IC

THE CANADIAN PETROLEUM REFINING AND MARKETING INDUSTRY

Volume 1

SECTOR COMPETITIVENESS FRAMEWORK

March 9, 1995

THE CANADIAN PETROLEUM REFINING AND MARKETING INDUSTRY

Volume 1

SECTOR COMPETITIVENESS FRAMEWORK

March 9, 1995

TABLE OF CONTENTS
VOLUME 1

LIST OF APPENDICES
VOLUME 2

OTHER FREQUENTLY CONSULTED SOURCES

1. Purvin and Gertz, Inc. "North American Crude Oil Markets in Transition". (November 1993)

2. Natural Resources Canada. Canadian Petroleum Industry Monitoring Report.

3. Natural Resources Canada. Petroleum Product Marketing Report.

4. Statistics Canada, Industry Division and Natural Resources Canada, Energy Division. " Energy Statistics Handbook".

LIST OF FIGURES

LIST OF TABLES

PREFACE

The Sector Competitiveness Framework (SCF) process is an Industry Canada approach to examining competitiveness of Canada's major industrial sectors, based on sound data, partnerships, and rigorous analysis. The process is intended to improve understanding of the issues affecting the long term competitiveness of the sectors, lead to more effective policies and reduce uncertainties for future investment.

The SCF for the petroleum products sector is covered in Volumes 1 and 2 of this report. Volume 1 is a document prepared by Industry Canada with the assistance of Dr. George Lermer, Dean of the Faculty of Management, University of Lethbridge, Lethbridge, Alberta; and represents an analysis which goes beyond the work in Volume 2.[1]

Volume 2 is the work done by the Petroleum Products Competitiveness Task Force, a partnership of industry, federal

---

[1] Dr. Lermer was initially invited to write a review based exclusively on the information and analysis in appendices A2 through A8. Given the delay from when the appendices were first prepared to the writing of the summary, Dr. Lermer sought up to date input from an industry source. Dr. Lermer, after consultation with Industry Canada personnel, wrote a summary that built on the appendices but also updated the paper to reflect the rapidly changing environment affecting Canadian refiners over the past three years since for example the reports in Appendix A7 and A8 were written. Dr. Lermer's initial draft report has been edited several times in response to feedback from many participants in the original Task Force and other industry and government experts. Nevertheless, this report should be clearly treated as work in process because the speed with which conditions confronting the refining industry change threaten to make short the half-life value of any study. For example, the introduction of RFG to the US market in January, 1995 is disturbing the supply demand balance in North America and Europe for unleaded gasolines, and by affecting the pricing of Canadian gasoline, is adversely affecting the refiner. Several vital areas for future research are as follows: (1) a region-by-region analysis of the exposure of Canadian refiners to imports for a variety of potential business and regulatory reasons; (2) a comparative analysis of refinery performance by region with US refinery performance in a contiguous US region; (3) a determination of how comparative capital and other fixed costs may affect the existing measures of relative US-Canadian refinery performances reported herein based solely on comparisons of variable operating costs; (4) a better fix on the cost implications for US environmental regulations to affect petroleum refiners and the likely impact of those regulations on future US refiners investments and operating costs; (5) better data on Canadian refiners' operating costs and the proxies for costs measured from several different margins between prices at different stages of the chain from crude oil to refined product retail sales; (6) the effect of refinery complexity on the costs of meeting environmental regulations; (7) the potential for joint economies of scope from jointly meeting several environmental regulations and building complexity into refineries because complexity simultaneously increases flexibility in responding both to changing market prices for feedstocks and products and to meet future environmental regulations; (8) refinery gate prices for a broad range of Canadian refined products that can be compared with similar prices at various US refinery centres;(9) greater detail on the transportation and other distribution cost differentials that may explain the greater spread in Canada between the rack price and the dealer tank-wagon price; (10) greater detail on the US service station sector and a better basis for inferring the likely developments in the Canadian marketing and service station businesses; (11) the cost structure of the refiner-marketers' service station networks compared ot that of the independents; and finally, (12) the likely speed at which the Candain service station network will rationalize to permit the remaining capital employed to earn a standard rate of return.

departments and consumers. Industry was represented on the Task Force by four member companies of the Canadian Petroleum Products Institute(CPPI). These included two national refiner/marketers, one regional refiner/marketer and one regional marketer. The federal government departments that participated in the Task Force work program included Industry Canada (for the business analysis expertise), Environment Canada (for the knowledge of the environmental scenarios), and Natural Resources Canada (for the understanding of the petroleum industry's technologies and markets). A perspective of the Canadian consumer was provided by a representative of the Consumers Association of Canada (CAC). In addition, the Task Force extensively consulted with a range of stakeholders that includes provincial governments, other federal departments and agencies, and individual company executive management teams.

The analysis and findings in Volume 2 represent the consensus views of the partnership. Those views were successfully reviewed and tested at a multi-stakeholder workshop in February of 1994.

On the advice of the Bureau of Competition Policy, the study team was vertically integrated with the inclusion of the member of the CAC, and only data available from public sources was used. As a result, no attempt was made to deal with areas where propriety information was required.

The next cycle of the SCF will be addressing competitiveness issues resulting from the international product pricing and trade dynamics flowing from international differences in environmental standards and international differences in investments needed to meet common standards.

I. INTRODUCTION

Canada's manufacturing industry is challenged by international competitors and is adapting to a rapidly changing regulatory system at home and abroad.[2] The Sector Competitiveness Framework (henceforth SCF) program, which incorporates this study of the Canadian petroleum refining and marketing industry, is aimed at developing a sector by sector Micro-economic Action Plan for strengthening and expanding Canada's industries. The present economic recovery, and the current level of exchange rates may be masking underlying weaknesses or unexploited opportunities for growth. A micro-economic analysis investigates an industrial sector's past performance and its relative strengths and weaknesses in comparison with competitors in the US and elsewhere. The analysis can reveal threats and opportunities and provide a rational approach to collaboration among public and private stakeholders to assist industrial firms to address the challenges.

For almost a century, petroleum refining has been perceived by the Canadian public as an indicator of the country's growing industrial capacity. That perception reflected the refiner's need to locate close to the users of gasoline, diesel fuel, aviation fuel and heating oils and other refined petroleum products. Major industrial complexes were identified by the recognizable towers of a refinery complex located in a convenient urban suburb. Crude oil was brought to the refinery. Refinery complexes were a hub. Many business firms downstream from the refiners that acquired refined petroleum products for transportation, heating, power generation and chemical feedstocks, tended to locate in urban areas, close to refineries in part to have economical access to refined petroleum products.

Today, refined products are shipped by pipeline and marine tanker over vast distances at a moderate premium to the cost of shipping the crude oil from which products are refined. The location of the refinery is therefore becoming unbundled from the location of the end user. Refineries are still far from being footloose factories that can be picked up and reassembled elsewhere. Each refinery represents for the investors a large sunk cost investment both in the

---

[2] Canadian price and import regulations affecting the energy sector were dismantled in 1985. However, environmental regulations are today in flux. In other sectors, international trade regulations are changing as are regulations in transportation and telecommunications.

refinery and in the network of transportation infra-structures that support the refinery. Nevertheless, change can be rapid. For example, over as little time as a decade, the structure of the Canadian industry has been transformed, and only two major refinery centers in Canada survive, at Edmonton and in the Sarnia-Toronto region; and three minor centers in Montreal, the Atlantic region and Vancouver. There is a risk that in the future the Canadian refinery sector may decline further and that refined petroleum product demand will be supplied from imports.

Public regulation of the petroleum business emerged in response to the public's awareness of the industry. The public associates refineries with industrial strength and a refinery closure becomes a political as well as an economic event. Motorists are sensitive to variations in gasoline prices and seek answers from government agencies when prices appear to differ between communities or swing apparently without reason from day to day. The community sometimes expresses concerns about the scale of large and multi-national petroleum firms, many of which are integrated from crude oil supply and transportation to gasoline retailing.

The industry has been and remains subject to federal excise and provincial sales taxes on gasoline that far exceed US taxes, but which are not out of line with taxes elsewhere. It has also been buffeted, possibly more than any other single industry, by a broad range of government policies --- energy policies, environment and especially clean air policies, foreign investment policies, trade policies in both Canada and the US, public concerns about gasoline pricing, and government participation through direct ownership and regional development policy.

Since 1985 Canadian regulators no longer control prices, profit pass-through and international trade in crude and refined products. Today the spotlight is on the industry's economic performance and the impact that environmental regulations have on that economic performance. Environmental costs are separable into those that are related to a site's direct environmental impact (at refineries, service stations and transportation facilities) and those that affect the air pollution from vehicles and other facilities burning fossil fuels. It is important to distinguish between these two different types of environmental costs. Site-related operating costs to meet environmental standards may raise a domestic refiner's costs without providing protection from foreign suppliers and thereby place the domestic refiner at a potential disadvantage to those foreign refiners positioned economically to export refined petroleum products to Canada . Operating costs to meet specifications for meeting more stringent environmental refined products will allow Canada within the rules of international trade law to force foreign suppliers to meet those same environmental standards.

In this initial SCF document, the wide ranging and rapid changes in the Canadian refining and marketing industry are presented and evaluated. The current status and past performance of the industry are compared where possible with the status and performance of the US refining industry. Though not the only source of competition, the US industry is the most likely potential supplier of refined products in Southern Ontario and British Columbia, which in turn will affect prices in Northern Ontario, Quebec and on the Prairies. This paper provides analysis and in its appendices detailed data about prospective environmental costs, industry structures and refinery margins between revenues and expenses at the refining, wholesaling and retailing stages of the industry. That information and analysis has not previously been available to all stakeholders - those inside and others outside the industry. Future consultations will build on this study and will highlight the areas that require further research towards establishing a collaboration on public policies and private strategies to meet sector challenges.

Section I contains a brief outline of the process used to develop this paper, the background for the study, and challenges and issues facing the industry that make this study timely. Section II is a profile sketch of the industry's growth prospects, its employment levels, its structure in comparison with those of the US industry, and is sets the historical scene. Section III presents a comparison of of the Canadian and US industry's profit, revenue and operating costs performances. The next section (Section IV) evaluates several of the factors that affect the Canadian industry's competitiveness in relation to that of the US refinery industry. Long Term Fundamentals (Section V) presents the prospects that the industry will need to make major new investments to improve refineries and to comply with environmental mandates. Since investment decisions depend on profitability, a return to profitability is an immediate social concern due to the social origin of the demands on refiners to make additional investments to meet environmental objectives. Section VI is a brief summary of the kev issues and includes recommendations for further co-ordination, specific actions and additional research.

1. Process

Industry Canada commissioned the Petroelum Products Sector Competitiveness Framework study in partnership with Environment Canada, Natural Resources Canada and the Canadian Petroleum Products Institute. Personnel from all four organizations contributed to research presented in several of the attached appendices. This report builds on that research and also on extensive consultations with the Bureau of Competition Policy, the Department of Finance, the Canadian Consumers' Association and several major refiners (See Appendix A1, Partnership Summary). As part of the process, The Canadian Petroleum Products Institute (henceforth CPPI) co-chaired with Natural Resources Canada an Industry Task Force on the Petroleum Products Industry. That Task Force reported in August, 1993 in a paper titled "The Report of the Working Group on Competitive Issues (See Appendix A8)." Earlier in the process, the CPPI commissioned a special study by Purvin & Gertz Inc, titled "Competitive Outlook for the Canadian Petroleum Refining and Marketing Industry", dated May 4, 1992 (See Appendix A7).

This paper however is the responsibility of Industry Canada. It is more analytic than the previous reports. Though it relies on research reported in the appendices, other sources of information have been canvassed to make this report as up to date as possible when studying a fast-paced, dynamic industry.

Because this paper is meant to be used for consultations among numerous stakeholders inside and outside the industry, it relies on information that is already in the public sector and information from a comprehensive consulting study by Purvin and Gertz Inc. of North American petroleum demand and supply.

This report evaluates a number of issues and challenges affecting the industry's prospects, and suggests approaches to future policies for government and industry participants. It also identifies a number of areas that decision makers may wish to be continually monitored and to be subject to further research.

2. Background

Since 1982 the refining petroleum industry has been coping with high costs and low profits generated by declining demand for refined products and low refinery utilization rates.[3] In 1993, refiners showed a marked improvement in utilization rates following a series of refinery closures and increased demand for gasoline and they cut operating costs per unit output sharply between 1991 and 1993. Nevertheless, profitability remains below standard and refiners anticipate a need for large new investments to improve refineries between now and 2010 to meet environmental requirements and to increase the complexity level of their refineries towards US levels. These private sector investments will be made only if firms believe there is a good prospect for a return to long term profitability.

Government is committed to encouraging industry competitiveness and where possible giving comfort to potential investors in petroleum refining that future policy and tax interventions will not impair long term profitability. For the government's assurances to be convincing, those policies should be co-ordinated across government departments and between federal and provincial governments.

Profitability in the petroleum refining industry has in the past been adversely impacted by a broad range of regulations and a high level of excise taxation in relation to the United States, because higher prices reduces domestic demand for refined petroleum products. Since 1985, Canadian refined product prices reflect strong Canadian and potential import competition. Deregulation has fostered historically low petroleum product prices. It is therefore important to explain to all stakeholders the impacts of proposed government policies on industry competitiveness, in the context of the realities of industry economic opportunities. Rumours about new excise taxes would quash investment as much as would the reality.

---

[3] Petroleum Monitoring Agency (PMA). The Canadian Petroleum Industry 1987 Monitoring Report, Annual observes in respect of return on shareholder's equity that "the five-year average ending in 1987 for the petroleum industry was 5.8% compared with 10.2% for the other industries." For rate of return on capital employed the PMA reported that the rate for the Petroleum industry was 6.8% versus 8.9% for all other (excludes petroleum) non-financial Canadian industry. Returns for the second half of the decade remained poor. The five year average rate of return to shareholders equity to 1992 was just 1% compared to an all non-financial industry rate of 7.1%, and 5.3% on capital employed compared to an all industry rate of 6.3%.

The SCF process is designed to increase the credibility of the government's "competitiveness" policies with the commercial community and through the media also with the public. Absent a reliable analysis, public and political stakeholders are often sceptical of the validity and objectivity of industry evaluations about the costliness of specific policy initiatives and the merits of an industry case for slowing adaptation of a regulation or considering an alternative regulatory approach. The consensus approach adopted by the SCF process is designed to overcome that scepticism.

3. Challenges and opportunities

Each Canadian refiner has in recent years made difficult decisions about how best to downsize and rationalize its refineries and its marketing network. Downsizing may continue in the refinery sector and will certainly occur in the retailing segment of the industry. Each refiner will also be making a series of decisions about whether to commit large investments to make its refinery meet environmental standards for refining operations, to meet new specifications for gasolines to reduce automobile emissions, and to adapt refineries to enable the use of a broader range of crude oils. Though there are uncertainties about the precise amount of the investment needed and its timing, there is a broad consensus that a Canadian refiner cannot postpone investment indefinitely if it is to remain competitive with other Canadian refiners and with imports.

Large investments will be avoided in favour of importing refined products unless prospects for long term profitability improve. Those prospects will be affected by refiners' efforts to rationalize the Canadian industry. The industry has improved performance dramatically in the past two years, but profitability remains below industry standards and below the expectations of investors. Long term profitability is threatened by the potential for imports from off shore refineries that may be able to avoid costly investments and operating costs associated with improving site related environmental requirements. Unlike off shore refiners, US refiners are likely to face higher environmental costs than Canadian refiners, but it is still possible that certain US refineries will avoid making investments to meet US product specifications and will shift to delivering product to the Canadian market. International trade law may prevent Canada from responding to those additional shipments by erecting a barrier to imports at the border.

4. Tests of competitiveness

The Canadian refinery industry is deemed to be competitive if firms in the industry can earn at least a standard rate of return (the industry estimates this to be about 12%) on capital invested while retaining the industry's share of Canadian refined product sales. Over the past decade, the refining industry has succeeded in selling virtually all the gasoline and other refined petroleum products sold in Canada. A small volume of imports is balanced by larger exports, and Canada enjoys a balance of payments surplus in the trade of refined petroleum products. To maintain market share in Canada, Canadian refiners have met or undercut the price of potential imports.[4]

In short, the test of competitiveness for Canadian refiners as a group is that they are able to earn on a sustained basis at least a standard rate of return and importers are unable to capture a significant share of the Canadian market. This paper, especially in several appendices below, evaluates current prospects for Canadian refiners to succeed in returning to competitiveness in the above stated sense.

The Canadian refinery sector is unlikely to become a major exporter of refined products because the US industry has already invested heavily in refinery complexity. That higher level of complexity gives US refiners greater flexibility in the choices of crude oil types and product slates than the short-term options available to most Canadian refiners. US refiners are therefore able to reduce their crude acquisition costs as the relative prices change for crude oils of different specific gravity and sulphur content.

Whether or not that enormously expensive investment in greater flexibility is being repaid through lower crude oil costs and/or higher valued outputs, the US industry has committed to those investments and the Canadian industry is still to make them.

However, the impact of mandated increases in operating costs to meet environmental objectives could swamp all other investment considerations. The future of the Canadian industry will be

---

[4] Being a price taker, a Canadian refiner cannot raise revenues by increasing prices. To raise revenues it must increase market share at the expense of another refiner. That process can be costly and unsuccessful. Instead, to return to profitability each refiner has focussed on reducing costs and maintaining market shares.

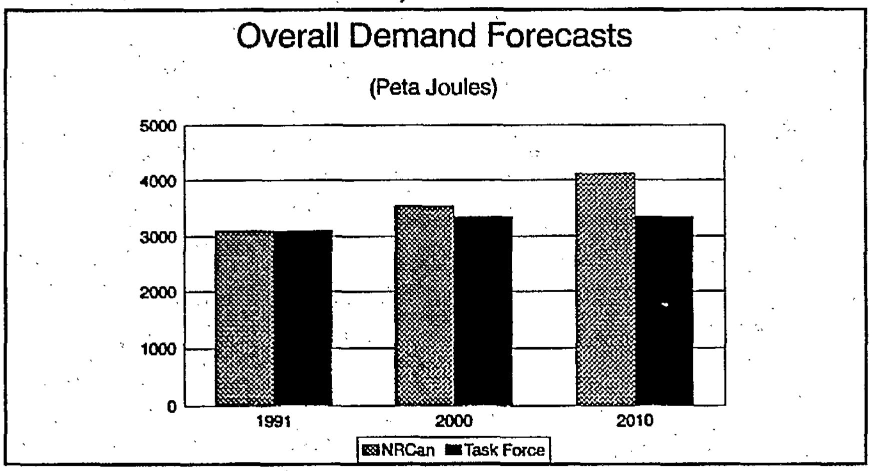
determined by the ability of the government and the industry to settle on environmental changes that can be financed from earnings in the market place. Refiners ability to recoup environmental costs will depend on the costs to be incurred by competing US and off shore product sources affected by different levels of environmental regulations. Trade policies pose a concern for refiners because differential environmental standards and different means of mandating environmental outcomes may sharply alter costs of production and therefore also trade and spatial investment patterns. Site specific environmental investments that affect air, water and ground pollution in the vicinity of the site may raise domestic costs that an exporter to Canada might avoid. Those imports to Canada could not be interfered with at the border. In contrast, investments needed to lower pollution from burning fuels can be protected at the border only if Canadian governments insist that imports meet the same specifications as apply in Canada.

II SECTOR PROFILE

1. A mature industry

The Canadian refinery and marketing industry is mature in the sense that demand growth is slow and revolutionary new technologies affecting supply are not on the horizon. A forecast of future Canadian demand is determined by Natural Resources Canada.[5] The department is predicting a 1.5% annual rate of growth to 2010. In contrast, The Petroleum Products Task Force predicts that growth will be 0.4% to 2000 and will disappear after that (see Figure 1). Purvin and Gertz use an annual growth rate of 0.7% to forecast North American demand. Different forecasts are to be expected for future demand that is by its nature uncertain, but for public policy on setting environmental mandates it would be useful to reach a consensus on a range of demand forecasts for refined petroleum products.

Figure 1:
Refined Petroleum Products
Forecasts of Demand in 1991, 2000 and 2010



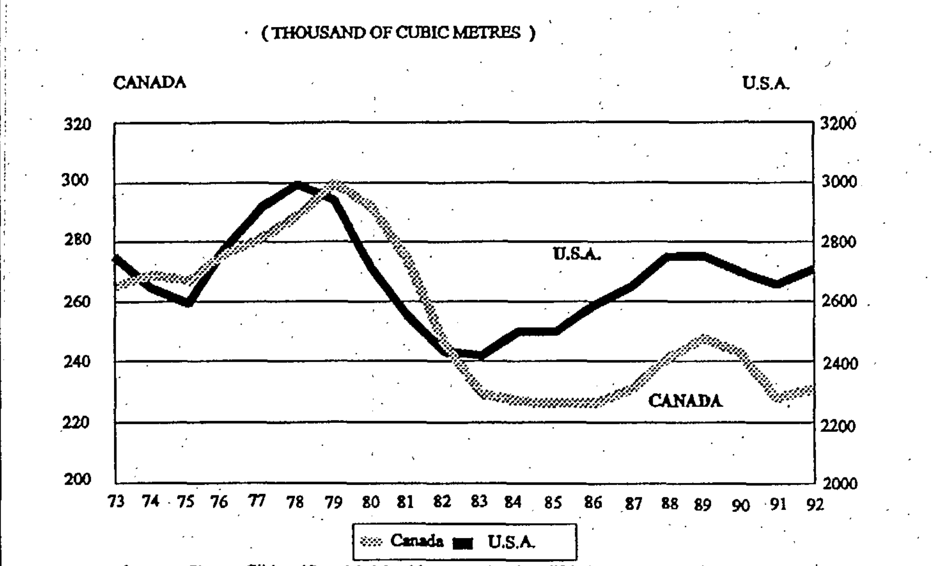
Demand growth has been stagnant in part for cyclical reasons, but demand is expected to grow only slowly during the present economic recovery and in the long term as recessions and

---

[5] Appendix A4. reports that the National Energy Board is still more optimistic about demand growth. Appendix A4. outlines why the Task Force is pessimistic about future growth except for the demand for diesel oil.

recoveries come and go. Efficiencies in heating systems and automobile consumption together with greater competition from natural gas and electricity has reduced the use of gasoline as well as heating oil and heavy oil throughout North America, except that demand for heavy oil to produce electricity continues to be strong in Atlantic Canada. Demand for heating oils has declined but gasoline continues to be the principal fuel for sales to motorists. Nevertheless, demand for gasoline has also declined and even during and after the current economic recovery is expected to grow only slowly. Vehicles were for a time being driven less and smaller cars were in vogue. Today, as Canada emerges from the recession, those trends are being reversed, but automobile engines are achieving ever improving fuel efficiency at a rate that balances the shift to larger vehicles and more driving. Figure 2 illustrates the overall petroleum products demand picture, Canada and USA, from 1973 to 1992.

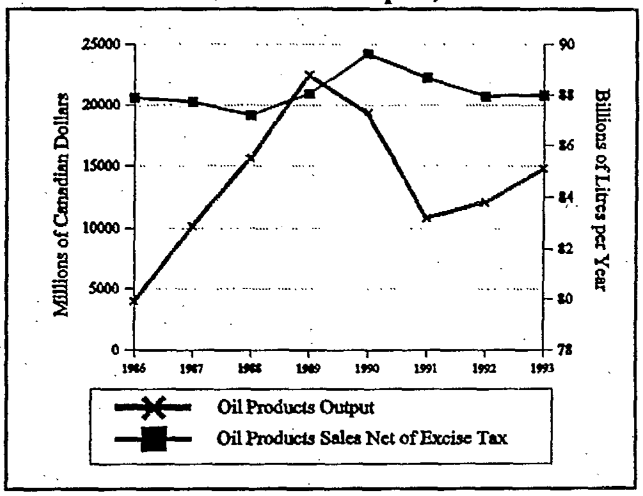
Figure 2: Daily Refined Petroleum Products Demand: Canada & USA; 1973 - 1992



Sources: Clayton Gilders (Canada): Monthly Energy Review (U.S.A.)

Reduced demand for heavier refined petroleum products and softening demand for gasoline, has led the refined petroleum products industry, after a decade of low profits, to rationalize and retrench. Downsizing has reduced the scope of the refinery businesses in Montreal and Vancouver. Canada's two remaining centers for refining petroleum are Edmonton and the Toronto-Sarnia region. The small Ultramar refinery at Dartmouth Nova Scotia, that formerly belonged to Texaco and was sold to Ultramar as part of the Imperial acquisition of Texaco, was recently closed.

Figure 3
Oil Products Sales and Output; 1985-1993



Revenue and output data (output meets demand and is illustrated in Figure 3) on refinery performance underscores that the industry is mature. Canada's petroleum product refiners' downstream revenues (net of federal excise taxes and provincial taxes) from the sale of oil products totalled $22.3 billion in 1991, $20.7 billion in 1992 and $20.8 billion in 1993 (These figures exclude the refiners' petrochemical sales).[6] Fifty-four percent of Canadian refined petroleum products are sold as motor gasoline and aviation fuel, and the total of transportation fuels including diesel oil takes 67% of petroleum products. In the transportation segments of the business, there are few available substitute fuels to replace gasoline and diesel oil. Propane and compressed natural gas take small shares of the motor vehicle business, partly because government provides tax advantages to those fuels, and partly because of perceived (though some think doubtful) environmental advantages over gasoline. The latter segments are largely confined to fleets of taxis and light delivery vehicles and are not an immediate or significant threat to gasoline and diesel sales for most motor vehicles and trucks. Remaining petroleum products compete vigorously with natural gas and electricity as a fuel for heating or

---

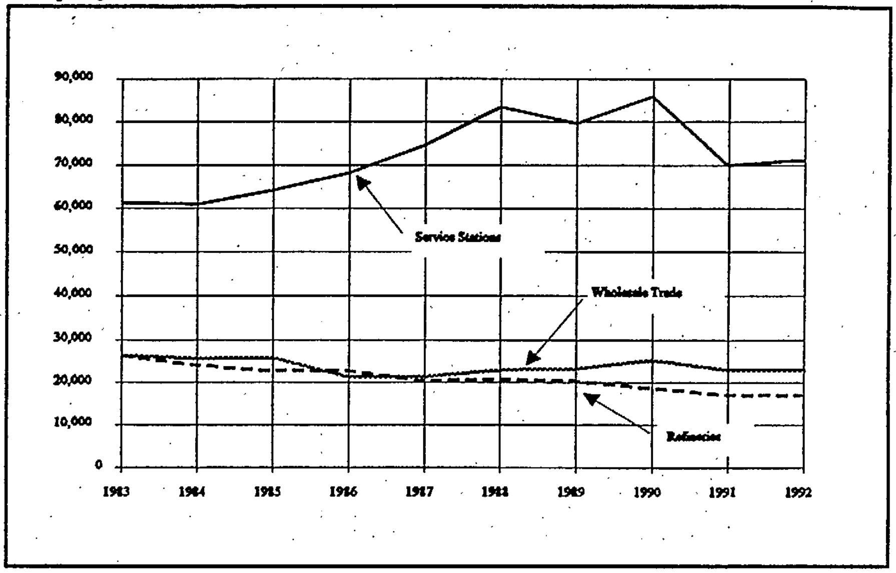
[6] Natural Resources Canada, Canadian Petroleum Industry 1993 Monitoring Report, Annual, Table B9 and B17, and previous issues.

generating power.

2. Employment

There are 13,000 persons employed in the manufacturing segment

Figure 4: Petroleum Refining and Marketing Employment; 1983 - 1992



of the refining-marketing industry producing tradeable end products. That number is down from 25,300 in 1982 and is expected to fall still more. Another 68,000 persons are employed in the retail marketing and distribution segment of the industry, mostly in service stations. Employment in wholesale distribution totals 23,400 persons.[7] Wholesale and retail distribution is a local service business (with the modest influence of tourist choices and cross border shopping as exceptions to the rule). Therefore, the usual measure of "competitiveness", success in exporting to the US and the world, and success in replacing imports, must be cautiously applied to the Canadian petroleum refining and marketing business.

Regardless of the future of the Canadian refinery industry, distribution of refined products will continue in Canada both at retail and wholesale. Employment in Canada will therefore only be modestly affected by the fate of Canadian refiners, though

[7] See Appendix A2, Page 37.

reduced employment downstream may be anticipated as closures of service stations continue regardless of the fate of Canada's refiners. However, refinery jobs are quality jobs.[8] The industry is three times more capital intensive than the average manufacturing industry as measured by the ratio of book value of capital to annual gross domestic product (GDP). Consequently, GDP per employee is $149,000 per person. More importantly, the knowledge intensity level of refinery workers, shown in Figure 5, is among thehighest of Canada's industries. Because refineries are capital intensive, it comes as no surprise that output is high per employee. Also, labour productivity in the industry has improved sharply as employment has fallen over the past decade.[9]

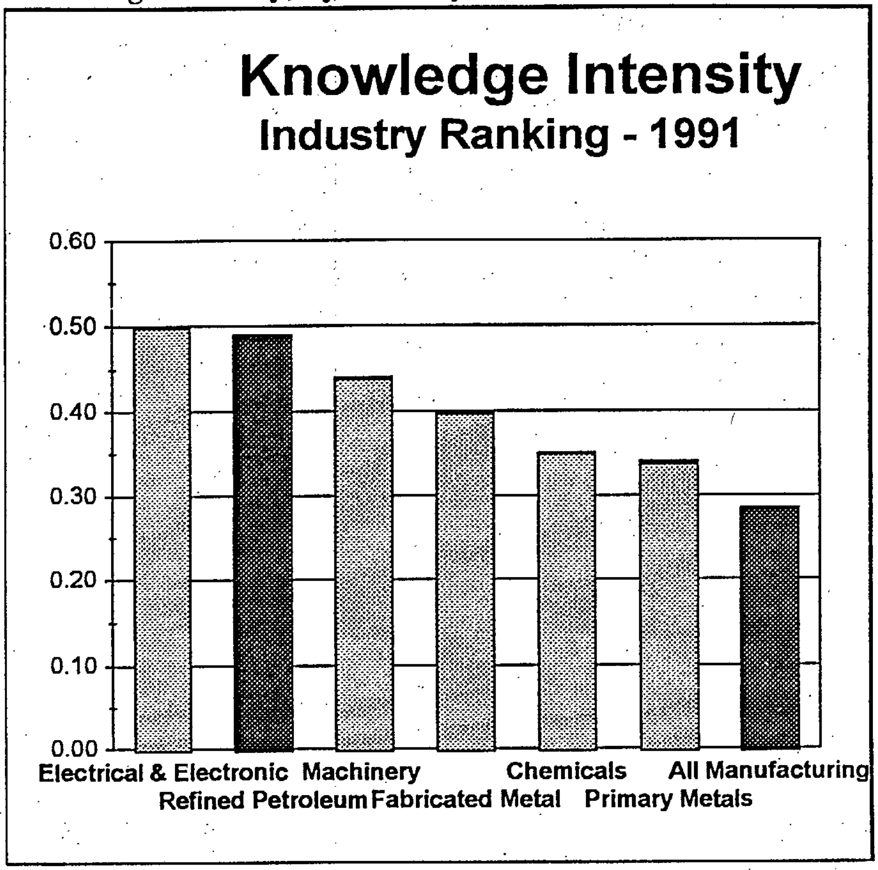
---

[8] Buchanan, Bob reports in a recent study that the downstream indirect employment multiplier taken from the Statistics Canada's Industrial-Output (I/O) industrial code in 1994 was 7.21. To a non-specialist a multiplier of 7.21 suggests that there are 7.21 non-refinery jobs that are dependant on the continuation of the refinery sector in Canada. That would only be the case if the resources used to supply petroleum refineries that make use of labour have no alternative uses and are totally specialized to supplying refining, and that the resources themselves had no alternative uses. For example, that would include labour used in steel production, or computer services or plumbing services and so on. To the extent these are factors of production that have alternative uses (for instance exporting products and services to US refineries), it is not valid to say that the disappearance of the Canaadian petroleum refining industry and its 13,000 jobs (11,900 in 1994) would in turn lead to the loss of 79,000 (73,900 in 1994) other jobs. The Buchanan paper also reports that service station employment was 82,5000 in 1993 and 75,700 in 1994. These are significantly higher than the service station employment reported in Appendix A2 below, page 36. See Buchanan, "Report on Employment in the Canadian Petroleum Industry, 1985-1994" Canadian Energy Research Institute for the Canadian Energy Research Institute for the Petroleum Communication Foundation, December, 1994

[9] See Appendix A3, page 7.

There is a traditional and widely shared unease about Canada becoming exclusively reliant on the "import" option for refined petroleum products, should Canadian refiners turn to imports in

Figure 5
Knowledge Intensity; by Industry; 1991



place of upgrading refining capacity. It is difficult to predict the indirect effect of refinery closures and import replacement on the employment among downstream users of refined petroleum products. Downstream businesses buy 64% of refined petroleum product sales. Downstream effects will therefore be widespread, but the impact on employment may be minor if imports are priced attractively. The effects may be significant if the extra costs of importing refined products disadvantages downstream firms competing with US producers located close to a US refinery.

Of the many downstream industry sectors that use refined petroleum products, twelve are major users. For five of these industries the purchase of refined petroleum products accounts for more than 4% of purchased material inputs. Those industries are Transportation (10.4%), Power Utilities (8.6%), Chemical and Chemical Products (6.4%), Agricultural and Related Service Industries (5.8%), and Mining (4%). Any increase in the price of refined petroleum products in Canada above US levels clearly affects the relative competitiveness of those industries. Furthermore, industries further downstream acquire inputs from firms directly acquiring refined petroleum products from refiners, and the latter will also suffer any pass through of higher refinery costs.[10]

Like the refinery stage of the industry that is downsizing and rationalizing under the pressure of competition and excess capacity, the service station stage of the industry is adjusting to change. The implication for employment indices of declining service station numbers will be greater than the impact that the downsizing of the refinery sector is having on employment. The typical Canadian service station operates with higher unit retail costs than the typical station in the United States because it sells far less gasoline per month, is less likely to be self-serve and is less likely to be cross-merchandising as effectively. Disequilibrium in the Canadian service station segment of the industry and a frequent recurrence of price wars in many Canadian communities has made the public keenly aware of gasoline pricing.

Given the difference between the US and Canadian service station numbers (In 1991, 10,000 litres per day in the US compared to 5,000 litres per day in Canada; Natural Resources Canada estimates) employment in the retail service station segment of the business is likely to fall. Service station numbers have already fallen since 1980 from 24,200 to 17,000 in 1994. Several refiners have announced they intend to reduce their station networks still further. However, independent dealers may choose to sell unbranded gasoline, and independent distributors maintain significant shares of regional and especially urban markets across the country.

One factor working at slowing the rate at which stations are closed to match the far more rapid decline in the United States (the decline

---

[10] Canada's petrochemical industry in Southern Ontario and Quebec is reported to be largely viable only because it enjoys lower cost petrochemical feedstock flowing from Canadian refineries as compared to the cost of refinery supplied feedstock for major petrochemical producers at the US Gulf Coast. Sarnia and Montreal have become significant centres for petrochemical production because of their proximity to refineries.

in the US ended in 1987) is the difficulty firms are encountering in trying to transfer a station from a petroleum to a non-petroleum use. Firms find it difficult to sell because the buyers and potential financial lenders are unwilling to accept the liability for clean-up costs. That issue may need to be addressed at a social level through legislation or a government program.

Though service station numbers in Canada are falling, if the US example is a good one, the Canadian service station segment of the business will be downsized further possibly as much as by 25% as measured by number of outlets. The decline would need to be 50% for Canadian stations to reach the US service stations current throughput levels. However, Canada's dispersed population may mean that the equilibrium number of service stations will remain higher than needed to reach the US standard throughput in Canada. Since the refiner-marketers are active participants in the wholesale-retail business, that area may well be a serious drag on their overall profits. Distribution costs are lower in the United States, but that observation is based on national averages and may not be true for the network operated by a refiner-marketer in Canada.

Even were the distribution system to remain high cost compared to the US network, those higher costs would apply equally to a wholesaler and/or retailer who decides to import gasoline. Therefore, the retail cost may modestly affect demand in Canada, but it also has a modest influence on the "make or import" decision that a refiner-marketer may be considering.

