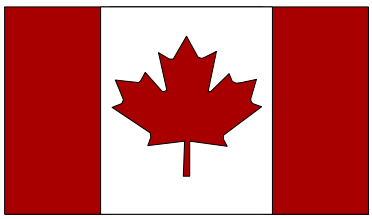


Environment Canada | Environnement Canada

Environmental Protection Service | Service de la protection de l'environnement

Benzene in Canadian Gasoline:

Report on the Effect of the Benzene in Gasoline Regulations

2002

by **Jeffrey Guthrie**
Oil, Gas and Energy Branch
Air Pollution Prevention Directorate
Environment Canada

and **René Sabourin**
Co-op Student
Carleton University

and **Elysia Brunet**
Co-op Student
University of Waterloo

November 2003

Environment Canada

Benzene in Canadian Gasoline

2002

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.

Table of Contents

1.0 Summary 1

2.0 Introduction 4

- 2.1 Benzene in Gasoline Regulations 4
- 2.2 Alternative Limits for the BEN 5
- 2.3 Options for Meeting the Requirements of the Regulations 5
- 2.4 Reporting Refineries and Importing Companies 6

3.0 Compliance with the Regulations 7

- 3.1 Information Reported 7
- 3.2 Reports on Gasoline Composition 7
- 3.3 Exceedances of Regulated Limits 8
- 3.4 Prosecutions under the Regulations 8
- 3.5 Results of Independent Audits 13

4.0 Canadian Gasoline Composition 14

- 4.1 Volume of Gasoline 14
- 4.2 Regulated Parameters: Benzene and BEN 15
- 4.3 Reported Composition of Gasoline 20
- 4.4 Trends of Aromatics and Olefins 21
- 4.5 Comparison of Imported vs. Domestic Gasoline 22
- 4.6 Toxic Emissions Number (TEN) and the Complex Model 22

Tables

Table 2.1 : Regulated Limits for Benzene and the BEN 4
Table 2.2: Number of Gasoline Pools Subject to Flat and Yearly Pool Average Limits 5
Table 2.3 : Primary Suppliers Reporting on Gasoline Composition 6
Table 3.1 : Dates of Submission 7
Table 4.1 : Regional Volumetric Data for 2002 14
Table 4.2 : Benzene Concentration and BEN for 2002 15
Table 4.3 : Average Benzene Content of Canadian Gasoline 1995-2002 15
Table 4.4: Average Concentration of MTBE Reported 20
Table 4.5: Average Concentration of Ethanol Reported 20
Table 4.6 : Average Aromatics Content of Canadian Gasoline 1995-2002 21
Table 4.7 : Average Olefins Content of Canadian Gasoline 1997-2002 21
Table 4.8: Comparison of All Importers and Refiners for All Parameters 22
Table 4.9 : Annual TEN 2002 & 2005 23
Table A3.1 : Average Benzene Concentration (% by volume) 41
Table A3.2 : Average BEN 42
Table A3.3 : Average Sulphur Concentration (mg/kg) 43
Table A3. 4 : Average Olefin Concentration (% by volume) 44
Table A3.5 : Average Aromatic Concentration (% by volume) 45
Table A3.6 : Average E200 (% by volume) 46
Table A3.7 : Average E300 (% by volume) 47
Table A3.8 : Average Vapour Pressure (kPa) 48
Table A3.9 : Average Oxygen Concentration (% by weight) 49
Table A4.1 : Reported Data for Benzene: Maximum, Minimum and Yearly Pool Averages (% by volume) 53
Table A4.2 : Reported Data for BEN: Maximum, Minimum and Yearly Pool Averages 53
Table A4.3 : Reported Data for Sulphur: Maximum, Minimum and Yearly Pool Averages (mg/kg) 53
Table A4.4 : Reported Data for Olefins: Maximum, Minimum and Yearly Pool Averages (% by volume) 53
Table A4.5 : Reported Data for Aromatics: Maximum, Minimum and Yearly Pool Averages (% by volume) 54
Table A4.6 : Reported Data for E200: Maximum, Minimum and Yearly Pool Averages (% by volume) 54
Table A4.7 : Reported Data for E300: Maximum, Minimum and Yearly Pool Averages (% by volume) 54

Table A4.8 : Reported Data for Vapour Pressure: Maximum, Minimum and Yearly Pool Averages (kPa) 54
Table A5.1: Averages and Maxima Reported for Benzene (% by volume) 57
Table A5.2: Averages and Maxima Reported for BEN 58
Table A5.3: Averages and Maxima Reported for Aromatics (% by volume) 59
Table A5.4: Averages and Maxima Reported for Olefins (% by volume) 60
Table A5.5: Averages and Maxima Reported for Sulphur (mg/kg) 61
Table A5.6: Averages and Maxima Reported for Oxygen (% by weight) 62
Table A5.7: Averages and Maxima Reported for Vapour Pressure (kPa) 63
Table A5.8: Averages and Maxima Reported for E200 (% by volume) 64
Table A5.9: Averages and Maxima Reported for E300 (% by volume) 65
Table A6.1: Average TEN of Canadian Gasoline 69
Table A6.2: Average TEN 70

Figures

Figure 1.1: Average Benzene Content of Canadian Gasoline 1994-2002 2
Figure 1.2: Average Aromatics Content of Canadian Gasoline 1994-2002 2
Figure 1.3: Average Ambient Benzene Concentration in Canada 1992-2002 3
Figure 3.1: Reported Maximum Benzene Levels for Suppliers on a Flat Limit, 2002 9
Figure 3.2: Reported Maximum BEN for Suppliers on a Flat Limit 10
Figure 3.3: Reported Benzene Levels (Average and Maximum) for Suppliers on a Yearly Pool Average Limit, 2002 11
Figure 3.4: Reported BEN (Average and Maximum) Levels for Suppliers on a Yearly Pool Average Limit, 2002 12
Figure 4.1: Average Benzene Content of Gasoline - Canada 1995-2002 16
Figure 4.2: Average Benzene Content of Gasoline - Atlantic 1995-2002 16
Figure 4.3: Average Benzene Content of Gasoline - Quebec 1995-2002 17
Figure 4.4: Average Benzene Content of Gasoline - Ontario 1995-2002 17
Figure 4.5: Average Benzene Content of Gasoline - West 1995-2002 18
Figure 4.6: Average Benzene Concentration of Canadian Gasoline 2002 18
Figure 4.7: Average BEN of Canadian Gasoline 2002 19
Figure A3.1: Average Benzene Concentration of Canadian Gasoline 2002 41
Figure A3.2: Average BEN of Canadian Gasoline 2002 42
Figure A3.3: Average Sulphur Concentration of Canadian Gasoline 2002 43
Figure A3.4: Average Olefin Concentration of Canadian Gasoline 2002 44
Figure A3.5: Average Aromatics Concentration of Canadian Gasoline 2002 45
Figure A3.6: Average E200 of Canadian Gasoline 2002 46
Figure A3.7: Average E300 of Canadian Gasoline 2002 47
Figure A3.8: Average Vapour Pressure of Canadian Gasoline 2002 48
Figure A3.9: Average Oxygen Concentration of Canadian Gasoline 2002 49
Figure A6.1: Average TEN of Canadian Gasoline 69

Appendices

Appendix 1: Annual Compliance Package with Sample Reporting forms including: Registration Form; Report on Composition of Gasoline 25
Appendix 2: Alternative Limits under the Benzene in Gasoline Regulations 33
Appendix 3: Regional and National Quarterly Data for all Parameters 39
Appendix 4: Regional Data on the Maximum and Quarterly Averages for all Parameters 51
Appendix 5: Company Reported Data 55
Appendix 6: Toxic Emission Number (TEN) Data 67

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 effects the regulations have had on the composition of gasoline in 2002. All of the information summarized in this report was provided to Environment Canada by the primary suppliers, 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 *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.

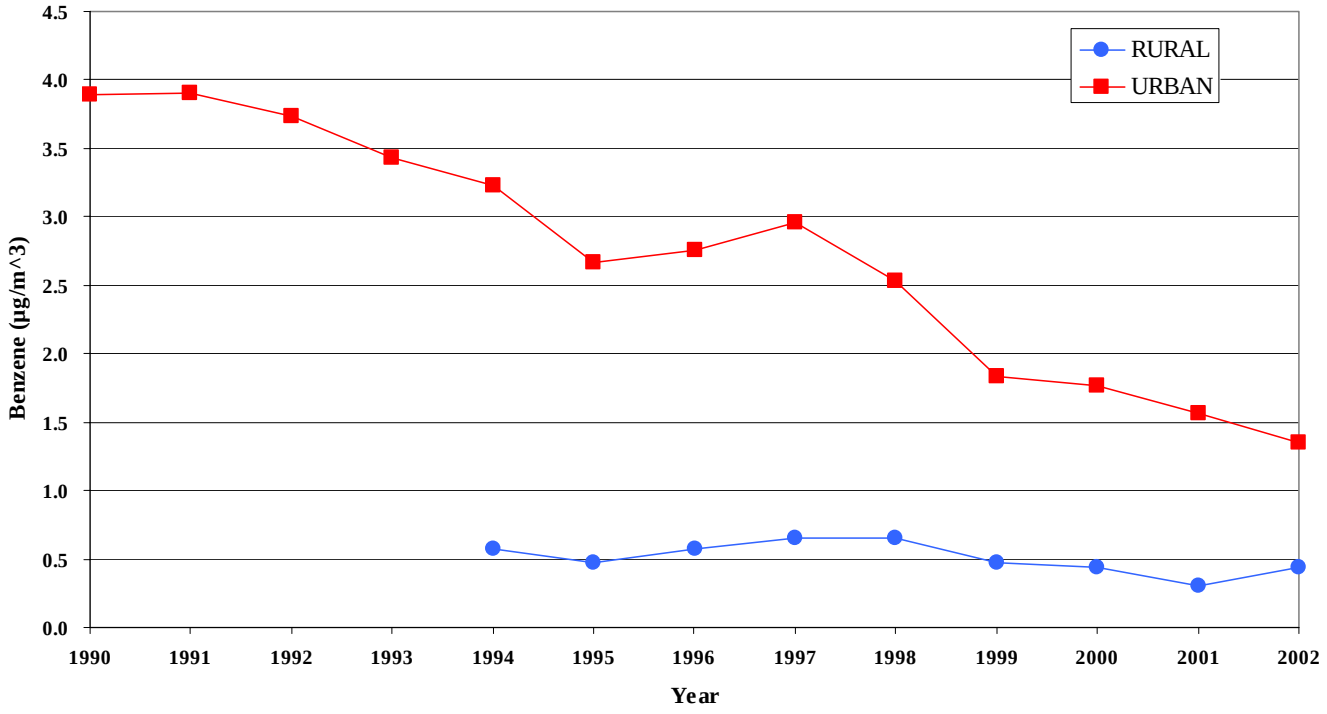
The regulations have been very successful in achieving both of the recommendations of the Task Force: reported benzene levels have been significantly reduced and reported aromatic levels are about the same as they were in 1994. Figures 1.1 and 1.2 show how benzene and aromatics levels have changed since 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% since 1992 and 47% since 1998, the year prior to the regulation. Rural ambient benzene concentrations have fallen by over 32% since 1998. In addition, based on the information collected under the regulation, it should also be noted that the level of MTBE in Canadian gasoline has fallen 82% since 2001.

Primary suppliers reported that all gasoline supplied in Canada in 2002 met the regulated requirements with respect to benzene concentration (with one exception discussed in Section 3.3) and BEN levels. There were six batches supplied during Q2/Q3 that had BEN levels higher than the summer BEN limits. These may have been gasoline subject to the winter BEN limits. Independent audits (required for those electing to be on a yearly pool average) 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.

Figure 1.1: Average Benzene Content of Canadian Gasoline 1994-2002

Figure 1.2: Average Aromatics Content of Canadian Gasoline 1994-2002

Figure 1.3: Average Ambient Benzene Concentration in Canada 1992-2002



Source: Tom Dann (Environment Canada), personal communication, 2003

2.0 Introduction

2.1 Benzene in Gasoline Regulations

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 2002. The information used for this report was provided by primary suppliers, as required under the 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 or competition vehicles or for use in scientific research.

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

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)

The regulated limits apply to individual refineries, blending facilities, and imports into a province from outside Canada. A primary supplier can elect to use flat limits or a yearly pool average limit for each of its refineries, blending or import pools. The yearly pool average is the volume-weighted average of benzene or BEN of the gasoline supplied by the primary supplier during a year. The yearly pool average limit may be selected for either benzene, BEN, or both. A maximum benzene concentration of 1.5% applies at the point of sale of gasoline.

[1] SOR/97-493, as amended by SOR/99-204 and SOR/208-318 ; 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 mixing of complying gasoline, or the adding of only additives, commercially-pure butane or oxygenate to complying gasoline.

All primary suppliers must submit quarterly until the end of 2002, annual thereafter, reports on the levels of various parameters of gasoline to Environment Canada. Importers must notify Environment Canada at least 12 hours in advance of their intention to import more than 100 m^3 of gasoline at one time, or any amount of gasoline-like blendstock. Independent audits must be submitted to Environment Canada by companies electing to be on a yearly pool average for benzene, BEN or both.

Final 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 ASTM 5453. 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. A requirement to notify Environment Canada at least 12 hours in advance of the 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 in 2002.

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	9	6
BEN	Refineries	6	11
	Blending Facilities	1	0
	Import Pools	13	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 supplied gasoline during 2002. 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
	Sunoco	Sarnia, Ontario	YPA	YPA
	Ultramar - St-Romuald	St-Romuald, Quebec	YPA	YPA
Blenders	Robbins Feed & Fuel	Thorold, Ontario	Flat	Flat
Importers	BP (Arco)	British Columbia	YPA	Flat
	CAMI	Ontario	Flat	Flat
	Ford	Ontario	Flat	Flat
	GM	Ontario	Flat	Flat
	Imperial Oil - BC (Burrard)	British Columbia	Flat	Flat
	Mackenzie Petroleum	Yukon	Flat	Flat
	Neste Petroleum	Quebec	Flat	Flat
	Northern Transportation	Nunavut	Flat	Flat
	Olco - ON	Ontario	Flat	Flat
	Parkland - YK	Yukon	Flat	Flat
	Petro-Canada- ON	Ontario	YPA	YPA
	Petro-Canada - BC (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, quarterly average 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 sampled, and the name of any oxygenates used.

3.2 Reports on Gasoline Composition

For the period beginning January 1, 1999 and ending December 31, 2002, every primary supplier must submit a quarterly report on gasoline composition. The report must be submitted within 45 days after the last day of each calendar quarter in which gasoline was supplied. Starting in 2003, the report must be submitted once per year before February 15 of the following year.

Table 3.1 shows the date by which reports should have been submitted in 2002, and the number of reports that were either punctual or late for each quarter. Late submissions shown here are those reports dated after the date required by the regulation.

Table 3.1: Dates of Submission

2002	Deadline for	Total number of	Number of punctual	Number of late
Quarter	submissions	submissions	submissions	submissions
First	15-May-02	30	26	4
Second	14-Aug-02	33	30	3
Third	14-Nov-02	35	32	3
Fourth	14-Feb-03	35	32	3

3.3 Exceedances of Regulated Limits

There was one reported exceedance of the Benzene limit that occurred in the second quarter. The reported benzene maximum was 1.53 for a refinery on the YPA limit option which includes a never-to-be exceeded limit of 1.5%. The audit report for this refinery noted the exceedance, but it explained it was a non-exceedance with the audit report statement *"based on the ASTM and CGSB rounding practices, the batch was confirmed within Benzene complying limits (1.5%)"*.

