Vard Marine Inc.

ARCTIC FUEL SWITCHING IMPACT STUDY

345-001-01

Date: 11 October 2016

WWF Canada

Report No.:	345-001-01
Title:	Arctic Fuel Switching Impact Study
VARD Contact:	Andrew Kendrick
Tel:	613-238-7979 ex. 201
Email:	andrew.kendrick@vard.com

EXECUTIVE SUMMARY

This report analyzes the potential cost impact for the Arctic Sealift of requiring the use of low-sulphur fuels rather than residual fuel oils. Low sulphur emissions are now required in North American waters south of 60^0N following the implementation of the North American Emission Control Area (ECA). The Sealift has been exempted from this requirement by Transport Canada. North of 60^0N, the Arctic does not form part of the ECA.

Burning residual fuels creates a range of undesirable emissions, and the consequences associated with accidental spills are much higher than those from diesel and other refined fuels.

The study has used data from 2012 (most complete data sets readily available) to derive totals for dry cargo and bulk petroleum shipped through the Arctic Sealift operations, by community and as overall values. Fuel use north and south of 60^0N has also been calculated. In order to fill data gaps a number of assumptions have been made and are listed in full in the report.

Fuel use has been calculated in terms of the amount of fuel required to deliver a tonne of cargo, for dry cargo and for bulk petroleum products. Once the fuel use is calculated, cost differentials between refined (low–sulphur diesel) and residual (heavy fuel oil) fuels have been used to estimate the impact of fuel switching. Results are shown in the table below.

	General Cargo	Tanker
Arctic Only	$15.16	$11.77
South of 60	$6.34	$4.47
Total	$21.50	$16.24

For dry cargo, these represent roughly 7% of current shipping rates, or which 5% is incurred for the Arctic portion and 2% for the voyages within the existing ECA.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

This report, undertaken on behalf of WWF Canada, presents an analysis of the economic impact on community resupply of introducing more stringent air emission controls in the Canadian Arctic.

Currently, much of the vessel traffic in the Canadian Arctic operates using residual fuels, Heavy and Intermediate Fuel Oil (HFO & IFO). Heavy fuels are banned in the Antarctic. Canadian waters south of 60^0 are already designated as an emission control area (ECA) in which SO_x, NO_x and other emissions are more tightly regulated than they are in Canada's Arctic. However, vessels involved in the Arctic Sealift have been provided with an exemption from ECA requirements, and can operate on residual fuels throughout their voyages (Transport Canada, 2016).

There is growing concern that the impacts risks associated with the use of residual fuels are substantial, and that Arctic shipping should be required to use more environmentally friendly refined fuels, such as low Sulphur diesel. Air emissions of various pollutants would be reduced significantly, and in the event of accidental spills management and clean-up would become much easier.

Some stakeholders have expressed concerns over the cost impact for the sealift of requiring a change to cleaner fuels. A wide range of numbers have been claimed by those on both sides of the debate. The aim of this study has been to provide an objective assessment of the likely cost impact of fuel switching.

2 BACKGROUND

2.1 SEALIFT SHIPPING

Marine transportation is the most cost-effective mode for the carriage of most commodities over medium or long distances, and for the transportation of a much wider range of goods where rail or road linkages are unavailable or inadequate. In Canada's North, the lack of alternative transportation infrastructure increases the relative importance of the marine mode. The annual sealift of dry cargo and petroleum products is essential to the communities in Nunavut, coastal areas of the Northwest Territories, and the Nunavik areas on Northern Quebec.

The sealift is not cheap, for reasons discussed below. High shipping costs are a burden on northern communities and a barrier to development. An example of the 2016 freight tariffs for dry cargo for 27 Arctic communities is shown at Table 1. It should be noted that these published tariffs are not paid by all users, and some larger shippers (including government organizations) can be assumed to pay lower rates; the extent of such discounts is not known.

Table 1: Sealift Tariffs (from Nunavut Sealift & Supply)

