as part of the same EEDI database.

There could be widespread support to rework the smaller-vessel end of the dataset to examine the application of vessels that are well above and well below the existing baseline curve fit. It is possible that more than one curve fit could be used, depending on the type of service a vessel is in. The issue of data spread for smaller vessels is most relevant to the coastal/SSS fleets but could also be a concern for smaller ocean-going vessels. In this regard, it is noteworthy that the sample database used in the least squares-regression derivation of the baseline coefficients had many variations of interpretation. The coefficients are sensitive to which vessels were eliminated, due to either a lack of data for some inputs required by the EEDI or because they were assessed as being outliers. The IMO's final resolution (RESOLUTION MEPC.203(62), adopted on July 15, 2011) contained baseline coefficients that evolved from a number of previous recommendations from member countries that interpreted the database with different results — for example, GHG-WG 2/2/7, MEPC 60/4/14 and MEPC 58/4/8 all have different results based on the available data.

The two main productivity factors in the EEDI formula (i.e., capacity and distance) pose a disadvantage to the Canadian laker fleet in comparison with large ocean-going vessels. While the EEDI formula does reflect vessel capacity in its denominator, one can question whether it fairly accounts for capacity differences across vessel sizes. Also, the coastal/SSS fleets, including the Canadian laker fleet, have capacity aspects that are not included in the formula (e.g., self-unloaders versus straight bulkers, and draft variations/limitations). The EEDI is described as providing an indication of grams emitted per tonne-nm of transport benefit; however, it is important to realize that this is based on canceling the units (per-hour) in both the numerator and denominator, such that the EEDI actually reflects a one-hour, at-sea design condition. Thus, while distance is reflected in the EEDI formula, the distance is associated with one-hour's travel at sea rather than a full trip.

This EEDI focus on "one hour at sea" is quite reasonable for long-distance ocean vessels but is one element of the disparity between ocean vessels and coastal/SSS fleets. The design condition does not identify the appropriate energy-saving potential for a coastal vessel. A measure of total emissions and total transport work done in a full return-trip voyage would be a more accurate measure of performance and would possibly produce a more equal footing between ocean vessels and coastal vessels. A key issue is whether the EEDI can be transitioned from being an at-sea design condition — which is difficult to uniformly apply across different operational environments — into a "performance index," which more accurately measures the ratio of emissions to transport-work-done and provides more flexibility in design aspects. The following discussion addresses both aspects — changes to coefficients in the EEDI to reflect the design differences of the laker fleet and changes to the EEDI formulation to better measure its original target performance measure (i.e., emissions/transport-work-done).

The capacity and distance factors noted above are indeed important; however, many other factors need to be considered in assessing the fairness of the EEDI formula. Countries with coastal fleets need to consider the differences between ocean and coastal vessels' operating environments, in order to produce regulations that are fair and equitable. The differentiation of the coastal and ocean fleets must be accurate and based on sound principles of technical and economic analysis. Both fleets should be allowed to achieve the goal of reducing environmental impact in a way that realizes an impact/cost ratio that is fair and equitable with other vessel classes/operating-environments. As illustrated in the remainder of this section, these goals are not met by the present EEDI.

6.3.2.2 Unexpected ECA Influence Affecting EEDI

As previously discussed (Section 3.1), the ECA regulations have a much larger cost impact on SSS fleets than on ocean fleets. While ocean-going vessels must also deal with the ECA inside the 200-nm limit, much more time is spent at sea and the cost impact is not as great for ocean vessels as for SSS fleets (which, in most cases, are operating inside the ECA limit 100% of the time). One way to mitigate this disproportional impact would be to recognize the societal benefit of reducing CAC emissions in ECAs within the numerator of the EEDI — since both ECAs and the EEDI address the societal cost of air emissions. However, not only does the EEDI formula not recognize the societal benefits of ECAs, the coastal/SSS fleets will be penalized in the EEDI for meeting the ECA regulations with marine diesel oil (MDO) fuel. That is because the CO_2-intensity value used in the EEDI is higher for MDO than for heavy fuel oil (HFO), when measured on the basis of grams of CO_2 emitted per gram of fuel consumed (g/g). Since MDO has a lower density than HFO, changing the EEDI definition to measure CO_2 in terms of grams of CO_2 emitted per liter of fuel consumed (g/L) would reflect a benefit from the use of MDO — rather than the penalty that is assessed under the existing g/g ratio. Since a vessel's cargo capacity is related to volume available, it could be argued that the use of grams per liter (g/L) is a more accurate measure for marine; additionally, it is the commonly used measure for surface modes. The fact that the change would benefit both ocean fleets and SSS fleets might make it an appealing modification for the IMO to consider.

… the ECA regulations have a much larger cost impact on SSS fleets than on ocean fleets.

6.3.3 Economic Issues in Application of the EEDI

Two of the key factors that benefit ocean carriers' adoption of EEDI are the total cost reductions realized and the absence of other sources of competition beyond those that must comply with the EEDI. As discussed below, neither of these ingredients exists for the SSS fleets.

6.3.3.1 Cost Structure Comparison

Large ocean-going vessels are not in competition with the Canadian laker fleet; however, there is an issue of fairness around the EEDI formula, in terms of the economic burden to owners and operators. The main factor that influences the energy efficiency of marine transport is speed. Reducing speed and locking that reduced speed into the vessel's life-time operation via the engine size (as the EEDI requires) is a benefit to ship owners in a non-competitive market because it means more vessels are required to meet a given transport demand. Independent ship operators, on the other hand, must pay for the vessel and crew on a daily-charter basis and the fuel savings might not offset the increased charter rates.

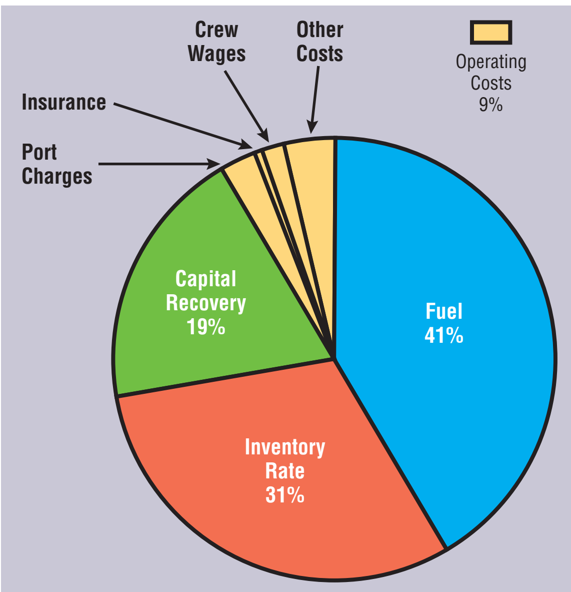


Figure 9: Components of Voyage Expense for a 5,500 TEU, 25-knot Containership

Source: Larkin, et al. TRB, 2010 (Op. cit.).

Some insight into the economic impacts of the EEDI for ocean fleets is illustrated by the cost distribution. Larkin, et. al.[25] assessed the fuel-savings impacts of the EEDI on a 5,500 TEU container ship with a 25-knot design speed. In their cost assessment — which includes the inventory costs of the containers onboard — fuel costs represent 41% of the complete-voyage costs (see Figure 9). If the container inventory costs are excluded, fuel becomes 60% of the carrier's total cost. Larkin's analysis found that the optimal speed at a fuel cost of $500/tonne occurred well below the vessel's design speed.

Examination of the cost characteristics of this containership helps to explain the motivation for large ocean carriers to fully support a regulation like the EEDI. Propulsion fuel costs on a vessel increase with speed raised to the square power. Port costs are independent of speed and other costs, such as capital recovery, labour and insurance. Port costs are also time-based and are therefore related to the inverse of speed. The basic cost equation is:

$$TC=PC+PF\times V^{\wedge 2}+OC/V$$

Where:

TC = total voyage costs

PC = costs at port

PF = propulsion fuel costs

OC = other costs

V = speed

25 Larkin, John, Yoshi Ozaki, Kirsi Tikka, Keith Michel, *Influence of Design Parameters on the Energy Efficiency Design Index (EEDI)*, Climate Change and Ships Increasing Energy Efficiency, TRB, Feb, 2010.

Figure 10 illustrates the cost curves that result for the above-referenced containership, assuming that 5% of the fuel costs are for auxiliaries and 95% are for propulsion. Shipowners will have to reduce speed to meet the EEDI but their customers, the shippers, will want increased speed. Thus, these ocean carriers are faced with the dilemma of being able to reduce total costs but having shippers who would face higher logistics costs. Introduction of a regulatory instrument that forces these speed reductions would be welcomed by these ocean carriers, as it would eliminate the pressure from shippers to increase speeds. Much like the player salary-cap policies adopted by professional sports team owners, the EEDI prevents individual operators from being influenced by shippers to provide faster service and the eventual return by all operators to higher speeds in order to offer a competitive service.

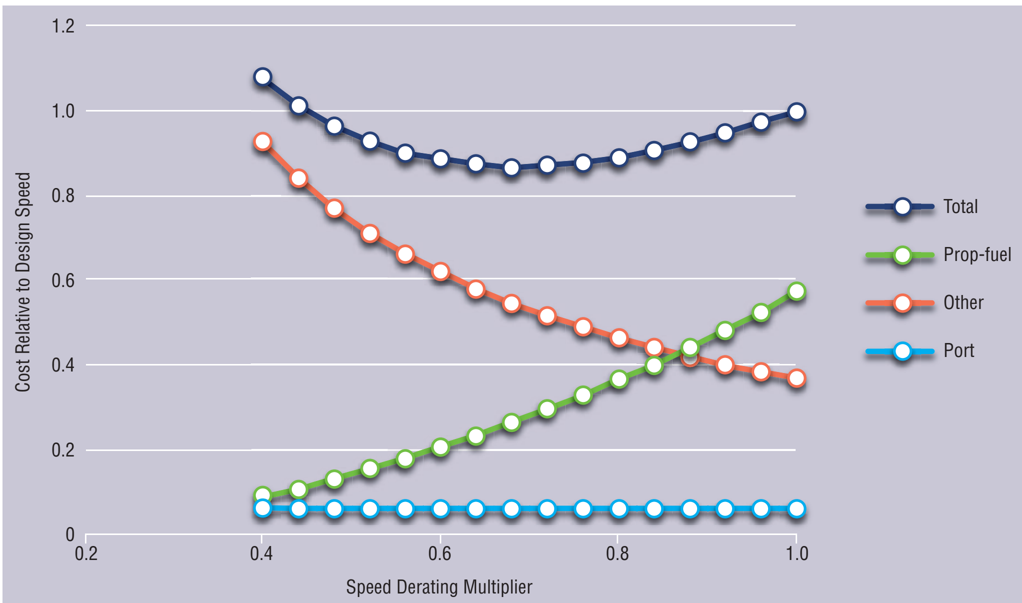


Figure 10: Containership Cost Relationship to Speed

Source: RTG analysis of costs reported by Larkin et al.

The vessel cost structure is much different for SSS operators. In its assessment of the potential mode shift impacts of extending the North American ECA into the Great Lakes, RTG estimated that fuel represented about 25% of total costs (excluding cargo inventory) for the Great Lakes-Seaway fleet.[26] Furthermore, 17% of the fuel consumed and 24% of the fuel costs for this fleet were for auxiliary power that is not influenced by speed reduction. Consequently, about 20% of costs are related to propulsion fuel. Thus, propulsion fuel savings would have almost triple the impact on total vessel costs for ocean-container vessels than for Great Lakes-Seaway vessels. It is clear that fuel-saving measures will be much more beneficial to ocean-container ships than to the Great Lakes-Seaway fleet. The latter fleet's cost relationship with speed is illustrated in Figure 11 and the total cost curves for containerships and lakers are compared in Figure 12. One can see that any reduction below the design speed leads to increased total costs for lakers. The minimum-cost operating speed for the containership shown in Figure 12 realizes a total-cost reduction of about 13% but corresponds to a 21% increase in total costs for Great Lakes-Seaway vessels. The total spread is a 34% advantage to the ocean containership.

26 Research and Traffic Group, *Study of Potential Mode Shift Associated with ECA Regulations In the Great Lakes*, for Canadian Shipowners' Association, 2009.

In addition, containerships continue to get ever larger (e.g., Maersk recently ordered 20 containerships of 18,000 TEU capacity), which will tend to increase the advantage in the above calculations. In contrast, the Great Lakes-Seaway fleet is limited in size by the Seaway lock system.

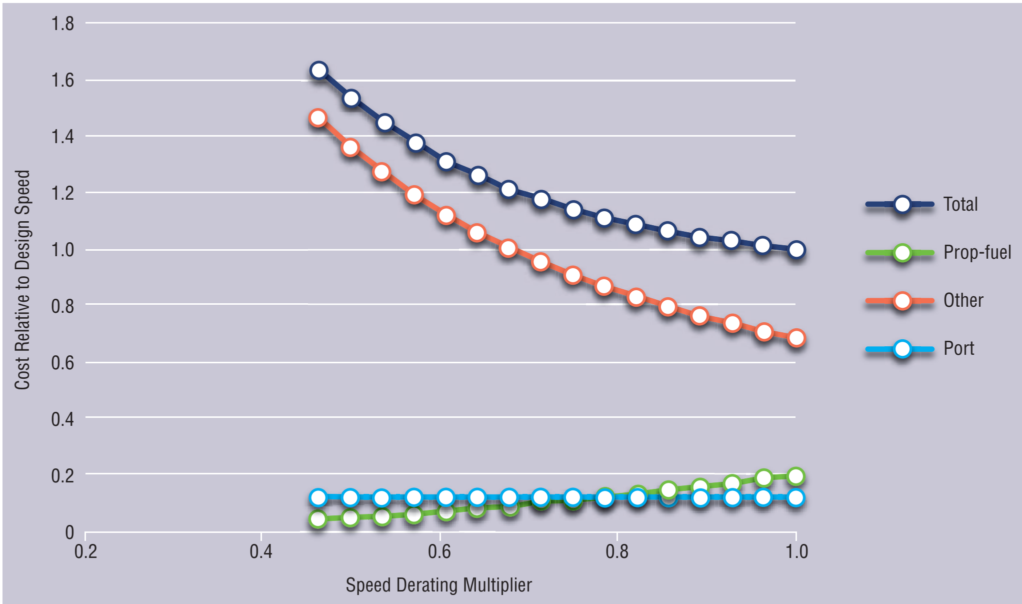


Figure 11: Laker Cost Relationship to Speed

Source: RTG analysis of laker costs

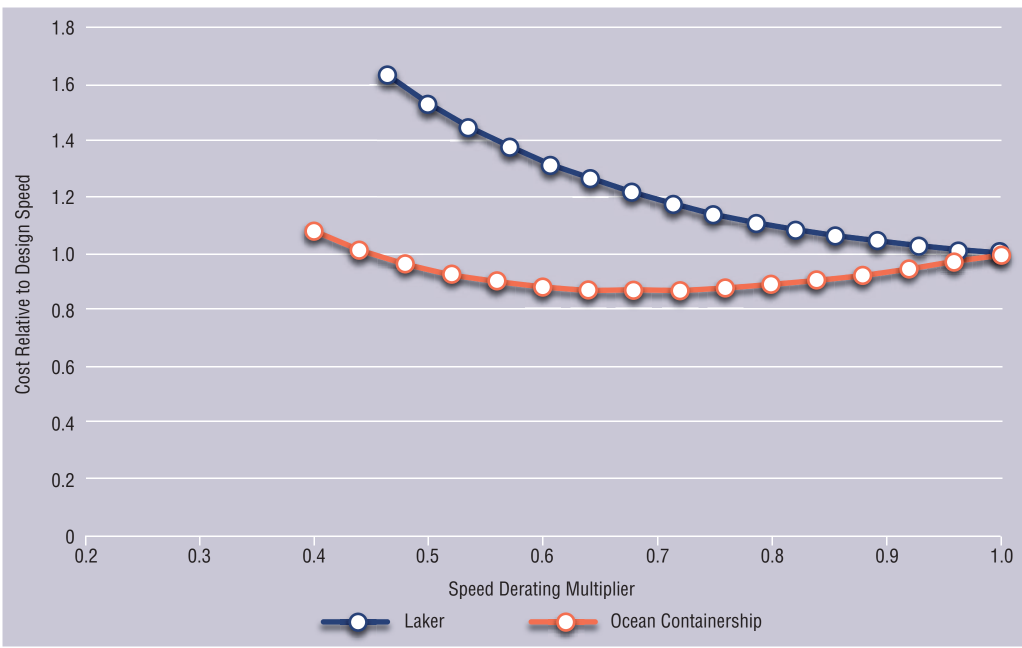


Figure 12: Containership and Laker Total Carrier Cost Relationship to Speed

Source: RTG analysis

6.3.3.2 Competitive Environment Comparison

As noted above, the EEDI's impact on ocean containerships is lower carrier costs and higher shipper costs. Since ocean vessels compete only with similar ocean vessels, shippers will have limited options: paying higher rates, finding alternate sources or not shipping. The competitive impacts will be minimal for ocean carriers.