3. Industry structure

The Canadian refining industry is more concentrated than is the US refinery industry. As a group, the major and regional refiner-marketers in Canada together sell almost 80% of gasoline sold at retail through branded company owned and branded dealer owned service stations, compared to just 36% for refiner-marketers in the US. Three major Canadian refiner-marketers (Petro Canada, Imperial and Shell) sell 47% of gasoline and the top three firms in the US sell 25%. The 47% figure is however misleading as an indicator of the competitive impact of the three majors' market share of gasoline sales. That impact is a regional phenomena and the combined share of the major national refiners in each region is lower in some regions than others. More importantly, in each region the major refiners encounter at least one local refiner that may not have a significant national market share but does hold a large share of sales in that region. In Atlantic Canada Irving is a well established refiner-marketer. In Quebec, Ultramar is a significant refiner-marketer. In Ontario, Sunoco operates widely and Ultramar distributes in part of the province. On the Prairies the Co-op and Husky (from their own refineries) and Mohawk (supplied under a processing agreement with a major refiner) are significant refiner-marketers. Finally, in BC, Chevron is the major refiner-marketer. Since each of the three national refiner-marketers has a different level of representation in each region, the national average is not an indicator of performance in any one region.

In addition to competition from regional refiners, all refiner-marketers encounter competition at the service station stage of the industry from jobbers and independently owned retail chains. Across the country, the independently owned (unbranded) independents market is about 20% of retail gasoline sales, but in certain cities that ratio reaches well over 30% of sales. The refiner-marketers compete with one another to supply the independents gasoline that is typically offered at wholesale prices tied to US rack prices or to US spot prices adjusted for landing costs, storage and delivery to the Canadian customer.

4. Regional differences

Analysts often divide Canada's refinery centres into five distinct regions: the Atlantic, Montreal-Quebec City, Sarnia-Toronto, Edmonton and Vancouver. In the West, only Chevron operates a refinery in Vancouver and the region is served by Edmonton area refineries, making it more useful to link the Prairies and British Columbia in a single market. Ontario and Quebec refiners exchange product and also compete for sales in Eastern Ontario. From a refinery, if not from a retailing perspective, the two provinces are part of the same geographic market. It is therefore often useful for economic analysis to define three distinct Canadian geographic market regions for refined petroleum products, each of which overlaps with adjacent areas in the US. The three regions are the Atlantic region, the Ontario-Quebec (or Great Lakes-St Lawrence) region, and the Prairies-BC region.[11]

[11] Several studies draw different regional boundaries. The CPPI Task Force (Appendix A8) identifies three regional markets as follows - Atlantic and Quebec, Ontario and Prairies and BC. The commonality between the

As mentioned above, measures of the structure of refinery ownership for Canada as a whole, rather than for each distinct region, are of limited value for public policy, or for inquiring about industry efficiencies. Also, comparisons between Canadian and US petroleum refining and retailing are not as useful as comparisons of each of Canada's three regions and that region's adjacent US refining and distribution district.

The Atlantic Region has four refineries. The Come By Chance refinery and the Irving Refinery at Saint John process imported crude oil and export a large share of their products to the New England states (accounting for 67% of Canadian refined product exports). They both produce at times large volumes of heavy end products that find a convenient local market especially with Atlantic electric utilities that still import heavy fuels to supplement local supplies.[12]

Ultramar has closed the Texaco Dartmouth refinery.[13] Those marketers not operating refineries in the Atlantic region arrange for supplies through exchange agreements with Imperial and Irving. Imports are an alternative, to local refining or exchange, but imports to date have not been a significant source of gasoline supply in the area. Imports of heavy fuel oil to the Atlantic area are 46% of total Canadian refined product imports.

Atlantic and Quebec regions is their shared exposure to marine shipments of crude and refined products. Ontario on the other hand is linked to the industry in PADD 1 in the northern US. The Prairies are now linked to BC through the supply of BC from the Edmonton refinery complex. A reason for identifying Quebec and Ontario as being in the same regional market is the widespread refinery exchanges between refiner-marketers in the two regions and the overlapping supplies from Montreal and Toronto in Eastern Ontario.

[12] The Come by Chance refinery was recently sold by Newfoundland Refining Co. to Swiss based Vitol SA which is reported to be planning to invest $30 million over two years to upgrade the refinery to allow it to meet US specifications. Both the Come by Chance and Irving refineries have cracking capabilities but the equipment is small compared to the nameplate capacity of the refineries.

[13] The Ultramar refinery at Dartmouth is a small and old Texaco refinery that was slated for closure by Texaco and later Imperial but has been kept open by order of the Competition Tribunal. According to evidence led by the Director of Investigations and Research before the Competition Tribunal in the hearing on the Imperial-Texaco merger, the refinery would be better utilized as an import depot for refined products. It has recently been used exclusively to process light Norwegian oil for Statoil, and has not been supplying domestic markets. It is now mothballed and at the time of writing the Nova Scotia government and the refinery workers union are seeking through the courts to force the Director to in turn force Ultramar to reopen trhe refinery. Ultramar is reported to be planning to use the port facilities located on the refinery site to import products, and is now offering the refinery for sale.

In the Quebec-Ontario region there are nine refineries - three in Quebec and six in Ontario. All are of reasonable size. One refinery, Novacor's in Sarnia is designed to produce petrochemical feedstock and produces a small amount of gasoline as a by-product. Ontario and Quebec refineries serve primarily the domestic market, and they export small amounts occasionally in order to increase their utilization rates. Despite several refinery closures in the Montreal area that reduces supplies in the Ontario-Quebec region, utilization rates in Ontario remain low.

Gasoline and heating oil supplies have from time to time been imported into Quebec in substantial amounts, and the infrastructure to accommodate and store imports is in place. Those facilities are owned by both refiner-marketeters and by independent brokers and jobbers, and there exists capacity to rapidly expand throughput of imported refined products. Ontario can be supplied from off-shore through imports through the Seaway during the open season, but the impact of actual and potential imports is more directly through supplies from Buffalo and other refinery terminals in the northern United States supplied by pipelines from refineries in the New York City and Philadelphia areas.

There are five significant refineries in the Prairies-BC region: Co-op in Regina, Imperial, Petro-Canada and Shell (Scotford) in the Edmonton region, and Chevron in Burnaby B.C. All Prairie-BC refineries produce almost exclusively for the domestic market. In Alberta the petrochemical industry is based on ethane feedstock from natural gas rather than ethane or propane byproducts from refinery operations as in Eastern Canada, natural gas accounts for most home and commercial heating, and coal is used to generate electricity. By-products from Alberta refineries are therefore not used extensively in downstream petrochemical production.

In conclusion, Canadian refinery markets each overlap with adjacent US regions and are separated from each other. Therefore a regional analysis is a more accurate reflection of economic realities than is a national analysis. However a national perspective on petroleum markets is fostered by a traditional concern for defence and emergencies. Defence and emergency motives have been advanced as a rationale for public concern about a domestic capability to supply crude oil to Canadian refineries. Economic efficiency however has dictated the development of an extensive logistical infrastructure comprising pipelines and storage terminals that knit together sources of crude oil with refineries across North America and around the world. The continental scope of the industry's supply flows is protected by the Canada-US Free Trade Agreement which prevents in an emergency Canada from cutting off supply and charging "export taxes" on US sales.

5. Historical background

Past profitability of the Canadian petroleum refining and distribution business has been strongly influenced by Canadian and US government policies. On the one hand, until the early seventies and the OPEC crisis, the downstream refining and distribution business was pushed by the upstream policies of oil companies seeking outlets for increasing volumes and sources of crude oil supplies. On the other hand, the industry was pulled by Canada's rapidly expanding demand for gasoline and heating oil. From the late fifties to the early seventies, off shore crude oil supplies, but not Canadian products or crude oil, had under US law limited access to the United States market because of quotas on oil and gasoline imports. In response, the Canadian National Oil Policy (henceforth NOP) reserved refineries in Canada east of a line between Kingston and Ottawa for lower cost imported crude oil. West of the line, refineries were supplied by Alberta crude oil by pipeline. The latter crude oil source of supply was higher priced than off shore supplies because of the higher opportunity cost of Alberta oil, the result of Alberta's unique access to the otherwise protected and higher priced United States market. Following informal agreement with the U.S., the NOP reserved Ontario markets for western Canadian crude to take the Alberta crude oil that would otherwise have been redirected to the US and replaced in Ontario by off shore crude imports.

On the eastern side of the NOP line, regional refiners with crude oil supplies off shore entered the refinery and service station business. Petro Fina, British Petroleum and Ultramar entered the market. Irving Oil, in conjunction with Standard Oil of California entered the Atlantic region market. East of the NOP line oil product imports competed with domestic refiners and imports into Quebec during the sixties reached significant levels of total sales. West of the NOP line however, Canadian refiners were protected from product imports because US gasoline prices were high and off shore imports were prevented from crossing the NOP line. On both sides of the NOP line rapidly expanding demand for petroleum products and natural protection for domestic refiners in the form of lower costs for shipping crude oil compared to petroleum products, together with modest tariffs, induced a rapid expansion of refinery capacity close to the urban centres of demand.

After the OPEC crisis, during the seventies, the Canadian petroleum refining and petroleum product marketing business became subject to direct government regulation of crude oil and product pricing. Despite several different regulatory regimes intended to cushion Canadian energy consumers and energy using industry from high world crude oil prices, domestic prices rose and resulted in reduced demand associated with an extended period of economic recession. These policies created barriers to imported oil products and opportunities to export downstream refined products produced from low cost feedstock, and resulted in some expansion of Canadian refinery capacity (Polysar) and greater reliance on Canadian crude oil supplies. In 1980 the National Energy Policy taxed away upstream profitability and advantaged Canadian owned over foreign owned firms. With the 1985 signing of the Western Accord between the Alberta and Canadian governments, price regulation disappeared in the petroleum industry and the National Energy Board, while retaining control over exports, began to rubber stamp applications for a license to export crude oil and refined petroleum products.

In the eighties, Canadian refiner-marketers refocussed their attention on the profitability of their downstream assets. Despite that attention, losses accumulated as demand fell and excess capacity prevailed, driving up average operating costs per unit of output of refined products. The worst year for profits was 1991. Losses in 1991 were compounded by the effects of the Iraq-Kuwait war. When crude oil prices rose, refiners postponed raising prices for products several months. When later crude oil prices fell, refiners were forced by competition from US supplies to lower prices and they were therefore forced to sell refined products at low prices even though they had previously paid elevated prices for the crude oil.

Poor profitability damaged the balance sheets of those refiners that had bought the assets of the refiners exiting the business at prices based on valuations that were ununrealized. Petro-Fina, British

Petroleum, Gulf Oil, Pacific Pete and lastly Texaco, all sold their assets in Canada at prices that in retrospect may have been to the advantage of the seller over the buyer.

With the collapse of world oil prices and with deregulation in the mid-eighties, the industry entered its current difficult circumstances. Low profitability followed because in most parts of Canada oil product sales encounter competition from actual and potential imports of foreign and especially US refined products, because there is excess refinery capacity in Canada, and because demand for gasoline fell and is today growing slowly.

Poor profitability gave way to a modest recover in 1993 when the Canadian petroleum products industry improved profitability after a decade of economic losses (below standard accounting profits reported on a FIFO basis but equally true using a LIFO accounting model). Those losses were induced by declining demand for gasoline in Canada and the competition from actual and potential imports primarily from the United States.[14] First half downstream profits for the "total downstream oil products" industry rose in 1994 by 190% from $282 to $536 million, despite total revenues falling by 3.3% and sales realizations falling by 5.8%. The return on capital in the first half of 1994 rebounded to 7.5% from 5.3% over 1993 and 3.3% in 1992.[15]

---

[14] Several oil companies publish revised LIFO based accounts in addition to the FIFO accounts required by Canada. The effect is to shift profits between years, but does not otherwise lead one to revise the conclusion about low profitability over the past decade.

[15] Natural Resources Canada, Canadian Petroleum Industry, 1994 Monitoring Report, First Six Months. Net profits are from A7, page 43 and returns on capital employed are from Table 2, page 9.

III. INDUSTRY PERFORMANCE

1. Competitiveness is not measured by trade flows alone

A trade measure of competitiveness may be inaccurate. For example, the United States imports a larger share than does Canada of its domestic demand for refined petroleum products and especially gasoline. In 1993, US imports of gasoline were over 10% of gasoline demand, down from about 15% in 1988. In Canada, gasoline imports in 1993 were just 3.4% of demand, up from 1.5% in 1992. For refined petroleum products, Canadian exports typically exceed imports in Atlantic Canada, Ontario, and the Prairies, while Quebec imports more than it exports and British Columbia breaks even. Canada as a whole in 1993 imported 22 and exported 40 thousand cubic metres per day of refined products (1 cubic metre per day equals 1,000 litres per day). Exports in 1993 were $2.7 billion compared with imports of $1 billion. Canada enjoyed a trade surplus in refined products of $1.7 billion dollars of which amount $1.5 billion is a surplus with the United States.[16]

On the basis of import and export flows, one might reasonably conclude that Canada has a healthy and vigorous refinery business and that a Canadian firm outperforms its United States competitors. That conclusion is wrong. In reality, profits and investment in US refining have been stronger than in Canada, and US refineries include many that are among the most complex and sophisticated in the world. Canadian refineries rank second to the US in complexity but the level of complexity in Canada, in terms of coking capabilities, is far behind the level in the US.[17]

Canadian export and import shares of production and demand of refined petroleum products distort industry performance because only the Atlantic provinces are major exporters and importers. Most exports from the Atlantic provinces come from the Come By Chance refinery and the Irving refinery. The Come By Chance refinery is smaller and less sophisticated than the Irving refinery. The disadvantage of the low end refinery is that its product slate

---

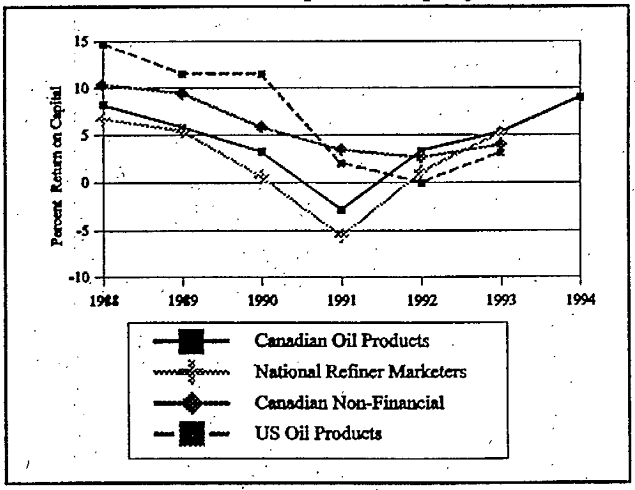
[16] Statistics Canada, Industry Division, Energy Statistics Handbook, July 1994 and Appendix A2.

[17] Appendix A7, Page V-12.

includes a large share of lower valued heavy products. In the US motor gasoline and aviation fuel comprise 68% of refined petroleum product sales. Middle distillate (heating oil and diesel fuel) sales take 24% of the business and heavy oil is just 8%. By comparison, in Canada gasoline and aviation fuel take 44%, middle distillate takes 34% of sales and heavy fuel oil takes 10%. However, the Canadian product slate varies dramatically between regions.[18] The Atlantic region's consumption of heavy fuel oil is 32% of its total consumption of refined products.[19] It is the only region in the country that is a major consumer of bunker fuel. Bunker fuel is widely used in the Maritime provinces because it is one of the few regions in North America that is not reached by a natural gas pipeline. By comparison, Ontario's demand for heavy fuel oil is just 6% of total demand for refined petroleum products.

2. Profitability

Figure 6
Rates of Return to Capital Employed



The future profitability and associated competitiveness of Canadian refineries is not assured. Certainly over the past decade it appeared that the Canadian petroleum refining industry would have an uncertain future. As shown in Figure 6, profitability measured as a return on capital employed has been low since 1988. In footnote 3 above we reported that profitability was also below standard over the previous period from 1982 to 1987. In 1991 firms in the downstream oil products industry

---

[18] Ibid.

[19] Data in Table 1 is from Statistics Canada. Energy Statistics Handbook. (May, 1994).

(including refining and marketing of oil products and excluding petrochemicals) together lost $636 million dollars[20] [21] as the firms collectively wrote off $700 million.

Table I

Oil Products Industry; Revenues, Expenses and Profits

	$millions			
	1990	1991	1992	1993
Total Revenues	29,636	25,473	24,002	24,242
Revenues after excise taxes	24,207	22,251	20,699	20,792
Excise Taxes	5,429	3,222	3,303	3,450
Cost of goods sold	17,839	16,987	15,486	15,032
Operating costs	4,046	4,199	3,696	3,658
R & D costs	64	70	42	39
Other expenses	(1)	49	35	60
Revenues after cash costs	2,259	946	1,440	2,003
Interest payments	307	284	174	139
Taxes	520	13	308	236
Depreciation	685	735	691	662
Revenues before extraordinary items	747	(86)	267	966
Deferred Income tax	9	(214)	(113)	199
Write-offs	(71)	(700)	(162)	(238)
Extraordinary items	2	(64)	85	(24)
NET INCOME	669	(636)	303	505

In just three years, 1991 through 1993, the downstream industry wrote off $1.1 billion dollars in assets or almost 10% of the book value of its 1991 capital employed. These write offs are largely associated with closing refineries. Despite the record of poor profitability, refiners are facing large investments in order to maintain operations in Canada.

[20] Data in Figure 6 is largely from Natural Resources Canada, Canadain Petroleum Industry, 1993 Monitoring Report; 1993 and previous issues. US rates of return are from Appendix A7. Page V-12 and updated by Industry Canada.

[21] Data in the text is from Tables B9 and B17 in the NRCan, Canadian Industry Petroleum Monitoring Report.

3. Comparative refinery revenues United States and Canada

More research is needed before we can definitively report revenues

Table II CANADIAN REFINED OIL PRODUCTS; OUTPUT VALUED AT JOBBER, TANK-WAGON; RETAIL; RACK AND TORONTO RETAIL PRICES; 1993

PRODUCTS	CANADA VOLUMES 1993 (000,000 CM)	CANADA JOBBER A10 (000,000 C$)	CANADA TANK A9 (000,000 C$)	CANADA STAT CAN RETAIL (EX TAX) (000,000 C$)	CANADA RACK(OBG) SARNIA (EX TAX) (000,000 C$)	CANADA RETAIL(OBG) TORONTO (EX TAX) (000,000 C$)
Other	15.1	$3,015	$3,166	$3,407	$2,317	$3,497
Premium gas	5.5	$1,348	$1,717	$1,898	$1,330	$1,776
Mid-grade gas	2.2	$484	$617	$678	$495	$631
Regular gas	26.3	$5,181	$6,601	$7,180	$5,379	$6,549
Jet/Kerosene	4.2	$944	$1,203	$1,203	$942	$942
Diesel/#2 fuel	17.4	$3,423	$3,805	$5,438	$3,606	$5,021
#2 Fuel Oil	11.0	$2,146	$3,395	$3,843	$2,206	$3,964
1% resid.	7.7	$843	$929	$975	$867	$998
TOTAL (million C $)	89.4	$17,384	$21,431	$24,621	$17,142	$23,379
Cents per litre (c)		19	23	27	19	25

NOTE: Value of gasoline sales at retail exceed the refiners' sales realizations (revenues ex excise tax) reported in Table 1, because part of the refiners' actual sales are at jobber prices, part are at rack prices and part are at dealer tankwagon prices. Another part is sold for off-road uses. A relatively modest share of refiners' gasoline sales are at retail pump prices. Also, these figures are based on unweighted average prices over the year times actual annual sales. If prices varied over different seasons a better measure of annual sales revenues would weight monthly prices by monthly volumes.

and sales realizations for Canadian and US refiners on the same basis. Canadian refiners sell far more than do US refiners at retail instead of at the refinery gate. Natural Resources Canada has taken over from the Petroleum Monitoring Agency the production of the Petroleum Monitoring Report in which is published data on average prices for refiners' sales to jobbers and data on prices for sales to commercial, dealer and end use customers (excluding the retail margin for gasoline which is about 4 cents per litre).[22] Other price data is available from Bloomberg's Oil Buyer's Guide, and Statistics Canada. Valuing refinery output at the reported Canadian average prices for 1993 indicates revenues of $17.4 billion at wholesale jobber prices, $21.4 billion at 'commercial - tankwagon' prices and $24.6 billion at retail prices (at which refiners sell a large share of their production of gasoline and heating oil). Valuations on the basis of Sarnia rack prices are slightly below jobber prices which could be a reporting anomaly. However, there is no surprise that Toronto retail prices are somewhat lower than retail prices averaged across Canada.

To compare Canadian with US performance, total US refinery production was valued at average USGC refinery gate prices. Valued at USGC prices, US refiners revenues averaged 15.7 cents Canadian per litre produced. The USGC prices tend to be lower than elsewhere in the US. For example, in 1993 California wholesale gasoline prices were 2.7 cents per US gallon higher than USGC prices. When total US output is valued at California prices, the revenues average 18.2 cents per litre.

The difference in revenues reflects differences in both the product mix and prices. As a group US refineries in 1993 sold 56% of their total output measured by volume as gasoline or aviation fuel. Canadian refineries sold just 45% of their output measured by volume in the same high-end categories (of which gasoline was 49% in the US and 38% in Canada). Because of the different output mix, if prices of the products were identical, US refiners revenues should have exceeded those of the Canadian refiners.

[22] See the Canadain Petroleum Industry, 1993 Monitoring Report. Table A10 reports prices to private brand dealers for premium unleaded and regular gasolines, diesel fuel and light fuel oil. Prices are not reported for aviation fuel, bunker fuels and "other". The missing prices were estimated by assuming that the ratio of the unknown Canadian price to the regular unleaded gasoline price was the same as for USGC prices. Table A9 reports an estimate of the average "dealer tankwagon" price for regular gasoline, diesel fuel, light and heavy fuels. Missing prices were estimated from US price ratios in the same manner as for jobber prices. The prices reported in Table A9 are estimated from net sales revenues after taxes and dealer margins are subtracted. Since the wholesale margin on refiner sales is not subtracted, the price series overstates the true "refinery gate" price. Canadian unbranded Rack Prices are also reported by Bloomberg's Oil Buyers Guide for all three grades of gasoline, diesel,furnace and stove oil. Rack prices were collected for Sarnia to get a proxy for a wholesale price at a location close to the refinery. There is little difference between the Sarnia rack prices and the Canadian Petroleum IndustryMonitoring Reports prices to private brand dealers. Retail prices were collected ex-tax for a variety of products from Statistics Canada "Energy Statistics Handbook" and from NRCan, "Statistical Summary of the Petroleum Product Market Report, 1993".

Table IIIDIFFERENCES IN SEVERAL PRODUCT PRICE SERIES; CANADIAN MINUS USGC AND CALIFORNIA REFINERY GATE PRICES; 1993; CANADIAN CENTS PER LITRE

	JOBBER-USGC	JOBBER-CAL	TANK-USGC	TANK-CAL	RACK-USGC	RACK-CAL
Prem unleaded gasoline	5.68	2.67	12.39	9.38	5.36	2.36
Mid-grade unleaded gasoline	3.85	1.21	9.88	7.24	4.36	1.72
Regular unleaded gasoline	2.01	-0.63	7.41	4.77	2.76	0.12
Jet/Kerosene	4.11	1.93	10.22	8.05	4.05	1.88
Diesel/#2 fuel oil	2.32	-0.53	4.52	1.67	3.38	0.52

In fact, Canadian refiners revenues per litre of output exceeded the same ratio for US refiners. In the important categories of gasoline sales however, Canadian refiners' revenues at jobber prices are just modestly higher than those at the USGC and for regular gasoline were lower in 1993 than in California. Canadian refiners in 1993 sold regular unleaded gasoline to jobbers at an average price of 2 cents more per litre than the USGC refiners and about .6 cents lower than California refiners.

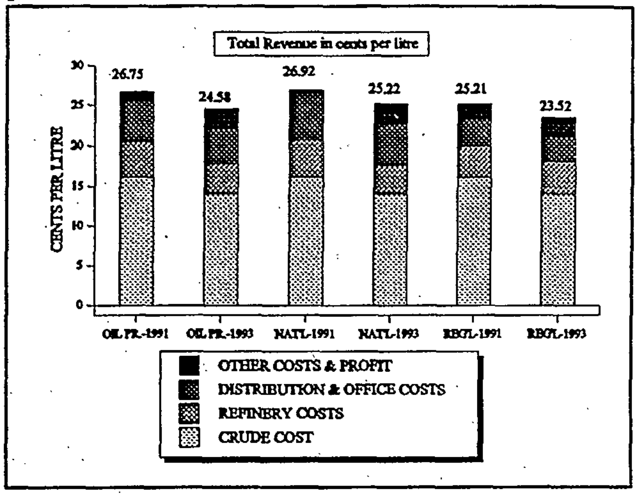
These higher revenues are related to the level of natural protection that Canadian refiners enjoy due to the cost of transporting refined products from US refinery centers to Canada. However, modestly higher revenues fail to compensate for the far higher costs Candian refiners incur as reported below.

4. Comparative refinery operating costs United States and Canada

To compare refinery costs in the two countries several components of refiners' costs need to be examined. Ideally one would compare the following measures: (1) variable, fixed and capital costs associated directly with the refining process, and (2) those operating costs associated with head office operations associated only with refinery operations and excluding all resources supporting wholesale and retail distribution costs. Ideally, one would remove from the data all marketing costs beyond the refinery gate and all retail costs incurred in the operation of service stations.

For the purpose of comparing US and Canadian refiners' performances, it is difficult to distinguish between these different levels of cost in the chain from crude acquisition to sales to end users because Canadian refiners typically sell far more at retail than do US refiners. Direct accounting cost comparisons of a US group of refiners with a Canadian group of refiners will be measuring the costs of two entities undertaking quite different activities.

Figure 7
Revenues and Components of Cost in cents per litre, 1991 and 1993



Canadian refiners' costs are distinguished in Figure 7 that also illustrates how revenues and cost categories varied from 1991 to 1993. Between those two years, national refiners reduced operating costs both at the refinery level and beyond the refinery. [23]
For 1993 we calculate refiners' operating (variable) costs to have been 3.76 cents per litre (3.62 cents per litre for national refiners and 3.99 for regional refiners).[24]

Appendix **A5** references a published source placing the operating cost of a USGC medium complexity refinery at C$3.73/bbl or equivalently 2.34 cents per litre.[25] Though not fully referenced, industry sources have confirmed that the figure seems to be an

---

[23] The data in Figure 7 is from the NRCan, Canadian Petroleum Industry, 1993Monitoring Report.

[24] Refinery operating costs are found by subtracting average refiners' crude oil acquisition costs per litre of refined product from the cost of goods sold per litre of output.

[25] In both the Canadian and USGC case operating costs <u>exclude</u> fixed costs and capital recovery. The Canadian numbers were calculated by us from the NRCan, Canadian Petroleum Industry, 1993 Monitoring Report by subtracting the refiners' crude acquisition costs from the Petroleum Monitoring Report's figures for Costs of Goods Sold. Therefore both the Canadian and the USGC figures are for product that is sold at wholesale at the refinery gate. Canadian calculations use an average refinery cost of crude across the country and that crude cost is for product purchased two months earlier than for output sales. Moreover, the calculation is made using annual average crude and output prices which was in turn calculated from monthly average prices.

accurate one and it is consistent with data from Purvin and Gertz. This comparison indicates that there is a 1.4 cent differential per litre between the most efficient US refineries and the average of Canadian refineries. The Canadian refinery cost per unit output is therefore 50% higher than the same measure of cost derived from a medium complexity USGC refinery.

The operating cost per litre is a narrow measure of refinery efficiency because one refinery may produce a quite different mix of outputs. For example, a litre of aviation fuel is typically worth more than five times a litre of heavy bunker fuel. A more accurate indicator of refinery performance is the operating cost per dollar sales realization instead of per litre of production.

Table IVOIL PRODUCTS; CANADIAN REFINERS; COSTS PER DOLLAR SALES REALIZATION; 1986-1993

	AVERAGE CRUDE ACQUISITION COST (CENTS/LITRE)	REFINERY OPERATING COST (CENTS/LITRE)	OUTPUT (MILLIONS OF LITRES)	SALES REALIZATIONS (CENTS/LITRE)	REFINERY COSTS PER DOLLAR SALES REALIZATIONS
1986	15.39	4.37	79.90	25.76	17
1987	14.80	3.87	82.90	24.42	16
1988	12.63	3.34	85.50	22.40	15
1989	15.42	1.68	88.80	23.55	7
1990	15.43	5.00	87.30	27.73	18
1991	16.09	4.33	83.20	26.74	16
1992	14.30	4.19	83.80	24.70	17
1993	14.01	3.76	85.10	24.43	15

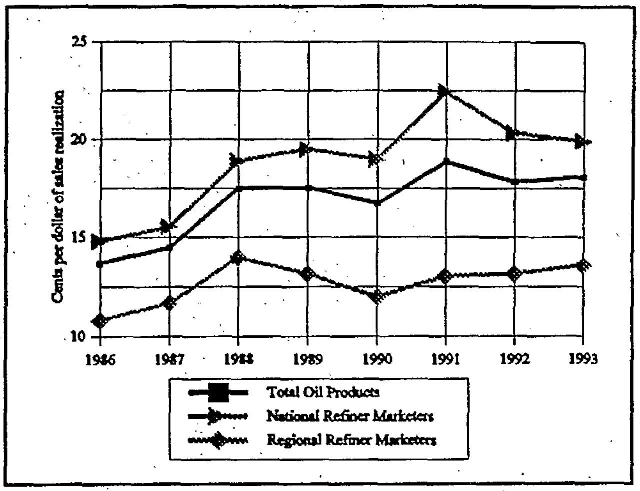
Notes: Calculated from data in The Petroleum Monitoring Report, several issues.

US operating costs per dollar sales realization are reported in Purvis and Gertz for USGC and California refineries using a variety of different refinery types and crude oils. In 1993 for crackers (but not cokers) that use light sweet crude (the typical feedstock used in Canada), the USGC ratio is 5.78%. The ratio is 7% for a cracker using sour light and 8.42% for a coker using sour light. Regardless of the refinery or the type of crude used the USGC ratio of operating costs to sales is well below the Canadian ratio for 1993 of 15% of total sales.[26] Moreover, as we point out below, the Canadian cost performance in 1993 was appreciably better than in several previous years.

Canadian refiners collectively reduced refinery costs per litre output from the high point of 5 cents in 1990 to 3.76 cents per litre in1993.

Moreover, cost reduction continued in 1994. Though the financial data is not yet available, employment levels in refineries fell from 13,000 in 1993 to 11.9 thousand in 1994, based on average figures for the period to August, 1994.[27]

Figure 8
Non-refinery Operating Costs
(Distribution/Sales and Administration) per dollar of sales realizations; 1986-1993



Refinery operating costs per unit output fell 27% over four years, a reduction at a constant level of output of $1.2 billion.[28]

---

[26] The difference between the two ratios can in part be explained by the different ways the operating cost ratios are calculated. The USGC operating cost ratio uses in the denominator the value of sales at the wholesale price of each of the refined products sold. The Canadian ratio calculated on that basis is 23%(4.4/19.19). The marketing margin earned by Canadian refiners averaged 5 cents per litre over total production (sales at wholesale, at dealer tankwagon and at retail). The 5 cent figure is the difference between the value of sales per litre at jobber prices (19.19 cents per litre) and the value of total refiner sales realizations from sales at retail and wholesale (24.2 cents per litre). Marketing costs probably exceeded marketing revenues because of the continued decline in the number of service stations and the major-refiners announced intention to close many more stations over the next several years, so that it is not possible to accurately calculate the refinery operating costs net of marketing costs.

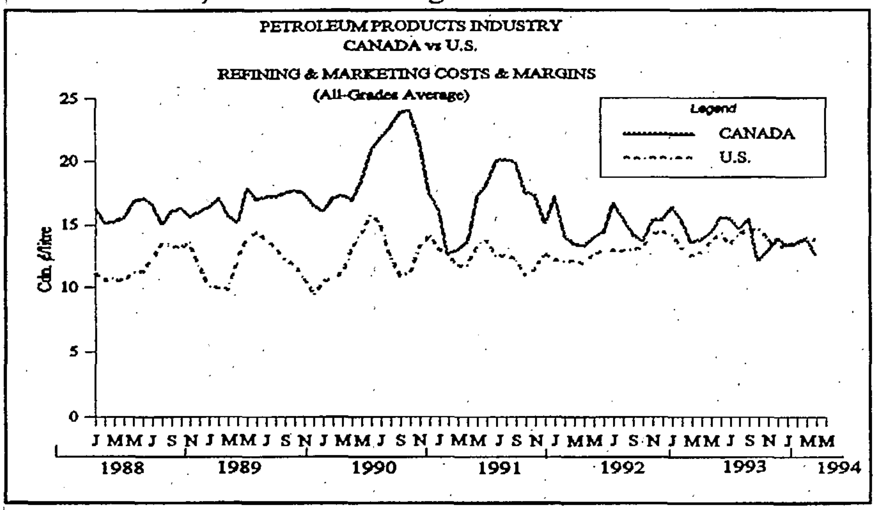
[27] Buchanan, Bob (December, 1994), Report on Employment in the Canadian Petroleum Industry, 1985-1994. Canadian Energy Research Institute, for the Petroleum Communication Foundation, December, 1994.

[28] Op. cit. Natural Resources Canada, Canadian Petroleum Industry, 1992 and 1993 Monitoring Reports, Annual. Table B1.

National refiners managed to reduce operating costs by 33% and regional refiners by 16%. Both the national and regional refiners also succeeded in reducing office, distribution and marketing costs. Those costs had skyrocketed over the decade to 1991 before turning down. In two years, 1992 and 1993, national refiners succeeded in reducing non-refinery costs per unit of refined product produced by about 17% from 6 to 5 cents per litre. The improved performance measured per unit of output is dramatic. That same performance when measured per unit sales realization is more modest. For all Oil Products the drop was just 4%, and for the national refiners the drop was just over 11%. The poorer performance measured from sales realization data reflects the lower prices for refined petroleum products.

Natural Resources Canada (NRCan) publishes series for Canada and the US that combine refining, marketing and retail costs (see Figure 9). The NRCan series is calculated from price data and not

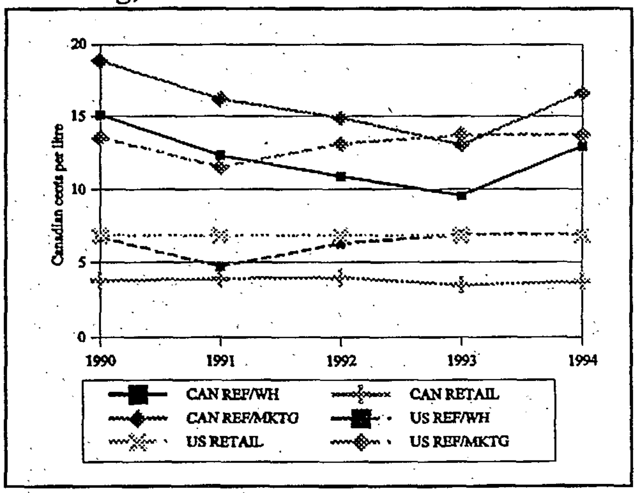
Figure 9
Refining and Marketing Costs and Margins
Canada and US; All-Grade Average



from accounting data. The margin calculated from price data can be interpreted as a reliable proxy for costs when both groups of refiners are earning standard rates of return. According to those series, Canadian refiners operating costs, as proxied by the margin data, have traditionally exceeded US levels by about 5 cents per litre. Recently however, that differential has vanished.[29] That drop may in part reflect improving profits for Canadian refiners and a shift from reasonable to depressed profits for US refiners (See **Figure 6**, page 24 above).

The NRCan series shown in Figure 9 is the difference between the average price of a litre of gasoline (average of all grades) sold at retail minus the average cost of crude oil acquistion. This series does not reflect the impact on the refiners revenues of variations in the prices of non gasoline sales. In 1993, gasoline's share of refined products sold was 40% and 49% in Canada and the US respectively. The direct measure of the respective US and Canadian refinery industry's operating costs per dollar sales realizations is therefore a far more useful measure of refinery performance than the NRCan margin.

