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Update on Availability, Quality and Quantity of Marine Fuels in Canada

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UPDATE ON AVAILABILITY, QUALITY AND QUANTITY OF MARINE FUELS IN CANADA

FINAL REPORT

July 17, 2008

Submitted to
Environment Canada

Submitted by
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BMT DOCUMENT QUALITY CONTROL DATA SHEET

REPORT Update on Availability, Quality and Quantity of Marine Fuels in Canada

DATE July 17, 2008

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EXECUTIVE SUMMARY

Background and Objective

Air pollution in the form of exhaust emissions from marine vessels is a growing part of the total emissions from the transportation sector in Canada. Of particular concern are emissions of sulphur oxides (SO_x). Environment Canada has been monitoring the levels of sulphur in liquid fuels refined in and imported into Canada for years; however, no data have been collected on the quality of fuels sold specifically to marine vessels in Canada.

In 2005, a study was conducted to provide a comprehensive picture of sulphur levels in marine fuels, the quantities of marine fuels produced and sold in Canada, and the future availability of the various grades of marine fuels at Canadian ports. This 2008 study updates the 2005 original to include information from 2006 and 2007 on the availability, quantity and quality of marine fuels sold in Canada, this information having been gathered through a survey of Canadian refiners and fuel suppliers. In addition, this study compares international marine fuel prices and quality to highlight Canada’s position in the global marine fuels market.

Supply and Blending of Marine Fuels in Canada

The path from crude oil to bunker delivery for marine fuels in Canada is often convoluted. Fuels are often transferred back and forth between Canada and the United States at various stages of processing prior to the final product being produced. Similarly, the mixing of residual and distillate fuels to achieve intermediate blends occurs at either the refiner’s or supplier’s facilities. Suppliers that do blending obtain fuels from various sources, adding another dimension to the already complex marine fuels supply chain.

Fuels sold as marine fuels are often fuels that were originally produced for an entirely different market; in many refineries, marine fuels are by-products. Both distillate and heavy fuels are used in many industries other than the marine industry, and the regulations and demand in these industries have a direct impact on the quality and availability of marine fuels.

Marine Fuels Market in Canada

Marine fuel refiners and suppliers from across Canada provided the project team with data on the sales and quality of the products they produced and sold in 2006 and 2007. Table 1 shows the availability of various fuel grades across the country.

Table 1. Availability of Marine Fuels in Canada, 2006 and 2007

Fuel Grades	**Atlantic 2006**	**Quebec 2006**	**Ontario 2006**	**Western 2006**
DMA	√	√	√	√
DMB	X	X	X	√
Other marine distillates	√	√	X	√
<IFO180	√	√	√	√
IFO180-IFO380	√	√	√	√
IFO380-IFO640	√	√	√	√
>IFO640	X	X	X	X
Fuel Grades	**Atlantic 2007**	**Quebec 2007**	**Ontario 2007**	**Western 2007**
DMA	√	√	√	√
DMB	X	X	X	√
Other marine distillates	√	√	√	√
<IFO180	√	√	√	√
IFO180-IFO380	√	√	√	√
IFO380-IFO640	√	√	√	X
>IFO640	X	X	X	X

√ - Available X - Unavailable

DMA = marine distillate fuel, grade A; DMB = marine distillate fuel, grade B; IFO = intermediate fuel oil, with number indicating viscocity (in centistrokes)

The sulphur content in marine fuels sold in Canada has been decreasing in recent years. Table 2 shows the overall volume-weighted average sulphur content in marine fuels, as reported by the Canadian industry for 2004, 2006 and 2007.

Table 2. Annual Average Sulphur Content (%) in Marine Fuels

Year	Distillate	Residual
2004	0.201	1.760
2006	0.118	1.678
2007	0.067	1.605

Canadian Marine Fuels Market from a Global Perspective

In general, marine fuels follow the worldwide price trends for crude oil. Since about 2000, the price of Canadian marine fuels has generally been slightly higher than that of marine fuels sold in the United States, Europe and Asia. Table 3 highlights the typical price differences between the most expensive and the cheapest fuels sold in Canadian ports, Canadian and American ports, Canadian and European ports, and Canadian and Asian ports.

Table 3. Price Difference Summary

	MDO	MGO	IFO180	IFO380
Canadian Ports	US$50-100/tonne until 2005 US$200/tonne after 2005	US$25/tonne	US$25-50/tonne	US$25-50/tonne
Canadian and American Ports	US$100-150$/tonne until 2005 US$200/tonne after 2005	US$50-100/tonne	US$50/tonne	US$50/tonne
Canadian and European Ports	US$100-200/tonne until 2005 US$300/tonne after 2005	US$50/tonne	US$50-100/tonne	US$50-100/tonne
Canadian and Asian Ports	US$50-150/tonne until 2005 US$150-250/tonne after 2005	US$100/tonne	US$50/tonne	US$50/tonne

Canadian marine distillate fuels are among those with the lowest sulphur content in the world. From 2005 to 2007, fuels sold in the West Coast of North America and Great Lakes regions had average sulphur content of 0.21% or less. Fuels sold in the East Coast of North America region had slightly higher sulphur content over the same time period: 0.21–0.42%. The highest concentration of sulphur in marine distillate fuels was 0.84–1.05%, in fuels sold in the South Africa region in 2006 and 2007.

Canadian marine residual fuels did not compare as favourably as distillates to their international counterparts. The lowest sulphur concentration in residual fuels was found in those sold in South America (1–1.5% over the three years from 2004 to 2007). Fuels sold in the Great Lakes region had sulphur content of 1.5–2% over the same period, and by 2007 many regions in Europe had lowered sulphur levels to this range. The two coastal regions of North America were mid-range on the global scale, with sulphur content in fuels sold there of 2–2.5% in residual fuels. The highest concentration of sulphur was 3–3.5%, which was found in fuels from many regions, including the United States Gulf, the Middle East, India and Asia.

Future of Low-Sulphur Fuels

As environmental awareness continues to increase worldwide, many governments and regulatory bodies are implementing stricter regulations in attempts to protect the environment. The International Maritime Organization (IMO) is no exception. Through Annex VI, *Regulations for the Prevention of Air Pollution from Ships*, of the *International Convention for the Prevention of Pollution from Ships* (known as MARPOL), the IMO has implemented regulations limiting the amount of sulphur in fuels. Recently, the organization proposed a timeline for reducing sulphur content in fuels to 0.5% globally and to 0.1% in Emission Control Areas.

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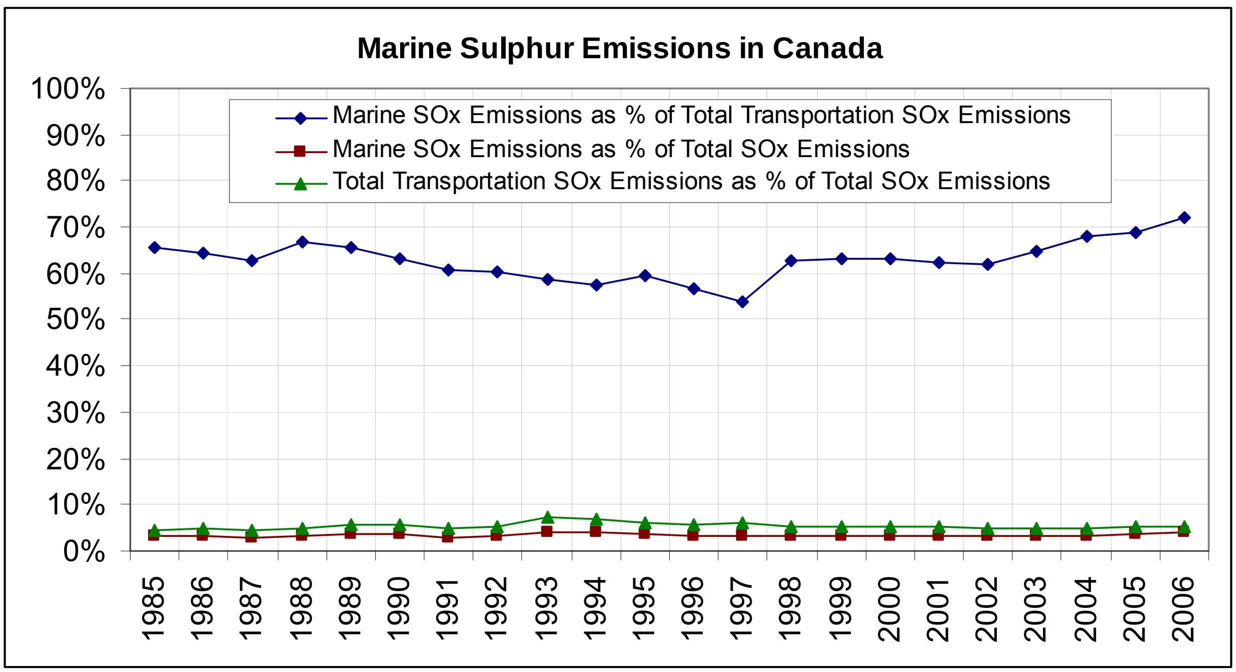
1. INTRODUCTION

1.1 Background

Air pollution in the form of exhaust emissions from marine vessels is a growing part of the total emissions from the transportation sector in Canada. Of particular concern are emissions of sulphur oxides (SO_x). Figure 1.1 presents SO_x emissions from the marine transportation industry in Canada as a percentage of emissions from the total transportation sector and as a percentage of the total SO_x emissions in Canada from 1985 to 2006. The figure also shows the SO_x emissions from the total transportation sector as a percentage of total SO_x emissions in Canada for that same period. In 2006, the marine industry, which uses a mix of diesel and heavy fuel oils, was responsible for 72% of the SO_x emissions from the entire transportation sector in Canada and about 4% of the total SO_x emissions in Canada. Global initiatives put in place by the International Maritime Organization (IMO) through Annex VI, *Regulations for the Prevention of Air Pollution from Ships*, of the *International Convention for the Prevention of Pollution from Ships* (known as MARPOL) continue to be updated in attempt to limit sulphur emissions from the marine industry.

Figure 1.1: Marine Sulphur Oxide Emissions in Canada, 1985–2006



Source: Environment Canada [date]

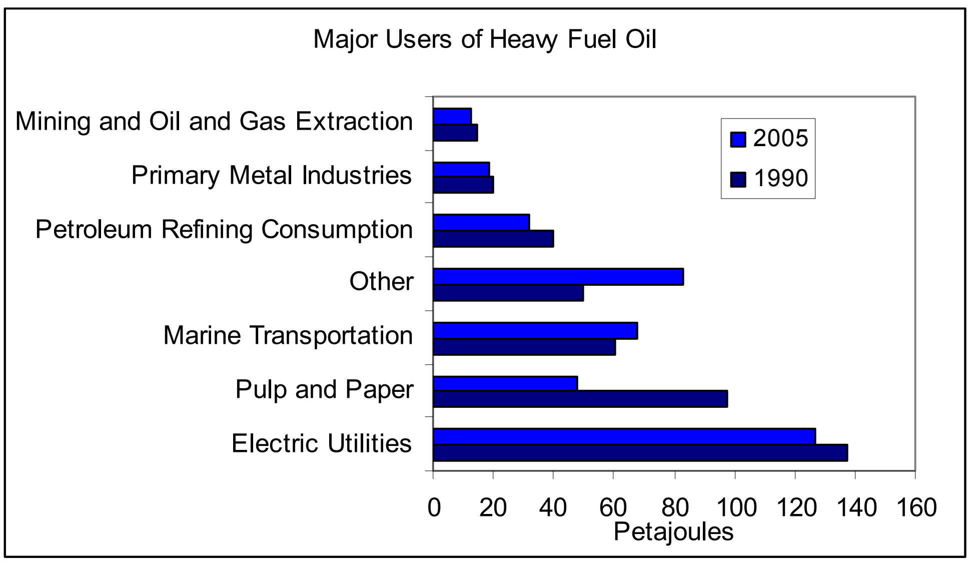
Modern marine vessels are mainly powered by diesel engines, which have favourable fuel consumption rates compared to steam and gas turbine plants. Diesel engines typically operate with heavier fuels that have a higher sulphur content than fuels used in gas turbine plants. The latter require high-quality fuels, while steam systems can burn even extremely low-quality fuels.

Diesel engines also possess inferior Criteria Air Contaminant release characteristics. Since the oil crises of the 1970s, crude oil has been processed to produce the maximum number of refined products from it (e.g. gasoline, diesels, kerosene and gases). This has likely resulted in increased concentrations of contaminants, such as sulphur, ash, asphaltenes and metals, in residual and intermediate fuels.

Marine fuels are generally categorized as either residual fuels or distillate fuels. Mixtures of these types, commonly termed intermediate fuel oils (IFO), also exist. Distillate fuels are those fractions of crude oil that are separated through the refinery process of distillation. The remaining portions of the crude oil that do not boil are referred to as residual fuels.

Heavy fuel oil (HFO) accounts for more than 60% of the energy consumed in the marine transportation industry in Canada; in fact, this industry continues to depend on HFO more than any other. As seen in Figure 1.2, most industries in Canada lowered their consumption of HFO between 1990 and 2005, unlike the marine transportation industry, which is the only specific industry in Canada to have increased its usage of HFO in that time (Statistics Canada 2007).

Figure 1.2. Major Uses of Heavy Fuel Oil in Canada, 2005 and 1990



Source: Statistics Canada, CANSIM tables 128-0002 and 128-0009.

BMT Fleet Technology Limited conducted a study for Environment Canada in 2005, published as *Report on Availability, Quality and Quantity of Marine Fuels Sold in Canada*. This study estimated the average sulphur content of marine fuels sold in Canada in 2004 to be 0.20% for marine distillate fuels and 1.76% for marine residual fuels (BMT Fleet Technology Limited 2005). In 2004, the global average sulphur content in residual fuels was roughly 2.8%, with less than 6% of fuels sold having a sulphur content of less than 1.5% and about 44% of fuels sold having a sulphur content of 3% or more (DNV 2005).

Diesel fuels have significantly lower sulphur content than do residual fuels. In Canada, the concentration of sulphur in diesel fuel in land-based vehicles has been regulated to 0.0015%

(15 mg/kg) since 2006. As of June 1, 2007, the sulphur content of marine diesel fuels produced or imported into Canada is limited to 0.05%; this will be lowered to 0.0015% in 2012.

The annual report *Sulphur in Liquid Fuels* (Environment Canada 2006) lists the sulphur content of fuels refined in and imported into Canada. However, it does not adequately describe the quality of fuels sold to marine vessels in the Canadian market. The *Report on Availability, Quality and Quantity of Marine Fuels Sold in Canada* was intended to expand *Sulphur in Liquid Fuels*, while this current work refines the 2005 study, updating the findings using 2006 and 2007 statistics.

1.2 Objective

The objective of this study was to develop an updated and comprehensive report, building on the findings of the 2005 study and detailing the availability, quality, quantity and price of marine fuels sold in the Canadian market in 2006 and 2007. As an extension of the 2005 report, the current study also includes a comparison of international and Canadian data, specifically the price of and sulphur levels in marine fuels.

For the purposes of this study, marine vessels are defined as ships with compression-ignition engines rated above 37 kW used for propulsion and auxiliary power production. These engines are used on commercial vessels in a variety of applications, including deep-sea vessels (e.g. freighters, tankers and other large ships normally operating offshore or in the Great Lakes), cruise ships, ferries, government vessels (e.g.. those operated by the Canadian Coast Guard, Fisheries and Oceans Canada and the Department of National Defence), fishing vessels, and inshore workboats and tugboats.

This report reviews various aspects of and provides updated statistics on marine fuels sold in Canada, including the following:

- marine fuel characteristics and qualities;
- sulphur concentrations in Canadian marine fuels;
- aspects of the marine fuels supply chain in Canada;
- marine fuels blending practices in Canada;
- availability of marine fuels (including low-sulphur fuels); and
- sales of marine fuels in Canada (including prices and availability of low-sulphur fuels).

This study also includes new international data to compare sulphur content in various grades of marine fuels sold internationally and in Canada, and the prices of those fuels.

1.3 Scope

The stated objective has been achieved through an in-depth review of the Canadian marine fuels supply chain. The complex path from refineries to suppliers and consumers is addressed, and the quality, quantity and availability of fuels determined for residual and distillate marine fuel grades by regions.[1]

[1] Availability, quantity and quality of fuels are not broken down by bunkering port or supplier due to confidentiality agreements.

The scope of this study encompasses:

- describing characteristics and qualities of residual and distillate marine fuels available in regions across Canada;
- comparing sulphur content of marine fuels sold in Canada to that of marine fuels sold internationally;
- determining current and future availability of low-sulphur fuels in view of regulations and demand;
- analyzing sales and prices of marine fuels in Canada and internationally; and
- assessing the future of low-sulphur fuel regulations and their potential effect on the shipping industry.

1.4 Project Methodology

As noted, the primary goal of this study was to update the 2005 *Report on Availability, Quality and Quantity of Marine Fuels Sold in Canada*. The methodology employed was to verify and update information, as outlined in the study objective, above. International data were then obtained from third-party sources (Bunkerworld and DNV Petroleum Services) for comparison with Canadian data.

The project team prepared questionnaires that were distributed to key industry stakeholders (see Appendix A). Two questionnaires were developed, one for refiners and importers, and one for marine fuel agents and resellers. The questionnaires requested detailed information on current production and sales (by grade), fuel quality (sulphur content) and blending practices. Further consultation with stakeholders (by phone and email) was conducted as required. For a complete list of stakeholders, see Table 2.1.

To supplement the questionnaire data, the project team reviewed the literature to update resources and retrieve additional information.

1.5 Organization of the Report

This section introduces the project, explains key terminology and provides background information on marine fuels and marine propulsion systems. The remainder of this report is organized as follows:

- 2. Marine Fuels Supply Chain in Canada: this section includes a comprehensive list of refineries, importers, distributors, marketers, and marine fuel retailers and bunker agents in Canada. The section also shows the path marine fuels take from producer to consumer by region.

- 3. Marine Fuel Blending Practices in Canada: this section assesses current blending practices and their effect on fuel quality and characteristics.

- 4. Overview of Marine Fuels Sold in Canada: this section summarizes the various types and grades of marine fuels in Canada, comparing quality (sulphur concentrations) and characteristics.

- 5. Sulphur Content in Marine Fuels: this section identifies and assesses current and historic sulphur content in various grades of marine fuels sold in Canada and internationally.

- 6. Availability of Marine Fuels in Canada: this section identifies sources of supply, trends in marine fuels supply and sales, fuel quality (sulphur content and variability) and the current availability of low-sulphur fuel by region.

- 7. Marine Fuel Sales and Prices: this section reviews the prices of marine fuels sold in Canada and compares those prices to those of marine fuels sold internationally. This section also examines the prices of low-sulphur fuels.

- 8. Future Effects of Low-Sulphur Fuels: this section discusses the future effects of Sulphur Emission Control Areas and regulations on the Canadian marine fuels market, and addresses the potential effect of low-sulphur fuels on the shipping industry in Canada.

Supporting documentation and information are provided in appendices, which are identified and referenced throughout the report.

1.6 Terminology and Background

1.6.1 Fuel Types

This section introduces terminology that is used throughout this report (see Table 1.1).

Table 1.1. Types and Grades of Marine Fuels

Fuel Type	Common Industry Name	Example Fuel Grades
Distillate	Marine Gas Oil (MGO) or Marine Diesel Oil (MDO)	DMX, DMA, DMB, DMC
Intermediate	Intermediate Fuel Oil (IFO)	IFO180, IFO380, IFO420
Residual	Fuel Oil or Residual Fuel Oil	RMA, RML

The three broad fuel types (Distillate, Intermediate and Residual) in the marine industry are commonly referred to as Marine Gas Oil (MGO) or Marine Diesel Oil (MDO) (distillates), Intermediate Fuel Oil (IFO) and Residual Fuel Oil.

A distillate fuel is boiled into a gas prior to being condensed into liquid oil; the non-boiling fractions of the crude become the residual fuel oils. The various grades of residual fuels are created through distillation at a refinery. These distillation processes vary in pressure and in temperature, resulting in slight variations in the quantities of gas oil that remain in the non-boiling fractions of the crude. An intermediate fuel is a mixture of distillate and residual; intermediate fuel oil grades are produced directly during distillation or by blending the residual with the distillate (US EPA 1999, 4).

Diesel fuel used in automobile and trucks is 100% distillate, whereas marine diesel fuels are typically blends of distillate and residual oils.

The predominant standard for marine fuels worldwide is ISO 8217:2005, as set by the International Organization for Standardization or ISO. Other sources of fuel property standards are the ASTM International Council on Combustion Engines, *Platt's Guide to Petroleum Specifications* and certain major petroleum refining and marketing companies (e.g. Shell and Mobil). There are standards for both marine distillate fuels (DMX, DMA, DMB and DMC) and the most widely used intermediate fuels. Marine fuels employ a series of letters to identify them as distillate (D) or residual (R) fuels, as marine fuels (M) and by grade (A, B or C); thus, DMA is marine distillate fuel A.

DMX and DMA are normally considered to be MGOs (100% distillate), while DMB and DMC are normally considered to be MDOs (a heavier distillate that sometimes contains a portion of residual oil).

DMA is the most common fuel used in small and medium compression-ignition marine engines. DMB is generally DMA that has picked up a small amount of contamination during storage or transfer. DMB is not a manufactured product; as such, it is not available at all bunkering ports.

DMC may be manufactured from the heavier fractions of distillate or may be a blend of DMA and residual fuels created in marine fuel terminals. The ISO specifications list DMC as a distillate; however, it may be considered a type of intermediate fuel, given that the specifications allow blending with residual oil (US EPA 1999, 9). The limitation on the amount of heavy fuel oil that can be blended into DMC is normally limited by the DMC viscosity specification, which depends on the quality of the residual fuel used for blending. The sulphur content, viscosity and density specifications for these fuels, as specified in ISO 8217:2005, are summarized in Table 1.2 (ISO 2005).

International specifications identify 15 residual fuels, each with individual grades designated by letters A through L, and a number to signify the viscosity limit in centistokes (cSt). Therefore, residual marine fuel A, with a viscosity of 10 cSt at 100ºC, would be codified as RMA10. IFO180 and IFO380 are the most common intermediate fuels; the numbers refer to the viscosity limits at the common fuel-handling temperature of 50°C. The official specification for IFO180 is RME180 or RMF180, and that for IFO380 is RMG380 or RMH380. As stated previously, intermediate marine fuels may be manufactured with or without blending with heavy distillates. The diversity of intermediate and residual marine fuels reflects the various properties of residuum from global crude oil sources, as well as the variety of engine design specifications (US EPA 1999).

Table 1.2. Selected ISO 8217:2005 Specifications for Marine Fuels

Characteristics	MARINE FUELS						
	Distillate			Intermediate		Residual	
	DMX	DMA	DMB	DMC	RME/F 180	RMG/H 380	RMK 700
Density at 15°C, kg/m^3 (max.)	–	890	900	920	991	991	1010
Kinematic viscosity (cSt at 40°C) (min./max.	1.4 5.5	1.5 6	– 11	– 14	180 at 50°C	380 at 50°C	700 at 50°C

for distillate; max. for residual)							
Flash point (°C) (min.)	43	60	60	60	60	60	60
Pour point (°C), winter (max.)	–	-6	0	0	30	30	30
Carbon residue (%) (max.)	0.3	0.3	–	–	15/20	18/22	22
Ash (%) (max.)	0.01	0.01	0.01	0.05	0.1/0.15	0.15	0.15
Water (%) (max.)	–	–	0.3	0.3	0.5	0.5	0.5
*Sulphur (%) (max.)	1	1.5	2	2	4.5	4.5	4.5
Vanadium, mg/kg (max.)	–	–	–	100	200/500	300/600	600
Aluminium plus silicon, mg/kg (max.)	–	–	–	25	80	80	80
Total sediment, mg/kg (max.)	–	–	0.1	0.1	0.1	0.1	0.1

*ISO 8217:2005 notes: A sulphur limit of 1.5% m/m will apply to all fuels in Sulphur Emission Control Areas (SECAs) designated by the International Maritime Organization, when its relevant protocol comes into force. There may be local variations. (Since 2005, two SECAs have come into force: Baltic and North Sea.).

1.6.2 Fuel Properties and Characteristics

Viscosity, which describes oil’s resistance to flow, is traditionally the main, and often the only, characteristic noted about marine fuels. However, there are actually several properties important to defining grades of marine fuels. As indicated in Table 1.2, these include flashpoint, density, water content, carbon residue, asphaltenes, wax, sulphur, sediment by extraction, ash, silicon, sodium, aluminium, vanadium, specific energy or calorific value, colour, sodium, additives, acids, ignition quality, stability and compatibility. Table 1.3 provides further definitions for some of the physical characteristics of marine fuels.

Table 1.3. Physical Properties of Marine Fuels

Property	Units	Definition	Significance
Viscosity	cSt	Resistance to flow	Amount of preheating for pumping processes; higher viscosity means poorer ignition and combustion
Flash point	°C	Temperature at which vapour ignites	Minimum temperature at which vapour is produced; safety measures; the lower the value, the easier the oil ignites
Density	kg/m^3	Relation between mass and volume	Less dense bunkers provide higher energy unit/mass; prices are often quoted in $/tonne, and deliveries are measured in volume (m^3); fuel purification processes in the ship use density differential
Water content	% vol	Water content	The more water, the less calorific value in the fuel; water can cause problems in the injectors; water forms emulsion and sludge that blocks filters and interrupts the flow
Carbon residue	% wt	Carbon remaining after total combustion	Results in late burning and high exhaust temperatures (which damage moving parts); indicator of carbon-depositing tendency and of the combustion properties
Asphaltenes	% wt	High-molecular-weight hydrocarbons	Play a role in the stability and compatibility of a fuel; are slow-burning
Wax	°C	Amount of wax in the fuel	High-wax bunkers cannot be easily preheated; even when the fuel has good calorific value, wax can cause problems for pumping and storage
Sulphur	% wt	Amount of sulphur in the fuel	Higher sulphur content fuels tend to have lower energy content; forms corrosive acids on the engine and exhaust system
Ash, silicon, sodium, aluminium, vanadium	% wt	Inorganic material in the fuel	Residue damages moving parts; highly abrasive material causes engine damage; forms salts resulting in deposits
Calorific value	Cal/g MJ/kg	Heat released	The higher the number, the more energy developed per unit of fuel
Ignition quality	Cetane no.	Ease of ignition	The higher the number, the more easily the engines can be started
Stability	–	Phase changes	Suspension or sludge formation; incompatibility with other fuels

Source: European Commission, 2002.

1.6.3 Engine and Fuel Choice

Generally, engine type dictates the type of marine fuels used on board ships. For much of the 1960s, when environmental impacts were less of a concern than they are now, and fuel resources were considered infinite, steam turbines were the most common engine used in the marine industry in North America. These inefficient machines burned low-quality, high-viscosity fuels and were relatively cheap to maintain.

With the fuel crises of the 1970s, fuel economy began to have a much greater influence on machinery selection; ship owners started to use diesel engines more often for main propulsion as well as auxiliary electrical power. Diesels engines are more sensitive to fuel quality than are steam turbines; typically, propulsion diesels run on residual fuel oil or intermediate fuel oil, and diesel generators run on distillate fuels (MDO and MGO). The reliability and economy of diesel engines is such that they are now the most common propulsive machinery at sea. With advances in design, such as high-pressure common fuel rail engines, they are becoming more environmentally friendly.

Traditionally, fuel choice was a matter of operational performance, but price increases and evolving technology influenced the bunker selection for specific vessels. While many large cargo ships have switched to residual fuels (even to drive generators and auxiliary machinery), other fleets (e.g. fishing boats, passenger vessels) are still constrained by the space needed or engine weight penalties associated with using residual fuel.

Similarly, the decision whether to burn residual fuels or distillates in cruise ships is not straightforward. Recent generations of cruise liners are driven by compact and powerful gas turbines that free up passenger space. Some operators also value the perceived environmental benefits of gas turbines, which have low visible emissions. However, gas turbines are significantly less fuel-efficient than diesel engines. Many naval vessels use gas turbines due to their high power density and fast response times.

With the IMO’s global sulphur limits, vessels will be running exclusively on distillate fuels by 2020, unless new refining technologies produce cost-effective low-sulphur residual fuels, since “it is difficult and costly to get residual fuels of less than 1% sulphur” (Fairplay 2008). Alternatively, exhaust gas cleaning systems, such as scrubbers, and other abatement technologies may be used.

Table 1.4 and Table 1.5 set out the possible uses for categories of marine distillate and residual fuels, respectively.

Table 1.4. Categories of Marine Distillate Fuels

ISO 8217	Type	Viscosity at 40°C (max.)	Uses
DMX	MGO	5.5	Suitable for use when the ambient temperature is low; high cetane number and reduced flashpoint; used for emergency machinery external to main machinery spaces; in the merchant marine, use limited to lifeboat motors and emergency generators
DMA	MGO	6.0	High-quality distillate generally used for auxiliary engines
DMB	MDO	11.0	Distillate mixed with some residual; intended for use in diesel engines not designed for combustion of residual oil
DMC	MDO	14.0	High-viscosity diesel oil; largely used by fishing fleets; not suitable for machinery and fuel oil treatment plants that are not designed for residual fuel

Source: European Commission, 2002.

