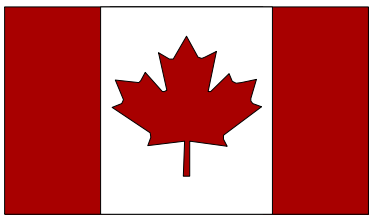

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Benzene in Canadian Gasoline:

Report on the Effect of the Benzene in Gasoline Regulations

2003

by **Lorri Thompson**
Oil, Gas and Energy Branch
Air Pollution Prevention Directorate
Environment Canada

and **Abeer Al-Azzawi**
Co-op Student
Carleton University

and **Hung Ngyuen**
Co-op Student
University of Waterloo

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Environment Canada

Benzene in Canadian Gasoline

2003

Notice

The information contained in this report is compiled from data submitted by the producers and importers of gasoline in Canada pursuant to the requirements of the *Benzene in Gasoline Regulations* under the *Canadian Environmental Protection Act, 1999*. Submissions have been verified for reasonableness but are subject to potential errors made at the source.

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1.0 Summary

This report reviews how primary suppliers have responded to the *Benzene in Gasoline Regulations* of the *Canadian Environmental Protection Act* and summarizes the information on composition of gasoline reported under the regulations for 2003. All of the information summarized in this report was provided to Environment Canada by producers, importers and blenders of gasoline, pursuant to the requirements of the regulations.

The *Benzene in Gasoline Regulations* came into effect on July 1, 1999, fulfilling a recommendation of the federal-provincial Task Force on Cleaner Vehicles and Fuels. In 1995, the Task Force recommended to the Canadian Council of Ministers of the Environment (CCME) that benzene in gasoline be reduced through a federal regulation to 1% by volume and that aromatics (or equivalent benzene tailpipe emissions) be frozen at 1994 levels. The CCME endorsed this recommendation. Consequently, the federal government passed the federal *Benzene in Gasoline Regulations* on November 26, 1997.

The regulations have been successful in achieving both of the recommendations of the Task Force: reported benzene levels have been significantly reduced and reported aromatic levels are about the same as they were in 1994. Figures 1.1 and 1.2 show how benzene and aromatics levels have changed since the coming into force of the regulations. Figure 1.3 shows that average urban ambient benzene concentrations, measured at Environment Canada monitoring stations across Canada, have fallen by almost 65% between 1990 and 2002 with a small increase from 2002-2003. Since 1998, the year prior to the regulation coming into effect, average urban ambient benzene concentrations have fallen by almost 47% and rural ambient benzene concentrations have fallen by over 32%. In addition, the reported level of MTBE in Canadian gasoline has fallen 82% since 2001.

As of 2003, primary suppliers are required to submit reports annually under the Regulations, rather than quarterly as previously required. Primary suppliers reported that all gasoline supplied in Canada in 2003 met the regulated requirements with respect to benzene concentration and BEN levels, with one exception discussed in Section 3.3.

Independent audits are required for those primary suppliers that elected to be on a yearly pool average and must be submitted to Environment Canada by May 31 of the year following the reporting period. This report includes analysis of the independent audits conducted for the **2002** reporting period. Those audits found several instances of non-compliance with the laboratory procedures along with a few instances of administrative non-compliance as required under the regulations. Most primary suppliers outlined corrective action to address these issues. Environment Canada views the audits as a crucial component of the enforcement provisions of the regulations and will continue to publish the analysis the year following their submission to Environment Canada.

Figure 1.1: Average Benzene Content of Canadian Gasoline 1994-2003

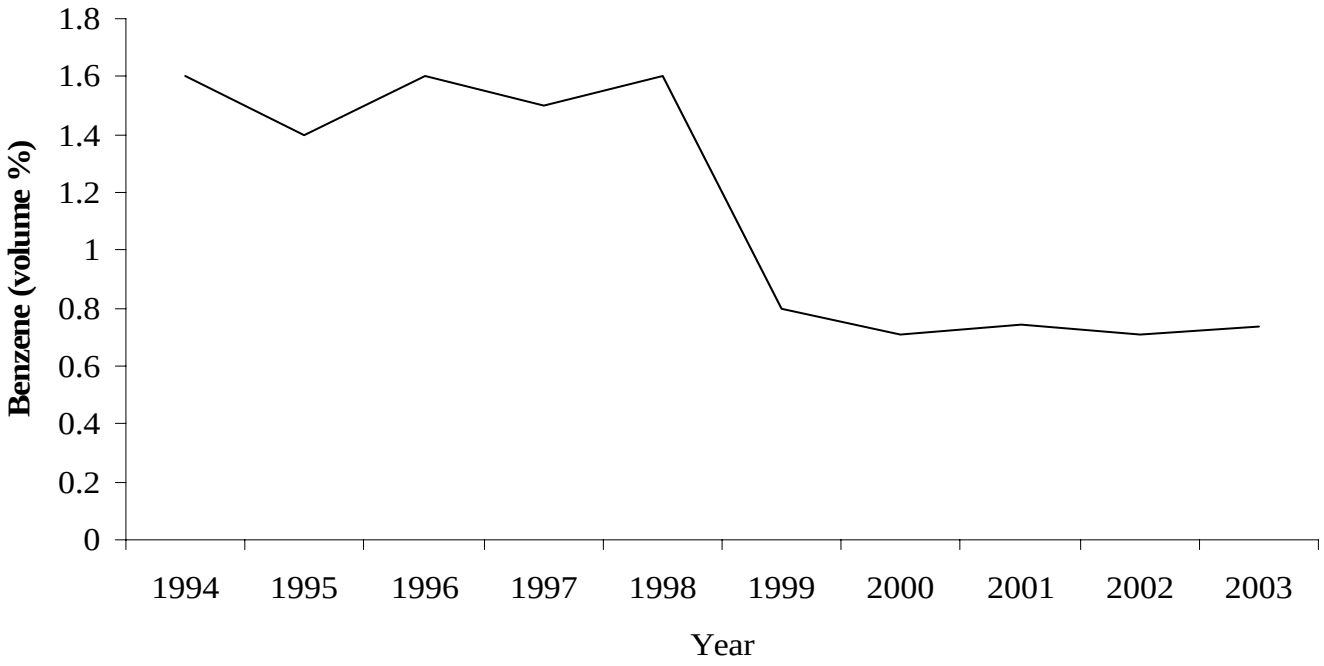


Figure 1.2: Average Aromatics Content of Canadian Gasoline 1994-2003

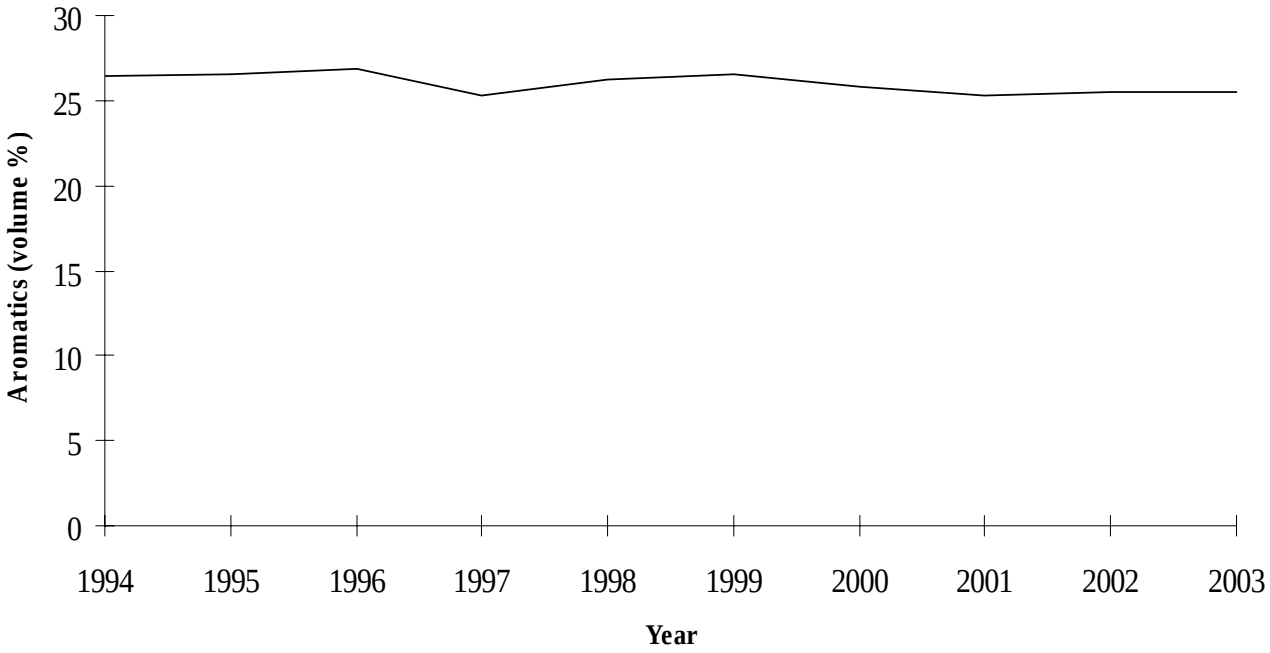
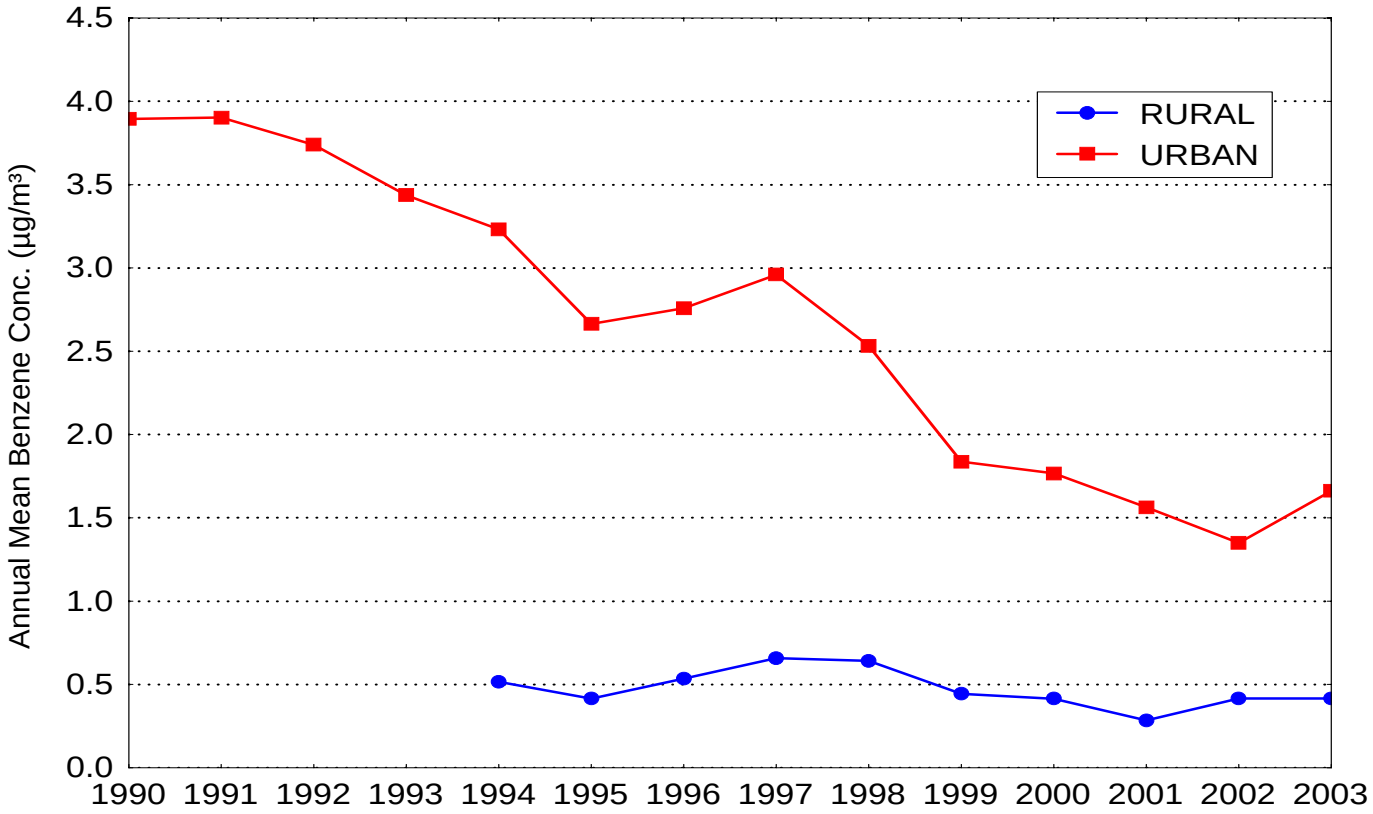

30
25
20
15
10
5
0
Aromatics (volume %)
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year

Figure 1.3: Average Ambient Benzene Concentration in Canada 1990-2003



Source: Tom Dann (Environment Canada), personal communication, 2004

2.0 Introduction

This report reviews the compliance of primary suppliers' (refiners, importers and blenders) gasoline with the *Benzene in Gasoline Regulations*[1] of the *Canadian Environmental Protection Act, 1999*, and summarizes levels of various parameters in Canadian gasoline for 2003. The information used for this report was provided by primary suppliers, as required under the regulations.

2.1 Benzene in Gasoline Regulations

The *Benzene in Gasoline Regulations* were passed in November 1997 in order to reduce emissions of benzene from gasoline-powered vehicles. The regulations limit the level of benzene and the benzene emission number (BEN)[2] of Canadian gasoline and require reporting on the composition of gasoline that is produced, imported or blended[3]. The regulations apply to all types of gasoline for sale or use in Canada, except gasoline for use in aircraft, competition vehicles or scientific research.

The *Benzene in Gasoline Regulations* introduced a new approach to controlling fuel composition by allowing regulatees the option to elect to use a yearly pool average as the basis for compliance. This option provides regulatees considerable flexibility in meeting the requirements of the regulations. The regulations are primarily focused on primary suppliers (refiners, blenders and importers) who can affect the composition of gasoline. There is also a per-litre limit for benzene at the point of sale. In addition to setting a limit for gasoline benzene content, the regulations also set a limit for the benzene emission number (BEN) of gasoline, a number that relates gasoline composition to estimated emissions of benzene from vehicles.

The regulated limits apply to individual refineries, blending facilities, and imports into a province from outside Canada. Primary suppliers are subject to use flat limits for each of their refineries, blending facilities or import pools unless they have elected for yearly pool average limits. The yearly pool average is the volume-weighted average of benzene or BEN of the gasoline supplied by the primary supplier during a year and may be selected for either benzene, BEN, or both. Independent audits must be submitted to Environment Canada by primary suppliers that elect to be on a yearly pool average.

Since July 1, 1999, primary suppliers have been subject to limits on the level of benzene and the BEN in the gasoline they produce, blend or import. Table 2.1 summarizes the regulated limits for benzene and the BEN.

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[1] SOR/97-493, as amended by SOR/99-204, SOR/2000-102 and SOR/2003-318; a copy of the regulations can be found at www.ec.gc.ca/CEPARegistry/regulations

[2] BEN - The Benzene Emission Number relates gasoline composition to the estimated emissions of benzene from vehicles. It is a number calculated using various gasoline parameters and relates gasoline composition to emissions of benzene from a "typical" 1990 vehicle. (see Schedule 1 of the Regulations)

[3] The definition of "blend" in the regulations excludes the mixing of complying gasoline or the adding of only additives, commercially-pure butane or oxygenate to complying gasoline.