Figure 10: Canadian-US Margins - Refining/ Marketing; Refining/Wholesaling and Retailing; 1990-1994



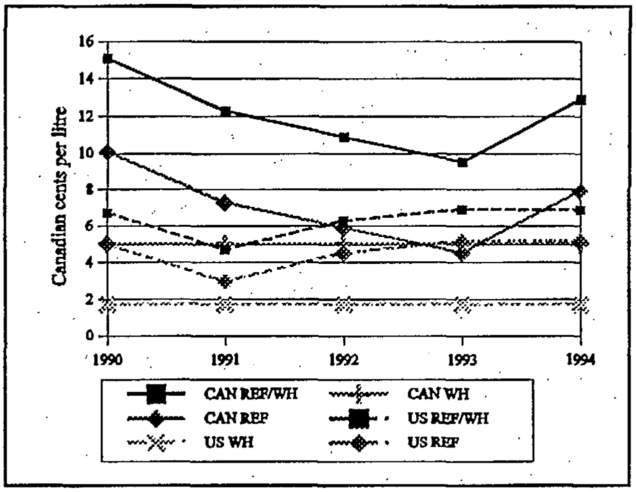
Until direct cost comparisons are available, however it is useful to estimate a comparative refinery margin from available public data. For the US, starting with the NRCan refinery-marketing margin figure we can subtract the average US retail service station margin reported to be 6.8 cents Canadian per litre and the US wholesale margin estimated to

[29] For several reasons, the US and Canadian NRCan series are unlikely to represent a valid relationship between refinery/marketing efficiencies in the two countries. First, the NRCan series is not a direct measure of refining and marketing costs. The measure is found by first subtracting crude acquisition costs per litre of output from a series of ex-tax retail pump prices for gasoline (all-grade average in each country). Next a cost of retailing that is collected from refiner/marketers using a survey instrument is subtracted. The resulting series is called the refinery /marketing margin. That margin ought to reflect sales of other refined products and differences in the mix of clean and heavy products. Finally, revenues per unit output may not identically reflect average costs in the two countries.

be 1.72 cents Canadian per litre. Similarly for Canada, we can subtract the retail margin reported by NRCan and the estimated wholesale price of 5 cents per litre. The estimated wholesale margin for gasoline in both countries is found by subtracting the difference between the rack (jobber) price and the dealer-tank wagon price.[30]

That analysis as shown in Figures 10 & 11 indicates that Canadian refining margins for gasoline have exceeded US margins for gasoline in each year except 1993. However, that comparison fails to adjust for differences between the two countries in the value of non-gasoline sales from the barrel of crude oil refined. That amount should be larger in Canada than in the US because in Canada gasoline's share of refined product sales, as reported above for 1993 was just 40% compared to a US ratio of 49%.

Figure 11: Gasoline Refining Margins; Canada and the United States; 1990-1994



5. Performance summary

Since 1990-91, Canadian refiners have collectively reduced their measured refinery operating costs and their distribution/office operating costs, both when measured per unit of output and per unit of sales. Consequently their profits improved dramatically from 1993 after a disastrous year in 1991 and a modest improvement in 1992. That profit improvement took place despite a greater fall in refiners' sales realizations than in their crude

[30] Canadian rack prices are not pure refinery gate prices. The average jobber price over 1993 from the NRCan Canadian Petroleum Industry, 1993 Monitoring Report is about 75 cents per gallon of regular gasoline lower than the average rack price in Sarnia. The Sarnia rack price is in turn lower than the rack price elsewhere in eastern Canada.

acquisition costs. Profits in 1994 are estimated will fall in the range of 8-10 percent on capital employed (The return for the first half of the year is 7.5%).[31]

The rise in Canadian refiners' profits in 1993 and 1994 was achieved entirely by reducing operating costs and improving refinery utilization. Consumer prices not only fell, those prices fell somewhat faster than crude oil prices. In short, despite poor refiner profits competition forced a share of that improvement to be passed through to consumers. That consumers paid less is confirmed by noting that refiners' sales realizations (net of excise taxes) fell more than crude oil prices .

Canadian refiners in 1993 earned at jobber prices in the important gasoline business about 1 cent per litre more than USGC refiners, and revenues per litre of gasoline were a bit lower than the average prices of sales by the California refiners. At the same time, the margin between crude acquisition costs and refinery gate sales for US refineries between 1990 and July 1994 averaged 4.57 cents Canadian per litre compared to Canadian refiner's margins of 7.14 cents per litre. However, a more accurate comparison would add to these margins the refinery gate revenues to be earned from other products produced from the barrel of crude oil. That amount should be higher for Canadian refiners because a larger share of refined product sales are other than gasoline.

At the same time, Canadian refiners also operated in 1993 with costs more than 1.4 cent per litre above the average of a medium complexity USGC refiners' costs. A 1.4 cent per litre premium is a large cost disadvantage and is just under 50% of the US level of costs. It is possible that fixed and capital charges may be higher for higher complexity US refiners which might explain part of the cost differential.

The refinery gate costs per unit sales realization better measures refinery efficiency than the refinery costs per unit output. Canadian refinery costs per dollar of sales in 1993 was 15 cents; national refiners and regional refiners operated with refinery costs of respectively 14 cents and 17 cents per dollar sales. USGC refinery variable operating costs per dollar sales realizations ranged from 6 to 8 cents depending on the type of crude used. Canadian refiners

[31] Natural Resources Canada, Canadian Petroleum Industry, 1994 Monitoring Report, First Six Months.

costs per dollar sales realization measured at jobber prices were far higher at about 23 cents per dollar sales. Therefore the Canadian refiners appear far less efficient than the best performing refineries in the United States. The Canadian refiners seem to be operating at a disadvantage of about 15 cents per dollar of sales (23-8). That cost difference partly reflects the larger share of the heavy end of the barrel in Canada that is sold rather than processed into lighter products.

However, it is important to again recall that the extra costs US refiners incur to service their investments in complexity are not recorded in this work. Higher complexity may improve performance measured by variable costs per dollar sales by lowering the average cost of feedstocks and increasing the value of sales realizations, (though variable costs per unit output may increase) but it also generates higher fixed costs, capital charges and depreciation. The latter costs may offset the variable refinery operating costs compared in this paragraph and reduce the apparent economic disadvantage of Canadian refiners. Indeed, regardless of the comparative data used, the Canadian refiners seem to be selling refined products at prices that generate slightly higher revenues that fail to compensate them for their higher operating costs. Therefore, if Canadian refiners are equally as profitable as their US counterparts it must be that capital and carrying costs are considerably higher in the US than in Canada. Throughout the eighties and to 1991, US profitability was far higher than the Canadian rates but that situation has reversed itself in the past several years.

Because Canadian refiners make a large share of their sales at tankwagon and retail prices and not at jobber prices, the poor profitability of refiners may also be due to high distribution costs that cannot be fully recovered from higher prices. Distribution costs of gasoline at wholesale measured by the difference between rack prices and dealer tank-wagon prices does indicate that the Canadian wholesale margin is about 5 cents per litre compared to just 1.72 cents in the US. By contrast, the retail margin is reported by others to average 6.8 cents per litre in the US and about 3 cents per litre in Canada.

It is impossible to be definitive on the profitability of distribution of gasoline and refined oil products generally because there is no direct data in the public domain that separates wholesale and retail distribution costs from the refiner-marketers total downstream expenses. There is therefore no means from public data for determining the expense of wholesale distribution costs compared to revenues.

It can be inferred that on average retailing costs exceed revenues when costs are defined to include a standard return on capital employed. The inference follows from the observation that service stations are being closed which is usually an indication that the typical station is earning a sub-standard rate of return. There is no similar means of interpreting the difference between US and Canadian wholesale costs. The latter may be higher because supplies are shipped to comparatively more service stations than in the US and those stations are dispersed thinly at greater distances from refining centres.

Despite improvements in 1992 and 1993, those post refinery gate costs rose by 50% between 1985 and 1991 from 15 to 22 cents per dollar of sales for national refiner-marketers and from 14 to 19 cents per dollar of sales for the oil products group.

In summary, at the refinery stage, Canadian refiners appear to be significantly less efficient than their US counterparts, but that conclusion may need to be modified after a detailed study is made of the comparative capital carrying costs of US and Canadian refiners. Canadian refiners operate with about a 2 to 3 cent per litre larger margin between crude costs and refinery gate sales for gasoline than does their typical US counterpart. However, that differential at best offsets the additional refinery cost of about 1.4 cents per litre over all products and the still larger differential of between 15 and 23 cents per dollar sales realization.

The margin between the jobber price and the tankwagon price is a measure of the revenues available at the wholesale stage of the industry. Canadian wholesale costs are about 5 cents compared to 1.72 cents per litre of gasoline. Revenues may be higher to cover the additional cost of supplying the Canadian as compared to the more compact US service station network, and that Canadian refineries absorb greater costs when supplying at the rack.

Retail margins in the US are about twice as high as those reported in Canada. Since a typical US station pumps twice the amount of a Canadian station, one would have anticipated that the margin would be higher in Canada than in the United States. One cannot isolate cost differentials from these observatiosn because the Canadian service station continues to be in decline whereas the US industry is stable

IV. FACTORS AFFECTING REFINERY PROFITABILITY

The combination of poor profitability and apparently high operating costs documented in the previous section suggests that at least to 1993 Canadian refiners were seriously ill-equipped to compete with the US industry. That is certainly the implication of the Purvin and Gertz study in Appendix A7. In that study and elsewhere Canadian refiners have been unfavourably compared with US refiners in respect to (1) crude oil acquisition costs, (2) operating costs, (3) utilization rates, (4) refinery scale, (5) complexity and (6) distribution costs. Operating cost differences were presented above and are considered indirectly through a review of revenue margins in Appendix A5. Each of the other five factors is reviewed below.

1. Crude oil acquisition costs

Purvin and Gertz Inc. writes that

> "The Canadian refining sector has slightly higher operating costs than the current U.S. industry. This is attributed to slightly higher labour and maintenance costs, some of which is weather related. The disadvantage is minor compared to the impacts of crude oil costs and wholesale prices. (Page II-3)"

Refiners average crude oil acquisition costs will differ for two reasons. First, the location of the refinery and the associated transportation facilities (marine and pipeline) will affect delivery costs to the refinery. Second, the refinery's technical structure and the mix of local product demand will affect the range of types of crude oil that will be best suited for use in that refinery. As a result, price variations across the range of crude oil types will affect the refiner's acquistion costs.

Some studies report that the average cost to US refiners of crude oil is lower than Canadian refiners' costs, reflecting both transportation advantages to US refiners and a higher share of heavy crude oil in the US mix. 1993 data on refiner crude costs fails to confirm that observation.

Table V below indicates that Canadian refiners have not been penalized by crude acquisition costs for light sweet crudes, and therefore have not suffered from a location disadvantage. In particular, Ontario refiners enjoy roughly the same acquisition costs as Gulf Coast refiners for light sweet crudes. This is unusual since Alberta light crude oil sells in the Chicago area to meet competition from crude oil shipped to the area from the US Gulf Coast. Alberta crude oils therefore are typically priced in Chicago at a premiuum over the Gulf Coast price to allow for the transportation charge from the US Gulf Coast to the Chicago area. Evidently, crude oil sold in the Sarnia-Toronto area will typically be be priced slightly higher to allow for the additional cost of transporting crude oil from Chicago on to Sarnia-Toronto.

One reason for Canadian acquisition costs at Toronto having recently been advantageous compared to Chicago and the Gulf Coast is that light crude from Alberta was unable because of bottlenecks in the pipeline to reach Chicago in the volumes the market was willing to buy. It is expected that the bottleneck in the pipeline moving crude to Chicago will soon be eliminated through a 170,000 b/d capacity expansion and Ontario prices should move up to the traditional premium over the Chicago price.

Chicago is reached by pipeline from the Gulf Coast and Alberta. If light oil is expensive in Chicago, the economics of reversing the existing pipeline between Montreal and Sarnia will shift in favour of proceeding with that project. At a modest cost, Ontario can be supplied by off shore light oils, and displaced Alberta light oil can be redirected to Chicago area refiners.

Table V
Crude Oil Prices by Type and Location in Canadian cents per litre

	ONTARIO AVERAGE	CHICAGO WTI SPOT SWEET	CHICAGO WTI SPOT SOUR	USGC LIGHT SWEET	USGC LIGHT SOUR	CALIF ANS (HEAVY)	CHICAGO HEAVY/SOUR BOW RIVER
1987	16.12	16.35	15.85	16.30	15.16	14.19	14.17
1988	12.53	12.70	11.84	12.53	11.01	10.42	10.03
1989	14.75	14.94	13.94	14.78	13.19	12.69	12.41
1990	18.28	18.30	17.01	18.27	16.18	15.69	14.38
1991	15.61	15.84	14.37	15.82	13.31	12.32	10.45
1992	15.78	16.04	14.93	15.89	13.90	13.22	11.91
1993	14.71	15.63	14.43	15.38	13.55	12.96	11.88

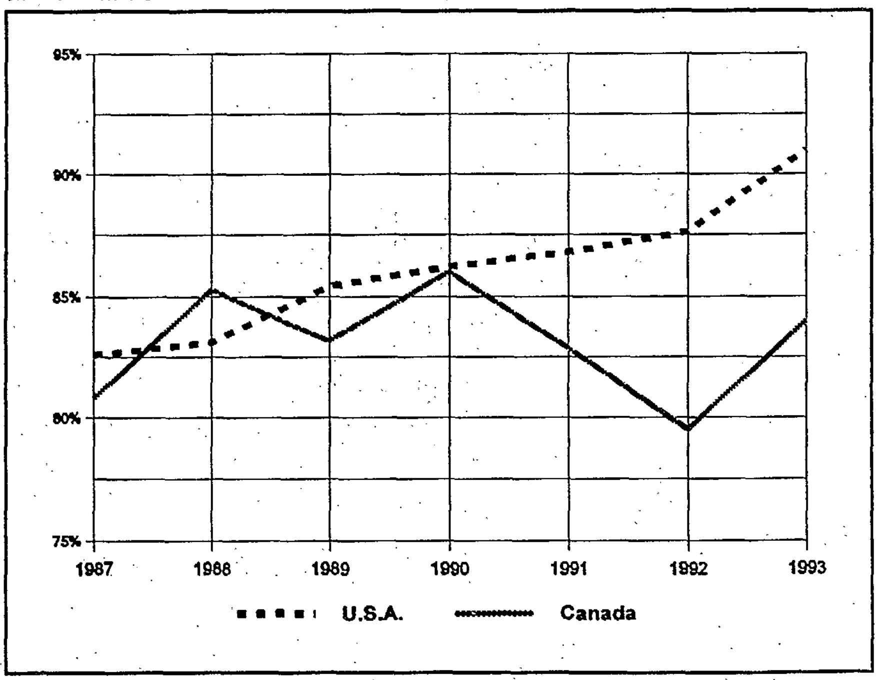
As shown in Table V, heavy oil prices rose after 1991 and light oil prices declined. California's heavy crude oil acquisitions are particularly low priced due to the restrictions on exports of Alaska North Slope crude oil.

In 1991, it appeared that heavy crude was falling in price relative to light crude to an extent that would justify investments in coking equipment. However, the price differential fell to 3.7 cents in 1993 and the "coking" decision became more questionable. Lower priced heavier crude oils do not necessarily advantage a refiner if his cost savings and increased sales realizations fail to generate sufficient extra revenues to compensate him for increased capital and operating costs.

2. Utilization rates

Canadian refinery performance is damaged by the refiners' recent

Figure 12
Refinery Utilization Rates %
1987 - 1992



inability to post high utilization rates. Appendix A8 and Figure 12 show that US utilization rates have exceeded Canadian rates by a significant amount between 1989 and 1992. For example, in 1992 the US utilization rate was 87.6% compared to a Canadian rate of 79.5%. Since refinery profitability is sensitive to utilization rates, the Canadian average cost of producing refined products appears to be higher than in the US, even if the marginal opportunity cost of increasing production may be the same. This conclusion may however be too strong. Utilization rates may be higher for several Canadian refiners and the average may be driven down by the method of reporting utilization for the Come By Chance and Irving refineries. [32]

Moreover, in 1993, Canadian refineries have been able to achieve higher utilization rates largely by closing smaller refineries. The Canadian refiner disadvantage may therefore be declining. Shell, Petro Canada and Imperial Oil's closures of inefficient and smaller refineries in the Vancouver area have contributed to improving the rate of utilization. Imperial and Petro-Canada are shipping product to Vancouver from their Edmonton area refineries through the Trans-Mountain Pipeline that was formerly used to ship crude oil. That realignment allows the large and efficient refineries in Edmonton to substantially increase their operating rates and lower their average cost of production. Elsewhere in Canada demand for refined petroleum products is increasing as the economy recovers from the recession.

3. Refinery size

The Restrictive Trade Practices Commission observed that rationalization of the refinery network was in the interests of an efficient petroleum refining and distribution industry, as follows:

> "The magnitude of investment required for refineries, for large terminals and for pipelines is such that, when taken with Canada's small geographically dispersed population, only a few such facilities are possible if reasonable economies of scale are to be achieved (p.447). . . . This

---

[32] The reported utilization measure may misrepresent the status of most refineries in Canada. It is often reported that the Come by Chance and Irving refineries typically operate below capacity for technical as well as market reasons. The picture may be quite different if one compares the remaining refineries across the country.

> is obviously not in the public interest, for example, for consumers to have to support the enormous multiple facilities and surplus capacity that would be necessary to reduce existing market power of refiners in that way (p. 448)." [33]

In the Director's Notice of Application to the Competition Tribunal in the matter of Imperial's acquisition of Texaco, the Director noted that,

> "Economies of scale relative to market size play a significant role in limiting the number of players in the refining industry in all countries . . . The RTPC found that with known technology average costs of production reach a minimum at 200,000 b/d (31,800 cu. metres per day) (Appendix 2, page 13)." [34]

Eight 200,000 b/d sized refineries could therefore in principle meet all of Canada's demand for refined petroleum products. In fact, despite the closing of six refineries over the past several years, there are still 24 operating Canadian refineries. Of those 24 refiners, two large refiners are committed largely to exports, 8 are very small refineries, and just 15 significant refineries focus on serving the Canadian domestic market. Since in the early 1980s, some relatively new refineries were built in the size range of 60,000 to 120,000 b/d, the gain from economies of scale for refineries larger than 60,000 b/d must be modest and insufficient to overcome other reasons that recommend building a smaller refinery.[35] Larger refineries lose their advantage as their utilization rate falls.

There is a possibility however that there is a strong correlation between the complexity level of a refinery and the scale of the

---

[33] Restrictive Trade Practices Commission. Competition in the Canadian Petroleum Industry. 1986. (Ottawa: Minister of Supply and Services Canada).

[34] The Director of Investigation and Research, Notice of Application, between the Director and Imperial Oil Limited, Competition Tribunal-89/3, June 29, 1989.

[35] Canadian Petroleum Products Industry Task Force on the Petroleum Products Industry. August 1993. Report of the Working Group on Competitiveness Issues. Page 8. Industry sources advise that cost minimization from scale economies is offset by unusual factors like the feedstock supply, petro-chemical demand and local market size. IN general, economies of scale remain significant well above 100,000 b/d and the return to larger scale increases with the level of refinery complexity and the greater the environmental requirements of the refinery.

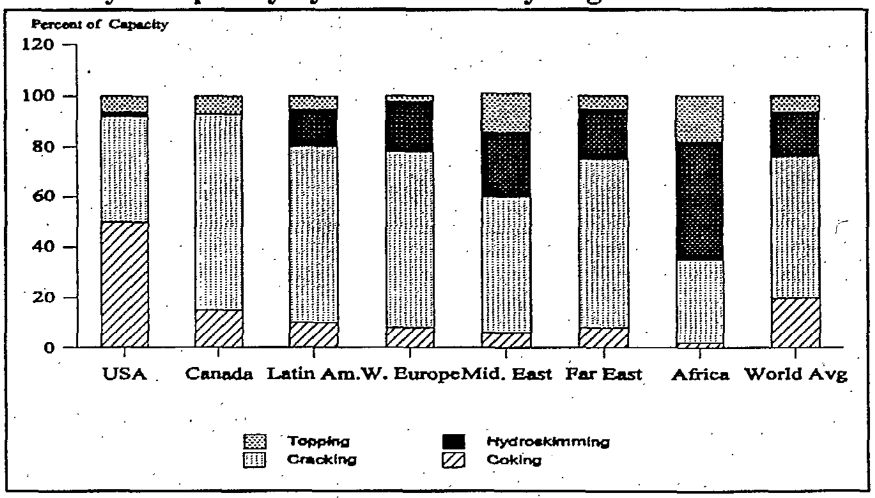
refinery. If true, as the economics in Canada favours more complex refineries, large refineries will expand and add complexity and some smaller refineries will not be worth upgrading.

4. Refinery complexity

As discussed above, refineries differ by degree of complexity. The optimal degree of complexity is related to the relative prices of heavier and lighter crude oils, sulphur content, the relative prices of light and heavy-end refined petroleum products, local market demand for several refined products which will affect sales realizations by minimizing transportation costs and finally, the cost of capital. Complexity is expensive and raises the refiner's fixed costs. The return on investment comes from two choices, or any intermediate combination of those two choices. One choice is to increase sales realizations based on a larger volume of more valuable light end products, and the other is to reduce acquisition costs by acquiring lower priced heavier crudes while retaining a stable output mix.

Complexity is measured over several dimensions, but a simplified scale allows for comparisons among refinery industries in different countries. Refineries are characterised on the simplified scale from least to highest complexity depending on whether they are topping, hydroskimming, cracking and coking.

Figure 13
Refinery Complexity by Process and by Region



Canadian refineries are typically in the low complexity range compared to US refineries (though far more complex than most other refinery centres) because of the past availability of light crudes at attractive prices (partly due to past regulations favouring the use of Candian crudes), and the past demand by Canadian resource based industries for the low-end of refined petroleum products. As shown in Figure 13, most Canadian refiners have considerable cracking capacity. Few Canadian refiners operate cokers. It has been predicted for some time that relative prices would move in favour of refineries using heavier crude oils. But supplies of light oil have continued to be plentiful and after rising for several years to a peak in 1991, heavy oil prices have since increased and light oil prices decreased.

The CPPI paper (Appendix A8) distinguishes for different degrees of complexity the net profit margin before charges for the cost of capital and taxes. Those profit margins are 0.39, 3.00 and 6.41 dollars per barrel for low, medium and high complexity levels.[36] Petroleum industry sources advise that adding a coker to an existing 100,000 barrel per day refinery would cost between 600 and 900 million dollars. At that level of cost, using typical assumptions, the heavy crude option is calculated to become profitable when the added revenues over twenty years are in the range of $3.75 (2.6 cents per litre) and $5.15 (3.24 cents per litre) Canadian per barrel.[37] Those revenues may be from lower average crude acquisition costs, higher sales realizations or both. These figures probably understate the high revenues required to become profitable because there is no allowance in the figures for the higher operating costs associated with a more complex refinery.

The Canadian refinery industry may therefore be forced to consider new investments to upgrade the level of complexity to use lower cost crude oils and to increase the higher valued share of refinery production, but that decision depends on the anticipation that both the crude acquisition cost will fall and the sales realizations will rise. In comparison, United States refineries have already committed to

[36] Op .cit CPPI Report. Table 1, page 7.

[37] The assumptions are: an 18% (before tax) hurdle rate, an 85% utilization rate for 350 days per year, a twenty year life for the refinery depreciated at a rate of 5% per year, and a 100,000 barrel per day refinery.

complexity on a massive scale.

Purvin and Gertz shows that coking is a good investment in California where heavier crudes are typically available. A coker generates an extra net return of US $7.35 (6 cents Canadian per litre) per barrel of heavy crude oil as compared with the returns from a hydroskimming refinery. The coker generates an extra US $4 (3.25 cents Canadian per litre) per barrel compared to a refinery cracking heavy crude oil.

A serious concern yet to be addressed is how new investments for complexity will affect the scale and nature of existing refineries. Will it be less expensive per unit of processing capacity to add sophisticated equipment to ever larger refineries, or will smaller refineries be in a position to keep pace? There are some indications that refinery complexity is positively correlated with refinery size. If that positive relationship also applies for environmental investments, the viability of smaller and medium sized refineries (most Canadian refineries) may be threatened.

5. Distribution costs - service stations

There is'nt always a direct correlation between the profitability of distribution and retail services in Canada and the opportunities for Canadian refineries. As long as imported refined product must market through the same distribution system as do the domestic refiners the two groups of refiners face equivalent distribution costs. The survival of domestic refining therefore is affected primarily by the ability of the refiners to be profitable with sales at the refinery gate regardless of the level of profitability of the downstream distribution network.

However, refiners like all manufacturers are concerned to reduce the costs of distribution of their products to end users for a specific level of quality offered.

The lesson typically taken away from a comparison of Canadian-US service station performances is that there is a lot of cost in the Canadian retailing network yet to be eliminated. Those reduced costs should assist the refiner-marketers bottom line. However, refiner-marketers have a less immediate concern than would a typical manufacturer about reducing distribution costs and associated distribution margins because lower retail costs will not appreciably affect gasoline sales in the short run. Even an extreme reduction in the cost of retail and wholesale marketing will have a modest impact on the relative price to the consumer because of already high consumption taxes. Moreoever, gasoline demand is highly inelastic in the short run.

Given the intense nature of competition in marketing, the refiner-marketers may enjoy a temporary improvement to their bottom line as retail networks are rationalized and upgraded. In the longer run however, lower costs will be passed on to consumers and the impact on the refiner-marketers bottom line will be small. The benefit of greater profitability at retail will accrue to those marketers who build market share while reducing costs, regardless of whether that firm is an integrated refiner or an independent jobber. A refiner-marketer will be motivated to protect their investments in the existing refinery system, so that if its service station network proves to be a drag on profits the refiner will shift gasoline sales from its own network to the more efficient distribution channels.

Like other costs, any unnecessary distribution costs increases the price to the consumer without adding to the manufacturer's profit line.[38] The refiner, like any other manufacturer, has every incentive to assure that distribution costs are minimized for the level of service offered whether that distribution is handled in-house (vertical integration) or through independently owned dealer-retailers (vertical restraints) or independent (unrestrained) jobbers. When the retailer (manufacturer) is a price-taker at the retail or wholesale level because of potential imports however, he absorbs any extra distribution costs. That cost accrues to the refiner whether or not he sells through a marketing channel that is vertically integrated (owned and operated), vertically restrained (owned and leased or independent dealers) or independent (jobbers). Again, as in the case of a general manufacturer, the refiner has every reason to avoid wasteful distribution expenses.

Vertical integration is common in petroleum refining and both in Canada and the United States most refiners build retail networks in addition to selling product at wholesale. The degree of vertical integration varies. Dealers are typical in rural areas and company owned and operated stations competing with independently owned

---

[38] The extra cost may be absorbed by the manufacturer if the manufacturer is a price taker.

and operated stations are common in urban areas.

The service station business has adapted to the changed nature of the automobile fleet. In the past, service stations cross merchandised gasoline sales with automobile parts and service. For two decades, the repair business has been in decline because cars need less maintenance and more maintenance is done at the automobile dealers or at specialized service bays at firms like Canadian Tire, or muffler and lube shops. Consequently, gasoline sales are now increasingly cross-merchandised with convenience stores that are particularly suited for combination with a self-serve gasoline outlet.

The process of adjustment to self-serves and cross-merchandising with food and convenience has been underway for some time, but it appears that the adjustment reached equilibrium in the US in 1987. Since 1987, sales per outlet and the volume of outlets is reported by a major US consulting-research firm to have remained stable.

In contrast to the US, in Canada, station numbers continue to drop. The number of Canadian service stations fell from 24,000 in 1980 to 18,800 in 1992, and to below 17,000 in September, 1994. It is likely to continue to fall rapidly over the next several years. For example,

> "During the first half of 1992, three major Canadian refiner/marketers announced the closures of 6 refineries, 18% of Canadian 1991 refining capacity, and about 3,000 retail outlets, 16% of all Canadian retail outlets. (emphasis added)"[39]

That drop in service station numbers is slowed by liability for environmental clean-up and an industry or government program may assist in mitigating that barrier to exiting an over-supplied industry.

Retailing petroleum products - mainly gasoline through service stations - is intensely competitive and it is easy to enter and exit, except that stations are kept in operation when they would otherwise be closed in order to avoid the environmental clean-up

---

[39] NRCan. Canadian Oil Markets and Emergency Planning Division, Oil and Gas Branch, 1993 Statistical Summary of the Petroleum Products Marketing Report, Statistical Summary, 1993, page 4.

when the sale is for other than a service station use. This barrier to exit from the service station business is a growing social problem for owner-dealers and independents. Many operators continue in business despite poor earnings because they cannot sell their site for alternative uses. Increased efficiency in retailing gasoline may require social intervention to spread the liability for station site clean up to the taxpayer or the motorist.

Until 1973 it was often argued that refiner-marketers cross-subsidized downstream operations from upstream profits, and the retail sector was therefore overextended. Regardless of whether in fact refiner-marketers subsidized downstream service station networks, today, all refiner-marketers seek to make the dowstream a profit centre. Therefore, the retail sector today is highly competitve and must be deemed efficient or be moving in the direction of efficiency, subject only to the anti-competitive impacts of the legal context in which stations operate. That context included until recently regulations in Atlantic Canada (recently discontinued in Nova Scotia and being maintained only in Prince Edward Island) that allowed the marginally profitable station to operate with low throughput and also limited the number of stations that might be converted to self-serve outlets, therefore forcing the sector to operate with higher costs and higher gross retail margins than elsewhere in Canada.[40] Elsewhere in Canada, the barrier to exit from service stations and therefore to rationalizing that segment of the industry is the liability for service station clean-up.

Independents have maintained significant shares of the markets (about 20% across the country and about 30% in several major cities) and refiner-marketers have been downsizing their own company-owned station networks, except for certain high volume urban outlets.

Service station throughput varies across Canada and is higher in urban areas and more urbanized provinces than in rural areas. The important observation however is that the average US service station pumps more than twice the volume of gasoline (NRCan

---

[40] Service stations are free to exit, but the impact of regulations is to allow service stations with low throughputs to remain profitable and therefore to remove the motive for the service station owner to exit the industry. The result is that after the unprofitable stations are removed, the remaining marginal station is breaking even and all infra-marginal stations are earning at least a break even return. The average remaining station operates with a lower throughput than in the absence of regulations.

estimates 10,000 litres per day are sold in a typical US service station but other estimates are lower).[41] The lower Canadian throughput per station often is given as a major reason for concluding that the Canadian gasoline distribution business is inefficient and that rationalization will continue rapidly.

In the US, between 1977 and 1987, a typical service station's sales rose by 10 thousand gallons per month to a level of 60 thousand gallons per month. After 1987, volumes stabilized and there has been little change between 1987 and 1993. Because of several factors that reduced retail costs, from 1977 to 1992, US retail marketing margins (between pump price and dealer tankwagon price) fell by 16 cents per gallon.[42] Of that amount, the increased throughput per station explains 6 cents per gallon (From 1970 to 1992, the margin fell from 45 cents per gallon to 20 cents per gallon in 1993 US dollars. That drop is about 15.5 cents 1993 Canadian per litre). The remaining drop is reported to be partly from a massive shift to self serves, accounting for about 5 cents per gallon and the remainder from more and more effective cross merchandising.

A margin of 20 cents per gallon is equivalent to 6.8 cents per litre in Canadian funds.[43] A margin of 6.8 cents per litre at retail is much higher than the margin reported in Canada by Natural Resources Canada. The latter margin varies between 3.5 and 4.5 cents per

---

[41] The Canadian market has been more seriously buffeted than the US market by the behaviour of motorists over the past decade. In the US, gasoline demand per vehicle fell from 640 to about 600 US gallons per year between 1983 and 1992. This was the result of fleet efficiency gains and a modest recovery during the eighties in the mileage per vehicle from the decline during the last half of the seventies. In the same period, Canadian consumption per vehicle fell far more from 625 to 520 gallons per vehicle. Fleet efficiency has increased from 12 mpg to 17 mpg in 1993, and the increase was still higher in Canada.

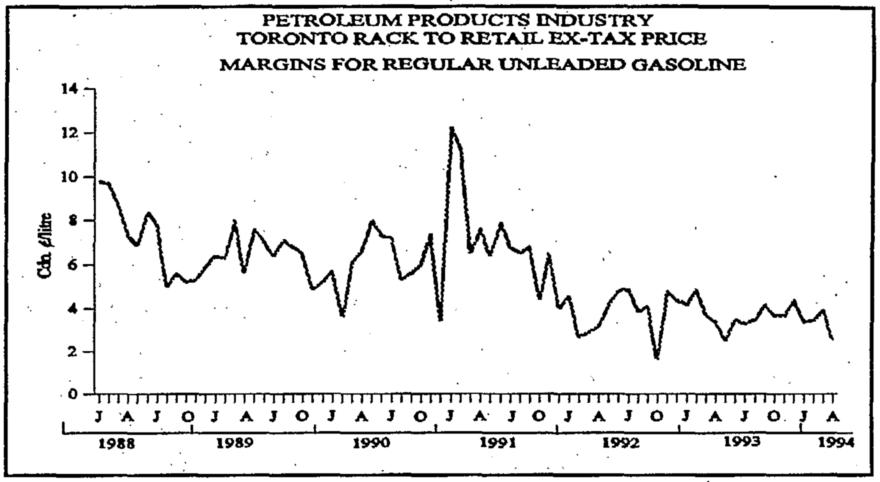
The annual rate of personal use vehicles from 1989 to 1992 declined at an average rate of 2.5% per year in Canada. For commercial use vehicles, the rate of decline averaged 3.2% per year. The drop in vehicle utilization rates that started in 1989 followed a rise in utilization rates during the prior economic recovery between 1982 and 1988. In Canada the annual rate of increase from 1982 to 1988 averaged 1.75% per year, and in the United States the utilization rate over the same six year period increased 1.14% per annum. Between 1982 and 1988, the average distance travelled by automobile in Canada and the United States increased 11% and 7%, respectively.

[42] Competition forces factors that reduce retail costs to result in lower revenue margins as each service station seeks to attract more custom by lowering retail prices until the revenue margin falls to the point that costs and a exit preventing rate of return is earned on the investment in the service station.

[43] The US margin is derived as the difference between a published series of tankwagon prices and average retail prices. Therefore the margin is the revenues earned by dealers, who in the US typically own their own stations.

litre, except in Northern Canada. The Canadian retail margin is especially low in Toronto as illustrated in Figure 14 for the difference between the rack price and the retail pump price.

Figure 14
Service Station Margin (Net of Tax) for a Jobber Purchasing at the Rack Price



The US retail margin reflects an equilibrium in the industry because service station numbers have been stable since 1988. The Canadian margin reflects a disequilibrium because service stations numbers continue to fall. In the US, station numbers and throughput levels after having dropped dramatically for over two decades have been stable since 1988. Service station operators appear to be earning a satisfactory return without attracting new entrants. That is what is meant by the term equilibrium. In these circumstances the retail margin is a good proxy for the cost of operating (including a standard rate of return on capital) a typical service station. In contrast, the number of Canadian stations is still declining, especially in urban areas of eastern Canada. The exiting of service stations indicates that retailers are failing to recover a standard rate of return. Therefore, the average Canadian retail margin will be lower than typical retail operating unit's costs and is therefore a poor proxy for unit retail costs.

If the US standard of profitability and performance of the service station network is to be reached, Canadian gasoline marketers will need to reduce unit retail costs or find it possible to raise pump prices in order to increase the retail margin by between 2.5 and 3 cents per litre. The US service station network operates on an average margin of 6.8 Canadian cents per litre and the Canadian system typically faces a margin between wholesale and retail prices of 3 to 4 cents per litre.