Port of Loading: Ste-Catherine, Quebec, Canada

Destinations		Northbound rate per revenue ton of 1,000 kg or 2.5 m³	Northbound rate per 20' standard container (rate per unit)	Retrograde cargo rate per revenue ton or 1,000 kg or 2.5 m³	Retrograde per 20' full standard container (rate per unit)	Retrograde rate per 20' empty standard container (rate per unit)	Retrograde rate for empty drums and cylinders (rate per unit)	Lateral cargo rate per revenue ton of 1,000 kg or 2.5 m³	Lateral rate per 20' standard container (rate per unit)
HIGH ARCTIC	Arctic Bay Clyde River Grise Fjord Nanisivik Pond Inlet Qikiqtarjuaq Resolute Bay	377.22 $	5,809.25 $	245.19 $	3,776.01 $	701.78 $	41.59 $	245.19 $	3,776.01 $
FOXE BASIN	Igloolik Hall Beach Repulse Bay	354.60 $	5,460.89 $	230.50 $	3,549.58 $	701.78 $	41.59 $	230.50 $	3,549.58 $
IQALUIT	Iqaluit	288.57 $	4,445.10 $	187.57 $	2,889.32 $	701.78 $	41.59 $	187.57 $	2,889.32 $
SOUTH BAFFIN	Cape Dorset Kimmirut Pangnirtung	327.11 $	5,037.44 $	212.62 $	3,274.34 $	701.78 $	41.59 $	212.62 $	3,274.34 $
KIVALLIQ FROM STE-CATHERINE (MONTREAL)	Arviat Baker Lake Chesterfield Inlet Coral Harbour Whale Cove Rankin Inlet	351.02 $	5,405.64 $	228.16 $	3,513.67 $	701.78 $	41.59 $	228.16 $	3,513.67 $
KITKMEOT	Bathurst Inlet Umingmaktok Cambridge Bay Kugluktuk Gjoa Haven Taloyoak	437.13 $	6,731.79 $	284.13 $	4,375.66 $	701.78 $	41.59 $	284.13 $	4,375.66 $
SANIKILUAQ	Sanikiluaq	365.42 $	5,629.38 $	237.52 $	3,659.10 $	701.78 $	41.59 $	237.52 $	3,659.10 $

Sealift operations to Nunavut and Northern Quebec are provided by a relatively small group of companies operating specialized vessels. The main operators are currently Groupe Desgagnes/Petronav, Nunavut Sealift and Supply, and the Woodward Group. Dry cargoes are shipped predominantly from the Montreal area, while fuel supplies come from a number of sources in Eastern Canada. A smaller volume of material is transported by tug/barge operations in the more Western areas of the Arctic. These have not been considered in this study, as the tugs already operate on diesel fuels.

2.2 FUEL ISSUES

2.2.1 FUEL COSTS

Cargo vessels have traditionally run on heavy fuels, due to their low cost. Heavy and Intermediate fuels such as HFO/IFO 380 and 180 are also often referred to as "residual" fuels – they are products that are left behind when crude oil is refined into other products such as diesel and gasoline, and have been available for less than the cost of crude.

Recent (August 2016) pricing in US dollars for various fuel grades in the Port of Montreal was:

- IFO 380 $251/tonne
- IFO 180 $300/tonne
- Marine Gas Oil (diesel) $550.50/tonne

It can be seen that refined product (diesel) is over twice the price of the lowest quality fuel, accounting for the popularity of the residuals. Obviously, if shipping companies are required to use better quality fuels, their costs will go up.

2.2.2 FUEL CHARACTERISTICS AND STANDARDS

Impurities in the crude oil become more concentrated in residual fuels, so that Sulphur, heavy metals and other contaminants can be present in relatively high concentrations. The majority of these are oxidized during the combustion process, and contribute first to air pollution before being precipitated into water or onto land.

As standards for contaminants in refined fuels have become more stringent, the residual fuels have become not only relatively but absolutely worse in quality. The International Maritime Organization (IMO) finally imposed upper limits on Sulphur content globally, but these are still very high, currently 3.5% by weight. In comparison, the North American standard for diesel fuel - ultra low Sulphur diesel (ULSD) – is 15 parts per million, i.e. 0.0015% by weight.

The IMO has also allowed for a higher standard for Sulphur emissions through the mechanism known as Emission Control Areas (ECAs). Within an ECA, the maximum allowable Sulphur level in fuel is 0.1% be weight. Alternatively, higher Sulphur content fuels can be used, provided that the exhaust is cleaned (scrubbed) in some way, which also tends to remove other contaminants. Canadian waters south of 60^0N are part of the North American ECA, but Arctic waters are currently excluded; and, as noted above, Arctic Sealift operations are exempted from compliance while South of 60^0N.

2.2.3 CARGO RATES AND COST COMPONENTS

Ship operating costs include factors such as:

- Fuel;
- Crewing and associated costs (food, hotel services);
- Maintenance and spare parts;
- Port charges;
- Insurance;
- Other smaller cost elements; such as registration and classification, and pilotage (some services).

Depreciation of the ship itself is another major component, while fleet management and administration can be significant.

Fuel cost is often one of the largest single element of cost, particularly for container lines and for other relatively high-speed vessels.

The special nature of Arctic sealift operations means that fuel cost, while still very significant, is less dominant than is the case in some other trades. Crew costs are relatively high, as the Sealift is labour-intensive. The lack of facilities also means that cargo discharge can be a lengthy process, and long periods are spent at anchor. In 2012, the data shows that within the NORDREG zone sealift vessels spent 680 days "in port" and 530 days in transit; i.e. more time incurring crew cost than burning propulsion fuel.

The specialized ships (ice class, and other features) are themselves relatively expensive to build, and can command a scarcity premium. Insurance costs for Arctic voyages are also high. All of these factors combine to mean that cargo transportation costs for Sealift services are much higher than those for other voyages of comparable length. Fuel costs, however, are not necessarily the dominant component.