Table 2.1: Regulated Limits for Benzene and the BEN

	Type of Limit	Benzene % by volume	BEN (*)	
			Summer	Winter
Production, Blending and Imports	Flat Limit	1.0	71	92
	Options of Yearly Pool Average YPA Limits	0.95	59.5 (annual average)	
	Not-to-be-exceeded cap	1.5	102	132
Sales	Flat Limit	1.5	N/A	N/A

*Four refineries use alternative (higher) limits for BEN (under subsection 17(2) of the regulations)

All primary suppliers must submit reports annually on the levels of various parameters of gasoline to Environment Canada (quarterly reports were required until the end of 2002). Importers must notify Environment Canada at least 12 hours in advance of their intention to import:

- more than 100 m^3 of gasoline at any one time;
- any amount of gasoline-like blendstock; or
- into a province, more than 1000 m^3 of gasoline within any one day.

Amendments to the *Benzene in Gasoline Regulations* were published on October 8, 2003. These amendments update the test method for measuring sulphur content from CAN/CGSB-3.0 No. 16.1 to the more accurate method ASTM D5453. At the same time a number of minor technical changes were also made to update the regulations, clarify some provisions and make the regulations more consistent with other federal fuels regulations. The requirement to notify Environment Canada at least 12 hours in advance of an importers intention to import more than 1000 m^3 of gasoline into a province within one day was also added.

2.2 Alternative Limits for the BEN

Under subsection 17(2) of the regulations, a primary supplier could elect before December 1, 1998 to use alternative (higher) limits for the BEN. These alternative limits are based on the historical composition of the primary supplier's gasoline, thereby reflecting its historical BEN number. There is no expiry date for alternative BEN limits, although a primary supplier may rescind the alternative limit at any time. A supplier rescinding its alternative limit would then be subject to the normal limits for BEN.

Petro-Canada and Shell elected to use alternative (higher) limits for the BEN at their Ontario and Quebec refineries. Their alternative limits were set out in a Notice published by the Minister of the Environment in the *Canada Gazette* on September 4, 1999 (see Appendix 2).

2.3 Options for Meeting the Requirements of the Regulations

As discussed in section 2.1, primary suppliers can select either flat or yearly pool average limits for benzene and BEN as the basis for compliance. The options are selected separately for each refining, blending facility and import pool. Table 2.2 shows the number of gasoline pools subject to each type of limit for benzene and the BEN for primary suppliers reporting in 2003.

Table 2.2: Number of Gasoline Pools Subject to Flat and Yearly Pool Average Limits

		Flat Limits	YPA Limits
Benzene	Refineries	1	16
	Blending Facilities	1	0
	Import Pools	4	5
BEN	Refineries	6	11
	Blending Facilities	1	0
	Import Pools	7	2

2.4 Reporting Refineries and Importing Companies

Primary suppliers are required to register with Environment Canada using the R*egistration Form for a Manufacturer, Blender or Importer of Gasoline* (Appendix 1). Table 2.3 shows the primary suppliers who were registered with Environment Canada and reported to have supplied gasoline during 2003. The table also shows the type of limit the supplier is subject to for benzene and BEN: "YPA" if the primary supplier has selected a yearly pool average as its basis for compliance, and "flat" (flat per-litre limits) if otherwise.

Table 2.3: Primary Suppliers Reporting on Gasoline Composition

	Name	Location of Production or Province of Import Facilities	Benzene Limit	BEN Limit
Refiners	Chevron Canada	Burnaby, British Columbia	YPA	YPA
	Consumer's Co-op	Regina, Saskatchewan	YPA	Flat
	Husky Oil	Prince George, British Columbia	YPA	YPA
	Imperial Oil - Dartmouth	Dartmouth, Nova Scotia	YPA	Flat
	Imperial Oil - Nanticoke	Jarvis, Ontario	YPA	Flat
	Imperial Oil- Sarnia	Sarnia, Ontario	YPA	Flat
	Imperial Oil - Strathcona	Strathcona, Alberta	YPA	Flat
	Irving Oil	Saint John, New Brunswick	YPA	YPA
	North Atlantic	Come-by-Chance, Newfoundland	Flat	Flat
	Petro-Canada - Edmonton	Edmonton, Alberta	YPA	YPA
	Petro-Canada - Montreal	Montreal, Quebec	YPA	YPA
	Petro-Canada - Oakville	Oakville, Ontario	YPA	YPA
	Shell - Montreal	Montreal, Quebec	YPA	YPA
	Shell - Sarnia	Sarnia, Ontario	YPA	YPA
	Shell - Scotford	Scotford, Alberta	YPA	YPA
	Suncor Energy	Sarnia, Ontario	YPA	YPA
	Ultramar - St-Romuald	St-Romuald, Quebec	YPA	YPA
Blenders	Robbins Feed & Fuel	Thorold, Ontario	Flat	Flat
Importers	CAMI	Ontario	Flat	Flat
	Ford	Ontario	Flat	Flat
	GM	Ontario	Flat	Flat
	Neste Petroleum	Quebec	Flat	Flat
	Petro-Canada- ON	Ontario	YPA	YPA
	Petro-Canada Burrard	British Columbia	YPA	YPA
	Petroles Norcan	Quebec	YPA	Flat
	Ultramar - NF	Newfoundland	YPA	Flat
	Ultramar - QC	Quebec	YPA	Flat

* Locations submitting “Nil” reports were excluded from this table

3.0 Compliance with the Regulations

This section reviews the compliance of primary suppliers with reporting requirements of the regulations and reported exceedances of the benzene and BEN limits.

3.1 Information Reported

Under section 8 of the regulations, primary suppliers must provide the information set out on the form entitled *Report on the Composition of Gasoline* (refer to Appendix 1). The information includes the maximum and year-to-date average values for a number of composition parameters. Primary suppliers must also report the volume of gasoline, the number of batches supplied, and the name of any oxygenates used. Starting in 2003, the report must be submitted once per year before February 15 of the following year. Prior to 2003, the reports were submitted quarterly.

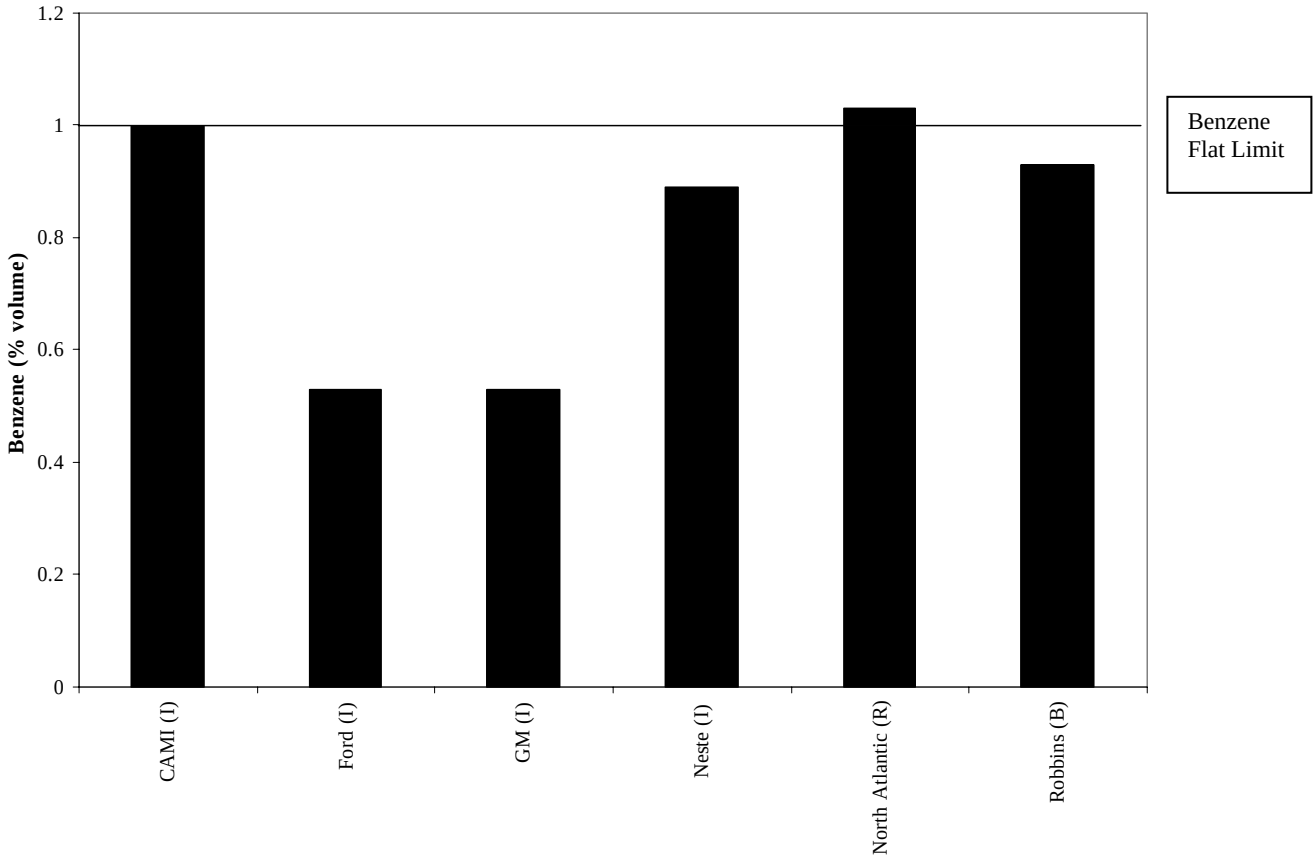
3.2 Exceedances of Regulated Limits

There was one reported exceedance of the Benzene limit that occurred in 2003. One refinery on a flat limit reported a benzene maximum of 1.03. There were no reported exceedances of the annual YPA limits for the BEN.

For primary suppliers using flat limits, Figure 3.1 shows the reported maximum and average benzene level and Figure 3.2 shows the reported maximum and average BEN as a percentage of the regulated limit.

For primary suppliers using YPA limits, Figure 3.3 shows the reported average and maximum benzene levels and Figure 3.4 shows the reported average and maximum BEN levels, as a percentage of the regulated limits. The yearly pool average data from Figures 3.3 and 3.4 represent the volume weighted average for all gasoline from a given primary supplier during the year. For Figure 3.4, the y-axis is in units of percent of the regulated limit, as some primary suppliers were on alternative limits.

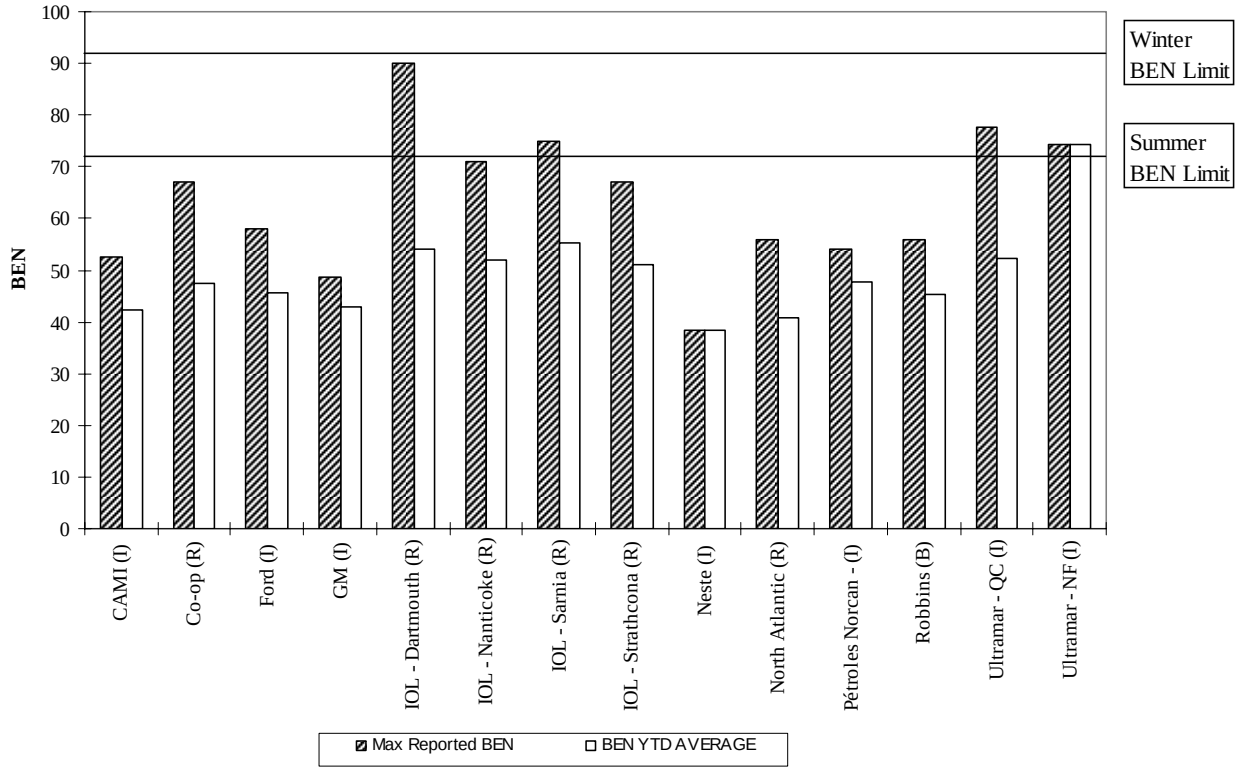
Figure 3.1: Reported Maximum Benzene Levels for Suppliers on a Flat Limit, 2003



Notes:

- 1.0% volume = Benzene Flat Limit
- R = Refiner, B = Blender and I = Importer

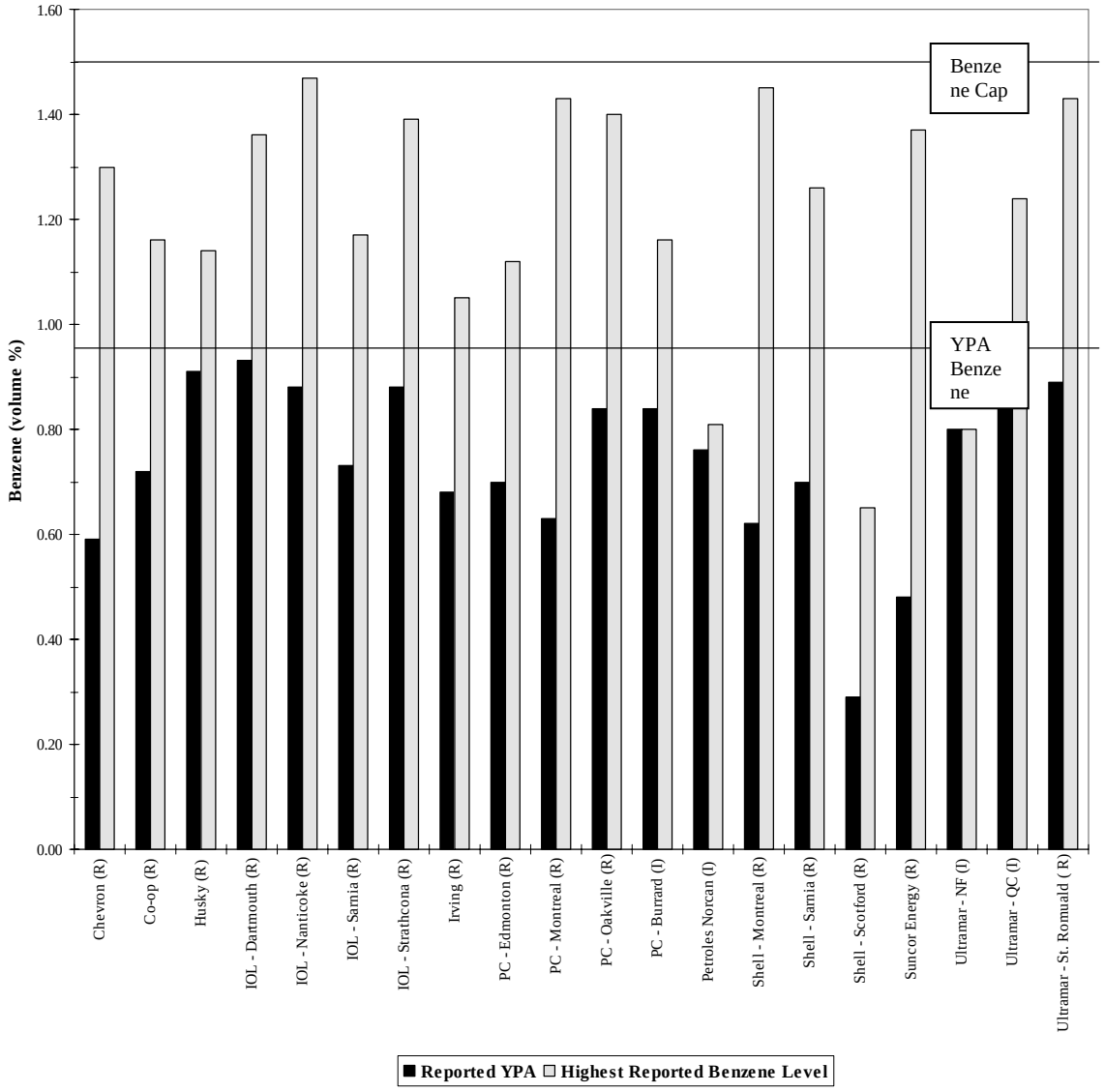
Figure 3.2: Reported Maximum and Average BEN for Suppliers on a Flat Limit, 2003