Table 1.5. Categories of Marine Residuals

ISO 8217	Viscosity at 50°C (max.)	Uses
RMA30 to RMB30	30	Suitable for use at low ambient temperatures in installations without preheating facilities in the storage tank; RMA10 has generally the lowest specific density and a minimum viscosity to improve ignition properties
RMD80 to RMH380	80 to 380	Fuel oils requiring on-board treatment and purification in ordinary purifier and clarifier extraction systems
RMH380 to RMK700	380 to 700	Fuel for use in installation with separators specially designed for the treatment of fuel oils with higher specific densities

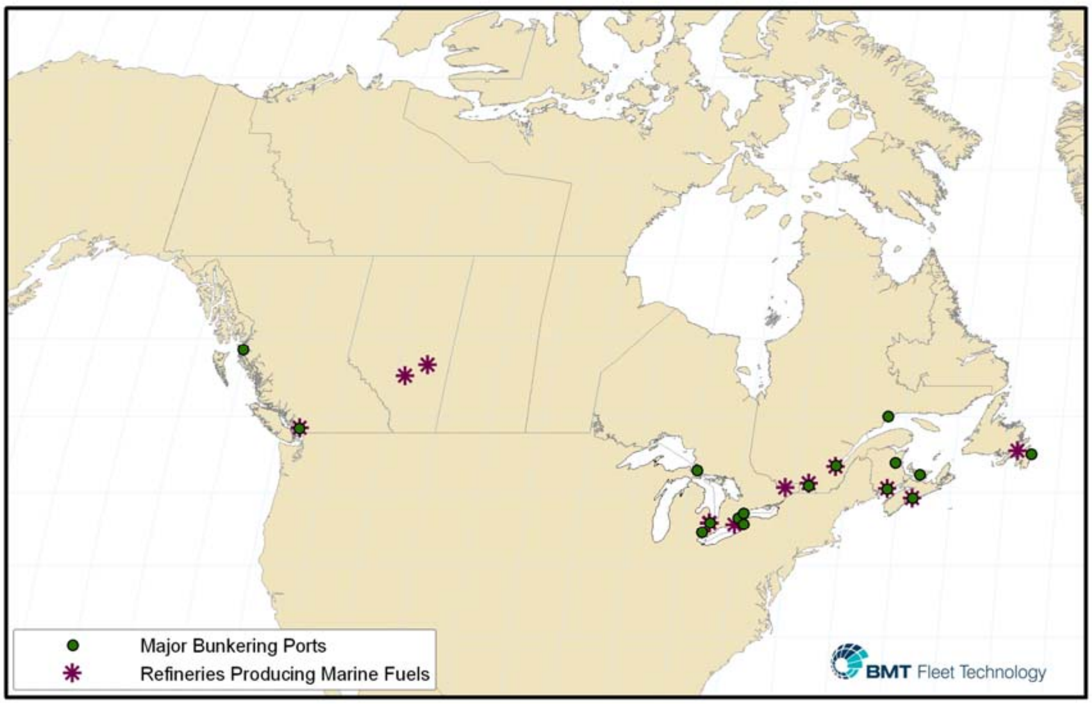
Source: European Commission, 2002.

2. MARINE FUELS SUPPLY CHAIN IN CANADA

2.1 Stakeholders in the Canadian Marine Fuels Market

There are currently 18 refineries in Canada, 12 of which supply the Canadian marine fuel market (Canadian Petroleum Products Institute [2008]).[2] A number of the refineries produce and sell not only self-branded marine fuels at bunkering ports throughout the country but also supply many independent resellers with marine fuels. There are 16major bunkering ports in Canada. Independent bunker resellers located at major bunkering ports across Canada source marine fuels from Canadian refineries as well as from some American refineries to meet demand. Figure 2.1 shows the major bunkering ports and refineries that produce marine fuels in Canada.

Figure 2.1. Major Bunkering Ports and Refineries Producing Marine Fuels in Canada



Twenty-one organizations were identified as refiners, bunker suppliers, bunker traders or a combination of these, to make up the stakeholders who service the major bunkering ports across Canada (see Table 2.1).[3] The organizations shown in bold in the table are those that participated in the survey. The availability of each grade of fuel by region (Atlantic Canada, Quebec, Ontario and Western Canada) is discussed in Section 4.

[2] Only 11 refineries appear in Figure 2.1, since two refineries are located in Sarnia.

[3] The table was compiled from information supplied by Bunkerworld (www.bunkerworld.com), combined with information from consultations with the individual organizations, when possible. Note that bunker suppliers sell bunker but do not necessarily produce it.

Table 2.1. Canadian Marine Fuel Stakeholders

Organization	**Primary Business**	**Port Authorities Served**
Bunkerina International Inc.	Bunker trader	Montréal
Chevron	**Refiner and bunker supplier**	**Vancouver**
ExxonMobil Marine Fuels Ltd.	Bunker supplier	Halifax, Montréal, Port Cartier, Québec, Sarnia, St. John's, Vancouver (distributed through Imperial Oil in Canada)
Hampton Bunkering Ltd.	Bunker trader	Montréal
ICS Petroleum Ltd. (Montréal)	Bunker supplier and trader	Halifax, Montréal
ICS Petroleum Ltd.	**Bunker supplier and trader**	**All British Columbia ports**
Imperial Oil	**Refiner and bunker supplier**	**Halifax, Vancouver, Montréal, Sarnia**
Irving Oil Limited	**Refiner and bunker supplier**	**Charlottetown, Dartmouth, Halifax, Saint John, St. John's**
Kildair Service Ltd.	Bunker supplier	Montréal, Québec
Marine Petrobulk	**Bunker supplier**	**Vancouver**
**Harvest Energy (North Atlantic Refinery)	Refiner and bunker supplier	St. John's
NuStar Energy LP	Bunker supplier	Does not currently supply bunker in Canada
Petro-Canada Products Ltd.	**Refiner and bunker supplier**	**Montréal**
Point Tupper Marine Services Limited	Bunker supplier	Halifax
Provmar Fuels Inc.	**Bunker supplier**	**Hamilton, Toronto, Oshawa, Welland Canal**
Reiter Petroleum Inc.	Bunker trader	Montréal, Québec
Shell Canada Products Ltd.	**Refiner and bunker supplier**	**Montréal, Sarnia**
Sterling Marine Fuels	**Bunker supplier**	**Windsor**
Ultramar Ltd.	**Refiner and bunker supplier**	**Québec**
Universal Maritime Agency & Trading Co. Ltd.	Bunker trader	Montréal
Warner Petroleum Corp.	Bunker supplier	Sault Ste. Marie

Notes
The organizations in bold returned a complete questionnaire
**** Some data were received; however, a complete questionnaire and dataset were not.**

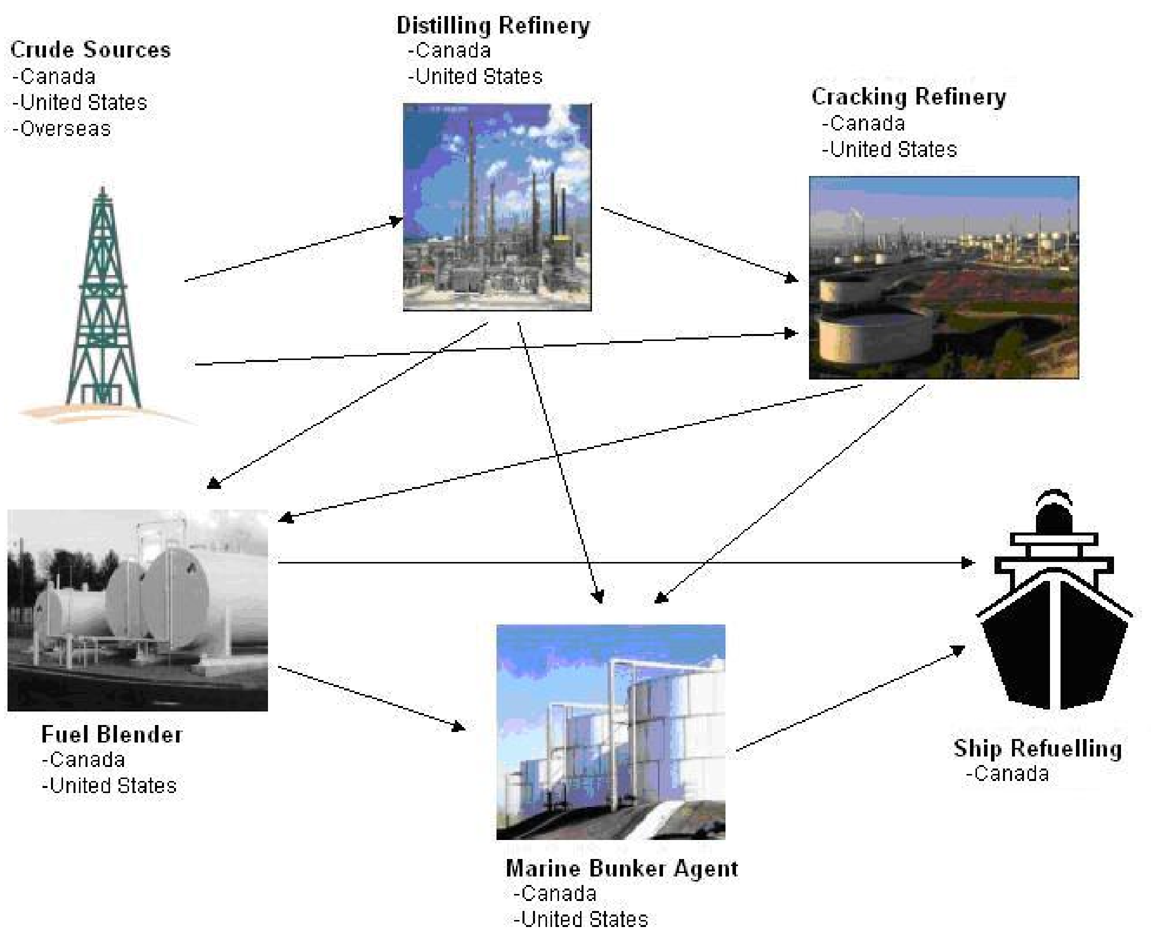
The following major port areas cover surrounding bunkering locations, as indicated:

- Charlottetown: Souris
- Halifax: Point Tupper, Shelburne
- Montréal: Contrecoeur, Cornwall, Sorel, Trois-Rivières, Valleyfield
- Port Cartier: Baie-Comeau, Sept-Iles
- Québec: Becancour, Port Alfred, St. Romuald
- Saint John: Canaport, Holyrood
- St. John's: Come By Chance
- Toronto: Port Weller
- Vancouver: Fraser River, Nanaimo, New Westminster, North Fraser, Port Moody, Victoria

2.2 Canada's Marine Fuels Supply Chain

The supply of marine fuels in Canada does not follow a single set path from crude source to ship; rather, it takes several paths, depending on the quality of crude oil and the capabilities of individual facilities refining and selling the resulting products. For example, a simple distillation refinery transfers products to a cracking refinery before they are sold to a supply agent, who in turn sells them to ship owners. A fuels blender could also be involved, either ahead, or in lieu, of the supply agent. Furthermore, the various facilities within the chain are not necessarily all in Canada: for example, residual fuels produced in Canada may be transferred to the United States for additional processing before being imported by a Canadian fuels supplier. The majority of imported marine fuels come from the United States; however, specific suppliers import marine fuels from overseas. Similarly, crude oil may be sourced from Canada, the United States, North American offshore locations and elsewhere in the world. Figure 2.2 shows the complexity of the marine fuels supply chain in Canada, due to the many paths fuel products take from crude source to end user.

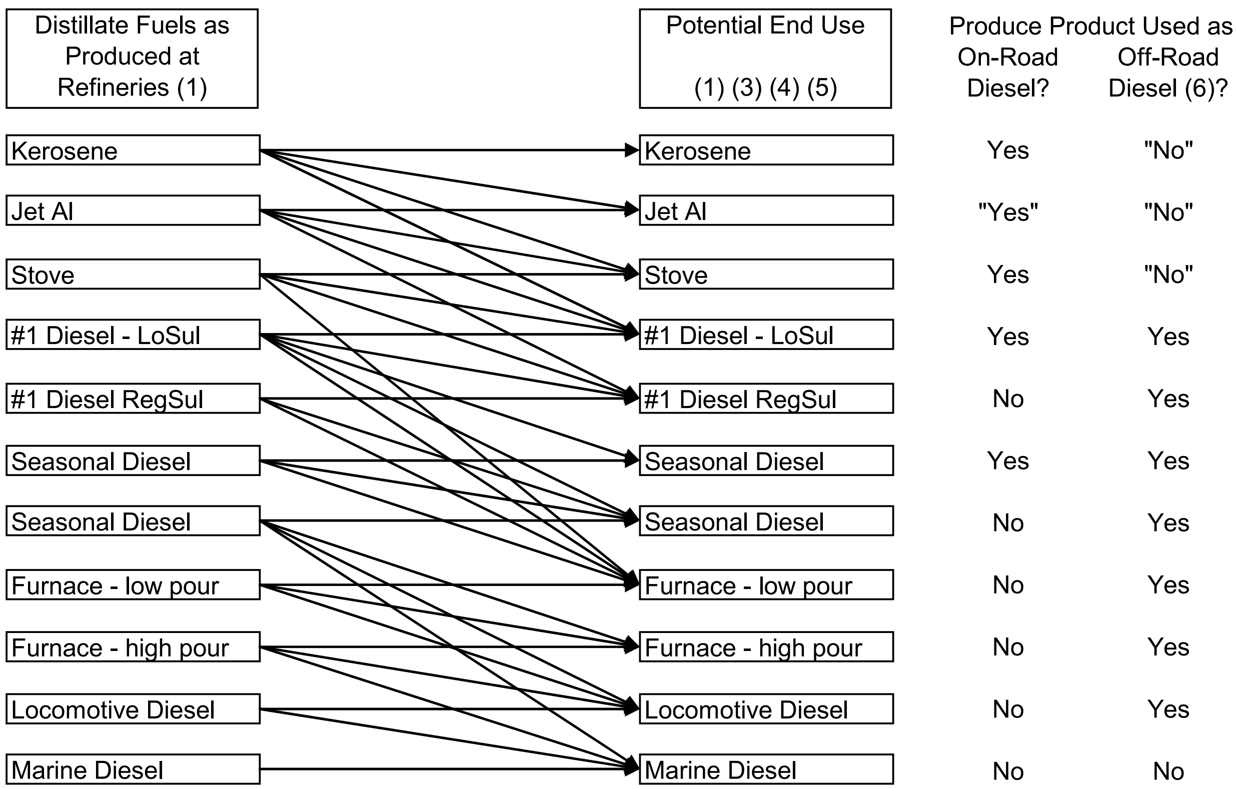
Figure 2.2 Canada's Marine Fuels Supply Chain



Beyond the complexity of the production path, the route fuels that end up in ships take is often equally convoluted. Fuel blenders and suppliers may purchase fuels from a number of sources, including importers, provided the fuels meet local and marine specifications. These fuels are stored in a single storage or collection tank, and the output either sold directly to marine users, used as a blendstock or both. When suppliers do the blending, the final product can be made from fuels sourced from various refineries in both Canada and the U.S.

Fuels termed and sold as marine fuels may have originally been produced for use in a completely different market, which underlines that marine fuels are not primary refinery products. Figure 2.3 shows the variety of primary refinery products that may be used or sold as marine diesel fuels (BMT Fleet Technology Limited 2005). In fact, some refineries do not produce a distinct marine diesel product, instead selling diesel batches that were refined for other markets but meet marine specifications.

Figure 2.3. Interchangeability of Diesel Fuels



Notes:
1. Where production quantities and product qualities are readily known
2. Incentive to "downgrade" is (typically) due to a supply/logistical constraint, disincentive is (typically) due to a resulting lower value product
3. Base on their cloud point and sulphur content, distillates can easily be interchanged by end-users
4. Terminals and Bulk Plants are all different in terms of (supply source options), tankage and blending capabilities, and ambient operating termperatures
5. Product exchanges between refiners and importers, plus ownership changes at sales transaction points, make routine tracking of production point to end-use a major administrative challenge
6. Off-road diesel is typically dyed - no road tax applies but excise tax does - at terminals but not at bulk plants: quotation marks mean unlikely but possible

Notes
1. Production quantities and product qualities are readily known.
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4. Terminals and bulk plants vary in terms of supply source options, tankage and blending capabilities, and ambient operating temperatures.
5. Product exchanges between refiners and importers, plus ownership changes at sales points, make routine tracking from production to end use a major administrative challenge.
6. Off-road diesel is typically dyed at terminals but not at bulk plants (no road tax applies to dyed fuels but excise tax does). Quotation marks around entries in this column indicate that dying is unlikely but possible.

2.3 Bunker Delivery Notes

Although the paths from crude oil to finished fuel oil product and refiner to ship can be convoluted, the final step—supplier to ship—is always the same. As discussed above, fuels sold as marine fuels are not necessarily refined for this purpose, so MARPOL Annex VI regulations require that suppliers accompany every delivery with a bunker delivery note, to ensure that the fuel supplied is of marine grade and quality. Companies that responded to the questionnaire for this project reported that, in Canada, bunker delivery notes are provided with every sale to international ships, to comply with the regulations. In contrast, domestic ships do not always require bunker delivery notes; however, they will receive one should they request it.

According to the regulations, a bunker delivery note must include at least the following:

- the name and IMO number of the receiving ship;
- the name of the port;
- the date of commencement of delivery;
- the name, address and telephone number of the marine fuels supplier;
- the name of the product(s);
- the quantity (in tonnes) of each product sold;
- the density at 15ºC (kg/m^3) of each product sold;
- the sulphur content (% m/m) of each product sold; and
- a declaration signed and certified by the supplier's representative that the fuel oil supplied conforms to the MARPOL Annex VI regulations.

In addition, the regulations require that the bunker delivery note be accompanied by a representative sample of the fuel oil being delivered.

3. MARINE FUELS BLENDING PRACTICES IN CANADA

Blending of various fuel products is a primary means of producing marine fuels. While marine diesel engines can burn very heavy fuels, many residual fuels need to be combined with at least a small amount of distillate to meet the requirements of the marine industry. For example, refineries have indicated that, depending on the grade of the fuel, the proportion of distillate used in the blend could be as high as 50%. Other important elements include the quality of the crude source and the capability of the individual refinery.

Marine fuels blending is not something that occurs at all refineries, and the process may differ from facility to facility, even within the same company. Whereas certain fuel suppliers do their own blending, others source their blended fuels from the refineries. Industry stakeholders reported that in western Canada blending is generally done at the refinery, while in Ontario it is more often done by the supplier. In the latter instance, fuel oils from various refiners, regions and even countries may be combined into the same storage tank. This practice may restrict the accuracy of any estimates of the actual sulphur content of fuels being burned in ships.

Table 3.1 contains a breakdown of the blended marine fuels supplied across the various regions of the country in 2006–2007. Product data that came from a single source in a particular region has been withheld to protect the confidential nature of that data. (See Appendix B for a sample confidentiality agreement.) Marine fuels blending practices in Canada for 2004 are set out in Table 3.2; the summary of 2006 and 2007 Canadian data are also included in this table for comparison.

Table 3.1. Marine Fuels Blending Practices in Canada, 2006–2007

	Atlantic 2006-2007			Quebec 2006-2007			Ontario 2006-2007		
	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)
<IFO180	**	**	**	12-50%	50-88%	0.8-2.09	15-50%	50-85%	1.2-2.69
IFO180 - IFO380	**	**	**	0-45%	55-100%	0.89-0.209	5-45%	55-95%	2-2.69
IFO380 - IFO640	n/a	n/a	n/a	n/a	n/a	n/a	0-7%	93-100%	1.7-2.66
>IFO640	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Western 2006-2007			Canada 2006-2007					
	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)			
<IFO180	**	**	**	12-50%	50-88%	0.507-2.69			
IFO180 - IFO380	**	**	**	0-45%	55-100%	0.507-2.69			
IFO380 - IFO640	n/a	n/a	n/a	0-7%	93-100%	1.7-2.66			
>IFO640	n/a	n/a	n/a	n/a	n/a	n/a			

**Information withheld to protect confidential data.

Table 3.2. Marine Fuels Blending Practices in Canada, 2004

	Atlantic 2004			Quebec 2004			Ontario 2004		
	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)
<IFO180	**	**	**	10-35%	65-90%	0.7-1.9	12-37%	63-88%	1.2-2.25
IFO180 - IFO380	5-21%	79-95%	1.2-4.9	0-12%	88-100%	0.9-1.9	5-13%	87-95%	1.2-2.4
IFO380 - IFO640	**	**	**	0-5%	95-100%	1.0-1.9	0-15%	85-100%	0.99-2.5
>IFO640	**	**	**	n/a	n/a	n/a	**	**	**
	Western 2004			Canada 2004			Canada 2006-2007		
	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)	Distillate	Residual	Sulphur (%w/w)
<IFO180	**	**	**	10-37%	63-90%	0.7-2.25	12-50%	50-88%	0.507-2.69
IFO180 - IFO380	5-12%	88-95%	1.2-1.9	0-21%	79-100%	0.9-2.4	0-45%	55-100%	0.507-2.69
IFO380 - IFO640	0-5%	95-100%	1.33-1.9	0-15%	85-100%	0.99-2.5	0-7%	93-100%	1.7-2.66
>IFO640	n/a	n/a	n/a				n/a	n/a	n/a

**Information withheld to protect confidential data.

The data in Table 3.1 show that although the distillate-to-residual ratios are comparable across the country, there is considerable variation in the level of sulphur in blended marine fuels. This can likely be attributed to the variations in crude oil qualities and in the processing capabilities of the various refineries. Both the Atlantic and Western Canada regions reported blending ratios with the distillate portion on the high end of the Canadian range.

It is noted that between 2004 and 2006–2007 the percentage of distillate fuel rose in IFO380 and lighter intermediate fuels, whereas the proportion of distillate is smaller in the heavier intermediate fuels. In addition, a wider range of sulphur content in blended fuels is observed for 2006–2007 than 2004. The smaller amounts of sulphur are most likely attributed to the higher percentage of distillates in some blends, while the higher concentrations of sulphur may be due to a combination of refining practices and the quality of crude available.

4. OVERVIEW OF MARINE FUELS SOLD IN CANADA

4.1 Sales of Marine Fuels in Canada

Canadian refineries, importers and marine fuel suppliers were consulted and requested to complete a questionnaire as part of this project (see Appendix A); any further consultation was conducted by phone and email. The questionnaire requested information on fuel sales and quality for 2006 and 2007. The resulting data were grouped for four regions across Canada; Atlantic Canada, Quebec, Ontario and Western Canada. When only one refinery or supplier in a region sold a particular product, that data point was excluded from the regional total in order to uphold confidentiality agreements (see Appendix B). Furthermore, the national totals for particular products have been withheld when omitted data could be determined from this information.

The availability of fuel grades by region and total volumes of marine fuel sales for 2006 and 2007 are set out in Table 4.1 and Table 4.2, below. An attempt was made to avoid double counting volumes, although due to the complex manner in which fuel is traded, combined with varying blending practices of suppliers and refiners across the regions, it was not always possible to trace fuel sources. In addition, due to the varying amount of detail in survey responses, the total volumes listed in the tables are best estimates.[4] Table 4.3 contains data from 2004 for comparison purposes.

Table 4.1. Volume (m^3) and Availability of Marine Fuels Sold in Canada, 2006

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	√	√	√	√	**334885**
DMB	X	X	X	√	**
Other marine distillates	√	√	X	√	**371349**
All Distillates	**231842**	**79480**	**97063**	***297849**	***706234**
<IFO180	√	√	√	√	***60572**
IFO180-IFO380	√	√	√	√	***1811430**
IFO380-IFO640	√	√	√	√	***60566**
>IFO640	X	X	X	X	**0**
All Residuals	**	**511982**	**173376**	**1247210**	***1932568**

√ - Available X - Unavailable

* Some values withheld from totals to protect confidential data.
** Information withheld to protect confidential data.

[4] Data were not obtained from all refiners and suppliers who service the Canadian marine fuels market. Data was provided with varying levels of detail and included some notes suggesting that the values were estimates.

Table 4.2. Volume (m^3) and Availability of Marine Fuels Sold in Canada, 2007

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	√	√	√	√	**667048**
DMB	X	X	X	√	**
Other marine distillates	√	√	√	√	**331244**
All Distillates	**256387**	**127755**	**83312**	***309395**	***776849**
<IFO180	√	√	√	√	**126351**
IFO180-IFO380	√	√	√	√	**2035793**
IFO380-IFO640	√	√	√	X	**47456**
>IFO640	X	X	X	X	**0**
All Residuals	**166557**	**564530**	**145009**	**1333504**	**2209600**

√ - Available X - Unavailable

* Some values withheld from totals to protect confidential data.
** Information withheld to protect confidential data.

Table 4.3. Volume (m^3) of Marine Fuels Sold in Canada, 2004

Fuel Grades	Atlantic	Quebec	Ontario	Western	Canada
DMA	201709	49100	86300	140790	477899
DMB	**	68500	38900	69619	**
Other marine distillates	192809	**	**	**	452293
<IFO180	**	9993	27000	**	43993
IFO180-IFO380	121610	346391	97000	541376	1106376
IFO380-IFO640	**	45100	109836	524634	**
>IFO640	**	0	**	0	91000

** Information withheld to protect confidential data.

The data in the tables show that the most notable change in the sales and availability of distillate fuels was a drop in both for DMB. In 2004, DMB was sold in all four regions; however, in 2006 and 2007, DMB was sold only in the Western Canada region. Although the actual reported volume sold has been withheld to preserve confidentiality, it was observed that the total volume of DMB sold in the Western Canada region in 2006 and 2007 was significantly lower than the volume sold in 2004. Since DMB is not a refined product, the sulphur level in DMB may be less controllable than that in other refined distillates, such as DMA. (See Section 1.6, above, for a description of DMB.) In addition, the ISO 8217:2005 standard allows higher sulphur content in DMB (1.5%) than in DMA (2%). As such, it could be postulated that the drop in DMB availability and sales is related to strict sulphur regulations in Canada: as of June 1, 2007, sulphur content in marine diesel fuels produced in or imported into Canada is limited to 0.05%.

In terms of residual fuels, the data obtained show that IFO640 and heavier fuels were not reported as being sold for marine purposes in Canada in 2006 or 2007.

4.2 Properties of Marine Fuels

Due to the varying levels of detail on the properties of marine fuels provided in the questionnaire responses, the data could not be summarized by region. However, Table 4.4 summarizes the national ranges of qualitative properties reported. (Sulphur content is discussed in Section 5.)

Table 4.4. Properties of Canadian Marine Fuels

		Boiling Point (°C)	Flash Point (°C)	Viscosity (cSt)	Density (kg/m^3)
Distillates		169-176	>60	1.4-6	819-880
Residuals	<IFO180	-	>61	30-180	892-998
	IFO180 to IFO380	-	>61	180-380	944-1008
	IFO380 to IFO640	-	>90	380-540	951-993

5. SULPHUR CONTENT IN MARINE FUELS

5.1 Sulphur Content in Marine Fuels Sold in Canada

The sulphur content in marine fuels sold in Canada in 2006 and 2007, as reported by industry representatives, was analyzed and amalgamated in a volume-weighted average format. As with the data in Section 4, the data presented here are estimates. The volume-weighted averages were calculated using the estimated volumes reported in the survey responses, and the average and maximum sulphur levels in fuels reported in the survey responses and during the follow-up consultations with stakeholders. As such, the values presented here should be considered to be conservative estimates of the average reported sulphur levels. Data for 2006 and 2007 are set out in Table 5.1 and Table 5.2, respectively. The national averages for 2006 and 2007 are compared with those from 2004 in Table 5.3. Some national sulphur content values are presented, even when the associated national volume was omitted (see Section 4). Due to the volume-weighted average analysis, the omitted volumes and sulphur data cannot be recreated and thus retraced to the source.