3 STUDY APPROACH

3.1 GENERAL

In order the assess the cost impact of fuel switching from residual to refined fuels, VARD has estimated the volumes of cargo transported for various Arctic Sealift operations and the fuel consumption incurred in doing so. The fuel cost per tonne of cargo can be derived for different types of fuel.

While simple in principle, this process is made more complex by a lack of hard data.

Fuel consumption per unit cargo delivery during Sealift operations has therefore been estimated in a number of steps:

1. Databases for the operation were selected.

2. A set of vessels known to have been involved in Sealift was identified, and vessel particulars taken from company website information (Desgagnes, NEAS, and Woodward)

3. Distances travelled by each vessel were derived, and split into 3 main segments:
    a. Distances inside the Canadian Arctic (North of 60^0 N)
    b. Distances inside the North American ECA
    c. Distances in international waters (where applicable)

    The first and second of these are the areas in which changes in fuel would be required if the Canadian Arctic became an ECA and if the ECA requirements were also imposed South of 60^0N in the current ECA.

4. Fuel use in each segment was estimated, based on vessel installed engine power and voyage duration. It was assumed that vessels operate at 85% of installed power in transit. Hotel power while at anchor is assumed in all cases to be provided using diesel fuel.

5. Fuel used per tonne of cargo delivered has been derived, assuming that all vessels are at 80% deadweight capacity at the start of the delivery voyages, and 15%/0% for dry cargo and fuel for the return voyages. Results are presented as (tonnes fuel used)/(tonne of cargo delivered).

6. Within the Arctic, the fuel assigned to any delivery is the estimated consumption for that leg, so that the first delivery is assigned the fuel consumed from entering the NORDREG area to that community, the second delivery is assigned all fuel consumed from community 1 to community 2, etc.

7. Fuel used on the final leg leaving the Arctic is assigned to the backhaul cargo (for dry cargo vessels). For tankers, this fuel is included in overall totals but not in initial destination usages.

8. Averages for the Sealift as a whole are calculated by summing the total cargo delivered by all ships to all communities and the total backhaul amounts. This sum is then divided into the total fuel used by all ships for all voyage legs.

3.2 ASSUMPTIONS AND SIMPLIFICATIONS

This process has involved several assumptions and simplifications, some of the more important of which are outlined below.

Cargo weight has been used as a metric for all deliveries, rather than trying to distinguish between containers, packaged cargoes and fuel supplies. As can be seen from Table 1, for outbound cargo a loaded 20 ft container is typically shipped at the rate of around 15 tonnes of packaged cargo. The maximum weight for this size of container would be 20 tonnes, so the ratio is reasonable.

The voyage databases available include AIS datasets for 2013 and 2014, which provide accurate routes and distances but not voyage durations. For 2012 and before NORDREG data was available, providing entry, exit and other key dates for voyages, but no accurate particulars and no information on the routes south of 60^0N. The 2012 NORDREG and 2013 AIS sets have therefore been used together to provide a more complete picture of the Sealift operations, which do not change dramatically year-to-year. The great majority of the vessels used in 2012 and 2013 were the same (2 new vessels joined the fleet in 2013); there was a similar total number of deliveries, and the total cargo volumes are also believed to have been quite similar (based on briefings provided to the TC CMAC Northern conferences).

A further very useful data source has been the actual itineraries and schedules followed by one of the operators (Desgagnes), which are available online. This information provided a cross-check for voyage durations, times actually spent in port, and different voyage types (northbound, lateral and retrograde).

There are no publicly-available statistics on the actual weights and volumes of cargo deliveries to each location/community, and so for a voyage that touches at various communities it is not possible to derive an accurate fuel use: cargo delivered ratio. A weighting system has been used which treats local populations as a volume indicator. For example, if a voyage touches 3 communities with populations of 1000, 500 and 100 residents respectively then the total cargo is assumed to have been split 10:5:1 between them.

The assumed average engine power for transit in the North is almost certainly too high. Many voyages in proximity to ice are undertaken cautiously, at speeds lower than those used in open water transit. If slower steaming is used, fuel consumption will drop, and so this is a conservative assumption for the purposes of these analyses.

Fuel consumed by electrical generators while at anchor/alongside is known in many cases to be diesel, and has been assumed to be diesel for all vessels. This may be slightly non-conservative, if some vessels are using HFO for some or all of this purpose.

The assumption of 15% backhaul cargo for dry goods includes empty and partially filled containers, pallets etc. which are returned South, as are some forms of waste. This may be an overestimate for some or all communities and can be adjusted easily if better data becomes available. There is also some “lateral” cargo movement, between communities (see Table 1). As the volumes involved are unknown, they have not been accounted for. This is a conservative assumption in terms of Sealift revenues.

The assumption that all fuel used on a voyage leg is assigned to the cargo delivered at the end of that leg is, effectively, a form of subsidy for the destinations later in the voyage. A different order of destination calls would provide different outcomes. However, it can be assumed that the itineraries are selected to give high overall efficiency to the service based on prior experience, and so the overall averages for fuel use per tonne will provide a realistic assessment of the overall impact of potential fuel switching.