There were no reported exceedances of either the summer or winter BEN limits. There were however 6 values of BEN higher than summer BEN limit. These may have been subject to the winter BEN limits in the early part of Q2 or the late part of Q3. All these Q3 and Q4 BEN values were lower than the winter BEN limits.

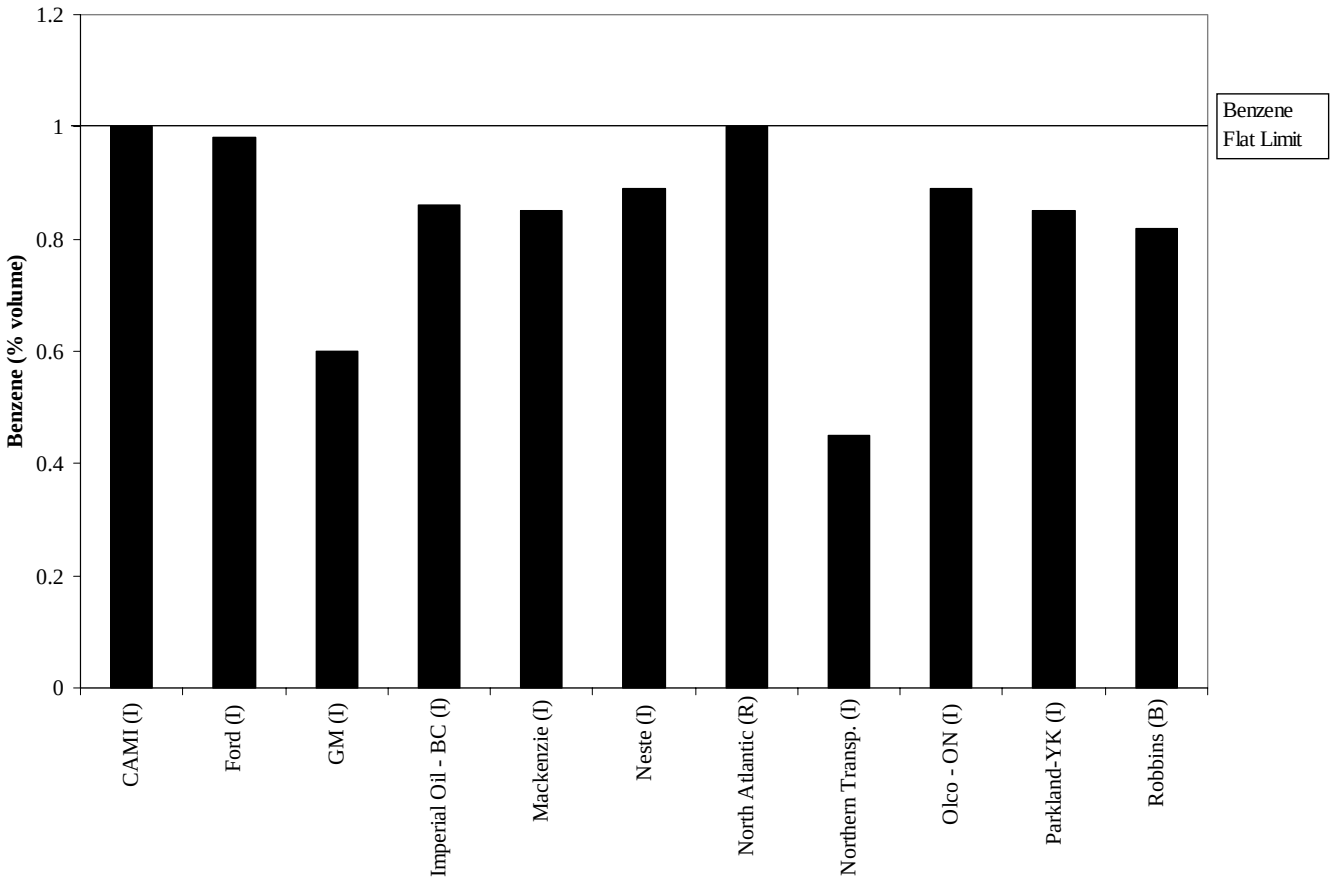
Figures 3.1 and 3.2 show the maximum benzene level and BEN reported by primary suppliers using flat limits, as a percentage of the regulated limit.

Figures 3.3 and 3.4 show benzene and BEN levels reported by primary suppliers using YPA limits, as a percentage of the regulated limits for 2002. 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.

3.4 Prosecutions under the Regulations

On February 21, 2003, in the Alberta Provincial Court, an Order against Shell Canada Products Limited was signed, sentencing the company for violations under the *Canadian Environmental Protection Act, 1999 (CEPA 1999)*. Shell Canada Products Limited pled guilty on December 20, 2002, to charges of unlawfully importing gasoline with a benzene concentration above the regulatory limit and for failing to report these imports. This is contrary to the *Benzene in Gasoline Regulations*, issued under *CEPA 1999*. The Court accepted a joint sentencing submission by the Crown and Defense, ordering penalties in the amount of $50,000: $7,000 in fines and $43,000 in the form of a creative sentence for environmental research at the University of Calgary's Faculty of Environmental Design. The sentence was for violations which occurred in 2001.

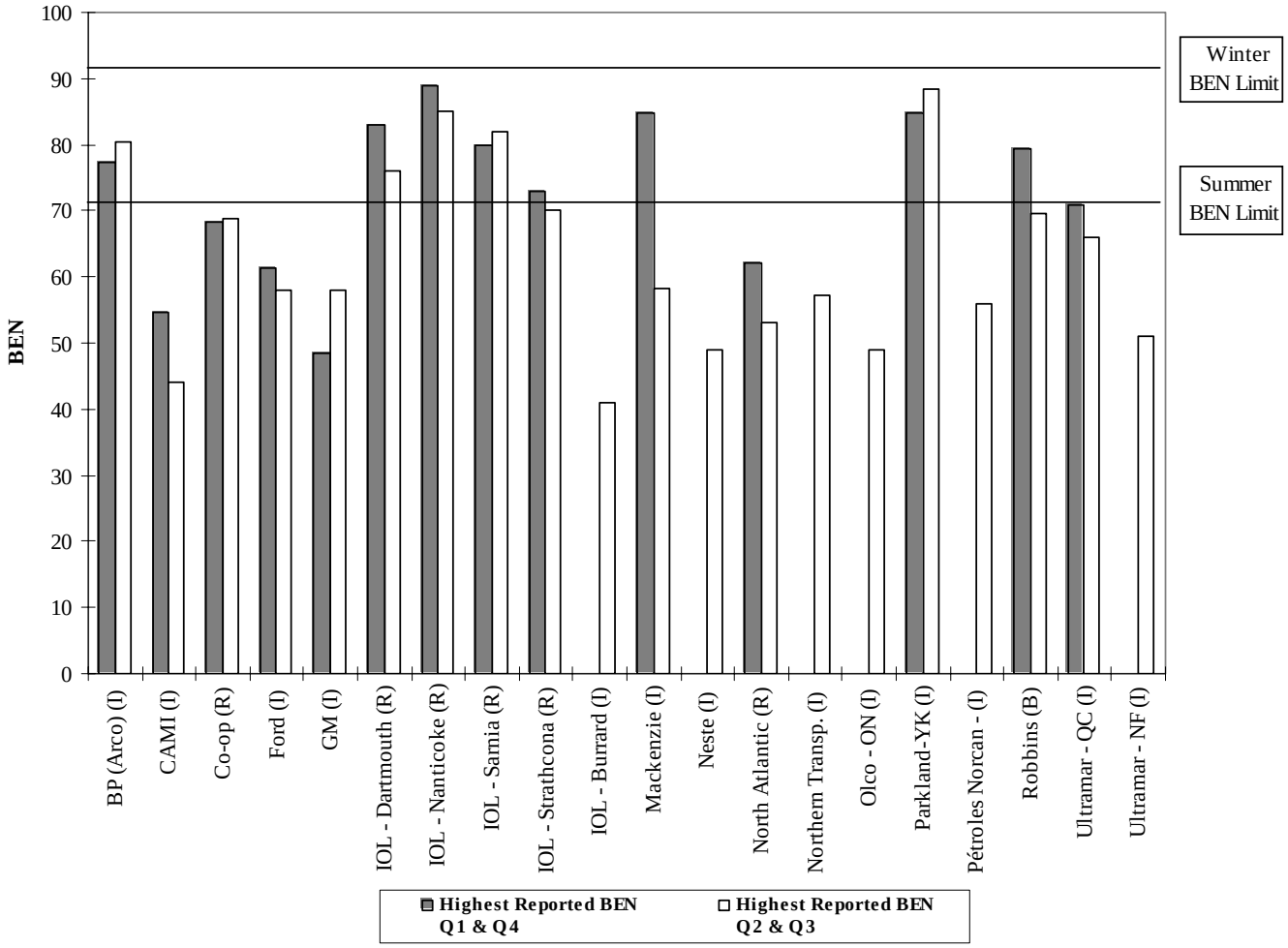
Figure 3.1: Reported Maximum Benzene Levels for Suppliers on a Flat Limit, 2002



Notes:

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

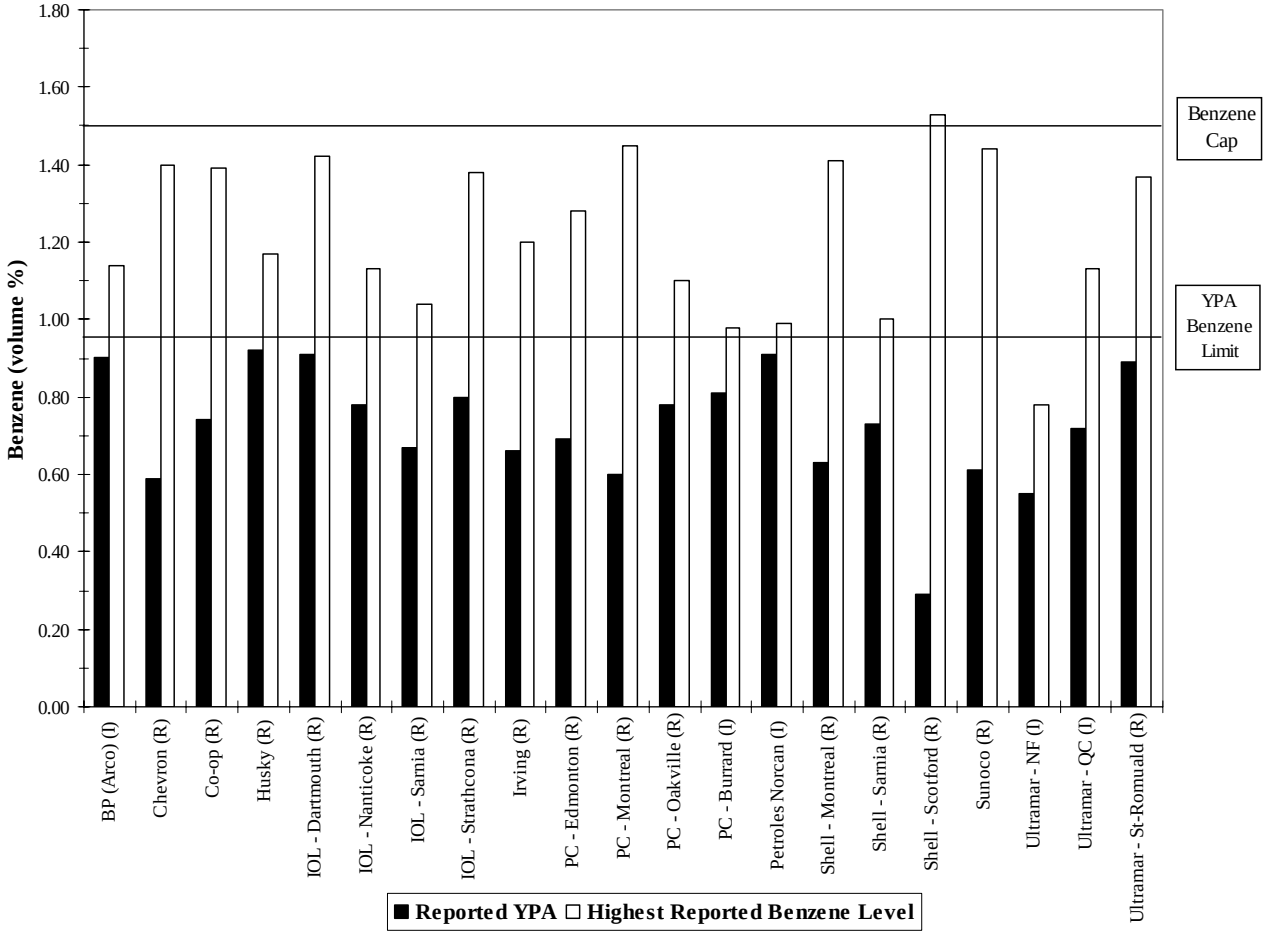
Figure 3.2: Reported Maximum BEN for Suppliers on a Flat Limit



Notes:

- 92 = Flat BEN Winter Limit
- 71 = Flat BEN Summer Limit
- R = Refiner, B = Blender and I = Importer
- It is important to note that Q2 and Q3 reported BEN values include some batches supplied under the winter BEN limits. Therefore, Q2 and Q3 values above the summer BEN limit do not necessarily imply any exceedance of the regulated limit.

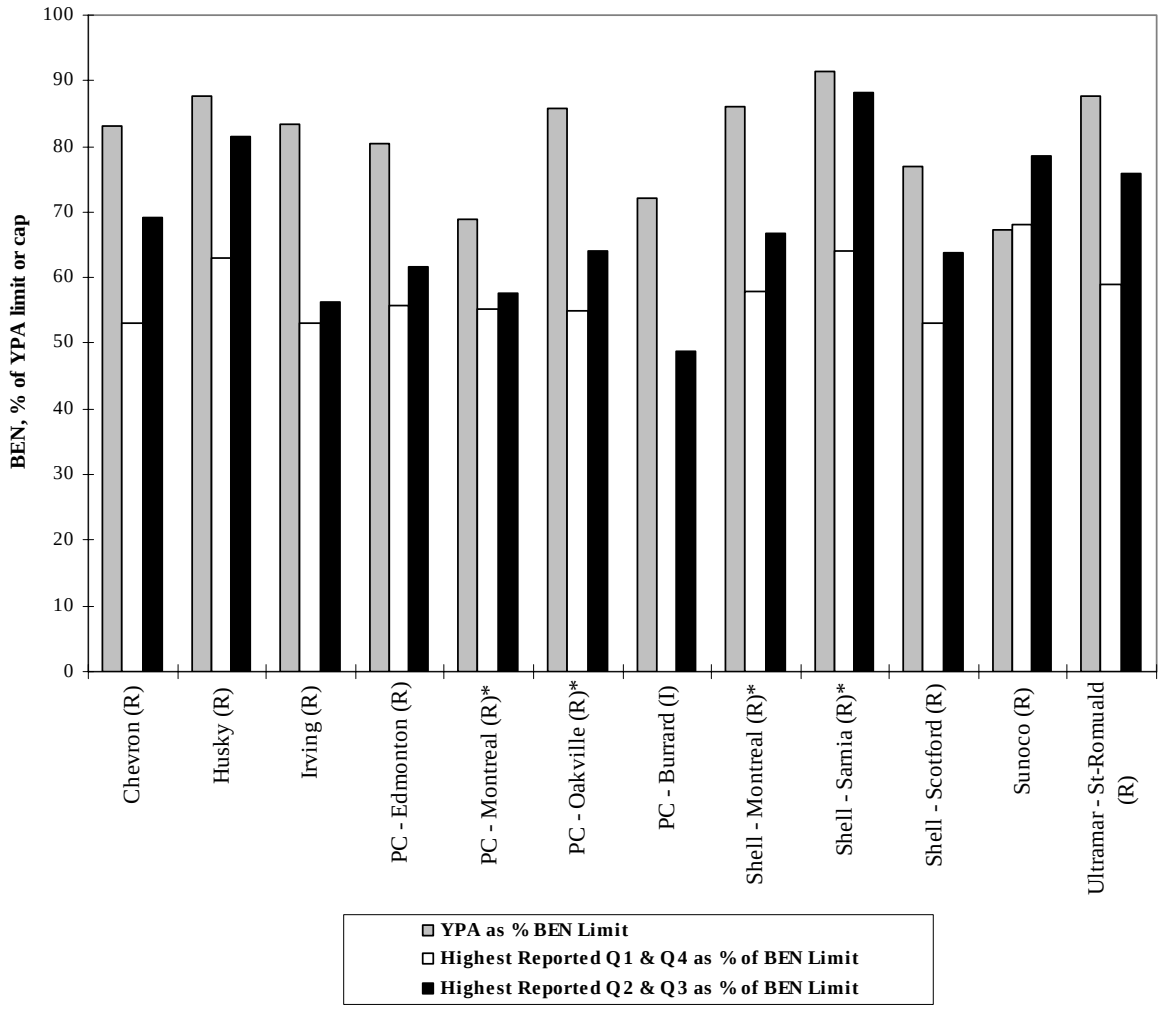
Figure 3.3: Reported Benzene Levels (Average and Maximum) for Suppliers on a Yearly Pool Average Limit, 2002



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, 2002 (% 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
- It is important to note that Q2 and Q3 reported BEN values include some batches supplied under the winter BEN limits. Therefore, Q2 and Q3 values above the summer BEN limit do not necessarily imply any exceedance of the regulated limit.