Notes:

- 92 = Flat BEN Winter Limit
- 71 = Flat BEN Summer Limit
- R = Refiner, B = Blender and I = Importer

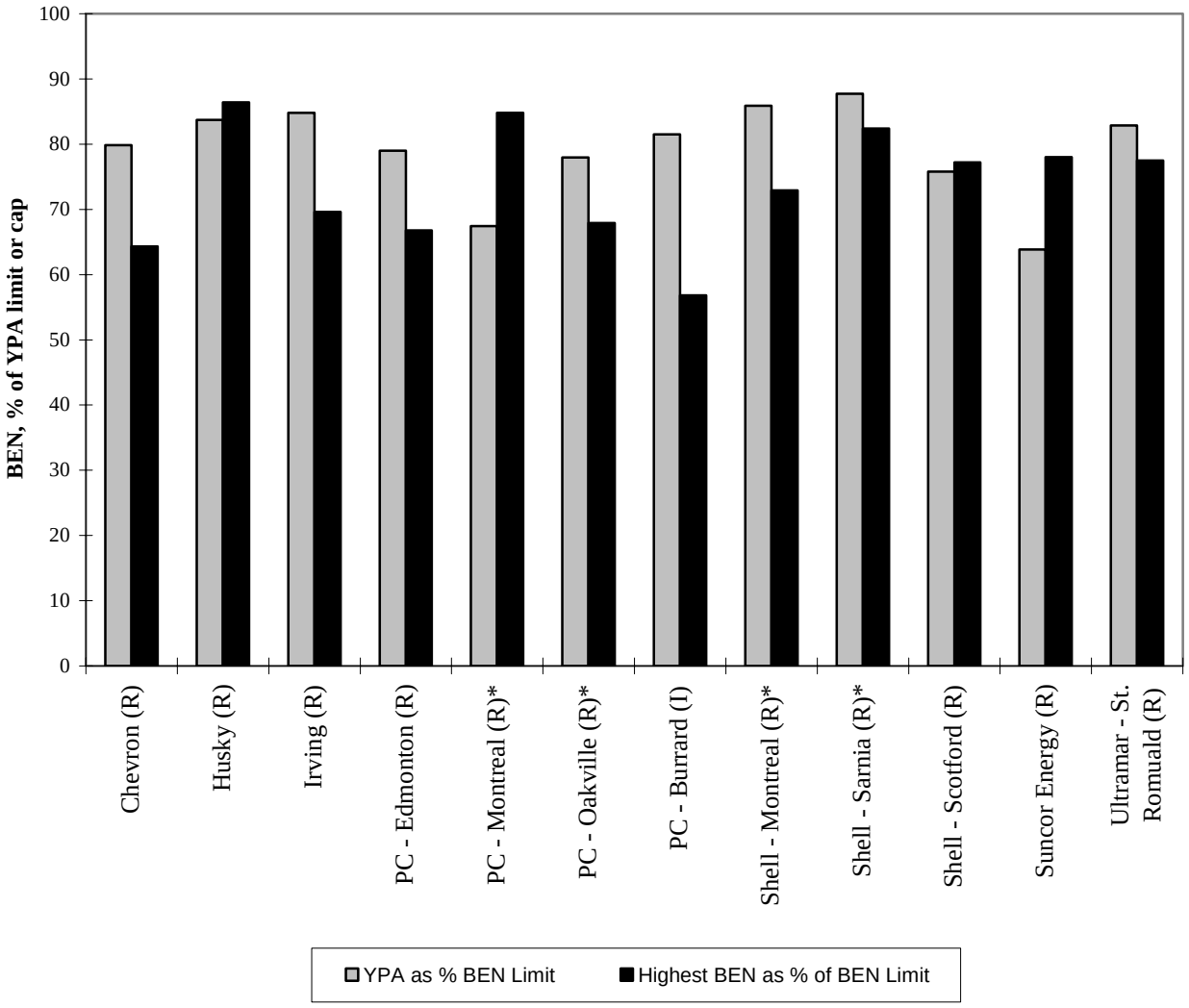
Figure 3.3: Reported Benzene Levels (Average and Maximum) for Suppliers on a Yearly Pool Average Limit, 2003



Notes:

- 0.95% vol. = YPA Benzene Limit
- 1.5% vol. = YPA Benzene Cap
- R = Refiner, B = Blender and I = Importer

Figure 3.4: Reported BEN (Average and Maximum) Levels for Suppliers on a Yearly Pool Average Limit, 2003 (% of limit)



Notes:

- 59.5 = YPA limit, unless a supplier used alternative limits (marked with an *).
- 132 = YPA winter cap, unless a supplier used alternative limits (marked with an *).
- 102 = YPA summer cap, unless a supplier used alternative limits (marked with an *).
- R = Refiner, B = Blender and I = Importer

3.3 Results of Independent Audits

Under section 22 of the regulations, a primary supplier that has elected to use a yearly pool average as its basis for compliance must have an independent auditor perform an audit of the primary supplier's systems, practices and procedures and its compliance with the regulations. The auditor's report must be submitted to Environment Canada by May 31 of the year following the reporting period. This section contains the analysis of the Independent Audits submitted for the **2002** reporting period[4].

3.4 Summary of 2002 Independent Audits

Eighteen audit reports were submitted by eleven companies in regard to sixteen refineries, six import pools and two blending facilities. Thirteen of these audits were combined audits capturing the audit requirements for both the *Benzene in Gasoline Regulations* and the *Sulphur in Gasoline Regulations*. The audits were conducted by six audit companies.

Paragraph 22(3)(e) of the Regulations requires that the audit contain: "*an assessment by the auditor of the extent to which the primary supplier has complied with these Regulations throughout the year of the audit*." The audits state that all primary suppliers subject to audits met the regulated limits for benzene concentration and BEN.

Nine audit reports identified one or more instance of minor non-compliance with the administrative requirements of the regulations. Many of these involved sampling, testing, compliance plans and reporting. With respect to testing, these included:

- testing equipment that was not calibrated regularly;
- quality control samples that were not run as required to standard;
- analytical methods that were used or deviated without Ministerial approval or proper notification;
- quality control programs that could not be demonstrated in the laboratory; and
- gasoline samples that were either missing or an insufficient quantity was stored.

With respect to reports required by the regulations, instances of non-compliance included:

- missed gasoline-like blendstock reporting;
- reporting to incorrect ignificant digits; and
- slip of digits.

Many of the recommendations of the auditors related to improving the clarity of compliance plans, clarification and consistency in reporting procedures, clearer definitions of batch and authorized official,

[4] Independent audits must be submitted to Environment Canada by May 31 of the year following the reporting period. In order to release the 2003 compositional data provided in this report in a timely manner, Environment Canada is publishing the analysis of the audit reports of the prior year (for 2002). An analysis of the independent audits for the 2003 reporting year will be incorporated into next year's annual report (for 2004).

and improvements in laboratory calibration frequency. Seven audits reports were accompanied by a list of corrective actions which had been taken by the primary supplier.

Environment Canada views the audits as a crucial component of the enforcement provisions of the regulations and, to be effective, the auditing process must be independent and thorough. The concept of a yearly pool average relies on the maintenance of complete records and reports. The audits are intended to provide Environment Canada assurance that the yearly pool averages are being correctly reported.

4.0 Canadian Gasoline Composition

This section reviews the composition of gasoline in Canada during 2003, based on data reported by primary suppliers pursuant to the regulations. The regulations require that the following parameters are reported:

- the concentration of benzene,
- the value of BEN,
- the concentration of aromatics,
- the concentration of olefins,
- the concentration of sulphur,
- the concentration of oxygen,
- the vapour pressure,
- the evaporation fraction at 93.3 ^{o}C (200 ^{0}F - E200),
- the evaporation fraction at 148.9 ^{o}C (300 ^{0}F - E300).

Appendix 3 shows the regional and national concentrations for all parameters. Appendix 4 shows the regional data on the maximum, minimum and volume-weighted average of all parameters. Appendix 5 shows the parameters reported by individual companies.

4.1 Volume of Gasoline

The number of batches and volume of gasoline (excluding exports) reported are summarized in Table 4.1.

Table 4.1: Regional Volumetric Data for 2003

Region	Total Volume (m^3)	Number of Batches
Atlantic	2,896,202	362
Quebec	11,301,189	1,009
Ontario	11,003,098	1,090
West*	15,778,165	2,617
National	40,978,654	5,078

*Includes all western provinces and northern territories.

4.2 Regulated Parameters: Benzene and BEN

Data reported on benzene and BEN levels for 2003 are summarized in Table 4.2. The national trend for benzene is shown graphically in Figure 4.1.

Table 4.2: Benzene Concentration and BEN for 2003

	Reported Volume Weighted Averages*					
	Benzene (% Volume)			BEN		
Year	Minimum	Maximum	Canadian Volume Weighted Average	Minimum	Maximum	Canadian Volume Weighted Average
2003	0.1	0.93	0.73	27.60	74.40	49.16

* Includes primary suppliers on alternative limits

Table 4.3 shows the trend in benzene levels between 1995 and 2003[5]. Nationally, benzene levels in 2003 were half of those between 1995 and 1998. These trends are shown graphically for each region and for Canada in Figures 4.1 to 4.5. As the Regulations took effect mid-1999, the data for that year is presented separately for the first and second half of the year. Figures 4.6 and 4.7 show the regional and national average values for benzene and BEN.

Table 4.3: Average Benzene Content of Canadian Gasoline 1995-2003

Region	Average Benzene Content (volume %)									
	1995	1996	1997	1998	1999		2000	2001	2002	2003
					1st half	2nd half				
Atlantic	2.6	2.5	2.6	2.2	2.1	0.7	0.8	0.9	0.8	0.8
Quebec	1.6	1.9	1.7	1.7	1.4	1.0	0.6	0.7	0.7	0.7
Ontario	1.2	1.4	1.3	1.7	1.3	0.8	0.8	0.8	0.7	0.7
West	1.2	1.3	1.3	1.2	0.7	0.6	0.7	0.7	0.7	0.7
Canada	1.4	1.6	1.5	1.6	1.2	0.8	0.7	0.7	0.7	0.7

[5] The data for 1995 to 1998 was collected from primary suppliers under a voluntary survey of benzene, aromatics and olefins in gasoline. All refiners and a number of importers participated in the survey. Annual reports on the survey were published by Environment Canada.