The fuel consumption estimates for the voyage legs South of 60^0N are based on the distances from the port of departure for the Arctic to the approximate positions at which the vessels crossed into the NORDREG zone, assuming normal cruising speeds throughout the voyage North (and subsequent return South).

4 RESULTS

4.1 ROUTES

The Sealift routes in 2012 are shown in Figures 1 and 2 for dry cargo and bulk petroleum products (mainly diesel fuel) respectively.

Most of the communities served are the same for both types of cargo, but there are typically more dry cargo deliveries to the larger communities than is the case for fuels; for example, Iqaluit saw 11 dry cargo and 4 fuel deliveries.

Most vessels serve multiple destinations on most voyages. In some cases, some delivery points are outside the strict definition of waters north of 60^0N, for example some of the Northern Quebec villages in Hudson Bay. These have been left in the data set for simplicity.

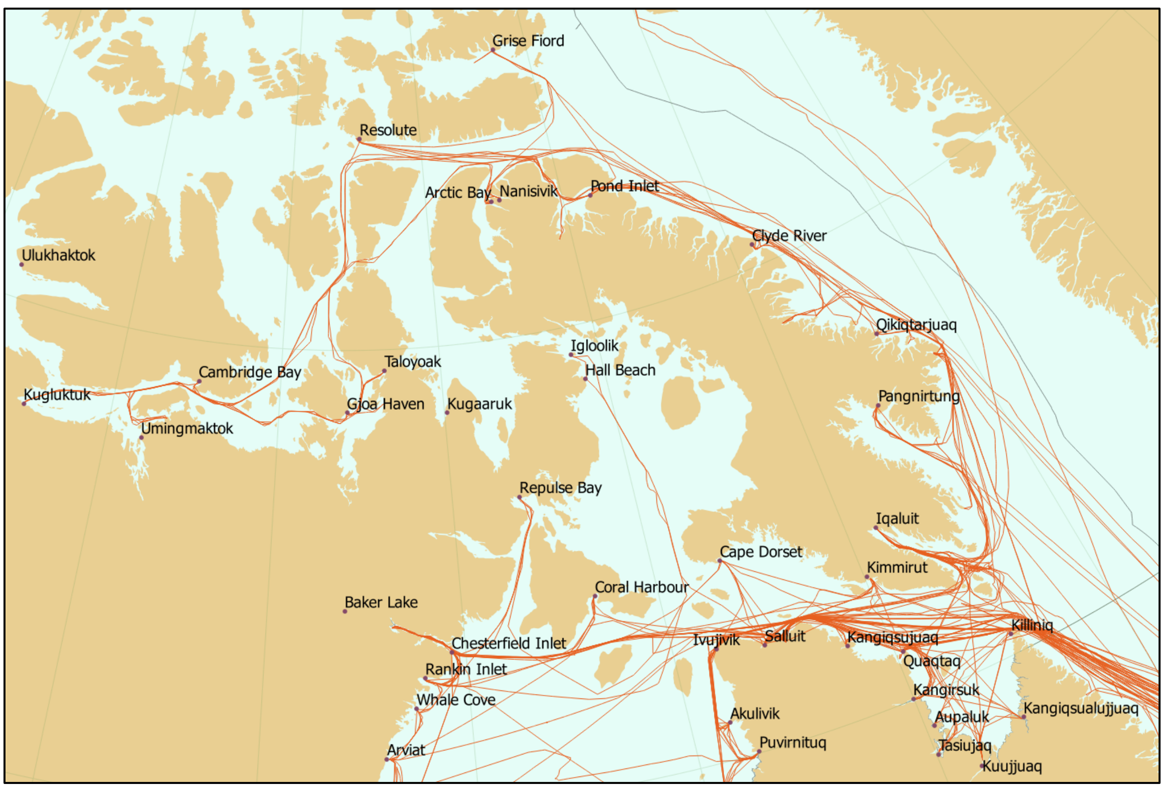

Figure 1: Sealift Dry Cargo Voyages, 2012

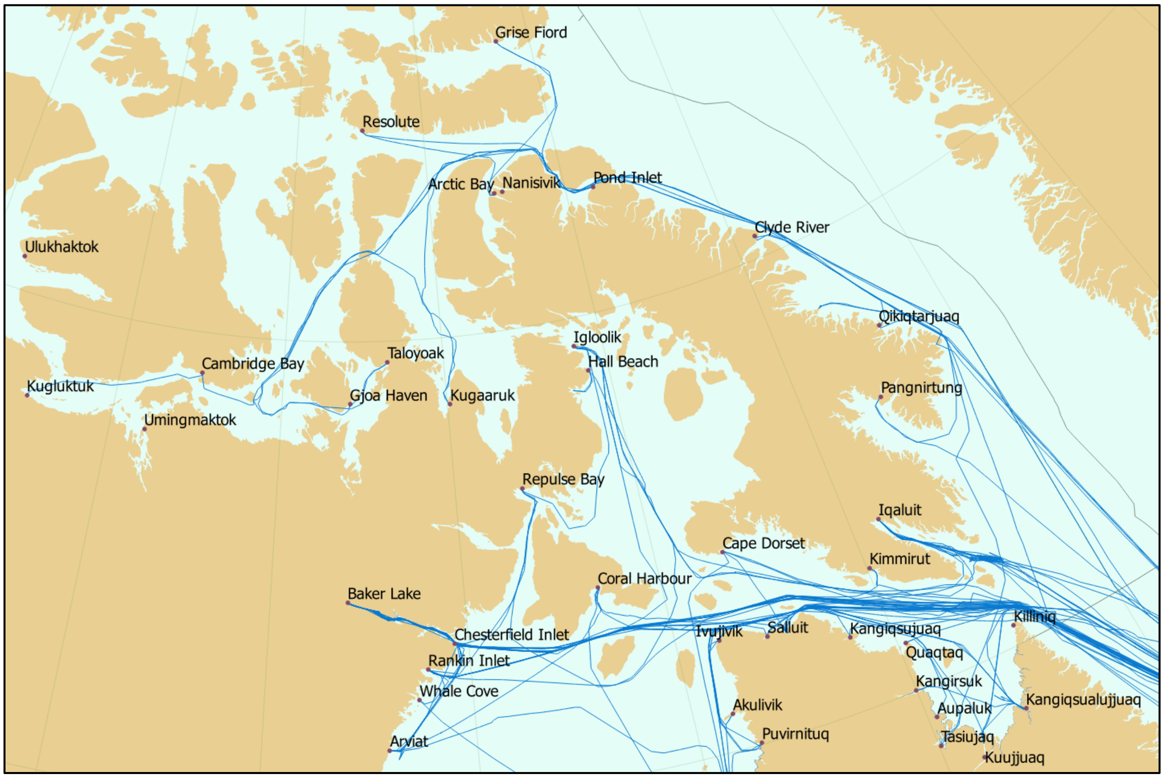

Figure 2: Sealift Bulk Petroleum Voyages, 2012

4.2 FUEL USE

4.2.1 NORTH OF 60^{0}N

The approach described in Section 3 has been used to generate a range of fuel used:cargo delivered ratios for each community served by Sealift operations. As noted above, these are presented in terms of tonnage of fuel required per tonne of cargo delivered, resulting in values shown as t/t.