Table 5.1. Volume-Weighted Average Sulphur Content, 2006

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	**	0.097	0.212	0.213	**0.171**
DMB	n/a	n/a	n/a	**	******
Other marine distillates	0.098	0.057	n/a	0.048	**0.069**
All Distillates	**0.112**	**0.094**	**0.212**	**0.100**	**0.118**
<IFO180	**	1.255	1.815	1.552	**1.352**
IFO180-IFO380	**	1.419	2.239	1.792	**1.676**
IFO380-IFO640	**	1.560	2.259	1.891	**2.171**
>IFO640	n/a	n/a	n/a	n/a	**n/a**
All Residuals	******	**1.410**	**2.189**	**1.791**	**1.678**

** Information withheld to protect confidential data.

Table 5.2. Volume-Weighted Average Sulphur Content, 2007

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	0.076	0.005	0.107	0.111	**0.083**
DMB	n/a	n/a	n/a	**	******
Other marine distillates	0.095	0.002	0.230	0.049	**0.061**
All Distillates	**0.086**	**0.005**	**0.107**	**0.067**	**0.067**
<IFO180	**	1.473	1.694	**	**1.459**
IFO180-IFO380	**	1.233	2.197	1.809	**1.619**
IFO380-IFO640	**	**	2.243	n/a	**2.228**
>IFO640	n/a	n/a	n/a	n/a	**n/a**
All Residuals	******	**1.244**	**2.135**	**1.801**	**1.605**

** Information withheld to protect confidential data.

Table 5.3. National Volume-Weighted Average Sulphur Content, 2004, 2006 and 2007

Fuel Grades	2004 Canada	2006 Canada	2007 Canada
DMA	0.207	0.171	0.083
DMB	0.144	**	**
Other marine distillates	0.224	0.069	0.061
All Distillates	**0.201**	**0.118**	**0.067**
<IFO180	1.763	1.352	1.459
IFO180-IFO380	1.819	1.676	1.619
IFO380-IFO640	1.672	2.171	2.228
>IFO640	1.806	n/a	n/a
All Residuals	**1.760**	**1.678**	**1.605**

** Information withheld to protect confidential data.

The data in Table 5.3 show that overall volume-weighted average sulphur content for both distillates and residuals in Canada has decreased since 2004. Figures 5.1 and 5.2 further illustrate this.

Figure 5.1. Sulphur Levels in Canadian Marine Distillates, 2004–2007

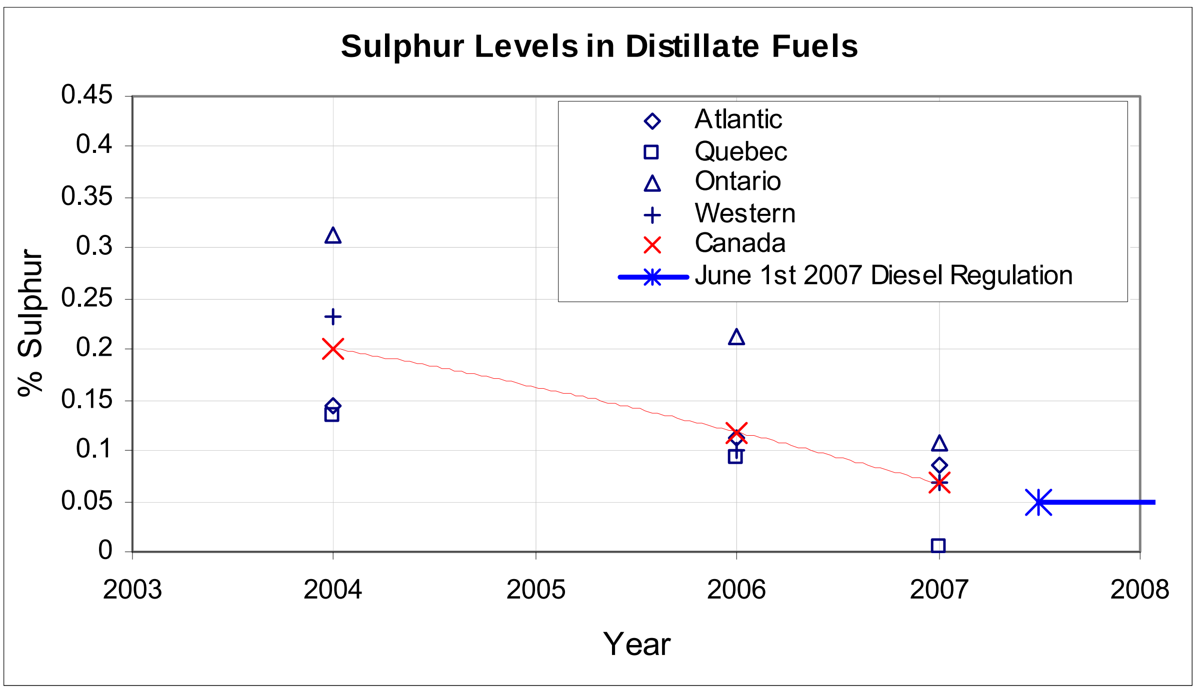


Figure 5.1 shows the average sulphur content in distillate fuels in each region and the national averages for 2004, 2006 and 2007. It can be seen that the sulphur content in distillate fuels across Canada has been decreasing, with the Ontario and Western Canada regions exhibiting the most significant reductions. Ontario has consistently had the highest levels of sulphur in marine distillates and the most significant decrease in sulphur content over the analyzed period. The Quebec and Atlantic Canada regions had comparable sulphur levels in 2004 and 2006; however, a large drop in sulphur content, to well below the limit of 0.05% that came into effect on June 1, 2007 (bold blue line in Figure 5.1), occurred in Quebec in 2007. It should also be noted that some regions showed values over this limit in 2007, as did Canada as a whole. This is due to the volume-weighted average approach to accounting for sulphur content in fuels produced and imported in the first half of 2007, as well as the likely overly conservative reporting of sulphur levels resulting from the varying level of detail within the survey responses.

Figure 5.2. Sulphur Levels in Canadian Marine Residuals, 2004–2007

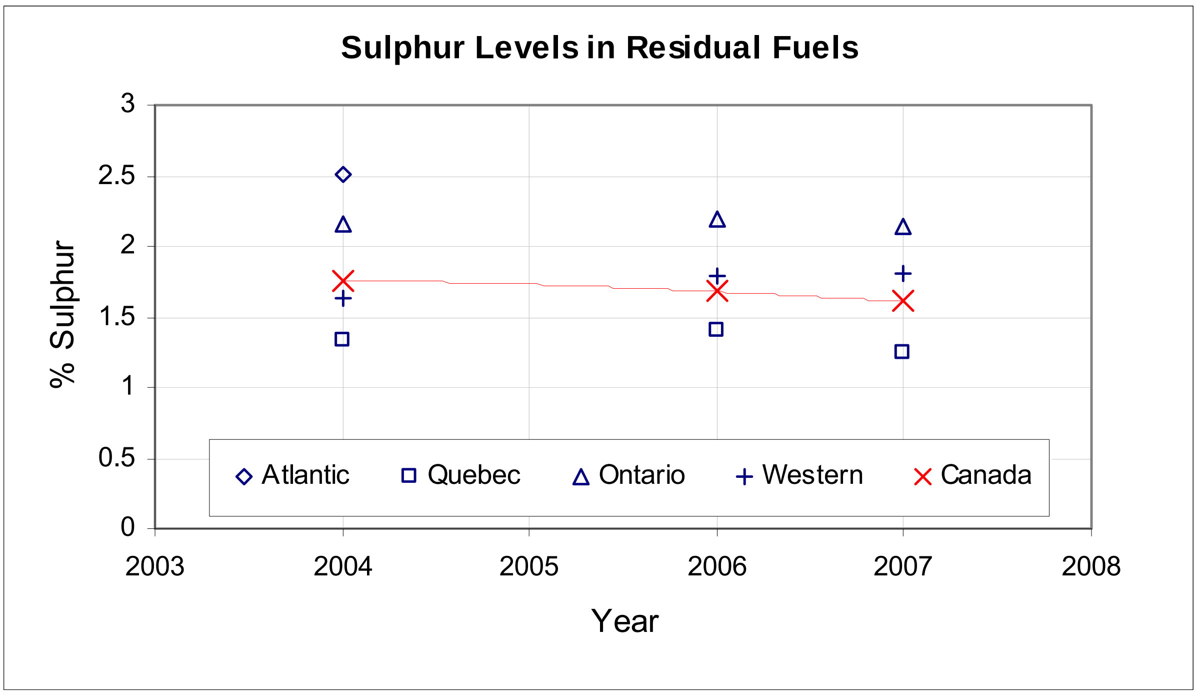


Figure 5.2 shows the average sulphur content in residual fuels in each region and the national averages for 2004, 2006 and 2007. It can be seen that the sulphur levels have been decreasing across Canada, with the exception of in the Western Canada region. The sulphur levels in residual fuels sold in Canada during 2004, 2006 and 2007 were well below the global limit of 4.5% for marine fuels. Note, however, as stated above, that these values are estimates.

5.2 Sulphur Content in Marine Fuels Sold Internationally

This section sets out the sulphur content in marine residual fuels and marine distillate fuels for various regions around the world from 2004 to 2007. The main bunkering ports that make up the geographical regions are listed in Appendix C. The data used to compile this section were sourced from DNV (2005, 2006 and 2007) and the *Evaluation of Low Sulfur Marine Fuel Availability—Pacific Rim* (2004 data) (Starcrest Consulting Group 2005).[5] It will be seen that there are no data for many geographical regions for 2004 and that the presented averages were also calculated using fewer sample ports than were those for the other years. Consequently, the 2004 data is simply compared by region, while trends in sulphur content for 2005 through 2007 are discussed more thoroughly. The information presented in this section is for fuels *sold* in specific geographical regions and does not necessarily reflect data on the fuels *burned* in those same regions.

Canadian ports are part of three geographical regions: Western North America, Eastern North America and Great Lakes. Figure 5.3 shows these regions, along with the two Sulphur Emission Control Areas (SECAs)—North Sea (including Amsterdam-Rotterdam-Antwerp (ARA)) and Baltic— that came into effect in 2007 and 2006, respectively. These regions are used as benchmarks for comparison throughout the remainder of this section. Note that the three North American regions shown in the figure are not contiguous with the Atlantic, Western Canada, Ontario and Quebec regions discussed in Section 5.1. The average sulphur contents presented here include those for fuels sold in ports in Canada and the United States; thus, in some regions small discrepancies may exist between the data in this section and those in Section 5.1.

[5] The data in this study was also sourced from DNV; however, the overall sample set is different from that of the 2005, 2006 and 2007 data.

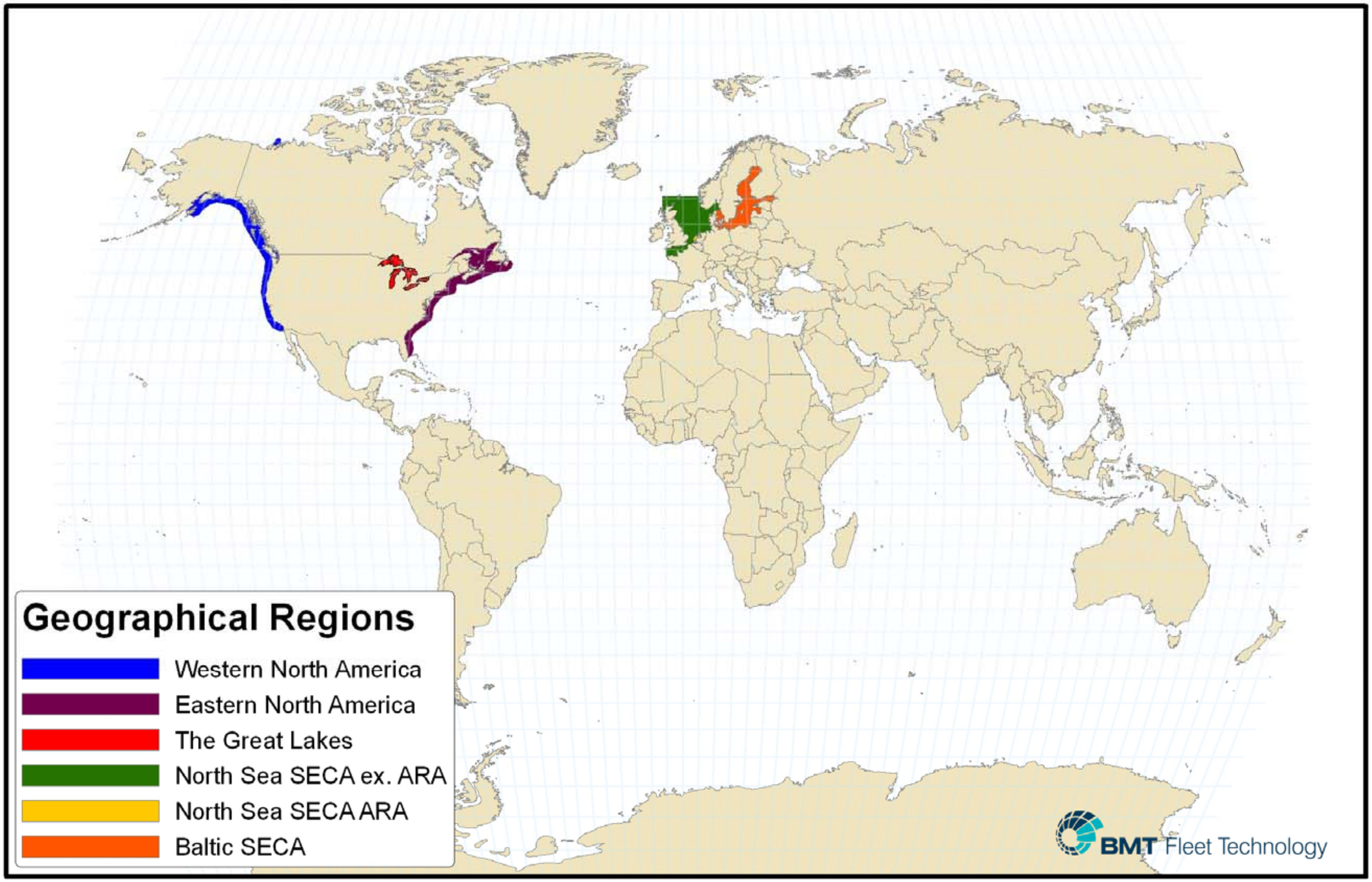


Figure 5.3. Geographical Regions

5.2.1 Sulphur Levels in Distillate Fuels Sold Internationally

Sulphur levels in marine distillate fuels sold in a number of regions around the world are presented in Figures 5.4 through 5.7 for 2004, 2005, 2006 and 2007, respectively. It will be seen that all marine distillate fuels sampled over these years met not only the current global sulphur emission limit of 4.5% but also the current SECA limit of 1.5%; thus, compliance with these limits are not discussed in further detail.

The data on sulphur content in distillate fuels for 2004 (Figure 5.4) indicate that the regions in Central America were the only ones producing fuels falling within the lowest sulphur content bracket (0–0.21%). All other regions, except Antwerp-Rotterdam-Amsterdam (ARA) at 0.42–0.63%, had sulphur content in their marine distillate fuels of 0.21–0.42%.

As detailed in Figure 5.5, the Western North America and Great Lakes regions both had distillate supplies with sulphur content in the lowest range in 2005 (0–0.21%). The figure for Eastern North America was slightly higher, at an average of 0.21–0.42%. Distillate supplies in the North Atlantic and West Coast of South America regions also had low sulphur concentrations, in the 0–0.21% range. The highest sulphur concentrations recorded in 2005—0.63–0.84%—were for distillates from the East Asia, the Middle East, South Africa and United States Gulf regions.

Review of Figure 5.6 indicates that in 2006, the Western North America and Great Lakes regions both had distillate fuel sulphur content in the lowest range (0–0.21%). The figure for Eastern North America was slightly higher, at an average of 0.21–0.42%. Distillate supplies in the North Atlantic and West Coast of South America regions also had low sulphur concentrations, 0–0.21%. The highest sulphur concentration was 0.84–1.05%, observed only in South Africa. The next highest was in distillates from the Middle East and United States Gulf regions: 0.63–0.84%.

The data presented in Figure 5.7 indicate that the Western North America and Great Lakes regions both had sulphur content in distillates in the lowest range in 2007 (0–0.21%). The figure for Eastern North America was slightly higher, at an average of 0.21–0.42%. In June 2007, the regulation limiting sulphur content in marine diesel fuels refined in or imported into Canada to 0.5% came into effect, and fuels from all North American regions comply with it. The North Atlantic and Oceania regions also had low sulphur concentrations in their distillates, in the range of 0–0.21%. The highest sulphur level was 0.84–1.05%, which was found for distillates from South Africa; all other regions had sulphur concentrations in their distillates of 0.42–0.63% or lower in 2007.

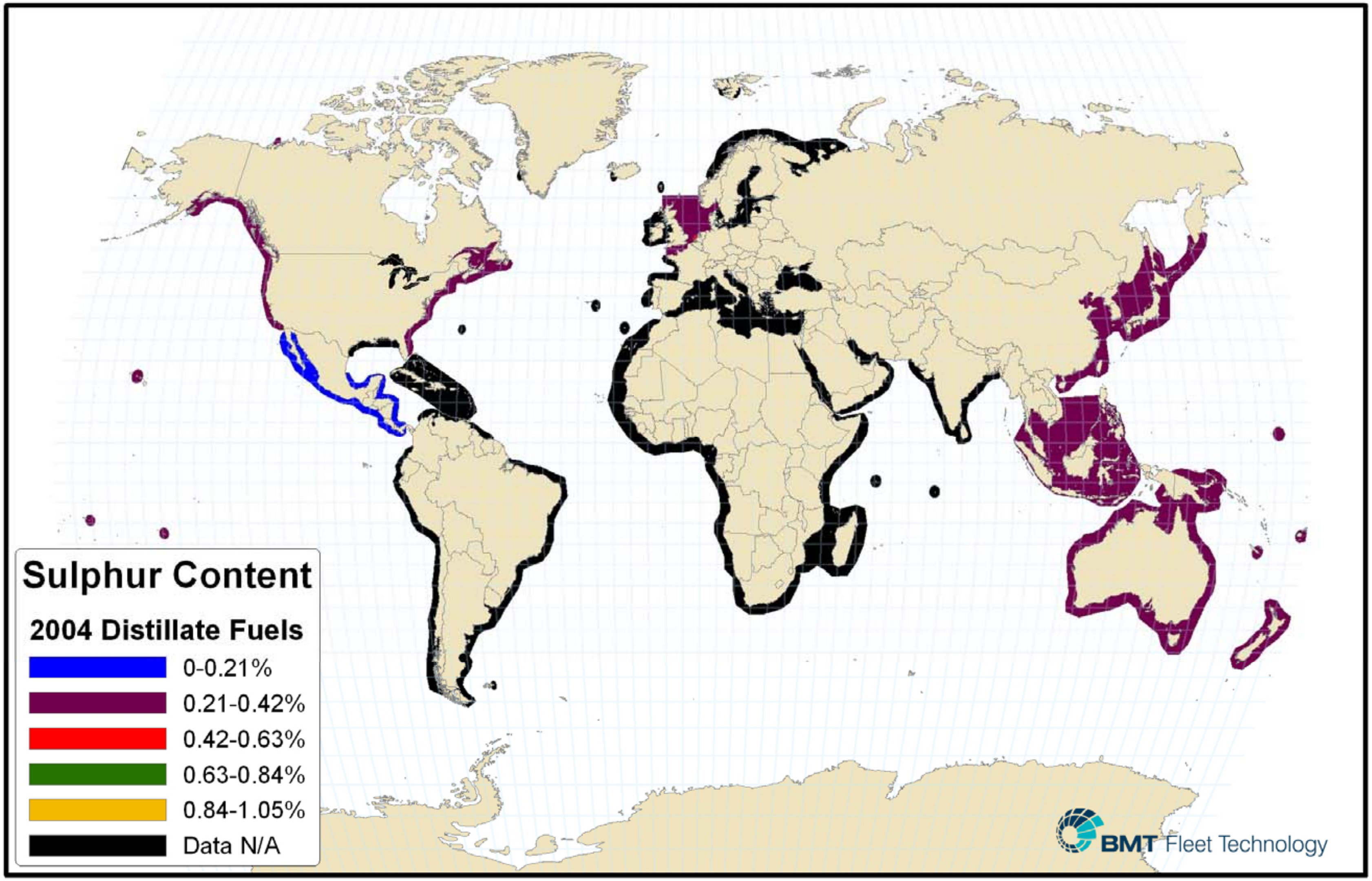


Figure 5.4. Global Sulphur Content in Distillate Fuels, 2004

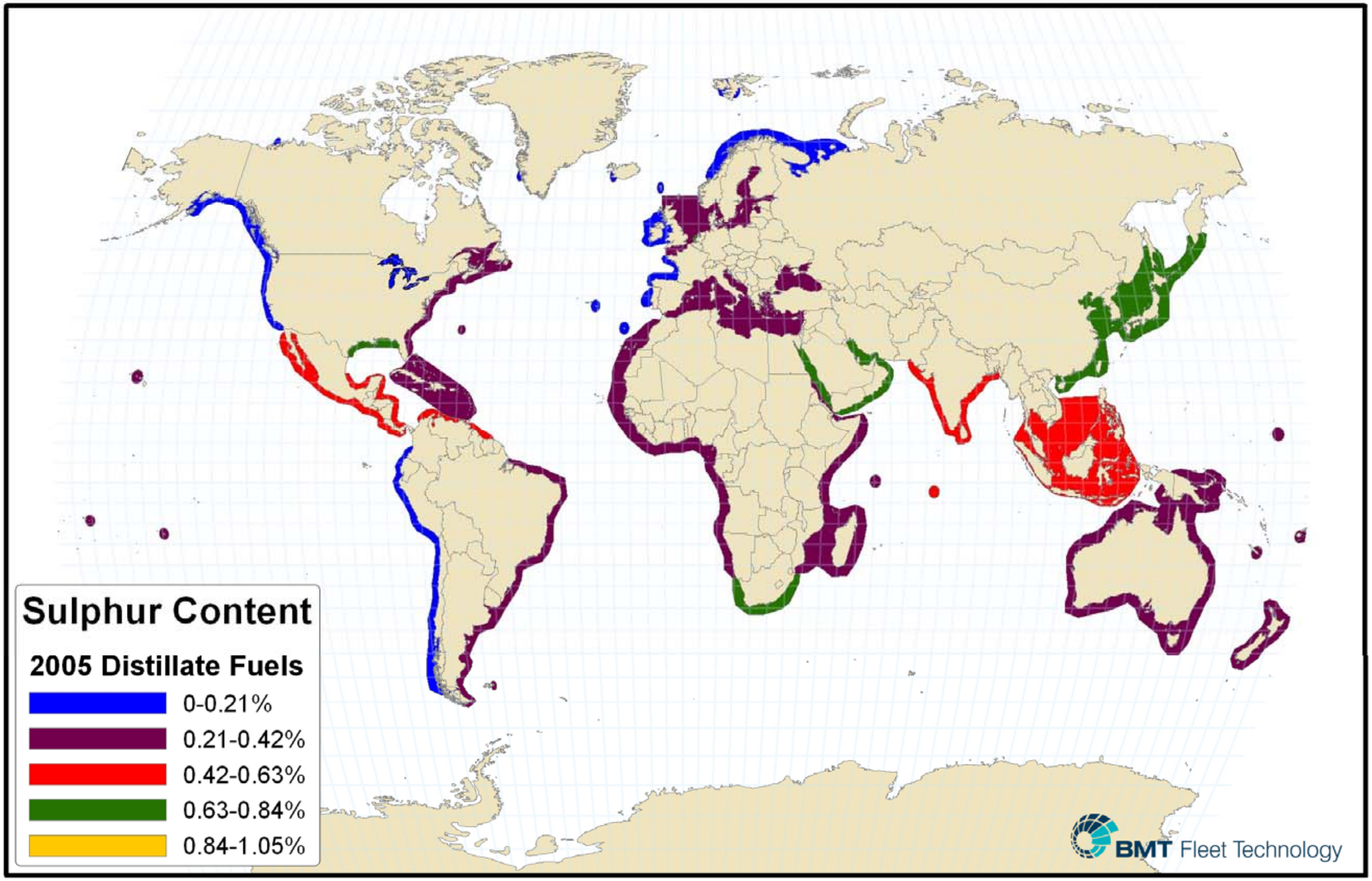


Figure 5.5. Global Sulphur Content in Distillate Fuels, 2005

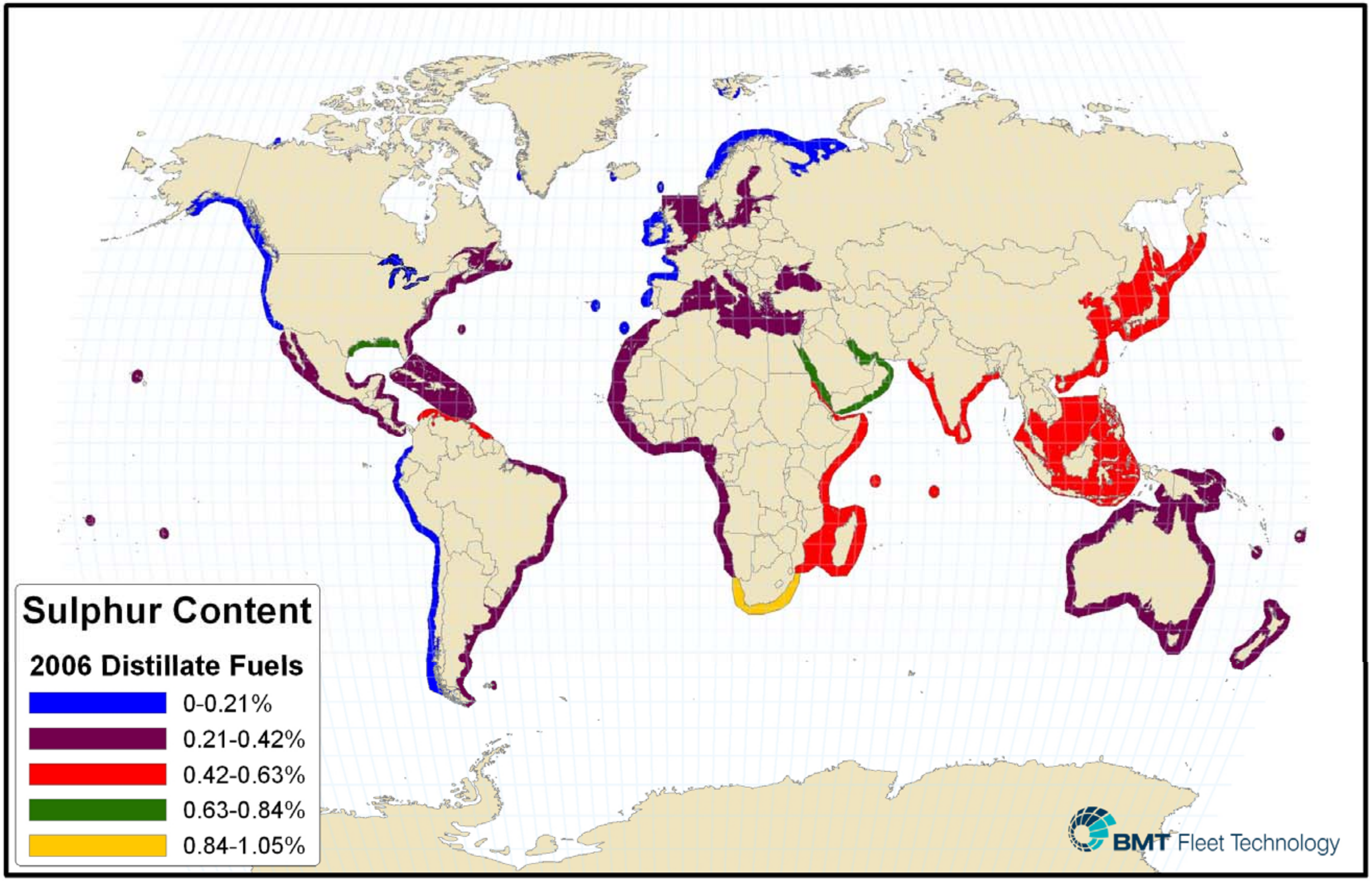


Figure 5.6. Global Sulphur Content in Distillate Fuels, 2006

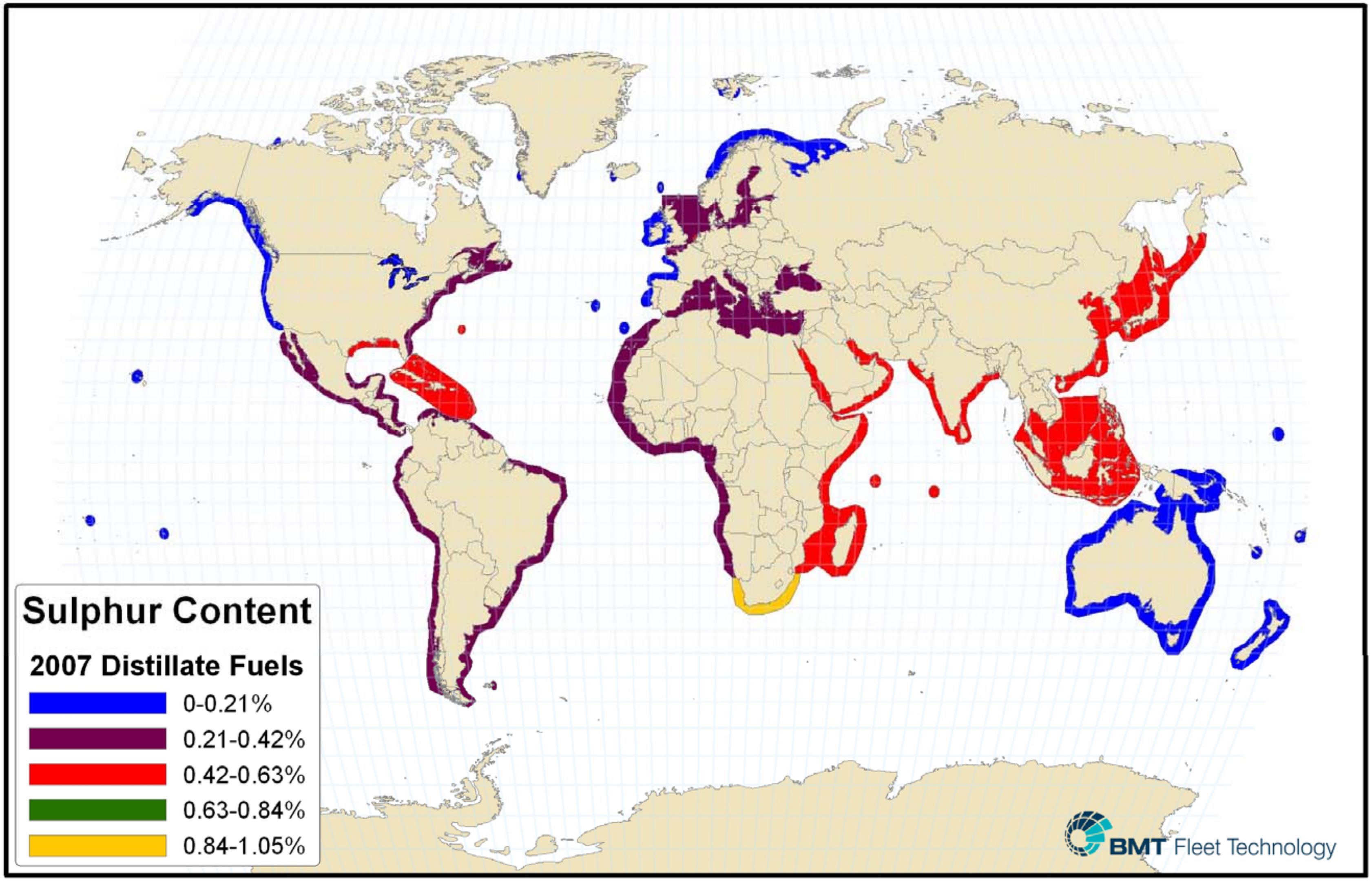


Figure 5.7. Global Sulphur Content in Distillate Fuels, 2007

5.2.2 Global Trends in Sulphur Content in Marine Distillate Fuels

From 2005 to 2007, the sulphur content in distillate fuels from the three Canadian regions was constant. The distillates from two regions, Western North America and Great Lakes, were in the lowest sulphur-content bracket (0–0.21%); fuel from the third region, Eastern North America, was in the second lowest bracket (0.21–0.42%). Distillates from the United States Gulf had considerably higher sulphur content of 0.63–0.84% in 2005 and 2006, and a slightly lower concentration, 0.42–0.63%, in 2007.