3.5 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.

Eighteen audit reports were submitted by eleven companies in regard to sixteen refineries, six import pools and two blenders. 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, and include:

- with respect to testing:
    - testing equipment was not calibrated regularly
    - quality control samples were not run as required to standard
    - analytical methods were used or deviated without Ministerial approval or proper notification
    - quality control program could not be demonstrated in the laboratory
    - gasoline samples 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 significant digits
    - 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, and improvement 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 2002, 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 maximum, minimum and volume-weighted average of both the reported maximum and quarterly average concentrations 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 2002

Region	Total Volume (m^3)	Number of Batches
Atlantic	2,849,121	370
Quebec	10,471,401	1,495
Ontario	13,120,859	1,335
West*	12,408,036	4,914
National	38,849,417	8,114

*Includes all western provinces and northern territories.

4.2 Regulated Parameters: Benzene and BEN

Data reported on benzene and BEN levels for 2002 are summarized in Table 4.2. The trends for benzene and BEN levels are shown graphically in Figures 4.1 and 4.2.

Table 4.2: Benzene Concentration and BEN for 2002

	Reported Values*					
	Benzene (% Volume)			BEN		
Quarter	Minimum	Maximum	Volume Weighted Average	Minimum	Maximum	Volume Weighted Average
First	0.08	1.42	0.67	35.70	94.70	59.63
Second	0.28	1.53	0.74	33.70	93.40	46.28
Third	0.26	1.44	0.73	32.00	80.00	44.51
Fourth	0.25	1.45	0.71	18.20	91.60	57.08

* Includes primary suppliers on alternative limits

Table 4.3 shows the trend in benzene levels between 1995 and 2002[4]. Nationally, benzene levels in 2002 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.

Table 4.3: Average Benzene Content of Canadian Gasoline 1995-2002

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

Figures 4.6 and 4.7 show the regional and national average values for benzene and BEN on a quarterly basis. As the Regulations took effect mid-1999, the data for that year is presented separately for the first and second half of the year.