As examples, the average amounts are in the order of 0.046 t/t for Iqaluit, 0.059 t/t for Rankin Inlet, and 0.043 t/t for Cambridge Bay. The equivalent numbers for bulk petroleum products are 0.027 t/t for Iqaluit, 0.051 t/t for Rankin Inlet and 0.038 t/t for Cambridge Bay.

An average for all dry cargo delivered during the 2012 season is 0.045 t/t. The global average for bulk petroleum is 0.036 t/t. These global averages are taken by summing the total of cargoes delivered into the Arctic plus (for dry cargo only) the backhaul, and dividing this into the total fuel burned for all voyage segments within the NORDREG zone. As noted in Section 3, all vessels entering the Arctic are assumed to carry 80% of their deadweight as cargo, dry cargo is backhaul. Fuel burn assumes 85% main engine power for all transit days.

These results are indicated in Figures 3 - 5, for cases in which there were a significant number of deliveries over the season (as indicated by dates). There is considerable scatter, which is affected by the ship size and type and also by the voyage itineraries, due to the methodology adopted (as described in 3.1). Averaged values for a destination therefore provide a better overall impression of the potential fuel switching impact than numbers for individual voyages.

As noted above, the global averages take account of fuel used both inbound and outbound. For dry cargo, the average fuel usage for backhaul is quite similar to that for delivery. For bulk fuels, there is no backhaul.