The impact will be much different for SSS fleets. In addition to facing a negative cost impact that will result in higher rates, the Great Lakes-Seaway fleet operates in a more complex competitive environment than the ocean fleet. The SSS fleets face competition from ground modes — truck in Europe and mainly rail in North America. Truck competition for the Great Lakes-Seaway fleet is usually derived from shorter-distance alternate sources of supply rather than on the origin-destination trade (see RTG, 2009).[27] Rail competes with the Great Lakes-Seaway fleet for both domestic trades and international trades — either via the same transfer ports as the lakers use (e.g., Quebec City for wheat) or to U.S. ports (e.g., coal exports and primary steel imports). Ground mode competition involves an element of fairness that cannot easily be addressed via comparison of the direct impacts of the EEDI performance index on the operation of different vessel types. One possible option is to adjust the target reduction required by the EEDI in proportion to the total cost impact on the fleet — further adjusted by the degree of competitive threat faced by that fleet.

6.3.3.3 Technological Factors

The above focus has been on speed reduction as a means of attaining EEDI standards. Technological improvements are another means of meeting EEDI requirements. There have been improvements in propeller and hull design that might make the 2015 EEDI feasible, without significant speed reductions. However, some owners and operators are concerned that lower vessel speeds might be the only means by which EEDI reductions can be made in later years, without significant technological risk.[28] Nonetheless, technological change is an option over the longer term, as research is conducted. As with vessel speed impacts, the effectiveness of technological change also favours large ocean vessels.

As with vessel speed impacts, the effectiveness of technological change also favours large ocean vessels.

Economies of scale exist in both the design options available and the savings derived from those modifications. On the design side, some alternative technologies are only feasible for large vessels and/or large engines. For example, waste-heat recovery can be economical when applied to displace fuel and/or electric heaters (e.g., boilers for fuel viscosity); however, to make a significant economic impact, waste-heat recovery needs to replace electricity generation. The International Council on Clean Transportation (ICCT) indicates that the use of waste-heat recovery to generate steam for a turbine-driven electrical generator is only applicable to ships where the “main engine average performance is higher than 20,000 kW and auxiliary engine average performance higher than 1,000 kW. The size requirements limit the number of ships using this technology.” (See ICCT, 2011, p. 17[29] or IMarEST, 2011, p. 59[30]). For those technological alternatives that can be used on smaller vessels, economies of scale will exist in both the cost of, and savings from, those options.

27 Research and Traffic Group, *Study of Potential Mode Shift Associated with ECA Regulations In the Great Lakes*, for the Canadian Shipowners’ Association, August, 2009.

28 Braxton Scherz, D., Eirik Nyhus and Tore Longva, *Climate Change Regulations Consequences for Ship Design in a Rapidly Changing Environment*, Det Norske Veritas AS., 6 January 2010.

29 International Council on Clean Transportation, *Reducing Greenhouse Gas Emissions from Ships, Cost Effectiveness of Available Options*, White Paper No. 11, July, 2011.

30 Institute of Marine Engineering, Science and Technology (IMarEST), *REDUCTION OF GHG EMISSIONS FROM SHIPS Marginal Abatement Costs and Cost Effectiveness of Energy-Efficiency Measures*, IMO, MEPC 62/INF.7 Annex, 8 April, 2011, p.59.

6.3.3.4 Operational Factors that Favour Technological Investments by Ocean Fleets

The return on investment (ROI) is much higher for ocean vessels, which spend a much higher proportion of time at sea than do SSS fleets. The following differential factors all make the ROI comparatively lower for SSS fleets.

Stage length is important, as shorter trips mean less time at sea. The EEDI formula assesses auxiliaries only for the at-sea condition. The Great Lakes-Seaway fleet has much higher fuel consumption from auxiliaries than do ocean vessels, yet efficiency improvements made in this area are not recognized by the EEDI. The use of shaft generators to improve the efficiency of auxiliary power generation while underway is a valid efficiency measure for SSS fleets; however, it realizes modest influence (and in fact might be penalized) within the EEDI formula. Similarly, more time in port means less time at sea and lower fuel savings from propulsion-engine efficiency measures. The return on investment is tied to fuel saved, which will be lower for shorter trip lengths.

Utilization rates have a direct impact on return on investment. As with stage length, fewer miles traveled mean less fuel saved and a lower ROI from improving propulsion efficiency. The Great Lakes-Seaway fleet already has a significantly lower utilization due to seasonal closure of the Seaway.

… the Great Lakes-Seaway fleet's higher daily crew costs result in higher incremental costs compared to internationally crewed ocean vessels.

Crew Costs: The Canadian laker fleet is protected from foreign-flagged vessel competition under the *Coasting Trade Act*. Canadian crews are also protected under the *Immigration and Refugee Protection Act (IRPA)* and the *Oceans Act*, such that Canadian-flagged vessels are crewed with Canadian mariners. While this has no direct link to the EEDI, it does affect the ROI from those efficiency measures that lead to reduced speed. Reduced speed means more travel days per trade and the Great Lakes-Seaway fleet's higher daily crew costs result in higher incremental costs compared to internationally crewed ocean vessels. As RTG noted in 2005, the United Kingdom and Norway have long allowed foreign-crewed vessels in coastal trade, while others such as Australia, New Zealand and the European Union (EU) recently relaxed cabotage constraints.[31] The U.S. — and possibly other countries — require domestic crews on coasting trade vessels.

Ballast ratio: The laker fleet has a higher ratio of ballast-miles/laden-miles than many trades served by the ocean fleet. Consequently, the laker fleet has fewer cargo-miles to recover capital investments and higher impacts on rates for shippers of that cargo. Where ocean fleets have a high ballast ratio (e.g., fuel tankers), the competitive environment is such that the increased costs are more easily passed on to shippers as discussed in subsection 6.3.3.2.

Scheduling constraints are important for all services but are possibly more restrictive for shorter trips. In a report for the European Maritime Safety Agency (EMSA), Deltamarin Ltd. cites the case of European Ro-Ro carriers — where vessel speed is dictated by a 7-day cycle and size is dictated by the volume of cargo available for that cycle, further noting that:

> *The current EEDI philosophy is not applicable for schedule defined transport systems. In this kind of ships, application of EEDI could easily lead to sub optimization, and probably also use of oversized vessels. A strict EEDI approach would concentrate the cargo to big hubs thus increasing the size of vessels used.* [Source: Deltamarin, 2009, p.25][32]

31 Research and Traffic Group, *Research Study on the Coasting Trade Act*, Transport Canada, November, 2005.
32 Deltamarin Ltd, *EEDI Tests and Trials for EMSA*, European Maritime Safety Agency, 11.12.2009.

In this regard, it is interesting to note the difference in response to the global economic downturn of 2008–09 — many ocean going tankers and container lines did slow down fleets to utilize more vessels and realize fuel savings, while the Great Lakes-Seaway fleet operators maintained speeds and docked some vessels to sit out the downturn. The ocean-going fleets that slowed down had long-distance trip schedules with multiple vessels; these trip schedules could be served with one additional vessel by slowing down to a speed that was still acceptable. Serving a schedule with 6 vessels instead of 5 — traveling at 5/6ths the speed — is a trade-off that is convenient to accommodate. In the EU case, where some schedules involve one vessel, there is no easy way to slow down, without disrupting a shipper's required delivery window and the carrier's economic desires to reach a port during daytime on a week-day — to avoid handling surcharges. The consequences of not meeting a shipper's preferences because of a shifted schedule are also much more significant for the SSS carriers' competitive environment than for international carriers.

6.3.3.5 Fairness Issues Unique to Inland Waterway Systems

The disparities discussed above will to a large degree be experienced by all coastal fleets. This subsection identifies other issues faced by the Canadian laker fleet that are unique to inland waterway systems.

Vessel speed restrictions while underway/at-sea are much more frequent for the laker fleet than for ocean vessels or other coastal vessels. The principal delays are for locks but some river segments also have speed restrictions. These forced speed restrictions result in reduced fuel consumption that is not recognized in the EEDI formula, as well as unrecognized reductions to daily travel distance, which lower the laker fleet's return on investment.

Capacity utilization constraints due to Seaway draft limitations[33] and winter shutdown restrict the laker fleet's annual revenues in comparison with similar-sized ocean vessels. Thus, the increase in laker-fleet freight rates needs to be higher than those of ocean vessels to cover the same incremental capital costs.

Vessel design constraints: In addition to limiting capacity, the Seaway locks' dimensions constrain norms for vessel design — resulting in longer, more slender vessels for their deadweight tonnage (DWT) capacity. Also, the design option of lengthening the hull section to improve hydrodynamic drag and reducing the block ratio would be a far less economically attractive option for the Canadian Laker fleet. In fact, the opposite measure of increasing block ratio with the associated higher hydrodynamic drag is more cost-effective for the Canadian laker fleet. Another consideration is that the Seaway-max classification is unique to the laker fleet and thus, none of the vessels included in the EEDI baseline data represent the laker fleet's design constraints.

33 While the EEDI uses maximum operational draft, the Great Lakes-Seaway draft limits vary with seasons and the maximum is not always available.

Self-unloaders (SUs) represent an extension of the problem of Seaway-max vessels not being recognized in the present EEDI baseline data. Self-unloaders could require a separate vessel grouping within Seaway-max bulkers. Without a separate class of vessels or adjustment for the loss of carrying capacity associated with self-unloading gear, building new SUs might not be economically viable. IHS Fairplay 2010 World Fleet Statistics data indicate that there were 172 self-discharging dry bulkers registered in the world; of these, 37 were Canadian and 44 were U.S. registered. The majority of the world's fleet of SUs is owned by Canadian and U.S. companies. This number has grown in the past year with Canada Steamship Line's (CSL's) purchase of Jebsen's fleet of European short sea self-unloaders. Any separate designation for SUs by the IMO would presumably have to be a Canadian and/or U.S. initiative.

7

Consideration of Strategic Alternatives

There is a much broader need for SSS operators to have a distinct voice within the IMO or to have the opportunity to vet IMO initiatives before they are voted on by member countries. The IMO and other multilateral organizations are dominated by ocean companies. The EEDI experience is being felt by many countries and is perhaps a good rallying issue to strike strategic alliances in pushing for separate recognition at the IMO and the International Chamber of Shipping (ICS), with the formation of subcommittees or working groups. In particular, RTG notes the following issues raised in other jurisdictions:

- The Ro-Ro design issue is particularly relevant to European countries, Japan and China; and
- The EU's mode-shift policy initiatives will be negatively impacted by the EEDI.

The C-coefficient issue noted in Section 6.3.2 is less important to the Great Lakes-Seaway fleet than it is to Ro-Ro fleets. However, this issue can be raised as an important strategic factor in seeking allies for changes to the EEDI formula — the EU policy initiatives to divert traffic from highways are largely directed at large high-powered Ro-Ro vessels that can compete with trucks.

In a recent 2012 newsletter article titled, "EEDI Does Not Work for Ro-Ro Vessels," Interferry indicated that:

> *A new model for ro-ro sector EEDI is to be sent to IMO by Denmark. Hans Otto Kristensen of the Technical University of Denmark has created a methodology that could replace the flawed and inaccurate index, which the IMO is struggling to adapt for the sector. Prof Kristensen has now designed a formula for allocating values to the amount of cargo space, accommodation space used and passengers onboard ro-ro vessels.*
>
> *He has looked at a number of specific vessels in operation and calculated the amount of space needed for rolling cargo, for passengers, such as restaurants and lounges, service space, and sleeping accommodation for passengers. The environmental performance of each of these areas can be calculated and an overall performance for a ship on a specific voyage found, given its speed. In this way, the energy efficiency operational indicator is more effectively calculated and errors in the EEDI can be avoided according to Kristensen.*[34]

There is a much broader need for SSS operators to have a distinct voice within the IMO or to have the opportunity to vet IMO initiatives before they are voted on by member countries.

34 http://www.interferry.com/node/2165

One limitation in seeking allegiance with the EU SSS operators is that they do not have a distinct voice at the IMO.

The fact that the IMO recognizes this issue and is in discussions with Ro-Ro stakeholders on how to extend the EEDI to fairly address Ro-Ro ship design, opens the door for the broader coastal fleets to seek a hearing at these discussions. The present discussions seem to be focused on the technical issues of the EEDI formulation; however, the Ro-Ro fleets face the same "economic-fairness" issues as the broader SSS fleets and might be amenable to raising these non-technical issues within the framework of discussions.

Perhaps, the IMO could be convinced that it should pursue EEDI regulations for ocean fleets, while encouraging member countries to develop variations of an EEDI for SSS fleets — such that the differences in cost/effectiveness are recognized. Over the longer term, it would be desirable to have the IMO recognize that SSS fleets need to be differentiated in the development of IMO policies and that a subcommittee be set up to review proposed policies from the perspective of SSS fleets.

Research Traffic Group's cost-effectiveness comparison focused on containerships for ocean vessels because the cost data were available in the literature. The ocean bulker fleet is less likely to see the scale of savings available to containerships. It might be possible to gain support for changes to the EEDI within segments of the ocean fleet. Perhaps, a segmentation of the baseline data into larger- and smaller-capacity vessels would gain more support than segmentation based on fleet service.