[4] 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 1995-2002

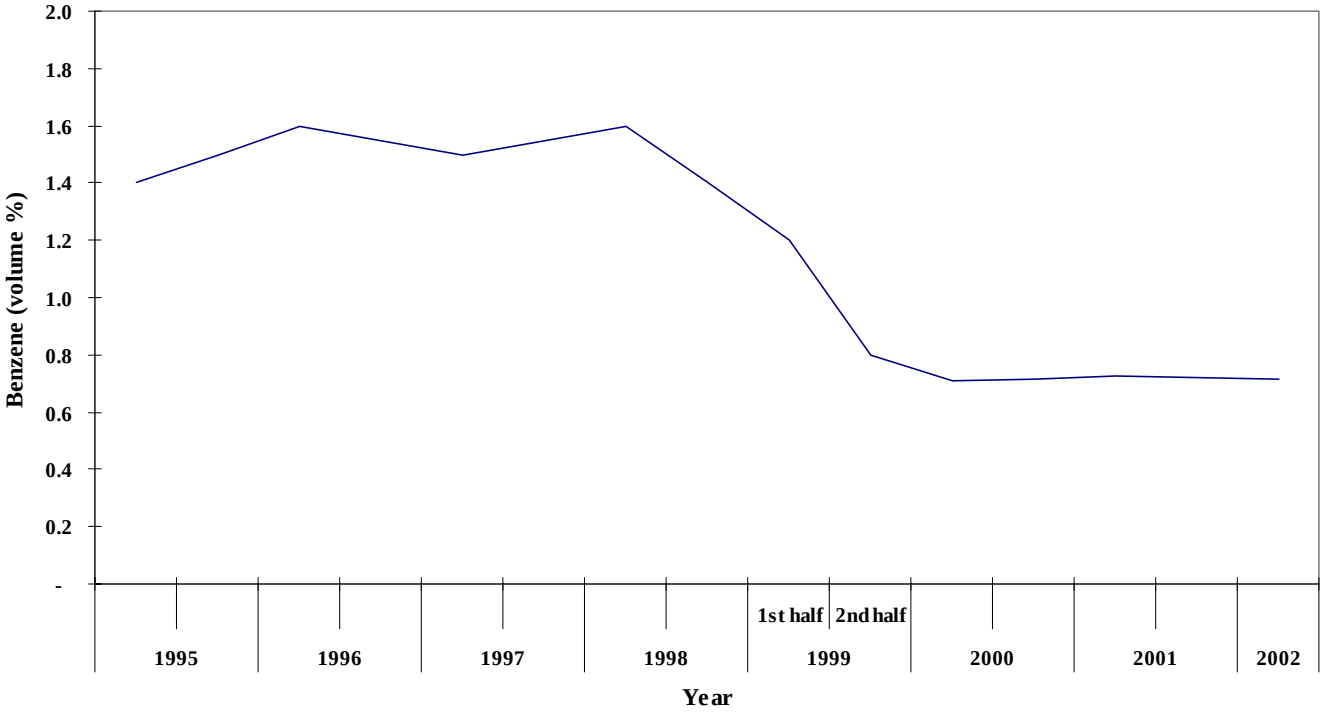


Figure 4.2: Average Benzene Content of Gasoline – Atlantic 1995-2002

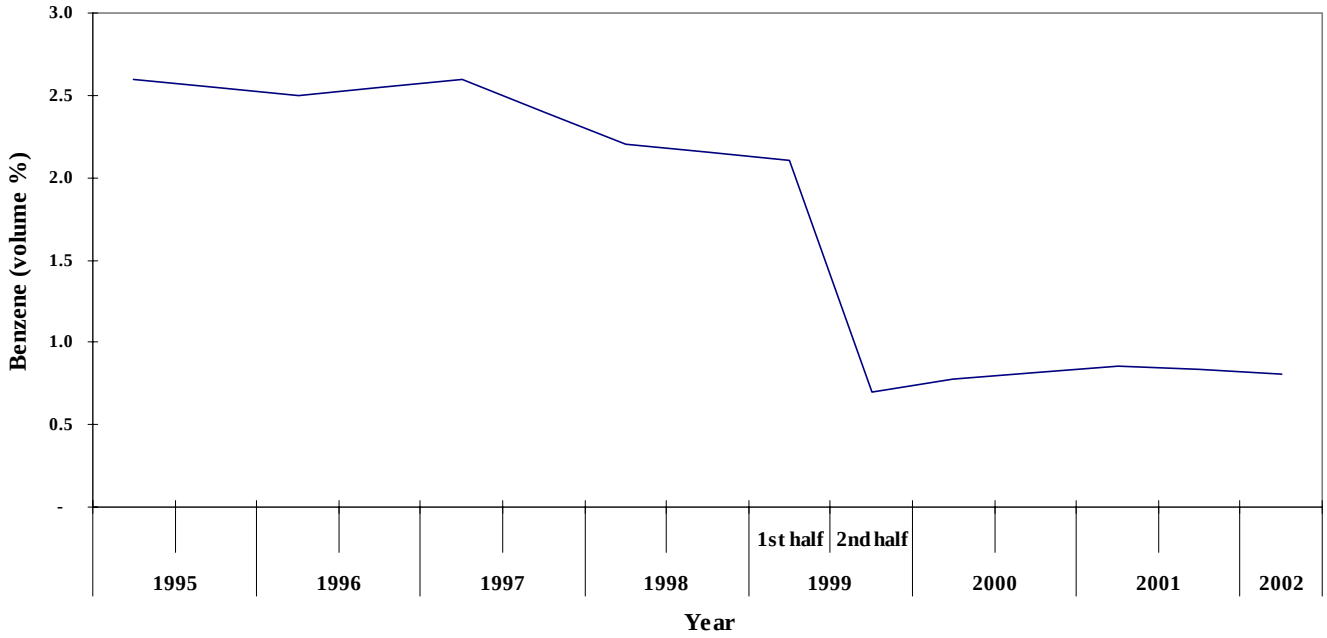


Figure 4.3: Average Benzene Content of Gasoline – Quebec 1995-2002

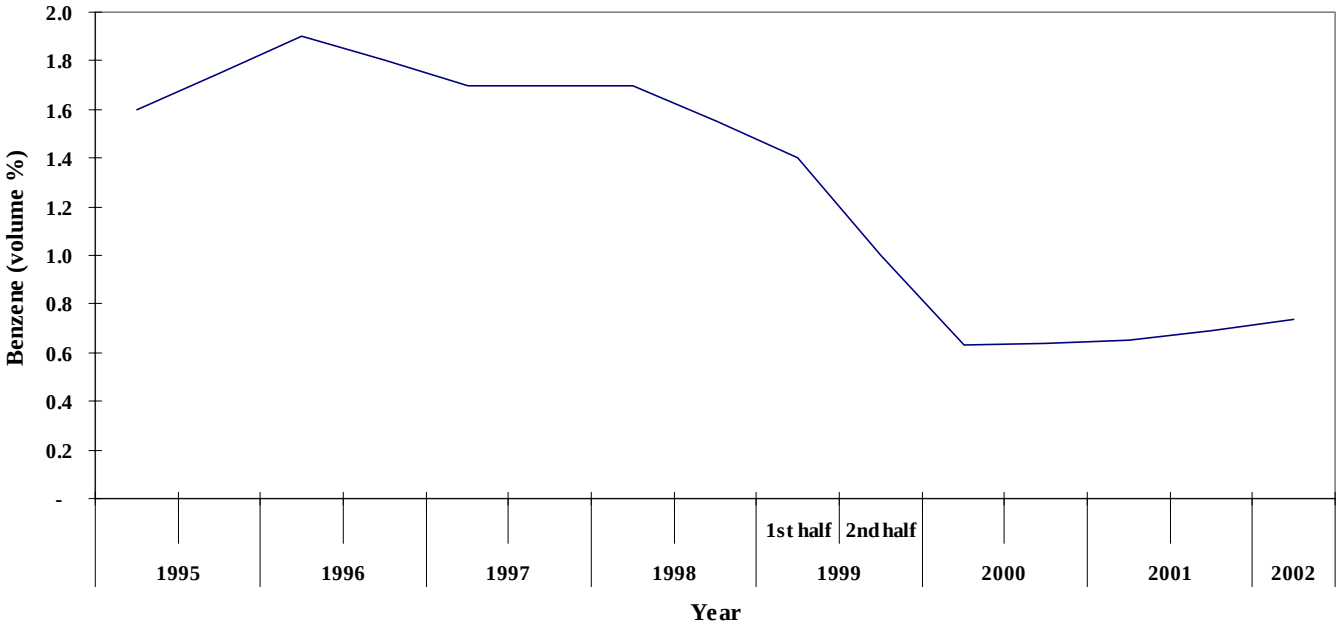


Figure 4.4: Average Benzene Content of Gasoline – Ontario 1995-2002

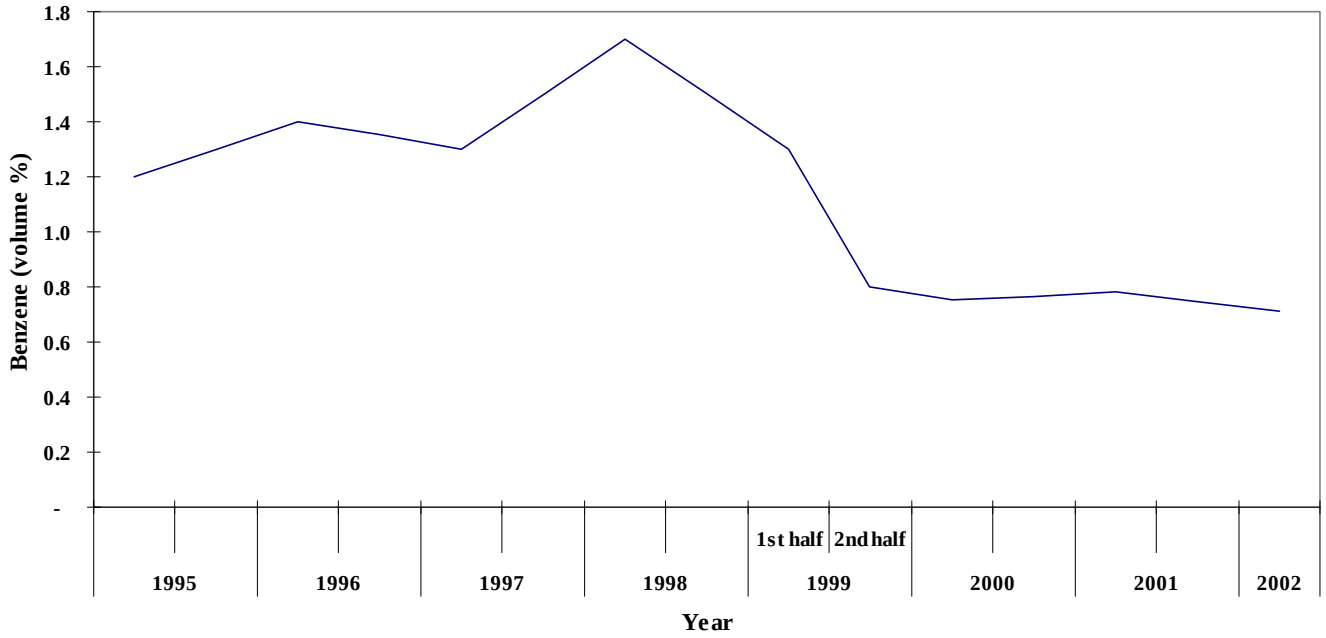


Figure 4.5: Average Benzene Content of Gasoline – West 1995-2002

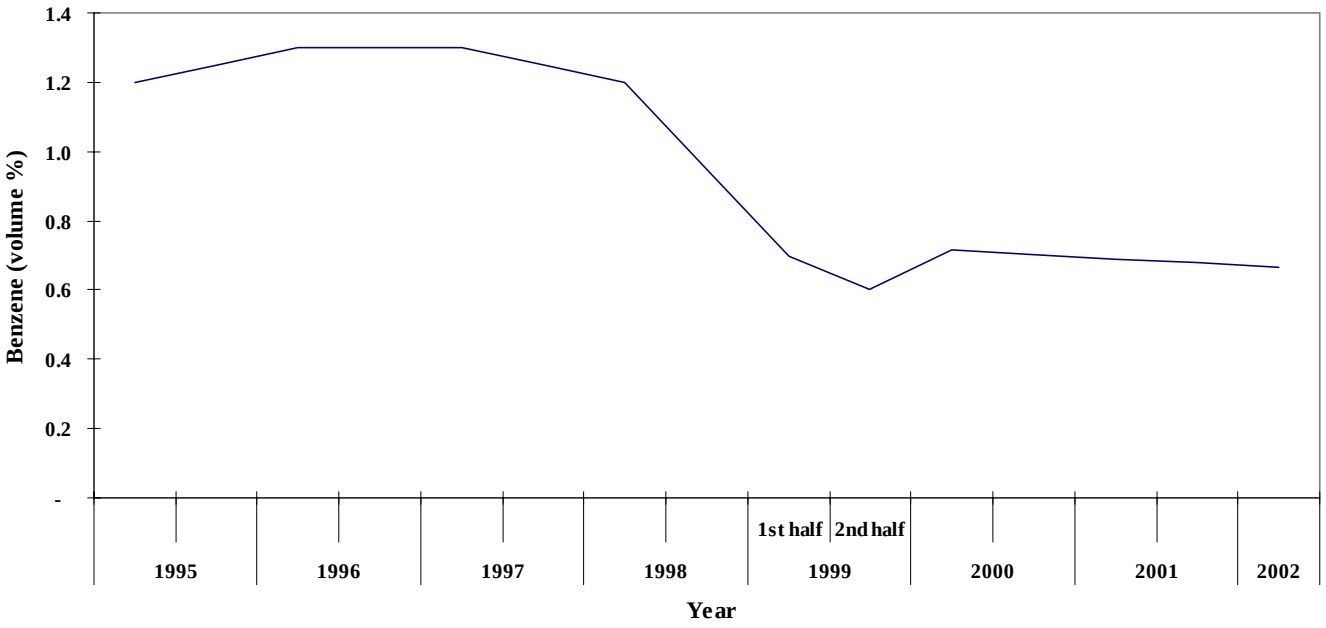


Figure 4.6: Average Benzene Concentration of Canadian Gasoline 2002

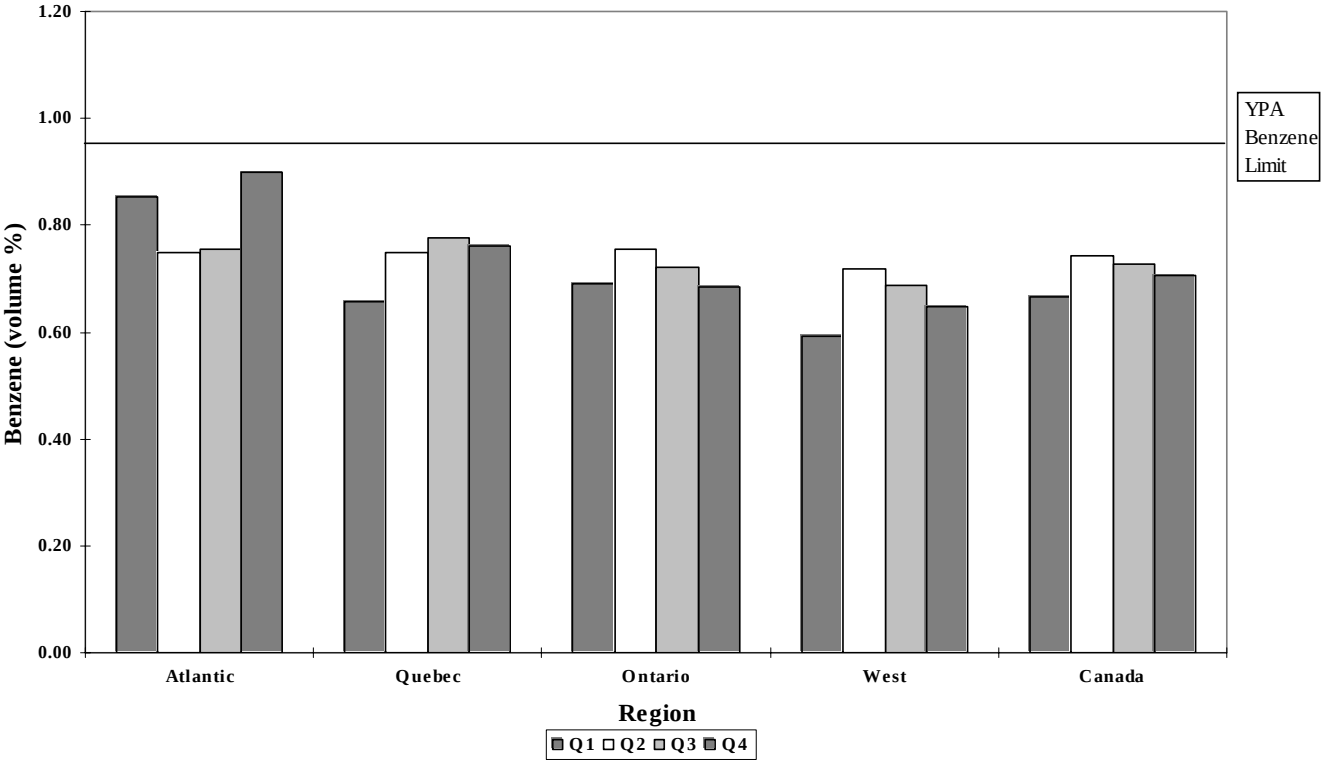
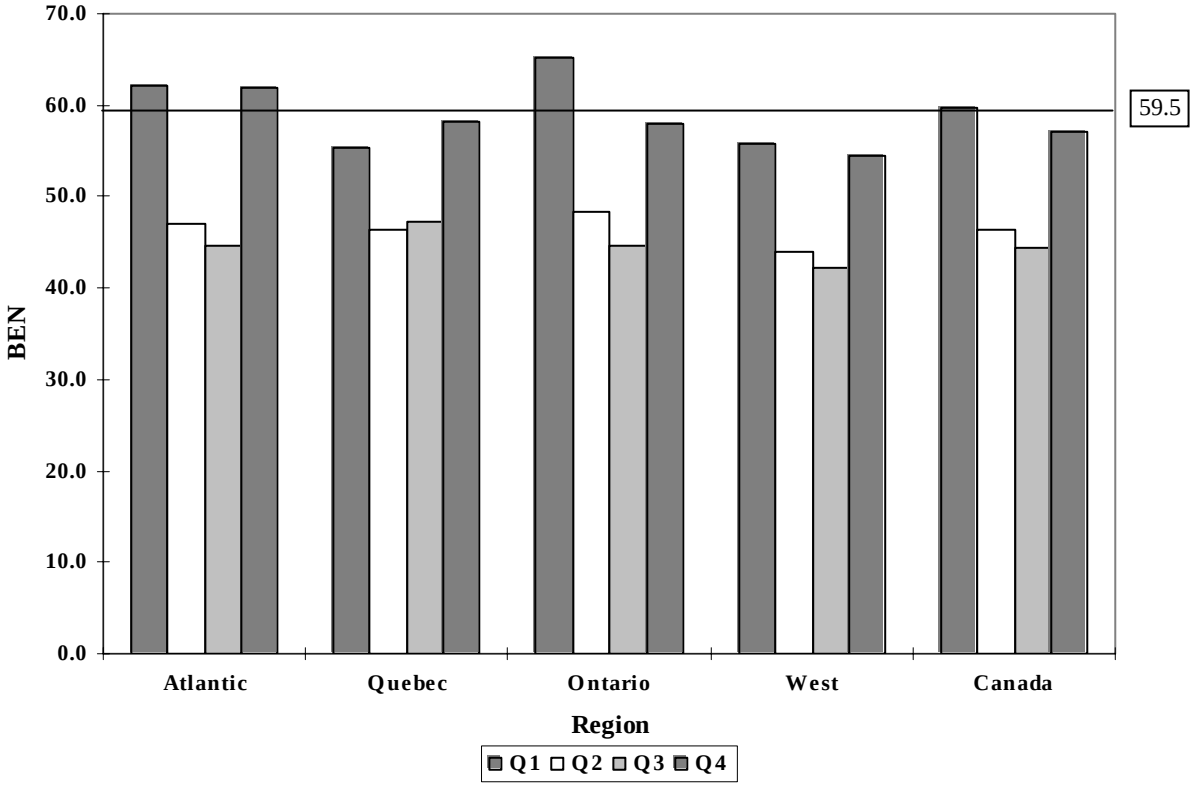


Figure 4.7: Average BEN of Canadian Gasoline 2002



Notes:

- 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 concentration of oxygen resulting from the addition of MTBE and ethanol, respectively. Note the average level of MTBE in Canadian gasoline has decreased by 82%, while that of ethanol has increased by 2%.

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	2000	2001	2002
Atlantic	0.85	1.13	0.14	14.89	15.39	14.83
Quebec	0.02	0.08	0.04	3.00	7.11	2.22
Ontario	0.00	0.00	0.00	11.44	12.22	0.28
West	0.21	0.01	0.01	15.56	0.00	3.33
Canada	0.14	0.11	0.02	15.56	15.39	14.83

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	2000	2001	2002
Atlantic	0.00	0.00	0.00	0.00	0.00	0.00
Quebec	0.04	0.00	0.01	10.00	10.00	10.00
Ontario	1.43	1.69	1.81	10.00	10.00	10.00
West	0.00	0.00	0.002	0.57	0.00	10.00
Canada	0.46	0.60	0.61	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

During 1994 to 1998 data on the aromatic and olefin concentration in gasoline were collected by Environment Canada under a voluntary survey of benzene, aromatics and olefins content of gasoline. 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[5]. These data shows that reported levels of aromatics and olefins for 2002 are similar to those for previous years.

Table 4.6: Average Aromatics Content of Canadian Gasoline 1995-2002

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

Table 4.7: Average Olefins Content of Canadian Gasoline 1995-2002

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

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

[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.

4.5 Comparison of Imported vs. Domestic Gasoline

Table 4.8 compares the data provided by refiners and importers. As 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 lower average values for parameters other than E300, aromatics, olefins and benzene.

Table 4.8: Comparison of All Importers and Refiners for All Parameters

	Reported Maxima		Average Reported	
	Importers	Refiners	Importers	Refiners
Oxygen (wt %)	0.60	3.70	0.03	0.24
Sulphur (wt %)	0.045	0.096	0.013	0.025
Vapour Pressure (kPa)	103.2	109.6	60.8	84.9
E200 (vol %)	65.2	80.2	46.7	50.1
E300 (vol %)	94.5	98.0	85.5	84.2
Aromatics (vol %)	57.0	61.7	33.2	25.3
Olefins (vol %)	27.7	36.9	12.2	11.5
Benzene (vol %)	1.14	1.53	0.72	0.71
BEN	88.5	94.7	47.5	51.7

4.6 Toxic Emissions Number (TEN) and the Complex Model

The Complex Model is a set of equations relating gasoline composition to emissions from a "typical" 1990 vehicle. The model was developed by the EPA and used to establish the regulated requirements for reformulated gasoline in the U.S. The Complex Model addresses emissions of VOCs, NOx and five toxics - benzene, 1,3-butadiene, formaldehyde, acetaldehyde and polycyclic organic matter (POM). The first four of these, benzene, 1,3-butadiene, formaldehyde, and acetaldehyde, have been classified as toxic under the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

The Canadian *Benzene in Gasoline Regulations* include limits for the Benzene Emissions Number, which is calculated using the EPA's complex model equations. The controls on the BEN were developed with the view that the concept could be expanded to address other toxic substances in the future. In this regard, the *Notice of Intent on Cleaner Vehicles, Engines and Fuels*[6] indicates that Environment Canada will study the effect on emissions of toxic substances from vehicles of setting additional limits for gasoline composition. This study was completed in March 8, 2002 by SENES Consulting Limited and Air Improvement Resource, Inc. The report is available from the Transportation Systems Branch of Environment Canada.

[6] Environment Minister David Anderson's Notice of Intent on Cleaner Vehicles, Engines and Fuels was published in the Canada Gazette on February 17. The Notice sets out the federal agenda on vehicles and fuels in Canada for the next decade. The Notice is available at http://www.ec.gc.ca/Ceparegistry/documents/notices/g1-13507_n1.pdf

This section of the report analyzes the toxics emissions performance of Canadian gasoline. The analysis is based on the sum of the four substances that have been found to be "toxic" under CEPA 1999. 'TEN' is used to refer to this Canadian toxics emission number. (The difference between TEN and the U.S. sum of toxics is that TEN does not include POM.)

TEN values for Canadian gasoline have been estimated based on the properties reported by primary suppliers in 2002. The resulting regional and national values for TEN are presented in Table 4.9 below[7]. TEN values for individual refiners/importers are presented in Appendix 5. An analysis was also carried out for TEN using the same parameters as before but with a sulphur concentration of 25 mg/kg, expected to be representative of gasoline sulphur levels in 2005 after the final compositional requirements of the *Sulphur in Gasoline Regulations* take effect.

Table 4.9: Annual TEN for 2002 & 2005

Region	Annual TEN (based on reported parameters)			Annual TEN (estimated, assuming 25 mg/kg S and 2002 values)
	2000	2001	2002	2005
Atlantic	89	88	87	83
Quebec	84	84	84	80
Ontario	92	90	87	79
West	82	82	81	67
Canada	86	86	85	76

The regulated requirements for U.S. reformulated gasoline for 2000 and beyond limit the sum of toxics to 83.2 (21.5% below a baseline of 106). Subtracting a constant value for POM (taken to be 3.6) from this value gives a TEN value of 79.6. It is estimated that the Canadian gasoline pool will have a value below this by 2005, except in Quebec and Atlantic Canada.

In 1998, the total toxics performance averaged across the U.S. reformulated gasoline pool was 11.6% lower than the required level. This is roughly equivalent to a toxics performance of 76.2 (using the Complex Model equations for the year 2000 and beyond). Subtracting POM gives a TEN equivalent of 72.6. Therefore, it is expected that the average TEN levels for gasoline in 2005 in all regions of Canada except the West, will be above the average TEN level for 1998 US gasoline.

[7] The TEN values were computed from average concentrations of the input gasoline parameters, rather than using batch-by-batch analysis (as was reported for BEN). Such batch-by-batch TEN values are not available to Environment Canada. Due to the non-linearity of the TEN equations, there will be a small error introduced by the use of average data for the input parameters.

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

GOVERNMENT NOTICES

DEPARTMENT OF THE ENVIRONMENT

Alternative Limits under the Benzene in Gasoline Regulations

This notice provides information on alternative limits that have been approved by the Minister of the Environment under the federal *Benzene in Gasoline Regulations.*

The federal *Benzene in Gasoline Regulations* set limits for the level of benzene in gasoline and for a parameter called the benzene emissions number (BEN). The BEN relates gasoline composition to the estimated emissions of benzene from vehicles. The limits under the Regulations came into effect on July 1, 1999.

Under subsection 17(2) of the *Benzene in Gasoline Regulations*, primary suppliers of gasoline (refiners, blenders and importers) could elect to be subject to alternative limits for the BEN, based on their historical gasoline composition. Under subsection 16(2), primary suppliers unable to meet the July 1, 1999, implementation date could also apply to be subject to temporary (higher) limits for both benzene and the BEN for up to six months.

Temporary Limits under Subsection 16(2)

Under subsection 16(2) of the Regulations, primary suppliers may apply for temporary alternative limits for benzene and the BEN if, for reasons beyond their control, they cannot meet the implementation date of July 1, 1999. Primary suppliers may only use the temporary limits until December 31, 1999. Under subsection 16(4) of the Regulations, the Minister of the Environment approves these applications only if:

— the primary supplier has made all reasonable efforts to meet the implementation date of July 1, 1999; and
— that non-authorization of the temporary limits would
— have a significant effect on the supply of gasoline or other petroleum products in the region,
— require the primary supplier to significantly curtail operations or cease operating for a period of time and thereby result in financial hardship, or
— result in the primary supplier going out of business.