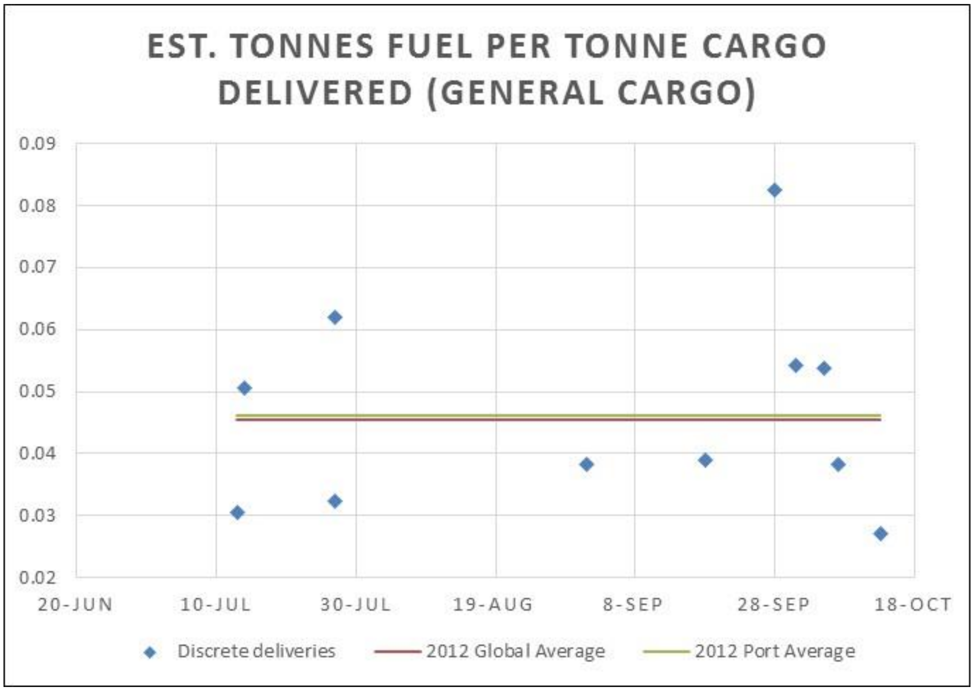

Figure 3: Dry Cargo fuel use – Iqaluit

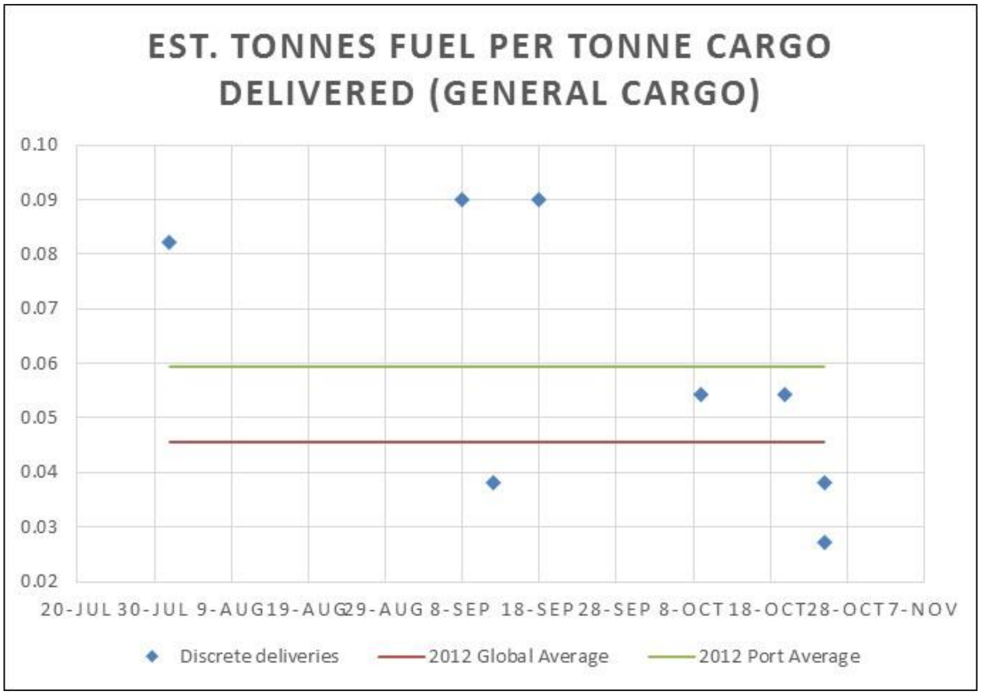

Figure 4: Dry Cargo fuel use - Rankin Inlet

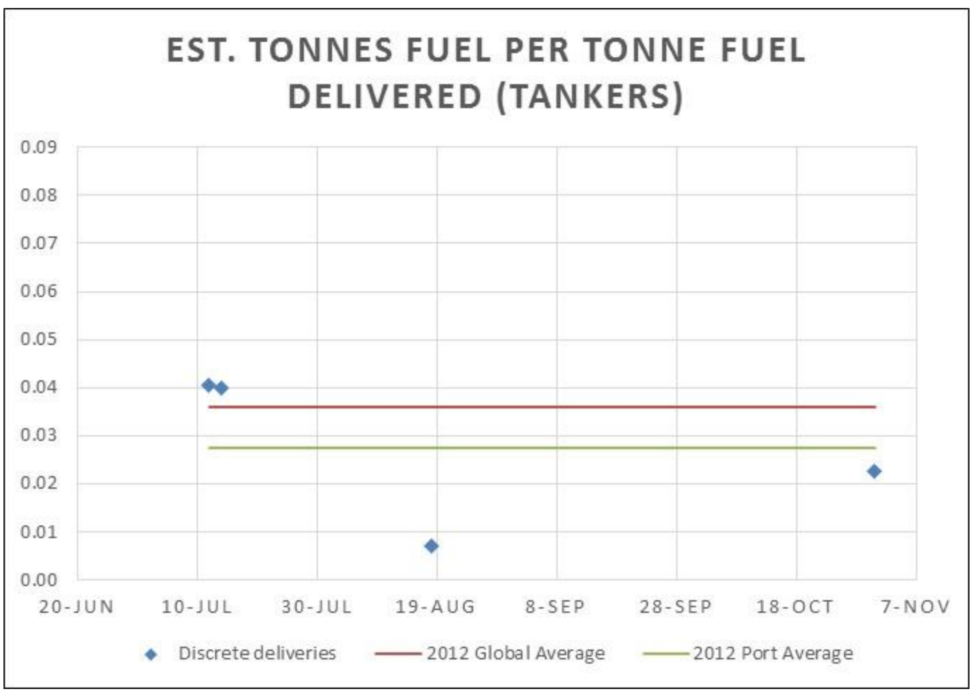

Figure 5: Bulk Petroleum fuel use – Iqaluit

4.2.2 SOUTH OF 60^{0}N

Fuel use for the voyage legs South of 60^{0}N varies for the different ships and ports of origin, according to the engine power, cargo capacity and distance travelled. These legs add between 0.007 t/t to 0.024 t/t to the total fuel usage; with generally smaller values for tanker traffic reflecting the shorter voyages (Newfoundland rather than Montreal area for dry cargoes).

The effect on the global averages presented in 4.2.1 is to increase these as shown in Table 2 below.

Table 2: Fuel use per tonne cargo delivered (averages)

Region	Tonne fuel/tonne cargo	
	General Cargo	Tanker
Arctic Only	0.0455	0.0353
Additional distance South of 60^o	0.0190	0.0134
Total	0.0645	0.0487

4.3 COST IMPACT

The fuel quantities in 4.2 represent heavy fuel that would be replaced by diesel. The current (August 2016) cost differential in the Port of Montreal between IFO 180 and diesel is US$250/tonne (US$300/tonne for IFO 380). At the current CAD/USD exchange rate this is a price premium of CAD$333.33 per ton of diesel compared to IFO 180.

The data used in this study suggests a combined (North and South of 60^o) average ratio of 0.0645 tonnes of fuel burned for every tonne of general cargo delivered. The premium of CAD$333.33 per tonne for diesel represents a premium of approximately CAD$21.50 per tonne of general cargo delivered over current costs for a switch to diesel.

The average of the current rates in the schedule shown at Table 1 is CAD$357.30 per tonne of cargo. The CAD$21 premium for diesel is therefore equivalent to approximately 7% of the average rate.

These rates range from a low of $288/tonne (Iqaluit) to a high of $437/tonne (Cambridge Bay). The basis for rate variance is not available to the public, and so comparing the premium to the average rate is the most realistic overall metric for cost increase given the available data.

Considering the same fuel costs for only the Arctic segment at a ratio of 0.045 tonnes of fuel burned for every tonne of general cargo delivered, this represents approximately CAD$16 per tonne cargo cost premium over current costs, which is roughly 5% of the average of current rates.

Somewhat similar cost results can be derived for tanker fuel deliveries. There are no published delivery rates as a basis for comparison, and so percentage increases cannot be estimated. The cost impact at the average of 0.049 t/t ratio would be approximately CAD$15/t, and CAD$12 for the Arctic leg only.