Figure 4.1: Average Benzene Content of Gasoline – Canada 1995-2003

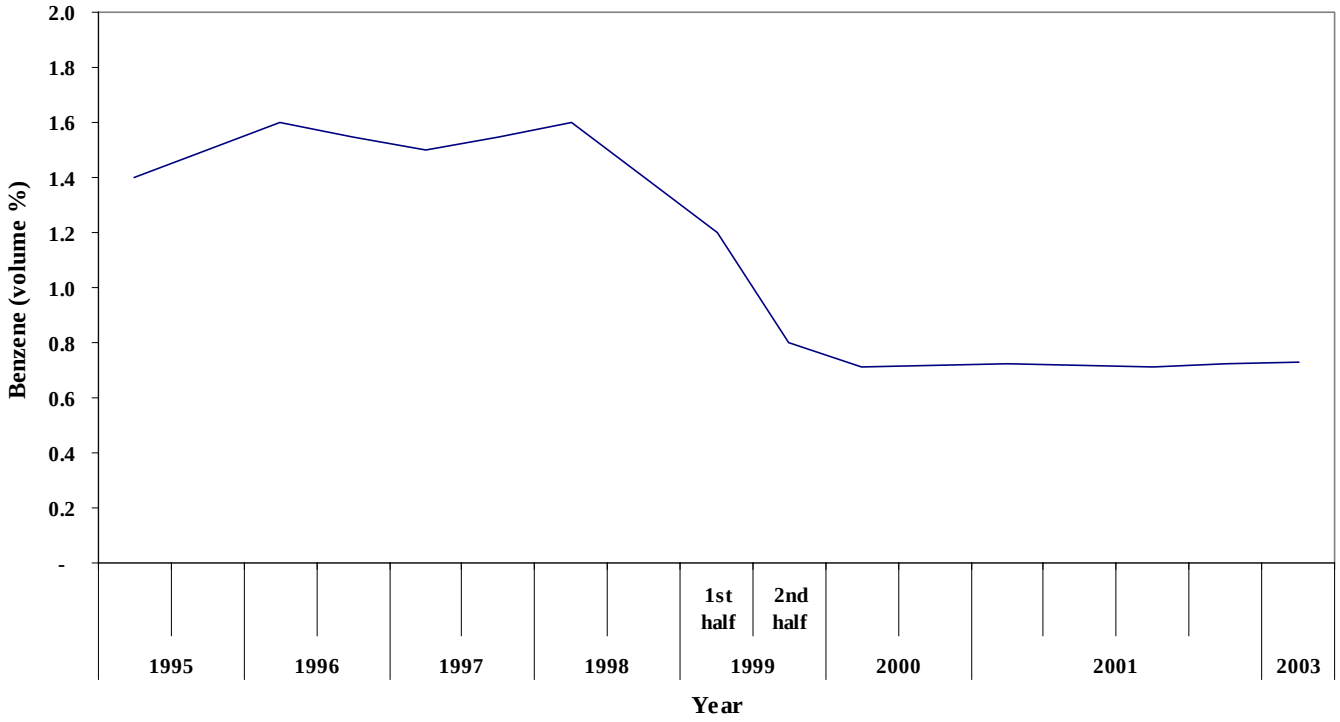


Figure 4.2: Average Benzene Content of Gasoline – Atlantic 1995-2003

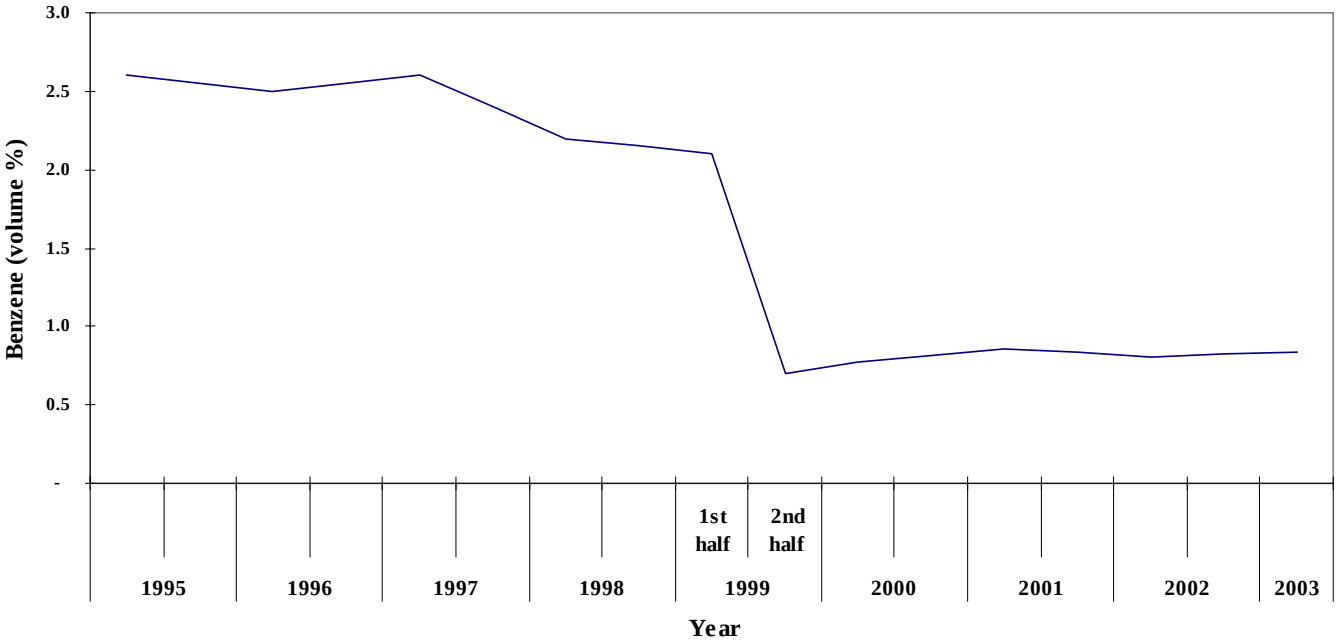

3.0
2.5
2.0
1.5
1.0
0.5
-
Benzene (volume %)
1st half
2nd half
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year

Figure 4.3: Average Benzene Content of Gasoline – Quebec 1995-2003

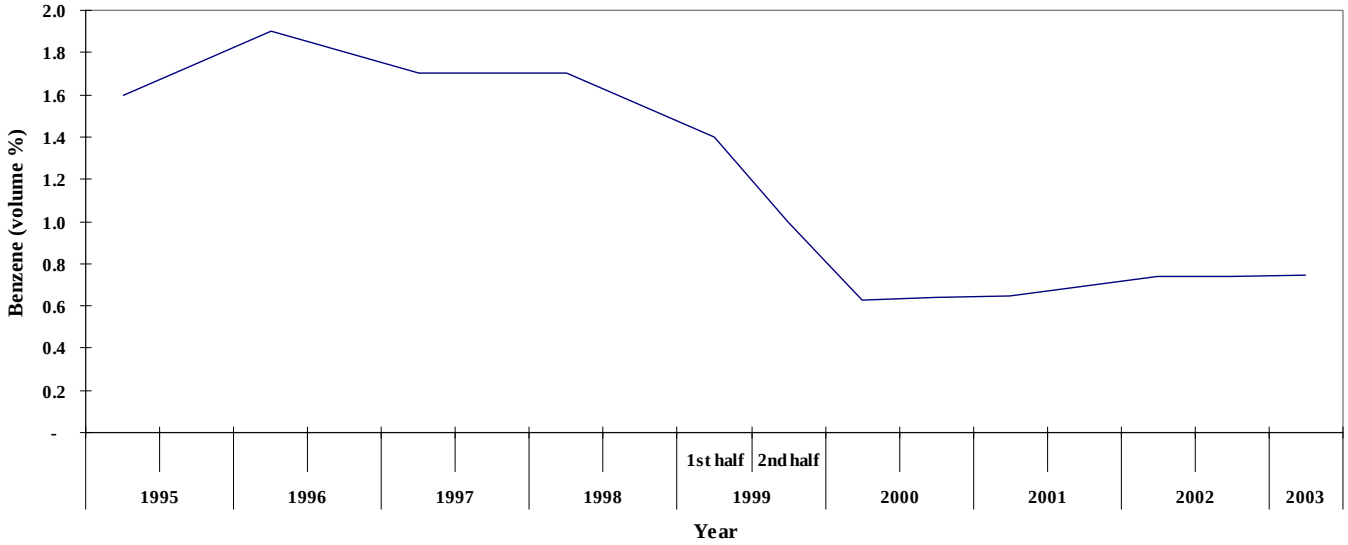


Figure 4.4: Average Benzene Content of Gasoline – Ontario 1995-2003

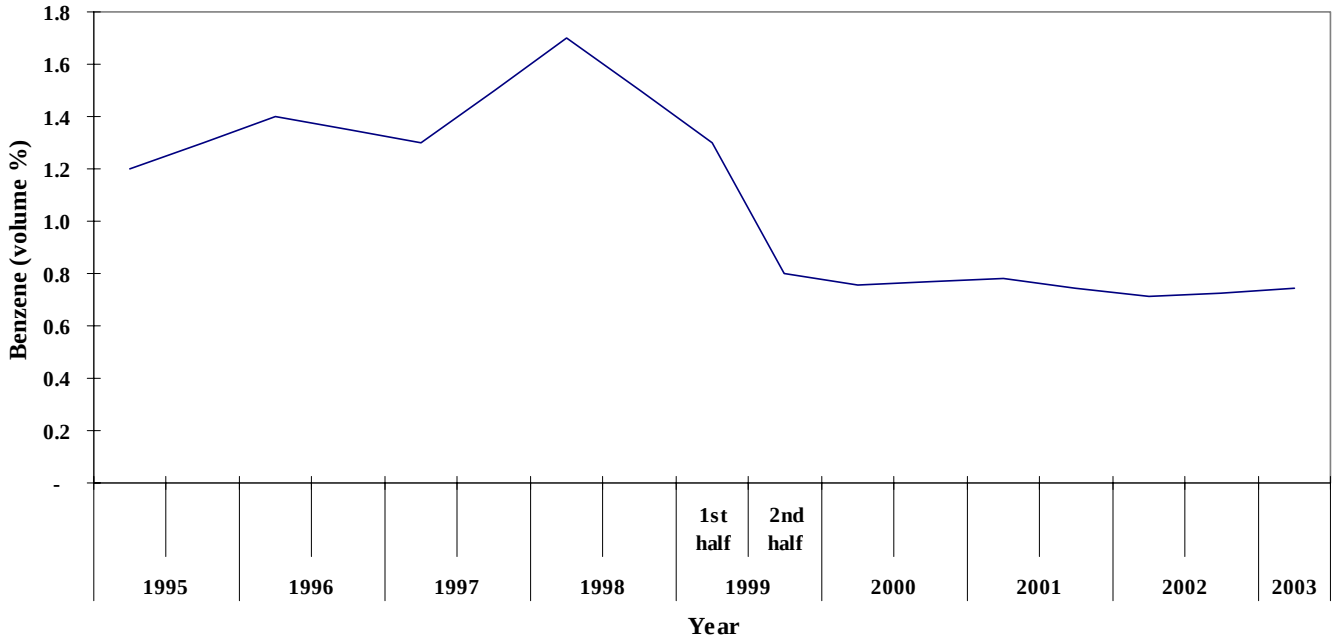


Figure 4.5: Average Benzene Content of Gasoline – West 1995-2003

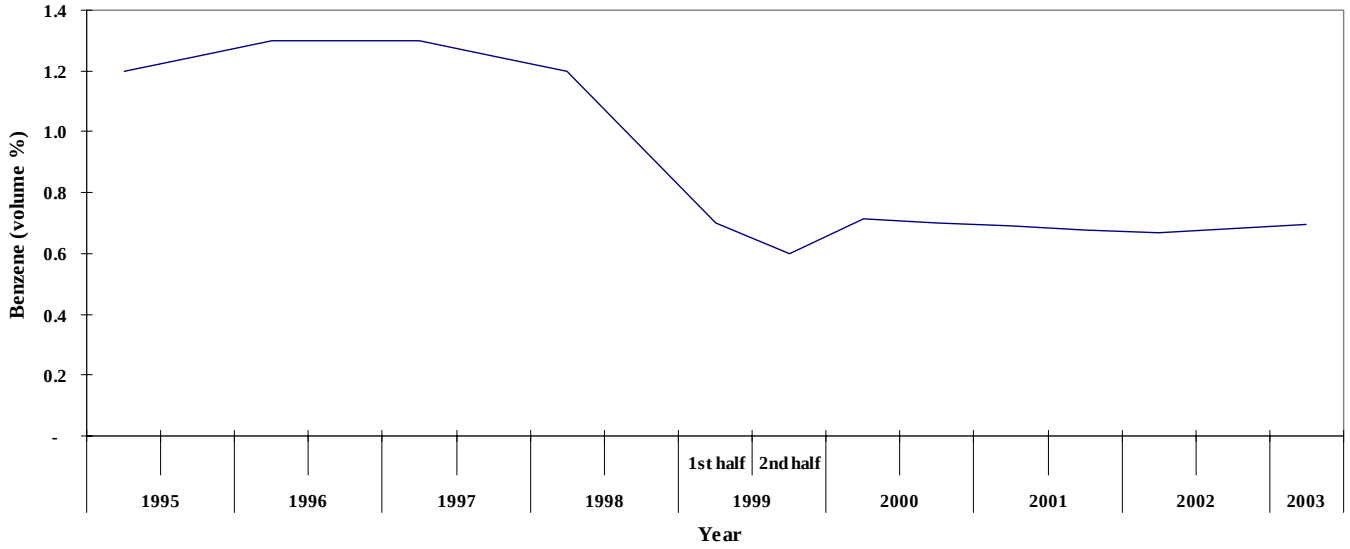
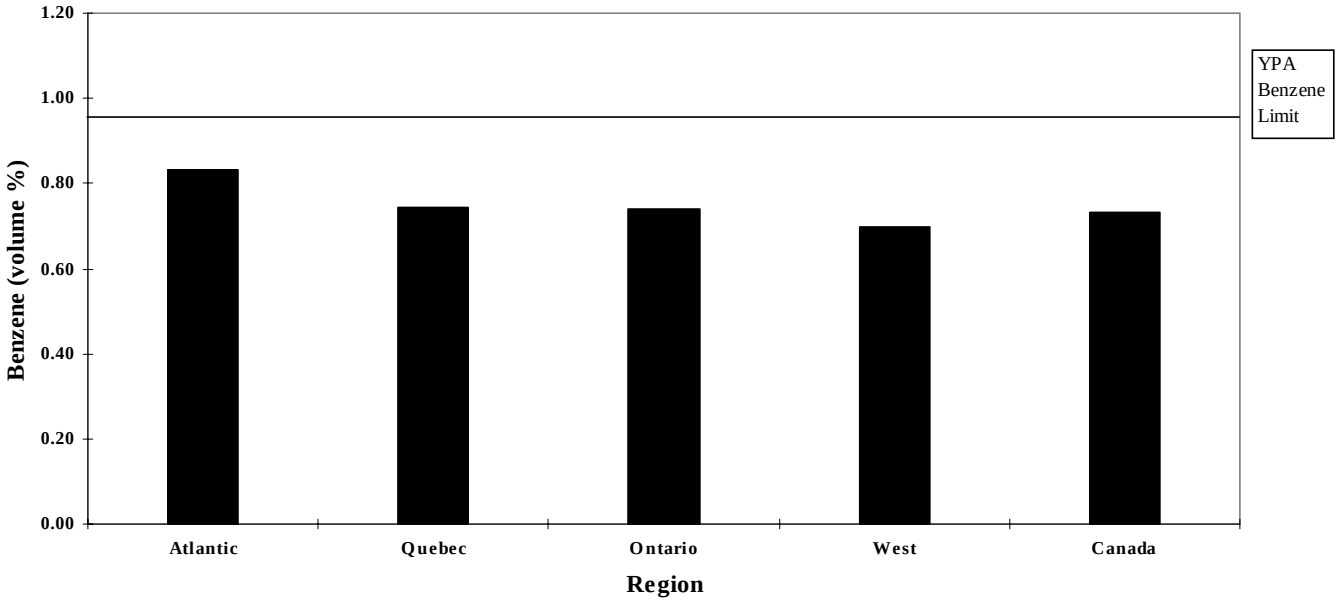


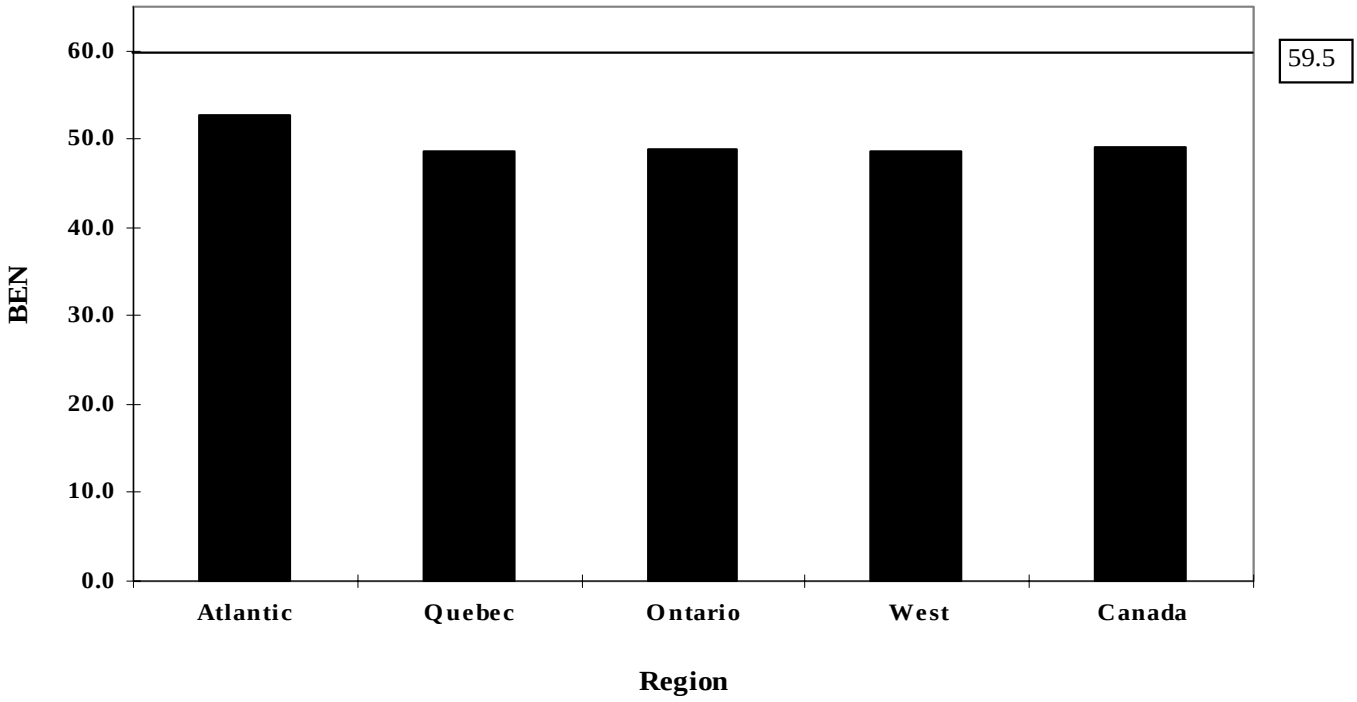
Figure 4.6: Average Benzene Concentration of Canadian Gasoline 2003



Note:

- The annual average Benzene limit for primary suppliers on a YPA is 0.95% vol.