In the Regulatory Impact Analysis Statement that accompanied amendments to the *Benzene in Gasoline Regulations*, published in the *Canada Gazette*, Part II, on May 26, 1999, the Minister of the Environment announced her intention to "publish a notice in *Canada Gazette* Part I identifying the company, its alternative limits, and the period that the limits apply". Pursuant to that intention, the following tables show the temporary alternative limits for benzene and the BEN that have been applied for and approved. It should be noted that under the Regulations, companies can elect to meet the requirements on the basis of yearly pool average limits with associated never-to-be-exceeded caps, rather than meeting "flat" never-to-be-exceeded limits.

AVIS DU GOUVERNEMENT

MINISTÈRE DE L'ENVIRONNEMENT

Limites de remplacement en vertu du Règlement sur le benzène dans l'essence

Cet avis fournit de l'information sur les limites de remplacement approuvées par la ministre de l'Environnement en vertu du *Règlement sur le benzène dans l'essence*.

Le *Règlement sur le benzène dans l'essence* du gouvernement fédéral établit des limites pour la teneur en benzène de l'essence et pour un paramètre appelé indice des émissions de benzène (BEN). Le BEN relie la composition de l'essence à l'estimation des émissions de benzène provenant des véhicules. Les limites en vertu du Règlement sont entrées en vigueur le 1er juillet 1999.

En vertu du paragraphe 17(2) du *Règlement sur le benzène dans l'essence*, un fournisseur principal d'essence (raffineur, mélangeur ou importateur) peut choisir d'être assujetti à des limites de remplacement pour le BEN en fonction de l'historique de la composition de son essence. En vertu du paragraphe 16(2), un fournisseur qui est incapable de se conformer à la date de mise en vigueur du 1èr juillet 1999 peut aussi demander d'être assujetti à des limites temporaires (plus élevées), et pour le benzène et pour le BEN, pour une durée maximum de six mois.

Limites temporaires en vertu du paragraphe 16(2)

En vertu du paragraphe 16(2) du Règlement, un fournisseur principal peut demander des limites de remplacement temporaires pour le benzène et le BEN si, pour des raisons hors de son contrôle, il ne peut se conformer à la date de mise en vigueur du 1er juillet 1999. Il ne peut utiliser les limites temporaires qu'au plus tard le 31 décembre 1999. En vertu du paragraphe 16(4), la ministre de l'Environnement n'approuve cette demande qu'à condition que :

— le fournisseur principal ait fait tous les efforts raisonnables pour se conformer à la date de mise en vigueur du 1er juillet 1999;
— le refus d'autorisation des limites temporaires occasionne :
— soit un impact considérable sur l'approvisionnement en essence ou autres produits pétroliers dans la région,
— soit une réduction considérable des activités d'exploitation du fournisseur principal ou un arrêt pour une période de temps, ce qui causerait des difficultés financières,
— soit le retrait du marché du fournisseur principal.

Dans le résumé de l'étude d'impact de la réglementation qui accompagne les modifications au *Règlement sur le benzène dans l'essence*, publiées dans la Partie II de la *Gazette du Canada* le 26 mai 1999, la ministre de l'Environnement a annoncé son intention de publier « un avis dans la *Gazette du Canada* Partie I indiquant le nom de la compagnie, ses limites de remplacement, et la période au cours de laquelle les limites s'appliqueraient ». Conformément à cette intention, les tableaux suivants démontrent les limites de remplacement temporaires pour le benzène et le BEN qui ont été demandées et approuvées. Il est à remarquer qu'en vertu du Règlement, une compagnie peut choisir de se conformer en fonction de limites de moyennes annuelles incluant des plafonds à ne jamais dépasser au lieu de se soumettre à des limites « simples » à ne jamais dépasser.

Temporary Limits for Primary Suppliers having Elected to use Yearly Pool Averages

Company	Refinery or province of importation	Temporary yearly pool average limits (all expire on December 31, 1999)	Temporary never-to-be-exceeded caps	Expiry date for temporary never-to-be-exceeded caps
		Benzene (% vol.) *BEN*	*Benzene (% vol.)* *BEN*	
Petro-Canada	Montréal refinery	1.28% 76.4	4.61% 156.8/198.1	November 15, 1999
Shell	Montréal refinery	2.0% 86.8	4.7% 117.8/220.0	November 15, 1999
Ultramar	Québec refinery and Montréal terminal	1.2% —	3.55% —/134.8	November 15, 1999
Pétroles Norcan	Imports into Quebec	1.54% 66.68	3.0% —	November 15, 1999
Petro-Canada	Oakville refinery	1.75% 80.4	4.29% 140.6/—	September 15, 1999
Standard limits under subsections 16(1) and 17(1)				
Standard limits	Benzene BEN	0.95% 59.5	1.5% 102/132	

Temporary Limits for Primary Suppliers Subject to “Flat” Limits

Company	Refinery or province of importation	Temporary flat (per-litre) limit		Expiry date for temporary flat limit
		Benzene (% vol.)	*BEN*	
Olco/Neste	Imports into Quebec and Ontario	3.0%	—	November 15, 1999
Spur/Murphy	Imports into Ontario	2.06%	—	September 15, 1999
Parkland	Bowden refinery	1.5%	—	December 31, 1999
Standard limits under subsection 3(1) and section 4				
Standard limits		1.0%	71/92	

Notes:

1. There are different seasonal per-litre limits for the BEN — summer (1st number) and winter (2nd number).
2. Temporary average limits, which expire on December 31, 1999, take into account gasoline produced/imported before and after the expiry date for the temporary per-litre limits. After the expiry dates, regular limits apply.
3. “—” indicates that no temporary limit was applied for by the primary supplier.

Limites temporaires pour les fournisseurs principaux ayant choisi l’emploi d’une moyenne annuelle

Compagnie	Raffinerie ou province d’importation	Limites temporaires des moyennes annuelles (expiration — 31 décembre 1999)	Plafonds temporaires à ne jamais dépasser	Date d’expiration pour les plafonds temporaires à ne jamais dépasser
		Benzène (% en vol.) *BEN*	*Benzène (% en vol.)* *BEN*	
Petro-Canada	Raffinerie de Montréal	1,28 % 76,4	4,61 % 156,8/198,1	15 novembre 1999
Shell	Raffinerie de Montréal	2,0 % 86,8	4,7 % 117,8/220,0	15 novembre 1999
Ultramar	Raffinerie de Québec et terminal de Montréal	1,2 % —	3,55 % —/134,8	15 novembre 1999
Pétroles Norcan	Importation au Québec	1,54 % 66,68	3,0 % —	15 novembre 1999
Petro-Canada	Raffinerie d’Oakville	1,75 % 80,4	4,29 % 140,6/—	15 septembre 1999
Limites normatives en vertu des paragraphes 16(1) et 17(1)				
Limites normatives	Benzène BEN	0,95 % 59,5	1,5 % 102/132	

Limites temporaires pour les fournisseurs principaux assujettis à des limites « simples »

Compagnie	Raffinerie ou province d'importation	Limite simple temporaire (par litre)		Date d'expiration de la limite simple temporaire
		Benzène (% en vol.)	*BEN*	
Olco/Neste	Importation au Québec et en Ontario	3,0 %	—	15 novembre 1999
Spur/Murphy	Importation en Ontario	2,06 %	—	15 septembre 1999
Parkland	Raffinerie de Bowden	1,5 %	—	31 décembre 1999
Limites normatives en vertu du paragraphe 3(1) et de l'article 4				
Limites normatives		1,0 %	71/92	

Remarques :

1. Il y a différentes limites saisonnières par litre pour le BEN — été (1er chiffre) et hiver (2e chiffre).
2. Les limites moyennes temporaires expirant le 31 décembre 1999 prennent en considération l'essence produite/importée avant et après la date d'expiration des limites par litre temporaires. Les limites habituelles s'appliquent après les dates d'expiration.
3. « — » indique qu'aucune limite temporaire n'a été demandée par le fournisseur principal.

Under paragraph 3(2)(*b*) of the Regulations, the areas where gasoline sold is subject to temporary alternative limits are:

— Quebec, except that portion of the province that is in the northern supply area (as defined by the Regulations);
— all of Ontario; and
— southern Alberta and southeastern British Columbia (roughly the towns of Provost, Leduc, Drayton Valley and Revelstoke, and all other locations in Alberta and British Columbia south and east of those towns).

In the above areas, the prohibition on selling (as opposed to manufacturing, blending or importing) gasoline containing benzene at a concentration that exceeds 1.5 percent by volume is deferred from October 1, 1999, to April 1, 2000.

Alternative Limits for BEN under Subsection 17(2)

Under subsection 17(2) of the Regulations, primary suppliers may elect for alternative limits for the BEN based on the historical composition of their gasoline. There is no expiry date for alternative BEN limits.

In the Regulatory Impact Analysis Statement that accompanied the *Benzene in Gasoline Regulations*, published in the *Canada Gazette*, Part II, on November 26, 1997, the Minister of the Environment announced her intention that the alternative limits "will be publicly available and will be published by Environment Canada". Pursuant to that intention, the following alternative limits for the BEN have been applied for and approved:

En vertu de l'alinéa 3(2)*b*) du Règlement, les zones où l'essence vendue est assujettie aux limites de remplacement temporaires sont :

— le Québec, sauf la partie de la province qui se situe dans la zone d'approvisionnement du nord (tel qu'il est défini dans le Règlement);
— l'Ontario en entier;
— le sud de l'Alberta et le sud-est de la Colombie-Britannique (aux environs des villages de Provost, Leduc, Drayton Valley et Revelstoke, et tous les endroits en Alberta et en Colombie-Britannique au sud et à l'est de ces villages).

Dans les endroits ci-dessus, l'interdiction de la vente (à l'opposé de la fabrication, du mélange ou de l'importation) de l'essence contenant du benzène à une concentration dépassant 1,5 p. 100 en volume est reportée du 1er octobre 1999 au 1er avril 2000.

Limites de remplacement pour le BEN en vertu du paragraphe 17(2)

En vertu du paragraphe 17(2) du Règlement, un fournisseur principal peut choisir d'être assujetti à des limites de remplacement pour le BEN en fonction de l'historique de la composition de son essence. Il n'y a pas de date d'expiration pour les limites de remplacement du BEN.

Dans le résumé de l'étude d'impact de la réglementation qui accompagne le *Règlement sur le benzène dans l'essence*, publié dans la Partie II de la *Gazette du Canada* le 26 novembre 1997, la ministre de l'Environnement a annoncé son intention que les limites de remplacement « seront rendues publiques et publiées par Environnement Canada. » Conformément à cette intention, les limites de remplacement pour le BEN qui suivent ont été demandées et approuvées :

Alternative Limits for BEN

Company	Refinery	Benzene Emissions Number	
		Alternative yearly pool average limit	Alternative never-to-be-exceeded cap (summer/winter)
Petro-Canada	Montréal	67.9	115.0/151.0
Shell	Montréal	65.3	110.5/144.7
Petro-Canada	Oakville	65.3	117.1/141.4
Shell	Sarnia	65.0	106.0/147.8
Standard limits under subsection 17(1)			
Standard limits		59.5	102/132

Limites de remplacement du BEN

Compagnie	Raffinerie	Indice des émissions de benzène	
		Limite de remplacement de la moyenne annuelle	Plafond de remplacement à ne jamais dépasser (été/hiver)
Petro-Canada	Montréal	67,9	115,0/151,0
Shell	Montréal	65,3	110,5/144,7
Petro-Canada	Oakville	65,3	117,1/141,4
Shell	Sarnia	65,0	106,0/147,8
Limites normatives en vertu du paragraphe 17(1)			
Limites normatives		59,5	102/132

Contact

Bruce McEwen, Oil, Gas and Energy Branch, Air Pollution Prevention Directorate, Environment Canada, (819) 953-4673.

[36-1-o]

Personne-ressource

Bruce McEwen, Direction du pétrole, du gaz et de l'énergie, Direction générale de la prévention de la pollution atmosphérique, Environnement Canada, (819) 953-4673.

[36-1-o]

Appendix 3

Regional and National Quarterly Data for all Parameters

Figure A3.1: Average Benzene Concentration of Canadian Gasoline 2002

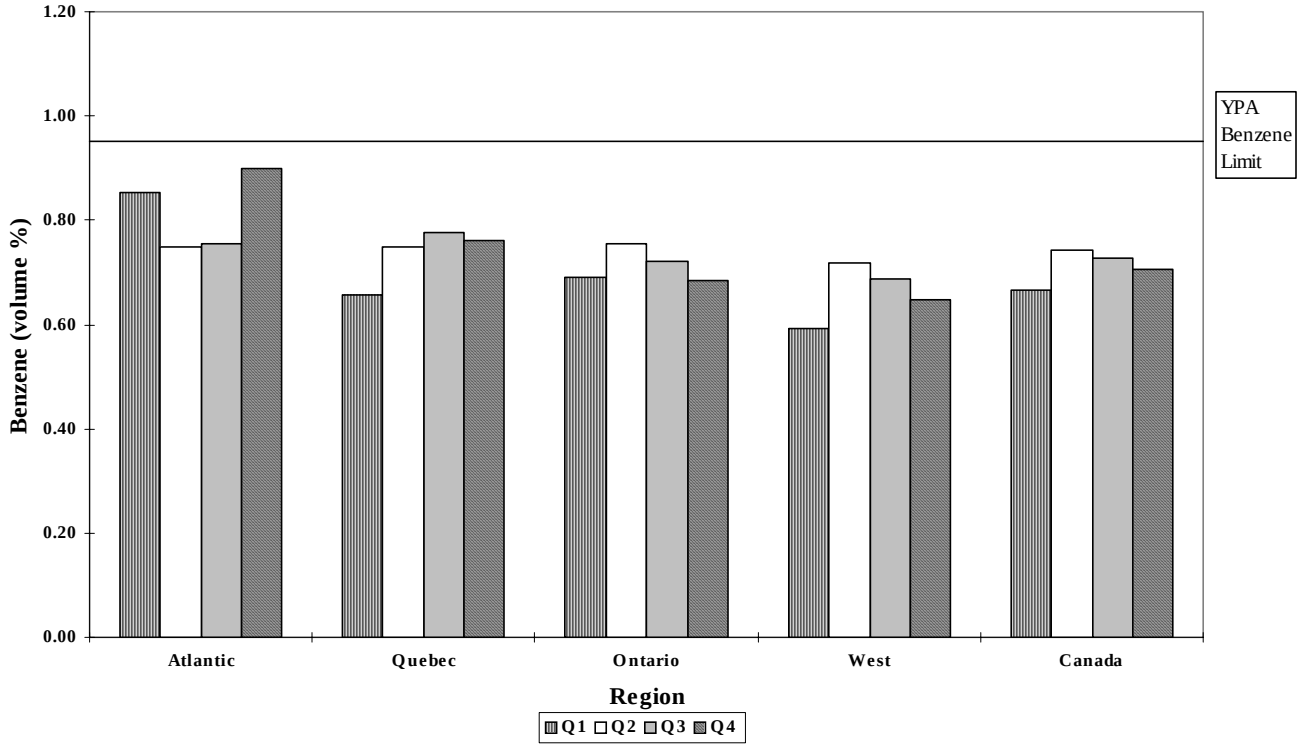
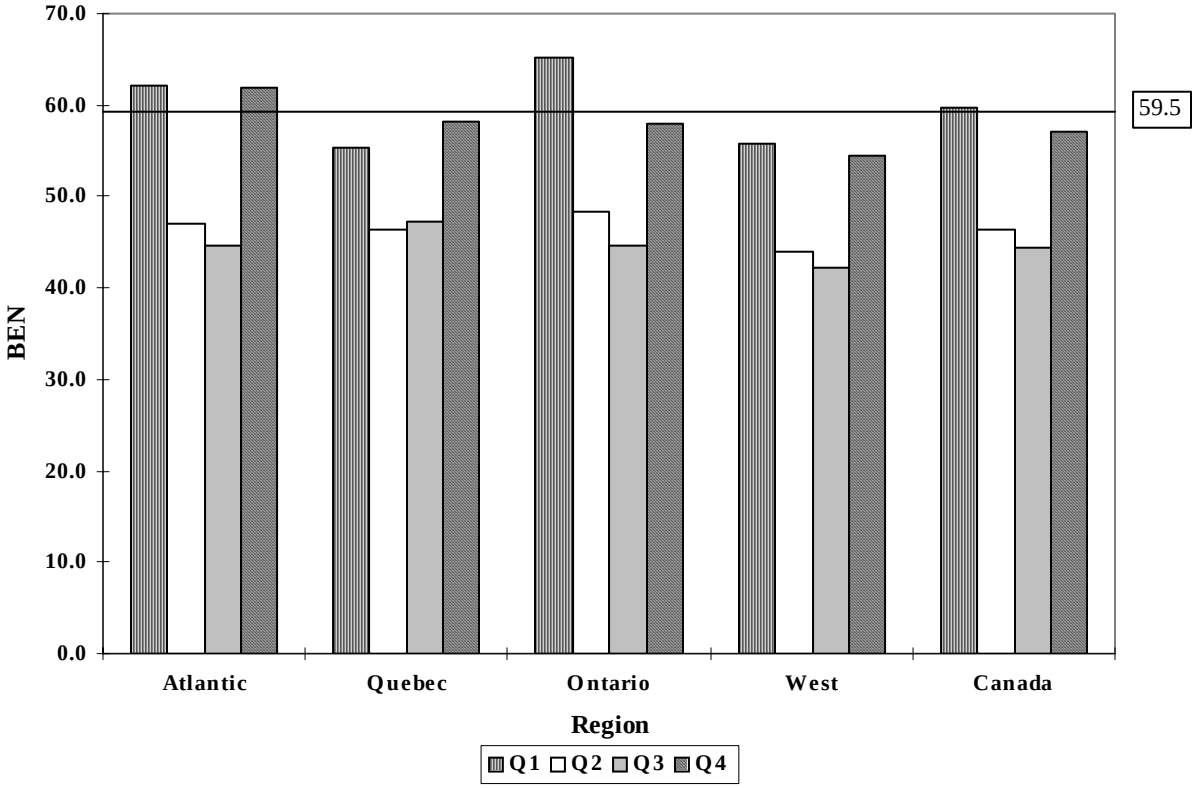