The Great Lakes-St. Lawrence Seaway competitive environment will be particularly difficult to capture within the EEDI framework. Disparity can still result, if the EEDI equation is adjusted such that the cost impact is the same for both ocean fleets and the laker fleet. The incremental costs to the ocean fleet are borne by shippers, while increased costs to the laker fleet will result in a loss of some shippers to competing ground modes. To the degree that marine is a lower-emitting mode, the EEDI would have a negative environmental impact. Referring back to the GHG modal comparison in Figure C4, based on the post-renewal scenario, marine is the lowest-emitting mode — rail is 1.7 times higher and truck 7.1 times higher. The comparison does not include EEDI reductions for the Great Lakes-Seaway fleet and highlights the unfairness of singling out the marine mode for further efficiency improvements via the EEDI. The "fairest" strategy to resolve this disparity would be for local governments to adopt the same regulations for ground and marine modes in terms of the required emission reductions. Meeting the EEDI's 2025 reduction requirement (i.e., 30% reduction in CO_2 over the 1999–2009 average) would be a significant challenge for the rail and truck modes (as it will be for the marine mode).

In the case of Canada, it is within the regulatory purview of Transport Canada (under the *Railway Safety Act*) to impose a harmonized reduction on the rail operators; this could be a strategic option to press for, since rail is the main competitor for the Great Lakes-Seaway fleet. The SSS industry could also highlight the fact that rail competes more directly with truck and the proposed GHG reductions under the *Motor Vehicle Fuel Consumption Standards Act* call for the truck mode's tractor manufacturers to attain reductions from 6% to 20% from a defined baseline performance level. The lower reductions are associated with vocational and short-haul trucks of the type that compete with marine for aggregate, salt and agricultural products — while the higher reductions are associated with long-haul merchandise trucks that compete with rail. Research and Traffic Group notes that the 7.1 times multiple for emissions of GHG from trucks (shown in Figure C4), already includes the GHG reductions for truck required by the GHG regulatory initiative of the Environmental Protection Agency (EPA) and Environment Canada (EC).

Strategic alternatives/combinations to be considered in pursuing discussion with the IMO and/or with Transport Canada include the following:

IMO and/or Transport Canada modifications to EEDI:

- Segment the baseline database to better reflect the wider range of design differences for smaller vessels;
- Modify target reductions required under the EEDI to reflect the relative cost impacts and competitive influences in the SSS markets.
- Modify EEDI factors to improve fairness between ocean and SSS fleets;
- Encourage the IMO to expand the EEDI to recognize full-voyage environmental impact and actual work done, such that all vessels are fairly treated within the new EEDI.

Transport Canada adoption of EEDI:

- Defer adoption of the EEDI for the domestic fleet until a set of harmonized domestic regulations for the laker fleet and the competing ground modes (and possible U.S. regulations) can be accomplished.
- Partially adopt the EEDI for the 2015 targets using the "hypothetical" 1999–2009 design-builds of Seaway-max vessels and defer full adoption until fairness (via a modified EEDI formula) and harmonization with ground modes can be achieved.
- As a fallback option, Great Lakes-Seaway operators might seek funding support from Transport Canada or Environment Canada to assist with research into cost-effective EEDI technologies or as direct funding incentives to equalize the competitive playing field — if Transport Canada chooses to force the ocean-based EEDI on the domestic fleet.

Certain aspects of the Great Lakes-Seaway fleet differentiate it from other coastal fleets (e.g., lock delays and self-unloading vessels) but clearly, many of the concerns and issues are shared. It would be desirable to categorize those aspects of coastal fleets that are similar for the Great Lakes-Seaway fleet, in comparison with the large ocean-going vessels. This would allow the findings and possible modifications to be shared with other countries that have coastal fleets — to solicit support in dealing with the IMO in its ongoing evolution of the EEDI formula.

Certain aspects of the Great Lakes-Seaway fleet differentiate it from other coastal fleets (e.g., lock delays and self-unloading vessels) but clearly, many of the concerns and issues are shared.

The factors that differentiate the Great Lakes-Seaway fleet from other coastal fleets also need to be categorized — in the event that the IMO does not wish to deal with unique circumstances, such as the Great Lakes-Seaway System. These differentiators will still be relevant in discussions with the U.S. and its potential support of different applications of the EEDI to coastal and Great Lakes-Seaway fleets.

The factors relevant to a "fairness" comparison include vessel-design attributes in the EEDI formula and characteristics of the fleet operating environment that influence the economic consequences of implementing the EEDI. Both types of factors need to be assessed in relation to the financial impacts.

A number of economic/operational factors have been identified that could be raised by the Great Lakes-Seaway fleet operators in voicing concern about the unfairness of the EEDI.

Summary List: A number of economic/operational factors have been identified that could be raised by the Great Lakes-Seaway fleet operators in voicing concern about the unfairness of the EEDI. Many of the factors will be faced by other coastal fleets, while some are unique to inland waterways. Thus, it is useful to group the fairness factors into the following two subclasses:

a) Fairness issues in common with many coastal/domestic fleets:

- economies of scale (both in costs and savings);
- disparities across vessel classes;
- schedule dependence;
- stage length (or ratio of trip-time/port-time);
- operating cost factors (utilization rates, ballast ratios, crew costs);
- competitive environment; and
- ECA influence.

b) Fairness issues unique to Great Lakes vessels (and other inland waterway systems):

- vessel speed restrictions while underway/at-sea;
- capacity utilization constraints (e.g., Seaway draft, season length);
- vessel design constraints (dimensional constraints in all 3 dimensions); and
- self-unloaders as a separate EEDI class.

8

Conclusions and Recommendations

As this report demonstrates, short sea shipping (SSS) requires an internationally accepted "**definition**" and a sizable segment of the world's fleet of shipping vessels needs to be strongly "**defended**" and "**promoted**" in the international regulatory arena and within adopting IMO Member national regulations.

Vessels engaged in short sea shipping are an important component of the global fleet. Analysis by Research and Traffic Group (RTG) estimates that the worldwide SSS fleet contains close to **16,000 vessels** with a combined deadweight tonnage **(DWT) of 77 million tonnes**.

Short sea shipping makes a significant socio-economic contribution to many nations. Promoting SSS trade contributes to the social good, by supporting a transportation mode that is safer in terms of injuries and fatalities and produces lower emissions than land modes. The economic value of SSS is also considerable in many countries in North America, Europe and the Far East, creating large numbers of direct and indirect jobs, and generating significant tax revenue for governments.

There is currently no clear advocate for the various SSS trades at the International Maritime Organization …

There is currently no clear advocate for the various SSS trades at the International Maritime Organization (IMO) or within the International Chamber of Shipping (ICS), and issues specifically affecting SSS are typically handled on an ad hoc basis. The trans-oceanic trades, on the other hand, are strongly represented at the global level and well-organized around key issues. Consequently, international maritime conventions best represent the interests of the ocean-going trades and frequently produce negative impacts for short sea shipping.

As detailed within this report, such is the case for two recent environmental IMO Conventions: the proposed Ballast Water Management Convention and parts of Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL) — the components dealing with Emission Control Areas (ECAs) and the technical components of the Energy Efficiency Design Index (EEDI).

Although these conventions are well-intentioned, aimed as they are at reducing the environmental impact of shipping, they threaten the interests of short sea shipping and are creating risks that could shift trade away from SSS to the rail and truck modes.

The unconsidered consequences of these conventions are negative to the environment in that they promote a negative modal shift to land transportation. They have come about in part because there is no mechanism at the IMO to analyze the impacts of impending regulations on the SSS sector, in order to advise member delegations before adoption.

Recommendations

1. DEFINE: IMO should establish a common definition of Short Sea Shipping.

In order to better focus and consolidate the interests of SSS globally, a widely accepted and broadly inclusive definition must be adopted …

Several countries and regions throughout the world have established their own unique — and sometimes geo-political — definitions of short sea shipping. In order to better focus and consolidate the interests of SSS globally, a widely accepted and broadly inclusive definition must be adopted — one that encompasses all aspects of SSS, and that would be acceptable to national and international governing bodies. While typically, short sea shipping primarily competes with road and rail, not all instances of SSS meet this absolute definition due to present infrastructure. Therefore, the definition should be broader as the same socio-economic benefits exist prior to the road and rail sectors being induced to set up for these additional tonnes. The following definition is recommended:

> **Short sea shipping (SSS) is defined as the commercial shipment of cargo or passengers by domestic and international maritime transport. In general, this subsector of marine transportation operates in coastal and inland waterways, does not cross an ocean and often competes with road and rail networks.**

While this definition may be inconsistent with some entities' definitions that seek to broadly expand geo-political boundaries (e.g., U.S. Marine Highways and the EC Shortsea Shipping Network), or with nations with particular interest in any one trading segment (container shipping, for example), it is consistent with the broad intent of SSS and with existing international conventions such as the SOLAS and Loadline Conventions.

2. DEFEND: IMO Member Administrations should establish a mechanism, either a new Sub-Committee or a Working Group within an existing Sub-Committee, to evaluate and make recommendations for the protection of the Short Sea Shipping sector, prior to adopting International Conventions that include the sector. The Sub-Committee or Working group should work with the SSS industry to identify the disproportionate and hidden impacts of Conventions on the industry.

Nearly all segments of the maritime industry are represented at the IMO by non-governmental organization (NGO) participants. At MEPC-64, there were no fewer than 15 such organizations representing nearly all facets of shipowners and operators. However, none of these organizations purport to solely represent the interests of SSS operators. While it is very important to ensure SSS interests are adequately represented by member administrations, it is equally important for SSS to have its own voice at the IMO. Until such an entity exists, various NGOs with SSS members and administrations with SSS interests should carefully balance these needs prior to the adoption of policies and conventions.

3. DEFEND: A mechanism must be developed within the International Chamber of Shipping (ICS) and/or within an exclusive Non-Governmental Organization, to ensure the interests of Short Sea Shipping are represented at the IMO, exclusive of Administration representation.

As outlined above, the impacts of international conventions — and often the more expansive national implementing regulations for those conventions — have a significant, disproportionate effect on short sea shipping. Thus, SSS organizations must identify agencies within their national administrations that are involved in policy development and convention negotiation, and educate the decision-makers on the socio-economic impacts of the SSS industry. Additionally, they must provide factual input and communicate the likely impacts of existing conventions; conventions that have not yet come into force; and proposed conventions and amendments (along with their national implementing laws and regulations) on the SSS industry. Likewise, federal administrations must be willing to engage SSS interests; make a concerted effort to better understand the impacts of the SSS industry; and understand the impacts of conventions and regulations on the SSS industry.

SSS organizations must identify agencies within their national administrations that are involved in policy development and convention negotiation, and educate the decision-makers on the socio-economic impacts of the SSS industry.

4. DEFEND: Short Sea Shipping nations should adopt as policy a defence of domestic Short Sea Shipping interests when adopting International Marine Conventions and in subsequent adoption of National Regulations.

In addition to recognizing the disproportionate impacts of international conventions on short sea shipping, administrations and the IMO must fully appreciate and value the public good associated with the continued development of short sea shipping as an integral part of a nation's domestic and international trade policies. To that end, the SSS industry, both regionally and globally, needs to develop quantified data and undertake analyses of the socio-economic impacts of unintended mode shifts from existing vessel routes to road and rail that could result from adoption of IMO policies. These include potential domestic policy disparities across competing modes in the SSS jurisdiction, and undesirable public impacts of unintended mode shifts (e.g., on employment, infrastructure maintenance costs, taxation revenues, transport injuries and fatalities, GHG and local CAC air emissions). While the IMO needs to encourage nations to adopt international conventions, it also needs to allow nations to modify the enabling regulations as applied to SSS operators, such that a fair and equitable representation of public good is realized.

5. PROMOTE: Short Sea Shipping nations must be clearly identified and targeted by SSS national shipping associations. Clear, concise and up-to-date information on the full socio-economic benefits — including public safety, reduced highway congestion, economic value and environmental footprint — must be fully evaluated and appreciated by political decision-makers and public advocacy groups.

Overall, there is a scarcity of reliable data for the short sea shipping segment of the transportation industry. Thus, many national governments do not have an appreciation for the socio-economic impacts of SSS on their countries or regions. As a distinct example, until the Canadian St. Lawrence Seaway Management Corporation and the U.S. St. Lawrence Seaway Development Corporation jointly sponsored an economic report for the North American Great Lakes region, there was no reliable data upon which governments could rely to make policy decisions. The resulting study reported that the Great Lakes-St. Lawrence Seaway maritime transportation system was responsible for producing 227,000 direct, induced and indirect jobs for the region with a business revenue impact of $35 billion. In addition, Great Lakes-Seaway shipping has a wider related impact on jobs, income and tax with the shippers (mining companies, farmers, manufacturers etc.) and supporting industries that move cargo through the marine terminals. Related jobs totalled 477,593 with a related business revenue impact of CDN$119 billion. SSS industry leaders need to advocate aggressively to local, national, regional and international decision-makers who are in a position to effect change.

Appendix A

Estimation and Characterization of Short Sea Shipping Global Fleet

For a variety of reasons detailed in the report, estimation of the size of the global fleet engaged in short sea shipping (SSS) is challenging. Furthermore, as vessels change owners or operating profiles, ships may change back and forth between trans-oceanic and SSS routes. Many of the major worldwide maritime databases, such as Lloyd's Register/Fairplay Vessel Registration and the International Transport Forum (ITF), sometimes must rely on incomplete data from Flag Administrations, Registries and Classification Societies' lists. For example, the ITF data underestimate the relative importance of the Canadian domestic fleet. It is not clear what the source of the ITF SSS data was for Canada; however, our research and interaction with Canada's SSS fleet leads to a much higher estimate. Our assessment of the *Coasting Trade Act* (Research and Traffic Group, 2005) showed that the domestic fleet's cross-border activity on a tonne-km basis is roughly equal to its total domestic activity. Thus, the Canadian data shown in Table A1 could be doubled to indicate the total activity of the domestic fleet in SSS trade. Also, the data do not illustrate the strong ties of Canada's fleet to SSS.

The relative importance of SSS and seaborne transport in general for the EU countries is illustrated in Figure A1. The UK, Italy and the Netherlands rank as the top-three in SSS tonnes handled, respectively; however, the Baltic region countries all have a significant level of SSS activity. In total, the EU-27 handled 1.73 billion tonnes of cargo in SSS activity in 2010. Of this total, 1.66 billion tonnes or 94% were handled by 15 member countries. Figure A2 illustrates the cargo breakout by region, with liquid bulk being the dominant cargo.

In total, the EU-27 handled 1.73 billion tonnes of cargo in SSS activity in 2010.