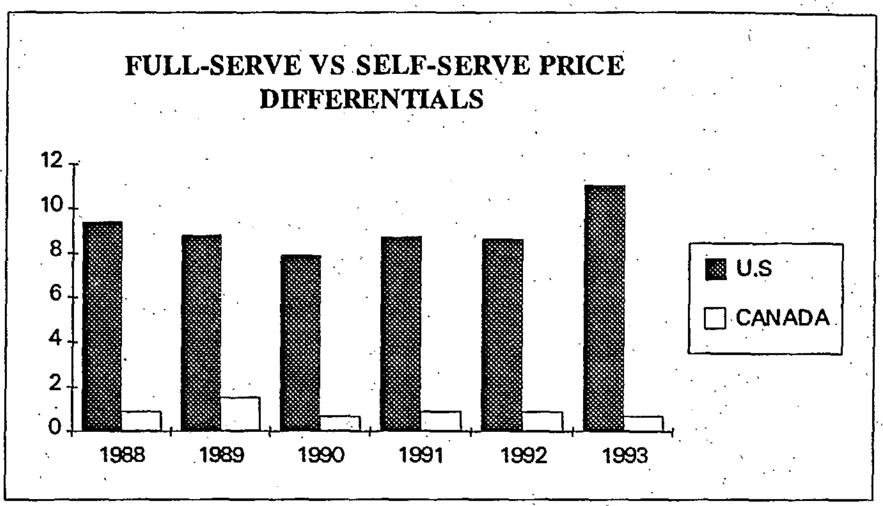
Part of the explanation for the higher US retail margin may arise because US demand is greater than Canadian demand for premium gasolines (and even more popular than in Quebec where the share of premium gasoline sold is far higher than elsewhere in Canada).[44]

Another factor may be that US marketers sell more product at full serve than Canadian retailers and the latter are unable to charge a similar premium (see Figure 15). Observing that these differences persist between the US and the Canadian retail gasoline systems is not an explanation of why Canadian adjustment has lagged the rate of change in the US. Moreover, there is every reason to believe that the average performance of the Canadian service station network fails to reflect the performance of the refiner-marketer owned and operated service station networks. The refiner-marketers stations typically are in urban areas, are self-serves, cross merchandise and have far higher througputs than the average of urban-rural service stations.

---

[44] In the US mid grade and premium unleaded sell about 32% of all gasolines. In Canada (1993) premium unleaded took just 16% and mid-grade unleaded took 7.56%. (SOURCE: Cansim Supply And Disposition As Reported By Canadian Refiners And Selected Major Distributors Of Motor Gasoline, Monthly, Cubic Metres). However, that share varies widely from a high in Quebec and British Columbia to a low level on the Prairies, with Atlantic and Ontario regions in between. In Canada, (1993) mid-grade gasoline sold at self serves exceeds the regular gasoline price (ex-tax) by between 1.3 cents (Charlottetown), 3.4 cents (Halifax, St John), 3.7 cents (Toronto) and 4.2 cents (Montreal). Premium gasoline sold at 2.4, 6.9, 7.4 and 7.7 cents more in each of the same cities. The higher US retail (service station) margin may be explained by several other differences in the two series. Most importantly, the US series is from a sample across the country which includes rural as well as urban stations. The Canadian series is for urban centres. The US margin is from data on an average service station and confounds self-serves with full serves and covers regular and premium gasolines. It is true that 75% of US service stations operate self serve pumps, but many US stations combine a self-serve with a full serve offering.

Figure 15
Full-Service vs Self-Service Price Differentials
Can. cents per litre



Canadian refiner-marketers sell just under 80% of their service station sales of gasoline (about 85% of gasoline sales - the rest is on farm or to fleets) through their own brand network. That network is divided into four general types of outlets - company owned and operated stations(28%); company owned commissioned dealers (16%); company owned and leased (lessee dealers) stations(12%); dealer owned branded stations(44%). Volumes sold by dealers is significant in rural areas, but company owned and operated stations though limited in numbers are the "large pumpers" in urban areas. In addition about 20% of the gasoline is sold to jobbers and independent service station operators including cross merchandisers like Canadian Tire and Sears.

In the US, gasoline is sold through between 155,000 and 200,000 outlets (American Petroleum Institute) depending on which source of information is used. Only 36% of US service station sales of gasoline compared to 80% in Canada is sold through the "direct" or "branded" network supplied by the top 14 major refiners. The bulk of sales is through thousands of jobbers and chain stores (according to the membership list of the Petroleum Marketers Association of America). However, many jobbers operate "branded" networks and pay a fee to the refiner for the use of the brand. Nevertheless, in the US, the difference between the retail price and the rack price covers far more actual transactions than does the same index in

Canada.

In consideration of these differences in retail networks, US - Canadian comparisons are often made of retail costs using Natural Resources Canada's combined refinery/marketing margin. The margin is calculated as a residual after subtracting crude costs and, taxes from the pump price. In Figure 10, page 33 above, the US retail margin of 6.8 cents is deducted from the refining - marketing margin to calculate a refining-wholesale margin. In 1993, the combined refinery-marketing margin per litre in Canadian funds for all grades of gasoline and at self-serve and full serve stations, was eliminated between Canada and the United States.[45] The traditional 5 cent difference disappeared as Canadian retail margins plummeted. For the first half of 1994, the Canadian margin has again returned to a level above the US level. More importantly, the refining-wholesale margins (found by subtracting the US and Canadian retail margins from the respective refining-marketing series in each country) are about twice as high in Canada than in the United States.

The Canadian refining-wholesaling margin varies between 3 cents and 9 cents per litre more than the similar US margin. A small part of that differential is from slightly lower crude acqusition costs in the US compared to Canada (between .3 cents and 1.4 cents per litre). Similarly, the sales realization based on the refinery gate in 1993 was about 1.3 cent based on USGC refinery gate prices but zero at California prices. The wholesale distribution (the difference between the jobber price and the dealer-tankwagon price) is a source of higher margins in Canada. In Canada, that differential for regular gasoline in 1993 was just over 5 cents per litre, and was somewhat higher for mid premium and premium gasolines. In the United States, the typical differential between the rack price (a jobber price) and the dealer tankwagon price for regular unleaded gasoline is typically about 5 cents per US gallon which is about 1.72 Canadian cents per litre at the 1993 exchange rate (1.3).[46] The difference between the Canadian and the US wholesale margin is therefore between 3 and 4 cents per litre.

---

[45] See Natural Resources Canada, Canadian Oil Markets and Emergency Planning Division, Oil and Gas Branch, 1993 Statistical Summary of the Petroleum Product Market Report, page 49.

[46] Sorensen, Philip E, et al. (April 1991) An Economi c Analysis of the Distributor-Dealer Wholesale Gasoline Price Inversionof 1990; The Effects of Different Contractual Relations. Unpublsihed manuscript.

That difference between the US and Canada may reflect greater distances over which gasoline is delivered from the refinery in Canada and the extra costs of distribution because products are delivered to relatively more stations. In short, higher wholesale distribution margins may be related to the lower throughputs and greater dispersion of the Canadian compared to the US service station network. The higher Canadian wholesale distribution margin probably reflects expenditures for the delivery of extra services, and fails to generate additional revenues to compensate the Canadian refiners for their higher refining costs.

These episodic comparisons of US and Canadian data may be misleading because refinery margins and retail margins vary significantly from region to region both in Canada and in the United States. A nation wide comparison may fail to capture regional differences. Unfortunately, the only regional data available is the margin for regular grade gasoline at self serve pumps in urban centres in Canada. Averaged (weighted by volumes) over 12 Canadian cities the combined refinery/marketing margin for 1993 was 9.6 cents per litre for refining and marketing and 13 cents per litre including also retail margins. More importantly, the combined refinery-marketing-retail margin for Toronto was 10.9 cents per litre and for Montreal was 12.2 cents per litre.

This brief review of the data underscores the market reality facing the Canadian refiners. Refiners can only recover in the marketplace the price allowed by the landed price of actual or potential imports in each region. Canadian refiners are price-takers, and there is no immediate short-term link between the refiners expenses and their revenues. US margins, because the service station industry is in equilibrium, reflects the full costs of retailing gasoline while Canadian margins, because the industry is still in the process of adjusting to a new equilibrium, seem to be between 2.5 and 3 cents per litre below the average level of marketing costs when the US margin is used as a measure of Canadian costs.

V. LONG TERM FUNDAMENTALS

Three threats or opportunities loom on the horizon of each Canadian refiner. One is the possible choice to shift from light to heavier crude oils should the premium price for light crude oil rise. If the premium for light oil should rise, Canadian refiners will be competing in product markets with US refiners that have already invested in the facilities to process heavier oils more cost effectively. Over the past decade, US refiners have invested far more than Canadian refiners to upgrade their refineries. Fortunately for Canadian refiners, the price premium paid for light oil that rose significantly in 1991 has since weakened. It is not apparent that the increased premium paid by refiners for light oils was sufficient to warrant heavy investment in additional complexity. In fact, that investment may in part explain the low profitability of US refiners over the past several years.

The second threat is that Canadian demand especially for gasoline will grow at the low end of the forecast range and thereby place continued pressure on refinery utilization rates.

Finally, there is a threat from the projected increased cost of meeting environmental requirements. Again, since Canadian refiners compete largely with US refiners, the important consideration will be the relative changes in Canadian environmental mandates and US regulatory induced environmental investments.

The US and Canadian environmental agendas for petroleum refiners may well differ in light of the higher level of air pollution in many US cities compared to Canadian couterparts. However, even if Canadian refiners may not need to make the same investments than their US counterparts, US refiners have already invested heavily in complexity that allows them more easily to meet environemntal standards. Canadian refiners are yet to make those investments.

Nonetheless, as is reported below and in Appendix A 6., a joint Environment Canada - Industry Canada forecast finds that US regulations will force US refiners to invest far more than Canadian refiners, and that difference may turn the additional environmental investments from a threat into an opportunity.[47]

It is yet to be determined to what extent the lower Canadian than US investments needed to meet environmental regulations are due to differences in environmental standards or in regulatory techniques. The US is a "first mover" in regulations and applies rigid legal standards before the extra costs for reaching the targeted objective are known. Canada operates using a looser informal arrangement that allows refiners to learn from prior US experience.

1. Investment requirements in the Canadian petroleum refining industry

One year ago, it appeared certain that despite all refiners having experienced low and in some years negative profitability over almost a decade, major investments would be needed to increase refinery complexity in order to more efficiently process heavier crude oils. Purvin and Gertz provide near term forecasts of investments to meet both environmental regulations and to process lower cost feedstocks. A refiner invests in greater complexity by adding equipment that can process a greater variety of crude oil types differentiated by sulphur content and specific gravity. The most expensive of such additions is a "coker". The addition of a single "coker" unit to upgrade a 100,000 barrel a day refinery may cost between 600 and 900 million dollars depending on the type of crude and the initial complexity of the refinery to which the "coker" is to be added. In addition, operating costs per unit crude oil processed rises with the complexity of the refinery, and that cost increase would have to be balanced against the benefit of lower feedstock costs and higher sales realizations.[48]

In 1992 it was understandable that Purvin and Gertz would have forecast

---

[47] The US study used as a baseline by Environment Canada and Industry Canada was sponsored by The Committee on Refining, Kenneth T. Dear, Chairman, U.S. Petroleum Refining, Meeting Requirements for Cleaner Fuels and Refineries, National Petroleum Council. August, 1993.

[48] Previous references to the variable costs falling with complexity referred to variable costs per unit sales realization and not variable costs per unit crude oil.

high investment needs for Canadian refineries. In 1991 the difference between the annual average price of West Texas sweet and West Texas sour crudes delivered in Chicago peaked at 1.47 cents Canadian per litre. The premium for sweet over sour rose steadily from .51, .86, 1, 1.29 to 1.47 cents per litre over the

Table VI
Estimates of Required Canadian Refinery Investments;
as forecasted at the end of 1991

REQUIRED CAPITAL EXPENDITURES OVER NEXT 5-7 YEARS ($ Billion)	
Ongoing Capital Improvement Programs	**5-10**
Environmental Improvements	**5-16**
Improvements to Process Lower Cost Feedstocks	**2-5**
Total	**12-31**

previous five years. The premium for sweet (WTI) over heavy/sour (Bow River) rose from 2.19 to 5.39 cents per litre.

Evidently, from the perspective of 1992, the advantages of expensive complex refineries were increasing steadily. In this connection, Purvin and Gertz noted that the Canadian industry investment for the period 1981-1990 averaged 8.6% of capital employed compared to a US rate of 15.9%.[49] The US industry built refinery complexity to handle more sour and heavy crude oils, and Purvin and Gertz believed Canadian refiners would soon need to follow the US industry's example. During the past two years however the premium price for light over sour and heavy crude oil dropped and in 1993 was 1.20 cents per litre of light over sour and 3.76 cents per litre of light over heavy/sour.[50]

[49] Op. cit. Purvin and Gertz Inc. (1992), page V-19.

[50] There are two purposes for looking back to the Purvin and Gertz forecasts. One reason is that the study is included as Appendix A7 and the unwary reader may otherwise wonder about the differences between the two studies about the magnitude of projected investment requirements. Second, the speed with which conditions in this fast paced industry change is an important warning about the need to continuously update any industry analysis.

2. Environmental regulations - Canada and the United States

Environmental investments reported by Purvin and Gertz as presented in Table VI above are for a broad category of possible requirements to meet new regulations. The SCF task force[51] undertook a careful item by item comparison of anticipated Canadian costs to meet similar environmental objectives as forecast to be implemented for the US. The task force analysis is more conservative than the Purvin and Gertz analysis reported in Appendix A7, and it is quite possible that regulatory change will exceed the present forecasts.

Table VII Estimated Total Investment by Canadian and US Refiners to Meet Environmental Objectives

(millions of Canadian dollars)

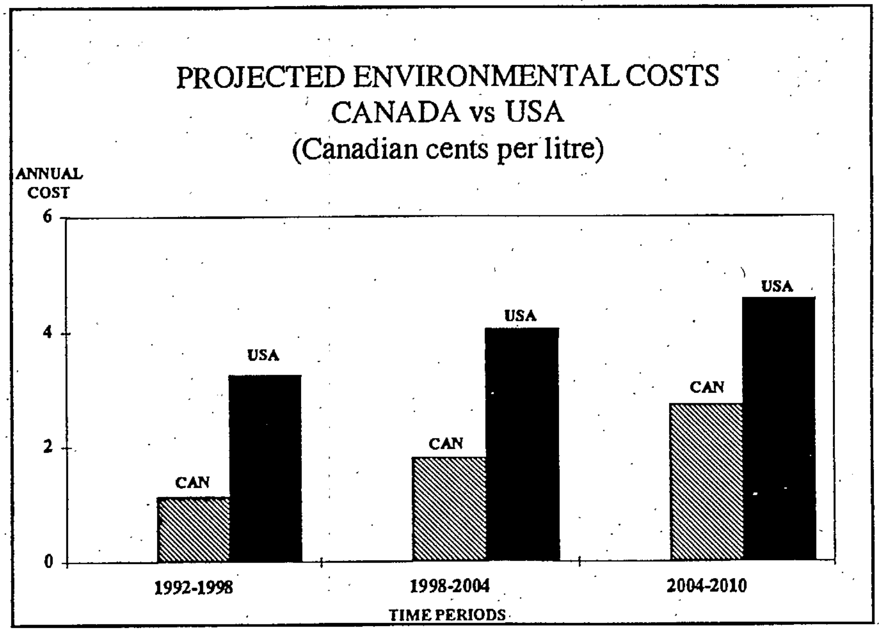
	SHORT 1998	MEDIUM 2004	LONG 2010	TOTAL TO 2010
Canada	2864	3863	3615	10342
percent	30	40	30	100
US (M$US)	58689	32823	12247	103759
US (M$Can)	78056	43655	16289	137999
US (prorated; M$Can)	9913	5544	2069	17526
percent	57	32	12	100
US/CAN	3.5	1.4	0.6	1.7

In Table VII and in Figure 16 we summarize our estimates from the analysis reported in Appendix A6. To place the scope of these environmental policy induced expenditures in context, one notes

[51] The SCF Task Force includes staff from Environment Canada, Natural Resources Canada, the Canadian Petroleum Products Institute and Industry Canada. The Task Force reviewed plausible initiatives for Canadian environmental initiatives and compared them with initiatives studied by the American Petroleum Institute. Appendix A 6. itemizes these initiatives for both countries' industries. It also assigns probabilities to the likelihood each initiative will be implemented in the assigned time period.

that the total downstream capital expenditures undertaken by Canadian refiners in recent years to improve and maintain their operations has varied between \$0.8 and \$1.3 billion per year.[52] Another measure of the scale of the projected "new" investments is the current replacement value of the petroleum refining and marketing assets, estimated to be between 11.6 (book value) and 14 billion dollars (Purvin and Gertz Inc., 1993). Thus Canadian investments will equal the current investment in Canadian refineries. The US investment level prorated for Canadian refinery capacity is 1.7 times larger at \$17.5 billion.

Figure 16
Projected Canadian and US Prorated Environment Induced Additions to Operating Costs; 1991 Can. cents per litre



Evidently a disparity in investment requirements of this magnitude deserves to be analyzed for its potential positive influence on the competitiveness of Canadian refiners. In particular, the level of competitiveness is influenced by (1) the level of annual carrying and operating costs associated with those investments and (2) the split of environmental expenditures between product specifications and

[52] Natural Resources Canada, CanadianPetroleum Industry, 1993Monitoring Report, Annual and back issues to 1986, Table 13.

site related marketing and refining improvements.

Table VIII
Annual Canadian and US Environmental Carrying and Operating Costs; in millions of Canadian dollars

	SHORT	MEDIUM	LONG
PREVIOUS	(1998)	(2004)	(2010)
US ($us)	8,000	7,000	6,000
CANADA ($can)	470	420	370
operating costs	270	270	270
FORECAST			
US ($us)	11,512	17,326	23,044
US ($can)	15,311	23,044	28,594
US (prorated for can.)	1,945	2,927	3,631
CANADA	587	1,285	2,204
CAN/US(prorated)	30%	44%	61%

We deal first with projected annualized costs for financing and operating environmental capital. Annualized costs are split between carrying costs and operating costs. The earlier in the period the investment must be made the larger will be the carrying costs in later years and the larger the sum of those costs over the period. The bulk of US investments are scheduled for the short period (59%), whereas Canadian investments are scheduled in the two subsequent periods. The difference in the timing of the investments in the two countries affects the present value of environmental costs. For the Canadian refinery industry, total environmental costs will rise from its present level of $470 million by an additional $600 million and rise to $2.6 billion annually by 2010. Just 30% of the Canadian investments and associated annual cost are scheduled for the period to 1998. The same ratio of pre-1998 to total investment in the US is 59%. That timing difference is a major potential advantage for Canadian refiners. It permits Canadian refiners to postpone investments and possibly to learn from the US experience.

Table IX
Estimated Distribution of Annualized Environmental Costs by Category; 2010

INVESTMENTS	CANADA (M$CDN)	%	US (M$US)	%
PRODUCT RELATED	1597	72%	1046	49%
MARKETING RELATED	180	8%	1650	8%
REFINERY RELATED	427	19%	9392	44%
TOTAL	2204	100%	2150	100%

More work is needed to separate environmental regulations between those affecting on-site operations and others which affect the specification of the products to be consumed by the consumer and the downstream business.

The former regulatory differences arising from initiatives to meet local area objectives cannot be used to justify erecting trade barriers against importing refined products. The latter differences arising from initiatives to meet tougher environmental product specifications are subject to trade control. Because there is a difference between site related investments and product related investments in so far as a country would be able to use trade barriers to protect its refiners, we have made an initial and rough distinction between the two types of environmental initiatives, as shown in Table IX.

Investments for product specification improvements are 72% of the total in Canada and 49% in the US. Only 19% of Canadian investments will be for refinery site related investments that are immune from trade interference. In the US, 44% of the total investment will increase refiners' costs regardless of whether the product is for export or domestic sale. Thus the data suggests that the fear is misplaced that some US refiners might avoid meeting US specifications in favour of exclusively supplying Canadian demand from a refinery that fails to meet site-related regulations. However, this observation about the tendency for US refiners to redirect output to Canada only applies to site related controls which may also differ widely between US regions.

The data reported above represent US wide average costs and may fail to reflect the extra costs for US refiners well located to ship to Canadian markets. Moreover, US regulations for gasoline specifications would not prevent US refiners from redirecting off-spec gasoline to Canada if Canada's gasoline specifications fail to track those in the U.S. For example, at the present time, the price of unleaded regular gasoline in the U.S. has dropped as refiners are shifting output to meet the requirement to supply reformulated gasoline (RFG) in several regions. The impact of that U.S. regulation has been to increase U.S. refiners capacity to produce the sum of regular and RFG gasolines, and that increased capacity has displaced unleaded regular gasoline formerly sold in the U.S. to Canada and those U.S. regions permitting regular gasoline. Accordingly, the price of regular gasoline has dropped throughout North America.

The most important conclusion from the comparative environment cost study is that the cost of refined petroleum products in the United States may rise about 1.5 cents Canadian (1991) per litre in the short run and about 2.5 cents Canadian (1991) per litre in the long run (This assumes an annual rate of refined product growth of 0.7%). By contrast Canadian operating costs would rise by .7 cents Canadian (1991) per litre in the short run rising to 2.1 cents Canadian per litre in 2010. These extra costs are allocated over total refinery output. However, most of the environmental costs will affect production of gasolines. Therefore the actual impact of differential approaches to mandating environmental standards may have a far larger, but imprecisely known, impact on the differential cost of producing gasoline in the two countries. To place this change in context, we note that even the conservative estimate for the US causes refinery operating costs per litre to double from 2.4 to 5 cents.[53] US gasoline prices would necessarily rise by that extra amount.

Should the SCF task forces's predictions be realized, Canadian refiners would likely be able to move domestic prices up to the higher US price level without attracting imports. That increase

---

[53] " The range of cost estimates for the environmental requirements is very large due to the uncertainties in requirements and the extent of the applicability. For example, the price of a "clean" gallon of gasoline could increase as little as 3 c/gal or as much as 27 c/gal. (<1 to 7 c/litre) depending on the season and the local requirements." ... "The 3 c/ga. is the lower estimate for oxygenated gasoline , 27 c/gal is the higher cost estimate for RFG II - API Discussion Paper #070R p. 50." See Appendix A 2.

would allow Canadian refiners to recover environmental investments. Canadian refiners may be able to increase exports into the United States if Canadian fuels can meet US standards. Moreover, the finding of higher site related costs in the US than in Canada prompts us to suggest tentatively that there will be an incentive to locate new refineries in Canada instead of in the United States.

In short, if this initial analysis of comparative environmental costs stands up to further scrutiny Canadian investments may appear attractive despite current low returns.

3. Prospects for the Canadian refinery industry

The industry's future appeared just a year or two ago to be fragile and the attractiveness of investing in refinery facilities to be sensitive to the pace at which environmental regulations would be imposed as compared to those coming into force in the United States. Today it appears that the Canadian industry may be able to postpone investing in complexity to handle heavier crude oils, and may enjoy additional natural protection from US refiners that will be raising prices to pay for the costly investments to meet environmental regulations. That degree of natural protection may turn out to be low. Nevertheless, on balance, during the past two years, circumstances appear to have shifted in favour of the Canadian refiners and the threat to the future profitability of the Canadian refinery industry has been postponed though not eliminated.

Today, it seems unlikely that Canadian refiners will be ceding a significant share of the domestic demand for refined petroleum products to imports. Yet the speed with which conditions changed in the last two years underscores that it is dangerous to be sanguine about the future of the industry. A rise in the premium for purchasing light sweet crude oil would seriously damage the competitive position of Canadian refiners. This is not expected because as world refiners add complexity, the premium for light oil is moderated. In addition, in the long run the rise in US environmental investments may provide a significant extra level of protection for Canadian refiners' gasoline production.

VI. IMPLICATIONS AND ISSUES

1. Summary

Public sources of information do not permit us to make a definitive statement about the comparative efficiencies of Canadian and US refineries. It can be concluded with certainty that since 1992 Canadian refiners have sharply lowered operating costs within the refinery. Despite that improvement, Canadian performance seems to be lagging best US performance. Measured either by variable operating costs per litre of output or per dollar of sales realization, the Canadian refiners collective performance in 1993 was well behind USGC refiners group's performance. But those measures are incomplete. First, it is important to caution again that this study did not examine capital and fixed costs in Candian and US refining. Second, the USGC refiners are among the most efficient so that we cannot say how the Canadian refiner average compares with a broad average for US refineries. More importantly, we are yet to identify data to permit us to compare respectively Canadian and US variable, fixed and capital costs per unit of output and of sales.

Because of missing data, one cannot determine the impact on US refiners' profits of the past investments in high complexity. With data on US capital charges and fixed costs, the conclusions reported herein about the US refiners performance could be different. Certainly, US profitability in 1993 was low, suggesting that the lower variable refinery cost per unit output and sales realizations in the US is matched by higher fixed and interest costs.

Regardless of the final conclusion about the relative status of total costs per unit of output and of sales in the US and Canada, the importance of the complexity agenda for the future of the Canadian refining industry demands that the issue be researched further. It is important to know whether increasing complexity also increases the minimum efficient scale of new refineries. Were that to be the case, we would anticipate further rationalization among Canadian refineries with particular consequences for the refineries in Montreal and the Atlantic region. Increased refinery complexity may ultimately lead Canada's refineries to be concentrated in just two centres - one in Edmonton and another in the Sarnia-Toronto area.

Even if small refineries can efficiently build complexity and meet future environmental mandates, the need to invest in increased complexity remains a threat to Canadian refiners' ability to recover costs, should the heavy-light crude spread increase. If investments are made and the spread fails to persist, refiners may well fail to recover their investment costs. At the moment, the future spread between heavy and light oil is uncertain.

Canadian refiners earn lower returns downstream from the refinery than their US counterparts and by independent service station operators and jobbers in the US. US refiners are more dependant on wholesale markets and have less directly invested in retail facilities. Canadian retail unit marketing margins are typically lower than US margins, but we cannot determine precisely how Canadian retail unit margins compare with retail operating costs. We can conclude that Canadian unit retail costs (including the oportunity cost of capital invested) are higher than revenues they are able to recover in the marketplace because the number of service stations is declining rapidly. That revenue shortfall is especially noticeable in the large Toronto and Southern Ontario gasoline retail market.

Poor performance in marketing and weak retail prices lower the refiner's bottom line and affects each refiner's ability or willingness to invest heavily in refinery upgrading even though Canadian refineries can produce refined products at a cost in line with those in the United States and elsewhere.

The inefficiencies in the Canadian retailing system are a social loss and tie up resources that might be redirected elsewhere. But those inefficiencies do not create an opportunity for gasoline importers and therefore do not directly or in the short run threaten the Canadian refiners' collective share of the Canadian market.

However, because Canadian refiners have huge sunk cost investments in the distribution system, their economic strength as corporate entities is sapped by poor marketing performance. If marketing performance fails to improve, Canadian refiners may postpone investing in improved refineries or may choose to withdraw from Canada should mandated environment related investments appear unprofitable. They may instead invest in improving the transportation infrastructure for importing refined products from the United States and off-shore.

Additional costs for improving the environmental performance of refineries and refined petroleum products may cause Canadian refiners to lose market share to imports. Our analysis indicates that at least in relation to the United States, relative environmental requirements may provide added protection for Canadian refiners and allow them to recover the additional environment related costs in the Canadian marketplace. The outcome depends significantly on the relative costs of implementing cost increasing improvements in Canada and the United States, and on policies that will assist refiners to foresee a return on new investments. Possibly those policies would involve tax advantages for environment related investments and for decommissioning service stations. Another approach is to slow the environmental agenda in relation to site related costs while advancing it in relation to product specifications

2. Key issues and recommendations

Vision for the Future

Within the SCF process and this review, Industry Canada has been guided by the vision of a dynamic petroleum refining industry capable of sustainable economic activity. Such an industry would manufacture and supply petroleum products which meet the needs of the Canadian domestic economy and the Canadian consumer. The industry would continue to be an important component of the infrastructure of the Canadian economy, heavily integrated with the other major industry sectors. The industry would have a strong domestic focus, maintain its competitiveness in the North American context, and be positioned to remain competitive as market dynamics become more global. The industry would be capable of dealing with the inefficiencies of the marketplace, while simultaneously providing a reasonable rate of return for its investors. This vision would be achieved by an industry committed to continuing to improving its environmental, employee health and safety performance.

The petroleum industry would likely add to this vision that its retail marketing business would become robust, efficient and profitable.

The role of Industry Canada will be to become an effective agent within a partnership that deals with issues of taxation, environment, trade and possibly competition policies that affect the viability of the refinery industry. For identified issues, the partnership will share information, and develop a deeper understanding and a consensus on actions that need to be taken. In many cases Industry Canada will have the lead role, and in other cases Industry Canada will be an active participant, under the leadership of other partners.

Agenda for Action

1. Industry Canada has established its role in the first cycle of the SCF. This role needs to be solidified within the partnership of private sector, consumer and government organizations. This role is based on a continuation within the SCF process of co-operative research, which relies on the micro-economic expertise of Industry Canada.

2. Because of the strong importance of the environmental issues, Industry Canada will partner with Environment Canada to ensure that economic and business criteria become factors in environmental decision making. The SCF process has determined that environmental objectives are consistent with a viable industry so long as policies are crafted to ensure that Canadian refiners are not disadvantaged in relation to competitors.

Recommendations

Supply

1) Canadian refined product requirements are presently supplied by Canadian refiners. It is anticipated that Canadian refineries will continue to meet domestic demand, and may develop additional sales to US customers. That outcome is not assured. It depends on how the cost structure of Canadian refiners compares to the cost structure of comparable US refiners, after investments are made to upgrade refineries to meet environmental objectives and to process heavier crude oils. The present paper does not allow us to confidently evaluate the prospects for Canadian refiners. That evaluation requires a detailed study of comparable refineries or groups of refineries on both sides of the border. In this paper we were limited by available data to a comparison of average national data for Canadian refiners and more specific data on the USGC as a proxy for US refiners. The appropriate methodology is to examine the performance and cost structure of Canadian refiners in each distinct Canadian region in relation to similar data for US refiners in the refinery centre that is the closest competing US source of supply.

Moreover, capital costs and fixed operating costs vary from refinery to refinery and particularly according to different levels of refinery complexity. Since refinery complexity is the heart of the issue as to whether Canadian refiners will be competitive with US competitors, a more complete approach to the study of relative refinery costs would extend the research beyond the comparison of variable operating costs to the comparison of all components of refinery costs.

> Recommendation: Industry Canada broaden the scope of the Petroleum Task Forces's research program beyond the level of broad national cost and performance comparisons to the level of region to region comparisons between refinery centres. Such work will cover variable and fixed costs, including capital charges as well as refinery yields. Initially, three regional comparisons would be undertaken: Atlantic Canada refineries vs US east/gulf coast refineries; Quebec refineries vs US east/gulf coast refineries and the New York/Rotterdam product markets; Sarnia Ontario refineries vs US mid-west refineries. Also, an analysis will be made of the efficiencies gained by the Sarnia area refineries from being fully integrated with the chemical and petro-chemical industries, contractors and educational facilities.

Demand

2) Demand forecasts will directly affect government policy making (e.g. CO_2 reductions to meet global climate change commitments) and refiners' investment decisions, and will indirectly affect the level of required investments to meet environmental mandates. The indirect effect is through mandates that are linked to total production of pollutants that is in turn correlated with refinery output. Forecasts range from virtually zero growth (Petroleum Task Force) to 1.5% annual growth (Natural Resources Canada). Individual petroleum refiners will develop policies in response to their own, different forecasts of future demand growth. Canadian demand patterns have diverged from US patterns and growth forecasts must be made domestically. Since Canadian refiners supply virtually all of Canadian demand, there is a high correlation between Canadian demand and Canadian production. Industry and government co-operation can improve forecasting by improving methodologies.

> Recommendation: Natural Resources Canada and CPPI jointly convene a forum to bring together forecasters from the petroleum industry, federal and provincial governments. The objectives would be to share forecasting assumptions, methodologies, etc. and to develop improved demand forecasts for petroleum products which both industry and government can support for policy planning purposes.

Implementing the Environment Agenda

3) Industry and government should continue to work together to develop plans for implementing environmental regulations that will permit Canadian refiners to remain profitable and competitive with imports. The environment agenda can have a serious impact on the profitability of Canadian refiners. Refiners are just at the point of correcting a long period of substandard profitability and continue to encounter stiff inter-refiner and international competition especially from the US. Moreover, Canadian refiners are likely at some time in the future to need to invest heavily to upgrade the complexity level of their refinery. The evidence reported above makes it clear that there are real opportunities for government and industry to manage the pace of change and the mix of environmental initiatives in a manner that protects the environment and sustains the competitiveness of the Canadian refinery industry. Environment Canada has the lead in developing the environmental scenarios. Industry Canada can play a key role in broadening and refining the evaluation of the potential economic impacts on the petroleum industry and its customers of the future environmental requirements.

> Recommendation: Environment Canada refine the environmental agenda and, in partnership with CPPI, forecast the associated implementation costs and set priorities.
>
> Recommendation: Industry Canada extend Environemnt Canada's initial analysis to an in-depth cost, profitability, and competitiveness impact analysis of the Canadian and US future environmental regimes. This will also be done with relevant export refineries in the Caribbean and Persian Gulf.
>
> Recommendation: Industry Canada and CPPI will support Environment Canada's efforts to develop priorities for the federal environmental agenda that ensures timely implementation and allocation of resources to the most cost effective and environmentally effective initiatives that may allow for local and regional differences across Canada.

Light sweet crude premium/Montreal-Sarnia pipeline reversal

4) Canadian refiners rely on access to light sweet crude oil at a reasonable premium to heavy and sour crudes. Pipeline connections, and especially the possible reversal of the Interprovincial Pipeline line 9 to

bring off-shore light oils to Ontario will affect the Ontario refiner's crude acquisition cost. The high rate of return for regulated pipeline utilities may ironically inhibit making the investments in reversal because high tariffs might well make deliveries to Ontario uncompetitive with Western light oil or with alternative sour and heavy oils. Industry and governments should influence the decision about the investments associated with reversing the pipeline that is a publicly regulated near-monopoly, and should also help determine the appropriate tariff. The interests of Alberta would have to be considered in any analysis.

> Recommendation: Industry Canada encourage Natural Resources Canada and the Province of Ontario to carry out an analysis of alternate crude supplies for Ontario and to examine the competitive impact of the regulated pipeline industry on the Ontario refiners' crude oil acquisition costs.

Small business implications of marketing rationalization - Service stations clean up costs

5) Increased marketing efficiency requires that the number of service stations declines, and that self-serve stations increase their share of the market. The rationalization of the service station network is impeded by the cost barriers to exit. An important factor inhibiting the closing of service stations is the liability for clean-up. There may be considerable potential benefit of transferring those costs to taxpayers or gasoline consumers and away from the owners and operators in order to permit the rationalization of the service station industry to proceed and to speed up the rate at which station sites are cleaned up. Financing investments to bring refineries and product performance up to ever rising environmental standards will be easier if refiners can improve profitability by reducing marketing costs, which may most easily be accomplished with fewer stations.

Of particular concern are the approximately 40% of retail outlets owned by independent businessmen, in the trade known as "Mom & Pop" stations. Many of these tend to be low volume, barely profitable operations. These stations face difficult choices with declining profits, potential investment requirements and, frequently, problems from site contamination that may give the prime asset a net negative value. This is a potential social and environmental problem.

> Recommendation: Industry Canada analyze the comparative sales volumes and margins for independents in key regions of

Canada, using one of the provinces as a test case; and evaluate the options available to overcome economic barriers to exit and facilitate rationalization. Industry Canada will seek to involve the appropriate provincial government in this work.

Fuel Standards

6) Though not receiving much attention in this report, there is a strong link between refinery investment requirements and changing motor vehicle technology and associated fuel requirements. Fuel standards are, for the most part, a provincial responsibility. Standards are established by the CGSB, but several provinces do not regulate to require adherence to CGSB. National fuel standards offer protection to both refiners and consumers. Dumping of off-spec product from other countries is a major concern of the Canadian industry, and potentially represents a serious environmental problem. Governments will need to spell out the conditions under which product can or cannot reach Canada from refiners that can evade similar environmental costs that will be mandated for Canadian refiners. There is a need for a nationally consistent set of product specifications, and authorities may need to commit themselves to enforcing them via appropriate trade policy actions.