Figure 4.7: Average BEN of Canadian Gasoline 2003



Note:

- The annual average BEN limit for primary suppliers on a YPA is 59.5.

4.3 Reported Oxygen Concentration

Primary suppliers are required to report the type of oxygenate that they use and the oxygen concentration of the gasoline produced or imported. Tables 4.4 and 4.5 summarize the concentrations of MTBE and ethanol, respectively, based on the reported oxygen concentrations and type of oxygenate. Since 2000, the average level of MTBE in Canadian gasoline has decreased by 86%, while that of ethanol has increased by 30%.

Table 4.4: Average Concentration of MTBE Reported

Region	Average Concentration of MTBE based on all Volumes of Gasoline Reported (% by volume)				Maximum Concentration of MTBE based on all Volumes of Gasoline containing MTBE (% by volume)			
	2000	2001	2002	2003	2000	2001	2002	2003
Atlantic	0.85	1.13	0.14	0.08	14.89	15.39	14.83	14.67
Quebec	0.02	0.08	0.04	0.06	3.00	7.11	2.22	9.44
Ontario	0.00	0.00	0.00	0.00	11.44	12.22	0.28	11.06
West	0.21	0.01	0.01	0.01	15.56	0.00	3.33	8.33
Canada	0.14	0.11	0.02	0.02	15.56	15.39	14.83	14.67

Notes:

1. The regulations do not require reporting of oxygenate blended downstream of the refinery (except for a few special incidences described in the regulations). These values are therefore likely to be underestimates of oxygenate usage.
2. 15 % MTBE by volume = approximately 2.7 wt % oxygen.

Table 4.5: Average Concentration of Ethanol Reported

Region	Average Concentration of Ethanol based on all volumes of Gasoline reported (% by volume)				Maximum Concentration of Ethanol based on all volumes of Gasoline containing ethanol (% by volume)			
	2000	2001	2002	2003	2000	2001	2002	2003
Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quebec	0.04	0.00	0.01	0.19	10.00	10.00	10.00	10.00
Ontario	1.43	1.69	1.81	2.02	10.00	10.00	10.00	9.73
West	0.00	0.00	0.002	0.00	0.57	0.00	10.00	10.00
Canada	0.46	0.60	0.61	0.60	10.00	10.00	10.00	10.00

Notes:

1. The regulations do not require reporting of oxygenate blended downstream of the refinery (except for a few special incidences described in the regulations). These values are therefore likely to be underestimates of oxygenate usage.
2. 10 % ethanol by volume = approximately 3.7 wt % oxygen.

4.4 Trends of Aromatics and Olefins

From 1994 to 1998, data on the benzene, aromatic and olefin concentrations in gasoline were collected by Environment Canada under a voluntary survey. When gasoline is combusted in the vehicle's engine, aromatics in the gasoline can form benzene (a known human carcinogen), while olefins can form 1,3-butadiene (a probable human carcinogen).

Trends for aromatics and olefins content are shown in tables 4.6 and 4.7, respectively[6]. These data show that reported levels of aromatics and olefins for 2003 are similar to those for previous years.

Table 4.6: Average Aromatics Content of Canadian Gasoline 1995-2003

Region	Average Aromatics (volume %)									
	1995	1996	1997	1998	1999		2000	2001	2002	2003
					1st half	2nd half				
Atlantic	31.6	29.4	30.3	31.5	30.8	28.3	28.0	25.9	26.4	26.4
Quebec	28.5	27.3	24.8	22.0	26.1	27.4	25.4	25.4	26.0	25.5
Ontario	26.3	28.5	28.1	30.2	27.9	29.0	28.3	27.6	27.0	25.9
West	24.6	24.5	23.1	24.1	23.9	23.4	23.6	23.5	23.3	24.5
Canada	26.6	26.9	25.3	26.2	26.2	26.6	25.8	25.5	25.5	25.3

Table 4.7: Average Olefins Content of Canadian Gasoline 1995-2003

Region	Average Olefins (volume %)									
	1995	1996	1997	1998	1999		2000	2001	2002	2003
					1st half	2nd half				
Atlantic	-	-	8.7	13.6	11.7	14.1	15.1	17.4	17.7	16.2
Quebec	-	-	14.1	12.5	13.3	14.2	13.6	14.1	13.4	13.4
Ontario	-	-	10.2	9.4	10.8	9.7	10.3	10.4	9.5	8.7
West	-	-	10.9	9.8	9.4	10.2	10.1	10.9	10.7	11.1
Canada	-	-	11.2	10.6	11.0	11.4	11.4	12.1	11.5	11.4

(-) = not available, olefins were not part of the survey until 1997.

[6] The data for 1995 to 1998 was collected from primary suppliers under a voluntary survey of benzene, aromatics and olefins in gasoline. All refiners and a number of importers participated in the survey. Annual reports on the survey were published by Environment Canada.

4.5 Comparison of Imported vs. Domestic Gasoline

Table 4.8 compares the data provided by refiners and importers. As was shown in Table 2.3, flat limits were selected by the majority of importers while the YPA option was selected by the majority of refiners. As shown in Table 4.8, importers reported lower maximum values for all parameters and refiners reported higher average values for oxygen, sulphur, vapour pressure and E200.

Table 4.8: Comparison of Reported Maximum and Average Values Importers and Refiners (for All Reported Parameters)

Parameter	Reported Maxima		Average Reported	
	Importers	Refiners	Importers	Refiners
Oxygen (wt %)	3.59	3.70	0.16	0.23
Sulphur (mg/kg)	303	995	94	141
Vapour Pressure (kPa)	105.7	111.0	67.0	81.6
E200 (vol %)	60.4	69.1	49.3	50.4
E300 (vol %)	96.2	97.7	88.4	85.2
Aromatics (vol %)	46.8	52.7	30.4	25.1
Olefins (vol %)	31.8	32.3	12.5	11.4
Benzene (vol %)	1.24	1.47	0.80	0.73
BEN	78.5	90.0	52.1	49.1

5.0 Other Gasoline Quality Information

5.1 The Gasoline Regulations

The Regulations *Respecting Concentrations of Lead and Phosphorus in Gasoline* (The *Gasoline Regulations*)[7] limit the concentration of lead in gasoline that is produced, imported, sold or offered for sale in Canada to 5 mg/L and limit the concentration of phosphorus in unleaded gasoline to 1.3 mg/L. The limit for lead in gasoline for use in specialized equipment such as farming, boats and large trucks is 30 mg/L. Gasoline for use in aircraft is exempt from the Regulations and, until January 1, 2008, leaded gasoline for use in competition vehicles is not subject to the lead concentration restrictions.

The *Gasoline Regulations* were passed in 1990, virtually eliminating the use of lead additives in gasoline. The Regulations were passed in response to the 1986 Royal Society of Canada Commission on Lead in the Environment, which recommended to the Government of Canada that "Public health and environmental policy should be to reduce blood lead to its lowest possible level". Of particular concern

[7] SOR/90-247, as amended by SOR/92-587, SOR/94-355, SOR/97-147, SOR/98-217, SOR/2000-104, and SOR/2003-106; a copy of the regulations can be found at http://www.ec.gc.ca/CEPARegistry/regulations

were emissions of lead particles to the atmosphere, of which the largest source was gasoline lead particulates from the combustion of tetraethyl lead and tetramethyl lead, antiknock additives that were commonly used in gasoline.

Under the Gasoline Regulations, producers, importers or sellers of leaded gasoline must submit reports to the Minister of the Environment as follows:

- Every person who produces or imports leaded gasoline for use or sale in Canada (excluding gasoline used for competition vehicles) is required to submit quarterly reports, within 15 days of the last day of each quarter, indicating the:
    - quantity of leaded gasoline produced/imported by grade;
    - quantity of lead added by grade; and
    - average lead concentration.

- Every person who produces, imports or sells (or offers for sale) in Canada leaded gasoline for use in competition vehicles is required to make and maintain records, which must be submitted annually to the Minister of the Environment, on or before March 31 of the year following the year the activity occurred. These records must include:
    - the brand name of the gasoline;
    - the octane rating and the method used for determining the octane rating of the gasoline;
    - the average yearly lead concentration in milligrams per litre (mg/L) of the gasoline for each brand name;
    - if the gasoline was sold for resale or distribution, the name and address of the re-seller or distributor;
    - if the gasoline was sold at a track or event location, the name and address of the track or event location where the gasoline was used; and
    - quantities of leaded gasoline produced, imported, sold or offered for sale.

For the 2003 reporting period, 16 companies submitted records of imports of leaded gasoline for use in competition vehicles. The reported average lead concentrations of that gasoline ranged from 0.2-2.1 g/L. Table 5.1 summarizes the regional and national volumes of leaded gasoline imported for use in competition vehicles for 2003.

Table 5.1 Regional Volumes of Gasoline Imported for Use in Competition Vehicles

Region	Total Volume (m^3)	Number of Companies
Atlantic	32	2
Quebec	100	1
Ontario	478	6
West*	731	7
National	1,341	16

*Includes all western provinces and northern territories.

There were no quarterly reports received for 2003 from producers or importers of leaded gasoline for uses other than in competition vehicles.

Appendix 1

Annual Compliance Package with Sample Reporting forms including:
Registration Form;
Report on Composition of Gasoline

Benzene in Gasoline Regulations

NOTE: Information contained in this page is for compliance promotional purposes and has NO legal status. For requirements under the regulations, refer to the actual regulations.

These regulations apply to importers, manufacturers and blenders of gasoline. They also apply to anyone that sells gasoline or offers it for sale.

The regulations prohibit the production or import of gasoline with a benzene content exceeding 1.0% by volume. They also restrict the Benzene Emissions Number (BEN), a calculated parameter that relates gasoline composition to predicted emissions of benzene from vehicle tailpipes to a maximum of 71 in the summer and 92 in the winter. Companies may elect to meet annual pooled averages for benzene and BEN, in place of the above limits.

The regulations also prohibit the sale of gasoline with more than 1.5% by volume of benzene.

Various reporting and record-keeping requirements are specified in different sections of the Regulations. For instance:

- Section 6 requires that applications for alternative sampling or analysis methods be submitted **60** days prior to use.
- Section 7 specifies that **registration as per Schedule 2** is required with Environment Canada **15 days prior** to commencing operations for new refiners, importers or blenders (a copy of Schedule 2 is attached for your convenience).
- Section 8 requires every primary supplier to submit quarterly gasoline composition reports as per Schedule 3 by February 14, 2003. Thereafter, the gasoline composition reports are due annually on February 15. A copy of schedule 3 is attached for your convenience.
- Section 12 specifies additional reporting requirements for importers. A page summarizing the reporting requirements is attached for your convenience.
- Subsection 21(2) requires that a compliance plan be signed by an authorized official of the primary supplier and sent to the Minister by registered mail or courier at least 150 days before the beginning of the first year (i.e. by August 4) for which the primary supplier has elected to meet a requirement on the basis of a yearly pool average. Any changes to the compliance plan require at least 45 days notice to the Minister as per section 21(3).
- Section 22(3) requires that auditor's reports for those on a yearly pool average be submitted each year by May 31.

Further details on the above are contained in an Environment Canada guidance document entitled "Questions and Answers on the Federal *Benzene in Gasoline Regulations* (May 27, 1998)". For a copy of this document, please refer to following website:

http://www.ec.gc.ca/CEPARegistry/regulations/

Environment Canada Environnement Canada

This form is provided for your convenience. Please refer to the Canadian Environmental Protection Act and the Benzene in Gasoline Regulations for information on requirements.

SCHEDULE 2 (Section 7)
REGISTRATION FORM FOR A MANUFACTURER, BLENDER OR IMPORTER OF GASOLINE

Mail To: Manager, Emergencies and Enforcement Division
Environment Canada – Ontario Region
Environmental Protection Branch
4905 Dufferin Street, Second floor
Downsview, Ontario, M3H 5T4

1. Company Name: _____

   Company Address: _____

   Type of primary supplier (check one or more): [ ] Manufacturer [ ] Blender [ ] Importer

2. Name and location of each refinery and typical annual volume, in m^3, of each type of gasoline manufactured at each refinery:
   _____
   _____
   _____

3. Name and location of each blending facility, typical blending material(s) and typical annual volume, in m^3, of each type of gasoline blended at each facility: (For cargo tankers, railway cars, boats, marine vessels or other mobile blending facilities, indicate only the type and number of mobile facilities and the province of operation.)
   _____
   _____
   _____

4. Each usual point and mode of importation and typical annual volume, in m^3, of each type of gasoline imported:

_____

_____

5. Authorized official _____ Telephone no. (___) _____-_____

   Title: _____ Fax no. (___) _____-_____

   Signature: _____ Date: _____

Environment Canada | Environnement Canada

BENZENE IN GASOLINE REGULATIONS **REPORT ON COMPOSITION OF GASOLINE**

NOTE: This form is provided for your convenience in reporting. For reporting details, refer to the Regulations.

This report, in respect of section 8 and schedule 3 of the federal Benzene in Gasoline Regulations should be submitted:

a) by every primary supplier as defined in the Regulations
b) within 45 days after the last day of each calendar quarter during which gasoline is supplied for the years 1999 to 2002, (quarterly reporting)
c) after 2003, on or before February 15 of each year (annual reporting)
d) to the appropriate regional office of Environment Canada (see back page)

Registration Number	Year	Quarter (if before 2003)
Company name		
Company address		

Type of primary supplier (check one or more) : [ ] Manufacturer [ ] Blender [ ] Importer

Has a yearly pool average been elected for this year? [ ] Yes [ ] No
If yes, for which parameters? [ ] Benzene [ ] Benzene Emissions Number
If yes, has your compliance plan been updated during the reporting period? [ ] Yes [ ] No

Note: Updated compliance plans must be submitted to the Minister pursuant to subsection 21(3) of the Benzene in Gasoline Regulations.

Name and location of the refinery, blending facility or points of importation in the province, covered by this report :
(Refer to Notes A) and B) on the next page)

Composition of gasoline supplied during this reporting period.

Volume of gasoline supplied, in m^3	Number of batches supplied	Name of any oxygenates added

Item	Column 1 Parameter	Column 2 Maximum Value	Column 3 Quarterly volume-weighted average value (not necessary after 2002)	Column 4 Year-to-date volume-weighted average value
1.	Oxygen Concentration (% by weight)			
2.	Sulphur Concentration (% by weight)			
3.	Vapor pressure at 37.8ºC (100ºF)(kPa)			
4.	Evaporative fraction at 93.3ºC (200ºF) (% by volume)			
5.	Evaporative fraction at 148.9ºC (300ºF) (% by volume)			
6.	Aromatics concentration (% by volume)			
7.	Olefins concentration (% by volume)			
8.	Benzene concentration (% by volume)			
9.	Benzene Emissions Number (Refer to note C)			

Authorized Official (*)	Telephone No. ( ) -
Title	Fax No. ( ) -
Signature	Date

(*) Refer to note (F) on next page

NOTES -- BENZENE IN GASOLINE REGULATIONS

A. This Report on Composition of Gasoline must be submitted separately for each refinery, blending facility and province of importation, or any combination of them described under section 18 of the Benzene in Gasoline Regulations.

B. For Note A, the name and location for cargo tankers, railway cars, boats, marine vessels or other mobile blending facilities are replaced by the type of mobile facilities, their number and the province of operation, or the name and location of the non-mobile facility with which they are grouped.