Table A1: Inland Waterways and Short Sea Shipping Freight Activity in 2008

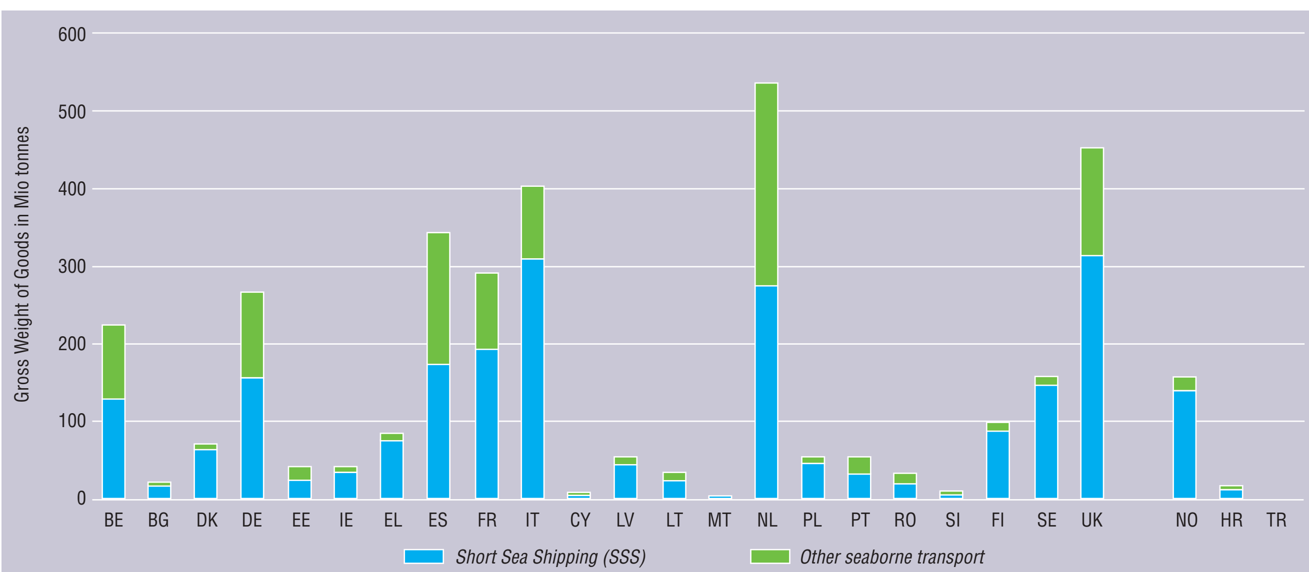
Selected Countries	Activity (Million Tonne-km)		
	Short Sea	Inland Waterways	Total
China		1,741,170	1,741,170
United States		380,994	380,994
Japan	187,859		187,859
Australia	124,540		124,540
Germany		64,061	64,061
Russian Federation		63,705	63,705
Canada	27,852	22,800	50,652
United Kingdom	48,400	160	48,560
Italy	47,017	64	47,081
Netherlands		44,446	44,446
Norway	23,859		23,859
Belgium		8,746	8,746
Romania		8,687	8,687
France		8,557	8,557
Ukraine		5,670	5,670
Finland	2,937	80	3,017
Other**	1,971	11,742	13,713
Total	**464,435**	**2,360,882**	**2,825,317**

Source: Derived from Trends in the Transport Sector, International Transport Forum

* The data underestimates the activity of Canada's domestic fleet by a factor of 2 (see text).
** Other countries with less than 2,500 million tonne-km.[1]

Figure A1: Share of Short Sea Shipping (SSS) of Goods in Total Sea Transport in 2010 (Gross Weight of Goods in million tonnes)

Source: Eurostat[2]



1 Other countries included: Austria, Hungary, Bulgaria, Ireland, Ireland, Serbia, Poland, Slovak Republic, Czech Republic, Luxembourg, Belarus, Croatia, Iceland and Lithuania.

2 http://epp.eurostat.ec.europa.eu/statistics_explained/images/2/22/Share_of_Short_Sea_Shipping_28SSS29_of_goods_in_total_sea_transport_in_2010_28gross_weight_of_goods_in_Mio_tonnes29.PNG

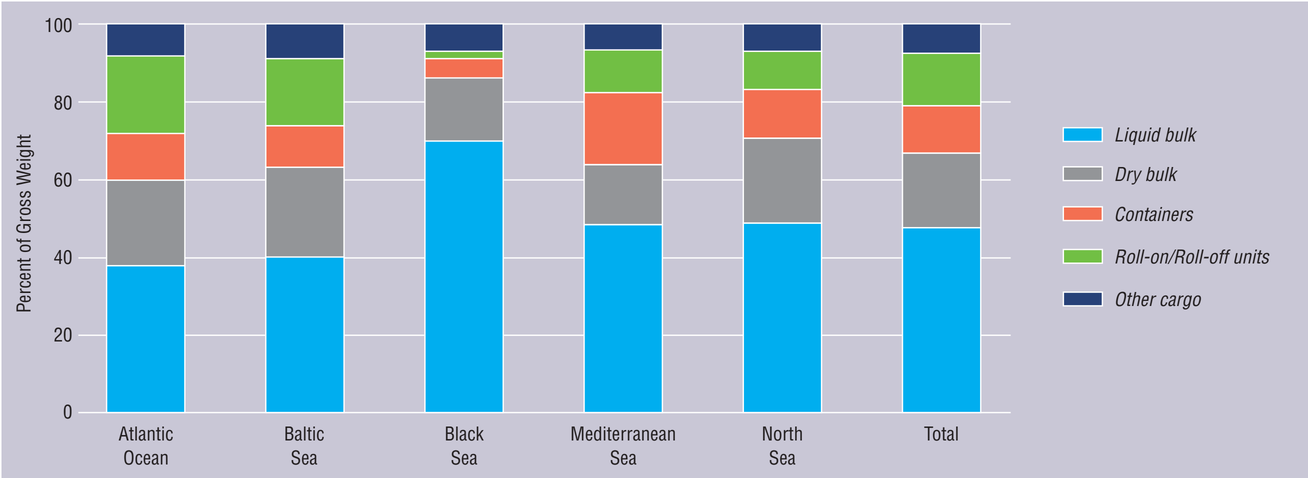


Figure A2:

SSS of goods by type of cargo for EU regions in 2010 (% gross weight)

Source: Eurostat[3]

Figure A3 illustrates the SSS activity among the EU-27 countries in comparison with several other countries, as estimated by the European Commission (EC). The EC estimates are in percentage-market share, rather than actual tonne-km of activity. Thus, it is difficult to compare the different estimates. The ranking by market share places China with the highest market share for coastal/inland waterways, followed by the EU-27, Japan and then the U.S.

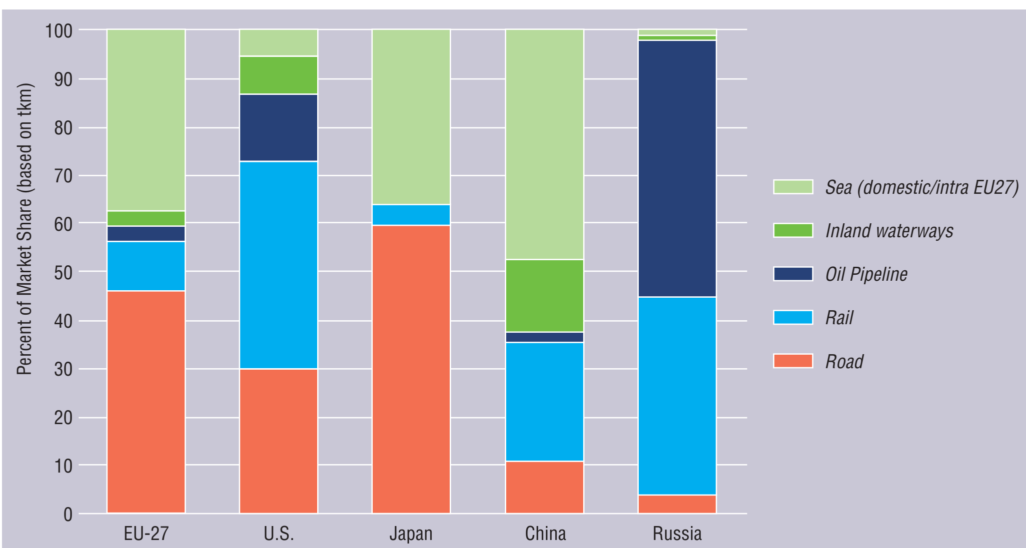


Figure A3:

Short sea shipping market shares in 2006

Source: Hjelle and Fridell, in turn derived from Eurostat 2009.

3 http://epp.eurostat.ec.europa.eu/statistics_explained/images/6/6e/EU-27_SSS_of_goods_by_type_of_cargo_for_each_sea_region_of_partner_ports_in_2010_28 25_based_on_gross_weight_of_goods_29.PNG

Table A2 provides a glimpse of the smaller dry bulk vessels registered with national governments. These are the size of vessels that could be employed in the Great Lakes-St Lawrence Seaway trades and that are most likely the ones used in SSS activities worldwide. From the source material, it is not clear whether the U.S. and Canadian Great-Lakes fleets are included in these data — as another publication (UNCTAD Review of Maritime Transport 2011) also uses data obtained from IHS Fairplay but which has a proviso that these fleets are not included in the Annexes to that document. Regardless, there are substantial numbers of vessels in the world that could be similarly affected by the Energy Efficiency Design Index (EEDI) requirements. The average age suggests that these vessels could soon be slated for replacement.

Similarly, the Table A3 on general cargo ships shows a listing that is probably even more tilted towards short sea shipping, with the preponderance of smaller vessels and replacement.

Table A2: World Fleet of Registered Dry Bulk Ships

Dry Bulk Ships up to 30,000 tonnes – Deadweight and Average Age					
Deadweight Range (tonnes)	**Number of Vessels**	**Combined DWT**	**Avgerage Age**	**% of Ships in Fleet**	**% of Fleet Tonnage**
4999 or less	92	286,623	14	1.4%	0.1%
5000 to 9999	120	899,694	19	1.8%	0.2%
10000 to 14999	112	1,412,651	22	1.7%	0.3%
15000 to 19999	272	4,861,553	22	4.1%	1.1%
20000 to 24999	345	7,885,129	19	5.2%	1.8%
25000 to 29999	767	21,239,555	18	11.6%	4.9%
Total to 29999	1,708	36,585,205		25.7%	8.4%
Total Fleet	**6,636**	**433,795,368**	**14**	**100.0%**	**100.0%**

Source: *World Fleet Statistics 2009*, IHS Fairplay

Table A3: World Fleet of Registered General Cargo Ships

General Cargo Ships up to 30,000 tonnes – Deadweight and Average Age					
Deadweight Range (tonnes)	**Number of Vessels**	**Combined DWT**	**Avgerage Age**	**% of Ships in Fleet**	**% of Fleet Tonnage**
4999 or less	12,169	27,425,876	>25	72.2%	34.3%
5000 to 9999	2,786	19,431,288	>16	16.5%	24.3%
10000 to 14999	790	9,771,551	17	4.7%	12.2%
15000 to 19999	447	7,602,158	23	2.7%	9.5%
20000 to 24999	241	5,585,239	19	1.4%	7.0%
25000 to 29999	103	2,861,976	16	0.6%	3.6%
Total to 29999	16,536	72,678,088		98.2%	90.8%
Total Fleet	**16,845**	**80,034,744**	**24**	**100.0%**	**100.0%**

Source: *World Fleet Statistics 2009*, IHS Fairplay

Appendix B

Short Sea Shipping Economic Data

North American Great Lakes-St. Lawrence Seaway System

The following data are from the Martin Associates report, which details the socio-economic contributions of the Great Lakes-St. Lawrence Seaway System to the countries of Canada and the U.S. Approximately 92% of the jobs and income are generated as a result of Great Lakes-Seaway System's short sea shipping, with the remaining contribution coming from vessels entering the System from outside the Exclusive Economic Zone of Canada or the U.S.

Table B1 provides some insight into the volumes of marine traffic by state and province, and the number of jobs (direct, induced and indirect) that the Martin report calculated as being related to this traffic.

As noted previously, most of the traffic is carried in Canadian- and U.S.-flag vessels but some considerable volume is also carried in foreign-flag vessels. Table B2 provides the Martin estimates on jobs related to the Great Lakes-Seaway traffic. Of particular note in this table is the major importance to the respective domestic economies of the domestic flag carriers.

Table B1: Cargo Volume Handled and Jobs by State and Province, 2010

State/Province	Volume (000 tonnes)	Total Jobs
Indiana	28,360	48,322
Ohio	40,122	28,081
Michigan	61,302	26,819
Minnesota	30,160	6,271
Illinois	7,219	7,177
Wisconsin	33,241	8,777
New York	2,216	1,967
Pennsylvania	605	854
Subtotal U.S.	**203,325**	**128,277**
Ontario	62,293	63,542
Quebec	56,511	35,013
Subtotal Canada	**118,804**	**98,556**
Total	**322,129**	**226,833**

Note: Volume handled is roughly twice the volume carried, as most traffic is both originated and terminated in the system. Also, cargo volumes and jobs impact totals include the effect of overseas import/export traffic both on the Great Lakes and the St Lawrence River.

Source: *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*, Martin Associates, Lancaster, PA, October 18, 2011, pp. 38-9.

Table B2: Employment Impact by Flag

Flag of Carrier	Impact in Canada	Impact in the U.S.	Total Impact
Canadian Flag	90,074	11,494	101,562
U.S. Flag	4,570	103,043	107,612
Foreign Flag	3,912	13,741	17,653
Total	**98,556**	**128,278**	**226,827**

Source: Martin Associates, *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*, October 18, 2011, p.46

Table B3: Direct Jobs by Flag and Commodity for Each Country

Table B3 is taken directly from the Martin study and provides insight into the importance of the jobs impact on the major industries around the Great Lakes. For the purpose of this discussion, steel, iron ore and part of coal and limestone traffic, and jobs, can be attributed to the steel industry.

	Jobs in Canada by Vessel Flag				Jobs in the United States by Vessel Flag			
Commodity	Canadian Flag	U.S. Flag	Foreign Flag	Total	Canadian Flag	U.S. Flag	Foreign Flag	Total
Steel	52	0	364	416	30	1,987	2,646	4,664
General Cargo	465	0	6	471	0	117	92	210
Iron Ore	18,284	1,507	97	19,888	864	16,055	402	17,321
Grain	1,995	0	112	2,107	296	68	679	1,043
Stone/Aggregate	640	98	0	738	310	3,160	25	3,496
Cement	1,452	0	0	1,452	881	576	177	1,633
Salt	1,464	0	15	179	699	888	0	1,587
Other Dry Bulk	9,684	0	324	10,008	92	2,689	43	2,824
Liquid Bulk	4,052	0	0	4,052	0	2,388	0	2,389
Coal	1,024	295	12	1,331	578	3,650	32	4,260
Wind Energy	0	0	93	93	0	0	196	196
Not Allocated	5,113	47	1,093	6,253	684	3,693	635	5,012
Total	**44,226**	**1,948**	**2,114**	**48,288**	**4,434**	**35,272**	**4,928**	**44,634**

Source: Martin Associates, *The Economic Impacts of the Great Lakes-St. Lawrence Seaway System*, October 18, 2011, p.47

Europe

The European Ro-Ro and ferry industry (which carries significant amounts of short sea cargo as “unaccompanied trailers” or “live” units) covers about 1,000 routes, with approximately 1,350 vessels.[4] An estimated 28-million trailers per year or 540,000 per week travel on either short sea Ro-Ro’s or ferries. There are some very large and easily identifiable companies involved in both the Ro-Ro and ferry sectors in Europe. Short sea shipping tends to be deployed on longer routes with an average distance of 1,385 km, while trucks move much shorter distances.