Recommendation: Environment Canada, Transport Canada and CPPI lead in developing and implementing, via coordination through the Petroleum Products Industry Advisory Committee (PPIAC), a strategy to put in place a consistent set of national fuel standards.

Recommendation: PPIAC lead in developing common approaches to policies on fuels harmonization with the USA.

Tax levels

7) High excise taxes do not affect demand significantly in the short run, but the elasticity of demand is high in the long run. Tax levels also have indirect effects on the competitiveness of the Canadian marketing system. For example, high tax levels in Canada compared to the US can lead to tax evasion schemes which in turn can lead to unfair competition in the marketplace, depressing margins for legitimate operators. This issue has a strong Ontario and Quebec focus, due to the size and peculiarities of their market place.

Recommendation: Industry Canada assess the impact of high taxes on fuel tax fraud and on overall demand for products. Finance Canada, Revenue Canada and provincial governments would be natural allies in such a study.

The Partnership process

8) Phase 1 of this SCF was characterized by a high degree of participation and buy-in from partners in the industry, other government departments and consumers. The value of this partnership must not be lost.

Recommendation: Industry Canada continue to involve partners in cooperative analysis and review of the ongoing action plan; and seek to involve new partners (e.g. Provincial departments) in specific action studies.

Communication

9) There was extensive consultation with a broad cross section of stakeholders within Phase 1 of the SCF. The feedback and support from stakeholders as a result of this effort has been very beneficial. It is important to continue to use such communications to improve the understanding of key industry competitiveness issues with stakeholders. This will also help to expand the web of consultations and lead to better solutions to issues.

Recommendation: Industry Canada continue to seek opportunities with Provinces, federal departments, company managements and others to discuss the SCF findings and action plan.

SECTOR COMPETITIVENESS FRAMEWORK
REFINED PETROLEUM PRODUCTS

APPENDIX A1

PARTNERSHIP SUMARY REPORT

PARTNERSHIP SUMMARY REPORT

TABLE OF CONTENTS

PARTNERSHIP SUMMARY REPORT
SECTOR COMPETITIVENESS FRAMEWORK:
REFINED PETROLEUM PRODUCTS

Introduction

This report is a brief summary of a series of five working papers on various aspects of competitiveness in the petroleum products industry. The full working papers are contained in the Appendices to this report. The working papers were prepared by a task force representing Industry Canada, Natural Resources Canada, Environment Canada, the Canadian Petroleum Products Institute (CPPI) and four of its member companies as well as the Consumers Association of Canada. These organizations worked together in a true partnership to reach consensus on the key issues facing the petroleum products industry and the scoping of an action plan to address those issues.

The overall study was conducted under the general guidance of Industry Canada's concept of a Sector Competitiveness Framework (SCF). This framework provides a structured approach to analyzing and understanding the competitive challenges and opportunities of an industry sector in Canada competing in a global marketplace. The study is not an end point, but rather a beginning. The findings of this first phase of the study will be updated and enhanced as new information becomes available and more rigorous analysis is completed.

Process

This Sector Competitiveness Framework study has been conducted in full partnership with the industry, other federal departments and consumers. As well, it has benefited from extensive consultation with a range of stakeholders that includes provincial governments, other federal departments and agencies and individual company executive management teams.

The analysis and findings in the working papers represent the consensus views of the participants. All data used in the study was obtained from public sources. Vertical integration of the study team and use of public data met concerns raised early in the process during consultations with the Bureau of Competition Policy. Issues of "competition", as opposed to "competitiveness", are very sensitive with this industry sector. Great care was taken at all times to comply fully with the provisions of the Competition Act.

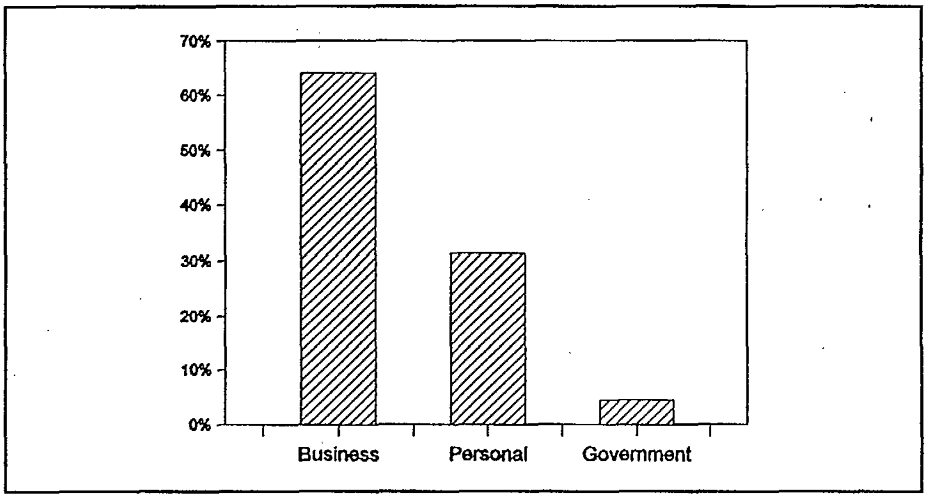
This study was preceded by two reports. The first was conducted in 1992 by Purvin & Gertz Consultants for the Canadian Petroleum Products Institute. The second was a report on competitiveness issues prepared by a joint government-industry working group co-chaired by Natural Resources Canada and CPPI which was released in August 1993. That report identified and discussed a number of key issues affecting the competitiveness of the industry in Canada, but attempted no in-depth analysis of the issues. This study expands on the earlier reports and analyzes new issues.

Profile

The refined petroleum products industry consists of petroleum refining, product distribution and marketing operations. The industry starts when crude oil and other feedstocks are received at a refinery, or when products are imported into Canada, and carries on until the product is sold to the final customer. The industry operates 24 refineries and markets products through a network of over 17,000 retail outlets.

The sector is an extremely important component of the infrastructure of the Canadian economy. Petroleum products are the fuel source for virtually all transportation in Canada and provide critical feedstock supplies to other major industry sectors, particularly petro-chemicals and chemicals. As can be seen in Figure 1, the study shows that over 64% of petroleum products in Canada are used as inputs to other business activity. Canada is a net exporter of petroleum products with a positive trade balance of $800 million in 1992, doubling to over $1.6 billion in 1993. The industry is also a critical source of revenue for governments, collecting about $9 billion in federal and provincial taxes on fuels alone. The industry employs over 100,000 people and generated revenues of over $24 billion in 1993. The workforce in refineries has one of the highest value-added levels in Canadian manufacturing and is a leader in knowledge based employees.

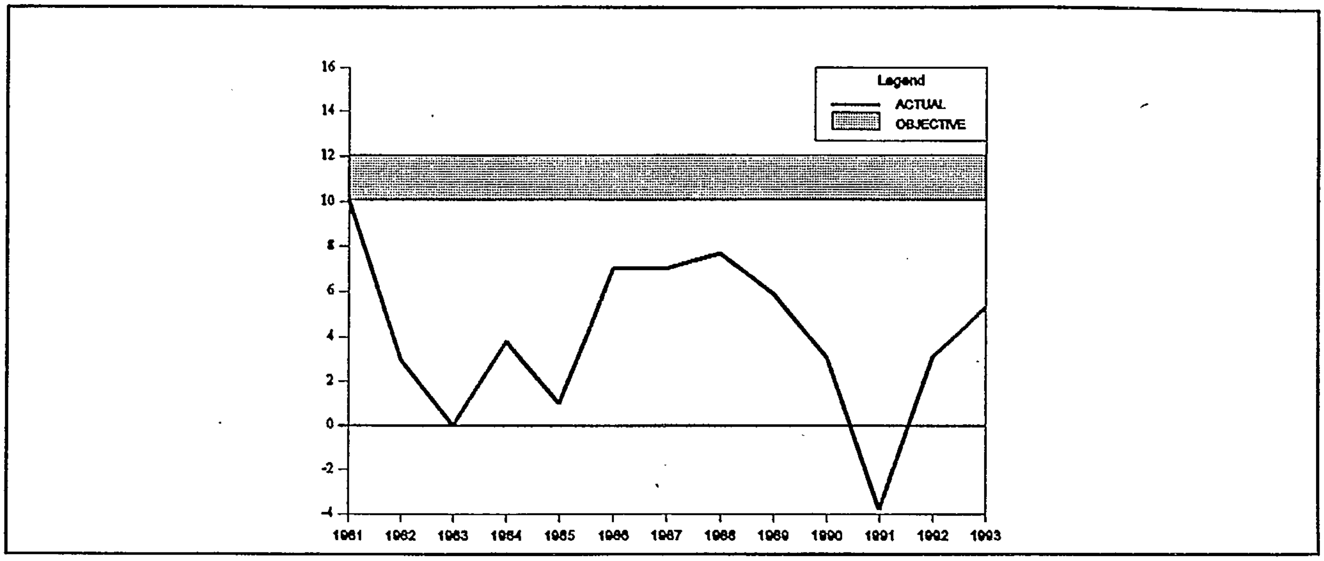
Figure 1
Disposition of Petroleum Products 1989



The industry can be characterized as a capital intensive commodity manufacturing and marketing business having a strong domestic focus, but competing in an open marketplace with global suppliers. Atlantic Canada refineries have a strong export focus, with substantial exports to the eastern United States.

The three largest refining companies control about 56% of refining capacity, with the other 44% controlled by 10 regional refiners. Canadian ownership stands at about 44% of refining capacity. The industry has been earning low rates of return, averaging about 4% over the last decade, with substantial losses in 1991 as a result of the recession. Since 1991, recovering demand and aggressive cost cutting have improved returns (Figure 2).

Figure 2
Percent Return on Capital Employed



The vast majority of the industry is represented nationally by the Canadian Petroleum Products Institute (CPPI). In 1992, CPPI helped create a unique government-industry-environmental group task force that has now structured itself as the Petroleum Products Industry Advisory Committee, consisting of senior executives from the industry, six federal departments and two environmental groups. The Advisory Committee is a forum for discussing policy issues of critical importance to the stakeholders. The Advisory Committee has reviewed the preliminary findings of this study and has offered helpful suggestions on the proposed action plan.

The petroleum products industry is now well into a major restructuring to reduce costs, cut capacity and improve low rates of return. This restructuring has been necessitated by long term declines in demand coupled with intense competition in the marketplace. The industry is deeply concerned about any policy initiatives which could impede this restructuring, cause further sharp declines in product demand or require major investment that does not improve competitiveness.

The issues facing the industry in its drive to improve efficiency are complex and inter-related. The issues are addressed here under three main headings:

1) Demand and supply;
2) Margins, and;
3) Environmental agenda.

Key Issues

1) Demand and Supply

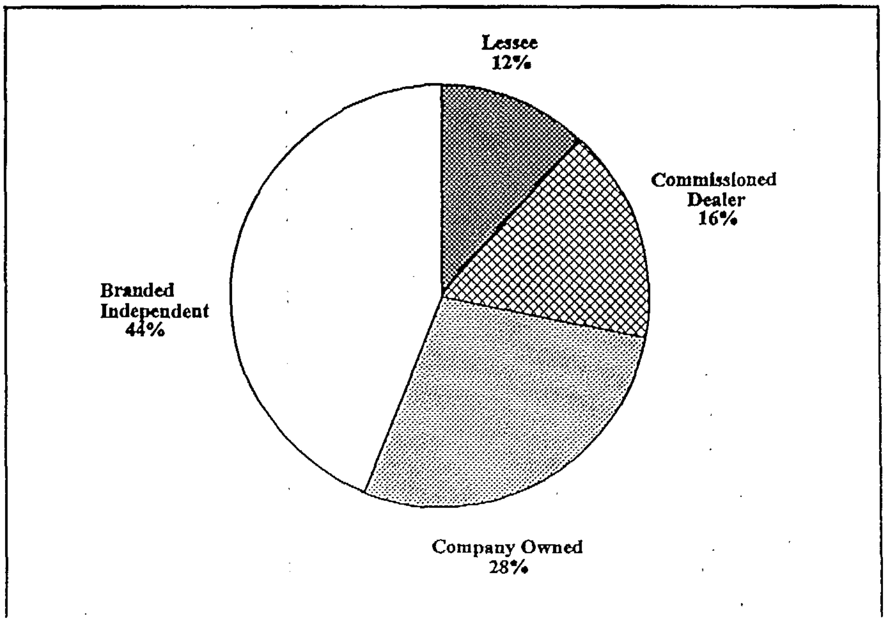
Demand for petroleum products in Canada has undergone major swings over the last two decades. Demand grew rapidly in the 1970's, declined sharply in the early 1980's due to recession and the effects of the NEP, partially recovered in the late 1980's and then dropped again as the economy went into recession in 1990. When compared to the US, Canadian demand has shown relatively greater declines and more moderate recovery. Canada's high fuel taxes, compared to the US, and fuel switching policies of the 1980's are contributing factors.

Refinery capacity in Canada expanded until the early 1980's, then major rationalization programs began to take effect as the industry tried to improve the rate of utilization in the face of falling demand. The net result has been to reduce the number of plants by 16, from 40 to 24, with two more closures planned for late 1994. Capacity utilization still remains below optimal levels.

Forecasters are quite divided in their views of future product demand. Government forecasts predict slow but steady growth in demand through the next two decades. Industry forecasters predict demand will remain virtually flat and then decline early in the next decade. In part, these variances can be attributed to different assumptions on demographics, the degree of policy neutrality and the characteristics of the models used. The variances between forecasts have major implications for capacity utilization, public policy, and the need for further rationalization that could influence demand.

Marketing capacity, the number of service stations, remains high despite many closures. The structure of this part of the industry, with some 44% of facilities owned by small, independent businessmen, makes rapid rationalization beyond the control of major suppliers (Figure 3). Proportionately, Canada has twice as many stations as the US pumping half the volume per station. A major barrier to more rapid rationalization is the environmental cost of cleaning up old sites. This cost often exceeds the value of the site and lenders will not finance the purchase of sites that may have some degree of contamination. This can encourage independent owners to continue to operate uneconomic sites as the best of several bad financial choices.

Figure 3
Type of Retail Outlet



Proposed Actions

- o Create a forum for forecasters from industry, government and academia to debate modelling techniques, demographic assumptions and compare product demand forecast results.

- o Ensure that public policy decisions impacting demand are based on forecasts that reflect the range of alternative scenarios. (See also the section on the environmental agenda).

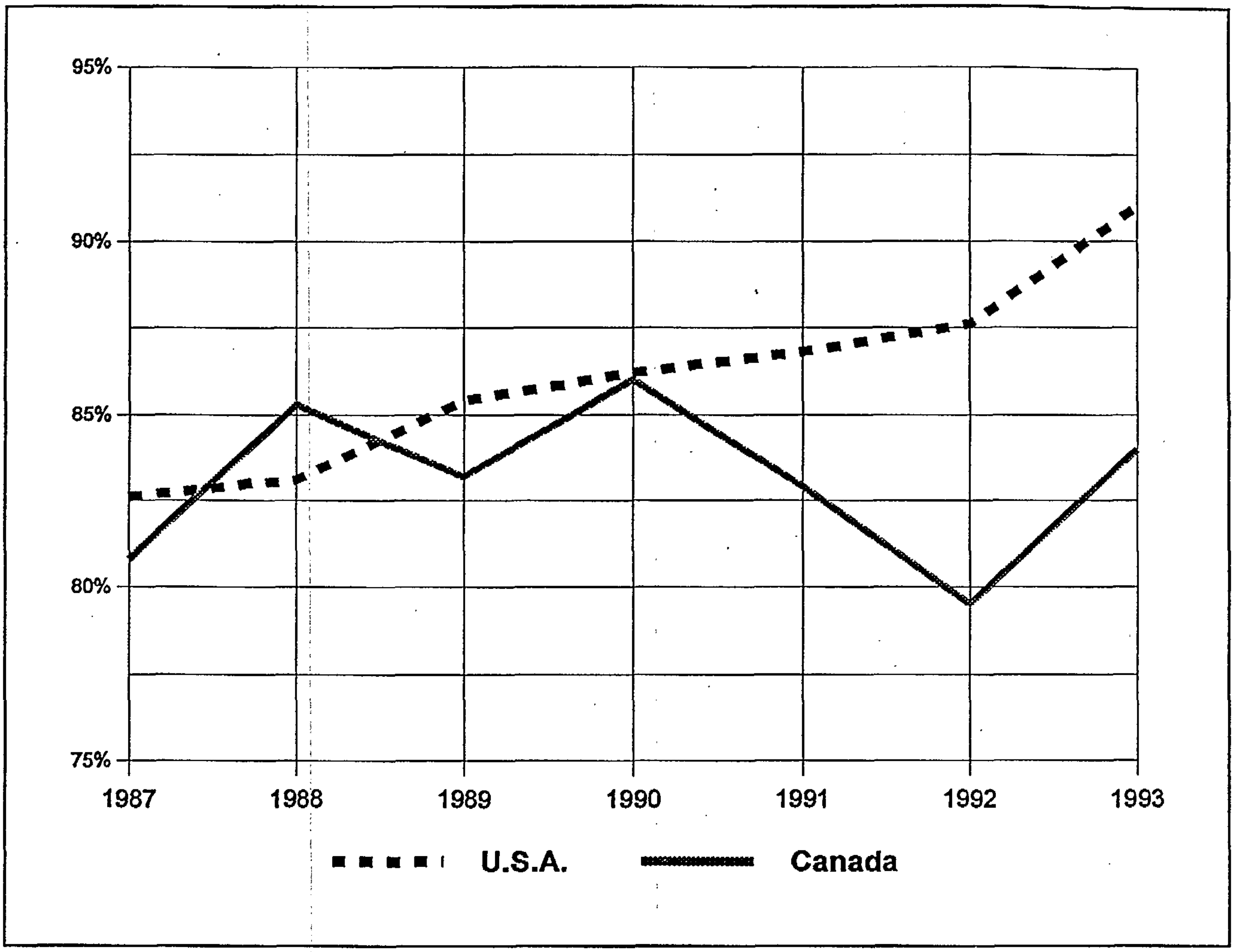
- o Develop creative financing mechanisms to assist small businesses to clean up and convert uneconomic sites to new uses.

- o Initiate a study to determine the potential impact on demand of further tax increases and to assess the impact of tax fraud on legitimate Canadian retailers.

2) Margins

Refinery margins are heavily influenced by access to low cost feedstocks, the ability of a refinery to process lower cost heavy sour crudes (complexity), economies of scale and control of operating costs. These factors must be viewed in the context that the Canadian refineries are price takers for both crude purchases and product sales. The Canadian refining industry is largely based on light sweet crude. Particularly in Ontario, this situation dominates the relative economics versus northern US plants, which have high heavy crude coking capabilities. The very high costs of building cokers make this option difficult for Ontario, so refiners are looking increasingly at the feasibility of reversing IPL line 9 at some future date to allow low cost imported light sweet crude oil to reach Sarnia. Rationalization has increased the average size of Canadian refineries to a more competitive scale with northern US plants. Rigorous cost cutting has brought most Canadian refineries to a good competitive position versus the offshore competition. Long term rates of return remain below the US, but results for 1992 and 1993 are encouraging. As shown in Figure 4, refinery utilization rates are still below the industry's minimum target rate of 90%.

Figure 4
Refinery Utilization Rates %

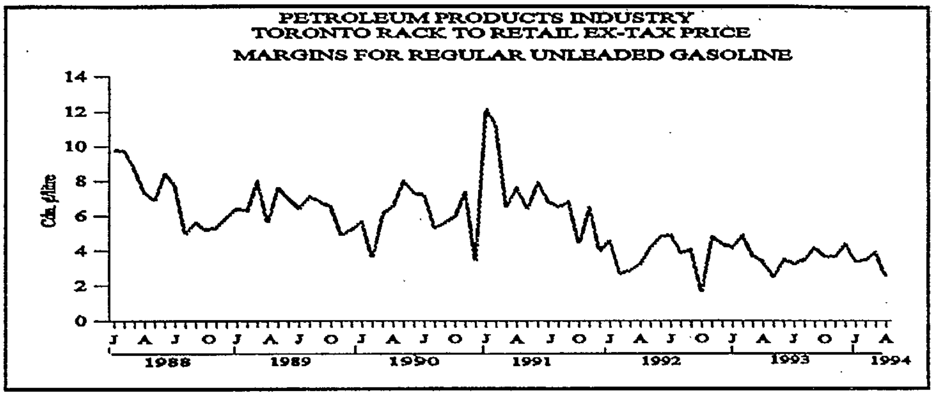


While the industry's cost cutting efforts have yielded better results, some costs remain beyond their direct control. Noteworthy among these costs are those arising from regulated industries such as pipelines and electric power utilities. Analysis shows that these costs can represent about 16% of non-capital operating costs for a refinery. The study shows that pipelines, for example, earn a rate of return that has averaged over 14% in recent years. These rates appear to be uncompetitive in today's business climate.

Refinery economics vary widely by region in Canada. This study has focused primarily on the national scene, but future activity must examine the strengths and weaknesses of the industry in the key geographic areas. In Atlantic Canada and Quebec, refineries enjoy access to tidewater transportation of crude oil and products. Here, exports to the US east coast dominate output for some refineries. In Ontario, refineries compete against marginal imports from the large US refineries mentioned above. In western Canada, as a result of further closures, refinery capacity is now well balanced with demand and imports play only a minor role. Two centres, Sarnia and Edmonton, offer a critical mass of refining, chemical and petro-chemical plants to support a dynamic and healthy infrastructure of suppliers, contractors and community services to make these centres of efficiency. The Montreal area would appear to have slipped below this critical mass in the last few years.

Retail margins are under extreme competitive pressure, with the key Toronto rack to retail margin dropping from the $.10/l range in 1988 to about $.04/l today (Figure 5). This is forcing major change in the gasoline retail business. As owners seek to maximize revenues from their sites, non-petroleum merchandising such as convenience stores and fast food are growing. Revenue diversification helps offset the inefficiencies of excess capacity to some extent. Most employment growth in the sector is in non-petroleum retailing.

Figure 5
Toronto Rack vs Retail (Net of Tax) Price Margins
Regular Unleaded Gasoline Cdn cents per litre



Policies that reduce demand have adverse impacts on the industry. High product taxes have helped reduce demand in past years, although there is evidence that this effect is now levelling off. High taxes also contribute to cross border shopping and several forms of tax fraud. Subsidies to alternate fuels also can tip the balance in the market, drive down demand for gasoline and reduce margins.

Proposed Actions

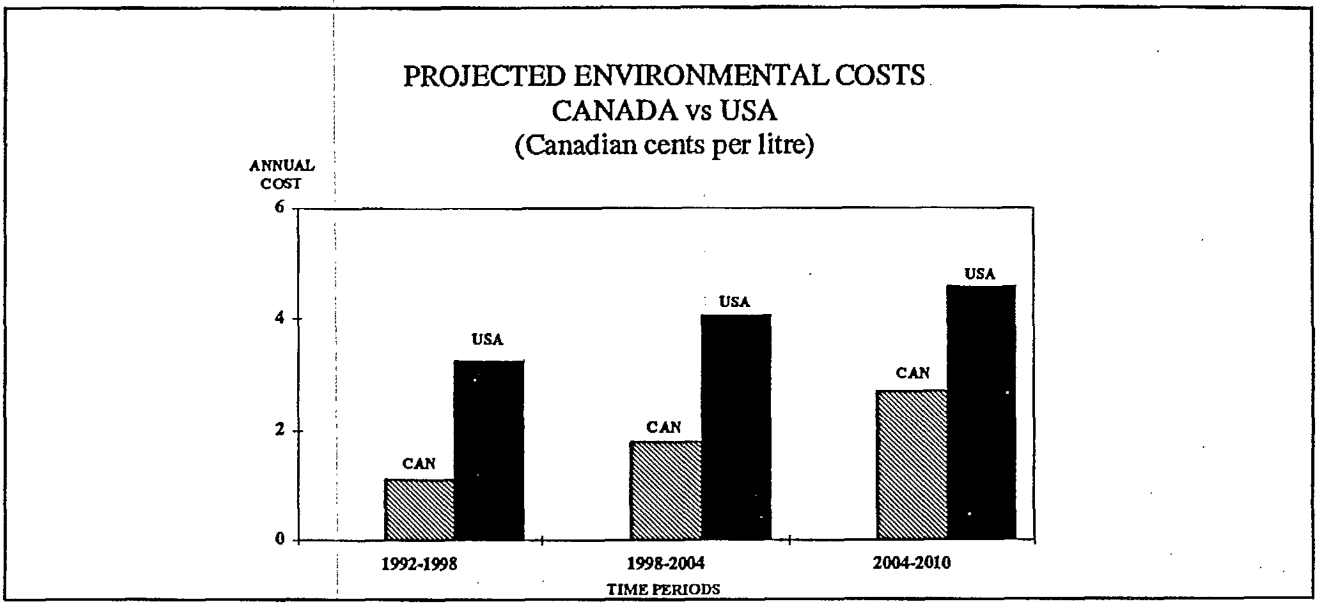
- The merits of a timely IPL line 9 reversal must be carefully analyzed for impact on Ontario refiners and western crude producers.
- The rates of return given to regulated industries in Canada, particularly pipelines and electrical utilities, must be reviewed for their competitive impact on operating costs.
- Future studies of refinery economics should focus on the geographic regions of Canada, with particular emphasis on the centres of efficiency.
- The competitive impacts of regulated industries on refinery economics must be examined.

3) Environmental Agenda

The industry has a history of environmental proactivity and has spent upwards of $2 billion since the early 1970's. Anticipated future environmental requirements are more numerous and potentially much more costly. This has led CPPI to initiate discussions on processes to help prioritize the agenda and ensure initiatives are both environmentally and economically effective.

This Sectoral Competitive Framework study has launched an examination of the comparative costs of a realistic scenario for Canada and the U.S. This examination has developed cost data sheets for about 50 initiatives, using the best information available from U.S. and Canadian sources. The compilation of that data can be seen in Figure 6.

Figure 6



These early results indicate that a more flexible and less demanding Canadian approach to environmental control appears to be less costly than the system in place in the U.S. by a factor of two to three. Therefore, on the basis of environmental costs alone, Canadian refiners do not have a disadvantage versus their competition in the U.S. The tidewater areas of Canada may be vulnerable, however, to increased competition from large export refineries in the Caribbean and Persian Gulf areas which are unlikely to face similar types of investment requirements.

Despite the lower relative cost, the annualized potential costs are still extremely large. They range from $CDN 1 billion for the high probability initiatives to $2.5 billion for the more exhaustive scenario which includes medium and low probability initiatives. As is the case in the U.S., these environmental expenditures are expected to exceed the current book value of the industry. Paying for those investments is a major concern given the current low returns and industry expectations of flat demand. The challenge is to develop a situation where the industry can recover incremental costs while the consumer continues to receive the lowest cost, highest quality and environmentally safe products.

The requirements for environmentally driven national product quality standards needs to be addressed. Most current standards are set through a voluntary process and tend to be at the common denominator level. They would not prevent significant deterioration of the environmental characteristics of the products should economic conditions dictate environmentally adverse changes in the product formulations. National standards may increase costs but they do so for everyone. Therefore they tend to level the playing field both internally and with respect to imports. They also provide a better opportunity to recover their incremental production costs than do voluntary initiatives from individual companies.

Forecasts of product demand vary widely. The impact of key environmental issues related to fuel formulation and control of greenhouse gas emissions adds more uncertainty. The latter has the potential to effect a step change in product demand, particularly if policy decisions are based on growth forecasts that prove to be optimistic. The lower demand would compound the difficulties of financing capital programs to meet other environmental objectives. To the extent possible, the environmental agenda should be clarified through industry/government consultations to add more certainty to the planning process.

Proposed Actions

- Continue to develop methodologies for environmental priority setting and test them.
- Continue to develop the cost information database for proposed environmental initiatives.
- Initiate a dialogue among stakeholders to clarify expectations about the role of voluntary initiatives in environmental control.
- Clarify government policy on harmonization of environmental standards with the US.
- Assess the need for national product quality standards (as distinct from harmonized standards with the US) in the context of internal and external competitiveness.

Overall Conclusions

Canada benefits from a strong domestic core refining industry. Some limited further rationalization may occur in refining and much more is needed in retailing. The sector is not subsidized in any way, nor does it want to be. It seeks no special tax treatment but is concerned with the current levels of taxation on fuels.

Environmental issues dominate the public policy agenda for the industry. Government must proceed with realistic priorities, giving full consideration to the business impacts and environmental needs and benefits of proposed actions. This is an area requiring full and open dialogue with all concerned stakeholders.

The action plan proposed in this SCF is a shared responsibility. It represents an opportunity to maintain and expand the outstanding working cooperation that now exists among the participants. Ownership of the action plan will continue to rest with Industry Canada and CPPI. Reporting of progress can be managed through the Petroleum Products Industry Advisory Committee.

This report is an important step in ensuring the future of a strong and competitive petroleum products industry in Canada. The findings and recommended actions should be communicated to various levels of government, members of the industry and customers of the industry.

Proposed Actions

- Continue joint dialogues on key issues through existing fora such as the PPIAC and the Joint Government Industry Committee on Transportation Fuels and Vehicle Control Technology.
- Maintain the industry database in evergreen condition.
- Communicate the findings of the study to a wide range of stakeholders and expand the partnership started with this study.

APPENDIX A2

INDUSTRY STRUCTURE AND PERFORMANCE

TABLE OF CONTENTS

Page

INDUSTRY STRUCTURE AND PERFORMANCE

The petroleum products industry represents the 'downstream' portion of the Canadian oil industry. It includes those companies which refine crude oil into petroleum products, transport them to distribution storage terminals and sell them directly to major users or through wholesale and retail outlets.

It operates independently from the 'upstream' sector of the petroleum industry which is engaged in oil and natural gas exploration, production and development. All downstream companies compete against each other on a level playing field and must perform satisfactorily within their markets in order to continue to justify ongoing investments by shareholders.

The largest companies own and operate refineries and marketing networks across the country. A second group of firms are regional refiner/marketers. The third group of companies — by far the largest number — do not refine crude oil and are involved only in marketing products in local (or regional) markets.

In the refining sector, 13 companies own and operated 24 refineries in 1993 in 8 provinces and one territory. This total is down from 36 refineries in 1980 following plant closures resulting from flat demand, acquisitions, growing competitive pressures and outdated technology.

In the distribution segment, all the refiners and some independent companies operate storage terminals and ship refined products to wholesale and retail outlets.

In the retail marketing segment, the 'majors' and the 'regional refiners' are joined in competition by a large number of independent companies who operate their own networks of retail outlets, usually in urban markets where the sales volumes are higher than in rural areas.

The vast majority of the industry is represented nationally by the Canadian Petroleum Products Institute whose headquarters are in Ottawa and whose regional offices are located in Halifax, Montreal, Toronto and Calgary.

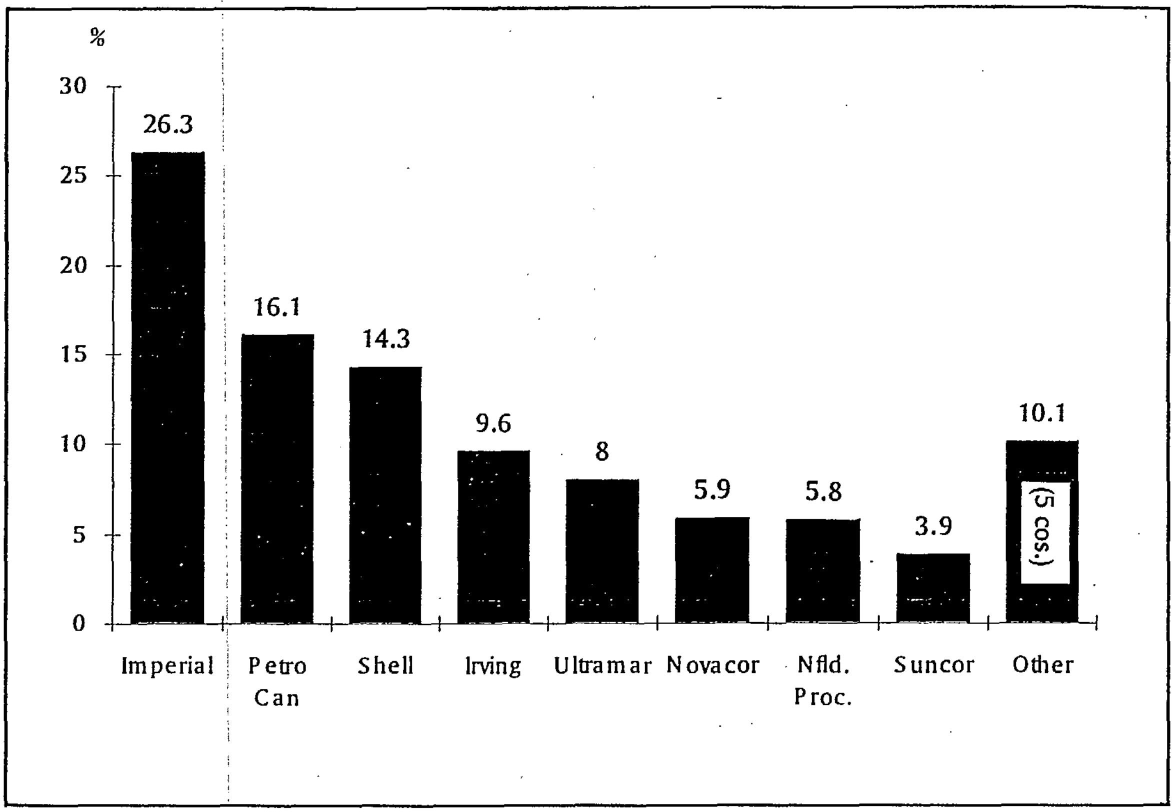
The Statistics Canada SIC codes applicable to the industry are 3610 and 3690, namely Refined Petroleum and Coal Products (i.e. virtually all refined petroleum products).

The industry's strengths and weaknesses must be assessed within the context of two overriding market conditions:

> Canadian petroleum products companies compete against each other in three highly competitive market environments, namely refining, distribution and marketing; and,
>
> The industry competes against international refiners and marketers in the United States, Latin America, Europe and the Middle East.

Figure 1

Concentration of Refinery Ownership (1992)



Source: Natural Resources Canada

The three largest refining companies, Imperial Oil, Petro-Canada and Shell Canada, are integrated with "upstream" (i.e. crude oil exploration, production and development) operations; they control 56% of Canada's refining capacity.

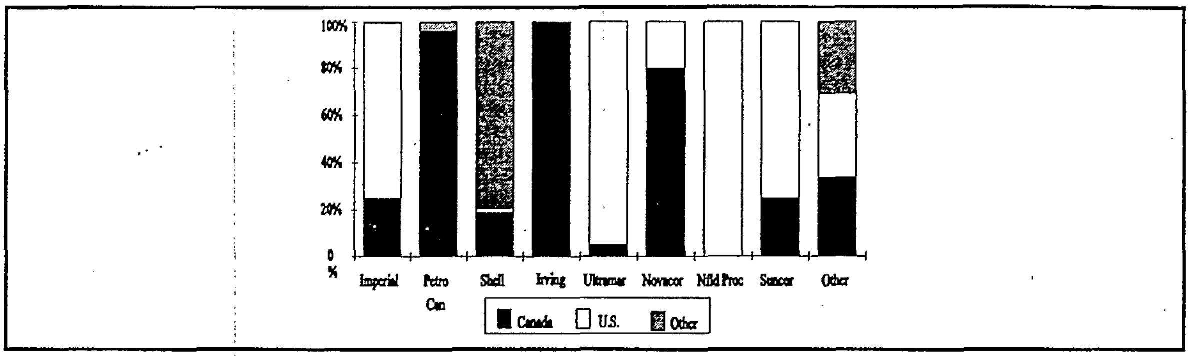
The 10 regional refiners, i.e. Irving Oil, Ultramar, Novacor, Newfoundland Processing, Suncor, Husky, Chevron, Co-Op-Newgrade, Saskatchewan Asphalt and Parkland, represent 44% of Canadian refining capacity.