Central America also decreased the sulphur levels in its marine distillate fuels: the 2005 average of 0.42–0.63% dropped to 0.21–0.42% in 2006 and 2007. The opposite was observed in the Caribbean region: the 2005 and 2006 average of 0.21–0.42% increased in 2007 to 0.42–0.63%.

The distillates from the East Coast of South America had a constant sulphur content of 0.21–0.42% over the three years, whereas the sulphur content in the fuels from the West Coast of South America increased from 0–0.21% in 2005 and 2006 to 0.21–0.42% in 2007. The fuels from the Northern South American region showed a decrease in sulphur content from the 0.42–0.63% range in 2005 and 2006 to 0.21–0.42% in 2007.

All of the European regions held constant distillate fuel sulphur levels over the three-year period. With the exception of the North Atlantic regions (0–0.21%) and the ARA region (0.42–0.63%), distillates from the remainder of the European regions had sulphur levels of between 0.21% and 0.42%.

The West Coast of Africa region had constant distillate fuel sulphur content of 0.21–0.42%; however, both the South Africa and East Coast of Africa regions had increased sulphur content in marine distillate fuels from 2005 to 2007. South Africa increased levels from 0.63–0.84% in 2005 to the highest sulphur content bracket, 0.84–1.05%, in 2006 and 2007. In fact, over the entire three-year period, South Africa was the only region in which the average sulphur content of distillates was in the highest bracket. Fuels from the East Coast of Africa had an average sulphur content of 0.21–0.42% in 2005, which increased to 0.42–0.63% in 2006 and 2007.

The sulphur content in distillate fuels from India and South Asia remained constant at the mid-range of 0.42–0.63% over the three-year period from 2005 to 2007. The Middle East and East Asia regions both decreased sulphur levels from 0.63–0.84% to 0.42–0.63%, the Middle East in 2007, and East Asia in 2006. The Oceania region also saw a decrease in sulphur levels, going from 0.21–0.42% in 2005 and 2006 to 0–0.21% in 2007.

Although the sulphur content of marine distillate in North American regions did not decrease from 2005 to 2007, it was among the lowest globally.

5.2.3 International Sulphur Levels in Residual Fuels

Sulphur levels in marine residual fuels for a number of geographical regions worldwide can be seen in Figures 5.8 through 5.11 for 2004, 2005, 2006 and 2007, respectively.

Figure 5.8 shows that the North American regions and the Oceania region had the lowest residual fuel sulphur content in 2004 (1.5–2%). The North Sea SECA (which was not a SECA in 2004), along with East Asia, had the highest recorded sulphur content for residual fuels in this period (2.5–3%).

In May 2005, MARPOL Annex VI came into effect, limiting the sulphur content in all marine fuels to 4.5% (alternatively, abatement technologies may be used to limit sulphur content in emissions). From 2004 to 2007, the highest sulphur content bracket was 3–3.5%, well below the 4.5% limit, thus all fuels sold globally appear to comply with MARPOL Annex VI.

As shown in Figure 5.9, Great Lakes residual fuels had lower sulphur content (1.5–2%) in 2005 than did those from the other two North American regions that include Canadian ports (2–2.5%). The sulphur level in marine residual fuels sold along the North American East Coast and West Coast was mid-range in terms of sulphur content compared to the worldwide figures.

Fuels from the East Coast and West Coast of South America regions both had sulphur concentrations in the lowest range (1–1.5%). The highest sulphur concentration was 3–3.5%, which was observed in various regions, including the United States Gulf, South Africa, Middle East, India and Asia.

In May 2006, the Baltic SECA came into being, with sulphur fuel content limited to a maximum of 1.5%. As Figure 5.10 shows, the average sulphur content in residual fuels sold in this region was 1.5–2% in 2006, which is slightly higher than the allowable limit.

The Great Lakes residual fuels had lower sulphur content (1.5–2%) in 2006 than did fuels from the other two North American regions that include Canadian ports (2–2.5%). The sulphur level in marine residual fuels sold along both the North American East Coast and West Coast was mid-range in terms of sulphur content compared to the worldwide figures.

Fuels from the East Coast and West Coast of South America regions both had the sulphur concentrations in the lowest range in 2006 (1–1.5%). The highest sulphur concentration was 3–3.5%, which was found in fuels from various regions, including the United States Gulf, South Africa, Middle East, India and Asia.

In November 2007, the North Sea SECA came into being, with sulphur emissions limited to a maximum of 1.5%. Figure 5.11 shows the average sulphur content in residual fuels sold in this region and the Baltic SECA was 1.5–2%, which is slightly higher than the allowable limit.

Residual fuels from the Great Lakes region had lower sulphur content (1.5–2%) in 2007 than did fuels from the two North American regions that include Canadian ports (2–2.5%). The sulphur level in marine residual fuels sold along the North American East Cost and West Coast was mid-range in term of sulphur content compared to the worldwide figures.

Fuels from all of the South American regions had the lowest sulphur concentrations in 2007 (1–1.5%). The highest sulphur concentration was 3–3.5%, which was observed in fuels from various regions, including the United States Gulf, Middle East and East Asia

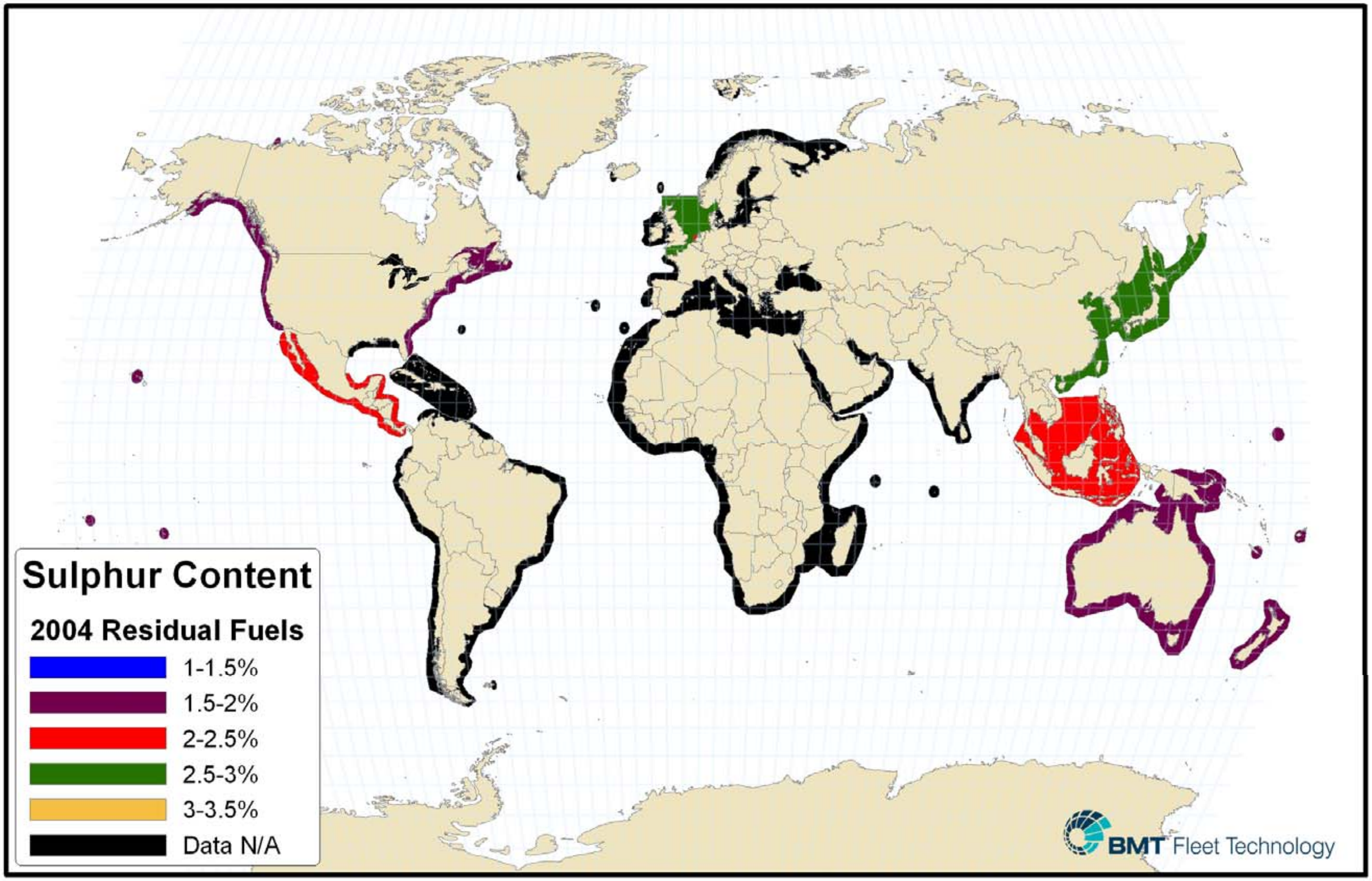


Figure 5.8. Global Sulphur Content in Residual Fuels, 2004

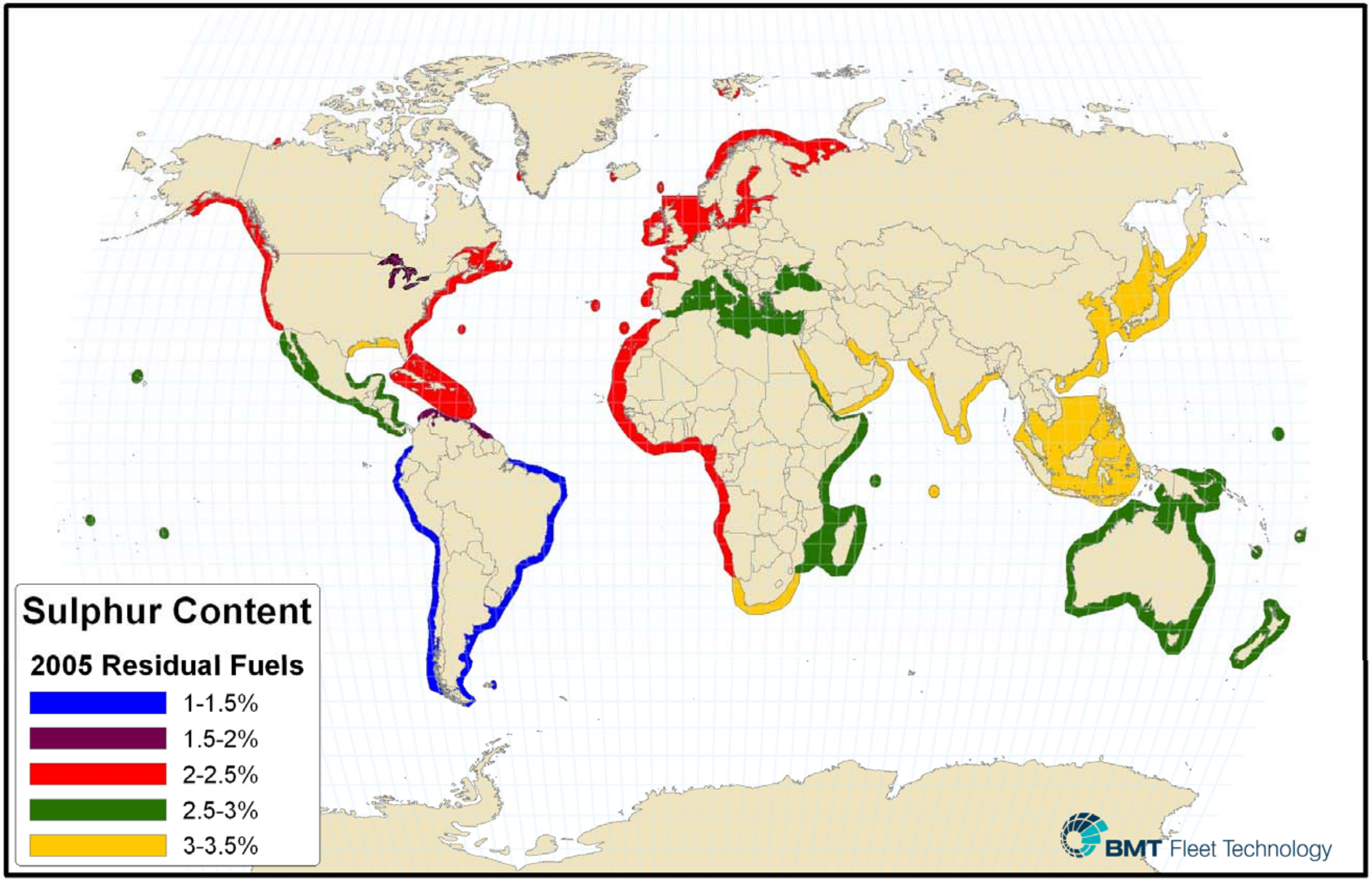


Figure 5.9. Global Sulphur Content in Residual Fuels, 2005

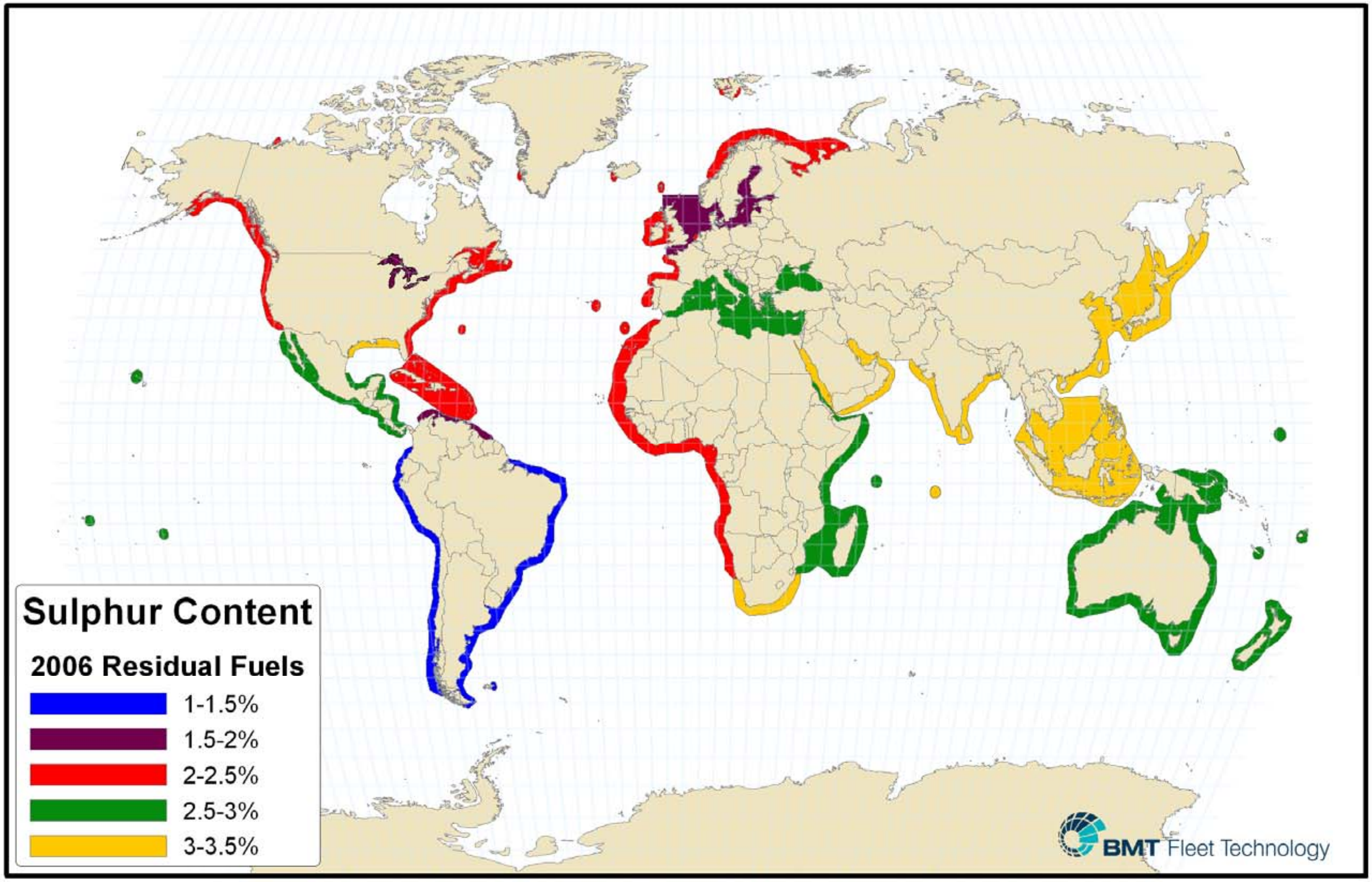


Figure 5.10. Global Sulphur Content in Residual Fuels, 2006

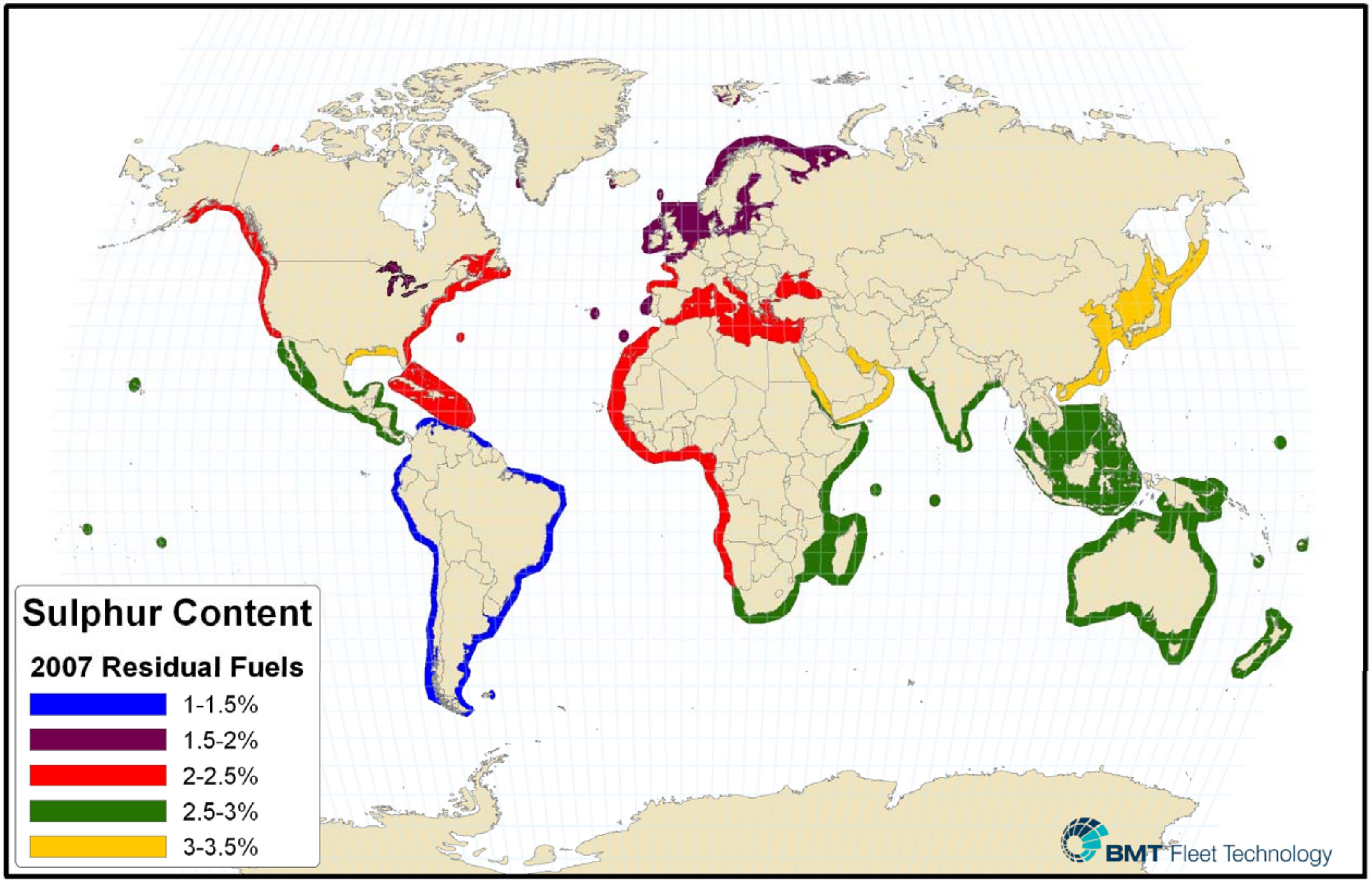


Figure 5.11. Global Sulphur Content in Residual Fuels, 2007

5.2.4 Global Trends in Sulphur Content in Marine Residual Fuels

From 2005 to 2007, residual fuels from the Great Lakes region had lower sulphur content (1.5–2%) than fuels from the other two North American regions that include Canadian ports (2–2.5%).

All regions in Europe, with the exception of Biscay (western France and northern Spain), showed drops in sulphur content in marine residual fuels between 2005 and 2007. By 2007, all regions in Europe had marine residual fuels with an average sulphur content in the range of either 1.5–2% or 2–2.5%.

There were no regions in North America, Central America or the Caribbean in which sulphur levels in marine residual fuels changed from 2005 to 2007.

The lowest sulphur content in residual fuels was found in South America. The highest was 1.5–2% in Northern South America, but by 2007 all of South America offered residual fuels with a sulphur content of 1–1.5%.

The West Coast of Africa region had fuels with sulphur content consistently in the mid-range (2–2.5%); the figures for the East Coast of Africa were also constant but slightly higher (2.5–3%). South Africa had the highest sulphur content in residual fuels (3–3.5%) in 2005 and 2006, but the level dropped to the 2.5–3% range in 2007.

The Middle East and East Asia regions both had high and constant sulphur levels of 3-3.5%. The sulphur content of fuels in the Oceania region also remained constant and fairly high (2.5–3%). Both the India region and the South Asia region registered a decrease from 3–3.5% sulphur content in residual fuels in 2005 and 2006 to 2.5–3% in 2007.

The Great Lakes region had constant sulphur content in the second lowest range (1.5–2%); the SECA region, and North Atlantic and Northern South America regions were the only others that achieved the same level. Only South American regions had residual fuels with the lowest sulphur content (1–1.5%). The two coastal Canadian regions fared only mid-range (2–2.5%) on the global scale.

5.2.5 Canada's Position Compared to Regions Around the World

When comparing sulphur content in both marine distillate fuels and marine residual fuels, South America is a leader in low-sulphur fuels, consistently offering fuels in the two lowest ranges of sulphur content, with the exception of two years mid-range in Northern South America. South America has the only regions that meet the SECA limit for sulphur in residual fuels.

The Canadian regions are leaders in terms of low-sulphur distillate fuels, with all regions offering fuels in the two lowest ranges of sulphur content. However, the sulphur levels in residual fuels were only mid-range in the two coastal regions of North America, and the second lowest in the Great Lakes region.

The European regions remain consistent (and comparable to Canada) in terms of sulphur content in distillate fuels; however, sulphur content in residual fuels from all European regions (with the exception of Biscay) was lower than in fuels from Canada.

6. AVAILABILITY OF MARINE FUELS IN CANADA

6.1 Availability of Fuel Grades by Region

The actual volume of fuel in the supply chain does not, at present, indicate a bottleneck or limit of access for the marine market; however, logistical issues associated with distribution and storage capacity, which constrain the ability to supply fuel, could cause short-term availability problems if demand were to change. Assessing current and historical diesel fuel and heavy fuel oil sales in Canada indicates that only a fraction is sold into the marine market. In 2005, the marine industry accounted for only about 5% of the total transportation energy use of refined petroleum products and only about 3.5% of the total energy use of refined petroleum products in Canada (Statistics Canada 2005, Table 2-1). Table 6.1 and Table 6.2 reiterate the total volumes of marine fuel sold and availability by region in 2006 and 2007 (from Section 4). A comparison of the volumes of fuel sold in Canada in 2006 and 2007 show that residuals, specifically IFO180–IFO 380, were the most popular products and that while DMB was available only in Western Canada, IFO380–IFO640 were available in all regions but Western Canada.

Table 6.1. Volumes (m^3) of Marine Fuel Sold in Canada

Fuel Grades	Canada 2004	Canada 2006	Canada 2007
DMA	477899	334885	667048
DMB	**	**	**
Other marine distillates	**452293**	**371349**	**331244**
All Distillates		*706234	*776849
<IFO180	43993	*60572	126351
IFO180-IFO380	1106376	*1811430	2035793
IFO380-IFO640	**	*60566	47456
>IFO640	91000	0	0
All Residuals		***1932568**	**2209600**

* Some values withheld from totals to protect confidential data.
** Information withheld to protect confidential data.

Table 6.2. Availability of Marine Fuel by Region

Fuel Grades	Atlantic 2006	Quebec 2006	Ontario 2006	Western 2006
DMA	√	√	√	√
DMB	X	X	X	√
Other marine distillates	√	√	X	√
<IFO180	√	√	√	√
IFO180-IFO380	√	√	√	√
IFO380-IFO640	√	√	√	√
>IFO640	X	X	X	X
Fuel Grades	**Atlantic 2007**	**Quebec 2007**	**Ontario 2007**	**Western 2007**
DMA	√	√	√	√
DMB	X	X	X	√
Other marine distillates	√	√	√	√
<IFO180	√	√	√	√
IFO180-IFO380	√	√	√	√
IFO380-IFO640	√	√	√	X
>IFO640	X	X	X	X

√ - Available X - Unavailable

The Canadian marine fuel market is supplied primarily by Canada and secondarily by the U.S. In western Canada, marine distillate fuels sold are generally refined in Canada, with many IFOs sourced from the U.S. In Ontario, distillates and residual fuels may both be sourced from either country, depending on availability. The complex trade patterns of fuel (crude, refined, partially refined, blended and unblended) between Canada and the U.S. are reason for supply and demand in one country to have a direct impact on them in the other. Since regulations affect the quality and types of fuel in demand, the regulations on marine fuels in the U.S. have a direct impact on the availability of marine fuels in Canada.

In many refineries, marine fuels are not refined products but simply by-products; thus, investments are not made to respond to market demands. The fuels available to supply the marine market are highly dependant on other markets. The heavier residual fuels are used in power generation, heating, and industrial steam and asphalt production. Diesel is used in many industries other than marine; in fact, the marine industry accounts for only a small portion of the diesel demand in Canada. Prime users of diesel are the trucking and rail industries; diesel is also used as furnace fuel. Increased demand in any of the above sectors could cause temporary shortages in the marine fuels market.