4 Dr. Arndt-Heinrich von Oertzen, “Will the Impact of Achieving Lower Sulphur Emissions Drive Up Costs and Force Freight Back onto the Road,” presentation at the 4th European Shortsea Congress, Hamburg, June 2011.

The container feeder sector is also very important in Europe. In terms of global feeder volume of 68 million twenty-foot equivalent units (TEU) in 2007, about 10.9 million were handled in northern Europe and 9 million in the Mediterranean.[5] The total global feeder fleet in 2007 was 5,872 vessels, which was 20% of the world's container fleet. Some feeder operators also engage in door-door short sea activity.[6] The largest North European feeder trades are in the Baltic, UK/Ireland, Spain and Portugal. In the Mediterranean, they are the Western Mediterranean, including North Africa, the Eastern Mediterranean (Adriatic, Greece, Turkey) and the Black Sea. Feeder operators can either own or charter their vessels. The largest one in Europe, Unifeeder, describes itself as a "non-asset based" transportation company that charters all of its 32 vessels (as of 2010). It had profit of €36 million on revenues of €344 million in 2010.

There is also a short sea sector for liquid and dry bulk cargo in Europe. An estimated 9,649 vessels from 1,000 to 9,999 DWT, totaling 35.8 million DWT, participate in this market, with another 700 vessels on order. In the handysize liquid bulk sector, from 10,000 to 59,999DWT, there are about 2,887 vessels, totaling 90 million DWT, with a further 1,072 vessels on order. Chemical tankers make up 56 million DWT or 1,899 of these vessels.[7]

The main (top-40) SSS routes within the EU are shown in Table B4.

Table B4: Main Routes in Intra-EU Maritime Transport (2009)

Rank	Country of loading port	Country of unloading port	Million tonnes transported
1	ITALY	ITALY	86.173
2	UNITED KINGDOM	UNITED KINGDOM	79.643
3	UNITED KINGDOM	NETHERLANDS	40.187
4	SPAIN	SPAIN	39.471
5	FRANCE	UNITED KINGDOM	28.991
6	GREECE	GREECE	27.217
7	NETHERLANDS	UNITED KINGDOM	24.937
8	UNITED KINGDOM	FRANCE	23.517
9	FRANCE	FRANCE	19.564
10	UNITED KINGDOM	GERMANY	14.389
11	SWEDEN	GERMANY	14.029
12	DENMARK	DENMARK	13.203
13	BELGIUM	UNITED KINGDOM	12.671
14	DENMARK	SWEDEN	12.495
15	SWEDEN	SWEDEN	12.434
16	UNITED KINGDOM	BELGIUM	11.635
17	GERMANY	SWEDEN	11.243
18	UNITED KINGDOM	IRELAND	11.153
19	ITALY	SPAIN	11.017
20	SWEDEN	UNITED KINGDOM	10.363
21	LATVIA	NETHERLANDS	9.888
22	FINLAND	GERMANY	9.760
23	SPAIN	ITALY	8.776
24	SWEDEN	FINLAND	8.736
25	LATVIA	UNITED KINGDOM	8.443
26	ITALY	GREECE	8.042
27	GERMANY	DENMARK	7.806
28	DENMARK	GERMANY	7.592
29	LATVIA	GERMANY	7.574
30	FRANCE	SPAIN	7.418
31	UNITED KINGDOM	SPAIN	7.168
32	PORTUGAL	PORTUGAL	7.115
33	SWEDEN	DENMARK	6.998
34	GERMANY	UNITED KINGDOM	6.856
35	FRANCE	NETHERLANDS	6.793
36	FINLAND	SWEDEN	6.500
37	NETHERLANDS	SPAIN	6.424
38	NETHERLANDS	FRANCE	6.171
39	IRELAND	UNITED KINGDOM	5.763
40	NETHERLANDS	GERMANY	5.717
Total			**53.872**

Source: Eurostat

5 Dynamar BV, "Feedering & Transhipment: Trades, Operators, Ships," 2007.

6 Berndt Bertram, Unifeeder, "Short Sea Feeders and Containers," European Shortsea Congress, Hamburg, June 2011.

7 Fred Doll, "Bulk Shipping Markets," European Shortsea Congress, Liverpool, June 2009; also "Liquid Bulk Shipping Markets: Feedstocks and Biofuels," European Shortsea Shipping Congress, Hamburg, June 2011.

As reported in Section 2.2, all major modes of transportation have lost market share to road over the 15-year period of 1995 through 2009. As indicated by Table B5, rail has lost the greatest market share, followed closely by inland waterways.

Table B5:
EU-27 Modal Split (in %) Trends 1995-2009

Year	Road	Rail	Inland Waterways	Pipelines	Sea	Air
1995	42.1	12.6	4.0	3.8	37.5	0.1
1996	42.1	12.7	3.9	3.9	37.5	0.1
1997	42.2	12.8	4.0	3.7	37.3	0.1
1998	42.9	11.9	4.0	3.8	37.4	0.1
1999	43.5	11.4	3.8	3.7	37.6	0.1
2000	43.4	11.5	3.8	3.6	37.5	0.1
2001	43.9	10.9	3.7	3.8	37.6	0.1
2002	44.5	10.6	3.7	3.6	37.6	0.1
2003	44.5	10.7	3.4	3.6	37.7	0.1
2004	45.2	10.8	3.5	3.4	37.0	0.1
2005	45.5	10.5	3.5	3.4	37.0	0.1
2006	45.4	10.8	3.4	3.3	37.0	0.1
2007	45.9	10.9	3.5	3.1	36.7	0.1
2008	46.0	10.8	3.5	3.0	36.6	0.1
2009	46.6	10.0	3.3	3.3	36.8	0.1
% Change	**10.7%**	**-20.6%**	**-17.5%**	**-13.2%**	**-1.9%**	**0.0%**

Source: http://ec.europa.eu/transport/publications/statistics/pocketbook-2011_en.htm

Appendix C

Modal Comparison of Energy Efficiency and CAC Emissions

Seaway Fleet Comparison

Methodology

To get a like-for-like comparison with the two ground modes, this evaluation does not include the ship's power used for cargo unloading. Therefore, we reduced the hotel power at port by 10% to account for the modal differences in loading/unloading. Greenhouse gas (GHG) and criteria air contaminant (CAC) emissions impact comparisons were made for both the current range of technologies in use within each mode — and for currently available technologies anticipated to be partially or fully adopted into the propulsion plants of the fleets of the three modes over a defined time frame (by 2015-2020). The Great Lakes-St. Lawrence Seaway renewal fleet data is predicated on meeting the 2014 IMO date but not the Energy Efficiency Design Index (EEDI) 2015. For the balance of this report, post-renewal refers to vessels meeting the air emissions requirements of MARPOL Annex VI (EEDI) as of 2014.

The effects of greenhouse gas (GHG) emissions are global and thus, the location of the emissions is not important in determining their impact. The effects of criteria air contaminants (CACs) are local and thus, the location of the emissions is important in determining the impact. At the request of Transport Canada, the Chamber of Marine Commerce (CMC) study combined all CAC emissions on the presumption of equal consequences. However, the dominant impact of CAC emissions is on human health — Transport Canada's Full Cost Investigation estimated over 96% of the economic impacts of transportation's CAC emissions were health-related (Marbek Resource Consultants, 2007). Furthermore, the health impacts are tied to the intensity of the emissions at populated locations and emissions intensity dissipates with distance travelled. Thus, impact assessments of CAC emissions must identify source locations, choose boundaries for what is to be included and estimate the impact of the included source emissions on specific areas of interest. As examples of boundaries for exclusion, consider that:

- Airplane emissions of CACs are only considered during the landing/takeoff cycle; the CACs emitted after climbing above 915 m. (3,000 ft.) are not included in impact study methodologies.
- Port emissions inventories, such as that conducted by the Environmental Protection Agency (EPA) for Cleveland in 1999, include vessel emissions when within 16km (10 miles) of land, thereby including roughly 11.3 km (7 miles) at open-water cruise speed [Harkins, 2008].
- Ocean vessel emissions are excluded from consideration outside some boundary distances.

Drawing on the findings of the Sahu and Gray study (see Section 6.2 for a discussion of their study), we reassessed the marine CAC emissions reported in the CMC study on the basis of "near-land-equivalent" intensities. Our process included emissions within 40 km (25 miles) of land at full intensity and the remaining open-water emissions were included at 1/25th their intensity at source. The 1/25th intensity was the average intensity found by Sahu and Gray at 40 km from source.

Energy Efficiency Comparison Charts

The energy efficiencies of the three modes in the year 2010 are compared in Figure C1. The efficiency comparison of the three modes under the post-renewal scenario for each mode is illustrated in Figure C2. The performance comparison is based on ratio of work done (weight of cargo moved per unit distance) divided by total fuel consumed (laden and empty/ballast trips). The lower axis indicates the average distance in km that each mode can carry one tonne of Seaway cargo for each litre of fuel consumed; while the upper axis indicates the average distance in miles that each mode can carry one ton of Seaway cargo for each U.S. gallon of fuel consumed. The "marine advantage" index at the right side of the chart indicates that the Seaway fleet can move cargo 24% farther (or is 24% more efficient) than rail and 531% farther (or is 531% more efficient) than truck.

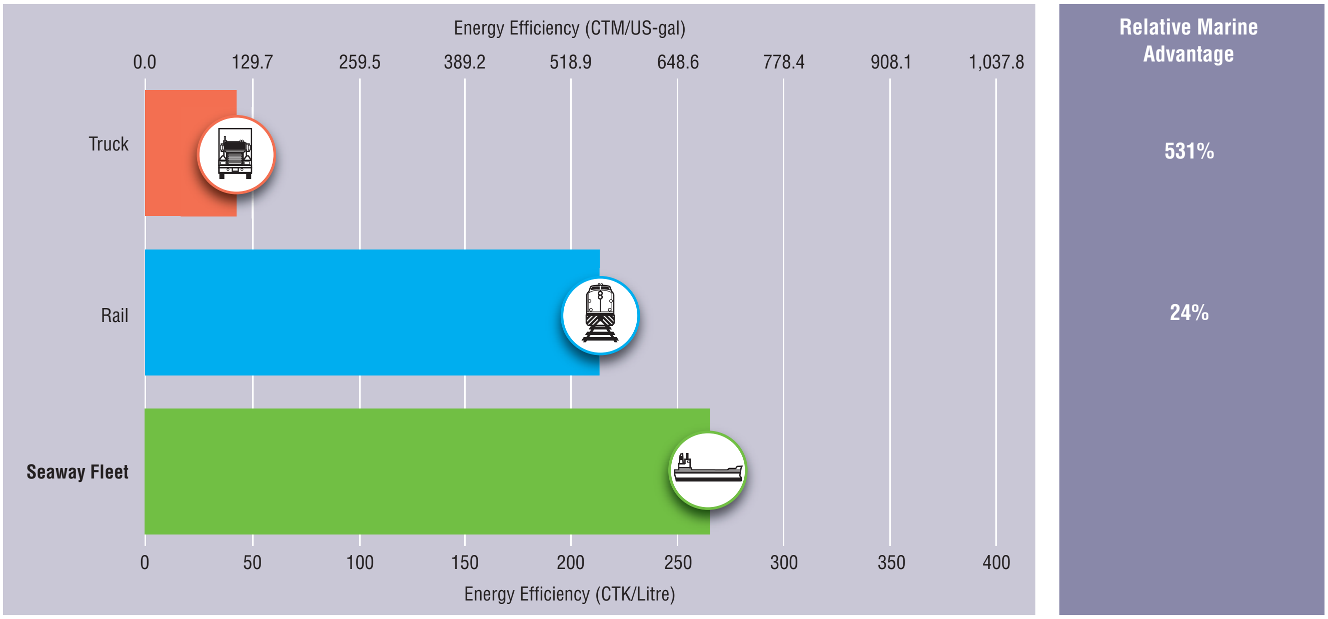


Figure C1:
Seaway Fleet Energy Efficiency Comparison for 2010

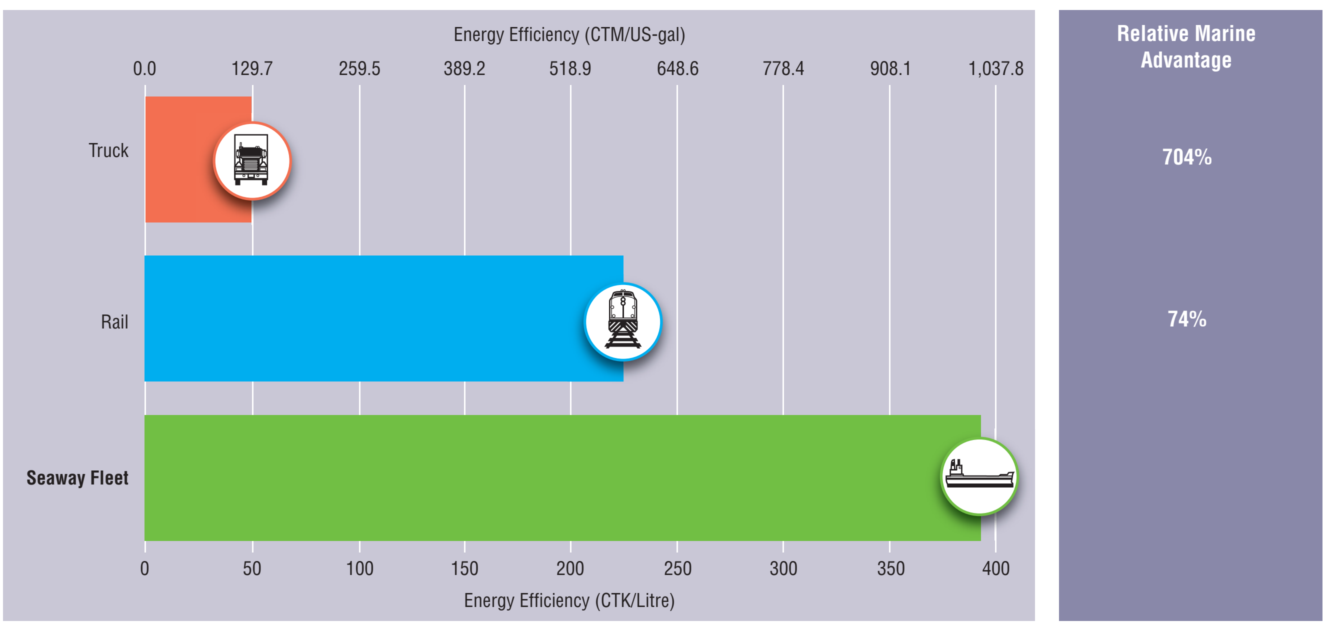


Figure C2:
Seaway Fleet Energy Efficiency Comparison Post Renewal of All Modes

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

Criteria Air Contaminants (CAC) Comparison Charts

The CAC charts are presented with the actual emissions intensities shown in metric units on the left side (grams per thousand cargo tonne-km – g/kCTK) and U.S. units (grams per thousand cargo ton-miles – g/kCTM) on the right side. In each CAC chart the marine emissions are segmented into two components: the solid bar shows marine emissions with open-water emissions intensity adjusted for "near-land-equivalent" and the dashed bar shows the total unadjusted intensity regardless of location (as reported in the CMC study). The relative intensities, when indexed to the Seaway-size fleet intensity, are shown at the bottom of each chart.