The number of refining companies has declined over time mainly through acquisitions and consolidation. Texaco Canada (acquired by Imperial Oil) and Gulf Canada (acquired by Petro-Canada and Ultramar) are prominent examples of major corporate acquisitions during the past 10 years.

As a consequence of the reduction in demand for petroleum products and the acquisition and consolidation of activity that took place during the 1980's and early 1990's, both the number of national refining/marketing companies and the number of operating refineries have declined.

The Novacor refinery (formerly Polysar) in Sarnia is a specialized facility which processes crude oil into petrochemical products rather than into the full range of petroleum products (such as gasoline and diesel fuels). Newfoundland Processing and Ultramar (Dartmouth) are also unique facilities because their production is dedicated exclusively to export markets in the United States. Saskatchewan Asphalt produces only one product — asphalt.

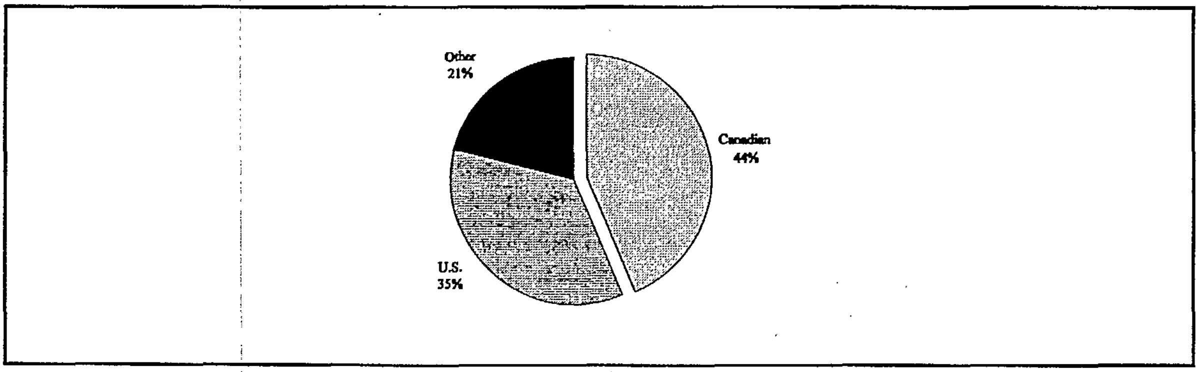
Figure 2
Company Ownership
(1992)



Source: Natural Resources Canada

Figure 3
Refinery Ownership
(as % of total capacity)

Source: Natural Resources Canada



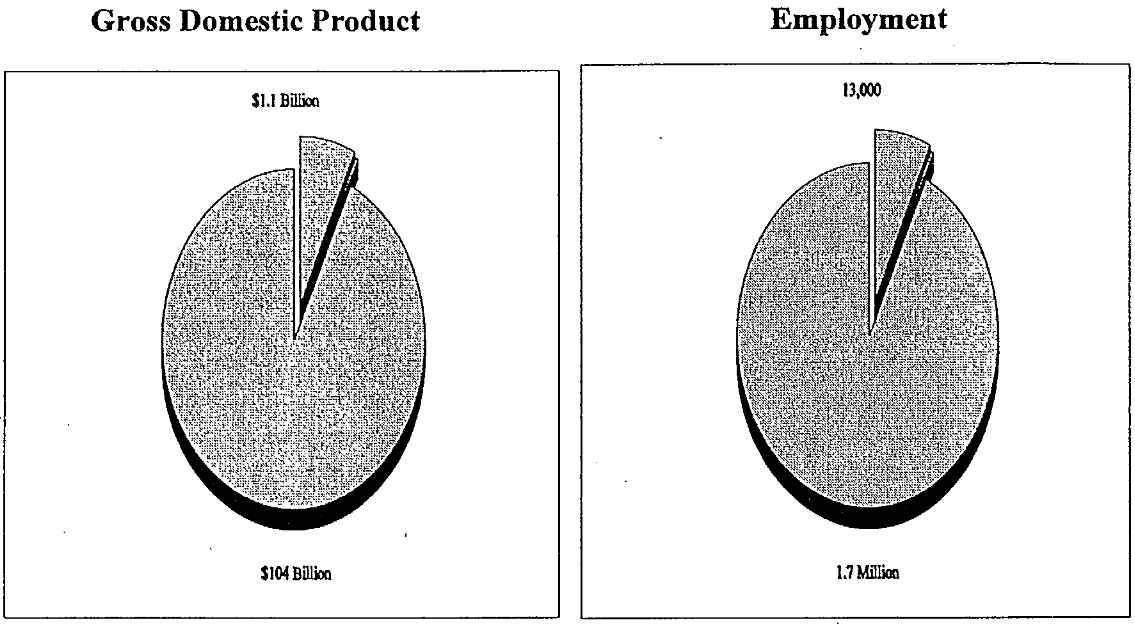
Canadian ownership represents 44% of refining capacity.

U.S. ownership is approximately 35%, and other foreign ownership, mainly European, represents 21%.

Figure 4

Refining Industry's Share of Total Manufacturing Sector

(1993, $ nominal)



Source: Informetrica Limited

The refining segment accounts for approximately $1.1 billion (or approximately 1%) of the Canadian manufacturing sector's Gross Domestic Product ('GDP'), and 13,000 (or approximately 1%) of the manufacturing sector's total employment.

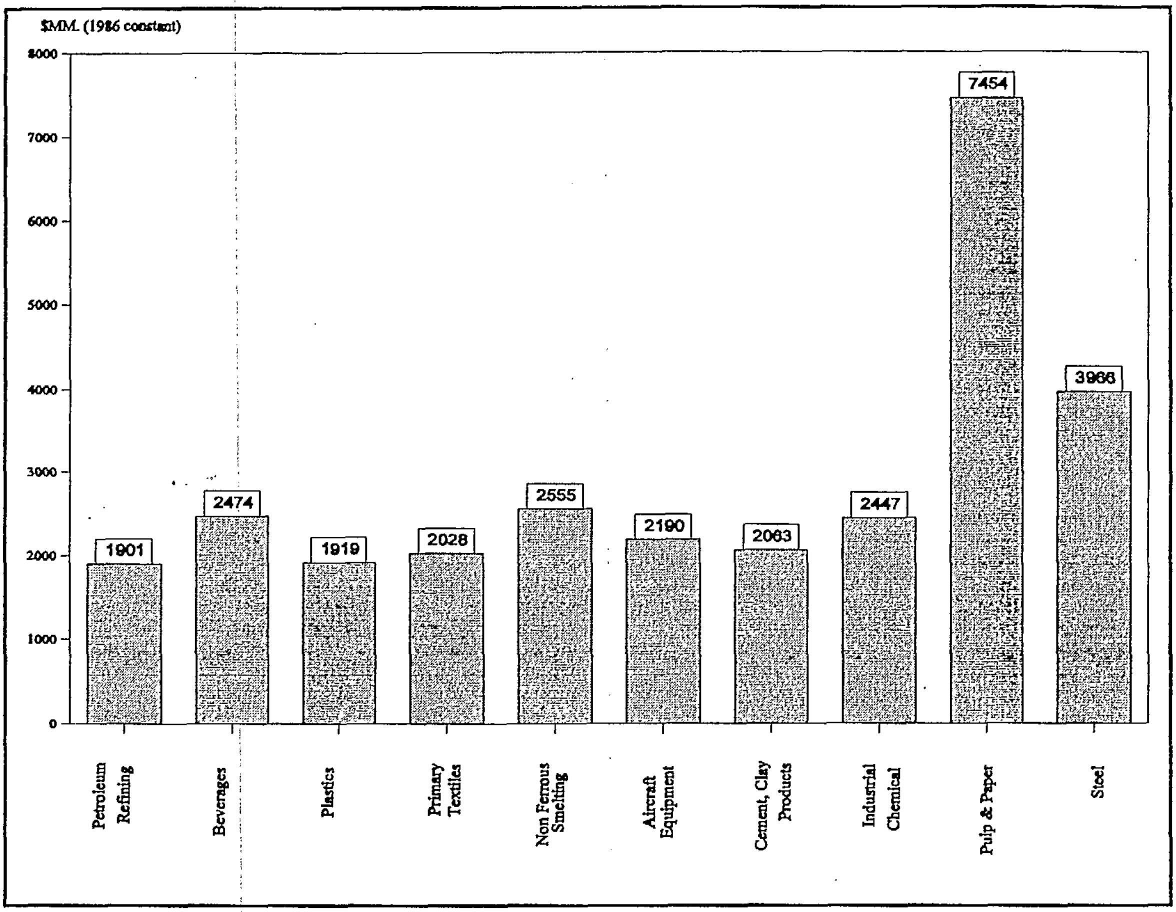
GDP represents an industry's "value-added" to the economy. It is calculated by determining the industry's total sales, from which are deducted certain costs such as crude oil feedstocks, transportation and construction costs and electricity.

The refining segment of the industry employs approximately 13,000 people directly.

Figure 5

GDP: Comparison between Petroleum Refining and Other Manufacturing Industries

(1993)

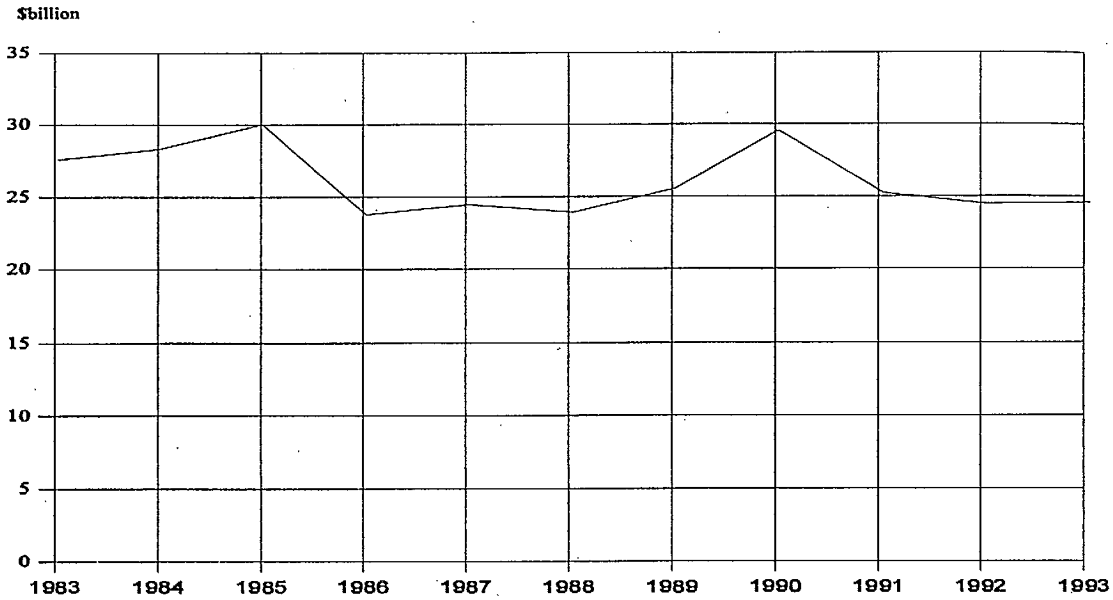


Source: Informetrica Limited

The petroleum refining industry's GDP is in the same order of magnitude as several other industries, including beverages (soft drinks, distilled and brewed products and wine), plastics, primary textiles and textile products, non ferrous smelting, aircraft equipment, cement and clay products and industrial chemicals.

Comparison has also been made with the pulp & paper and iron & steel industries because they, like the petroleum products industry, are subject to significant environmental and international competitive challenges.

Figure 6
Industry Revenues

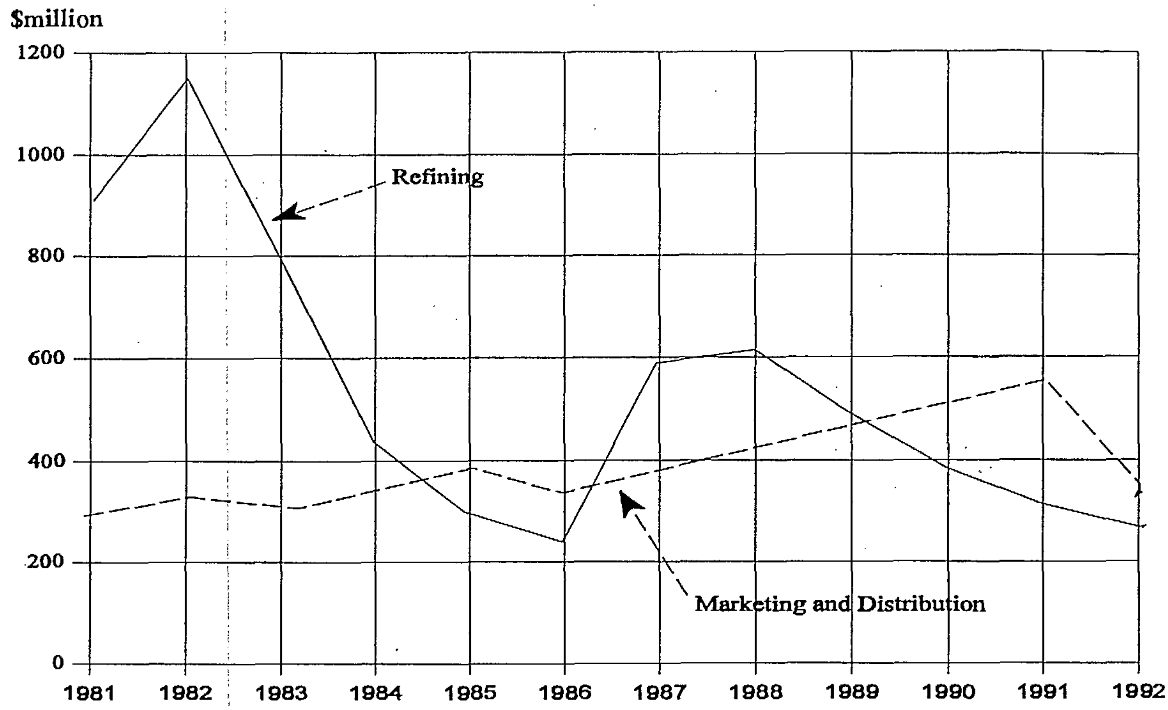


Source: Natural Resources Canada

Industry revenues (net of excise, sales and other taxes) have remained relatively flat during the last decade. In 1992, they were $24.4 billion, a decline of $1 billion from 1991. In constant dollars, the refining industry's revenues have declined.

The 'downstream' industry revenues closely track crude oil price changes.

Figure 7
Capital Expenditures



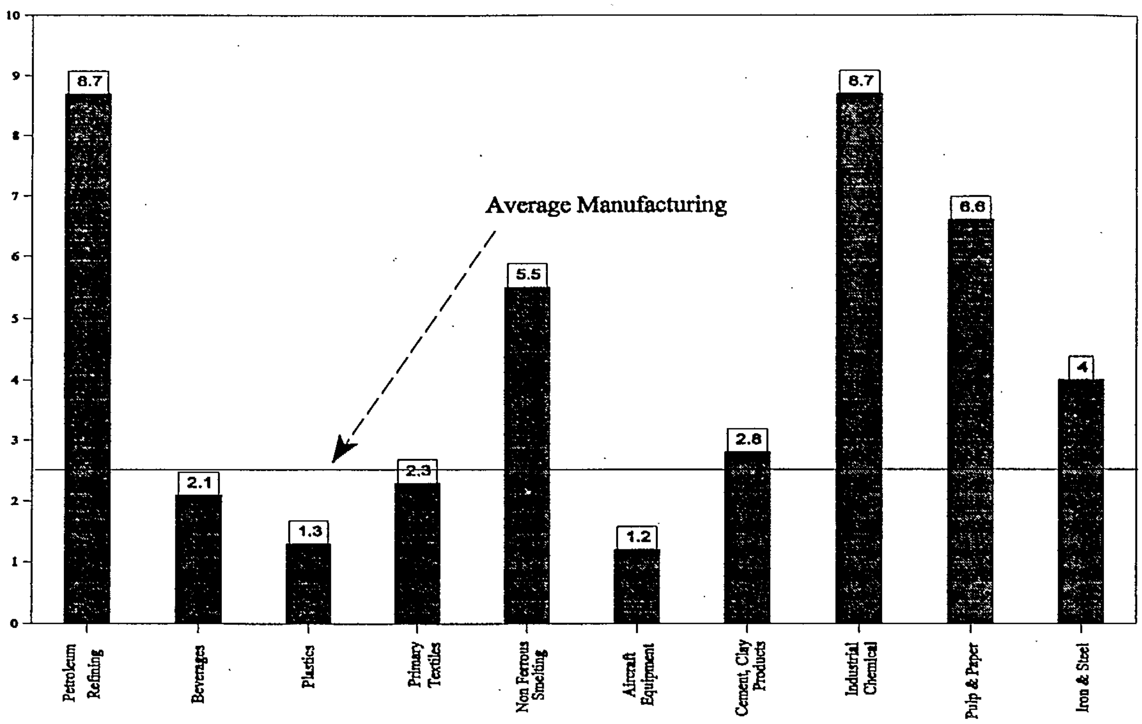
Source: Natural Resources Canada

The industry's aggregate capital expenditures have declined by 40% in four years as companies have struggled with inadequate profitability for over a decade, including a loss for the industry in 1983 and 1991.

After peaking at approximately $1 billion in the 1980 due to new plant construction, refinery investments (for capital expenditures) have averaged approximately $400 million/year since the mid-1980, showing a decline since 1988.

Investments in marketing and distribution grew during the mid and late 1980's. Tank replacement programs and site cleanups were the major areas of investment. Poor financial results and site rationalization programs lead to a reduction in expenditures since 1991.

Figure 8
Capital Intensiveness



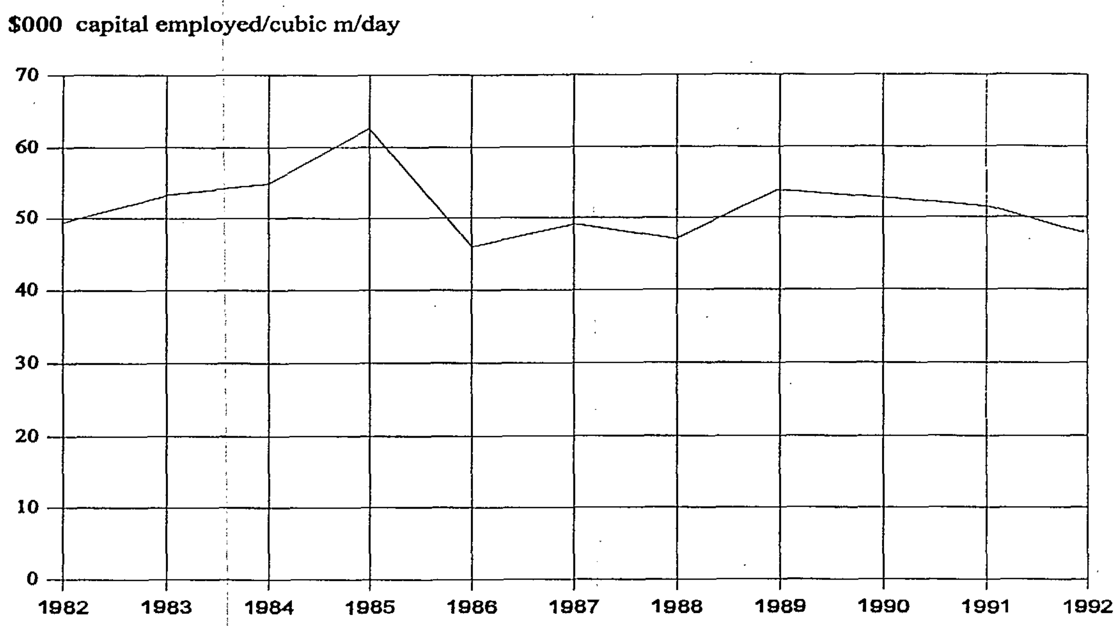
Source: Informetrica Limited

The capital intensiveness or capital-output ratio of an industry can be measured by determining the ratio of capital invested to Gross Domestic Product (value-added). This is calculated by dividing undepreciated capital stock by GDP.

It measures the capital investment per unit of value added. For example, there are 8.7 units of capital invested in the petroleum products industry for every unit of value-added.

The petroleum products and industrial chemicals industries are closely integrated and are very capital intensive. This underlines the industry's need for continued high levels of capital to renew its technology. The petroleum products industry is also capital intensive in comparison to the seven other manufacturing industries of equivalent size and to the pulp and paper, and iron and steel industries.

Figure 9
Capital Productivity

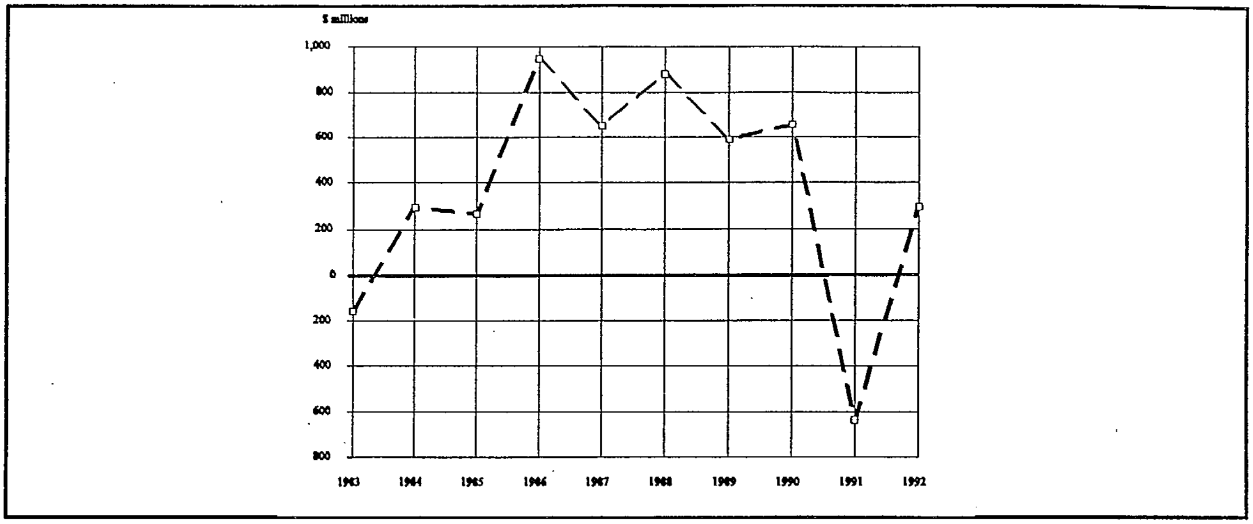


Source: Statistics Canada Cat. No. 57-601, Natural Resources Canada

The ratio of capital employed to refinery output, i.e. the industry's capital productivity, has remained steady in recent years, averaging approximately $50,000 of capital invested per cubic meter/day of production.

This index reflects total production and ignores the increase in production of high value lighter products (i.e. gasoline and diesel fuel) compared to a decade ago.

Figure 10
Net Income



Source: Natural Resources Canada

The industry's after tax profits have remained very modest relative to the amount of capital employed.

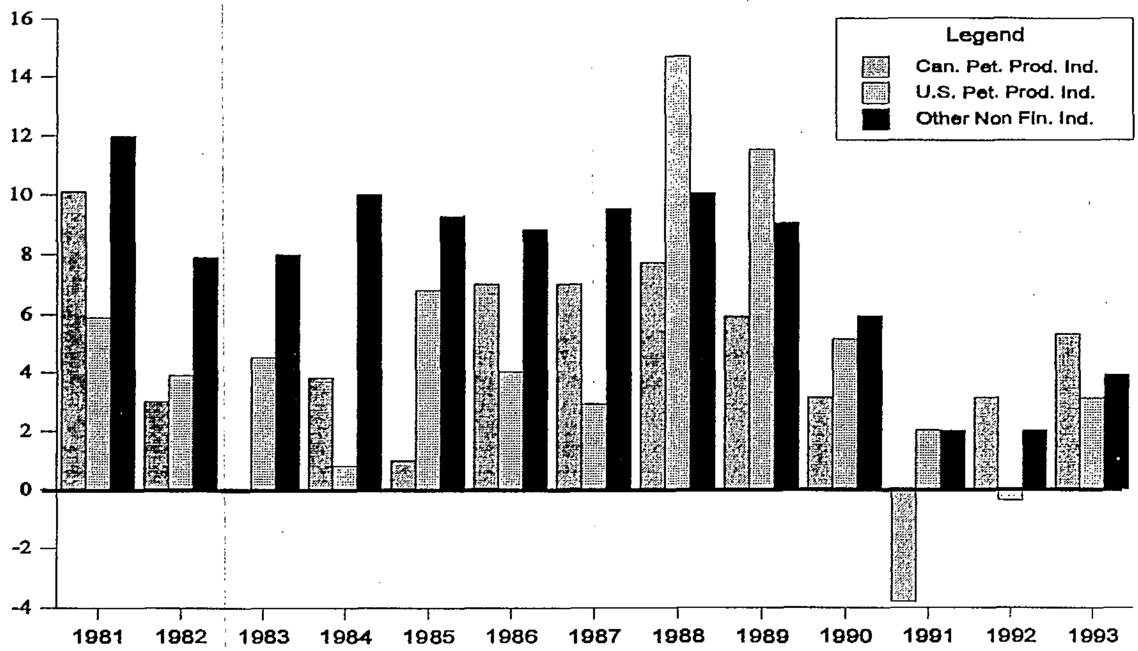
In 1992, the industry earned $292 million following a loss of $637 million in 1991. This loss was caused by the build-up of high cost crude inventories during the Gulf War which were not recovered in the market-place. During this period, the industry's accounting practices followed the First In First Out ('FIFO') rules.

Net income for the first half of 1993 was $203 million on the basis of preliminary reporting.

The impact of extraordinary items such as employee termination costs has been modest in 1992, as most of these costs were charged to prior years' results.

On a per litre of oil product basis, the 1992 results were the equivalent of 0.35 cents per litre profit for the oil companies. The preliminary results for the first half of 1993 were the equivalent of 0.51 cents per litre.

Figure 11
Return on Capital



Source: Natural Resources Canada, EIA Performance Profiles, Purvin & Gertz

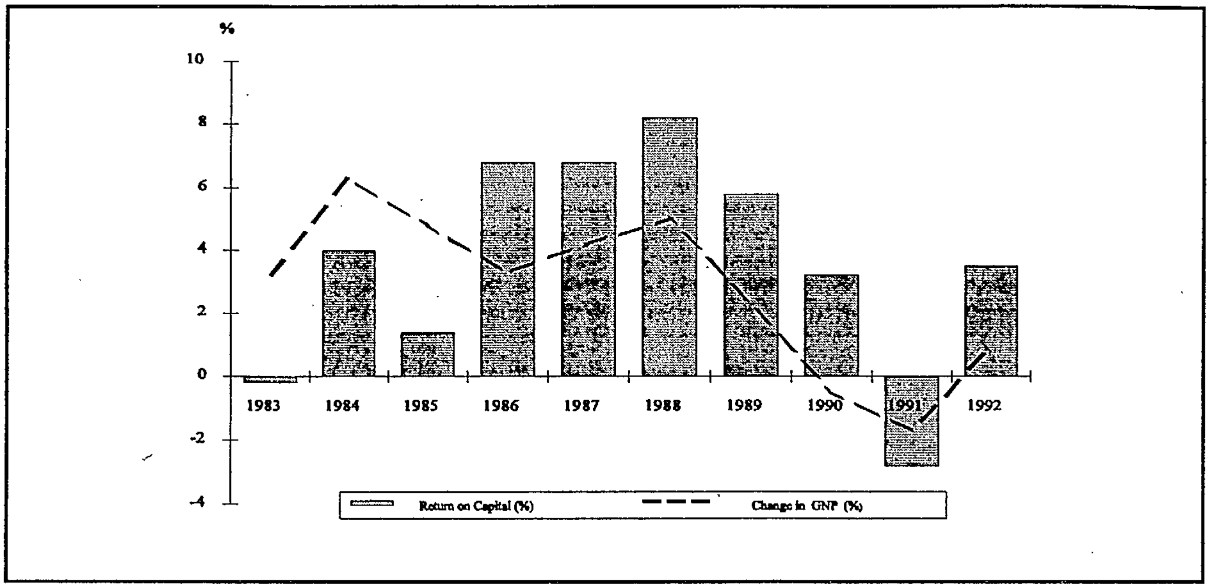
The financial performance of the petroleum products industry has been consistently (except for 1992) below the rest of the Canadian non financial sector.

This has occurred during upswings and downswings in the economic cycle.

With respect to the U.S. petroleum products industry, the Canadian industry has under-performed during 7 of the last 12 years. The Canadian twelve year average has been approximately 1% below the U.S. industry's average.

The heavy investments which the U.S. refining and marketing industry made during the mid 1980's to enhance their complexity, along with their greater size (which can lead to economies of scale) and higher utilization rates, have allowed the U.S. industry to achieve greater profitability than in Canada in four of the last five years.

Figure 12
Return on Capital vs. GNP

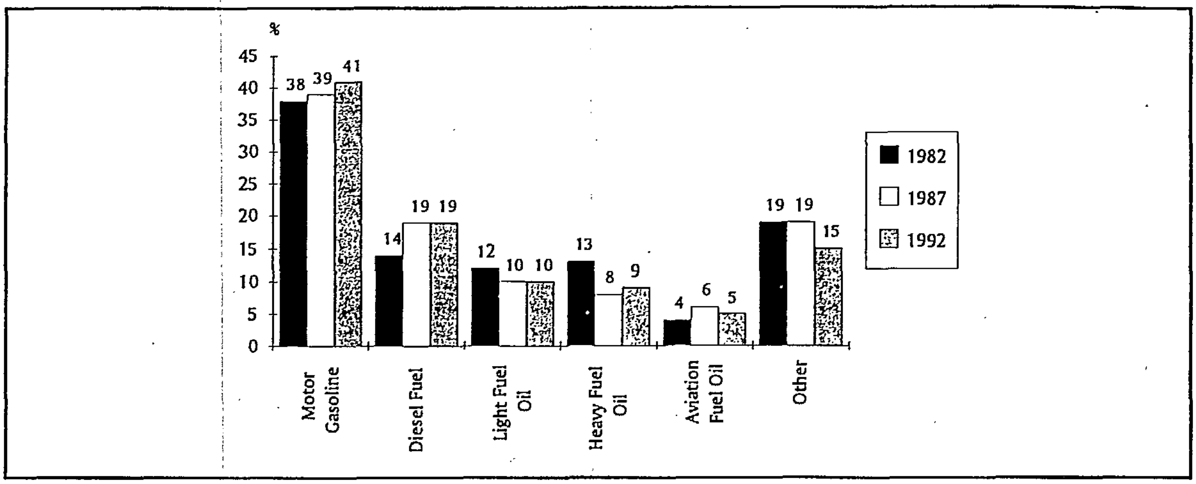


Source: Natural Resources Canada, Bank of Canada Review

There is a correlation between the industry's return on capital employed (ROCE) and changes in Gross National Product (GNP).

Changes in demand for petroleum products which occur when the economy moves into expansion or recession help ensure that the industry closely tracks the economic cycles.

Figure 13
Slate of Refined Products



Source: Natural Resources Canada & Statistic Canada

The petroleum products industry plays a vital strategic role in the Canadian economy by supplying products to key sectors of the economy.

Transportation is virtually 100% dependent on petroleum products. Conversely, over two-thirds of all refined products are consumed by the transportation sector, namely gasoline, diesel fuel, aviation fuel and lubricants. This represents an increase of approximately 10% from 1982.

Transportation fuels are higher value-added products which have the potential to generate higher refiner margins than non-transportation, 'black' products.

10% of refined products are light fuel oil ('LFO') which is used for fuel in home heating furnaces. And 9% is heavy fuel oil ('HFO') which is a by-product and is used mainly as boiler fuel in industrial furnaces.

The petroleum products industry is closely integrated with the petrochemical industry. The petrochemical industry buys approximately 5.5% of refined product output and uses them as feedstocks for higher value added products intended for domestic and export markets. In some cases, petroleum product and petrochemical facilities are owned by the same companies and are operated as integrated facilities. In the U.S., the petrochemical industry buys approximately 2% of refined product output, reflecting a larger base of natural gas.

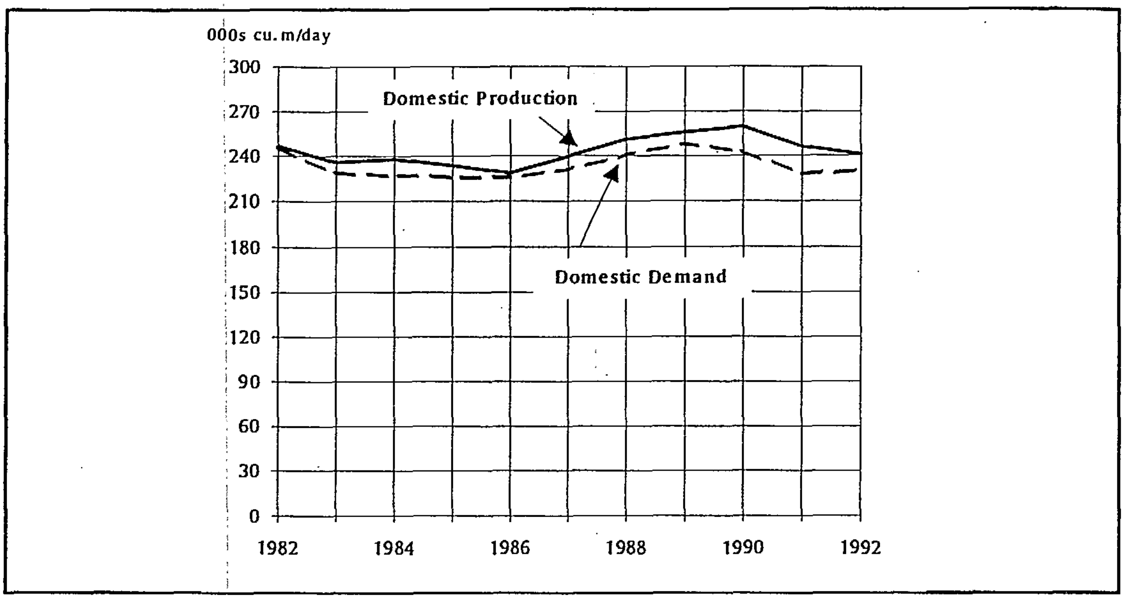
(Slate of Refined Products, Cont'd.)

"Other" products include liquefied petroleum gases ('LPG's'); petrochemical feedstocks; propane and butane; lubricating oils and greases (used for automotive and industrial purposes such as brake fluids, automatic transmission oils, industrial cutting oils or coolants and rust preventatives); asphalt; and petroleum coke (from refineries with cokers).

The lubricants and greases business can be a relatively high margin segment and includes several specialized companies in addition to the refiner-marketers.

Figure 14

Production and Demand for Petroleum Products



Source: Statistics Canada Cat. No. 57-601

Canada is self sufficient in petroleum products.

Demand for petroleum products is very sensitive to overall levels of economic activity. Demand increased during the late 1980 as the economy grew, followed by a decline as the economy slowed down during the recent recession.

The gap between supply and demand for all products increased during the past decade: Domestic production (which must not be confused with refining capacity) fell by 2% whereas domestic demand declined by 6%. The balance of domestic production entered the export market.

Gasoline demand, which represents approximately two-thirds of total transportation demand, decreased slightly during the decade as a result of increased fuel efficiency in vehicles. Canada and the U.S experienced significantly different trends in motor gasoline demand during the 1980's: U.S. demand increased 11% between 1982 and 1992 compared to the 3% decline in Canadian demand.

In Canada, average gasoline consumption per vehicle declined by 28% per automobile compared to only 8% in the U.S. during the 1980.

(Production and Demand for Petroleum Products, Cont'd.)