These averaged cost impacts are shown in Table 3 below.

Table 3: Cost Impacts of Fuel Switching

	General Cargo	Tanker
Arctic Only	$15.16	$11.77
South of 60	$6.34	$4.47
Total	$21.50	$16.24

5 ADDITIONAL CONSIDERATIONS

5.1 FUTURE FUEL COSTS

As of mid-2016, all fuel costs are at much lower levels than those which prevailed a few years earlier, though above recent lows. For example, in 2014 low Sulphur diesel was roughly C$1100 and IFO 380 C$600. This would lead to fuel switching premiums roughly 50% higher in dollar terms than those derived in section 4. It is probable that the overall freight rates would increase somewhat in a higher fuel cost environment, and so the switching premiums would not increase as much in percentage terms.

5.2 OTHER LOW SULPHUR FUEL SURCHARGES

Container shipping lines have used fuel surcharges for a number of years, in a similar fashion to many airlines. The basis for these charges has been criticized as being opaque, and they are not paid by some high volume customers. Few ports are served by enough lines to generate true price competition. However, subject to these caveats the surcharges provide some indication of the importance of fuel prices in shipping costs.

The advent of ECAs in Europe and North America led to container lines introducing supplementary low Sulphur surcharges for services required to use fuel switching (few container ships have scrubbers, and no trans-ocean routes yet use LNG or other non-traditional fuels). A study undertaken by Drewry Shipping[1] at the 2015 introduction of the 0.1% Sulphur limit summarized the range of charges being applied worldwide, as shown in Table 4.

As can be seen, the surcharges relate to the distances within an ECA, with the highest values being for Baltic to Canada. The $30-110 difference between rates to New York and to "Canada" (assume Montreal as worst case) reflects the additional 800 nm within the ECA

An online informational quote from the CMA/CGM website[2] on August 5th 2016 gave a general bunkering surcharge of US$175 and a supplementary low Sulphur surcharge of US$80 for a

[1] Cited in http://www.shapiro.com/low-sulfur-surcharge-high-confusion-and-high-costs/

[2] http://www.cma-cgm.com/ebusiness/tariffs

delivery Rotterdam/Montreal. Individual companies can have quite different policies, however, and some companies have now rolled the low Sulphur surcharge into an overall fuel surcharge.