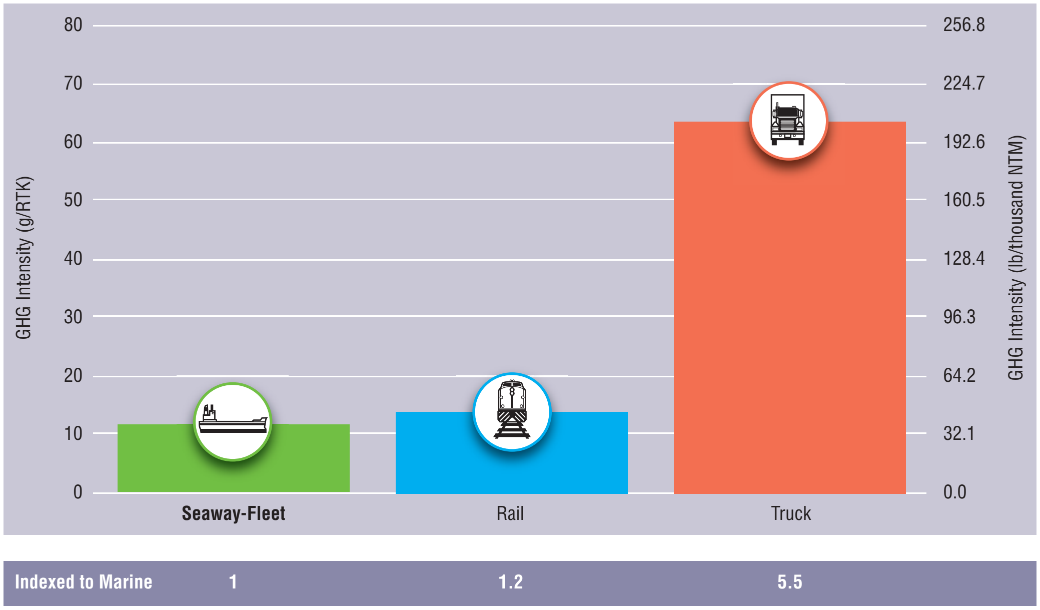


Figure C3: Seaway-fleet GHG Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

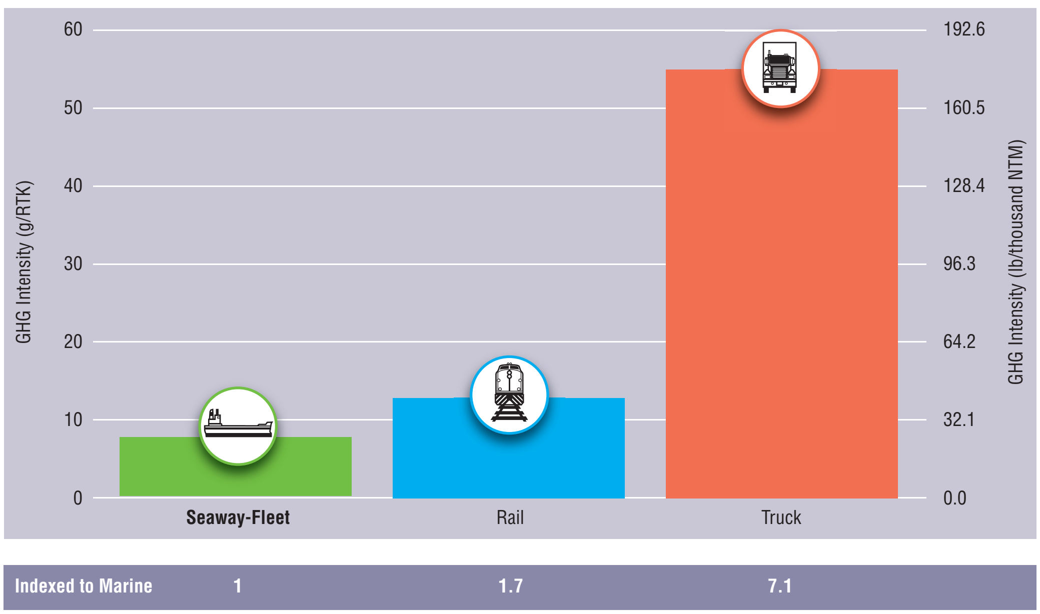
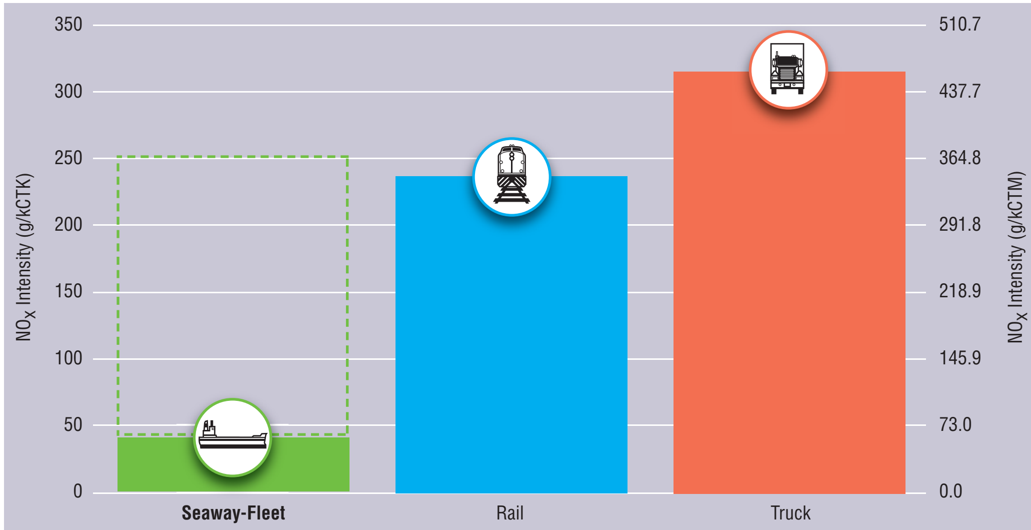


Figure C4: Seaway-fleet GHG Intensity Comparison, Post-renewal Scenario

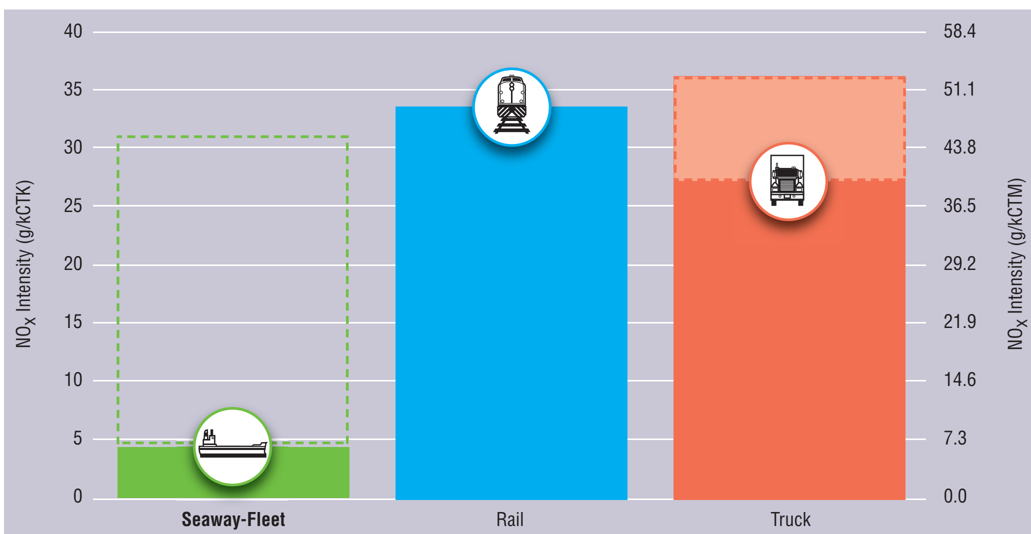
Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.



Indexed to Marine	1	5.76	7.66

Figure C5: Seaway-fleet NO_X Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.



Indexed to Marine	1	7.78	6.31

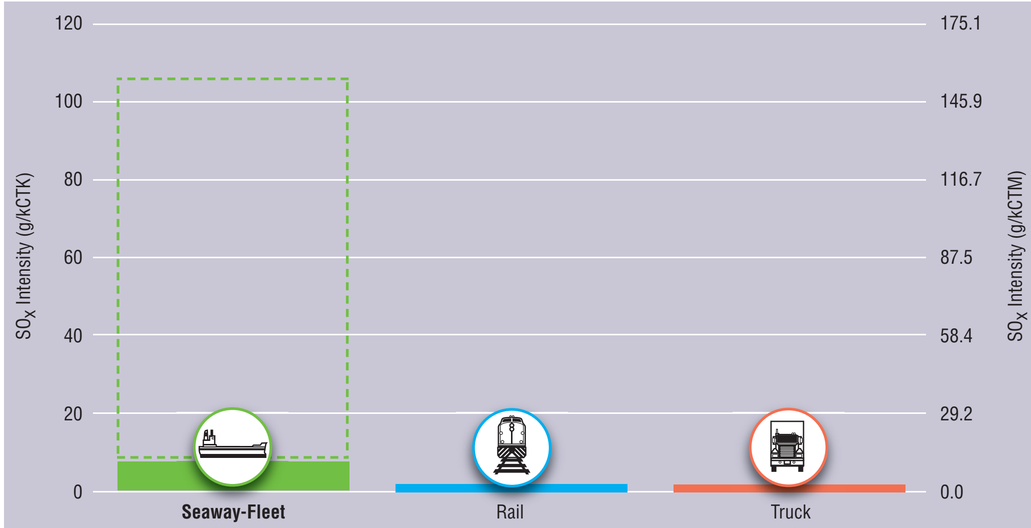
Figure C6: Seaway-fleet NO_X Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

Note: The lighter bar on truck indicates the truck mode's regulatory limit, while the solid bar indicates truck engine performance reported in EPA certification tests. Certification data do not yet exist for rail and marine, so the regulatory limit is used.

Figure C7:
Seaway-fleet SO_X Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

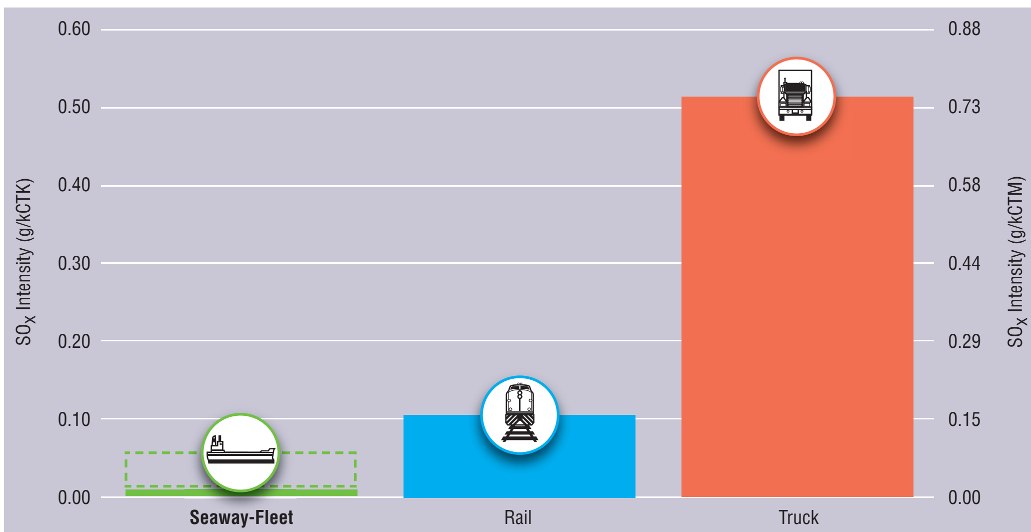


Indexed to Marine	1	0.11	0.08

Figure C8:
Seaway-fleet SO_X Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

Note: Marine based on 100% use of ultra-low sulfur fuel in propulsion and auxiliary engines.



Indexed to Marine	1	9.28	44.17

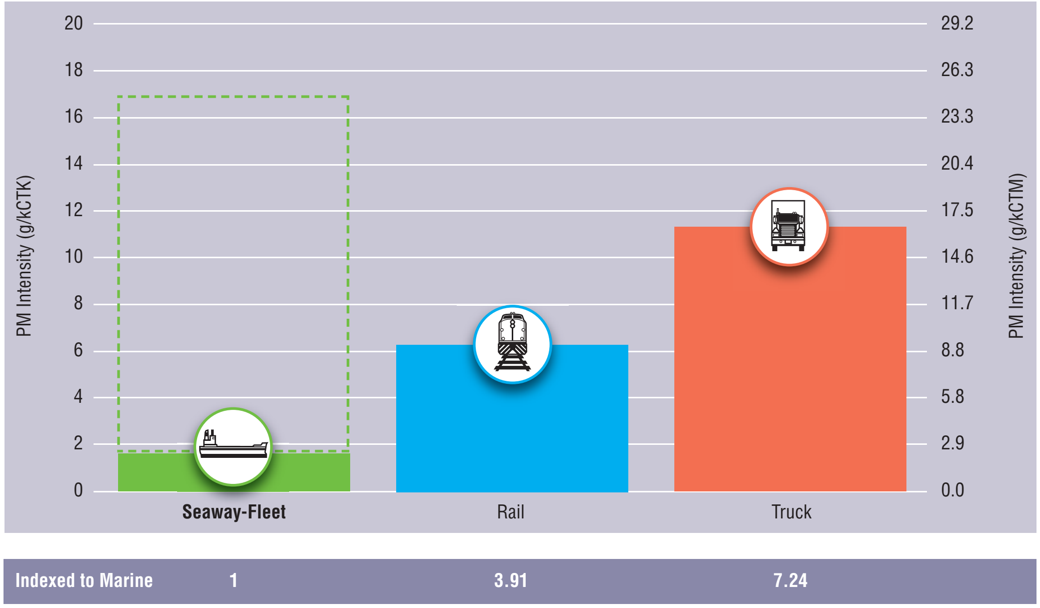


Figure C9: Seaway-fleet PM Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

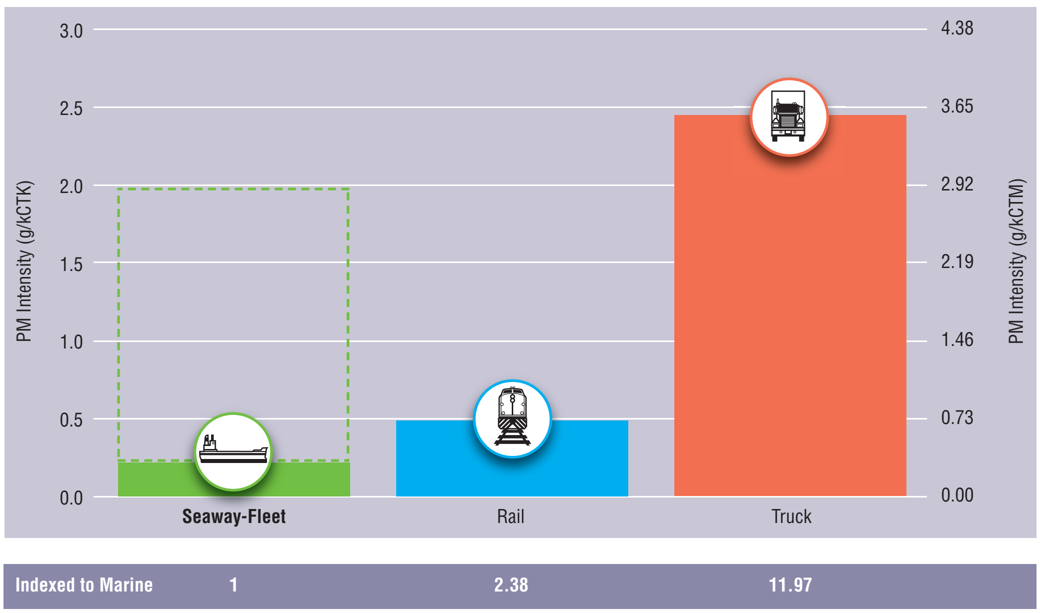


Figure C10: Seaway-fleet PM Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying Great Lakes-Seaway traffic an equal distance.