Table A3.1: Average Benzene Concentration (% by volume)

	Q1	Q2	Q3	Q4
Atlantic	0.85	0.75	0.75	0.90
Quebec	0.66	0.75	0.78	0.76
Ontario	0.69	0.76	0.72	0.68
West	0.59	0.72	0.69	0.65
Canada	0.67	0.74	0.73	0.71

Figure A3.2: Average BEN of Canadian Gasoline 2002



- The annual average BEN limit is 59.5.

Table A3.2: Average BEN

	Q1	Q2	Q3	Q4
Atlantic	62.1	46.9	44.6	61.9
Quebec	55.4	46.4	47.3	58.1
Ontario	65.2	48.4	44.6	58.0
West	55.9	43.9	42.1	54.5
Canada	59.6	46.3	44.5	57.1

Figure A3.3: Average Sulphur Concentration of Canadian Gasoline 2002

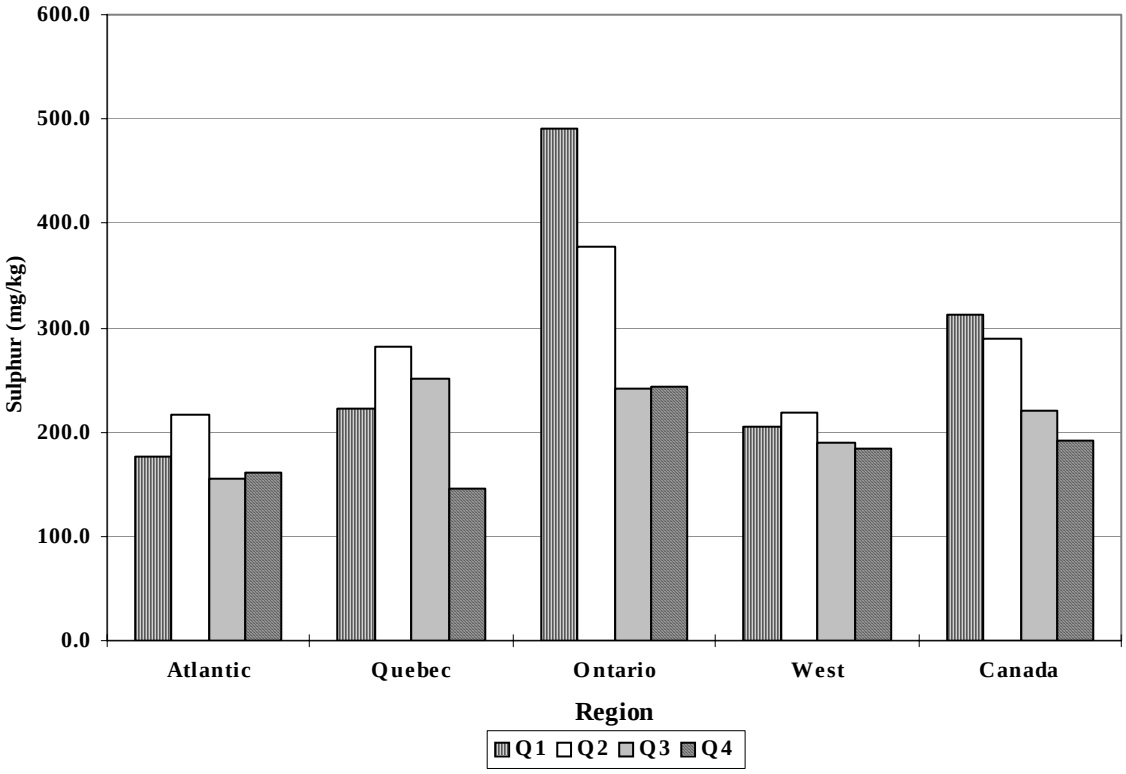


Table A3.3: Average Sulphur Concentration (mg/kg)

	Q1	Q2	Q3	Q4
Atlantic	176	217	156	162
Quebec	222	282	252	146
Ontario	490	378	242	244
West	204	219	190	185
Canada	312	289	221	192

Figure A3.4: Average Olefin Concentration of Canadian Gasoline 2002

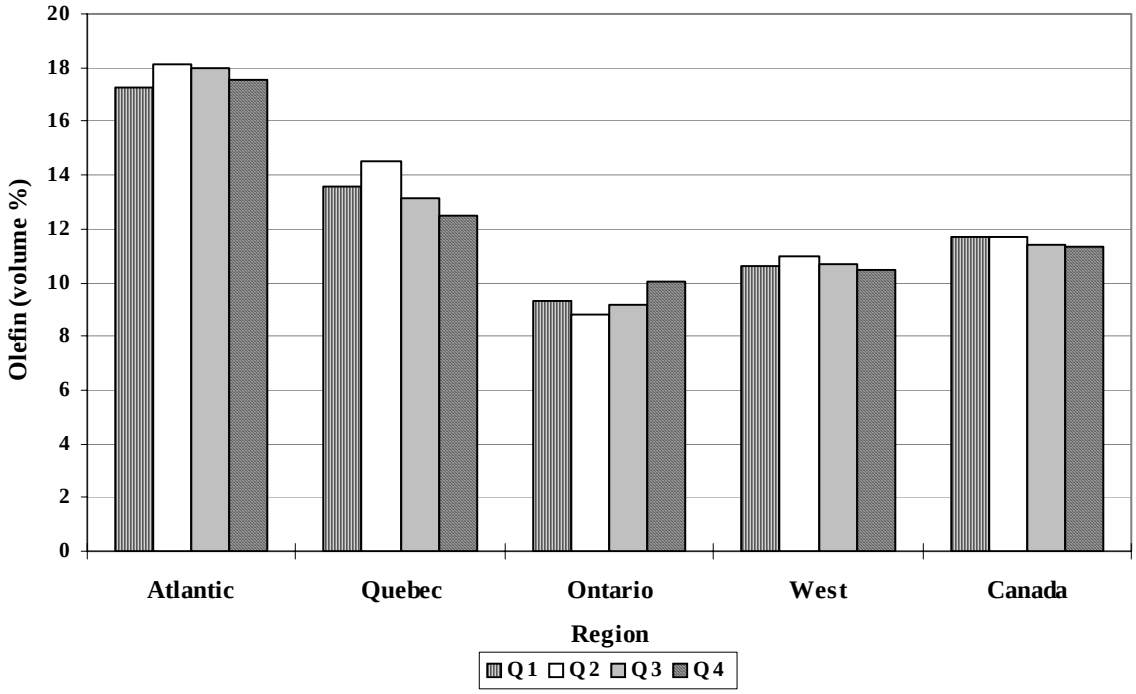


Table A3.4: Average Olefin Concentration (% by volume)

	Q1	Q2	Q3	Q4
Atlantic	17.2	18.1	18.0	17.5
Quebec	13.6	14.5	13.2	12.5
Ontario	9.3	8.8	9.2	10.0
West	10.6	11.0	10.7	10.5
Canada	11.7	11.7	11.4	11.3

Figure A3.5: Average Aromatics Concentration of Canadian Gasoline 2002

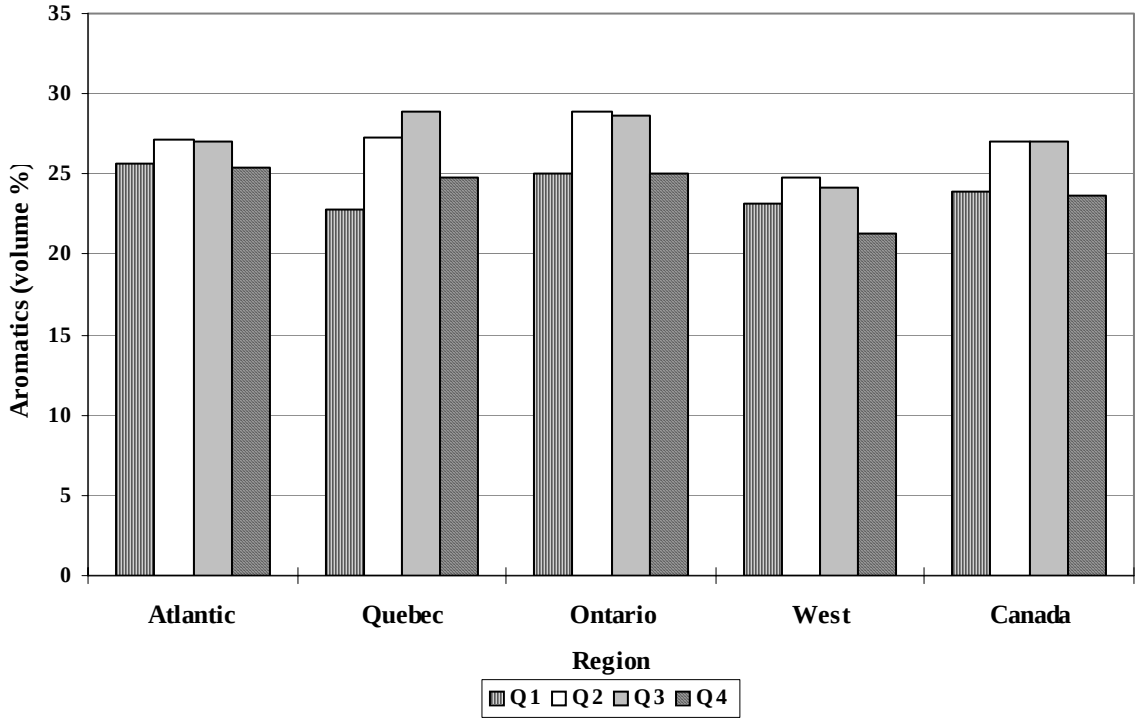


Table A3.5: Average Aromatics Concentration (% by volume)

	Q1	Q2	Q3	Q4
Atlantic	25.6	27.2	27.0	25.4
Quebec	22.7	27.3	28.9	24.8
Ontario	25.1	28.9	28.7	25.1
West	23.2	24.8	24.1	21.3
Canada	23.9	27.0	27.1	23.7

Figure A3.6: Average E200 of Canadian Gasoline 2002

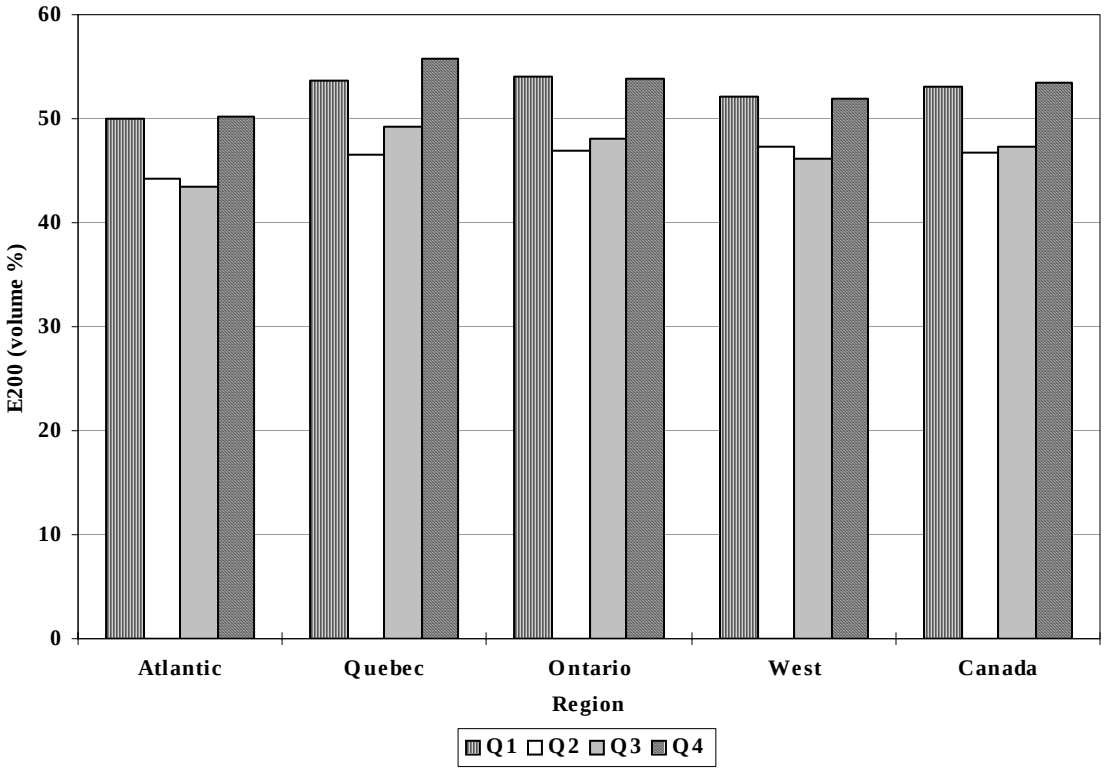


Table A3.6: Average E200 (% by volume)