C. The average benzene emissions number is the volume-weighted average of the benzene emissions numbers for each batch; it is not calculated from the average model parameters.

D. Under subsection 13(2) of the Benzene in Gasoline Regulations, for each batch of gasoline-like blendstock dispatched or imported by the primary supplier during the period covered by this Report, the primary supplier must report to the Minister, in an annex to this Report, the name and address of the purchaser or receiver, the date of dispatch or importation and the volume.

E. Under subsection 2(2) of Schedule 1 to the Benzene in Gasoline Regulations, the primary supplier must report to the Minister, in an annex to this Report, each occurrence of a model parameter that is outside the acceptable range, the reason for each occurrence, and the volume of gasoline affected.

F. Authorized official is a defined term (refer to subsection 1(1) of the Benzene in Gasoline Regulation).

Additional Requirements for Importers as per Sections 12(1), 12(2) 12(3) of the Benzene in Gasoline Regulations

NOTE: Information contained in this page is for compliance promotional purposes and has no legal status. For requirements under the regulations, refer to the actual regulations.

Subsection 12 (1) Every importer must notify the Minister, at least 12 hours before the time of importation, of the importer's intention to import at any one time

a) more than 100 m3 of gasoline identified under subsection 9(1) or (2) as complying gasoline, northern winter complying gasoline, U.S. reformulated gasoline or California Phase 2 gasoline; or

b) any amount of gasoline identified under subsection 9(2) as gasoline-like blendstock.

Section 12 (2) The notice required by subsection (1) must include

a) the name and registration number of the importer;
b) the type of gasoline identified under subsection 9(2), unless it is complying gasoline;
c) the volume of the gasoline;
d) the point of entry of the gasoline into Canada and the estimated date and time* that it will enter Canada;
e) the address of the first storage facility or refueling facility to which the gasoline is to be delivered and the estimated date and time of its delivery there; and
f) the name and telephone number of a representative of the importer through whom sampling arrangements can be made.

* Provide the best estimated date and time with your notice ; revise when more accurate date and time become available.
(A form containing above noted requirements is attached for your convenience)

Subsection 12 (3) No importer shall import gasoline by cargo tanker, railway car, boat, marine vessel or aircraft unless the gasoline is accompanied at the point of entry into Canada and at the point of delivery, and everywhere between those points, by a record that shows

a) the name, address and registration number of the importer;
b) the name and address of the person to whom the gasoline is to be sold or ownership transferred;
c) the address of the first storage facility or refueling facility to which the gasoline is to be delivered;
d) the volume of the gasoline; and
e) the type of gasoline identified under subsection 9(2), unless it is complying gasoline.

Environment Canada Environnement Canada

This form is provided for your convenience. Please refer to the Benzene in Gasoline Regulations for information on requirements.

Additional Requirements under subsections 12 (1) and 12 (2) of the Benzene in Gasoline Regulations **for Importers** intending to import at any one time more than 100 m3 of gasoline. Note **no** minimum for gasoline-like blendstock.

Notification: via fax

Manager, Emergencies and Enforcement Division
Environment Canada – Ontario Region
Environmental Protection Branch
4905 Dufferin Street, Second floor
Downsview, Ontario, M3H 5T4

a) Importer Name: _____

Importer Registration Number _____

Batch Number (Optional) _____

b) Type of gasoline identified under section 9, check or mark "x" below:

Complying gasoline	_____	California phase 2 gasoline	_____
Gasoline-like blendstock	_____	Northern winter complying gasoline	_____
US reformulated gasoline	_____		

c) Volume of gasoline (m^3)_____

d) Point of entry into Canada _____
Estimated date _____ and time of entry _____

e) Address of first storage facility or refueling facility to whom gasoline is to be delivered
_____

Estimated date of delivery _____ and time of delivery_____

f) Importer's representative through whom sampling may be arranged:

Name (Print) _____, Phone number _____

Following To Be Completed by Environment Canada (PLEASE PRINT):
Environment Canada Official receiving or reviewing information:

Name: _____ Signature: _____

Date: _____ Telephone: (_____) _____ -- _____

Appendix 2

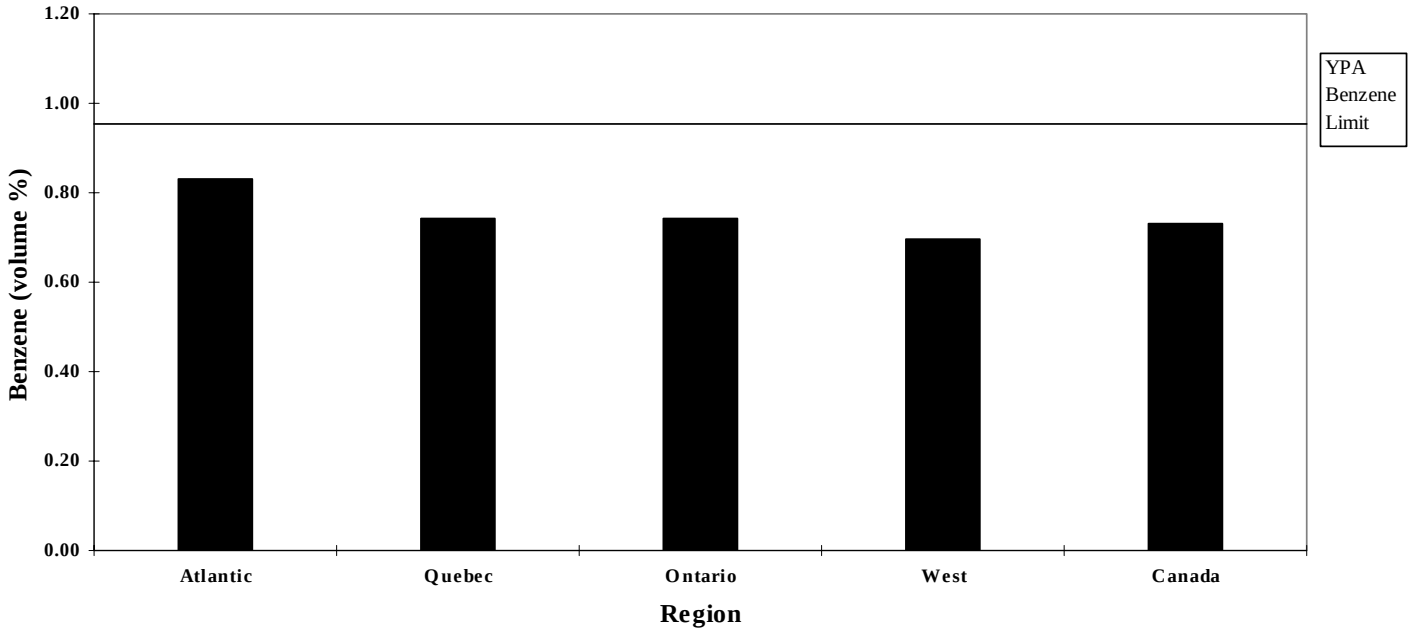
Alternative Limits under the Benzene in Gasoline Regulations

http://www.ec.gc.ca/Ceparegistry/documents/notices/g1-13336_n1.pdf

Appendix 3

Regional and National Data for all Parameters

Figure A3.1: Average Benzene Concentration of Canadian Gasoline 2003

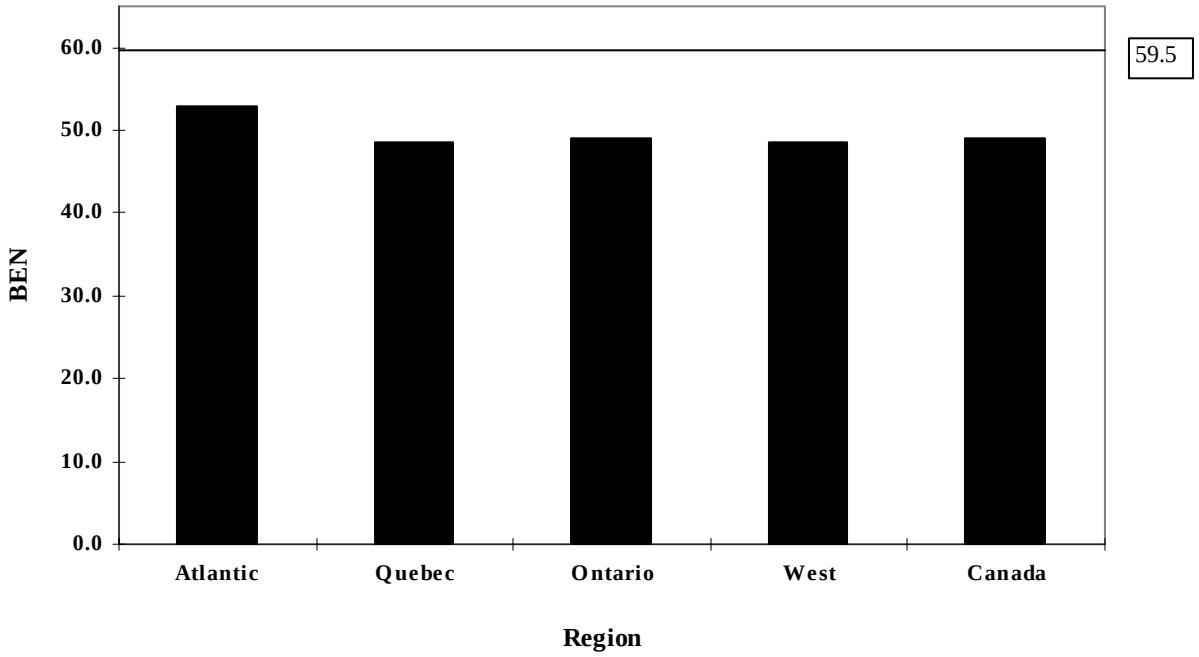


- The annual average Benzene limit for primary suppliers is 1.0% vol. or 0.95% vol. for those on a YPA.

Table A3.1: Average Benzene Concentration (% by volume)

	2003 Average
Atlantic	0.83
Quebec	0.74
Ontario	0.74
West	0.70
Canada	0.73

Figure A3.2: Average BEN of Canadian Gasoline 2003



- The annual average BEN limit for primary suppliers on a YPA is 59.5.

Table A3.2: Average BEN

	2003 Average
Atlantic	52.8
Quebec	48.5
Ontario	49.0
West	48.7
Canada	49.2

Figure A3.3: Average and Maximum Average Sulphur Concentration of Canadian Gasoline 2003

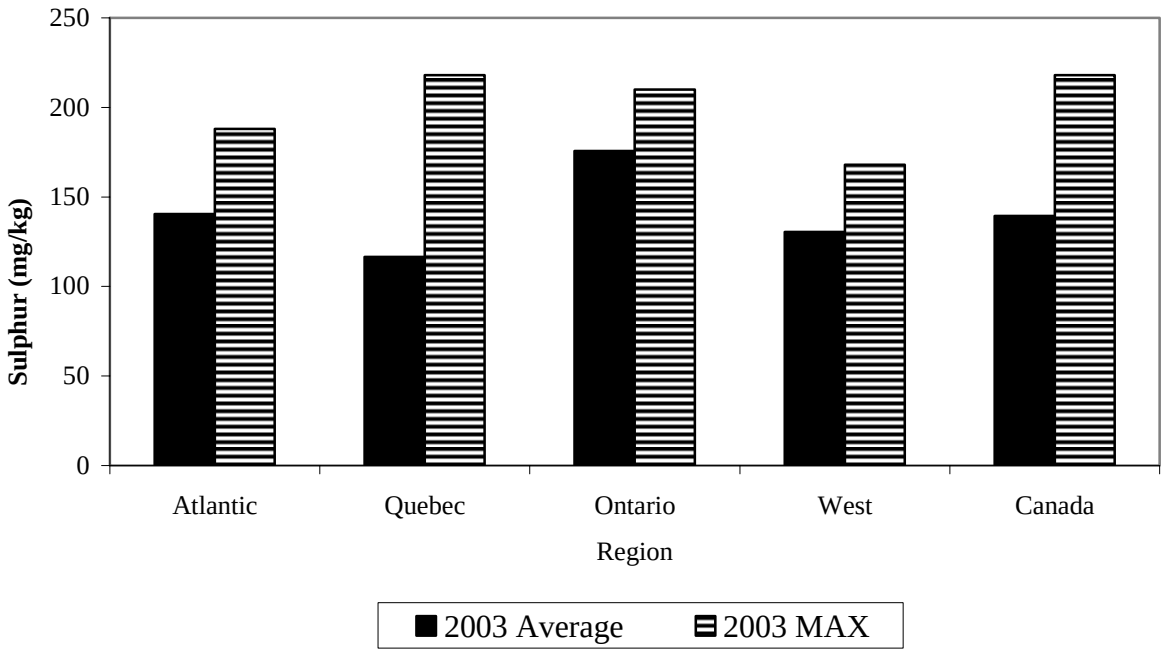


Table A3.3: Average and Maximum Average Sulphur Concentration (mg/kg)

	2003 Average	2003 Maximum Average
Atlantic	140	188
Quebec	117	218
Ontario	176	210
West	130	168
Canada	139	218

Figure A3.4: Average and Maximum Average Olefin Concentration of Canadian Gasoline 2003

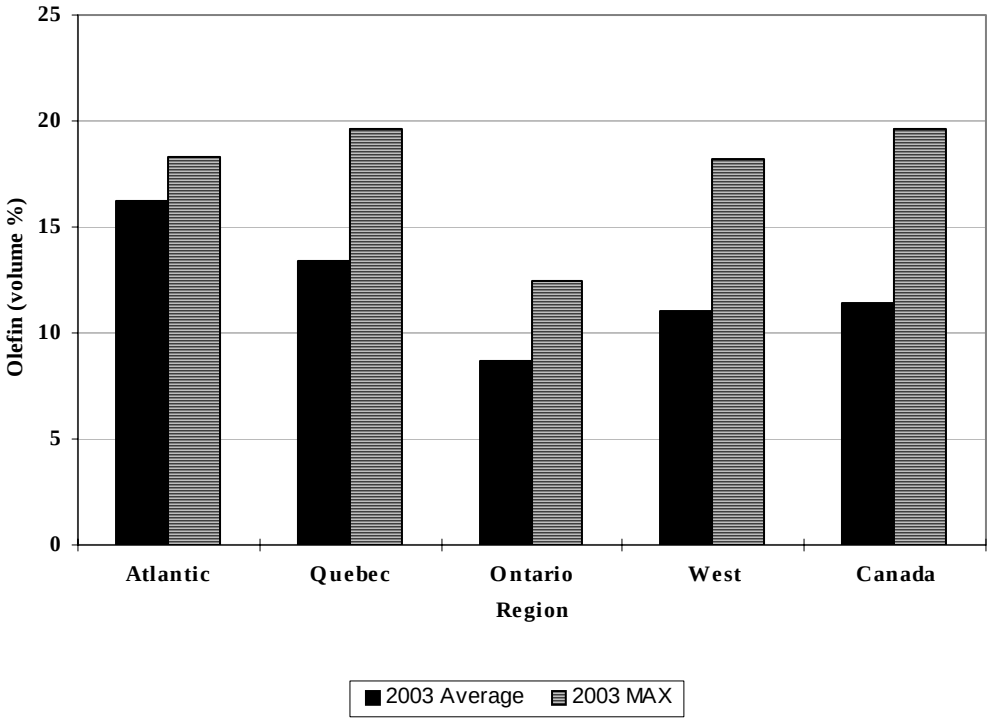


Table A3.4: Average and Maximum Average Olefin Concentration (% by volume)