Note: Marine based on 100% use of ultra-low sulfur fuel in propulsion and auxiliary engines.

CSL International Fleet Comparison

Methodology

CSL's international fleet was assessed for 2012 rather than 2010, as the vessels changed from year-to-year and 2012 was more complete. The technologies used are representative of year 2010 and since the comparison modes are based on 2010, the reference comparison is indicated to be 2010. As with the CMC study of the Seaway fleet, CSL's East Coast and West Coast international fleets were adjusted to remove self-unloading power and 10% of hotel power while at port. The reference ground modes are U.S. rail and truck. The resulting findings for CSL's international fleets are illustrated separately for the adjusted 2010 case and for the post-renewal scenario, in pairs of bar charts over the following 5 pages as follows:

- Energy Efficiency for 2010 in Figure C11 and for the post-renewal scenario in Figure C12
- GHG intensities for 2010 in Figure C13 and for the post-renewal scenario in Figure C14
- NO_X intensities for 2010 in Figure C15 and for the post-renewal scenario in Figure C16
- SO_X intensities for 2010 in Figure C17 and for the post-renewal scenario in Figure C18
- PM intensities for 2010 in Figure C19 and for the post-renewal scenario in Figure C20

Energy Efficiency Comparison Charts

The energy efficiencies of the three modes in the year 2010 are compared in Figure C11. The performance comparison is based on ratio of work done (weight of cargo moved a unit distance) divided by total fuel consumed (laden and empty/ballast trips). The lower axis indicates the average distance in km that each mode can carry one tonne of bulk cargo for each litre of fuel consumed; while the upper axis indicates the average distance in miles that each mode can carry one ton of bulk cargo for each U.S.-gallon of fuel consumed. The "marine advantage" index at the right side of the chart indicates that the more efficient marine fleet can move cargo 105% farther (or is 105% more efficient) than rail and 1,175% farther (or about 12 times farther and is 1,175% more efficient) than truck.

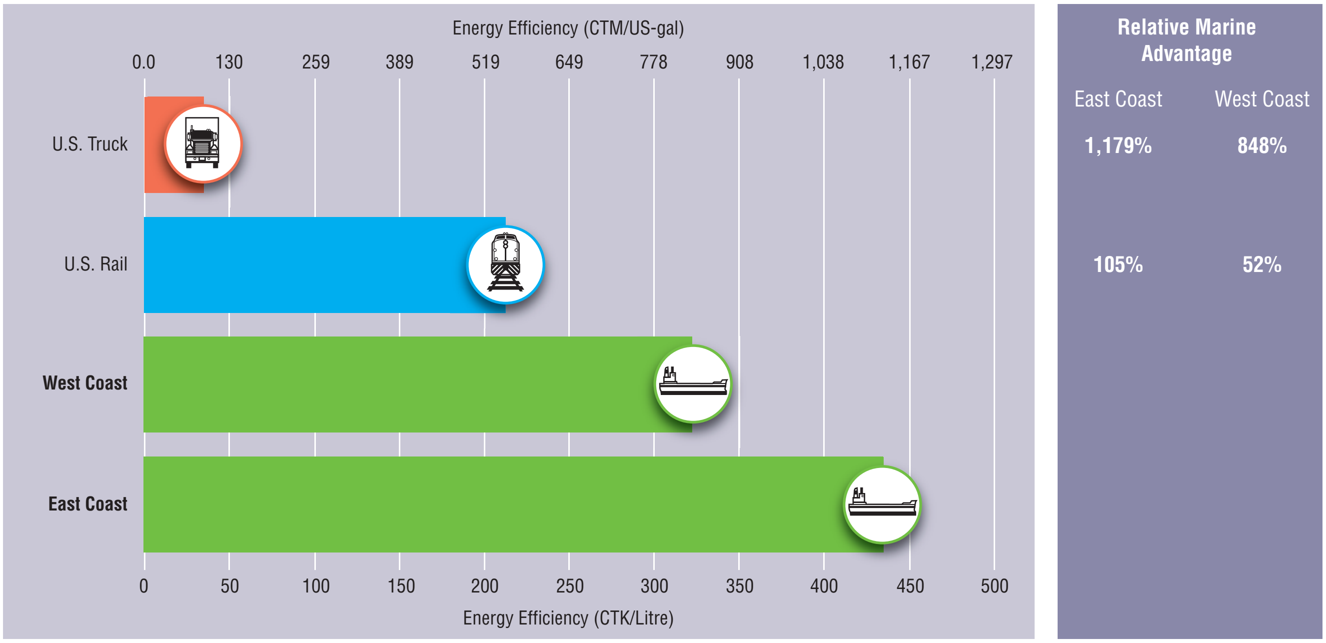


Figure C11:
CSL-International Fleet Energy Efficiency Comparison for 2012

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

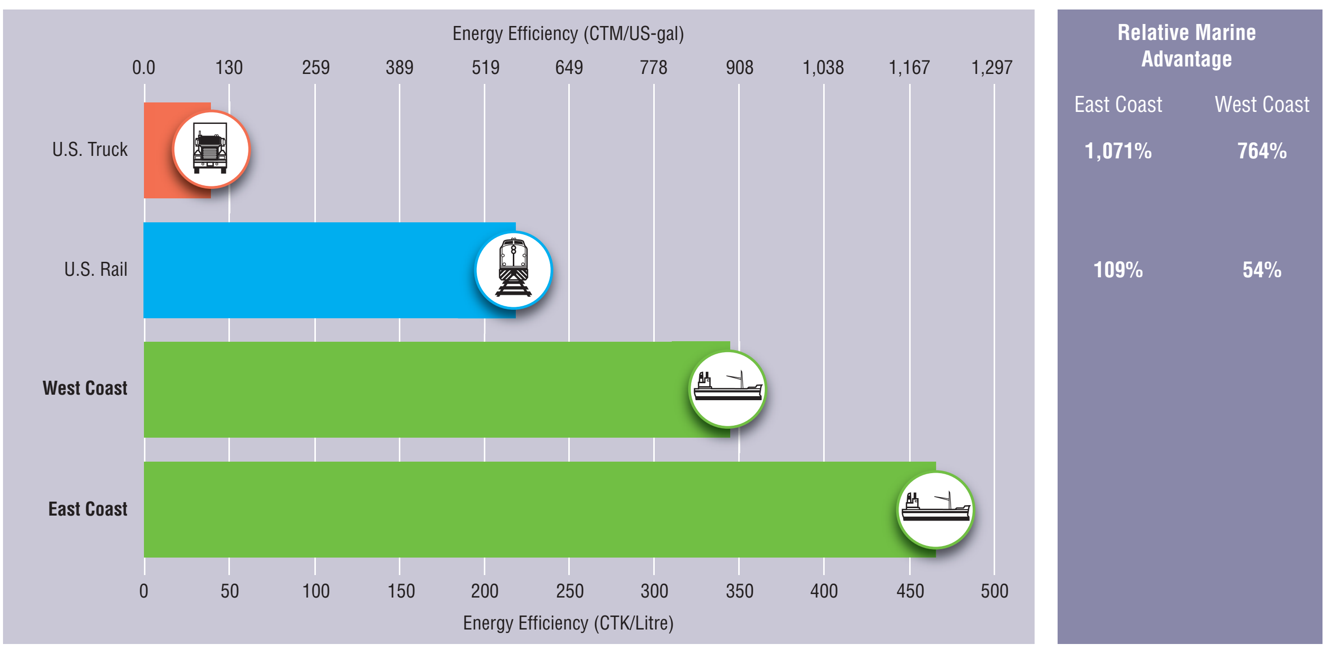


Figure C12:
CSL-International Fleet Energy Efficiency Comparison Post Renewal of All Modes

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

Criteria Air Contaminants (CAC) Comparison Charts

The post-renewal comparison for the international fleet's SO_X and PM intensities are based on 0.5% sulfur in intermediate fuel oil (IFO) fuel used beyond the assumed 40 km (25 mile) boundary and 0.1% sulfur in IFO fuel used inside the 40 km boundary. Ultra-low sulfur (0.0015%) marine diesel oil (MDO) is used in auxiliary engines at all times. The CAC charts are presented with the actual emissions intensities shown in metric units on the left side (grams per thousand cargo tonne-km – g/kCTK) and U.S. units (grams per thousand cargo ton-miles – g/kCTM) on the right side. In each CAC chart, the marine emissions are segmented into two components: the solid bar shows marine emissions with open-water emissions intensity adjusted for "near-land-equivalent" and the dashed bar shows the total unadjusted intensity, regardless of location (as reported in the CMC study). The relative intensities, when indexed to the minimum intensity of the East and West coast fleets, are shown at the bottom of each chart.

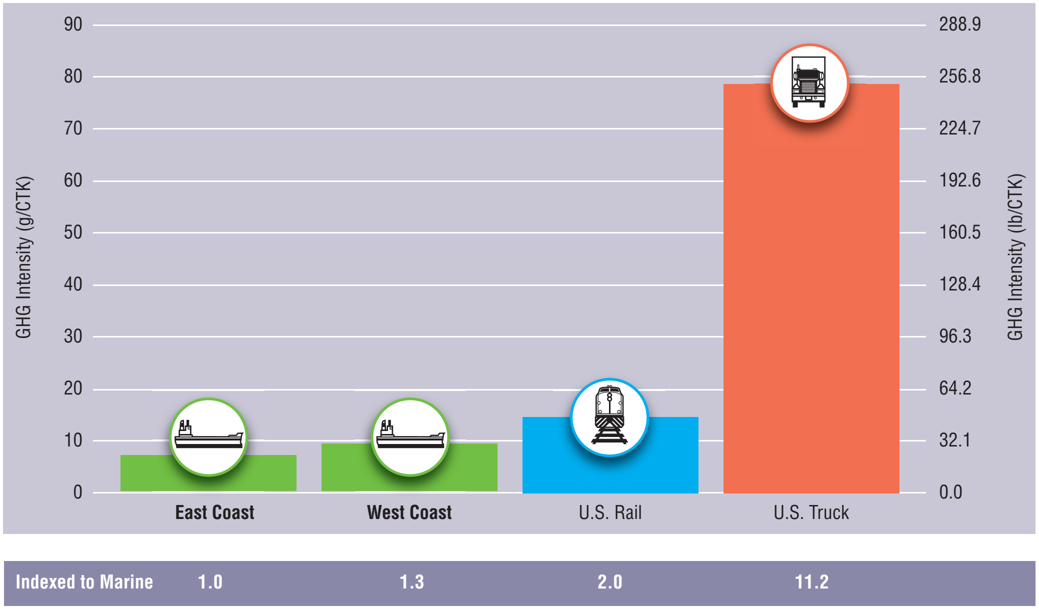


Figure C13: CSL-International Fleet GHG Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

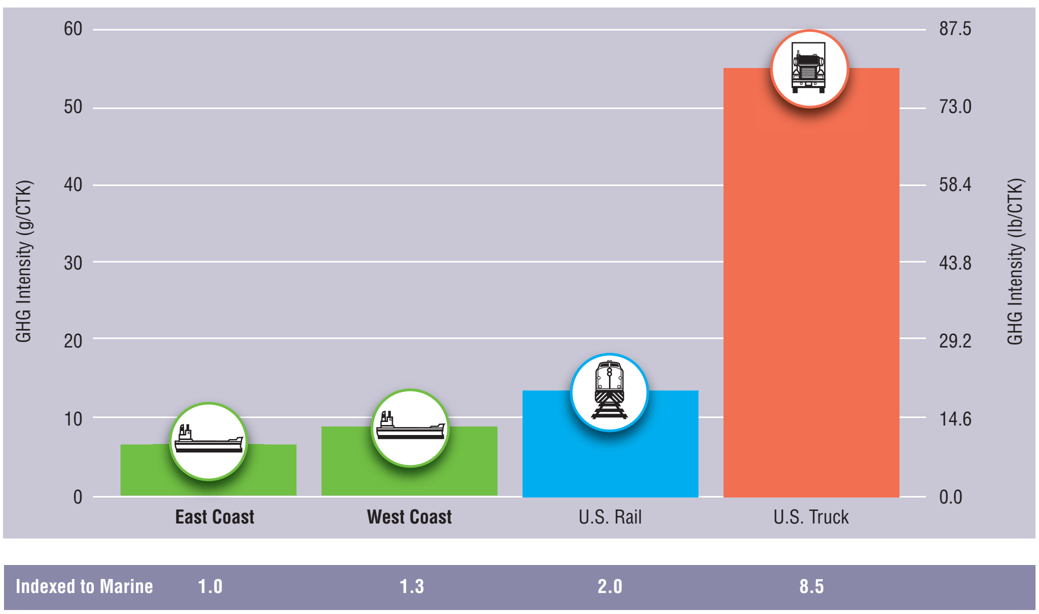
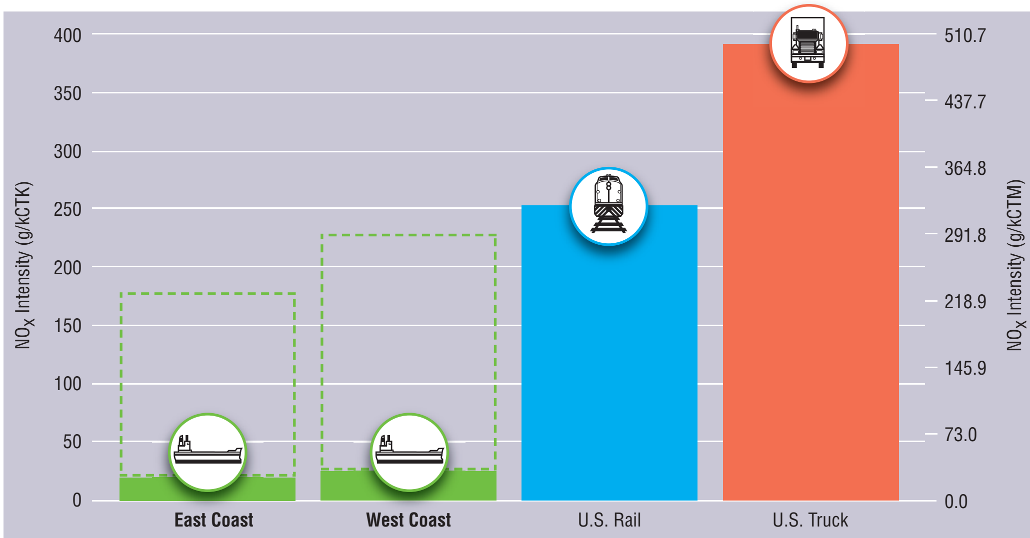