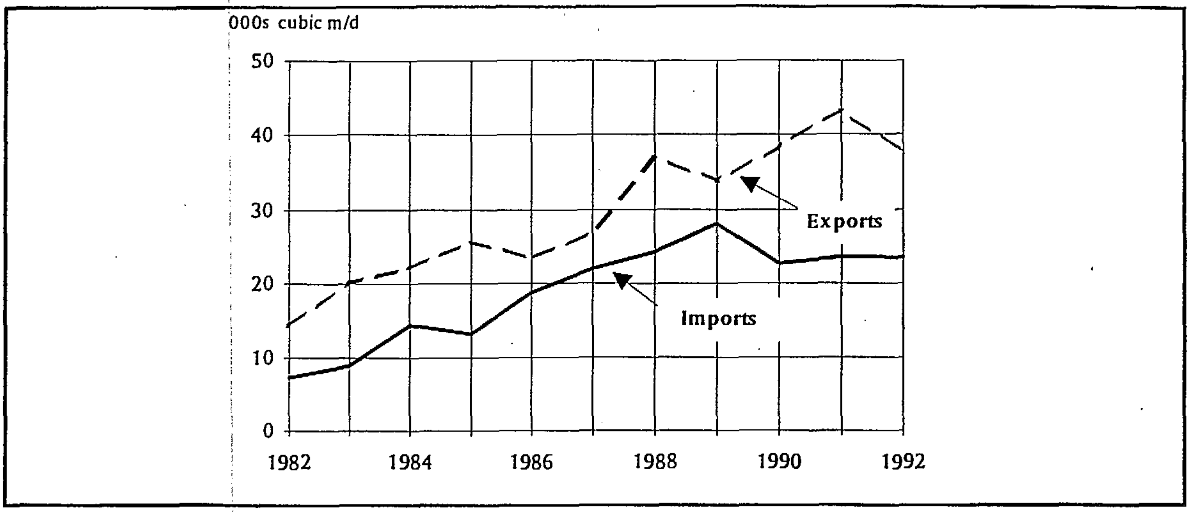
Contributing factors include the fact that:

- Canadian gasoline taxes (federal and provincial) increased by 18.7 cents per litre between 1980 and 1992 compared to only 7.3 cents per litre in the U.S.
- Automobiles in Canada consumed approximately 200 litres less fuel than in the U.S.(1990). (Canadians turn over their fleet of automobiles faster than in the U.S. which means that Canadian cars are more fuel efficient).

Light fuel oil (furnace heating oil) dropped from 12% to 10% of total production in the face of increased competition from natural gas and electricity. Diesel fuel grew from 14% to 19% of total production in response to increased truck and off-highway consumption.

Figure 15

Imports and Exports of Refined Products



Source: Statistics Canada Cat. No. 57-601

Although Canada's international trade in petroleum products is small relative to the overall size of the industry (i.e. it accounts for less than 10%), it is nevertheless large enough (approximately 14,000 cubic meters per day in 1992) to generate an $800 million surplus in Canada's balance of payments. The trend in international trade has been consistently upward during the past decade.

Exports:

The majority of Canada's refined product exports originate from three Atlantic refineries for export to northeastern U.S. markets. They are: Newfoundland Processing, Irving Oil (New Brunswick) and Ultramar (Nova Scotia). These refineries are able to transport their products to market by ship. This same ability to take advantage of the economics of bulk marine transportation tends not to be available to other refineries other regions (Ontario for example).

Almost all product exports go to the American market, i.e. $2.1 billion of total exports of $2.3 billion annually.

In 1992, there was a significant export surplus in motor gasoline (9,000 cubic meters per day), diesel fuel (5,000 cubic meters per day) and light fuel oil (7,500 cubic meters per day).

(Imports ands Exports of Refined Products, Cont'd.)

Imports:

Half ($755 million) of Canada's total petroleum product imports ($1.5 billion) arrive in Canada from the United States. The other half is delivered by offshore tanker to ports on the St. Lawrence and, to a lesser extent, the Atlantic coast.

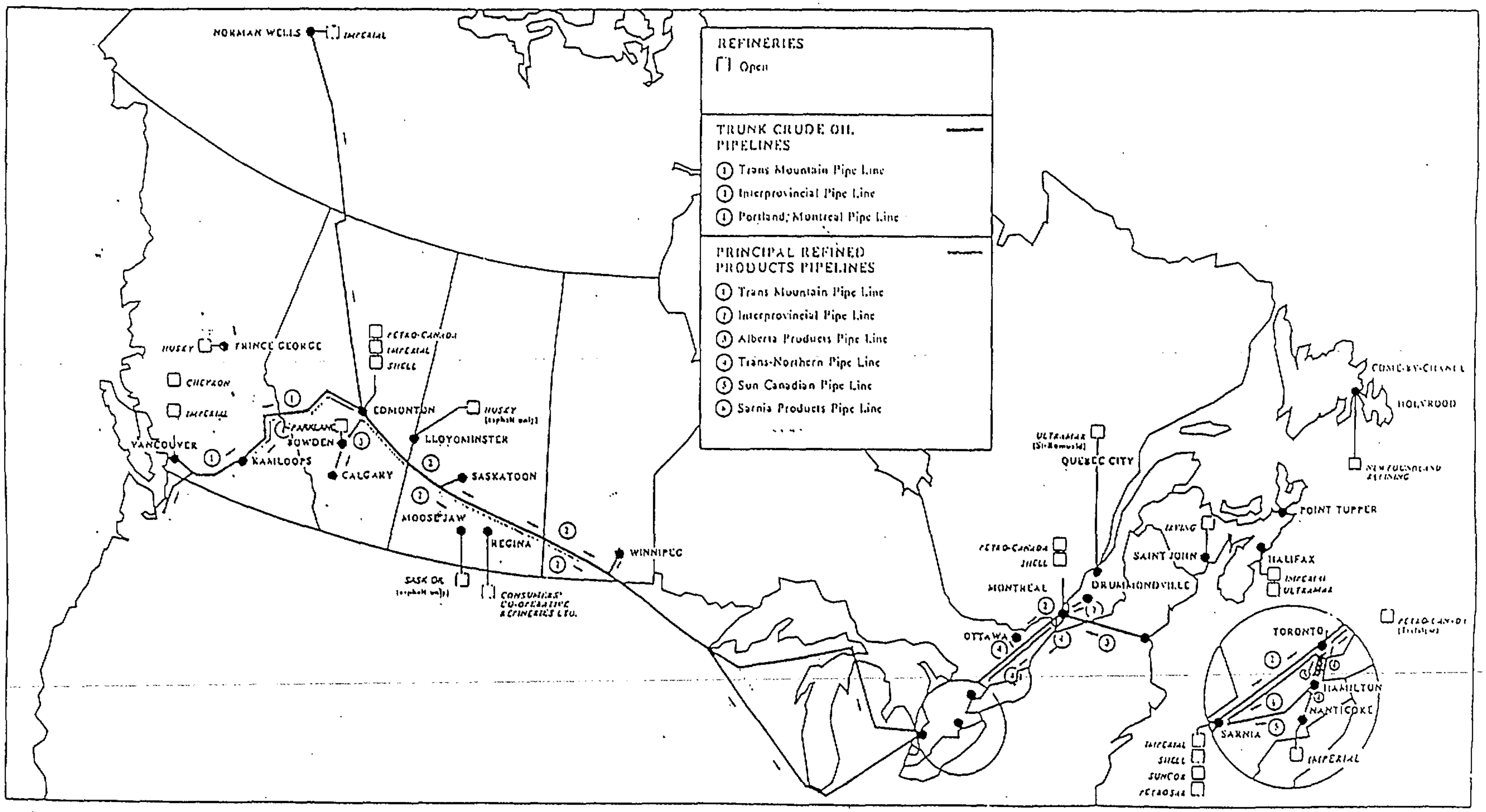
Most product imports enter the Canadian market in Ontario and Quebec.

Almost all product imports enter duty-free into Canada.

Canada ran a deficit in 1992 in heavy fuel oil (2,000 cubic meters per day) and a 3,500 cubic meters per day deficit in "non-energy products" (asphalt, coke, lubricating oils and greases).

Net imports of heavy fuel oil into Canada were 2000 cubic meters per day.

CANADIAN REFINERIES AND MAJOR PIPLINES



Source: Purvin & Gertz

Pipelines, Distribution and Pricing

Crude Oil

There are three main sources of crude oil for domestic refineries: (i) Western Canada, mainly Alberta and Saskatchewan, which supplies central Canada through the Interprovincial Pipe Line system and, to a much lesser extent, supplies British Columbia through Trans Mountain Pipe Line; (ii) offshore imports through Maine via the Portland Montreal Pipe Line to Montreal refineries; and (iii) offshore imports to Quebec City and Atlantic refineries via the St. Lawrence River and Atlantic ports respectively.

Domestic crude oil accounts for 63% of refinery feedstock.

The major sources of imported crude oil in 1992 were the U.K. and Norway (29% each), Saudi Arabia (15%), Nigeria (10%) and Mexico (6%).

Canadian crude oil prices have been established by the world crude oil market since they were decontrolled in 1985. Canadian crudes serve the Canadian market and northern border markets in the U.S. The Chicago market tends to be the major clearing centre for Canadian crude production, i.e. where Canadian and U.S. crudes compete directly for market share. Since Canadian crude prices are directly related to U.S. crude prices at Chicago, changes in U.S. domestic crude prices are immediately reflected in Canadian crude prices.

Canadian light crude (Alberta Mixed Blend) competes against other light crudes at Chicago, including West Texas Intermediate ('WTI') and North sea crudes (i.e. Brent). Canadian heavy crudes are also compared with imported heavy crudes at Chicago: Cold Lake Blend competes with imports of heavy Maya crude from Mexico.

Although the Ontario market relies mainly on western Canadian crude oil, it also imports crudes from the U.S. or through the U.S. Gulf Coast (en route from offshore sources). Discussions are under way to reverse Sarnia-Montreal pipeline ('Line 9') to allow imported crude to be shipped from Portland and Montreal into Ontario, which would increase the supply flexibility of Ontario refineries.

Price differentials between light and heavy crudes provide refineries with the incentive (or disincentive) to process heavier, sour crudes.

Refined Products

Refined petroleum products are distributed by pipeline, ship and truck to terminals or "tank farms" in major population centres, from which they are

delivered directly to customers or other distributors. Interprovincial Pipe Line, Trans Northern Pipe Line and Trans Mountain Pipeline are the largest distribution systems for refined products.

Some large industrial customers and independent retailers buy directly from refineries or import directly and by-pass Canadian refineries.

Product imports originate mainly from U.S. sources. They are either pipelined to Chicago and Detroit, or they arrive by tanker in New York harbour and are then pipelined to Buffalo. Products are trucked from U.S. border terminals which limits their geographic range.

Canadian wholesale product prices are closely tied to product prices in the U.S. market. Spot prices on the U.S. Gulf Coast, New York and Chicago are well established benchmarks for products traded across North America. Marketers often value their products at the spot price as their marginal cost of supply, whether purchased from their own refineries or on the open market. Refining economics are usually based on product spot prices.

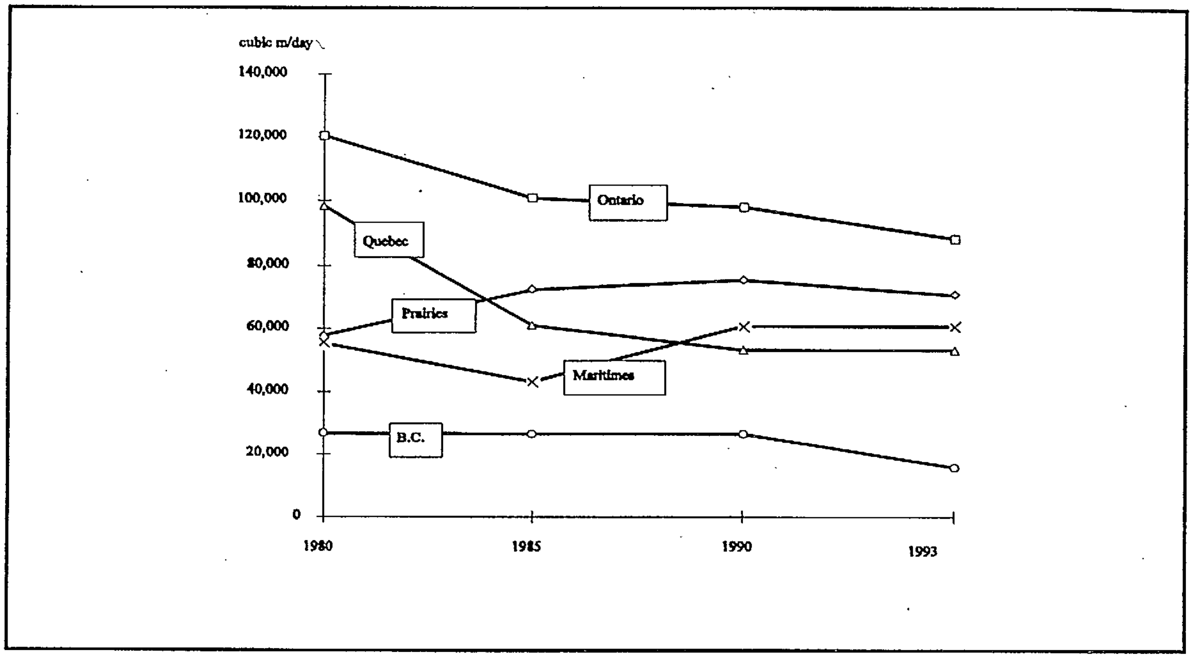
Wholesale prices in Ontario and Quebec reflect product prices in adjacent U.S. markets, adjusted for transportation costs. For example, when Canadian refiners export products, Toronto wholesale prices closely approximate Buffalo prices, minus transportation costs. Conversely, product imports are priced at the Buffalo distribution point, plus transportation costs. Buffalo prices are closely linked to prices at refineries and terminals in the New York - New Jersey - Philadelphia area due to the direct pipeline connections between them.

Quebec wholesale prices strongly reflect spot prices in New York, adjusted for transportation. New York spot prices, in turn, are closely tied to U.S. Gulf Coast prices because the products are transported from there by ship or pipeline.

Atlantic wholesale prices are also related to spot prices on the U.S. Gulf Coast.

In western Canada, wholesale product prices are less influenced by U.S. prices because of the greater distances between customers in the prairies and U.S. refineries. Changes in product prices more closely follow crude prices. In British Columbia, wholesale prices are influenced by Edmonton and Anacortes (Puget Sound) refinery prices because of the very large amount of product refined in Edmonton and pipelined (as semi-finished product) through the Trans Mountain Pipe Line system.

Figure 16
Regional Processing Capacity



Source: Petroleum Processing in Canada (1977, '90, '92)
Natural Resources Canada

There are 24 refineries operating in Canada with a total capacity of 289,000 cubic meters per day. This represents a one-third decrease (from 36) in the number of refineries and a decline of 65,000 cubic meters per day (18%) in processing capacity since 1980.

There are five refining 'regions' in Canada: British Columbia, Alberta, Ontario, Quebec and Atlantic Canada.

B.C. facilities receive crude and semi-refined products by pipeline from Edmonton. The crude oil processing capabilities of two Vancouver-Burnaby refineries have been closed, and a third closure has been announced for 1994. They upgrade semi-refined feedstock from Edmonton into the full slate of products.

Alberta refineries have become the dominant source of petroleum products in western Canada.

Eastern Canada and West Coast refineries are under the most competitive international pressure from offshore products.

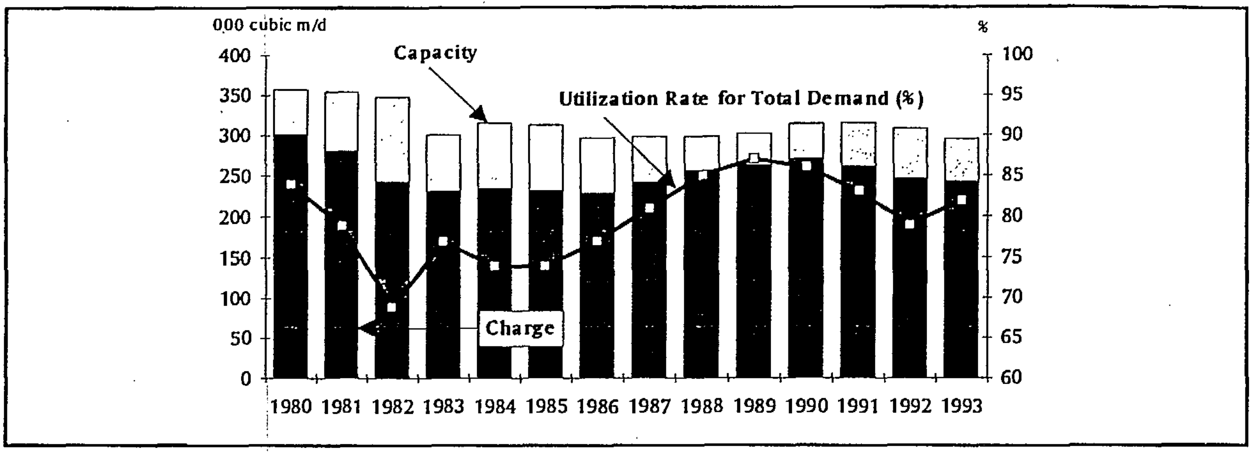
Atlantic refineries (Irving Oil, Ultramar Canada and Newfoundland Processing) are much more geared to export markets (in the northeastern U.S. and Europe) than refiners in other regions of Canada. This is largely due to the availability of deep water ports.

Companies often sell products to competitors in one centre or region and buy from them in another. Extensive exchange arrangements increase the market's effectiveness and reduce the cost of surplus refining and distribution networks.

Refining Capacity in Canada
(1993)

Company	City	Province	Crude Capacity (m^3/d)
Atlantic Region			
Newfoundland Refining	Come-By-Chance	NFLD	16700
Imperial Oil	Dartmouth	NS	13100
Ultramar Canada	Halifax	NS	3180
Irving Oil	Saint John	NB	27700
			60,680
Quebec Region			
Petro-Canada	Montreal	QUE	14300
Shell Canada	Montreal	QUE	19070
Ultramar Canada	St Romuald	QUE	19800
			53,170
Ontario Region			
Imperial Oil	Nanticoke	ONT	16900
Imperial Oil	Samia	ONT	19310
Petro-Canada	Oakville	ONT	12800
Novacor Chemicals	Samia	ONT	17000
Shell Canada	Samia	ONT	11280
Suncor	Samia	ONT	11200
			88,490
Prairie Region			
Co-Op/Newgrade	Regina	SASK	7180
Saskachewan Asphalt	Moose Jaw	SASK	2110
Imperial Oil	Edmonton	ALTA	26200
Petro-Canada	Edmonton	ALTA	19310
Husky	Lloydminster	ALTA	3650
Parkland	Bowden	ALTA	950
Shell Canada	Scotford	ALTA	10872
Imperial Oil	Norman Wells	NWT	510
			70,782
British Columbia			
Chevron Canada	Burnaby	BC	7150
Imperial Oil	Vancouver	BC	7200
Husky	Prince George	BC	1530
			15,880
Total Canadian Capacity			**289,002**

Figure 17
Refining Capacity Utilization



Source: Petroleum Processing in Canada, Natural Resources Canada

There is a close correlation between refinery capacity utilization and refining profitability. North American refineries need to operate at approximately 85% or higher of crude capacity in order to achieve an adequate level of profitability. This reflects the high proportion of fixed to variable costs in refinery operations.

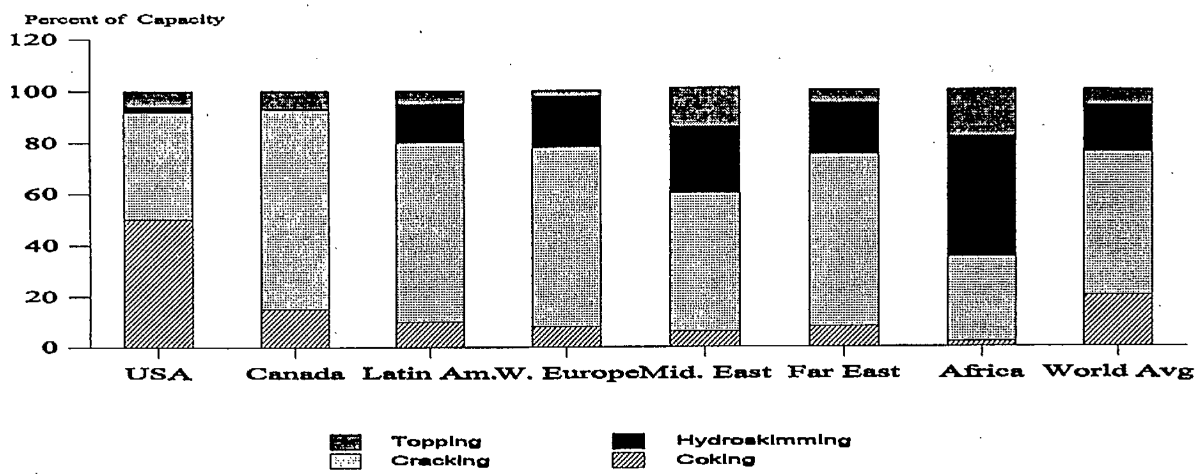
Refining economics are particularly sensitive to the utilization of facilities which convert crude into high end, value-added light products. The utilization of 'conversion capacity' to produce these products, usually cracking facilities, can be maximized by supplementing crude with purchases of other feedstocks such as catalytic cracker feedstock ('cat feed').

As noted in the earlier discussion ('Pipelines, Distribution and Pricing'), refineries which are not located on tide-water (i.e. those outside Atlantic Canada) obtain lower margins on product exports than on domestic sales because the transportation costs are largely absorbed by the exporter. Consequently, increasing capacity utilization by exporting may not result in increased refinery profitability and in some cases may lower the profitability.

This suggests that the most important measurement of the refiners' capacity utilization is domestic rather than total sales (for refiners outside Atlantic Canada).

To achieve high utilization rates, companies have been forced to close refineries in all regions of the country during the last decade.

Figure 18
Refining Processes



Source: Purvin & Gertz, 1992

Refiners around the world have been shifting away from light, sweet crude oil feedstocks toward heavier, sour grades. This transition reflects the diminishing supplies of lighter crudes which result in attractive price differentials between heavy, sour crudes and higher quality crudes.

In Canada, the proportion of light sweet conventional crude oil production in western Canada has declined from 51% in 1985 to 39% in 1992. This decline has been offset by increased production of non conventional crude (i.e. synthetic crude manufactured from oil sands production) and condensate. Combined, the quality of crude produced in western Canada is forecast to remain fairly constant to the year 2000, with around 55% expected to be light, sweet (conventional and non conventional) crude.

Most Canadian refineries were designed to run on light, sweet crudes. Many therefore have difficulty processing heavy, sour crudes and large volumes of non conventional crudes — both of which are becoming more plentiful and economic.

Price differentials between products and crudes (the 'crack spread') and between light and heavy crudes must be adequate over the long-term to justify the investments in facilities which can convert residual (low-end) products into transportation (high-end) products. These facilities (cokers and crackers) become more technologically advanced and expensive as the quality of crude oil declines.

The major refining processes are, in descending order of complexity: coking, cracking (catalytic and hydrogen), hydroskimming and topping.

Coking and cracking capacity are indicative of the highest levels of refining complexity.

Coking capacity allows further refinement of residual products into lighter and high value products. For example, cokers virtually eliminate all residual HFO. These facilities are highly desirable as lower grade crudes are expected to comprise an increasing portion of refinery feedstock in the future.

Cracking refineries convert most of the crude oil to gasoline, distillates and a high yield of residual fuel oil. As crudes become more sour, the residual fuel oil becomes more difficult to sell, primarily for environmental reasons (i.e. high sulphur content). Because HFO is a by-product, it is priced to clear the market and avoid storage costs.

The U.S. capacity to refine heavy sour crudes is substantially greater than the rest of the world. American refiners invested heavily during the 1980 to increase their 'complexity' in anticipation of a growing price differential between light and heavy crudes. Although Canada ranks considerably ahead of most world competitors in this respect, it nevertheless remains far behind the U.S., particularly with respect to coking.

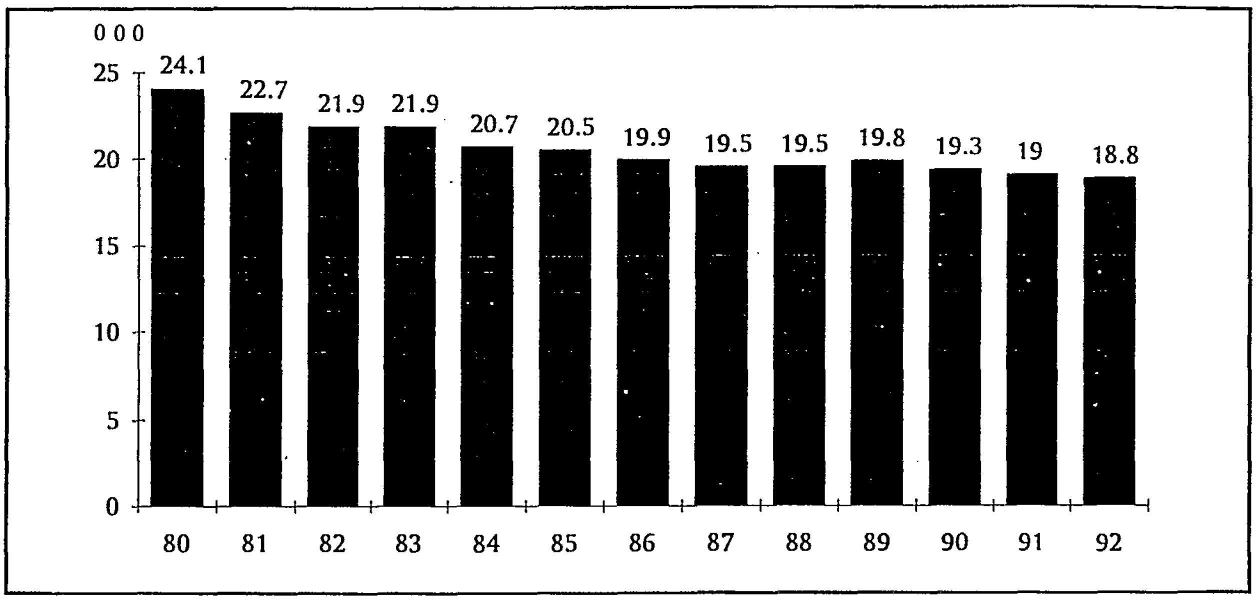
Canadian refiners did not invest in new complex technology during the 1980 to the same extent as American refiners because the differential between Canadian light and heavy crude oil prices was artificially set by the federal government rather than by international market forces. The administered (light/heavy) price differential was less than the open market spread, and too low to justify major facility investments.

The relative lack of complexity among Canadian refineries compared to U.S. refineries places considerable cost pressures on refineries in southern Ontario and Quebec whose margins are influenced by imported products from refineries with a lower cost structure.

Figure 19

Number of Retail Outlets

(1992)

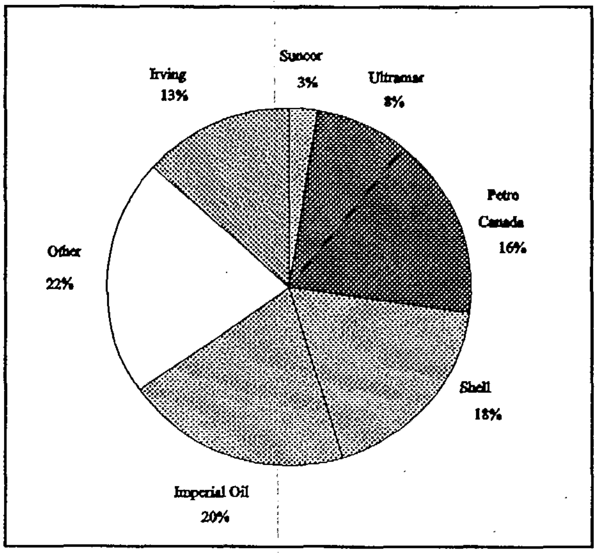


Source: Natural Resources Canada

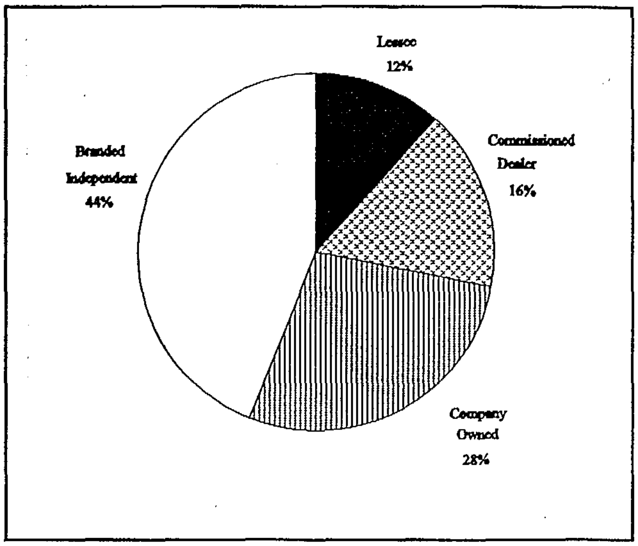
The number of retail outlets has continued to decline in recent years. Companies have closed lower volume, less efficient stations in order to reduce the cost per unit sold.

Figure 20
Gasoline Retail Outlets
(1992)

Retail Outlet Brand



Type of Retail Outlet



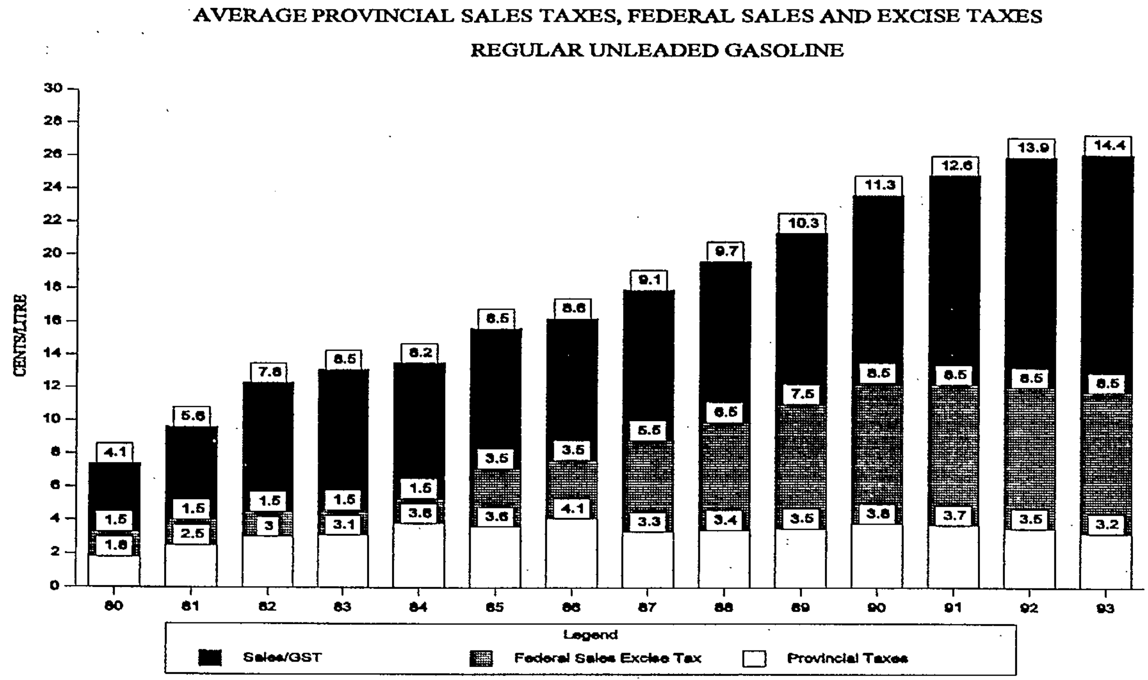
Source: Octane Magazine

Six companies account for three-quarters of Canada's retail outlets namely Imperial Oil, Shell Canada, Petro-Canada, Irving Oil, Ultramar and Suncor. The first four account for nearly two-thirds (64%) of the total.

There are four main types of gasoline retail outlets: **company-owned** (i.e. the facilities are owned by the product supplier, namely the oil company, and the employees are salaried by the oil company); **commissioned dealer** (i.e. the facilities are owned by the product supplier and the dealer operates on a commission basis); **lessee** (i.e. the facilities are owned by the product supplier and the products are owned by the dealer); and **branded independent** (i.e. the facilities and the product are both owned by the dealer).

Rationalization of retail networks is changing the mix of different types of stations. Branded independents are by far the largest type of outlet. They are independently owned and operated stations, and can be either refiner or non-refiner branded. They are being closed faster than other outlets, and now account for 43% of the market compared to 48% a year ago (i.e. 800 fewer — 7,560 versus 8,360 in 1992).

Figure 21
Gasoline Taxes

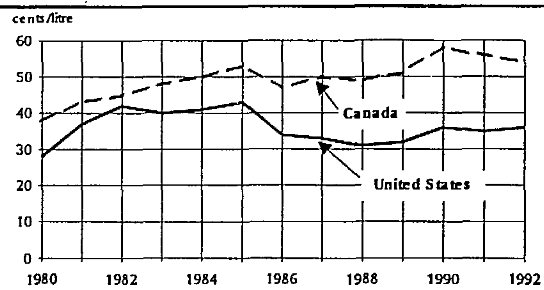


Source: Natural Resources Canada
Federal and Provincial Petroleum Product Taxes, Natural Resources Canada

Federal taxes (excise and sales — now GST) and provincial taxes have increased 235% since 1980; this represents an average annual increase of over 17%.

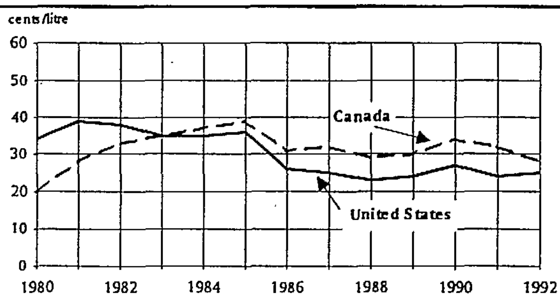
Figure 22
Marketing Comparisons:
Canada and the United States

Average Price of Regular Unleaded Gasoline
(Including Taxes)



Average Price of Regular Unleaded Gasoline

(Excluding Taxes)



Source: A Review of Gasoline Retailing

Canada vs. United States Update 1980-90
Natural Resources Canada

American consumers have enjoyed lower gasoline prices than Canadians for a decade. This is mainly attributable to higher federal and provincial taxes in Canada. Canadian taxes represent approximately one-half of the purchase price of gasoline.

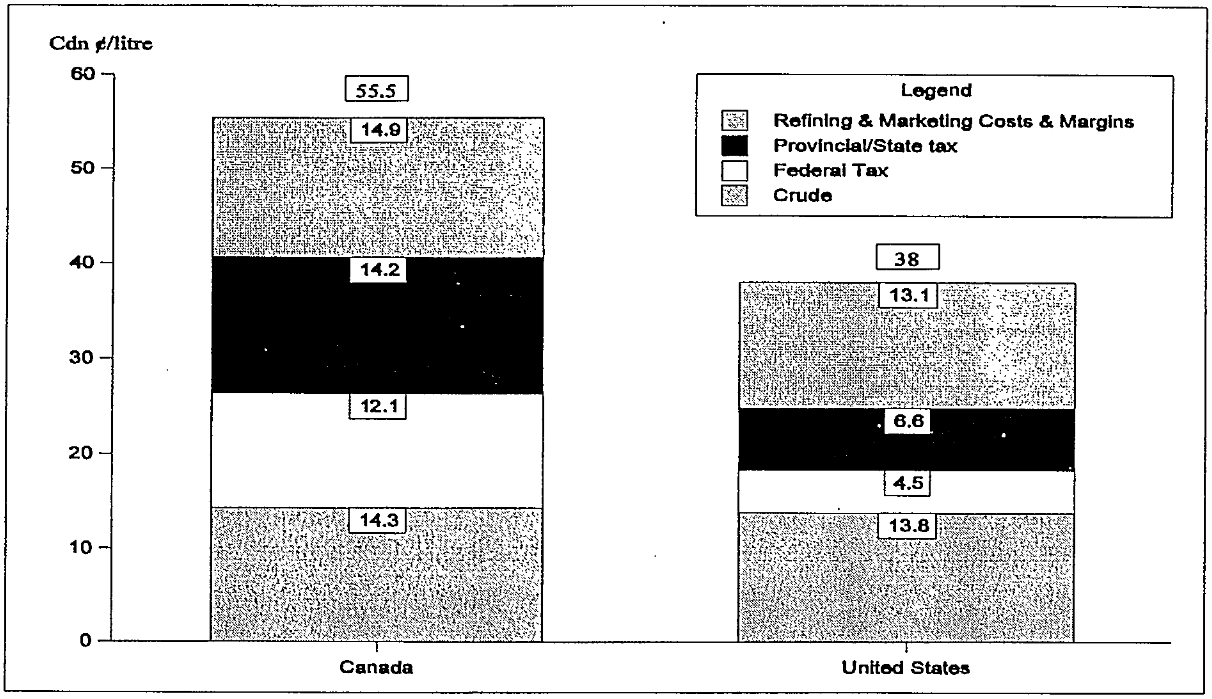
Other contributing factors include larger and more sophisticated (or complex) American refineries and greater economies of scale (resulting from ten times the population) in the refining and distribution segments of the business.