6.2 Availability of Low-Sulphur Fuels

For all grades, the demand for fuels can be strongly influenced by price and specifications. Specifications are part of regulations, and significant changes to specifications can delay the ability to respond to market demand. A reduction in the availability of low-sulphur crude also negatively affects refineries' capacity to produce low-sulphur fuels.

The proposed IMO requirements for low-sulphur fuels (see Section 8) could ultimately restrict the use of residual fuel (without the use of sulphur abatement technologies). This, in turn, may cause shortages of distillate fuels over the next 12–15 years, as refiners in Canada and worldwide attempt to meet the market demand while maintaining the specifications associated with new regulations. A concern that survey respondents noted was that stricter sulphur regulations, or essentially a switch to distillates, could result in shortages in distillate fuel from Canadian refiners. A lack of fuels may put independent resellers at a disadvantage, adversely affecting their ability to compete.

The sulphur content tables in Section 5.1 have been reproduced below to show the availability of low-sulphur fuels in Canada. As seen in Tables 6.3, 6.4 and 6.5, all distillate fuels had sulphur content of less than 1.5% in 2004, 2006 and 2007. Average sulphur content of less than 0.05% is highlighted in yellow to indicate those fuels that complied with the Canadian regulation on sulphur content in marine diesels that came into effect on June 1, 2007. In a similar fashion, all residual fuels with an average sulphur content of less than 1.5% are highlighted in green.

Table 6.3. Availability of Low-Sulphur Fuels, 2004

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	0.125	0.226	0.489	0.145	**0.207**
DMB	**	0.054	0.226	0.211	**0.144**
Other marine distillates	0.172	**	**	**	**0.224**
All Distillates	**0.144**	**0.134**	**0.313**	**0.233**	**0.201**
<IFO180	**	1.468	1.974	**	**1.763**
IFO180-IFO380	3.632	1.306	2.23	1.666	**1.819**
IFO380-IFO640	**	1.492	2.313	1.587	**1.672**
>IFO640	**	n/a	**	n/a	**1.806**
All Residuals	**2.505**	**1.331**	**2.162**	**1.627**	**1.76**

** Information withheld to protect confidential data.

Table 6.4. Availability of Low-Sulphur Fuel, 2006

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	**	0.097	0.212	0.213	**0.171**
DMB	n/a	n/a	n/a	**	**
Other marine distillates	0.098	0.057	n/a	0.048	**0.069**
All Distillates	**0.112**	**0.094**	**0.212**	**0.100**	**0.118**
<IFO180	**	1.255	1.815	1.552	**1.352**
IFO180-IFO380	**	1.419	2.239	1.792	**1.676**
IFO380-IFO640	**	1.560	2.259	1.891	**2.171**
>IFO640	n/a	n/a	n/a	n/a	**n/a**
All Residuals	**	**1.410**	**2.189**	**1.791**	**1.678**

** Information withheld to protect confidential data.

Table 6.5. Availability of Low-Sulphur Fuel, 2007

Fuel Grades	Atlantic	Quebec	Ontario	Western	**Canada**
DMA	0.076	0.005	0.107	0.111	**0.083**
DMB	n/a	n/a	n/a	**	**
Other marine distillates	0.095	0.002	0.230	0.049	**0.061**
All Distillates	**0.086**	**0.005**	**0.107**	**0.067**	**0.067**
<IFO180	**	1.473	1.694	**	**1.459**
IFO180-IFO380	**	1.233	2.197	1.809	**1.619**
IFO380-IFO640	**	**	2.243	n/a	**2.228**
>IFO640	n/a	n/a	n/a	n/a	**n/a**
All Residuals	**	**1.244**	**2.135**	**1.801**	**1.605**

** Information withheld to protect confidential data

The values in the tables above are conservative estimates of the volume-weighted averages for sulphur content in marine fuels (as discussed in detail in Section 5.1). In 2004, there were no regions that offered distillate fuels with less than 0.05% sulphur content. In 2006 and 2007, Western Canada provided other marine distillates that had sulphur content of less than 0.05%. Quebec is the only other region that provided distillates with less than 0.05% sulphur content (2007; see Table 6.5). It is also noted that since the regulations came into effect June 1, 2007, all suppliers reported that marine diesels sold in Canada met the low-sulphur specifications.

Quebec is also the only region that has consistently supplied low-sulphur residuals, with sulphur content of less than 1.5% (with the exception of IFO380–IFO640, which averaged just above that limit in 2006). Atlantic Canada also reported sulphur content averages of less than 1.5% for all residuals sold in 2006 and 2007.

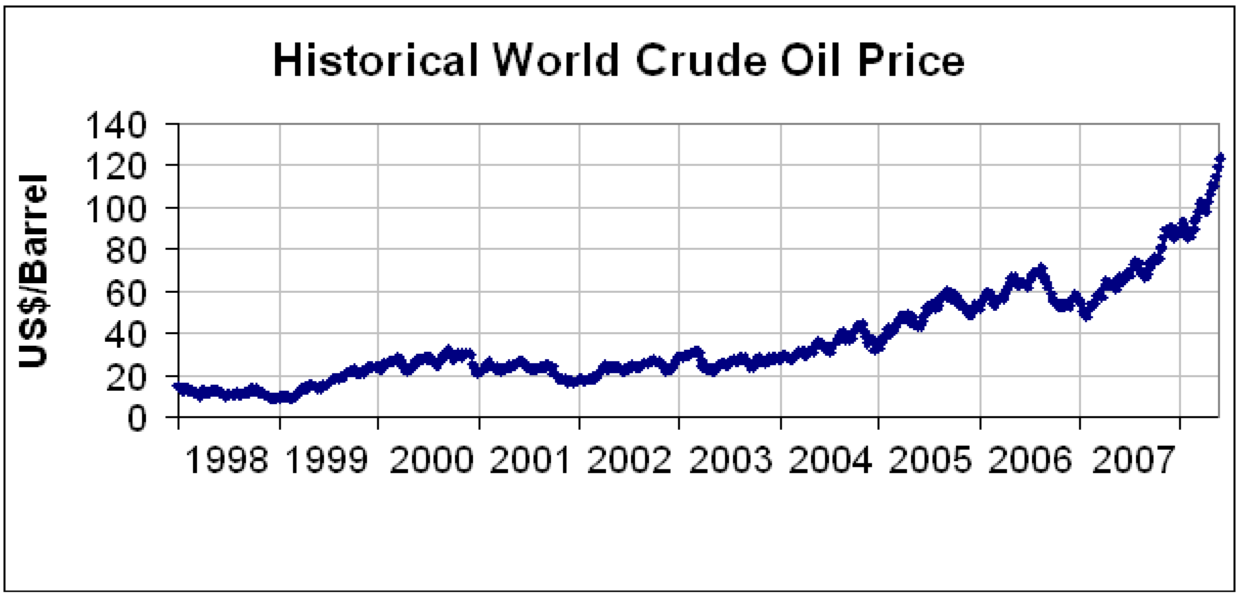
Both low-sulphur residual and distillate fuels may have been available in the other regions in 2004, 2006 and 2007; however, the availability considered in this section was based on the calculated volume-weighted averages as determined based upon the data reported in the survey responses (Section 5.1).

7. MARINE FUEL SALES AND PRICES

All of the figures in this section were created using the services of Bunkerworld. The prices of the various fuel grades (MDO, MGO, IFO180, IFO380, LSIFO180 and LSIFO 380) at worldwide bunker ports are limited by Bunkerworld's data. It should be noted that some fuel prices may not be plotted for certain ports for certain time periods, which likely indicates that Bunkerworld has no recorded data for these periods, and does not necessarily indicate that the specific fuel was not available.

Review of the following price data indicates that fuel prices, in general, exhibited only modest increases until about 2004, when they became much more volatile. This can likely be attributed to the increasing price of crude oil over the same period (1998 through 2007; see Figure 7.1).

Figure 7.1. World Crude Oil Prices, 1998–2007



Source: Energy Information Administration (date)

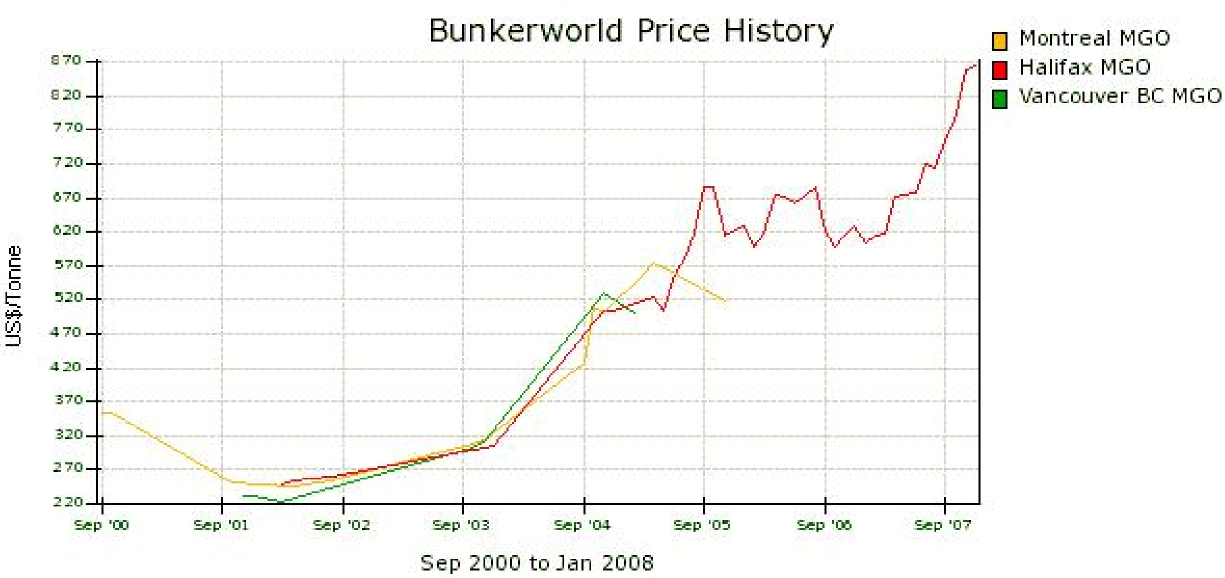
7.1 Marine Fuel Sales in Canada

The various marine fuel grades as well as those sold in Canada in 2006 and 2007, are discussed in Section 1 and Section 2, respectively. This section compares the historical prices in US$/tonne of marine fuels (MDO, MGO, IFO180 and IFO380) at three main bunker ports (Montreal, Halifax and Vancouver) in Canada. A price timeline (2000 to 2007) is presented for each grade of fuel in Figure 7.2 through Figure 7.5.

Figure 7.2. Canadian MDA Price, 2000–2007

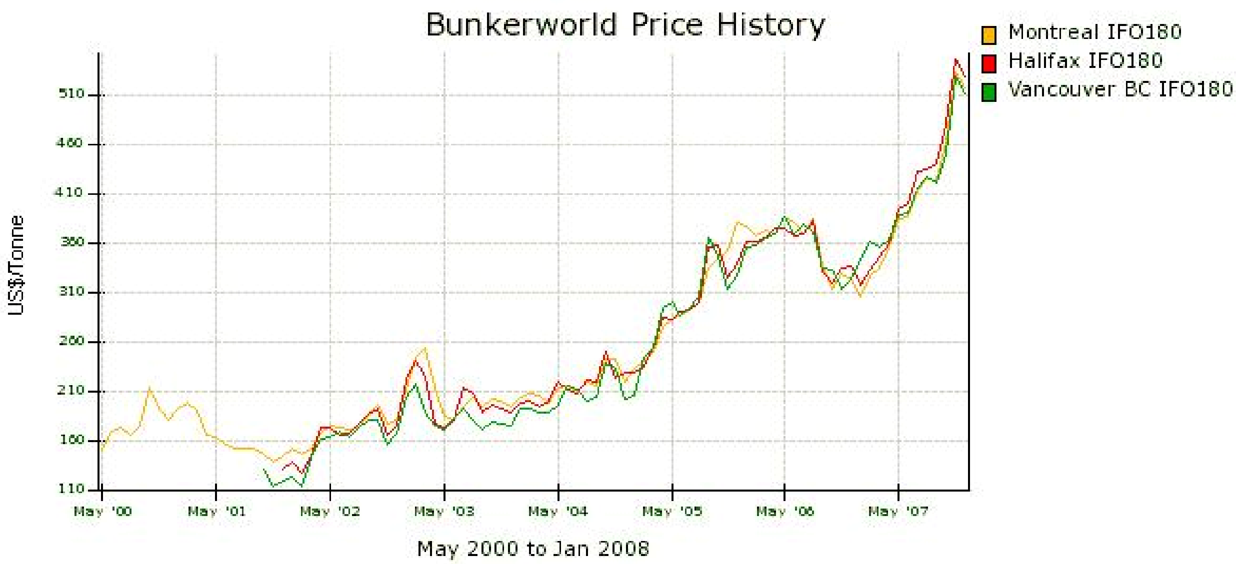
As shown in Figure 7.2, up until 2005, the largest price differences for MDO between ports was about US$100/tonne (as seen in May 2004 and May 2005). After May 2005 the price of MDO in Halifax did not increase as quickly as it did in Montreal and Vancouver, thereby increasing the price differential, at times to more than US$200/tonne. In 2004 to 2005, there appears to have been a steep increase in MDO prices; from 2005 to 2006 the overall price increase does not appear to have been as large; however, the month-to-month price was much more volatile.

Figure 7.3. Canadian MGO Price



As shown in Figure 7.3, the largest price differential for MGO appears to be in September 2004, of about US$75/tonne. Other than that, the difference was in the US$25/tonne range. The price increase between 2002 and 2003 was gradual and steady, with the price beginning to increase more rapidly in late 2003. From 2005 through 2007, the price of MGO became much more volatile than it had been previously, while continuing to increase.

Figure 7.4. Canadian IFO180 Price



As indicated in Figure 7.4, the price of IFO180 is comparable between the three ports, with the largest difference being about US$50/tonne, but typically in the range of US$25/tonne. In early 2005 and again in early 2007, the price began to increase more rapidly than it had previously.

Figure 7.5. Canadian IFO380 Price

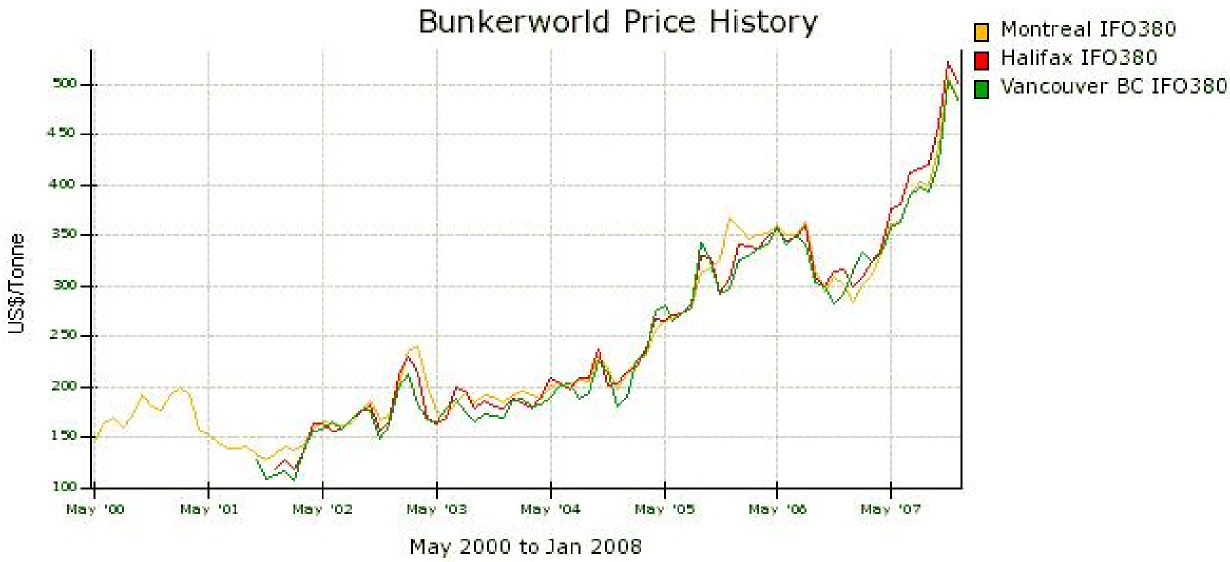


Figure 7.5 indicates the price of IFO380 is comparable between the three ports, with the largest difference being about US$50/tonne, but typically about US$25/tonne. In early 2005 and again in early 2007, prices began to increase more rapidly than they had previously.

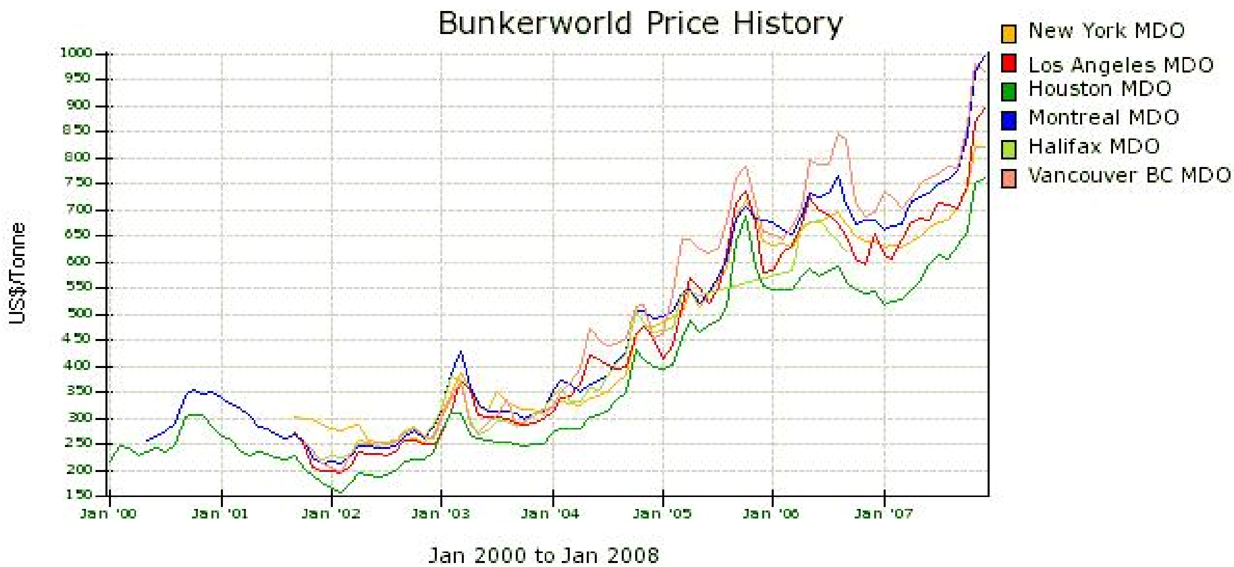
7.2 Marine Fuel Sales Internationally

The price of marine fuel sold in Canada was compared by grades to prices in the United States, Europe and Asia, as set out in the subsections below.

7.2.1 Prices of Marine Fuels in Canada and the United States

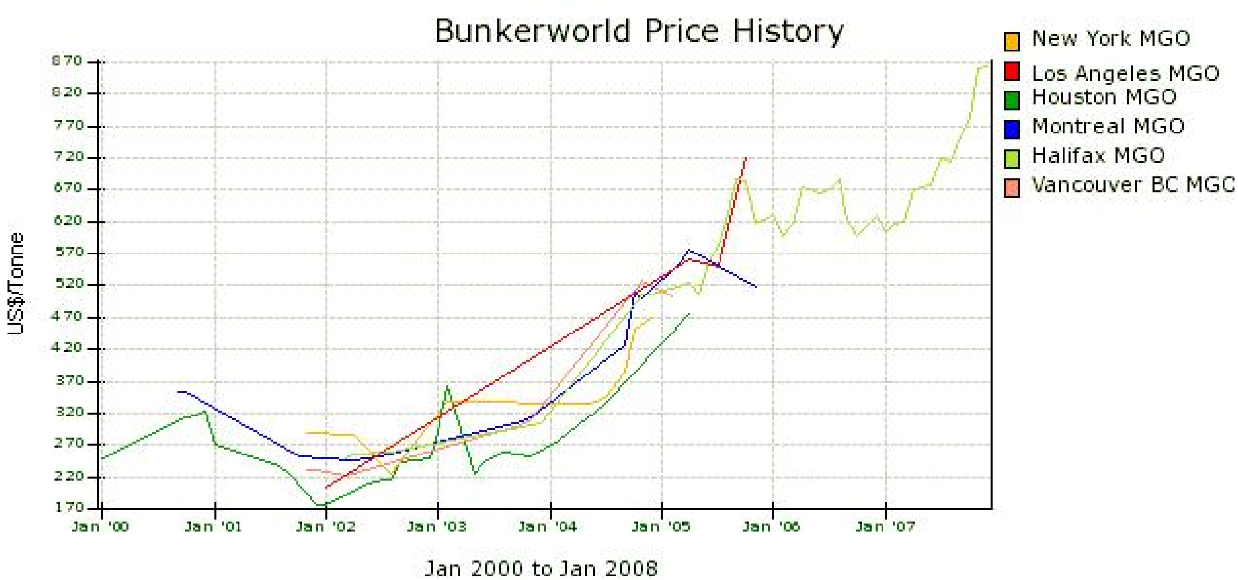
The prices of marine fuels (MDO, MGO, IFO180 and IFO380) at the Canadian bunkering ports of Montreal, Halifax and Vancouver were compared to the prices at the American bunkering ports of New York, Los Angeles and Houston for 2000 through 2007 (Figure 7.6 through Figure 7.9).

Figure 7.6 Canadian and American MDO Prices



As seen in Figure 7.6, MDO is almost always the cheapest in Houston, often costing in the range of US$50/tonne less there than at the other American ports and the Canadian ports. Although the price trends in the United States and Canada appear to be the same, the cost of MDO in the United States for the most part has always been less than it is in Canada. There was a fairly consistent difference between American and Canadian prices—in the range of US$100–$150/tonne—until about 2005; it recently increased to about US$200/tonne.

Figure 7.7 Canadian and American MGO Prices



As seen in Figure 7.7, the price trends in the United States are generally similar to those in Canada. The price of MGO in the United States, with the exception of Los Angeles, was more volatile than it was in Canada. The price in Houston was almost always lower than prices in Canada by a rough range of US$50–$100/tonne. Between mid-2002 and 2005 MGO, cost more in Los Angeles than it did in the Canadian ports, by about US$100/tonne. New York had prices within about US$50/tonne of Canadian ports. In early 2003, Houston and New York had price spikes, bringing prices there higher than in Los Angeles, which resulted in MGO at all American ports costing at least US$50/tonne more than it did at Canadian ports.

Figure 7.8. Canadian and American IFO180 Prices

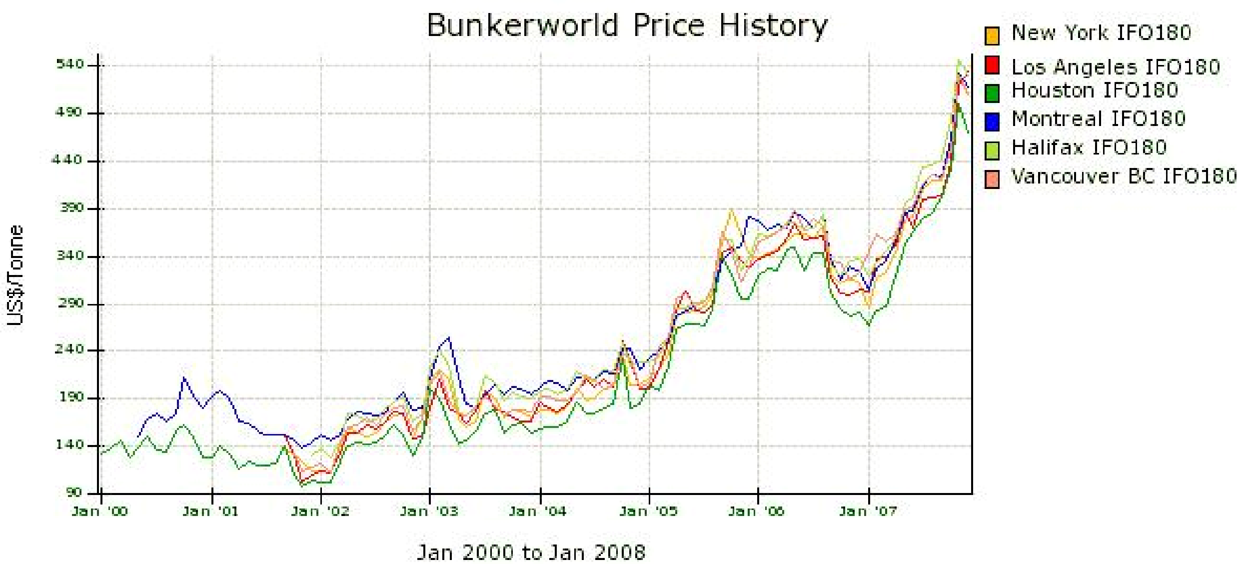


Figure 7.8 shows that IFO180 is almost always the cheapest in Houston; however, the price is comparable between all American and Canadian ports, with the difference always being about US$50/tonne or less. In early 2005 and again in early 2007, the price began to increase more rapidly than it had previously. The prices in Canada and the United States seem to have been equally volatile.

Figure 7.9. Canadian and American IFO380 Prices

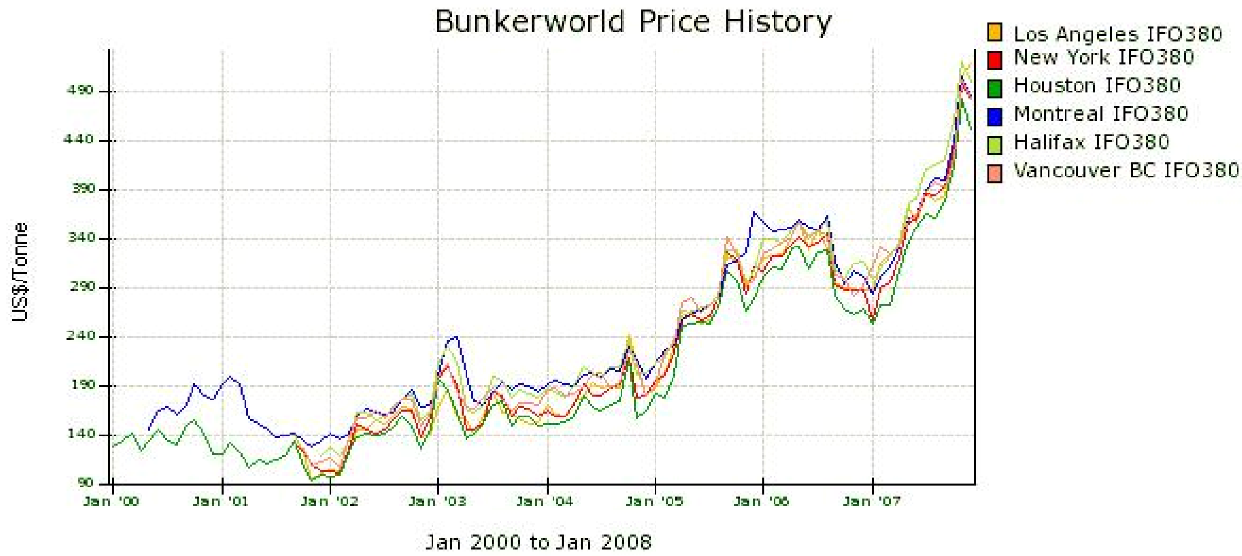
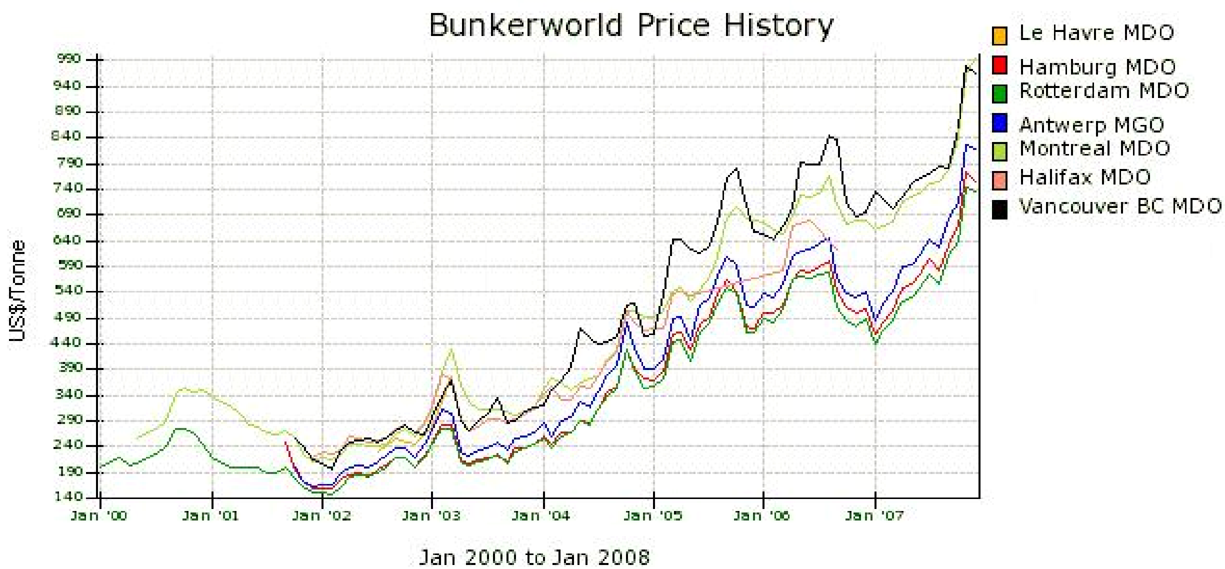


Figure 7.9 shows that although IFO380 is generally the cheapest in Houston, the price is comparable in all the North American ports, with the price differential usually being less than about US$50/tonne. In both late 2005 and early 2007, there were differential spikes in the range of US$100/tonne. In early 2005 and again in early 2007, the price began to increase more rapidly than it had previously.