Figure C14: CSL-International Fleet GHG Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

Figure C15: CSL-International Fleet NO_X Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

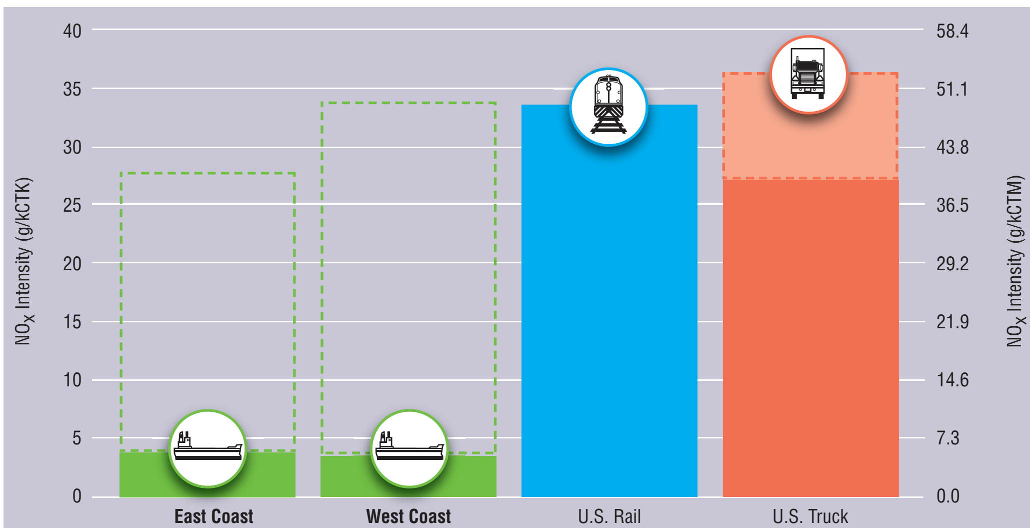


Indexed to Marine	1.0	1.1	11.8	18.4

Figure C16: CSL-International Fleet NO_X Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

Note: The lighter bar on "U.S. Truck" indicates the truck mode's regulatory limit, while the solid bar indicates truck engine performance reported in EPA certification tests. Certification data do not yet exist for rail and marine, so the regulatory limit is used.



Indexed to Marine	1.1	1.0	9.1	7.4

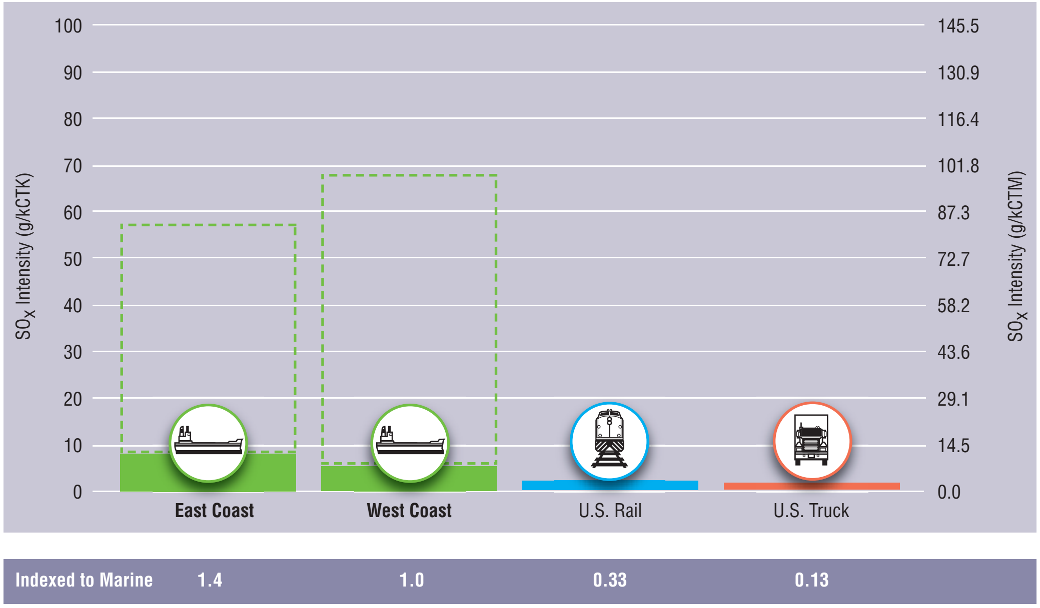


Figure C17: CSL-International Fleet SO_X Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

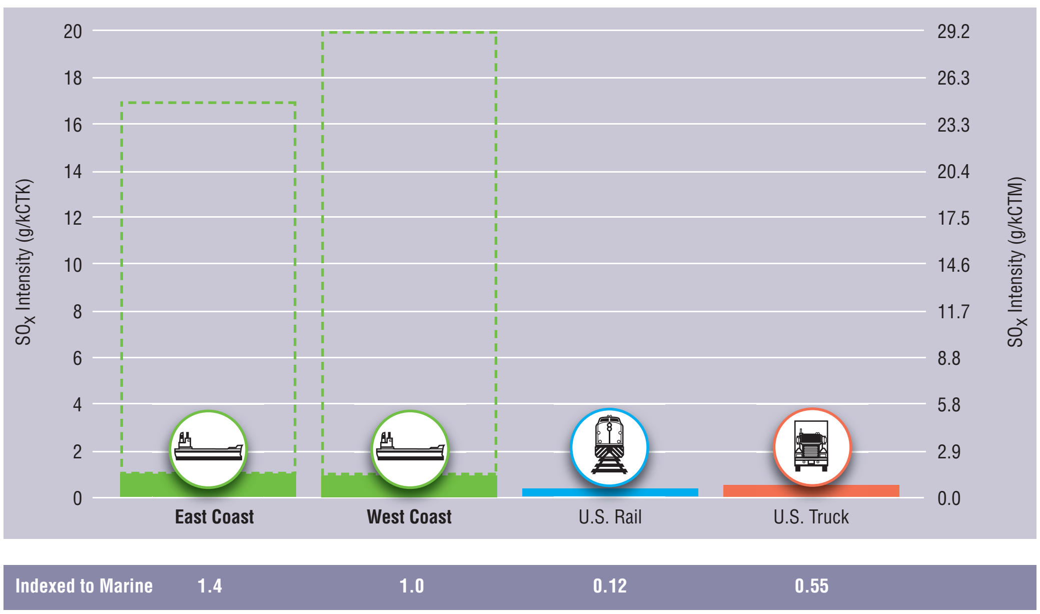
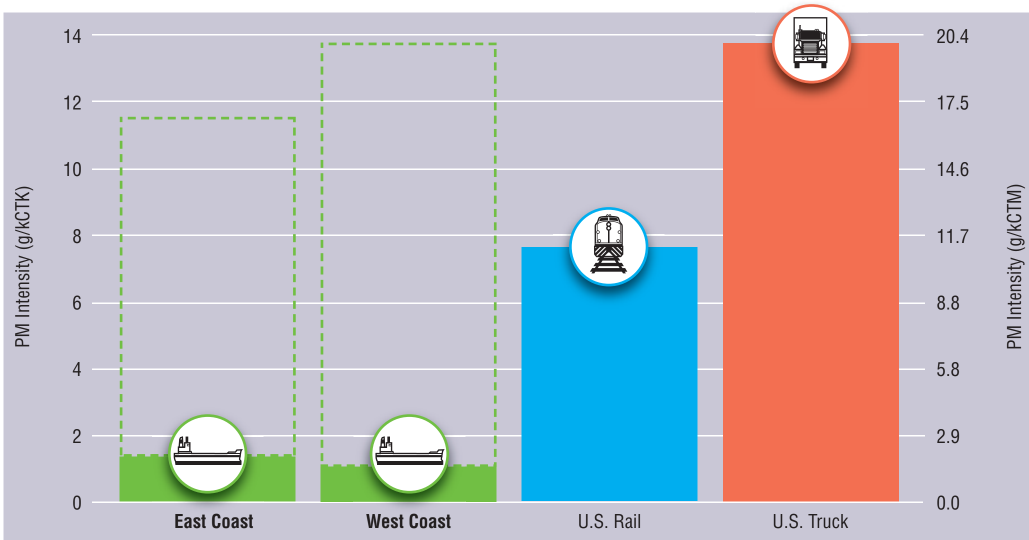


Figure C18: CSL-International Fleet SO_X Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

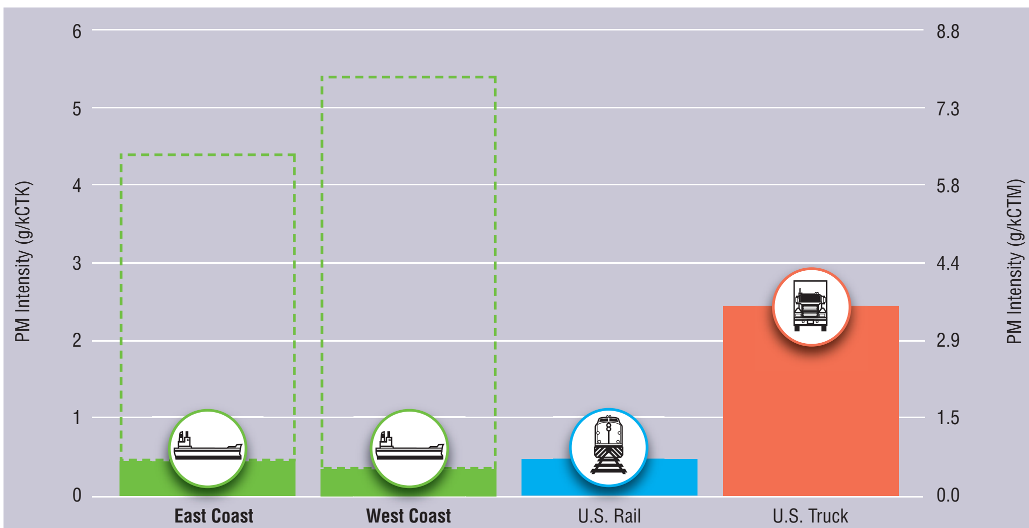
Note: Marine based on use of ultra-low sulfur MDO in auxiliary engines, 0.1% sulfur IFO inside 40 km from port and 0.5% sulfur IFO outside 40 km from port.



Indexed to Marine	1.3	1.0	7.0	12.6

Figure C19:
CSL-International Fleet PM Intensity Comparison, Adjusted 2010

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.



Indexed to Marine	1.3	1.0	1.5	7.3

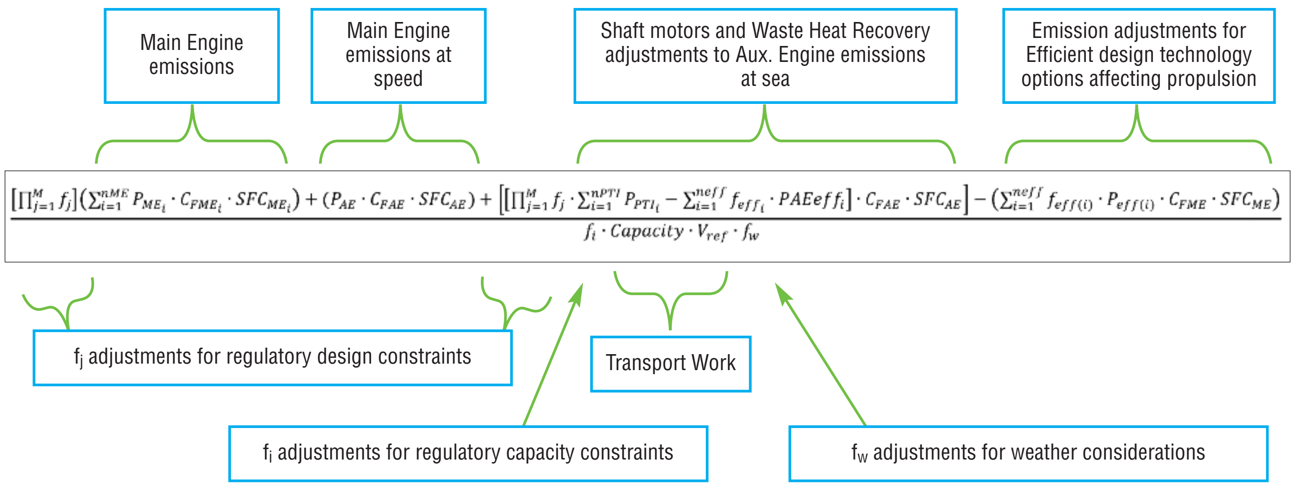
Figure C20:
CSL-International Fleet PM Intensity Comparison, Post-renewal Scenario

Source: RTG analysis based on each mode carrying bulk traffic an equal distance.

Note: Marine based on use of ultra-low sulfur MDO in auxiliary engines, 0.1% sulfur IFO inside 40 km from port and 0.5% sulfur IFO outside 40 km from port.

Appendix D

Energy Efficiency Design Index



$$\frac{\left[\prod_{j=1}^{M} f_j\right]\left(\sum_{i=1}^{nME} P_{ME_i} \cdot C_{FME_i} \cdot SFC_{ME_i}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}\right) + \left[\left[\prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI_i} - \sum_{i=1}^{neff} f_{eff_i} \cdot PAEeff_i\right] \cdot C_{FAE} \cdot SFC_{AE}\right] - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\right)}{f_i \cdot Capacity \cdot V_{ref} \cdot f_w}$$

- P is power in kW with subscripts meaning:
  - P_{ME} – main engine;
  - P_{AE} – auxiliary engine.
  - PTI/PTO – m
  - ain shaft power take off generator or power input motor;
  - PAE_{eff} – efficient design options that reduce at-sea auxiliary energy.
  - P_{eff} – efficient design options that reduce propulsion energy.
- C is the conversion factor of CO2 from fuel (g/g) with subscripts meaning:
  - C_{FME} – fuel used in the main engine;
  - C_{FAE} – fuel used in the auxiliary engine while at sea.
- SFC is the specific fuel consumption (g/kWh) with subscripts meaning:
  - C_{ME} – main engine, C_{AE} – auxiliary engine
- Capacity is the DWT in metric tonnes and represents cargo transported.
- Vref is the reference speed – attained at 75% of manufacturer's rating for the main engine after adjusting for any shaft generators.
- f_j and f_i are adjustment factors for power requirements and capacity utilization constraints due to regulatory influences (ice class vessels and double hull tankers are recognized in the application of the EEDI with prescribed factors).
- f_w is an adjustment to recognize weather influences on speed and was awaiting Guideline development as of Aug 2009.

Figure D1:

Illustration of the EEDI Equation and Annotation of its Components

Source: Research and Traffic Group – derived from IMO – MEPC.1/Circ.681, 17 August 2009.

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