	2003 Average	2003 Maximum Average
Atlantic	16.2	18.3
Quebec	13.4	19.6
Ontario	8.7	12.5
West	11.1	18.2
Canada	11.4	19.6

Figure A3.5: Average and Maximum Average Aromatics Concentration of Canadian Gasoline 2003

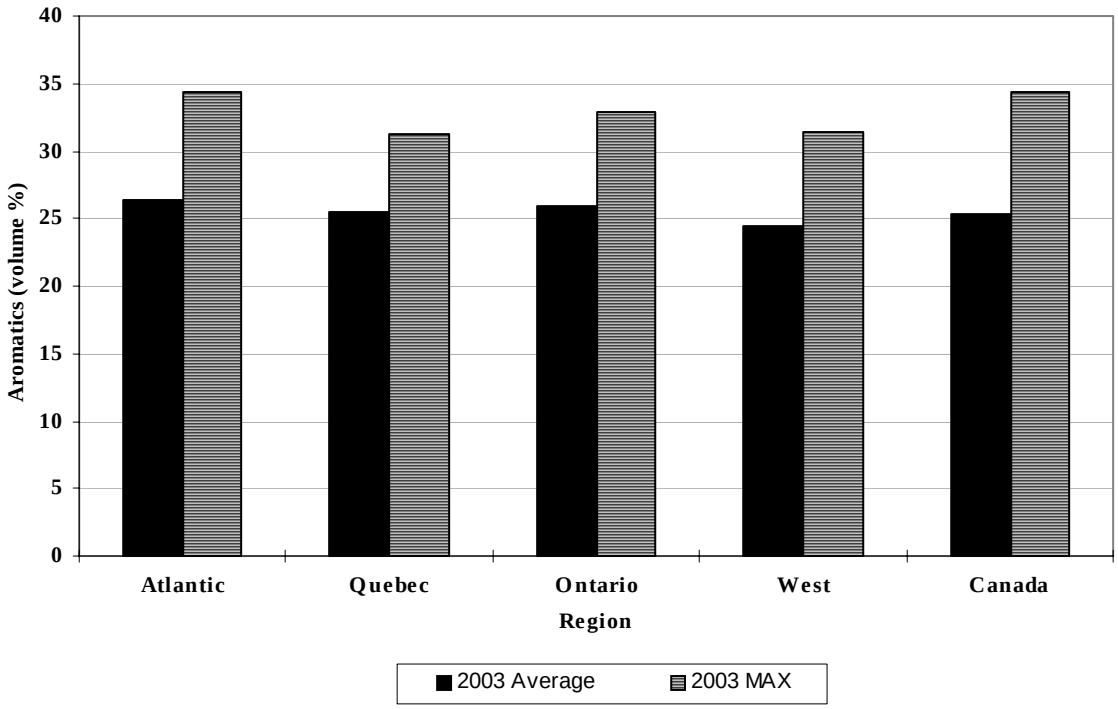


Table A3.5: Average and Maximum Average Aromatics Concentration (% by volume)

	2003 Average	2003 Maximum Average
Atlantic	26.4	34.4
Quebec	25.5	31.3
Ontario	25.9	32.9
West	24.5	31.4
Canada	25.3	34.4

Figure A3.6: Average and Maximum Average E200 of Canadian Gasoline 2003

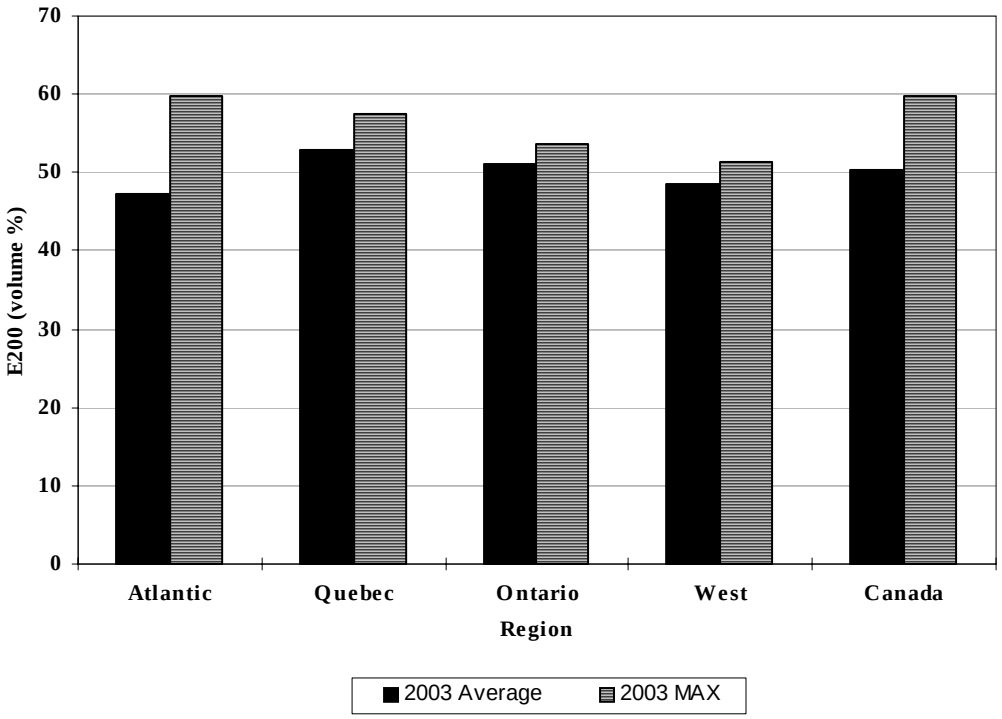


Table A3.6: Average and Maximum Average E200 (% by volume)

	2003 Average	2003 Maximum Average
Atlantic	47.2	59.7
Quebec	52.8	57.4
Ontario	51.1	53.6
West	48.6	51.4
Canada	50.3	59.7

Figure A3.7: Average and Maximum Average E300 of Canadian Gasoline 2003

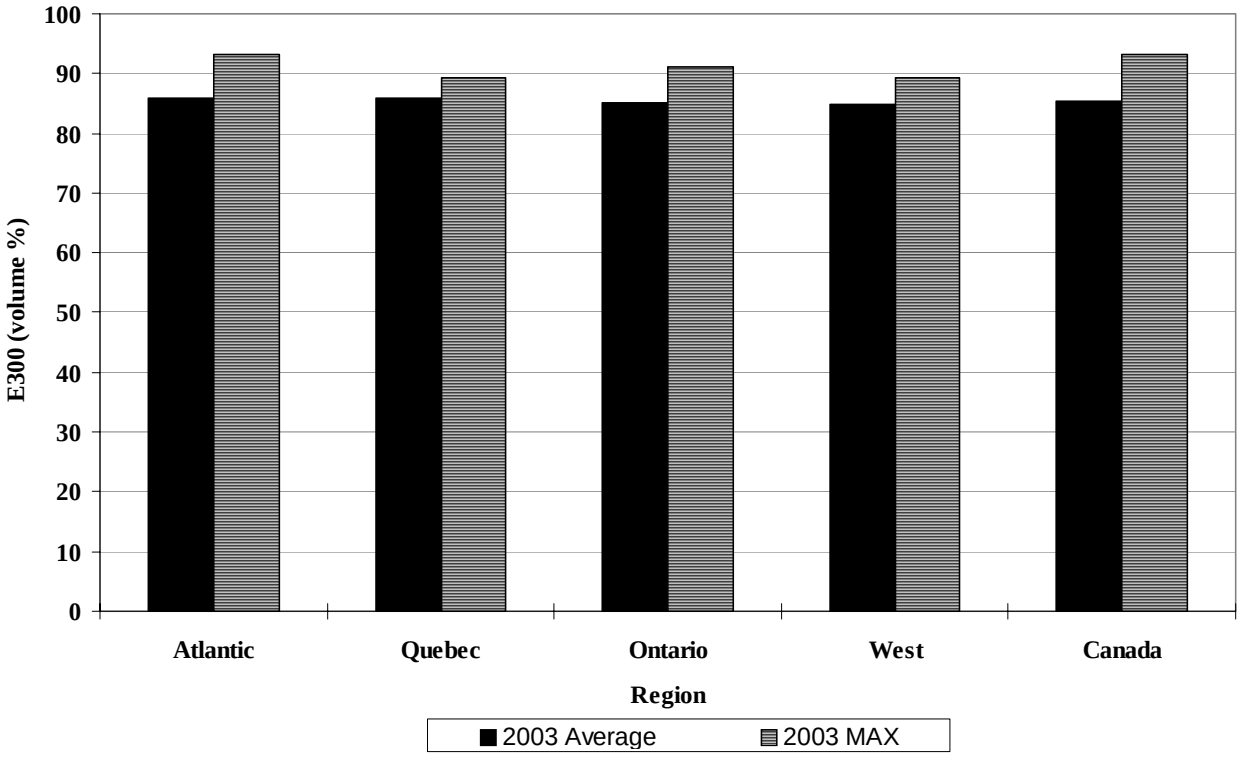
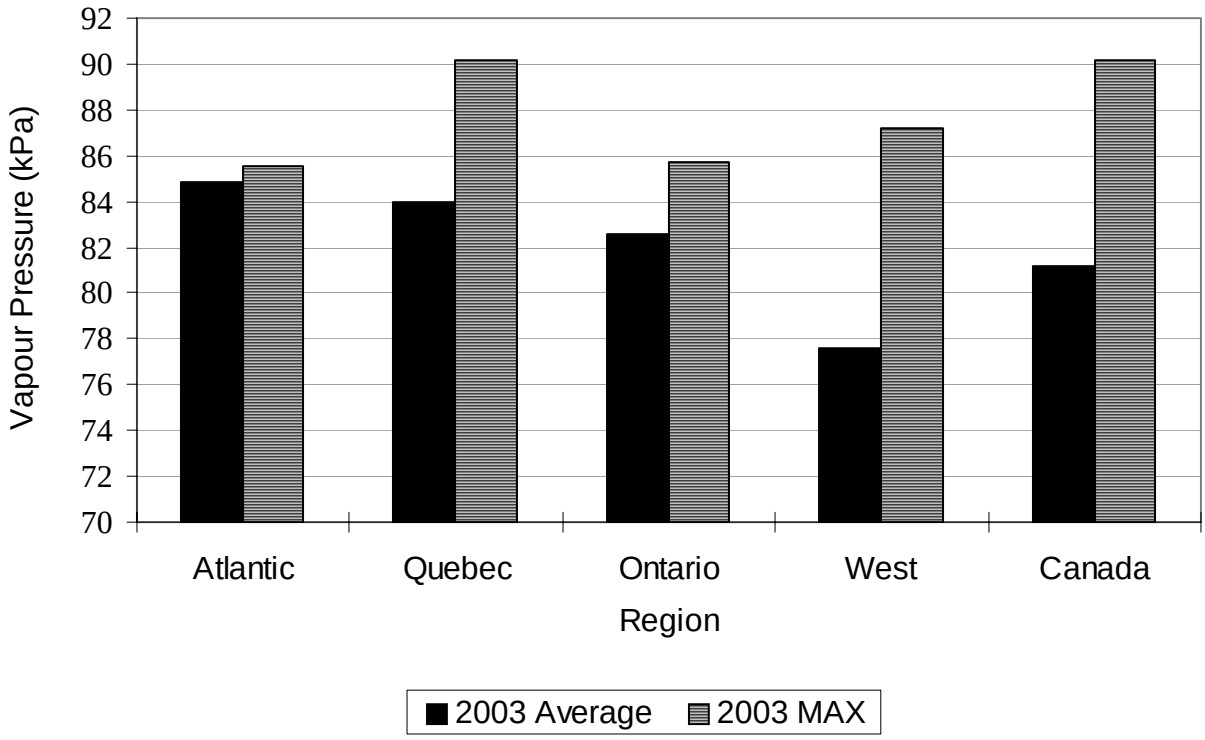


Table A3.7: Average and Maximum Average E300 (% by volume)

	2003 Average	2003 Maximum Average
Atlantic	85.9	93.2
Quebec	85.9	89.2
Ontario	85.2	91.0
West	84.9	89.2
Canada	85.3	93.2

Figure A3.8: Average and Maximum Average Vapour Pressure of Canadian Gasoline 2003

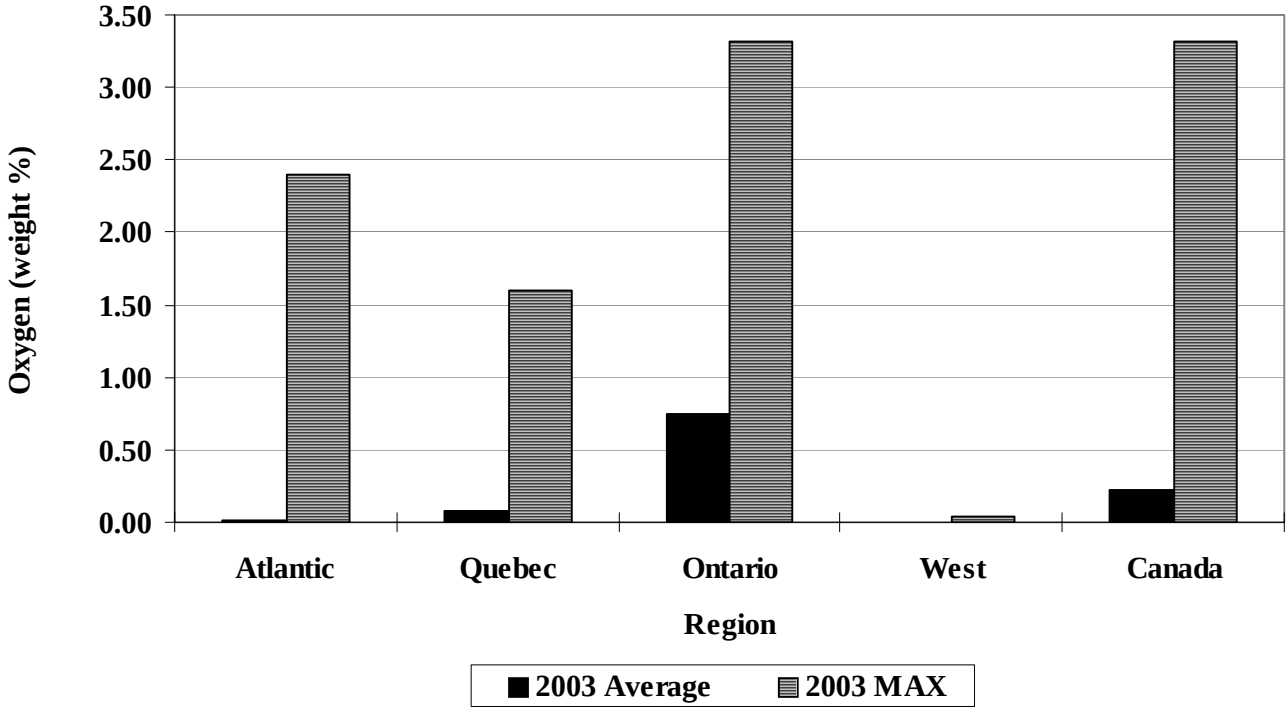


20 kPa = 2.9 psi

Table A3.8: Average and Maximum Average Vapour Pressure (kPa)

	2003 Average	2003 Maximum Average
Atlantic	84.9	85.5
Quebec	84.0	90.2
Ontario	82.6	85.7
West	77.6	87.2
Canada	81.2	90.2

Figure A3.9: Average and Maximum Average Oxygen Concentration of Canadian Gasoline 2003



- Primarily MTBE in Atlantic and Quebec and ethanol elsewhere.