7.2.2 Prices of Marine Fuels in Canada and Europe

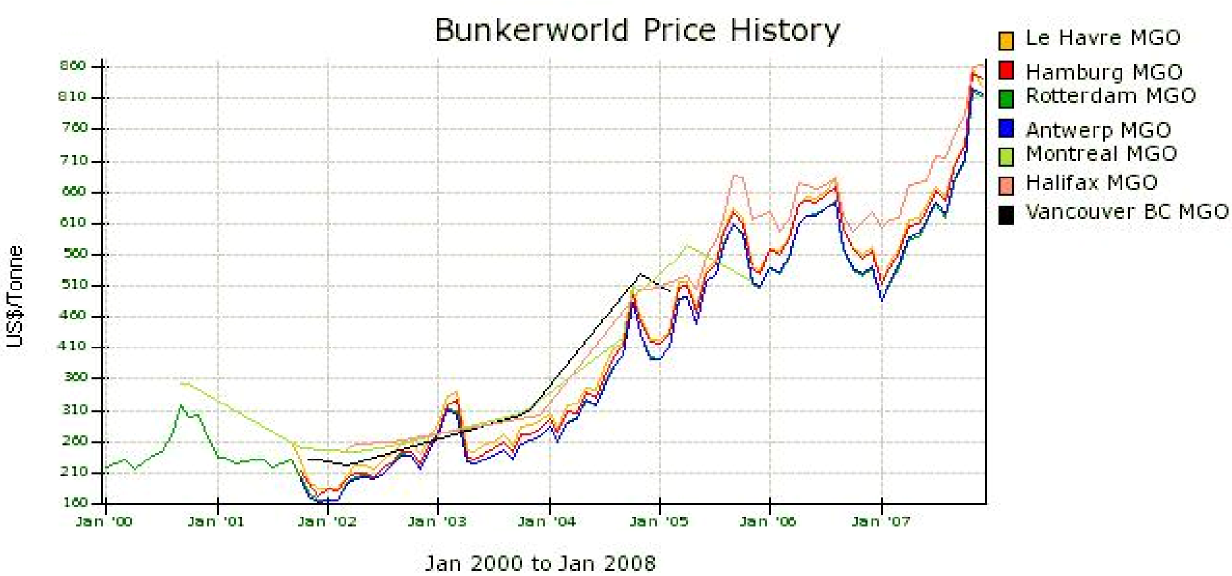
The prices of marine fuels (MDO, MGO, IFO180 and IFO380) at the Canadian bunkering ports of Montreal, Halifax and Vancouver were compared to prices at the European bunkering ports of Le Havre, Hamburg, Rotterdam and Antwerp for 2000 through 2007 (Figure 7.10 through Figure 7.13).

Figure 7.10. Canadian and European MDO Prices



As seen in Figure 7.10, the fluctuations in prices in Canada and Europe were more or less the same from 2007 to 2007. The European market had consistently lower prices than did the Canadian market. Until about 2005, there was a maximum price difference of about US$100/tonne, with larger differences (of up to US$300/tonne) occurring after 2005.

Figure 7.11. Canadian and European MGO Prices



As shown in Figure 7.11, the overall price trends for MGO were similar in the Canadian and the European markets from 2000 through 2007. Until 2005, European prices were more volatile; however, Canadian prices have since become just as unpredictable. The prices for MGO in Europe were consistently lower than Canadian prices, with the exception of in early 2003, when all European prices were higher than Canadian ones. The maximum price difference of about

US$100/tonne was recorded a few times; however, the difference was usually closer to US$50/tonne.

Figure 7.12. Canadian and European IFO180 Prices

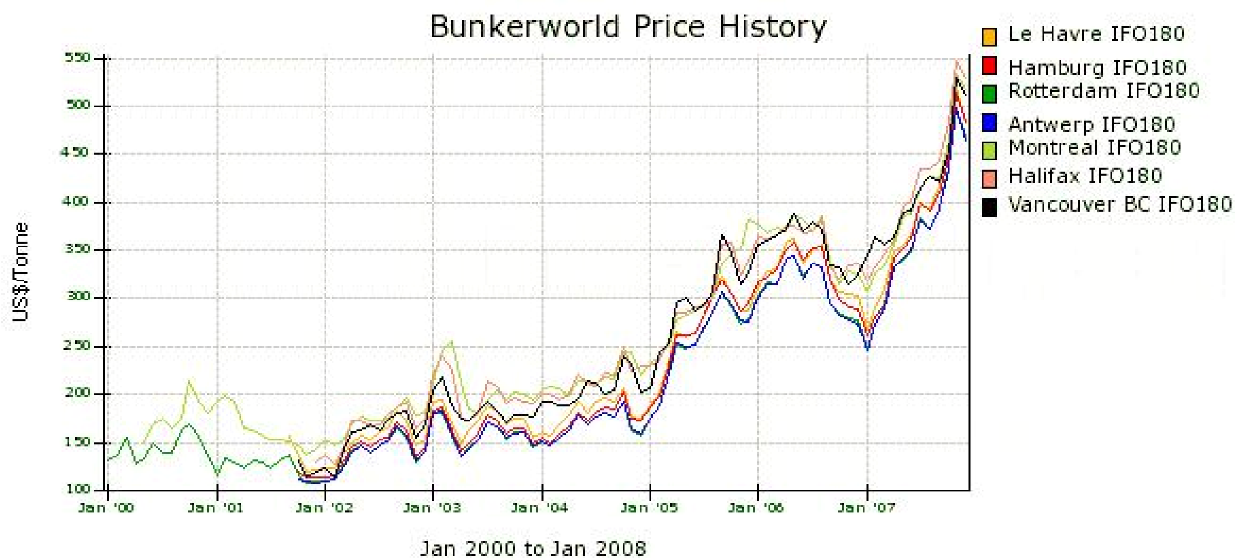


Figure 7.12 shows that the price for IFO180 fluctuated fairly consistently in Canada and Europe. The Canadian prices were almost consistently higher than the European prices. The maximum price difference was generally around US$50/tonne; however, some differences in the US$75/tonne to US$100/tonne range were recorded, specifically in early 2001, early 2003 and early 2007.

Figure 7.13. Canadian and European IFO 380 Prices

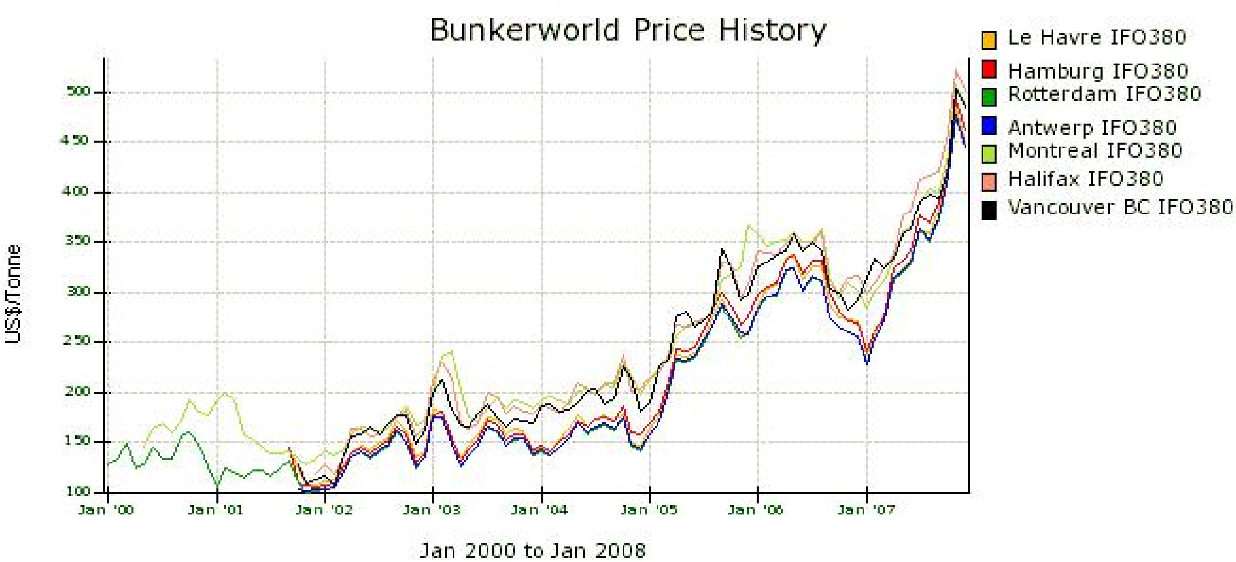
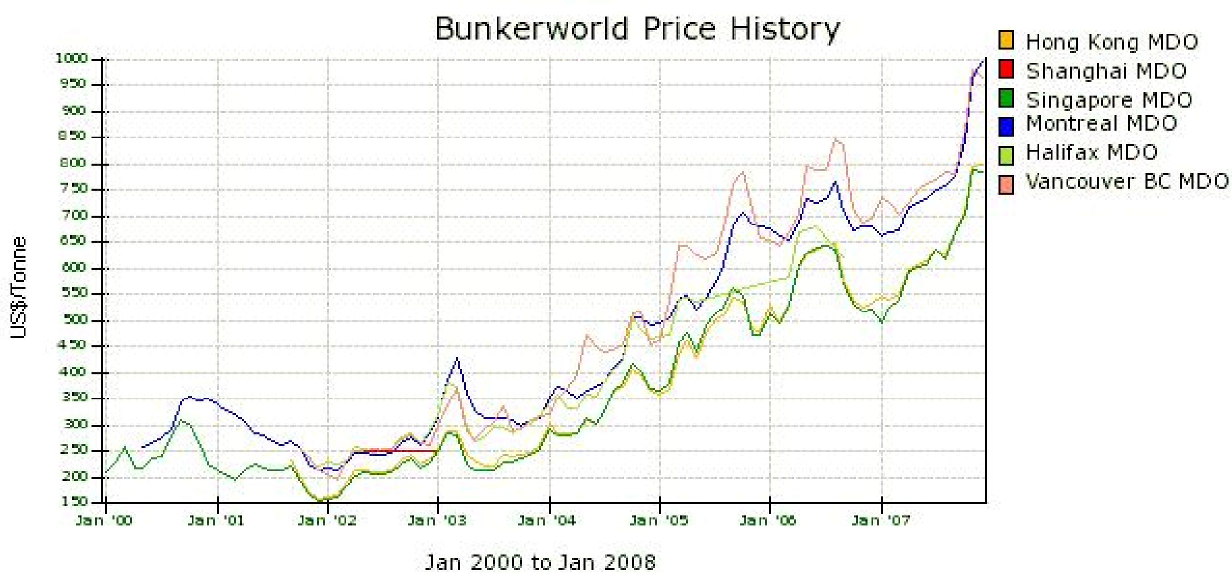


Figure 7.13 shows that the price for IFO380 fluctuated fairly consistently in Canada and Europe. The Canadian prices were almost consistently higher than the European prices. The maximum price difference was generally around US$50/tonne; however, some differences in the US$75/tonne to US$100/tonne range were recorded, specifically in early 2001, early 2003, late 2005 and early 2007.

7.2.3 Prices of Marine Fuels in Canada and Asia

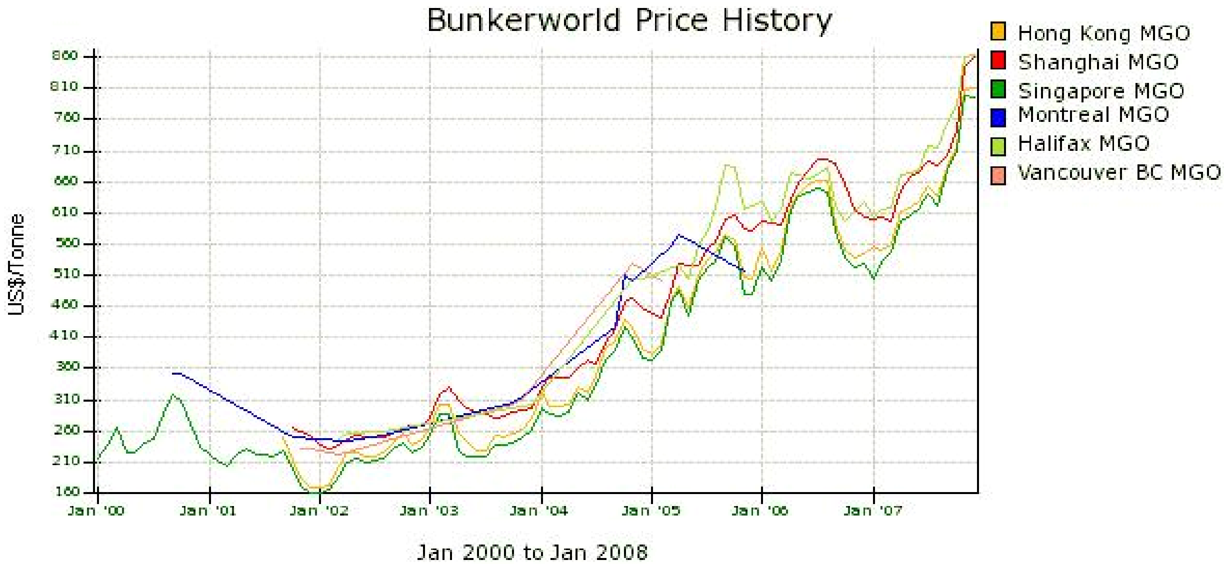
The prices of marine fuels (MDO, MGO, IFO180 and IFO380) at the Canadian bunkering ports of Montréal, Halifax and Vancouver were compared to those at the Asian bunkering ports of Hong Kong, Shanghai and Singapore for 2000 through 2007 (Figure 7.14 through Figure 7.17).

Figure 7.14. Canadian and Asian MDO Prices



As seen in Figure 7.14, the prices of MDO in Hong Kong and Singapore are almost identical. Price fluctuations are equally large in the Asian and Canadian markets. With the exception of Shanghai and, for one month in mid-2005, Halifax, the price for MDO was always lower in Asia than in Canada. Until about 2005, the price difference ranged from about US$50/tonne to US$150/tonne; after that, larger price gaps occurred, in the range of US$150–$250/tonne.

Figure 7.15. Canadian and Asian MGO Prices

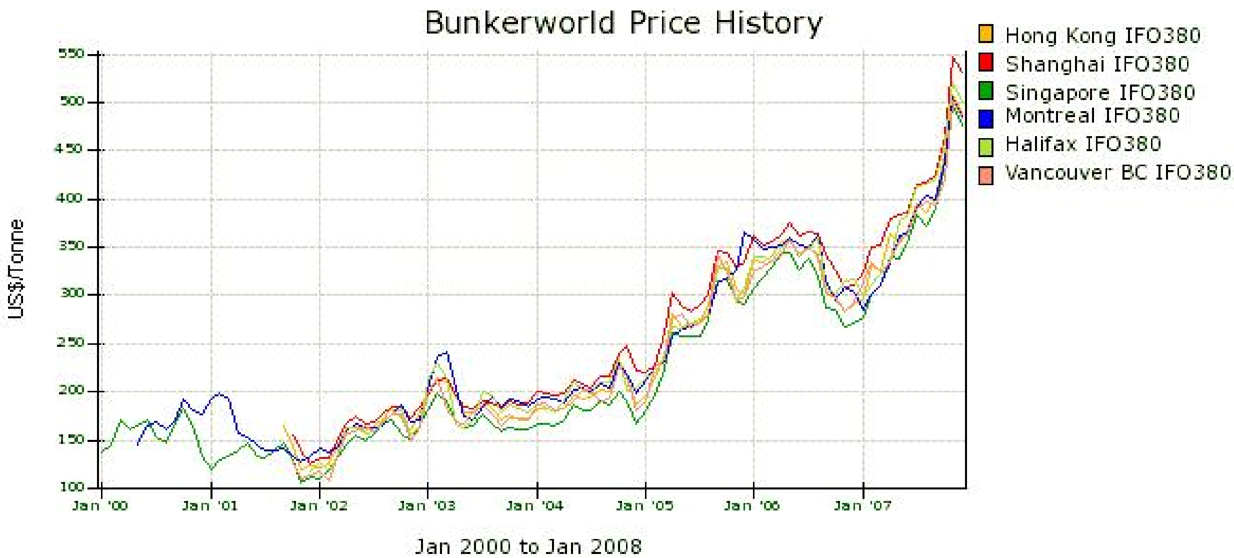


As seen in Figure 7.15, the price of MGO in Hong Kong and Singapore is almost identical, with the price in Hong Kong being slightly higher. The price fluctuations in Shanghai followed more or less the same trend as in the other Asian ports, but the price in Shanghai was slightly higher. The Asian market was much more volatile than the Canadian one up until early 2005, after which the MGO price was only tracked in Halifax. With the exception of early 2003, when the price was higher in all Asian ports than Canadian ports, Hong Kong and Singapore had lower MGO prices than did Canada. Shanghai's prices were closer to the prices in Halifax. The maximum price difference for the most part remained below US$100/tonne; however, it approached US$150/tonne in mid-2005.

Figure 7.16. Canadian and Asian IFO180 Prices

As seen in Figure 7.16, IFO180 price trends were quite similar in the Canadian and the Asian ports. The largest price difference was about US$50/tonne. With the exception of a dip in price in Shanghai in early 2007, Singapore almost always had the cheapest IFO180.

Figure 7.17. Canadian and Asian IFO380 Prices



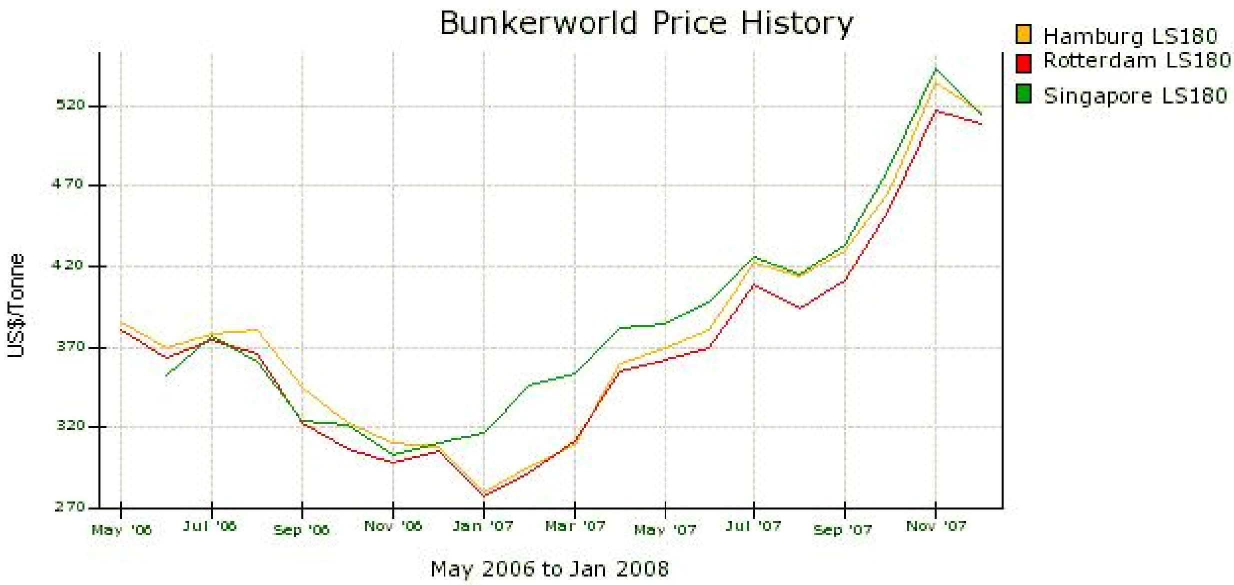
As seen in Figure 7.17, IFO380 price trends were quite similar in the Canadian and the Asian ports. The largest price difference was about US$50/tonne. Singapore almost always had the cheapest IFO380, while Shanghai's was almost always the most expensive.

7.3 Prices for Low-Sulphur Fuels

Low-sulphur marine fuels, as defined by a maximum sulphur content of 1.5%, have become, and will continue to be, more available in ports worldwide with the global push to reduce air emissions. Bunkerworld has tracked the prices of low-sulphur (LS) IFO180 and LSIFO380 in Hamburg, Rotterdam and Singapore since 2006.[6] A comparison of the costs of these fuels for the years 2006 and 2007 can be seen in Figures 7.18 and 7.19.

[6] No price data were available for low-sulphur marine fuels sales in Canada. The availability of low-sulphur marine fuels is discussed in Section 6.2.

Figure 7.18. Low-Sulphur IFO180 Prices



The price of LSIFO180 dropped throughout 2006 but increased fairly consistently in 2007. The price seems to have been the highest in Singapore and the lowest in Rotterdam. The largest price differential was about US$50/tonne, from January through March 2007. For the remainder of 2007, the price differential was in the US$25/tonne range.

Figure 7.19. Low-Sulphur IFO380 Prices

The price of LSIFO380 dropped throughout 2006 but increased fairly steadily through 2007. The price seems to have been the highest in Singapore and the lowest in Rotterdam. The largest price differential was of slightly more than US$50/tonne, from January 200 through March 2007; otherwise, the price differential was in the US$25/tonne range.

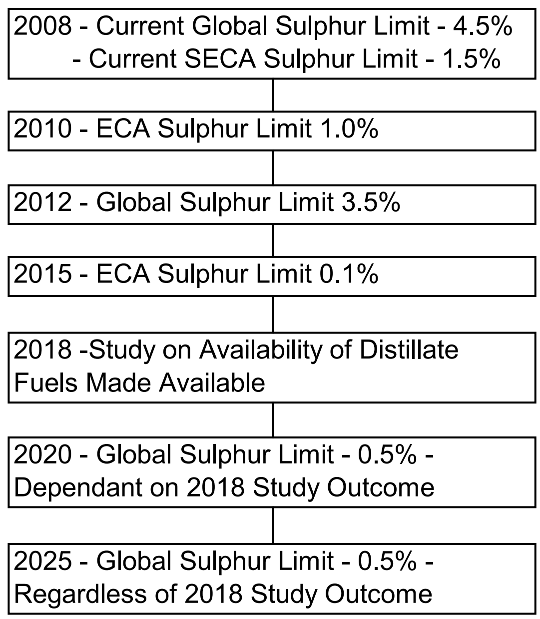
The prices for regular-sulphur IFO180 and IFO380 in Hamburg and Rotterdam have traditionally been fairly close to equivalent, with the price in Singapore being generally slightly higher (US$25–$50/tonne); the same can be said of the LS180 and LS380 prices above. Upon comparing the price of low-sulphur to regular-sulphur residual fuels, it becomes apparent that there is a premium of about US$25–$50/tonne on the low-sulphur options.

8. FUTURE OF LOW-SULPHUR FUELS

8.1 Global Low-Sulphur Fuel Regulations

At the 57th meeting of its Maritime Environment Protection Committee in April 2008, the IMO proposed regulations to reduce sulphur concentrations in marine emissions to be implemented over the subsequent 12–17 years. Figure 8.1 shows a timeline for these proposed regulations. These revisions to MARPOL Annex VI will likely be adopted in October 2008.

Figure 8.1. Future Sulphur Regulations



There is discussion within the marine industry that the regulations will mean that the industry will have to make a complete switch to distillate fuels. As discussed in the trade journal *Fairplay*, it is currently inefficient and costly to produce residual fuels with less than 1% sulphur content. Consequently, ships transiting ECA zones will almost certainly do so using distillate fuels by 2010. In addition, industry members argue that, barring significant technological advances within the refining industry, all global marine fuel will be distillate by 2020 (Fairplay 2008).

However, the use of exhaust gas cleaning systems, such as scrubbers, and other alternative technologies, provided they allow vessels to comply with ECA emission limits, may mean that a switch to distillate fuels will not necessarily be required to meet the IMO's regulation for sulphur emissions.

From the industry questionnaire responses, it is generally understood that there are no new refining methods being developed in Canada to reduce sulphur levels in residual fuels, since these methods are not considered to be commercially viable. This represents a problem that is exacerbated by the declining availability of low-sulphur crude supplies for Canadian refiners.

Thus, it seems reasonable to believe that, with the current refining position, ship owners and operators will soon need to further investigate the cost implications of switching to distillate fuels or adopting a suitable abatement technology.

A switch to distillate fuels would undoubtedly raise demand for them, which could ultimately make availability an issue. It was commented in the survey responses that a switch to distillate may cause large shortages in distillate fuels from Canadian refineries, which could put independent resellers at a disadvantage and, in severe cases, potentially render them unable to compete. Realistically, however, it is likely that the spike in demand would be closely followed by a price increase, which would work to limit consumption and return balance to the market.

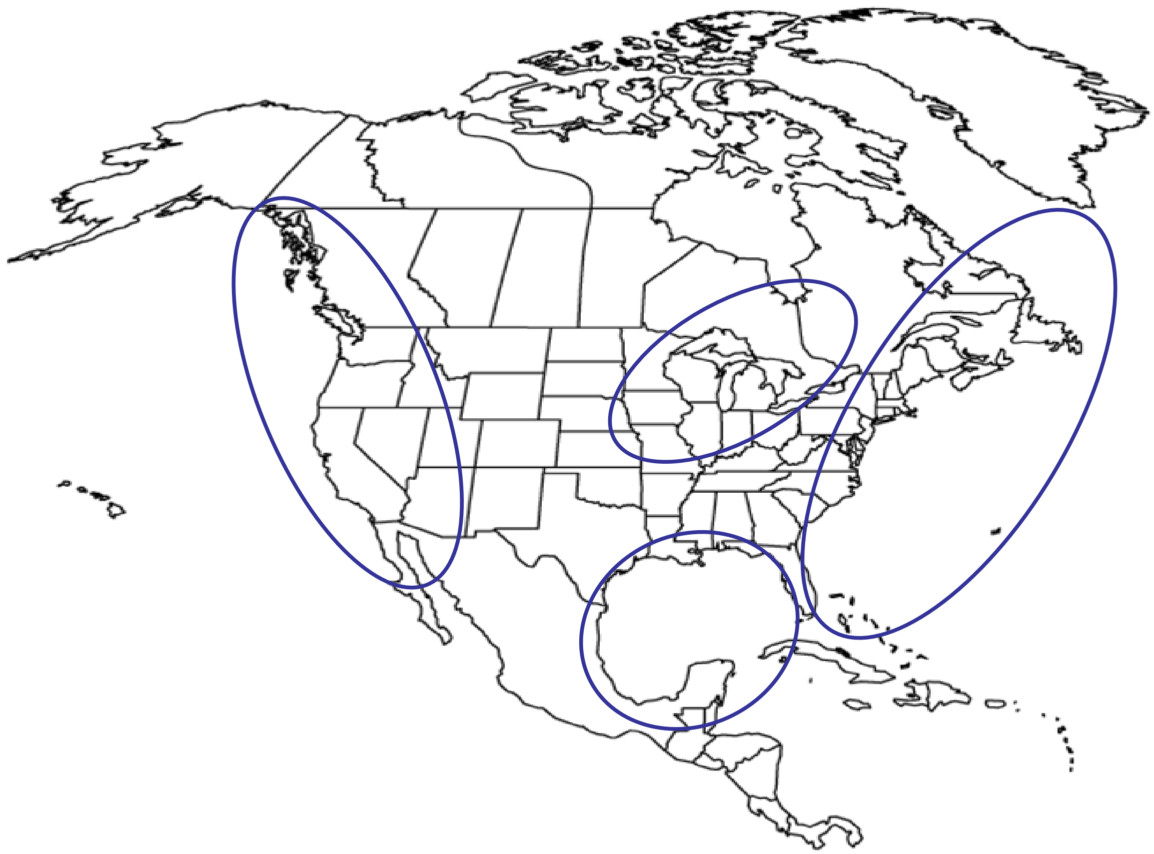
The question of availability of marine fuels to meet the global sulphur limits was not part of the scope of this project, since these revisions to MARPOL Annex VI were introduced well after this study began. However, the future availability of marine distillate fuels in Canada, based on the potential demand resulting from Annex VI compliance, may be a valuable future study to conduct.

8.2 Canadian Compliance with Sulphur Regulations

There are currently four potential SECA regions being assessed for North America (Figure 8.2) (Transport Canada 2008). The three regions that include Canada are West Coast North America, East Coast North America and Great Lakes. This section discusses the current and proposed sulphur regulations (Figure 8.1) in conjunction with the observed sulphur levels (Section 5.2) in Canada and globally.[7]

[7] The North American regions set out in Section 5.2 are quite similar to the proposed SECA regions (Figure 8.2); thus, the sulphur data from Section 5.2 were used here, instead of the Canadian industry sulphur data from Section 5.1.