	Q1	Q2	Q3	Q4
Atlantic	50.0	44.2	43.5	50.2
Quebec	53.7	46.5	49.2	55.8
Ontario	54.0	46.9	48.2	53.8
West	52.1	47.3	46.1	51.9
Canada	53.1	46.7	47.4	53.4

Figure A3.7: Average E300 of Canadian Gasoline 2002

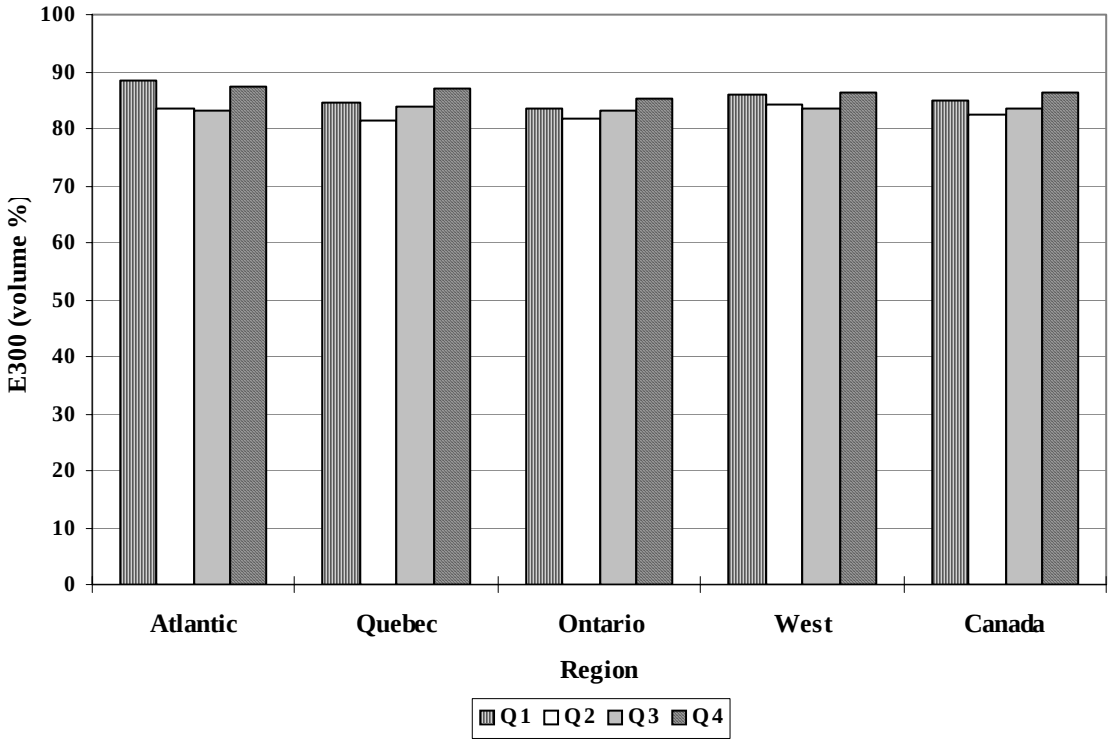
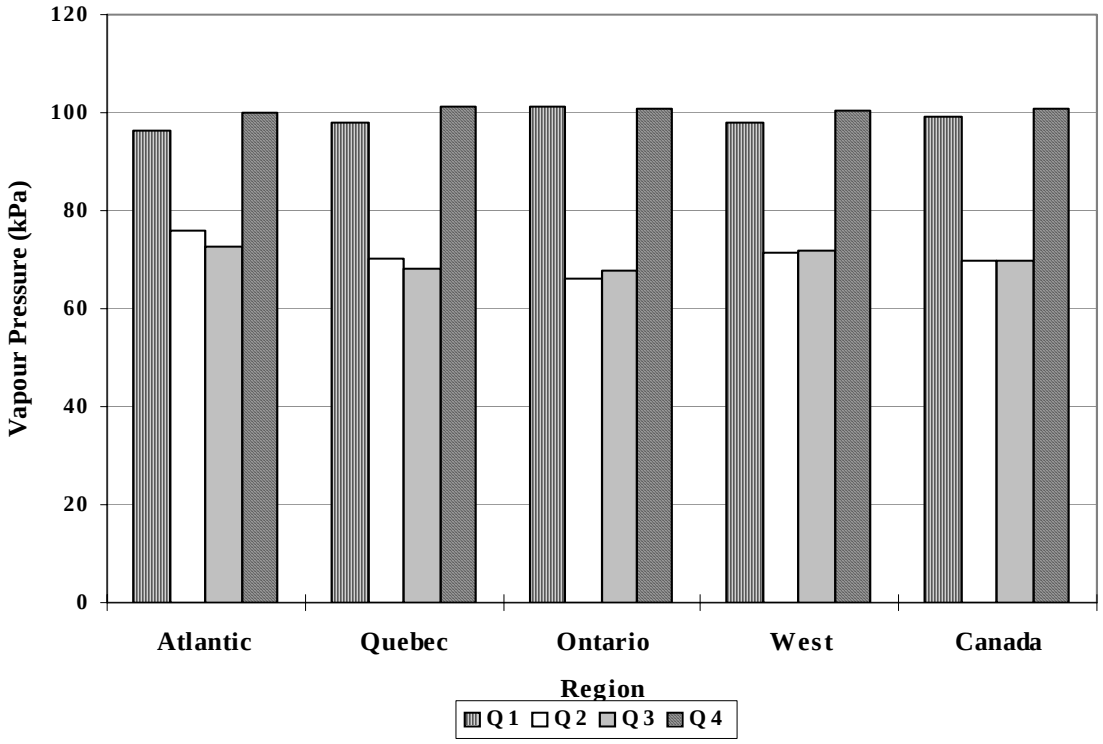


Table A3.7: Average E300 (% by volume)

	Q1	Q2	Q3	Q4
Atlantic	88.4	83.4	83.0	87.2
Quebec	84.7	81.3	84.0	87.2
Ontario	83.6	81.7	83.1	85.2
West	85.9	84.3	83.4	86.2
Canada	84.9	82.5	83.4	86.2

Figure A3.8: Average Vapour Pressure of Canadian Gasoline 2002

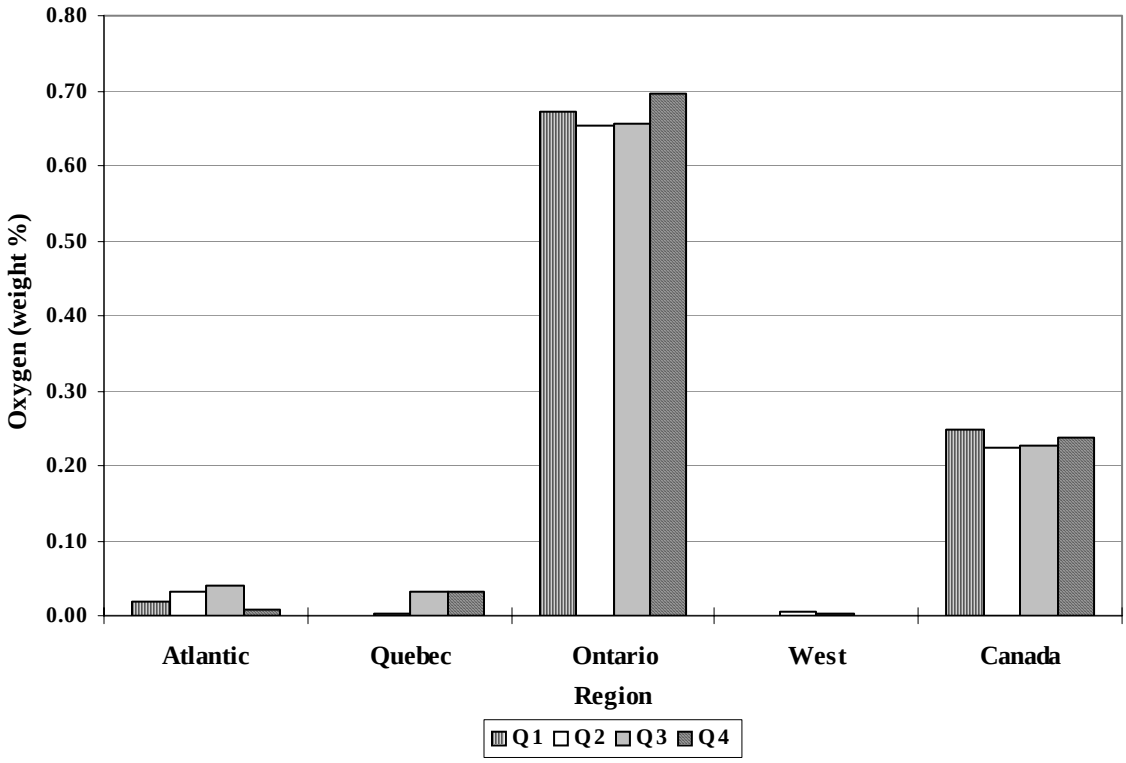


20 kPa = 2.9 psi

Table A3.8: Average Vapour Pressure (kPa)

	Q1	Q2	Q3	Q4
Atlantic	96.5	75.8	72.7	100.1
Quebec	97.8	70.0	68.3	101.4
Ontario	101.3	66.1	67.8	100.8
West	97.8	71.6	71.9	100.6
Canada	99.0	69.6	69.7	100.8

Figure A3.9: Average Oxygen Concentration of Canadian Gasoline 2002



- Primarily MTBE in Atlantic and Quebec and ethanol elsewhere.

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

	Q1	Q2	Q3	Q4
Atlantic	0.02	0.03	0.04	0.01
Quebec	0.00	0.00	0.03	0.03
Ontario	0.67	0.65	0.66	0.70
West	0.00	0.01	0.00	0.00
Canada	0.25	0.22	0.23	0.24

Appendix 4

Regional Data on the Maximum and Quarterly 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	2,849,121	1.42	0.08	0.81
Quebec	10,471,401	1.45	0.44	0.74
Ontario	13,120,859	1.44	0.25	0.71
West	12,408,036	1.53	0.26	0.67
Canada	38,849,417	1.53	0.08	0.71

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

Region	Winter (1st and 4th Quarters)				Summer (2nd and 3rd Quarters)			
	Volume (m^3)	Maximum	Minimum	Volume Weighted Average	Volume (m^3)	Maximum	Minimum	Volume Weighted Average
Atlantic	1,302,910	83	50	62.0	1,546,211	76	34	45.7
Quebec	5,126,188	84	46	56.8	5,345,213	77	43	46.9
Ontario	6,451,270	95	18	61.5	7,513,281	93	32	46.8
West	5,827,455	85	50	55.0	6,580,581	89	35	43.0
Canada	18,707,823	95	18	58.2	20,985,286	93	32	45.6

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

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	490	39	177
Quebec	700	105	225
Ontario	960	9	335
West	600	0	199
Canada	960	0	250

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

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	27.5	0.8	17.7
Quebec	36.9	4.5	13.4
Ontario	32.2	0.2	9.5
West	33.2	0.0	10.7
Canada	36.9	0.0	11.5

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

Region	Maximum	Minimum	Volume Weighted Average
Atlantic	43.4	18.7	26.4
Quebec	61.7	14.8	26.0
Ontario	52.7	19.6	27.0
West	51.2	19.0	23.3
Canada	61.7	14.8	25.5

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	94.7	80.7	85.3
Quebec	96.0	75.8	84.3
Ontario	98.0	75.9	83.4
West	95.6	77.0	84.9
Canada	98.0	75.8	84.2

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

Region	Winter (1st and 4th Quarters)				Summer (2nd and 3rd Quarters)			
	Volume (m^3)	Maximum	Minimum	Volume Weighted Average	Volume (m^3)	Maximum	Minimum	Volume Weighted Average
Atlantic	1,302,910	107	86	98.4	1,546,211	97	49	74.1
Quebec	5,126,188	107	59	99.7	5,345,213	106	59	69.2
Ontario	6,451,270	108	48	101.1	6,669,589	107	50	67.0
West	5,827,455	110	86	99.5	6,580,581	103	50	71.7
Canada	18,707,823	110	48	100.0	20,141,594	107	49	69.7

Appendix 5

Company Reported Data

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

	Company	Average	Maximum
Refiners	Chevron Canada	0.54	1.40
	Consumer's Co-op	0.74	1.39
	Husky Oil	0.92	1.17
	Imperial Oil - Dartmouth	0.91	1.42
	Imperial Oil - Nanticoke	0.79	1.13
	Imperial Oil - Sarnia	0.67	1.04
	Imperial Oil - Strathcona	0.81	1.38
	Irving Oil	0.66	1.20
	North Atlantic	0.67	1.00
	Petro-Canada - Edmonton	0.68	1.04
	Petro-Canada - Montreal	0.60	1.45
	Petro-Canada - Oakville	0.77	1.10
	Shell - Montreal	0.64	1.41
	Shell - Sarnia	0.74	1.00
	Shell - Scotford	0.29	1.53
	Sunoco	0.61	1.44
	Ultramar - St-Romuald	0.89	1.37
Blender	Robbins Feed and Fuel	0.59	0.82
Importers	BP (Arco)	0.90	1.14
	CAMI	0.66	1.00
	Ford	0.38	0.98
	GM	0.28	0.60
	Imperial Oil - BC (Burrard)	0.53	0.86
	Mackenzie Petroleum	0.84	0.85
	Neste Petroleum	0.74	0.89
	Northern Transportation	0.43	0.45
	Olco - ON	0.77	0.89
	Parkland - YK	0.77	0.85
	Petro-Canada - BC (Burrard)	0.81	0.98
	Petroles Norcan	0.91	0.99
	Ultramar - NF	0.55	0.78
	Ultramar - QC	0.72	1.13

Table A5.2: Averages and Maxima Reported for BEN

	Company	Winter (1st and 4th Quarters)		Summer (2nd and 3rd Quarters)	
		Average	**Maximum**	**Average**	**Maximum**
Refiners	Chevron	55.1	70	44.1	71
	Co-op	51.1	68	43.1	69
	Husky	58.5	83	46.7	83
	Imperial Oil - Dartmouth	64.3	83	48.8	76
	Imperial Oil - Nanticoke	66.5	89	47.0	85
	Imperial Oil - Sarnia	69.1	80	28.8	82
	Imperial Oil - Strathcona	58.0	73	46.3	70
	Irving	30.1	70	20.4	68
	North Atlantic	20.0	62	33.8	53
	Petro-Canada - Edmonton	53.6	62	41.1	63
	Petro-Canada - Montreal*	63.9	83	43.8	66
	Petro-Canada - Oakville*	62.6	78	49.7	75
	Shell - Montreal*	67.0	84	48.3	74
	Shell - Sarnia*	67.0	95	51.4	93
	Shell - Scotford	52.1	70	38.7	65
	Sunoco	45.5	90	35.0	80
	Ultramar - St-Romuald	56.0	78	47.9	77
Blender	Robbins Feed and Fuel	65.0	79	58.6	70
Importers	BP (Arco)	69.9	77	57.3	81
	CAMI	45.2	55	36.0	44
	Ford	48.5	61	39.6	58
	GM	18.2	49	38.5	58
	Imperial Oil - BC (Burrard)	-	-	37.1	41
	Mackenzie	80.3	85	61.9	58
	Northern Transportation	-	-	56.9	57
	Neste Petroleum	-	-	48.1	49
	Olco - ON	-	-	0.0	49
	Parkland - YK	75.6	85	83.8	89
	Petro-Canada - BC (Burrard)	-	-	42.9	41
	Petroles Norcan	-	-	49.7	56
	Ultramar - NF	-	-	34.7	51
	Ultramar - QC	63.9	71	47.3	66