Table A3.9: Average and Maximum Average Oxygen Concentration (% by weight)

	2003 Average	2003 Maximum Average
Atlantic	0.01	2.40
Quebec	0.08	1.60
Ontario	0.75	3.32
West	0.00	0.04
Canada	0.23	3.32

Appendix 4

Regional Data on the Maximum and Annual Averages for all Parameters

Table A4.1: Reported Data for Benzene: Maximum, Minimum and Yearly Pool Averages (% by volume)

Region	Volume (m^3)	Maximum	Minimum	Volume Weighted Average
Atlantic	2,896,202	1.36	0.68	0.83
Quebec	11,301,189	1.45	0.62	0.74
Ontario	11,003,098	1.47	0.10	0.74
West	15,778,165	1.39	0.29	0.70
Canada	40,978,654	1.47	0.10	0.73

Table A4.2: Reported Data for BEN: Maximum, Minimum and Yearly Pool Averages

Region	Volume (m^3)	Maximum	Minimum	Volume Weighted Average
Atlantic	2,896,202	90	41	52.8
Quebec	11,301,189	85	38	49.1
Ontario	11,003,098	78	28	49.0
West	15,778,165	86	45	48.7
Canada	40,978,654	90	28	49.2

Table A4.3: Reported Data for Sulphur: Maximum, Minimum and Yearly Pool Averages (mg/kg)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	630	29	140
Quebec	995	27	117
Ontario	750	10	176
West	447	7	130
Canada	995	7	139

Table A4.4: Reported Data for Olefins: Maximum, Minimum and Yearly Pool Averages (% by volume)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	27.0	5.3	16.2
Quebec	32.3	8.5	13.4
Ontario	21.1	0.5	8.7
West	27.4	0.8	11.1
Canada	32.3	0.5	11.4

Table A4.5: Reported Data for Aromatics: Maximum, Minimum and Yearly Pool Averages (% by volume)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	47.6	24.5	26.4
Quebec	50.0	21.2	25.5
Ontario	52.0	23.1	25.9
West	52.7	20.8	24.5
Canada	52.7	20.8	25.3

Table A4.6: Reported Data for E200: Maximum, Minimum and Yearly Pool Averages (% by volume)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	66.4	39.3	46.7
Quebec	80.2	43.7	51.3
Ontario	65.0	40.0	50.6
West	69.0	40.2	49.2
Canada	80.2	39.3	50.1

Table A4.7: Reported Data for E300: Maximum, Minimum and Yearly Pool Averages (% by volume)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	94.0	82.8	85.9
Quebec	96.2	84.1	85.9
Ontario	97.7	73.8	85.2
West	97.2	79.8	84.9
Canada	97.7	73.8	85.3

Table A4.8: Reported Data for Vapor Pressure: Maximum, Minimum and Yearly Pool Averages (kPa)

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	107	72	84.9
Quebec	107	45	84.0
Ontario	108	48	82.6
West	111	62	84.9
Canada	111	45	84.0

Appendix 5

Company Reported Data

Table A5.1: Averages and Maxima Reported for Benzene (% by volume)

	Company	Average	Maximum
Refiners	Chevron Canada	0.59	1.30
	Consumers' Co-op	0.72	1.16
	Husky Oil	0.91	1.14
	Imperial Oil - Dartmouth	0.93	1.36
	Imperial Oil - Nanticoke	0.88	1.47
	Imperial Oil - Sarnia	0.73	1.17
	Imperial Oil - Strathcona	0.88	1.39
	Irving Oil	0.68	1.05
	North Atlantic Refining Ltd.	0.84	1.03
	Petro-Canada - Edmonton	0.70	1.12
	Petro-Canada - Montreal	0.63	1.43
	Petro-Canada - Oakville	0.84	1.40
	Shell - Montreal	0.62	1.45
	Shell - Sarnia	0.70	1.26
	Shell - Scotford	0.29	0.65
	Suncor Energy	0.48	1.37
	Ultramar - St. Romuald	0.89	1.43
Blenders	Robbins Feed and Fuel	0.79	0.93
Importers	CAMI	0.66	1.00
	Ford Motor Company of Canada	0.25	0.53
	General Motors of Canada	0.28	0.53
	Neste Petroleum	0.89	0.89
	Petro-Canada - BC (Burrard)	0.84	1.16
	Petroles Norcan	0.76	0.81
	Ultramar - NFLD	0.80	0.80
	Ultramar - QC	0.80	1.24

Table A5.2: Averages and Maxima Reported for BEN

	Company	Average	Maximum
Refiners	Chevron Canada	47.50	64.30
	Consumers' Co-op	47.40	67.00
	Husky Oil	49.80	86.40
	Imperial Oil - Dartmouth	54.00	90.00
	Imperial Oil - Nanticoke	52.00	71.00
	Imperial Oil - Sarnia	55.40	75.00
	Imperial Oil - Strathcona	51.00	67.00
	Irving Oil	50.46	69.61
	North Atlantic Refining Ltd.	40.70	55.90
	Petro-Canada - Edmonton	47.00	66.80
	Petro-Canada – Montreal*	45.80	84.80
	Petro-Canada – Oakville*	50.90	67.90
	Shell – Montreal*	51.10	72.90
	Shell – Sarnia*	52.20	82.40
	Shell - Scotford	45.10	77.20
	Suncor Energy	38.00	78.00
	Ultramar - St. Romuald	49.30	77.50
Blenders	Robbins Feed and Fuel	45.20	55.80
Importers	CAMI	30.55	52.70
	Ford Motor Company of Canada	45.70	58.00
	General Motors of Canada	42.98	48.60
	Neste Petroleum	38.30	38.30
	Petro-Canada - BC (Burrard)	48.50	56.80
	Petroles Norcan	47.60	54.22
	Ultramar - NFLD	74.40	74.40
	Ultramar - QC	52.40	78.50

Note:

Primary suppliers that are shaded and marked with an asterisk have an alternative limit for the BEN.

Table A5.3: Averages and Maxima Reported for Aromatics (% by volume)

	Company	Average	Maximum
Refiners	Chevron Canada	23.3	36.8
	Consumers' Co-op	23.9	31.6
	Husky Oil	23.0	49.7
	Imperial Oil - Dartmouth	24.5	47.6
	Imperial Oil - Nanticoke	24.7	39.1
	Imperial Oil - Sarnia	30.8	37.1
	Imperial Oil - Strathcona	23.0	32.8
	Irving Oil	29.0	42.0
	North Atlantic Refining Ltd.	25.1	30.7
	Petro-Canada - Edmonton	20.8	34.3
	Petro-Canada - Montreal	22.8	50.0
	Petro-Canada - Oakville	25.3	40.9
	Shell - Montreal	30.4	48.9
	Shell - Sarnia	31.4	52.7
	Shell - Scotford	30.7	48.4
	Suncor Energy	24.0	52.0
	Ultramar - St. Romuald	22.7	47.0
Blenders	Robbins Feed and Fuel	29.1	38.4
Importers	CAMI	24.4	30.5
	Ford Motor Company of Canada	32.9	40.2
	General Motors of Canada	31.9	40.2
	Neste Petroleum	29.4	29.4
	Petro-Canada - BC (Burrard)	28.9	37.8
	Petroles Norcan	21.2	24.8
	Ultramar - NFLD	34.4	34.4
	Ultramar - QC	31.3	46.8

Table A5.4: Averages and Maxima Reported for Olefins (% by volume)

	Company	Average	Maximum
Refiners	Chevron Canada	13.2	24.6
	Consumers' Co-op	16.6	19.2
	Husky Oil	18.2	27.4
	Imperial Oil - Dartmouth	18.3	27.0
	Imperial Oil - Nanticoke	12.5	21.1
	Imperial Oil - Sarnia	6.6	15.1
	Imperial Oil - Strathcona	11.9	18.0
	Irving Oil	13.2	20.7
	North Atlantic Refining Ltd.	5.3	11.8
	Petro-Canada - Edmonton	11.1	25.7
	Petro-Canada - Montreal	16.0	32.3
	Petro-Canada - Oakville	10.5	21.0
	Shell - Montreal	9.8	22.9
	Shell - Sarnia	11.9	21.1
	Shell - Scotford	0.8	2.0
	Suncor Energy	3.8	13.4
	Ultramar - St. Romuald	14.2	22.3
Blenders	Robbins Feed and Fuel	8.1	10.7
Importers	CAMI	4.7	6.0
	Ford Motor Company of Canada	1.4	2.1
	General Motors of Canada	1.1	2.1
	Neste Petroleum	8.5	8.5
	Petro-Canada - BC (Burrard)	6.7	10.5
	Petroles Norcan	19.6	24.4
	Ultramar - NFLD	14.7	14.7
	Ultramar - QC	12.4	31.8

Table A5.5: Averages and Maxima Reported for Sulphur (mg/kg)

	Company	Average	Maximum
Refiners	Chevron Canada	135	299
	Consumers' Co-op	168	447
	Husky Oil	156	280
	Imperial Oil - Dartmouth	188	630
	Imperial Oil - Nanticoke	210	750
	Imperial Oil - Sarnia	189	450
	Imperial Oil - Strathcona	166	441
	Irving Oil	66	124
	North Atlantic Refining Ltd.	29	95
	Petro-Canada - Edmonton	168	437
	Petro-Canada - Montreal	218	995
	Petro-Canada - Oakville	133	337
	Shell - Montreal	41	460
	Shell - Sarnia	53	370
	Shell - Scotford	7	86
	Suncor Energy	159	440
	Ultramar - St. Romuald	108	298
Blenders	Robbins Feed and Fuel	119	156
Importers	CAMI	28	35
	Ford Motor Company of Canada	16	27
	General Motors of Canada	12	24
	Neste Petroleum	27	27
	Petro-Canada - BC (Burrard)	46	114
	Petroles Norcan	99	148
	Ultramar - NFLD	177	177
	Ultramar - QC	95	303

Table A5.6: Averages and Maxima Reported for Oxygen (% by weight)

	Company	Oxygenate	Average	Maximum
Refiners	Chevron Canada	-	0.00	0.00
	Consumers' Co-op	-	0.00	0.00
	Husky Oil	Ethanol	0.04	3.70
	Imperial Oil - Dartmouth	MTBE	0.00	0.50
	Imperial Oil - Nanticoke	-	0.00	0.00
	Imperial Oil - Sarnia	-	0.00	0.00
	Imperial Oil - Strathcona	-	0.00	0.00
	Irving Oil	MTBE	0.01	0.15
	North Atlantic Refining Ltd.	MTBE	2.40	2.64
	Petro-Canada – Edmonton	*	0.00	0.20
	Petro-Canada – Montreal	Ethanol	0.28	3.70
	Petro-Canada – Oakville	-	0.00	0.00
	Shell – Montreal	MTBE	0.00	1.70
	Shell – Sarnia*	-	0.00	1.50
	Shell – Scotford	-	0.00	0.00
	Suncor Energy	Ethanol	3.00	3.60
	Ultramar - St. Romuald	-	0.00	0.00
Blenders	Robbins Feed and Fuel	Ethanol	3.32	3.59
Importers	CAMI	MTBE	1.59	1.99
	Ford Motor Company of Canada	-	0.00	0.00
	General Motors of Canada	*	0.01	0.01
	Neste Petroleum	TAME and MTBE	1.60	1.60
	Petro-Canada - BC (Burrard)	MTBE	0.02	0.06
	Petroles Norcan	MTBE	1.12	0.01
	Ultramar - NFLD	-	0.00	0.00
	Ultramar - QC	-	0.00	0.00

* Primary supplier reported it did not add oxygenate, but measured oxygen present in batches.

Table A5.7: Averages and Maxima Reported for Vapour Pressure (kPa)

	Company	Average	Maximum
Refiners	Chevron Canada	81.1	107.3
	Consumers' Co-op	87.2	106.7
	Husky Oil	87.0	111.0
	Imperial Oil - Dartmouth	85.5	106.7
	Imperial Oil - Nanticoke	85.7	106.9
	Imperial Oil - Sarnia	80.9	107.9
	Imperial Oil - Strathcona	85.1	109.2
	Irving Oil	84.2	106.5
	North Atlantic Refining Ltd.	71.5	103.4
	Petro-Canada - Edmonton	84.2	107.0
	Petro-Canada - Montreal	83.3	107.0
	Petro-Canada - Oakville	83.2	107.0
	Shell - Montreal	81.4	106.1
	Shell - Sarnia	86.6	107.1
	Shell - Scotford	86.0	107.0
	Suncor Energy	79.3	106.9
	Ultramar - St. Romuald	90.2	106.8
Blenders	Robbins Feed and Fuel	82.6	105.7
Importers	CAMI	50.5	62.1
	Ford Motor Company of Canada	78.3	98.4
	General Motors of Canada	68.8	97.7
	Neste Petroleum	44.9	44.9
	Petro-Canada - BC (Burrard)	61.9	83.9
	Petroles Norcan	67.5	76.2
	Ultramar - NFLD	77.4	77.4
	Ultramar - QC	67.0	93.4

Table A5.8: Averages and Maxima Reported for E200 (% by volume)

	Company	Average	Maximum
Refiners	Chevron Canada	50.9	68.5
	Consumers' Co-op	48.5	57.2
	Husky Oil	50.0	62.0
	Imperial Oil - Dartmouth	49.9	65.8
	Imperial Oil - Nanticoke	48.9	68.9
	Imperial Oil - Sarnia	53.6	61.6
	Imperial Oil - Strathcona	46.0	56.8
	Irving Oil	42.8	51.9
	North Atlantic Refining Ltd.	59.7	69.1
	Petro-Canada - Edmonton	49.0	59.0
	Petro-Canada - Montreal	53.6	69.0
	Petro-Canada - Oakville	51.0	64.7
	Shell - Montreal	48.4	67.1
	Shell - Sarnia	49.0	60.1
	Shell - Scotford	51.4	65.2
	Suncor Energy	52.0	61.0
	Ultramar - St. Romuald	56.0	68.1
Blenders	Robbins Feed and Fuel	53.2	60.1
Importers	CAMI	46.6	48.0
	Ford Motor Company of Canada	44.8	49.3
	General Motors of Canada	43.7	47.0
	Neste Petroleum	42.8	42.8
	Petro-Canada - BC (Burrard)	48.4	58.8
	Petroles Norcan	57.4	59.3
	Ultramar - NFLD	44.6	44.6
	Ultramar - QC	48.7	60.4

Table A5.9: Averages and Maxima Reported for E300 (% by volume)

	Company	Average	Maximum
Refiners	Chevron Canada	89.2	95.0
	Consumers' Co-op	81.4	85.6
	Husky Oil	84.0	91.0
	Imperial Oil - Dartmouth	87.7	94.0
	Imperial Oil - Nanticoke	84.5	92.9
	Imperial Oil - Sarnia	88.9	94.5
	Imperial Oil - Strathcona	85.6	96.2
	Irving Oil	82.8	91.2
	North Atlantic Refining Ltd.	87.8	91.9
	Petro-Canada - Edmonton	87.1	93.8
	Petro-Canada - Montreal	84.1	95.4
	Petro-Canada - Oakville	87.3	97.7
	Shell - Montreal	86.1	92.6
	Shell - Sarnia	79.8	89.3
	Shell - Scotford	83.0	97.2
	Suncor Energy	81.0	97.0
	Ultramar - St. Romuald	86.3	92.5
Blenders	Robbins Feed and Fuel	85.6	91.9
Importers	CAMI	90.0	91.0
	Ford Motor Company of Canada	73.8	85.3
	General Motors of Canada	76.2	87.0
	Neste Petroleum	88.6	88.6
	Petro-Canada - BC (Burrard)	87.5	92.0
	Petroles Norcan	89.2	91.5
	Ultramar - NFLD	93.2	93.2
	Ultramar – QC	88.3	96.2