Figure 8.2. Areas Being Assessed as Potential SECAs



Currently SECA regions limit sulphur emissions to 1.5%. When assessing the proposed Canadian SECA regions against the recorded sulphur content of fuels produced there, all distillate fuels meet the current SECA requirements. The Great Lakes fuels had sulphur content in the range of 1.5–2%, which is slightly higher than the SECA limit; however, this sulphur content is the same as that of residual fuels being sold in the two current SECA regions. Both the Eastern and Western North America regions recorded sulphur levels in residual fuels in the range of 2–2.5%. Under current conditions, the implementation of North American SECAs would require a decrease in the sulphur level in residual fuels or require ship operators to switch fuels or install abatement technology on ships burning residual fuels with elevated sulphur content.

The three proposed SECAs that include ports in Canada all currently have distillate fuels that meet the proposed 2010 regulation capping sulphur emissions at 1% in ECAs. Similarly, all of the North American and global regions, meet the 2012 global cap of 3.5% sulphur content for both residual and distillate fuels.

One of the most significant regulatory changes affecting the Canadian marine fuel market since the 2005 study is the Canadian Sulphur and Diesel Fuel Regulation, which set limits for the sulphur content of marine diesel sold in Canada to 0.5%, as of June 1, 2007.

Currently the sulphur content in distillate fuels in the proposed Great Lakes and West Coast North America SECAs (0–0.21%) is already close to the proposed 2015 ECA limit of 0.1%. However, the sulphur content in distillate fuels in the proposed East Coast North America SECA is higher (0.21–0.42%) than that set by the proposed regulation.

All distillate fuels in Canadian regions meet the 2020 or 2025 global cap of 0.5% sulphur content. India, the Middle East, East and South Africa, the Caribbean and the U.S. Gulf are the only regions in which the sulphur level in marine distillates does not currently meet the 0.5% limit. There are no residual fuels worldwide that currently meet this limit, since the lowest recorded concentration is in the range of 1–1.5%. For it to be possible for ship owners to continue to use residual fuels in the future, either refinery-based technologies to lower the sulphur content in these fuels must be developed or ship owners must install abatement technologies on their ships.

8.3 Effect on the Shipping Industry

Arguably the biggest choice that will have to be made by ship owners or operators will be between switching to distillate fuels or implementing an exhaust gas cleaning system (EGCS). Currently, there is no easy or obvious option, since the most recent and rigorous changes to be implemented in regulations are still quite new. As such, there are many factors that must be considered.

First and foremost, the upfront capital costs directly associated with any vessel modification or fuel switch must be analyzed for each option: Are any retrofits necessary to use low-sulphur distillates? What are the costs for machinery on a new build? What are the predicted costs of maintenance, keeping in mind lower sulphur content means lower lubricity?

Any ship operator or owner thinking about installing an EGCS must answer similar questions. What are the costs to implement such a system on an existing vessel? On a new build? What are the costs of maintaining an EGCS? Will the EGCS require changes over the life of the vessel? If so, what are the likely costs? In addition, an analysis should be done on disposing of the scrubbing solution and associated sludges to make sure that it would be both cost-effective and environmentally sound.

Finally, the most complex and unpredictable issue must be analyzed in detail: using marine distillate fuels versus using marine residual fuels. There are many issues directly related to the fuels themselves that may affect ship operators’ or owners’ decision of which technology to use. Some scenarios and factors that may be investigated before making a decision are discussed below.

Ship owners or operators must consider the routes the vessels are likely to follow (Will SECAs or ECAs be visited?) and the bunkering ports they are likely to visit. Each potential bunkering port must be assessed for the current and future availability of fuels required for planned routes. This, in part, may be analyzed through historic and current availability of low-sulphur distillates, and analysis of current and proposed SECAs and ECAs; however, because nothing remains constant in this industry, making accurate predictions may be quite difficult. For example, new SECAs and ECAs may be proposed and implemented, thus driving the demand for low-sulphur fuels up, which may cause temporary shortages of these fuels until bunker agents and refiners can accurately predict and meet the new demand. Since fuel suppliers depend on shipping operators to determine types and quantities of fuels supplied, in the same manner ship operators may depend on various fuels being available at particular supply locations when making decisions. It is easy to see how complicated the analysis of fuel availability can become.

Furthermore, a ship operator or owner must consider and predict the costs of the various grades of fuel available at the various bunkering locations. Since the price of high-demand fuels will ultimately rise, and the price of low-demand fuels will drop, the cost can be enough to invert demand—since people want to spend less and get more—thus creating price and demand fluctuations, which may be quite difficult to predict accurately. The cost of refining fuels can also affect the prices at bunkering stations, since increased refining costs associated with producing low-sulphur fuels are sure to trickle down to the end of the supply chain. The costs associated with refining depend on many factors, including the demand for required products and grades, the capabilities of and processes practised at the individual refinery, and the quality of crude available to the refiner. A complex combination of all of these factors, and doubtlessly many more, make up the costs associated with refining, which may have direct impact on the delivery price of the finished product.

It is clear to see that the actual analysis and decisions that ship operators and owners will be making over a number of years to come will be quite difficult and convoluted. With an ever-increasing awareness of the need to protect the environment, the marine industry, locally and globally, is and will be continuously defining and refining regulations for the foreseeable future. The focus on and enforcement centred on various environmental issues, (i.e. sulphur levels in fuels or engine-based nitrogen oxide emissions) will continue to have a direct effect on how the shipping industry conducts its day-to-day operations.

9. CONCLUSION

Marine distillate fuels (DMA, DMB and others) and marine residual fuels (<IFO180–IFO640) are available at select bunkering ports across Canada. This study has focused on many topics, such as the fuel supply chain, fuel blending practices, fuel quality—specifically sulphur levels, availability and quantity of marine fuels sold and fuel prices. When appropriate, comparisons have been made between data from Canada and from other regions around the world.

Marine residual fuel blends (<IFO180–IFO380) sold in Canada were composed of a larger proportion of distillate fuel in 2006–2007 than in 2004. The sulphur content range for these fuels was also wider in 2006–2007 than in 2004; the lower sulphur content was most likely due to the higher component of distillate fuel, and the higher sulphur content was possibly due to a combination of crude quality and refining processes. For heavier marine residual fuel blends (IFO380–IFO640), higher sulphur content and a lower proportion of distillate were found in 2006–2007 than in 2004.

Marine residual fuels greater than IFO640 were not sold in any regions in Canada in 2006 or 2007. IFO380–IFO640 were not available in western Canada in 2007; all other residual fuel grades were available throughout Canada in these years. DMB was sold in western Canada in both 2006 and 2007, but was not reported as having been sold in any other region; both DMA and other marine distillates were sold in all regions in 2006 and 2007.

One of the most significant regulatory changes affecting the Canadian marine fuel market since the 2005 study is the Canadian Sulphur and Diesel Fuel Regulation, which set limits for the sulphur content of marine diesel sold in Canada to 0.5%, as of June 1, 2007. The average sulphur level in both marine distillates and marine residuals has been decreasing in recent years (2004–2007), as highlighted in Table 9.1.

Table 9.1. Annual Sulphur Content in Marine Fuels Canada

Year	Distillate	Residual
2004	0.201	1.760
2006	0.118	1.678
2007	0.067	1.605

The average sulphur content for distillate and residual fuels from three North American regions (Western North America, Eastern North America and Great Lakes) were compared to averages for various geographical regions worldwide for the years 2004 through 2007. The North American regions offered lower sulphur distillate fuel than did other regions; the Eastern North America region's distillate fuel was slightly higher in sulphur content (0.21–0.42%) than that of the other two North American regions (0–0.21%). In terms of low-sulphur residual fuels, the Great Lakes region average was 1.5-2%. Some regions in Europe were the only other ones to have sulphur content in this range, while lower sulphur content (1–1.5%) for residual fuels was found only in South America. The other two North American regions fared mid-range globally, with an average sulphur content of 2-2.5% in residual fuels.

In general, the prices for fuels (MDO, MGO, IFO180 and IFO380) were higher in Canada than in all other compared regions: the U.S., Europe and Asia. Table 9.2 summarizes the typical price differences for the respective fuels and regions, as discussed in Section 7. For all regions, the maximum difference in price for residual fuels and MGO was about US$100/tonne. Price differences were much higher for MDO (up to US$300/tonne), especially after 2005.

Table 9.2. Price Difference Summary

	MDO	MGO	IFO180	IFO380
Canadian Ports	US$50-100/tonne until 2005 US$200/tonne after 2005	US$25/tonne	US$25-50/tonne	US$25-50/tonne
Canadian and American Ports	US$100-150$/tonne until 2005 US$200/tonne after 2005	US$50-100/tonne	US$50/tonne	US$50/tonne
Canadian and European Ports	US$100-200/tonne until 2005 US$300/tonne after 2005	US$50/tonne	US$50-100/tonne	US$50-100/tonne
Canadian and Asian Ports	US$50-150/tonne until 2005 US$150-250/tonne after 2005	US$100/tonne	US$50/tonne	US$50/tonne

Marine fuels—both distillate and residual marine fuel products—can be considered by-products of products for land-based markets. As such, the future supply of marine fuels may be determined as much by what happens in terms of regulations and demand in the land-based markets as by those in the marine market. Since environmental protection is a growing concern worldwide, both the land-based and marine fuel markets are continuously making efforts (through regulations) to reduce the quantity and improve the quality of emissions.

The IMO's initiatives, through MARPOL Annex VI, to control emissions were particularly relevant to this study. The proposed schedule for reducing sulphur emissions, both for ECAs and globally, will require many industry players (i.e. refiners, bunker agents and suppliers, and ship owners) to assess the feasibility of meeting the world demand by using low-sulphur fuels, emission abatement technologies or both.

The sulphur content found in Canadian fuels in recent years was assessed against limits in the proposed IMO regulations. All marine fuels sold in Canada from 2005 to 2007 met the 2012 limit of 3.5% sulphur content, and all distillates fuels sold in Canada from 2005 to 2007 met the 2020 sulphur limit of 0.5%.

There are currently three regions of North America being considered to be SECAs: West Coast North America, East Coast North America and Great Lakes. This study compared the average sulphur content in fuels sold in these regions against the proposed ECA regulations. All distillate fuels sold in Canada from 2005 to 2007 met the 2010 ECA limit of 1% sulphur content; however, no residual fuels did. The distillate fuels sold in the West Coast and the Great Lakes regions both had average sulphur content ranging from 0% to 0.21%, with the 2015 ECA regulation sulphur limit being 0.1%. Fuels sold in the East Coast region had a sulphur content of 0.21–0.42%.

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This Report would not have been possible without input from and consultation with

- Bunkerworld
- Canadian Petroleum Products Institute
- Chevron Canada Limited
- DNV
- ICS Petroleum Ltd.
- Imperial Oil
- Irving Oil Limited
- Kuwait Oil Tanker Co.
- Marine Petrobulk Ltd.
- Petro-Canada
- Petronas
- Provmar Fuels Inc.
- Scandinavian Bunkering
- Shell Canada Products
- Sterling Marine Fuels
- Suncor
- Ultramar Ltée

APPENDIX A

SAMPLE QUESTIONNAIRES

BMT Fleet Technology Ltd
311 Legget Drive
Kanata, Ontario
Canada K2K 1Z8

Tel: +1 613 592 2830
Fax: +1 613 592 4950
www.fleetech.com

20 December, 2007 BMT Project #: 6340C

To Whom It May Concern:

BMT Fleet Technology Limited has been contracted by Environment Canada to perform a comprehensive review of the availability, quantity, and quality, of marine fuels sold at Canadian Ports and Terminals. In order for us to successfully complete this commission and accurately report the Canadian situation, we need the support of industry professionals such as you. While we understand from Mr. Gilles Morel that you are extremely busy addressing existing obligations, we are hopeful that you can spare a few moments and complete the attached questionnaire.

The predecessor to this study was undertaken in 2005 and represented the first comprehensive review of the Canadian marine fuel industry. The current study is designed to update the findings of the 2005 study, as well as introduce a comparison of the Canadian/North American marine fuel industry with those located in select European and Asian countries. This information will then be utilized by Environment Canada within their ongoing work regarding a potential North American Sulphur Emission Control Areas (SECA), as well in the development of the Canadian position regarding the ongoing revisions to MARPOL Annex VI currently being undertaken by the International Maritime Organisation (IMO). Because both of these proposed regulations cover both captive and ocean-going fleets, this study must reflect the Canadian situation as accurately as possible.

I cannot stress enough that your participation in this project is critical to its success. We recognize that the differences between 2005 and 2007 may not be great, but they still need to be acknowledged and reported accurately. If possible, it would be appreciated if a separate questionnaire could be completed for each of the facilities under your care. All data will be reported in aggregate form broken down by region and individual port. All data will be held in the strictest confidence and will not be passed on in its “raw” form to Environment Canada. Should you wish BMT Fleet Technology Limited to enter into a confidentiality agreement prior to viewing the supplied data, we will be happy to comply with your requirements. Please send the appropriate forms to the undersigned at the above address / fax / email.

In order to meet our contractual obligations, we would ask that the questionnaires be completed and returned to us no later than January 21st, 2008.

BMT Fleet Technology Limited wishes to acknowledge the assistance and support of the Canadian Petroleum Products Institute, who helped with the development of the attached questionnaire.

If you have any questions or concerns related to this request for information, please do not hesitate to contact me.

Sincerely,

ANDREW KENDRICK, P. Eng.
Vice-President

Registered Office:
311 Legget Drive,
Kanata,ON Canada K2K 1Z8
Registered in Canada No 10181
9902RC

Environment Canada Environnement Canada

December 21, 2007

To Whom It May Concern:

Subject: Availability, Quality and Quantity of Marine Fuels in Canada

Environment Canada has contracted ***BMT Fleet Technology (BMT)*** to update the comprehensive 2005 study undertaken by this department entitled *"Availability, Quality and Quantity of Marine Fuels in Canada"*.

The objective of this review is to investigate and discuss various aspects of the marine fuels sold in Canada, which include (but are not limited to):

- The sulphur content levels found in marine fuels for 2006/07
- The current and future availability of the various types and grades of marine fuels sold at Canadian ports
- The quantity of the various types and grades of marine fuels for 2006/07
- Blending practices for marine fuels
- Certain key marine fuel chemical characteristics

Under this study, BMT are required to contact refineries, importers, distributors and marketers involved with the marine fuel supply chain in Canada. Their intention is to collect data from the aforementioned on all aspects related to the availability, quality and quantity of marine fuels in order to gain a representative understanding of the marine fuel market in Canada.

It is important to note that the data collected under this study will not be provided to Environment Canada in its raw form. All raw data will be held in confidence by BMT, with only "processed data" being released via the report.

Your support and cooperation with respect to this study is clearly needed. The information provided to Environment Canada under this study will be utilized in both our ongoing evaluation of a North American Sulfur Emission Control Area (SECA), as well as in establishing the Canadian position within the ongoing debate concerning the revisions to MARPOL Annex VI which are currently being undertaken by the International Maritime Organization (IMO).

I would like to thank you in advance for your kind consideration and support in this matter. Should you have any questions or concerns, please feel free to contact me directly at the following coordinates:

Environment Canada Environnement Canada

Lynn Nadon
Program Engineer, Marine Emissions
Transportation Division
Environment Canada
Place Vincent Massey, 10th Floor
351 St. Joseph Blvd, Gatineau, Quebec, K1A 0H3
Tel: (819) 934-8782, Fax: (819) 953-7815

Sincerely yours,

Lynn Nadon

Fuel Refinery/Supply Data Collection Questionnaire

Report on Availability, Quantity and
Quality of Marine Fuels Sold in Canada

Please note that all data collected will be held in the strictest confidence and will not be passed on in its "raw" form to Environment Canada.

PART A: GENERAL INFORMATION

A-1: Organization: ______________________________

A-2: Location Address: ______________________________

City: ______________ Postal Code: ______________

A-3: Parent/Corporate Owner: ______________________________

Street: ______________________________

City: ______________ Province: ____Postal Code: _______

Country: ______________ Website: http://______________

A-4: Organization Description and Contacts:

Organization Description: ______________________________

Primary Business: REFINING / IMPORT/ DISTRIBUTION / AGENT / SALES / OTHER

If Other; specify: ______________________________

Contact: ______________ Phone: ______________

E-mail: ______________ Fax: ______________

PART B: MARKET BASE AND CLIENTS

B-1: What were the product volumes produced by the refinery in 2006/07 (see next page for details of fuel types)?

Refinery	Reg. S Diesel	Low S Diesel	Ultra Low S Diesel	Marine Diesel	Residuals (HFO)
______________	_________	_________	_________	_________	_________
______________	_________	_________	_________	_________	_________
______________	_________	_________	_________	_________	_________

B-2: What volumes of fuels did this refinery sell in 2006/07 to:

Customer Type	Reg. S Diesel	Low S Diesel	Ultra Low S Diesel	Marine Diesel	Residuals (HFO)
Own branded Marine Direct Sales	_________	_________	_________	_________	_________
Independent Marine Fuel Resellers	_________	_________	_________	_________	_________
Other Non-Marine Use	_________	_________	_________	_________	_________

PART C: MARINE PRODUCT SALES

Fuel Grades	Year 2006/07 Sales		Sulphur Content % w/w			Remarks
	Cubic Metres	$/Cubic Metre	Maximum	Minimum	Average	
Marine Diesel						
DMA						
DMB						
Marine Diesel Other Than Above (1)						
Intermediate Fuel						
< IFO 180						
IFO 180 to IFO 380						
Residual Fuel						
IFO 380 to IFO 640						
>IFO 640						

Note (1): includes No. 2 Diesel, DMX, DMC

PART D: BLENDING PRACTICES

D-1: What is the typical percentage range of components blended to produce the following marine fuels?

Supply / Grade	Range of Distillate Component (%)	Range of Residual Component (%)	Sulphur Content Range (%)		Properties			
			% w/w	mg/kg	Boiling Point	Flash Point	Viscosity	Density
DMA								
DMB								
Other Marine Diesel								
< IFO 180								
IFO 180 to IFO 380								
IFO 380 to IFO 640								
> IFO 640								

PART E: FUEL AVAILABILITY

E-1: *On a company-wide basis*, what factors influence the quality of the crude oil used in your refining process (e.g., other industries, source) and are these factors controllable (i.e., a specific choice on crude supplier) or are they driven by market demand?

E-2: What other industries, if any, have an influence on demand/availability of fuel types for use by the marine sector, and how do these influences affect the availability of fuel for use by the marine sector? *Please provide a general discussion only.*

PART F: FUTURE AVAILABILITY OF LOW SULPHUR FUEL

F-1: Are there any refining methods *other than hydro-treating* currently in place to achieve low sulphur distillate fuels?

F-2: What methods are (a) in place and (b) being developed to reduce sulphur in residuals?

Fuel Supply Data Collection Questionnaire

Report on Availability, Quantity and
Quality of Marine Fuels Sold in Canada

Please note that all data collected will be held in the strictest confidence and will not be passed on in its "raw" form to Environment Canada

PART A: GENERAL INFORMATION

A-1: Organization: ______________________________

A-2: Location Address: ______________________________

City: ______________ Postal Code: ______________

A-3: Parent/Corporate Owner:
Street: ______________________________

City: ______________ Province: ____ Postal Code: _______

Country: ______________ Website: http://______________

A-4: Organization Description and Contacts:

Organization Description: ______________________________

Primary Business: REFINING/IMPORT/DISTRIBUTION/AGENT/SALES/OTHER

If Other, specify: ______________________________

Contact: ______________ Phone: ______________

E-mail: ______________ Fax: ______________

PART B: MARKET BASE AND CLIENTS

B-1: What Port Authorities do you serve?

B-2: Primary customer base *(Please provide total sales volumes (cubic metres) for 2006/07)*:

Customer Type	Reg. S Diesel	Low S Diesel	Ultra Low S Diesel	Marine Diesel	Residuals (HFO)
Deep sea vessels (International)	________	________	________	________	________
Captive Fleet (Domestic)	________	________	________	________	________
Other (specify):	________	________	________	________	________

PART C: PRODUCT SALES

C-1:

Fuel Grades	Year 2006/07 Sales		Sulphur Content % w/w			Remarks
	Cubic Metres	$/Cubic Metre	Maximum	Minimum	Average	
Marine Diesel						
DMA						
DMB						
Marine Diesel Other Than Above (1)						
Intermediate Fuel						
< IFO 180						
IFO 180 to IFO 380						
Residual Fuel						
IFO 380 to IFO 640						
>IFO 640						

Note (1): includes No. 2 Diesel, DMX, DMC

C-2: Do you provide bunker delivery notes with the sales of bunker fuels? Please describe the extent to which this is done

PART D: BLENDING PRACTICES

D-1: What is the typical percentage range of components blended to produce the following marine fuels?

Supply / Grade	Range of Distillate Component (%)	Range of Residual Component (%)	Sulphur Content Range (%)		Properties			
			% w/w	mg/kg	Boiling Point	Flash Point	Viscosity	Density
DMA								
DMB								
Other Marine Diesel								
< IFO 180								
IFO 180 to IFO 380								
IFO 380 to IFO 640								
> IFO 640								

D-2: Blending performed by self, refinery, importer, reseller, marketer? Specify:

D-3: Where are fuels sourced from (e.g. refinery, region, and/or country):

Reg. S Diesel ____

Low S Diesel ____

Ultra Low S Diesel ____

Marine Diesel ____

Residuals (HFO) ____

APPENDIX B

SAMPLE CONFIDENTIALITY AGREEMENT

CONFIDENTIALITY AGREEMENT

STUDY OF THE MARINE FUEL SUPPLY CHAIN IN CANADA

BETWEEN

***

AND

BMT FLEET TECHNOLOGY LIMITED (BMT)

BMT Fleet Technology Limited (BMT) is retained by Environment Canada to undertake a study of the marine fuel supply chain in Canada. In undertaking this assignment, BMT will be collecting and validating information from *** related to production, sales, quality, distribution and locations. Such information will be treated as confidential as described below.

1. BMT understands that the nature of this assignment requires confidentiality provisions to be in place between BMT and ***.

2. In this agreement, Confidential Information means:

   i) information disclosed by *** to BMT relating to the business of *** or any of its affiliates which, if disclosed in writing, is marked "Confidential", is disclosed in reports in such a manner that Company specific information can be identified, or if disclosed orally is indicated to be confidential, and

   ii) correspondence with *** specifically prepared utilizing Confidential Information in connection with this assignment.

3. However, Confidential Information does not include:

   i) reports prepared for CPPI, as we understand that all Confidential Information will be aggregated;

   ii) *** specific information which *** agrees in writing that is no longer considered Confidential Information;

   iii) computer programs and methodology developed by BMT to assist it in performing this assignment;

   iv) market research and analyses of information in the public domain conducted by BMT;

   v) information which is or becomes generally available to the public other than as a result of a disclosure by BMT;

vi) information which is or becomes available to BMT on a non-confidential basis from a source other than *** provided that the disclosing source, to BMT's knowledge or reasonable belief, is not bound by a duty of confidence to *** or any of its affiliates or otherwise to BMT's knowledge or reasonable belief, prohibited from transmitting the information to BMT by reason of some contractual, legal or other form of obligation;

vii) information which is known to BMT on a non-confidential basis prior to disclosure to BMT by ***; and

viii) information that is independently developed by BMT through its employees who do not have access to the Confidential information.

4. The obligations of confidence contained in this letter do not apply to information BMT is required to disclose to a court of competent jurisdiction or any regulatory authority having jurisdiction, provided that BMT takes reasonable steps to maintain the confidentiality of the information and provided BMT provides *** with immediate written notice of the request for disclosure.

5. BMT agrees to keep in confidence and not disclose without the prior written consent of ***, the Confidential Information in any manner whatsoever in whole or in part and will not use the Confidential Information directly or indirectly for any purpose other than the purposes of this assignment. All persons within BMT to whom Confidential Information is disclosed shall be bound by a secrecy agreement with BMT and BMT shall use its best efforts to ensure that such parties do not use or disclose any Confidential Information contrary to the terms of this Agreement.

6. BMT shall keep a record of the location of the Confidential Information. At the end of the assignment, BMT shall deliver to *** any Confidential Information furnished by ***, or any of its affiliates, and shall destroy all other copies of Confidential Information in its possession, or in the case of information stored in digital form, shall render that information inaccessible.

7. The report prepared by BMT for Environment Canada shall be the sole property of Environment Canada, but BMT may retain copies of such reports, summaries, correspondence and tables for its own records.

8. This Confidentiality Agreement shall be governed by the laws of the Province of Ontario. It is agreed that for the purpose of obtaining injunctive relief, the parties hereto stipulate (a) the Confidential Information have tangible value and constitute trade secrets and are proprietary to *** and (b) unauthorized disclosure of the Confidential Information will cause irreparable harm to *** for which damages will not provide an adequate remedy.

9. BMT's obligations pursuant to this letter shall survive completion of this assignment, but shall terminate five years after the date of this agreement.

The parties hereby agree with the terms of this Confidentiality Agreement.
***

Name	Signature
Position	Date

BMT FLEET TECHNOLOGY LIMITED (BMT)

Name	Signature
Position	Date

APPENDIX C

GEOGRAPHICAL REGIONS AND PORTS

The table in this appendix shows the main ports and countries associated with each geographical region set out in Section 5.2. The geographical regions and subsidiary ports were identified by DNV. It is important to note that this is not the complete list from which fuel samples were taken to determine sulphur levels; many of these main ports represent a group of smaller, nearby ports. For example, the Port of Vancouver comprises many subsidiary ports, as the following table shows.