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	25	45
	Consumer's Co-op	23	35
	Husky Oil	24	51
	Imperial Oil - Dartmouth	25	43
	Imperial Oil - Nanticoke	26	38
	Imperial Oil - Sarnia	30	38
	Imperial Oil - Strathcona	22	34
	Irving Oil	28	38
	North Atlantic	27	35
	Petro-Canada - Edmonton	21	33
	Petro-Canada - Montreal	22	62
	Petro-Canada - Oakville	27	46
	Shell - Montreal	31	48
	Shell - Sarnia	23	51
	Shell - Scotford	30	44
	Sunoco	23	49
	Ultramar - St-Romuald	24	45
Blender	Robbins Feed and Fuel	41	53
Importers	BP (Arco)	36	39
	CAMI	25	31
	Ford	27	36
	GM	28	35
	Imperial Oil - BC (Burrard)	29	33
	Mackenzie Petroleum	42	45
	Neste Petroleum	35	40
	Northern Transportation	30	30
	Olco - ON	34	40
	Parkland - YK	39	46
	Petro-Canada - BC (Burrard)	37	37
	Petroles Norcan	34	45
	Ultramar - NF	19	42
	Ultramar - QC	34	57

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

	Company	Average	Maximum
Refiners	Chevron Canada	12	33
	Consumer's Co-op	18	22
	Husky Oil	17	24
	Imperial Oil - Dartmouth	20	28
	Imperial Oil - Nanticoke	13	21
	Imperial Oil - Sarnia	9	15
	Imperial Oil - Strathcona	12	20
	Irving Oil	14	21
	North Atlantic	4	11
	Petro-Canada - Edmonton	11	22
	Petro-Canada - Montreal	16	37
	Petro-Canada - Oakville	9	32
	Shell - Montreal	9	20
	Shell - Sarnia	12	18
	Shell - Scotford	1	2
	Sunoco	4	24
	Ultramar - St-Romuald	14	23
Blender	Robbins Feed and Fuel	5	8
Importers	BP (Arco)	7	9
	CAMI	4	6
	Ford	4	15
	GM	4	15
	Imperial Oil - BC (Burrard)	14	16
	Mackenzie Petroleum	0	0
	Neste Petroleum	14	25
	Northern Transportation	2	3
	Olco - ON	15	25
	Parkland - YK	0	0
	Petro-Canada - BC (Burrard)	13	21
	Petroles Norcan	14	26
	Ultramar - NF	20	22
	Ultramar - QC	16	28

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

	Company	Average	Maximum
Refiners	Chevron Canada	211	450
	Consumer's Co-op	180	305
	Husky Oil	210	380
	Imperial Oil - Dartmouth	258	490
	Imperial Oil - Nanticoke	370	960
	Imperial Oil - Sarnia	431	850
	Imperial Oil - Strathcona	274	600
	Irving Oil	49	89
	North Atlantic	58	180
	Petro-Canada - Edmonton	198	430
	Petro-Canada - Montreal	314	700
	Petro-Canada - Oakville	301	890
	Shell - Montreal	218	660
	Shell - Sarnia	400	730
	Shell - Scotford	50	160
	Sunoco	195	600
	Ultramar - St-Romuald	184	447
Blender	Robbins Feed and Fuel	221	388
Importers	BP (Arco)	115	140
	CAMI	48	100
	Ford	25	39
	GM	23	39
	Imperial Oil - BC (Burrard)	51	140
	Mackenzie Petroleum	240	276
	Neste Petroleum	222	300
	Northern Transportation	43	54
	Olco - ON	307	450
	Parkland - YK	264	320
	Petro-Canada - BC (Burrard)	93	139
	Petroles Norcan	166	270
	Ultramar - NF	146	270
	Ultramar - QC	151	352

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

	Company	Oxygenate	Average	Maximum
Refiners	Chevron Canada	Type not reported*	0.0	0.1
	Consumer's Co-op	-	0.0	0.0
	Husky Oil	Ethanol	0.0	3.7
	Imperial Oil - Dartmouth	-	0.0	0.0
	Imperial Oil - Nanticoke	-	0.0	0.0
	Imperial Oil - Sarnia	-	0.0	0.0
	Imperial Oil - Strathcona	-	0.0	0.0
	Irving Oil	MTBE	0.0	2.3
	North Atlantic	MTBE	2.2	2.7
	Petro-Canada - Edmonton	-	0.0	0.0
	Petro-Canada - Montreal	Ethanol	0.0	0.0
	Petro-Canada - Oakville	-	0.0	0.0
	Shell - Montreal	MTBE**	0.1	0.4
	Shell - Sarnia	Type not reported*	0.0	0.2
	Shell - Scotford	-	0.0	0.0
	Sunoco	Ethanol	3.0	3.7
	Ultramar - St-Romuald	-	0.0	0.0
Blender	Robbins Feed and Fuel	Ethanol	0.5	3.6
Importers	BP (Arco)	-	0.0	0.0
	CAMI	MTBE	0.1	0.1
	Ford	-	0.0	0.0
	GM	-	0.0	0.0
	Imperial Oil - BC (Burrard)	-	0.0	0.0
	Mackenzie Petroleum	-	0.0	0.0
	Neste Petroleum	Type not reported*	0.1	0.2
	Northern Transportation	Type not reported*	0.1	0.1
	Olco - ON	Type not reported*	0.1	0.2
	Parkland - YK	-	0.0	0.0
	Petro-Canada - BC (Burrard)	ETBE, MTBE	0.1	0.6
	Petroles Norcan	Type not reported*	0.1	0.2
	Ultramar – NF	-	0.0	0.0
	Ultramar – QC	-	0.0	0.0

* Primary supplier reported it did not add oxygenate, but measured oxygen present in batches.
** From blendstock imported in 2001 and in imported gasoline in 2002

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

	Company	Q1 & Q4		Q2 & Q3	
		Average	**Maximum**	**Average**	**Maximum**
Refiners	Chevron	96	107	71	95
	Co-op	101	106	74	95
	Husky	103	108	76	103
	Imperial Oil - Dartmouth	100	107	75	96
	Imperial Oil - Nanticoke	101	107	65	95
	Imperial Oil - Sarnia	102	108	66	88
	Imperial Oil - Strathcona	100	110	72	103
	Irving Oil	96	105	37	97
	North Atlantic	34	100	52	91
	Petro-Canada - Edmonton	99	107	71	97
	Petro-Canada - Montreal	93	107	71	106
	Petro-Canada - Oakville	103	107	66	97
	Shell - Montreal	103	106	64	104
	Shell - Sarnia	103	107	78	99
	Shell - Scotford	100	107	75	97
	Sunoco	97	107	65	107
	Ultramar - St-Romuald	104	107	75	106
Blender	Robbins Feed and Fuel	102	106	67	92
Importers	BP (Arco)	90	92	65	88
	CAMI	48	48	54	62
	Ford	93	98	55	68
	GM	71	103	56	68
	Imperial Oil - BC (Burrard)	-	-	53	61
	Mackenzie	93	99	85	86
	Northern Transportation	-	-	90	94
	Neste Petroleum	-	-	60	61
	Olco - ON	-	-	60	61
	Parkland - YK	98	103	92	96
	Petro-Canada - BC (Burrard)	-	-	57	61
	Petroles Norcan	-	-	60	61
	Ultramar - NF	-	-	62	63
	Ultramar - QC	73	98	59	77

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

	Company	Average	Maximum
Refiners	Chevron Canada	51	69
	Consumer's Co-op	50	57
	Husky Oil	47	57
	Imperial Oil - Dartmouth	50	63
	Imperial Oil - Nanticoke	47	63
	Imperial Oil - Sarnia	54	62
	Imperial Oil - Strathcona	49	59
	Irving Oil	42	54
	North Atlantic	58	66
	Petro-Canada - Edmonton	48	57
	Petro-Canada - Montreal	52	80
	Petro-Canada - Oakville	51	61
	Shell - Montreal	48	66
	Shell - Sarnia	50	61
	Shell - Scotford	51	64
	Sunoco	52	61
	Ultramar - St-Romuald	53	68
Blender	Robbins Feed and Fuel	48	64
Importers	BP (Arco)	54	57
	CAMI	41	42
	Ford	43	47
	GM	43	65
	Imperial Oil - BC (Burrard)	43	49
	Mackenzie Petroleum	48	49
	Neste Petroleum	46	46
	Northern Transportation	49	51
	Olco - ON	43	46
	Parkland - YK	49	52
	Petro-Canada - BC (Burrard)	47	53
	Petroles Norcan	47	58
	Ultramar - NF	62	65
	Ultramar - QC	46	62

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

	Company	Average	Maximum
Refiners	Chevron Canada	86	95
	Consumer's Co-op	82	85
	Husky Oil	82	90
	Imperial Oil - Dartmouth	87	94
	Imperial Oil - Nanticoke	83	95
	Imperial Oil - Sarnia	85	92
	Imperial Oil - Strathcona	86	96
	Irving Oil	82	92
	North Atlantic	88	95
	Petro-Canada - Edmonton	86	92
	Petro-Canada - Montreal	82	92
	Petro-Canada - Oakville	86	93
	Shell - Montreal	86	96
	Shell - Sarnia	82	88
	Shell - Scotford	81	91
	Sunoco	82	96
	Ultramar - St-Romuald	84	93
Blender	Robbins Feed and Fuel	90	98
Importers	BP (Arco)	90	92
	CAMI	82	84
	Ford	78	84
	GM	80	92
	Imperial Oil - BC (Burrard)	85	87
	Mackenzie Petroleum	83	85
	Neste Petroleum	83	85
	Northern Transportation	89	90
	Olco - ON	83	85
	Parkland - YK	81	82
	Petro-Canada - BC (Burrard)	84	90
	Petroles Norcan	87	95
	Ultramar - NF	91	92
	Ultramar - QC	85	93

Appendix 6

Toxic Emission Number (TEN) Data

Figure A6.1: Average TEN of Canadian Gasoline

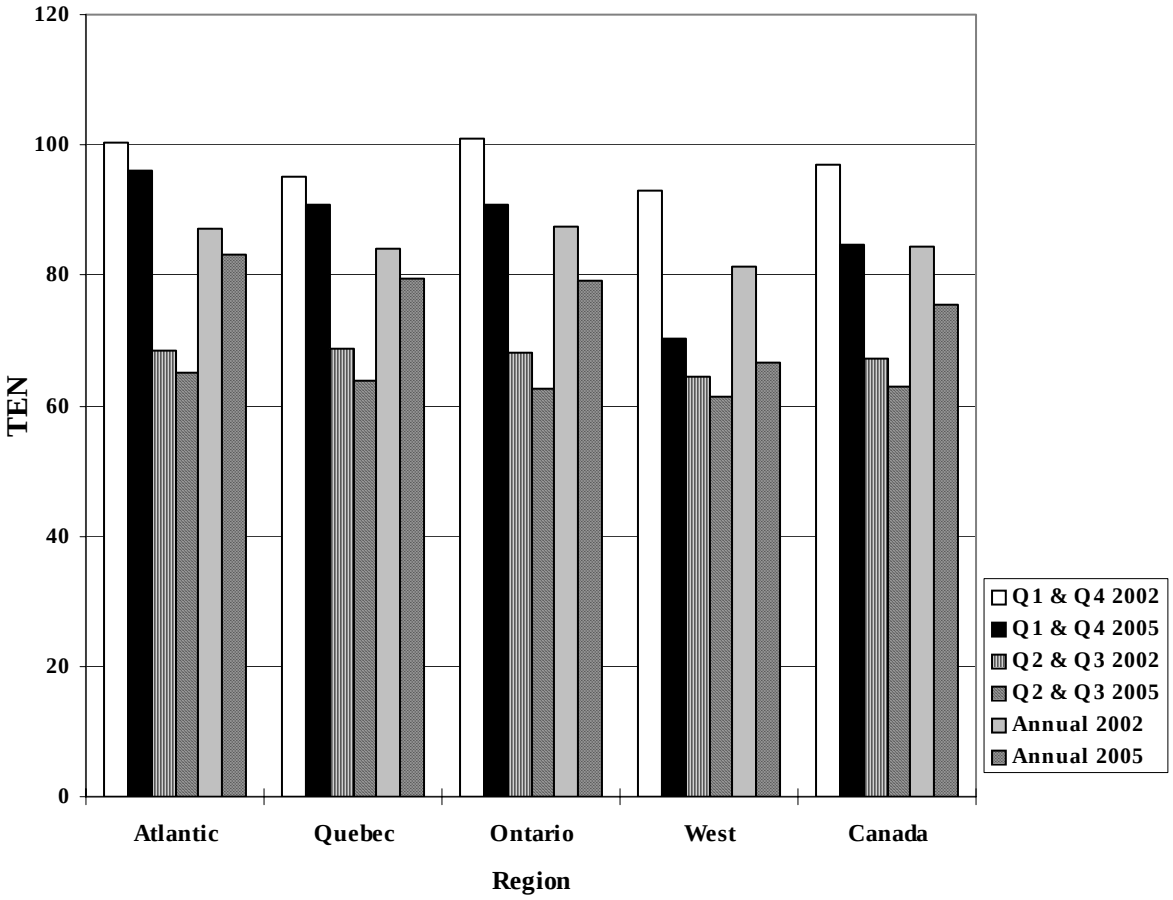


Table A6.1: Average TEN of Canadian Gasoline

	Q1 & Q4 2002	Q1 & Q4 2005	Q2 & Q3 2002	Q2 & Q3 2005	Annual 2002	Annual 2005
Atlantic	100	96	69	65	87	83
Quebec	95	91	69	64	84	80
Ontario	101	91	68	63	87	79
West	93	70	65	61	81	67
Canada	97	85	67	63	85	76

Table A6.2: Average TEN

	Company	Year 2002			Year 2005		
		Summer TEN	Winter TEN	Annual TEN	Summer TEN	Winter TEN	Annual TEN
Refiners	Chevron	65	92	81	61	88	77
	Co-op	67	94	83	65	90	80
	Husky	70	101	88	67	96	84
	Imperial Oil - Dartmouth	72	103	90	67	96	84
	Imperial Oil - Nanticoke	69	106	91	64	93	81
	Imperial Oil - Sarnia	71	105	91	63	91	79
	Imperial Oil - Strathcona	67	96	84	62	89	78
	Irving	64	97	83	63	96	82
	North Atlantic	54	85	72	58	84	73
	Petro-Canada - Edmonton	63	91	79	60	86	75
	Petro-Canada - Montreal	68	92	82	62	85	75
	Petro-Canada - Oakville	68	100	87	63	91	79
	Shell - Montreal	67	99	86	62	95	81
	Shell - Sarnia	74	107	93	67	94	83
	Shell - Scotford	59	88	76	58	87	75
	Sunoco	61	90	78	58	86	74
	Ultramar - St-Romuald	70	94	84	66	91	81
Blender	Robbins Feed and Fuel	76	99	89	71	93	84
Importer	BP (Arco)	74	102	90	71	99	87
	CAMI	60	92	79	60	92	79
	Ford	58	87	75	58	87	75
	GM	57	82	72	57	83	72
	Imperial Oil - BC	60	-	N/A	59	-	N/A
	Mackenzie	79	114	99	74	105	92
	Northern Transportation	59	-	N/A	60	-	N/A
	Neste Petroleum	71	-	N/A	67	-	N/A
	Olco - ON	73	-	N/A	67	-	N/A
	Parkland - YK	80	111	98	73	103	91
	Petro-Canada - Burrard	69	-	N/A	68	-	N/A
	Petroles Norcan	71	-	N/A	68	-	N/A
	Ultramar - NF	58	-	N/A	56	-	N/A
	Ultramar - QC	69	103	89	66	99	85

- * TEN cannot be calculated due to addition of methanol to gasoline which is not supported by Complex Model calculations.
- N/A indicates that annual TEN cannot be calculated if gasoline was not supplied during both the summer and winter.