Table 4: Low Sulphur Fuel Surcharges

Routing	Low Sulfur Surcharge Range (Based on FEU[1], in USD)
Northwest Europe/New York	$50-150
Baltic/New York	$150-260
Northwest Europe/Savannah	$100-200
Baltic/Savannah	$150-300
Northwest Europe/East Coast, Canada	$80-260
Baltic/East Coast, Canada	$180-370
China/Northwest Europe	$30-50
China/Baltic	$130-150
China/West Coast, US	$35-150
China/East Coast, US	$50-60

Note 1: FEU – forty foot equivalent unit (container)

These surcharges are less than those calculated for the Sealift operations on a per tonne basis, which is considered reasonable. The large container vessels used in international service are much more fuel efficient than the small and specialized Sealift ships.

5.3 FUTURE EMISSION REGULATIONS

The IMO has adopted requirements under Annex 6 of the MARPOL convention that will require marine fuels to meet a 0.5% Sulphur cap by 2020; unless market studies show that this will be impractical due to supply constraints. In this case, the deadline will be extended until 2025. A study commissioned by IMO (CE Delft, 2016) concludes that the 2020 is achievable; an alternative study commissioned by the marine industry (EnSys, 2016) concludes otherwise. Both studies, and several related submissions will be considered by IMO in October 2016. It is intended that a final decision on the implementation date will be taken at this meeting.

The two studies use similar baselines for considering marine fuel requirements; Table 5 below is drawn from the CE Delft report. In the baseline year of 2012, marine HFO constituted roughly 6% of global refinery production. This, however, had an average Sulphur content more than 25 times that of the other fuels (average 2.5% compared with less than 0.1%) and so contributed an absolute majority of SO_x emissions from transportation sources.

Table 5: Global Fuels Production (from CE Delft)

	Production in 2012	Production in 2020
Gasoline	963	1,086
Naphtha	256	305
Jet/Kero Fuel	324	331
Middle Distillate	1,316	1,521
Of which MGO	64	39
Total Marine Heavy Fuel Oil (HFO)	228	269
Of which Marine HFO (S ≤ 0.50% m/m)	0	233
Of which Marine HFO (S > 0.50% m/m)	228	36
LPG	113	110
Other	784	537
Total	3,984	4,159

Both studies agree that most ships will need to adopt low Sulphur fuels, as the take-up of scrubbers or alternative fuels by 2020 will be relatively small. Ships that can operate on high Sulphur HFO with scrubbers will see continuing large fuel cost differentials, but may themselves have supply shortages. However, the cost differential between ECA-compliant (0.1% Sulphur) and "general" (0.5% Sulphur) fuel will narrow, as the low Sulphur fuel will need sourcing (low Sulphur crude), refining, blending, or a mix of these. The CE Delft model assumes a differential in 2020 of only $20/tonne between 0.01% Sulphur MGO and 0.5% Sulphur HFO. At this differential the cost premium of switching to low or ultra-low Sulphur diesel would be less than 1% of current freight rates.

6 CONCLUSIONS

Delivering cargo to the Canadian Arctic is a costly and complex undertaking. Extending the North American Emission Control Area to encompass the Arctic would require the use of low Sulphur fuels rather than the residual fuels that are now permitted (and used) for all ships north of 60^0N. Requiring compliance with the ECA by Sealift ships south of 60^0N would increase the impact. New ships on the Arctic sealift services could be designed with scrubbers, but retrofitting the majority of the existing ships would be very challenging and costly.

The low Sulphur fuel required will cost very roughly twice as much as the residual fuel which it will replace. This cost increase will be reflected in increases in freight rates for the dry cargo and petroleum products carried by the Sealift. However, the increases will be relatively modest. The conservative analysis reported in this study concludes that an overall average increase would be in the order of $21/tonne of dry cargo and $16/tonne of bulk fuels. This is roughly 7% of current rates (dry cargo). A return to the high fuel prices of the 2013/14 period would increase this to around 8-10%.

The current exemption for Sealift ships South of 60^0N contributes roughly 30% of this potential cost impact; i.e. 2-3% at current shipping rates.

In future, the low Sulphur premium will reduce as the permissible Sulphur in “standard” fuels is reduced to 0.5% in 2020/2025. Projections suggest that at this point the premium would be 1% or less.

7 REFERENCES

CE Delft, July 2016, IMO MEPC.70/INF.6 “Assessment of Fuel Oil Availability”

EnSys Energy, July 2016, IMO MEPC.79/INF.9 “Supplemental Marine Fuel Availability Study”

Transport Canada RDIMS 11902771 “Discussion Paper on Carriage of Heavy Fuel Oil in the Arctic”