Geographical Region	Country	Main Port	Subsidiary Ports
Canada & US West Coast	CANADA	VANCOUVER (CA)	VANCOUVER
			FRASER RIVER PORT
			NANAIMO
			NEW WESTMINSTER
			PORT MOODY
			VICTORIA

Geographical Region	Country	Main Port
Baltic SECA	DENMARK	AALBORG
Baltic SECA	DENMARK	AARHUS
Baltic SECA	DENMARK	BORNHOLM
Baltic SECA	DENMARK	COPENHAGEN
Baltic SECA	DENMARK	FREDERICIA
Baltic SECA	DENMARK	GREAT BELT
Baltic SECA	DENMARK	KORSOR
Baltic SECA	DENMARK	NYKOBING
Baltic SECA	DENMARK	ODENSE
Baltic SECA	DENMARK	SKAGEN
Baltic SECA	DENMARK	SONDERBORG
Baltic SECA	DENMARK	SVENDBORG
Baltic SECA	ESTONIA	TALLINN
Baltic SECA	FINLAND	HAMINA
Baltic SECA	FINLAND	HELSINKI
Baltic SECA	FINLAND	JAKOBSTAD
Baltic SECA	FINLAND	KASKINEN
Baltic SECA	FINLAND	KEMI
Baltic SECA	FINLAND	KOTKA
Baltic SECA	FINLAND	KRISTIINANKAUPUNKI
Baltic SECA	FINLAND	MANTYLUOTO
Baltic SECA	FINLAND	OULU
Baltic SECA	FINLAND	PORVOO
Baltic SECA	FINLAND	TURKU
Baltic SECA	FINLAND	VAASA
Baltic SECA	GERMANY	FLENSBURG
Baltic SECA	GERMANY	KIEL
Baltic SECA	GERMANY	LUBECK
Baltic SECA	GERMANY	ROSTOCK
Baltic SECA	LATVIA	RIGA
Baltic SECA	LATVIA	VENTSPILS
Baltic SECA	LITHUANIA	KLAIPEDA
Baltic SECA	POLAND	GDANSK
Baltic SECA	POLAND	RIVER ODER
Baltic SECA	RUSSIAN FEDERATION	KALININGRAD
Baltic SECA	RUSSIAN FEDERATION	ST.PETERSBURG
Baltic SECA	SWEDEN	GOTHENBURG
Baltic SECA	SWEDEN	KALMAR
Baltic SECA	SWEDEN	KARLSHAMN
Baltic SECA	SWEDEN	LULEA
Baltic SECA	SWEDEN	MALMO
Baltic SECA	SWEDEN	ORNSKOLDSVIK
Baltic SECA	SWEDEN	OSCARSHAMN
Baltic SECA	SWEDEN	SKELLEFTEA
Baltic SECA	SWEDEN	SLITE
Baltic SECA	SWEDEN	STOCKHOLM
Baltic SECA	SWEDEN	SUNDSVALL
Baltic SECA	UNKNOWN	BALTIC SEA
Biscay	FRANCE	BAYONNE
Biscay	FRANCE	BORDEAUX
Biscay	FRANCE	BREST
Biscay	FRANCE	LA PALLICE
Biscay	FRANCE	NANTES
Biscay	FRANCE	ST.NAZAIRE
Biscay	SPAIN	BILBAO
Biscay	SPAIN	CORUNNA
Biscay	SPAIN	GIJON
Biscay	SPAIN	VIGO
Canada & US East Coast	CANADA	BAIE COMEAU

Geographical Region	Country	Main Port
Canada & US East Coast	CANADA	QUEBEC
Canada & US East Coast	CANADA	SAINT JOHN, NB
Canada & US East Coast	CANADA	ST.JOHN'S
Canada & US East Coast	CANADA	SYDNEY (CA)
Canada & US East Coast	UNITED STATES OF AMERICA	BALTIMORE
Canada & US East Coast	UNITED STATES OF AMERICA	BOSTON
Canada & US East Coast	UNITED STATES OF AMERICA	CHARLESTON
Canada & US East Coast	UNITED STATES OF AMERICA	FALL RIVER
Canada & US East Coast	UNITED STATES OF AMERICA	JACKSONVILLE
Canada & US East Coast	UNITED STATES OF AMERICA	MIAMI
Canada & US East Coast	UNITED STATES OF AMERICA	NEW YORK
Canada & US East Coast	UNITED STATES OF AMERICA	NORFOLK
Canada & US East Coast	UNITED STATES OF AMERICA	PHILADELPHIA
Canada & US East Coast	UNITED STATES OF AMERICA	PORT CANAVERAL
Canada & US East Coast	UNITED STATES OF AMERICA	PORTLAND, ME
Canada & US East Coast	UNITED STATES OF AMERICA	PORTSMOUTH, NH
Canada & US East Coast	UNITED STATES OF AMERICA	PROVIDENCE
Canada & US East Coast	UNITED STATES OF AMERICA	SAVANNAH
Canada & US East Coast	UNITED STATES OF AMERICA	WILMINGTON, NC
Canada & US West Coast	CANADA	PRINCE RUPERT
Canada & US West Coast	CANADA	TUKTOYAKTUK
Canada & US West Coast	CANADA	VANCOUVER (CA)
Canada & US West Coast	UNITED STATES OF AMERICA	ANCHORAGE
Canada & US West Coast	UNITED STATES OF AMERICA	COOS BAY
Canada & US West Coast	UNITED STATES OF AMERICA	KETCHIKAN
Canada & US West Coast	UNITED STATES OF AMERICA	KODIAK
Canada & US West Coast	UNITED STATES OF AMERICA	LOS ANGELES
Canada & US West Coast	UNITED STATES OF AMERICA	PORTLAND, OR
Canada & US West Coast	UNITED STATES OF AMERICA	SAN DIEGO
Canada & US West Coast	UNITED STATES OF AMERICA	SAN FRANCISCO
Canada & US West Coast	UNITED STATES OF AMERICA	SEATTLE
Canada & US West Coast	UNITED STATES OF AMERICA	SKAGWAY
Caribbean	ANTIGUA AND BARBUDA	ST.JOHN'S (AG)
Caribbean	ARUBA	ARUBA
Caribbean	BAHAMAS	FREEPORT (BS)
Caribbean	BAHAMAS	NASSAU
Caribbean	BAHAMAS	OFF BAHAMAS
Caribbean	BARBADOS	BRIDGETOWN
Caribbean	BERMUDA	ST.GEORGE'S
Caribbean	CAYMAN ISLANDS	GEORGE TOWN (KY)
Caribbean	CUBA	CIENFUEGOS
Caribbean	CUBA	HAVANA
Caribbean	CUBA	NUEVITAS
Caribbean	CUBA	SANTIAGO DE CUBA
Caribbean	DOMINICAN REPUBLIC	PUERTO PLATA
Caribbean	DOMINICAN REPUBLIC	SANTO DOMINGO
Caribbean	GRENADA	ST. GEORGE'S
Caribbean	GUADELOUPE	GUSTAVIA
Caribbean	GUADELOUPE	POINTE A PITRE
Caribbean	JAMAICA	KINGSTON
Caribbean	JAMAICA	MONTEGO BAY
Caribbean	MARTINIQUE	FORT DE FRANCE
Caribbean	NETHERLANDS ANTILLES	BONAIRE
Caribbean	NETHERLANDS ANTILLES	CURACAO
Caribbean	NETHERLANDS ANTILLES	ST.EUSTATIUS
Caribbean	NETHERLANDS ANTILLES	ST.MAARTEN
Caribbean	PUERTO RICO	PONCE
Caribbean	PUERTO RICO	SAN JUAN

Geographical Region	Country	Main Port
Central America	EL SALVADOR	ACAJUTLA
Central America	EL SALVADOR	CUTUCO
Central America	GUATEMALA	PUERTO BARRIOS
Central America	GUATEMALA	PUERTO QUETZAL
Central America	HONDURAS	PUERTO CORTES
Central America	HONDURAS	SAN LORENZO (HN)
Central America	MEXICO	ACAPULCO
Central America	MEXICO	CAYOS ARCAS
Central America	MEXICO	CIUDAD DEL CARMEN
Central America	MEXICO	COATZACOALCOS
Central America	MEXICO	COZUMEL
Central America	MEXICO	DOS BOCAS
Central America	MEXICO	ENSENADA
Central America	MEXICO	GUAYMAS
Central America	MEXICO	LA PAZ (MX)
Central America	MEXICO	MAZATLAN
Central America	MEXICO	TAMPICO
Central America	MEXICO	VERACRUZ
Central America	NICARAGUA	CORINTO
Central America	PANAMA	PANAMA CANAL
Central America	PANAMA	PUERTO ARMUELLES
East Africa	COMOROS	MAYOTTE
East Africa	DJIBOUTI	DJIBOUTI
East Africa	ETHIOPIA	ASSAB
East Africa	FRANCE	KERGUELEN ISLAND
East Africa	KENYA	MOMBASA
East Africa	MADAGASCAR	ANTSIRANANA
East Africa	MADAGASCAR	TOAMASINA
East Africa	MADAGASCAR	TOLIARY
East Africa	MAURITIUS	PORT LOUIS
East Africa	MOZAMBIQUE	MAPUTO
East Africa	MOZAMBIQUE	NACALA
East Africa	MOZAMBIQUE	OFF MOZAMBIQUE
East Africa	REUNION	ST.DENIS
East Africa	SEYCHELLES	PORT VICTORIA
East Africa	SUDAN	PORT SUDAN
East Africa	UNITED REPUBLIC OF TANZANIA	DAR-ES-SALAAM
East Asia	CHINA	BEIHAI
East Asia	CHINA	DAGU
East Asia	CHINA	DALIAN
East Asia	CHINA	GUANGZHOU
East Asia	CHINA	HAI HE RIVER
East Asia	CHINA	LONGKOU
East Asia	CHINA	QINGDAO
East Asia	CHINA	QINHUANGDAO
East Asia	CHINA	SHANGHAI
East Asia	CHINA	SHAOGUAN
East Asia	CHINA	TAKU BAR
East Asia	CHINA	XIAMEN
East Asia	CHINA	YANTIAN
East Asia	CHINA	ZHANJIANG
East Asia	HONG KONG	HONG KONG
East Asia	JAPAN	AOMORI
East Asia	JAPAN	FUNAKAWA
East Asia	JAPAN	FUSHIKI
East Asia	JAPAN	HACHINOHE
East Asia	JAPAN	HAKODATE
East Asia	JAPAN	HIRAO

Geographical Region	Country	Main Port
East Asia	JAPAN	NAGOYA
East Asia	JAPAN	NIIGATA
East Asia	JAPAN	NIIHAMA
East Asia	JAPAN	OITA
East Asia	JAPAN	OKAYAMA
East Asia	JAPAN	OKINAWA
East Asia	JAPAN	OSAKA
East Asia	JAPAN	OWASE
East Asia	JAPAN	SHIMONOSEKI
East Asia	JAPAN	SHIOGAMA
East Asia	JAPAN	TAKAMATSU
East Asia	JAPAN	TOKYO BAY
East Asia	JAPAN	TOMAKOMAI
East Asia	JAPAN	TOYAMA
East Asia	JAPAN	TSURUGA
East Asia	JAPAN	WAKAYAMA
East Asia	JAPAN	WAKKANAI
East Asia	REPUBLIC OF KOREA	BUSAN
East Asia	REPUBLIC OF KOREA	INCHON
East Asia	REPUBLIC OF KOREA	MOKPO
East Asia	RUSSIAN FEDERATION	KHOLMSK
East Asia	RUSSIAN FEDERATION	PETROPAVLOVSK-KAMCHATSKIY
East Asia	RUSSIAN FEDERATION	VANINO
East Asia	RUSSIAN FEDERATION	VLADIVOSTOK
East Asia	TAIWAN	HUALIEN
East Asia	TAIWAN	KAOHSIUNG
East Asia	TAIWAN	KEELUNG
Great Lakes	CANADA	PORT COLBORNE
Great Lakes	CANADA	SAULT ST.MARIE (CA)
Great Lakes	CANADA	TORONTO
Great Lakes	CANADA	WINDSOR (CA)
Great Lakes	UNITED STATES OF AMERICA	CHICAGO
Great Lakes	UNITED STATES OF AMERICA	DETROIT
Great Lakes	UNITED STATES OF AMERICA	DULUTH
Great Lakes	UNITED STATES OF AMERICA	MILWAUKEE
Indian Sub-Continent	BANGLADESH	CHITTAGONG
Indian Sub-Continent	BANGLADESH	MONGLA
Indian Sub-Continent	BRITISH INDIAN OCEAN TERRITORY	DIEGO GARCIA
Indian Sub-Continent	INDIA	CALCUTTA
Indian Sub-Continent	INDIA	COCHIN
Indian Sub-Continent	INDIA	KANDLA
Indian Sub-Continent	INDIA	MADRAS
Indian Sub-Continent	INDIA	MAGDALLA
Indian Sub-Continent	INDIA	MORMUGAO
Indian Sub-Continent	INDIA	MUMBAI
Indian Sub-Continent	INDIA	PARADIP
Indian Sub-Continent	INDIA	PIPAVAV
Indian Sub-Continent	INDIA	TUTICORIN
Indian Sub-Continent	INDIA	VISAKHAPATNAM
Indian Sub-Continent	PAKISTAN	KARACHI
Indian Sub-Continent	SRI LANKA	COLOMBO
Mediterranean & Black Sea	ALGERIA	ALGIERS
Mediterranean & Black Sea	ALGERIA	BEJAIA
Mediterranean & Black Sea	ALGERIA	ORAN
Mediterranean & Black Sea	ALGERIA	SKIKDA
Mediterranean & Black Sea	BULGARIA	BALCHIK
Mediterranean & Black Sea	BULGARIA	BOURGAS
Mediterranean & Black Sea	CROATIA	RIJEKA

Geographical Region	Country	Main Port
Mediterranean & Black Sea	GREECE	CORFU
Mediterranean & Black Sea	GREECE	KALAMATA
Mediterranean & Black Sea	GREECE	KALILIMENES
Mediterranean & Black Sea	GREECE	KAVALA
Mediterranean & Black Sea	GREECE	OFF GREECE
Mediterranean & Black Sea	GREECE	PATRAS
Mediterranean & Black Sea	GREECE	PIRAEUS
Mediterranean & Black Sea	GREECE	PREVEZA
Mediterranean & Black Sea	GREECE	RHODOS
Mediterranean & Black Sea	GREECE	SYROS ISLAND
Mediterranean & Black Sea	GREECE	THESSALONIKI
Mediterranean & Black Sea	GREECE	VOLOS
Mediterranean & Black Sea	ISRAEL	HAIFA
Mediterranean & Black Sea	ITALY	ANCONA
Mediterranean & Black Sea	ITALY	AUGUSTA
Mediterranean & Black Sea	ITALY	BRINDISI
Mediterranean & Black Sea	ITALY	CAGLIARI
Mediterranean & Black Sea	ITALY	CIVITAVECCHIA
Mediterranean & Black Sea	ITALY	CROTONE
Mediterranean & Black Sea	ITALY	GENOA
Mediterranean & Black Sea	ITALY	LEGHORN
Mediterranean & Black Sea	ITALY	NAPLES
Mediterranean & Black Sea	ITALY	PESARO
Mediterranean & Black Sea	ITALY	RAVENNA
Mediterranean & Black Sea	ITALY	REGGIO DI CALABRIA
Mediterranean & Black Sea	ITALY	SARDINIA
Mediterranean & Black Sea	ITALY	SPEZIA
Mediterranean & Black Sea	ITALY	TARANTO
Mediterranean & Black Sea	ITALY	TRIESTE
Mediterranean & Black Sea	ITALY	VENICE
Mediterranean & Black Sea	JORDAN	AQABA
Mediterranean & Black Sea	LEBANON	BEIRUT
Mediterranean & Black Sea	LIBYAN ARAB JAMAHIRIYA	BENGHAZI
Mediterranean & Black Sea	LIBYAN ARAB JAMAHIRIYA	ES SIDER
Mediterranean & Black Sea	LIBYAN ARAB JAMAHIRIYA	OFF LIBYAN
Mediterranean & Black Sea	LIBYAN ARAB JAMAHIRIYA	TOBRUK
Mediterranean & Black Sea	LIBYAN ARAB JAMAHIRIYA	TRIPOLI
Mediterranean & Black Sea	MALTA	VALLETTA
Mediterranean & Black Sea	MONACO	MONTE CARLO
Mediterranean & Black Sea	ROMANIA	CONSTANTZA
Mediterranean & Black Sea	RUSSIAN FEDERATION	NOVOROSSIYSK
Mediterranean & Black Sea	RUSSIAN FEDERATION	ROSTOV
Mediterranean & Black Sea	SERBIA AND MONTENEGRO	DUBROVNIK
Mediterranean & Black Sea	SERBIA AND MONTENEGRO	KONTOR
Mediterranean & Black Sea	SLOVENIA	KOPER
Mediterranean & Black Sea	SPAIN	ALGECIRAS
Mediterranean & Black Sea	SPAIN	ALICANTE
Mediterranean & Black Sea	SPAIN	ALMERIA
Mediterranean & Black Sea	SPAIN	BARCELONA
Mediterranean & Black Sea	SPAIN	CADIZ
Mediterranean & Black Sea	SPAIN	CARTAGENA (ES)
Mediterranean & Black Sea	SPAIN	CASTELLON
Mediterranean & Black Sea	SPAIN	CEUTA
Mediterranean & Black Sea	SPAIN	HUELVA
Mediterranean & Black Sea	SPAIN	IBIZA
Mediterranean & Black Sea	SPAIN	MALAGA
Mediterranean & Black Sea	SPAIN	PALMA DE MALLORCA
Mediterranean & Black Sea	SPAIN	TARRAGONA

Geographical Region	Country	Main Port
Mediterranean & Black Sea	TURKEY	SAMSUN
Mediterranean & Black Sea	UKRAINE	ODESSA
Mediterranean & Black Sea	UKRAINE	YALTA
Middle East	BAHRAIN	BAHRAIN
Middle East	EGYPT	RAS SHUKHEIR
Middle East	EGYPT	SAFAGA
Middle East	EGYPT	SUEZ
Middle East	IRAQ	BASRAH
Middle East	ISLAMIC REPUBLIC OF IRAN	BANDAR ABBAS
Middle East	ISLAMIC REPUBLIC OF IRAN	BANDAR MAHSHAHR
Middle East	ISLAMIC REPUBLIC OF IRAN	BUSHIRE
Middle East	ISLAMIC REPUBLIC OF IRAN	KHARG ISLAND
Middle East	ISLAMIC REPUBLIC OF IRAN	LAVAN ISLAND
Middle East	ISRAEL	EILAT
Middle East	KUWAIT	KUWAIT
Middle East	KUWAIT	MINA SAUD
Middle East	OMAN	MINA QABOOS
Middle East	OMAN	OFF OMAN
Middle East	OMAN	SALALAH
Middle East	QATAR	DOHA
Middle East	QATAR	UMM SAID
Middle East	SAUDI ARABIA	JEDDAH
Middle East	SAUDI ARABIA	RAS AL KHAFJI
Middle East	SAUDI ARABIA	RAS TANURA
Middle East	SAUDI ARABIA	YANBU
Middle East	SYRIAN ARAB REPUBLIC	TARTOUS
Middle East	UNITED ARAB EMIRATES	ABU DHABI
Middle East	UNITED ARAB EMIRATES	DUBAI
Middle East	UNITED ARAB EMIRATES	FUJAIRAH
Middle East	UNITED ARAB EMIRATES	RUWAIS
Middle East	YEMEN	ADEN
North Atlantic ex. Biscay	FAROE ISLANDS	TORSHAVN
North Atlantic ex. Biscay	GREENLAND	NUUK
North Atlantic ex. Biscay	ICELAND	REYKJAVIK
North Atlantic ex. Biscay	IRELAND	CORK
North Atlantic ex. Biscay	IRELAND	DUBLIN
North Atlantic ex. Biscay	IRELAND	GALWAY
North Atlantic ex. Biscay	IRELAND	LIMERICK
North Atlantic ex. Biscay	IRELAND	SLIGO
North Atlantic ex. Biscay	IRELAND	WATERFORD
North Atlantic ex. Biscay	NORWAY	BODO
North Atlantic ex. Biscay	NORWAY	KIRKENES
North Atlantic ex. Biscay	NORWAY	LONGYEARBYEN
North Atlantic ex. Biscay	NORWAY	MO I RANA
North Atlantic ex. Biscay	NORWAY	NARVIK
North Atlantic ex. Biscay	NORWAY	TROMSO
North Atlantic ex. Biscay	NORWAY	TRONDHEIM
North Atlantic ex. Biscay	PORTUGAL	FUNCHAL
North Atlantic ex. Biscay	PORTUGAL	LISBON
North Atlantic ex. Biscay	PORTUGAL	OPORTO
North Atlantic ex. Biscay	PORTUGAL	PONTA DELGADA
North Atlantic ex. Biscay	RUSSIAN FEDERATION	ARCHANGEL
North Atlantic ex. Biscay	RUSSIAN FEDERATION	KOVDA
North Atlantic ex. Biscay	RUSSIAN FEDERATION	MURMANSK
North Atlantic ex. Biscay	RUSSIAN FEDERATION	NARYAN MAR
North Atlantic ex. Biscay	UNITED KINGDOM	AVONMOUTH
North Atlantic ex. Biscay	UNITED KINGDOM	AYR
North Atlantic ex. Biscay	UNITED KINGDOM	BELFAST

Geographical Region	Country	Main Port
North Sea SECA ARA	NETHERLANDS	AMSTERDAM
North Sea SECA ARA	NETHERLANDS	FLUSHING
North Sea SECA ARA	NETHERLANDS	ROTTERDAM
North Sea SECA ex. ARA	BELGIUM	ZEEBRUGGE
North Sea SECA ex. ARA	DENMARK	ESBJERG
North Sea SECA ex. ARA	FRANCE	BOULOGNE
North Sea SECA ex. ARA	FRANCE	CHERBOURG
North Sea SECA ex. ARA	FRANCE	DIEPPE
North Sea SECA ex. ARA	FRANCE	DUNKIRK
North Sea SECA ex. ARA	FRANCE	LE HAVRE
North Sea SECA ex. ARA	FRANCE	ROSCOFF
North Sea SECA ex. ARA	FRANCE	ROUEN
North Sea SECA ex. ARA	FRANCE	ST.MALO
North Sea SECA ex. ARA	GERMANY	BREMERHAVEN
North Sea SECA ex. ARA	GERMANY	EMDEN
North Sea SECA ex. ARA	GERMANY	HAMBURG
North Sea SECA ex. ARA	GERMANY	WILHELMSHAVEN
North Sea SECA ex. ARA	NETHERLANDS	DELFZYL
North Sea SECA ex. ARA	NETHERLANDS	DEN HELDER
North Sea SECA ex. ARA	NORWAY	BERGEN
North Sea SECA ex. ARA	NORWAY	MANDAL
North Sea SECA ex. ARA	NORWAY	OSLO FJORD
North Sea SECA ex. ARA	SWEDEN	UDDEVALLA
North Sea SECA ex. ARA	UNITED KINGDOM	ABERDEEN
North Sea SECA ex. ARA	UNITED KINGDOM	DOVER
North Sea SECA ex. ARA	UNITED KINGDOM	DUNDEE
North Sea SECA ex. ARA	UNITED KINGDOM	FALMOUTH
North Sea SECA ex. ARA	UNITED KINGDOM	GRANGEMOUTH
North Sea SECA ex. ARA	UNITED KINGDOM	HARWICH
North Sea SECA ex. ARA	UNITED KINGDOM	INVERGORDON
North Sea SECA ex. ARA	UNITED KINGDOM	LERWICK
North Sea SECA ex. ARA	UNITED KINGDOM	NEWCASTLE
North Sea SECA ex. ARA	UNITED KINGDOM	OFF UNITED KINGDOM
North Sea SECA ex. ARA	UNITED KINGDOM	PLYMOUTH
North Sea SECA ex. ARA	UNITED KINGDOM	POOLE
North Sea SECA ex. ARA	UNITED KINGDOM	RIVER HUMBER
North Sea SECA ex. ARA	UNITED KINGDOM	SCAPA FLOW
North Sea SECA ex. ARA	UNITED KINGDOM	SCRABSTER
North Sea SECA ex. ARA	UNITED KINGDOM	SHOREHAM
North Sea SECA ex. ARA	UNITED KINGDOM	SOUTHAMPTON
North Sea SECA ex. ARA	UNITED KINGDOM	TEESSIDE
North Sea SECA ex. ARA	UNITED KINGDOM	THAMES ESTUARY
Oceania	AMERICAN SAMOA	PAGO PAGO
Oceania	AUSTRALIA	ADELAIDE
Oceania	AUSTRALIA	ALBANY
Oceania	AUSTRALIA	BRISBANE
Oceania	AUSTRALIA	DAMPIER
Oceania	AUSTRALIA	DARWIN
Oceania	AUSTRALIA	FREMANTLE
Oceania	AUSTRALIA	GLADSTONE
Oceania	AUSTRALIA	HOBART
Oceania	AUSTRALIA	MELBOURNE
Oceania	AUSTRALIA	SYDNEY
Oceania	AUSTRALIA	TOWNSVILLE
Oceania	AUSTRALIA	WHYALLA
Oceania	FIJI	SUVA
Oceania	FRENCH POLYNESIA	PAPEETE
Oceania	GUAM	GUAM

Geographical Region	Country	Main Port
Oceania	UNITED STATES OF AMERICA	HONOLULU
South Africa	SOUTH AFRICA	CAPE TOWN
South Africa	SOUTH AFRICA	DURBAN
South Africa	SOUTH AFRICA	PORT ELIZABETH
South America - East	ARGENTINA	BAHIA BLANCA
South America - East	ARGENTINA	BUENOS AIRES
South America - East	ARGENTINA	COMODORO RIVADAVIA
South America - East	ARGENTINA	LA PAZ
South America - East	ARGENTINA	MAR DEL PLATA
South America - East	ARGENTINA	PUERTO MADRYN
South America - East	ARGENTINA	USHUAIA
South America - East	BRAZIL	BELEM
South America - East	BRAZIL	FORTALEZA
South America - East	BRAZIL	IMBITUBA
South America - East	BRAZIL	MANAUS
South America - East	BRAZIL	PARANAGUA
South America - East	BRAZIL	RECIFE
South America - East	BRAZIL	RIO DE JANEIRO
South America - East	BRAZIL	RIO GRANDE
South America - East	BRAZIL	SALVADOR
South America - East	BRAZIL	SANTOS
South America - East	BRAZIL	VITORIA
South America - East	FALKLAND ISLANDS	STANLEY
South America - East	URUGUAY	MONTEVIDEO
South America - North	COLOMBIA	CARTAGENA (CO)
South America - North	COLOMBIA	SANTA MARTA
South America - North	GUYANA	GEORGETOWN (GY)
South America - North	SURINAME	PARAMARIBO
South America - North	VENEZUELA	CARIPITO
South America - North	VENEZUELA	CIUDAD BOLIVAR
South America - North	VENEZUELA	CUMAREBO
South America - North	VENEZUELA	LA GUAIRA
South America - North	VENEZUELA	MARACAIBO
South America - North	VENEZUELA	OFF VENEZUELA
South America - North	VENEZUELA	PUERTO CABELLO
South America - North	VENEZUELA	PUERTO LA CRUZ
South America - North	VENEZUELA	PUNTA CARDON
South America - West	CHILE	ANTOFAGASTA
South America - West	CHILE	CHACABUCO
South America - West	CHILE	HUASCO
South America - West	CHILE	IQUIQUE
South America - West	CHILE	LIRQUEN
South America - West	CHILE	PUNTA ARENAS (CL)
South America - West	CHILE	SAN VICENTE
South America - West	CHILE	VALPARAISO
South America - West	COLOMBIA	BUENAVENTURA
South America - West	ECUADOR	BALAO TERMINAL
South America - West	ECUADOR	GUAYAQUIL
South America - West	ECUADOR	MANTA
South America - West	ECUADOR	PUERTO BOLIVAR (EC)
South America - West	ECUADOR	PUNTA ARENAS (EC)
South America - West	PERU	CALLAO
South America - West	PERU	ILO
South America - West	PERU	TALARA
South Asia	INDONESIA	BALIKPAPAN
South Asia	INDONESIA	BELAWAN
South Asia	INDONESIA	BENOA
South Asia	INDONESIA	BITUNG

Geographical Region	Country	Main Port
South Asia	INDONESIA	SURABAYA
South Asia	INDONESIA	TANJUNG UBAN
South Asia	INDONESIA	UJUNG PANDANG
South Asia	MALAYSIA	BINATANG
South Asia	MALAYSIA	KUANTAN
South Asia	MALAYSIA	LABUAN
South Asia	MALAYSIA	MELAKA
South Asia	MALAYSIA	PASIR GUDANG
South Asia	MALAYSIA	PENANG
South Asia	MALAYSIA	PORT KLANG
South Asia	MALAYSIA	TANJUNG PELEPAS
South Asia	MALAYSIA	TELUK EWA
South Asia	PHILIPPINES	DAVAO
South Asia	PHILIPPINES	GENERAL SANTOS
South Asia	PHILIPPINES	ILIGAN
South Asia	PHILIPPINES	ILOILO
South Asia	PHILIPPINES	LEGASPI
South Asia	PHILIPPINES	MANILA
South Asia	PHILIPPINES	PORO
South Asia	PHILIPPINES	TACLOBAN
South Asia	SINGAPORE	SINGAPORE
South Asia	THAILAND	BANGKOK
South Asia	THAILAND	KO SICHANG
South Asia	THAILAND	SIAM PORT
South Asia	UNKNOWN	SINGAPORE OPL
South Asia	VIETNAM	DA NANG
South Asia	VIETNAM	HANOI
South Asia	VIETNAM	HO CHI MINH CITY
South Asia	VIETNAM	NHA TRANG
US Gulf Coast	UNITED STATES OF AMERICA	BROWNSVILLE
US Gulf Coast	UNITED STATES OF AMERICA	CORPUS CHRISTI
US Gulf Coast	UNITED STATES OF AMERICA	FREEPORT, TX
US Gulf Coast	UNITED STATES OF AMERICA	HOUSTON
US Gulf Coast	UNITED STATES OF AMERICA	LAKE CHARLES
US Gulf Coast	UNITED STATES OF AMERICA	MOBILE
US Gulf Coast	UNITED STATES OF AMERICA	MORGAN CITY
US Gulf Coast	UNITED STATES OF AMERICA	NEW ORLEANS
US Gulf Coast	UNITED STATES OF AMERICA	OFF US GULF
US Gulf Coast	UNITED STATES OF AMERICA	PENSACOLA
US Gulf Coast	UNITED STATES OF AMERICA	PORT ARTHUR
US Gulf Coast	UNITED STATES OF AMERICA	TAMPA
West Africa	ANGOLA	CABINDA
West Africa	ANGOLA	LOBITO
West Africa	ANGOLA	LUANDA
West Africa	ANGOLA	NAMIBE
West Africa	ANGOLA	OFF ANGOLA
West Africa	BENIN	COTONOU
West Africa	CAMEROON	DOUALA
West Africa	CAMEROON	OFF CAMEROON
West Africa	CAPE VERDE	ST.VINCENT
West Africa	CONGO	POINTE NOIRE
West Africa	COTE D'IVOIRE	ABIDJAN
West Africa	COTE D'IVOIRE	SAN PEDRO (CI)
West Africa	DEMOCRATIC REPUBLIC OF CONGO (ZAII	MATADI
West Africa	EQUATORIAL GUINEA	BATA
West Africa	GABON	LIBREVILLE
West Africa	GABON	PORT GENTIL
West Africa	GAMBIA	BANJUL

Geographical Region	Country	Main Port
West Africa	NAMIBIA	OFF NAMIBIA
West Africa	NAMIBIA	WALVIS BAY
West Africa	NIGERIA	LAGOS
West Africa	NIGERIA	OFF NIGERIA
West Africa	NIGERIA	PORT HARCOURT
West Africa	NIGERIA	QUA IBOE
West Africa	NIGERIA	WARRI
West Africa	SAO TOME AND PRINCIPE	SANTO ANTONIO
West Africa	SAO TOME AND PRINCIPE	SAO TOME
West Africa	SENEGAL	DAKAR
West Africa	SIERRA LEONE	FREETOWN
West Africa	SPAIN	LAS PALMAS
West Africa	SPAIN	TENERIFE
West Africa	TOGO	LOME
West Africa	WESTERN SAHARA	OFF DAKHLA