Figure 23

Marketing Comparisons: Canada and the United States

(1992 Average)

Pump Price Components

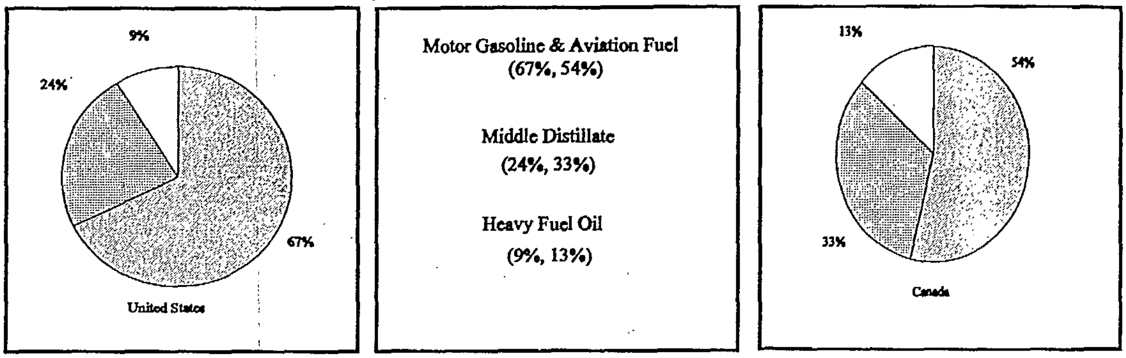


Source: Petroleum Product Market Report
Natural Resources Canada
Exchange Rate: $Cdn. 1.2087 = $U.S. 1.00

Federal and Provincial taxes account for almost 50% of the purchase price of gasoline.

Figure 24
Marketing Comparisons: Canada and the United States
(1990)

Sales of Main Petroleum Products



Source: A Review of Gasoline Retailing
Canada vs. United States Update 1980-90
Natural Resources Canada

The average product slate produced by refiners not only affects the cost of petroleum products, but also their profitability.

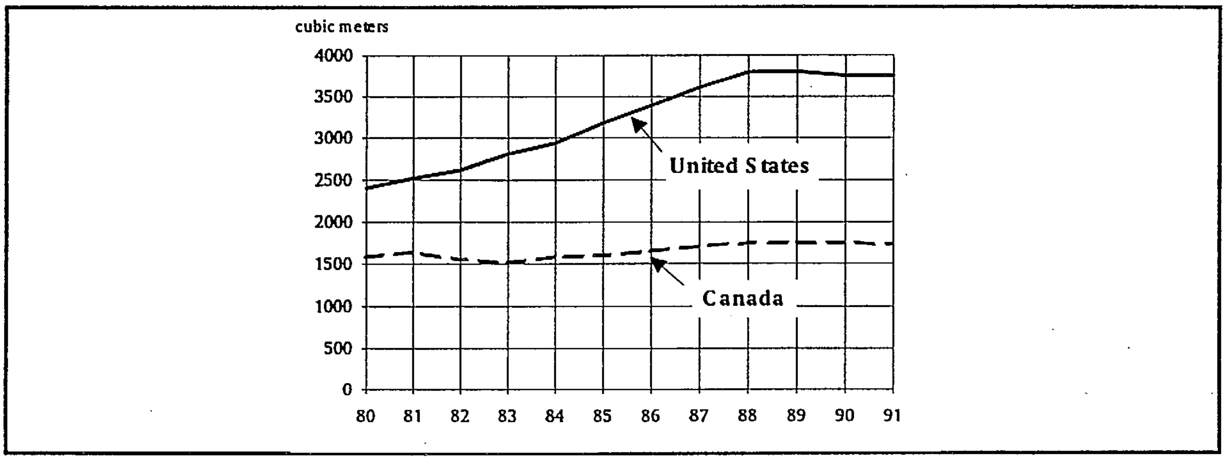
The petroleum product mix in the U.S. has a higher proportion of high value-added products – gasoline and aviation fuel (67%) – than in Canada (54%). This reflects the older and less fuel efficient vehicle fleet in the U.S. and the much larger number of American military planes.

In Canada, conversely, there is greater demand for lower value-added products (distillates and heavy fuel oil) than in the U.S. This reflects Canada's heavier reliance on the resources sector (e.g. pulp and paper, mining and oil and gas) and the severity of Canadian winters which increases consumption of heating oils.

Heavy fuel oil ('HFO') is a refinery by-product. Because it is priced to clear the market, it generally has a low (and sometimes negative) margin. As refinery processes become more complex by adding coking facilities, the amount of HFO declines and is replaced by lighter products, thereby increasing the refinery's profitability.

Figure 25
Marketing Comparisons: Canada and the United States

Average Yearly Sales per Retail Outlet (m3)



Source: Natural Resources Canada

The rate of outlet rationalization in the U.S. outpaced Canada during the 1980s resulting in American stations that are twice as productive as Canadian stations. This allows for greater profitability due to significantly lower average unit costs. For example:

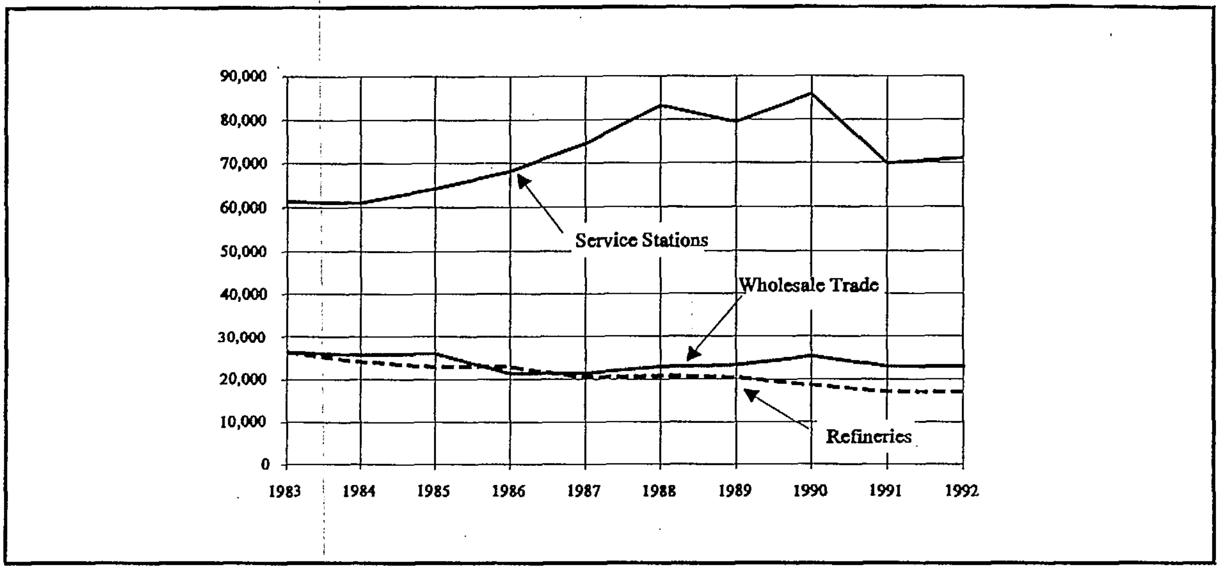
Average sales per Canadian outlet increased by 10% during the 1980s compared to 56% in the United States;

American stations experienced much larger efficiency gains which resulted in average sales being twice (10,000 litres per day) those of the average Canadian station (5,000 litres per day).

During the 1980s, the average number of cars per U.S. outlet increased by 531 to 1,280 (70%) whereas it increased by only 228 to 648 (54%) in Canada;

Canadian companies are continuing their rationalization programs to improve the productivity of their stations.

Figure 26
Petroleum Product Industry
Total Employment



Source: Statistics Canada Cat. No. 57-601

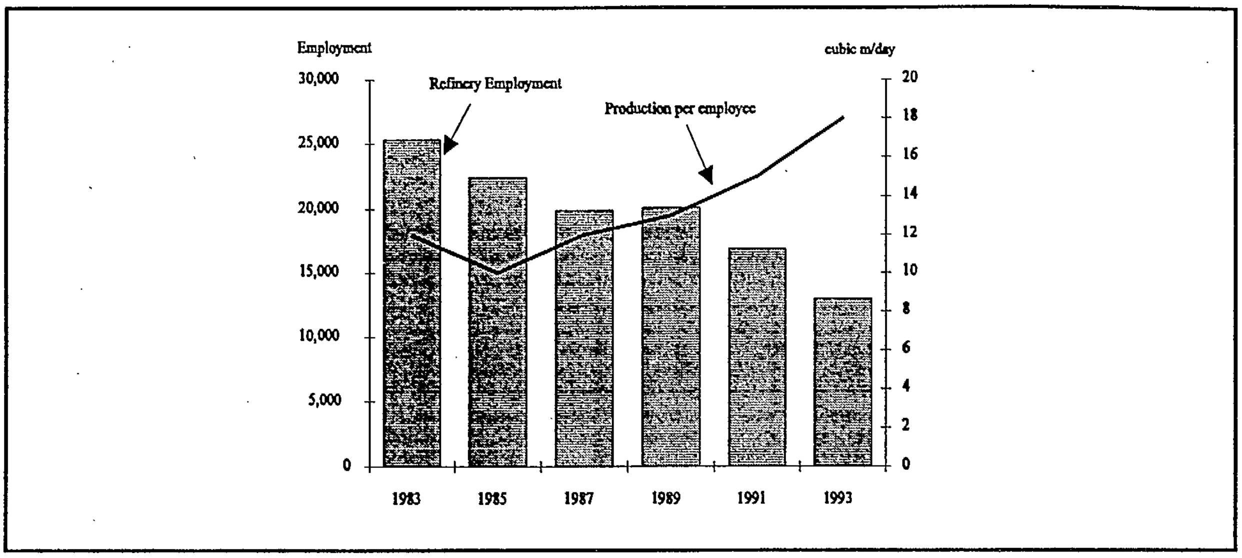
The petroleum products industry employs approximately 105,000 people directly, compared to 112,000 ten years ago. The indirect employment total would be very much higher.

There are some 13,000 people directly employed in the refining segment in Canada. This is approximately one-half the number employed (25,300) in 1982. This is mainly attributable to the large number of refinery closures during that period, although operating efficiencies have also played an important role.

Employment in the distribution segment, 23,400, has remained stable during the past decade.

Despite the decline in the number of service stations, they employ more people (68,000) now than ten years ago (61,000). This results from the shift in service stations toward convenience stores ('C-Stores') and car washes. C-Stores have been a successful marketing strategy because they attract new customers, and the non-fuel merchandise generates positive and less cyclical margins. It should therefore be noted that many of the employees included in the retail total are not directly involved in fuel-related marketing.

Figure 27
Labour Productivity in Refining



Source: Statistics Canada Cat No. 57-601

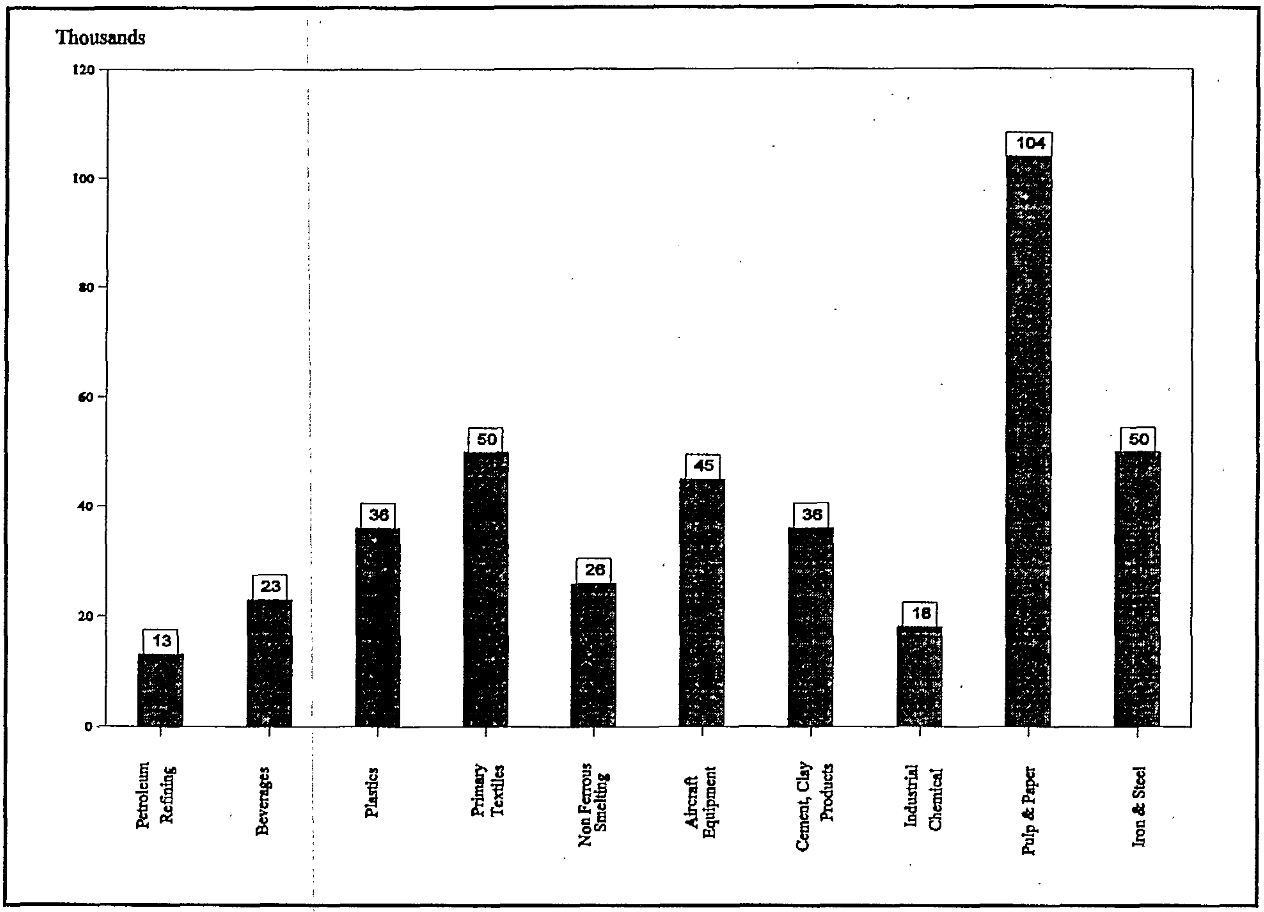
As a result of several refinery closures and investments in refining technology, the labour productivity of refineries has increased significantly during the last decade.

Production per employee has increased from approximately 10 cubic meters per day in 1985 to almost 18 in 1993.

Petroleum product companies have dramatically reduced their hiring in recent years. However, skills requirements and training programs have grown in order to utilize advanced technologies.

Figure 28
Employment: Comparison between Petroleum Refining and Other Manufacturing Industries

(1993)

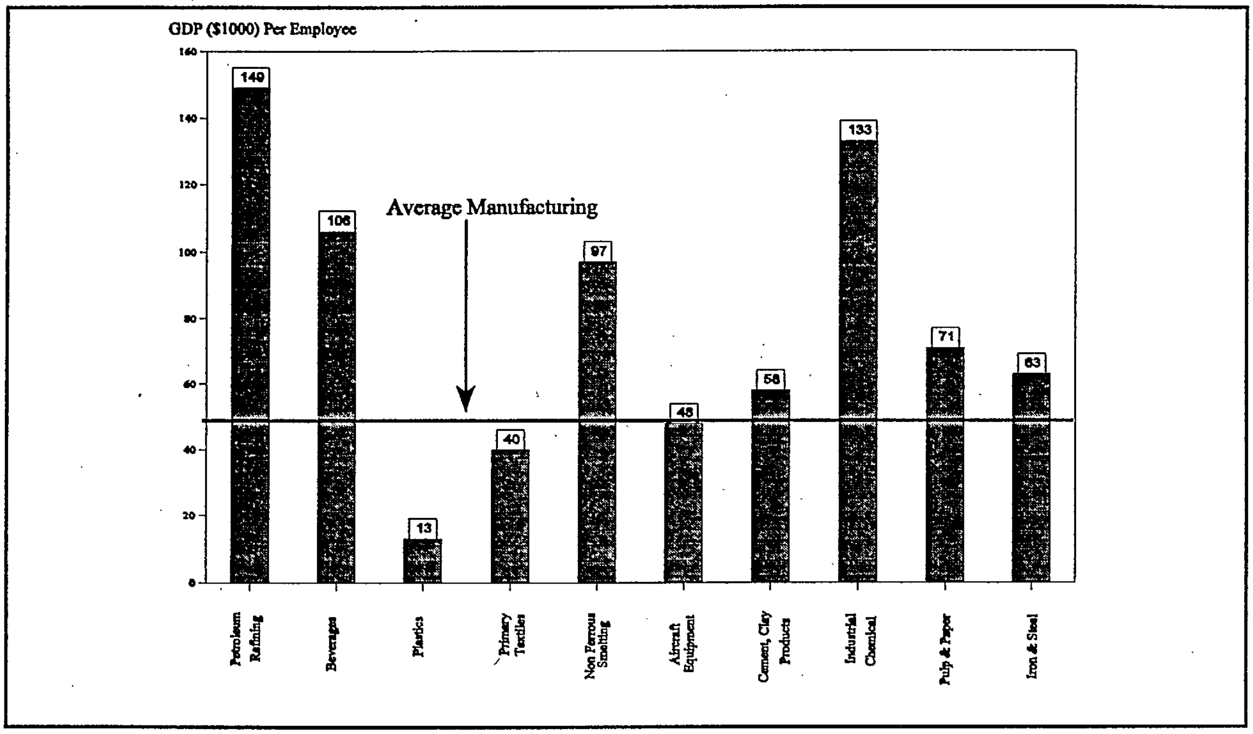


Source: Informetrica Limited

Compared to the seven other manufacturing sectors of equivalent GDP, the petroleum refining segment is a relatively small employer. This underlines its low level of labour intensiveness.

It accounts for 1% of Canada's total employment in manufacturing (13,000 out of a total 1.67 million).

Figure 29
Labour Productivity: Comparison between Petroleum Refining and Other Manufacturing Industries (1993;$1986)



Source: Informetrica Limited

By dividing a sector's GDP (value added) by the number of persons employed, the sector's labour productivity can be calculated.

The inverse of the previous chart reveals the very high level of labour productivity ($149,000 in GDP per employee) in the petroleum refining business compared to the seven other industries of equivalent size and to the pulp & paper and iron & steel industries.

The petroleum refining segment's labour productivity is nearly three times the average for the total Canadian manufacturing sector ($54,000).

SECTOR COMPETITIVENESS FRAMEWORK
REFINED PETROLEUM PRODUCTS

APPENDIX A3

INPUT/OUTPUT LINKAGES OF THE REFINING INDUSTRY

Strategic Linkages of the Refining Industry

This section presents some findings on the Refining Industry, from analysis based mainly on the Input-Output Tables produced by Statistics Canada.

The Input-Output Tables provide the most detailed data available on Inter-Industry Linkages. At their most detailed level of aggregation, the Tables contain information on the Inputs and Outputs of 216 Industries, and on the Final Demand of 627 commodities. The latest year available for the Tables is currently 1989, although some preliminary Tables have been released for 1990.

The 216 Industries defined in the Input-Output Tables are based on the Standard Industrial Classification (SIC) of 1980. In the Input-Output Tables, the Refining Industry correspond to the SIC 361, and SIC 369; which include the Coal Products Industries and exclude the distribution of Refined Petroleum Products. The inclusion of the Coal Products Industries is non-significant, due to its relatively small size.

The Input-Output Tables are published in Producers Prices. These are closely related to Factory Gates Prices, and are net of any taxes.

Table 1 presents the Outputs of the Refining Industry on a commodity basis; **Table 2** shows the Inputs of the Refining Industry, from other Industries; **Table 3** looks at the Final Disposition by type of user of Refined Petroleum Products; and **Table 4** presents the industries relying the most on Inputs from the Refining Industry.

Table 1	Outputs of the Refining Industry - 1989 (Millions, $1989)			
	Refining Industry		Business Sector	
Commodity	Output	Production Share within the Refining Industry	Output	Refining Share of the Refining Industry
Gasoline	6,291	39.9%	6,291	100.0%
Diesel Oil	2,536	16.1%	2,536	100.0%
Light Fuel Oil	1,777	11.3%	1,777	100.0%
Petrochemical Feed Stock**	1,198	7.6%	1,200	99.8%
Liquid Petroleum Gases*	846	5.4%	1,593	53.1%
Lubricating Oils & Greases	778	4.9%	792	98.2%
Aviation Fuel	717	4.6%	717	100.0%
Heavy Fuel Oil	635	4.0%	635	100.0%
Asphalt & Products	527	3.3%	529	99.6%
Coke*	39	0.2%	109	35.8%
Sulphur, Crude & Refined*	7	0.1%	395	1.8%
Paints & Related Products	7	0.1%	1,711	0.4%
Other Commodities & Services	393	2.5%		
Total Outputs	**15,751**	**100.0%**	**1,006,316**	**1.6%**

* Most of the production for these commodities has been assigned to the Crude Petroleum & Natural Gas Industries.

** Petrochemical Feed Stock, as defined in the Input-Output Tables, excludes any Feed Stock produced by the Natural Gas Industry.

þ The Refining Industry produced $15.8 Billions worth of commodities in 1989, or 1.6% of the Gross Domestic Output.

þ The Refining Industry is the sole domestic industry producing gasoline, diesel oil, light fuel oil, petrochemical feedstock, lubricating oils and greases, aviation fuel, and heavy fuel oil.

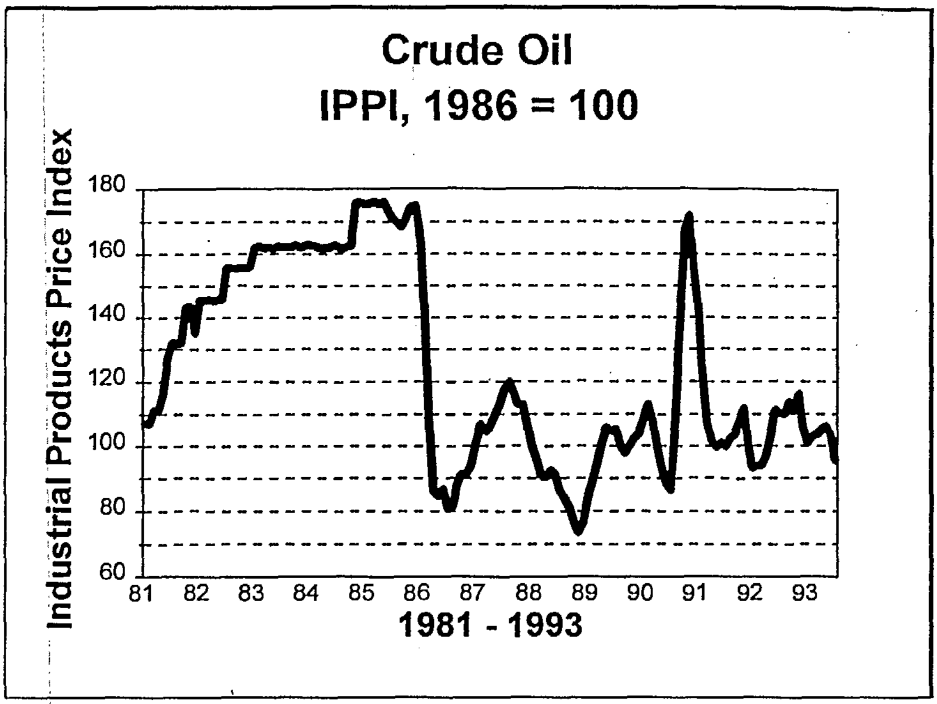
þ The Refining Industry, along with the Crude Petroleum & Natural Gas Industries, produce an important share of liquid petroleum gases, coke, and sulphur.

Table 2	Inputs of the Refining Industry - 1989 (Millions, $1989)		
Industry producing the input	**Inputs**	**Input Share within the Refining Industry**	**Input Share Excluding Crude Oil**
Crude Oil	11,436	72.6%	
Labour Income	964	6.1%	22.3%
Refined Petroleum Products	640	4.1%	14.8%
Chemical & Chemical Products	639	4.1%	14.8%
Pipeline Transport	485	3.1%	11.2%
Finance & Real Estate	403	2.6%	9.3%
Construction	280	1.8%	6.5%
Power Utilities	231	1.5%	5.3%
All Other Inputs	673	4.3%	15.6%
Total Inputs	**15,751**	**100.0%**	**100.0%**

þ Crude Oil is by far, the most important input to the Refining Industry. In 1989, it accounted for 72.6% of the Industry's total inputs.

þ In 1989, the Refining Industry generated about $1 Billion in Labour Income.

þ Other significant inputs to the Refining Industry come from the Chemical, Pipeline Transport, Finance & Real Estate, Construction, and Power Utilities Industries.



- The Industrial Products Price Index (IPPI), shows the price fluctuation of Crude Oil, which is the main input to the Refining Industry.

- The price of Crude Oil has fluctuated greatly since 1981, and without following any smooth, easy to forecast, trend.

- This suggests that the Refining Industry has little control over the price of its main input.

Employment & Labour Income

Refining Industry, $1986

1100 –

Table 3	Disposition - 1989 Refined Petroleum Products (Percent of Value)		
Commodity	Business Sector	Personal Consumption	Government Consumption
Gasoline	34.4%	63.6%	2.0%
Diesel Oil	93.1%	3.6%	3.2%
Light Fuel Oil	41.1%	48.9%	10.0%
Petrochemical FeedStock	99.6%	0.4%	0.0%
Liquid Petroleum Gases	79.9%	17.3%	2.8%
Lubricanting Oils & Greases	73.3%	25.1%	1.6%
Aviation Fuel	87.2%	0.1%	12.7%
Heavy Fuel Oil	95.5%	0.8%	3.7%
Asphalt	99.9%	0.1%	0.0%
Total Refined Products	**64.0%**	**31.4%**	**4.5%**

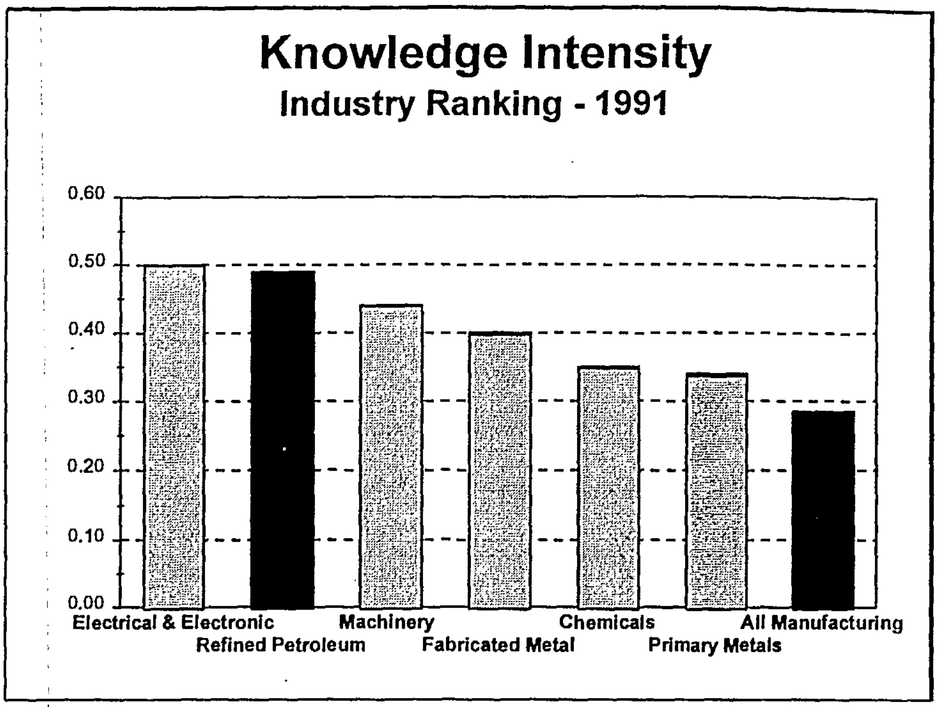
þ The Business Sector accounted for over two thirds of the overall domestic use of the commodities produced by the Refining Industry.

þ This suggests that the Refining Industry is an infrastucture industry to the Business Sector.

þ Personal consumption includes use by non-incorporated businesses. This indicates an even greater infrastucture role for the Refining Industry.

þ Personal Consumption was significant for gasoline, light fuel oil, lubricants, and liquid gases.

þ Government consumption was highest for light fuel oil and aviation fuel.



þ The Knowledge Intensity was measured by Mr. Paul Johanis of Statistics Canada, and is based on 1986 and 1991 Census Data.

þ Jobs were ranked in three categories; low, medium, or high Knowledge Intensity. High Intensity was associated with jobs requiring a university degree; Medium Intensity with jobs requiring other post-secondary certificates; and Low Intensity to jobs requiring a Secondary School diploma, or no diploma.

þ Points were allocated to the different level of Knowledge Intensity: High=2, Medium=1, Low=0. The Industry Knowledge Intensity was obtained by taking the average score of the jobs in an industry.

þ The Refining Industry score was 0.49, which is significantly larger than the manufacturing sector average of 0.285.

Sector Competitiveness Framework
Refined Petroleum Proucts

Appendix A4

Petroleum Product Demand and Supply

TABLE OF CONTENTS

PETROLEUM PRODUCT DEMAND AND SUPPLY

Demand Trends - 1973 to 1992

- There are many factors that have influenced, and will continue to influence demand for petroleum products in Canada. These include the overall state of the economy, product prices, demographic changes, fuel efficiency improvements, energy switching and the impact of public policy.

- From 1973 to 1979, demand for petroleum products grew from about 265,000 cu. m. per day to a peak of 300,000 cu. m. per day (Figure 1). During the early part of that period, Canada was sheltered from rapidly rising world prices for crude oil by the "two price policy" of the Canadian government. As a result, Canada was shielded from the temporary decline in demand that was experienced in the US from 1973-1975.

- When both economies went into recession in the early 1980's, demand dropped sharply for several years. In comparison to the US, Canadian demand dropped further to about 230,000 cu.m. per day in 1983 and continued to decline slowly to about 225,000 cu. m. per day by 1986. With the collapse of world oil prices in 1986, Canadian demand experienced several years of recovery, reaching almost 250,000 cu. m. per day in 1989. In the US, demand levelled out in 1982-83 and began to increase again for the remainder of the decade. In 1990, demand again dropped in both countries as economies went into recession, with the drop being more pronounced in Canada. Demand bottomed out in 1991 and began a slow recovery.

- Canadian policies of the early 1980's that encouraged energy conservation, fuel switching and higher product taxes can be seen to have influenced demand patterns when compared to the US. For example, the automotive fleet in Canada took on a higher proportion of compact, fuel efficient cars (Figure 2). This trend levelled out in the late 1980's as stable fuel prices helped consumers to choose more performance oriented vehicles and sport/utility vehicles in the new fleet. Nevertheless, overall motor gasoline demand has been relatively flat since 1983.

- Diesel fuel demand has been growing since 1982, with most of that growth coming from onroad use, essentially heavy trucks (Figure 3). Light fuel oil used for home heating has declined steadily since 1980 as a result of home insulation programs combined with fuel switching to natural gas or electric heat. Heavy fuel oil, used primarily in heavy industry and power generation in eastern Canada, has followed a pattern similar to overall demand, reflecting the linkage between demand for this fuel and the state of the economy (Figure 4).

FIGURE 1

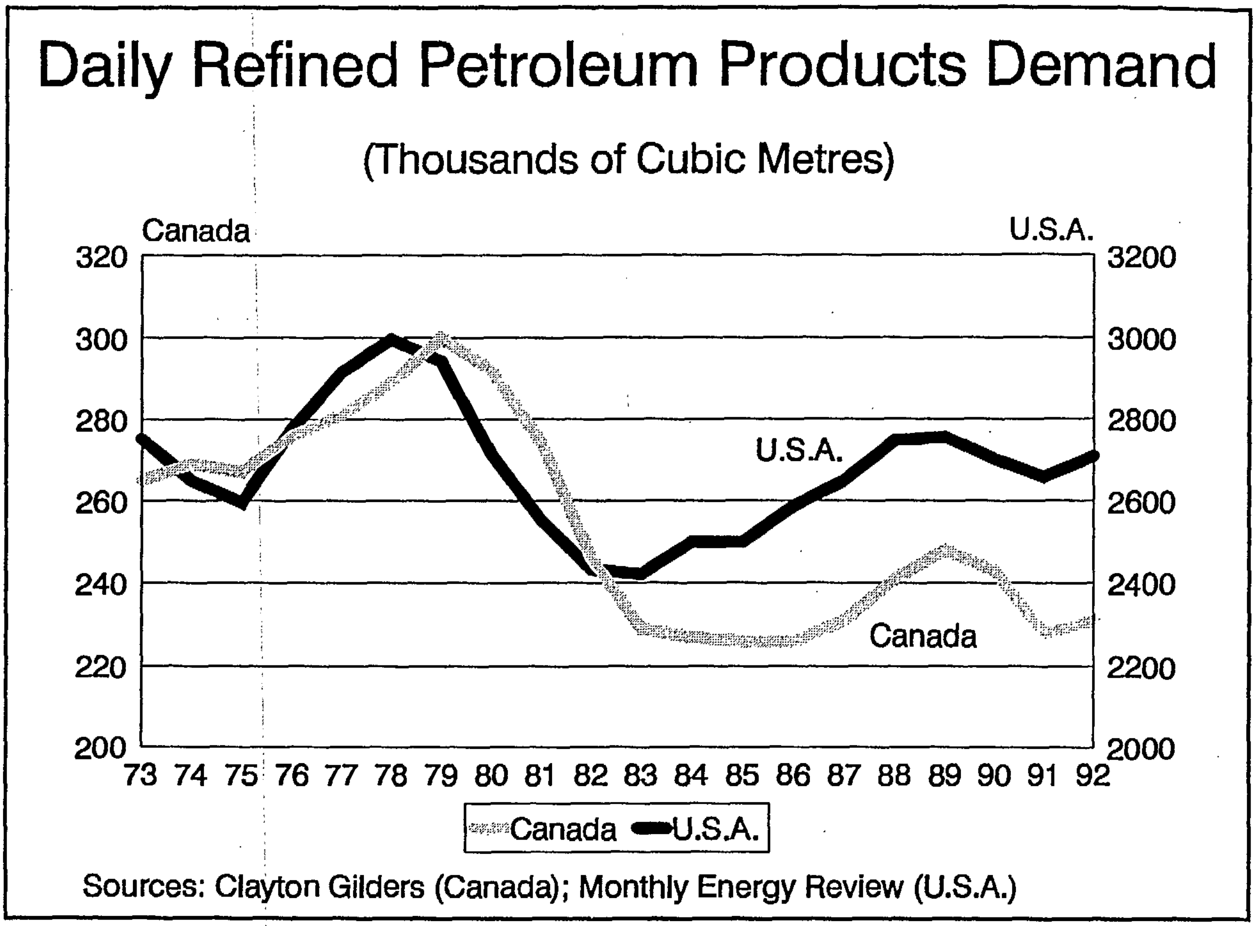
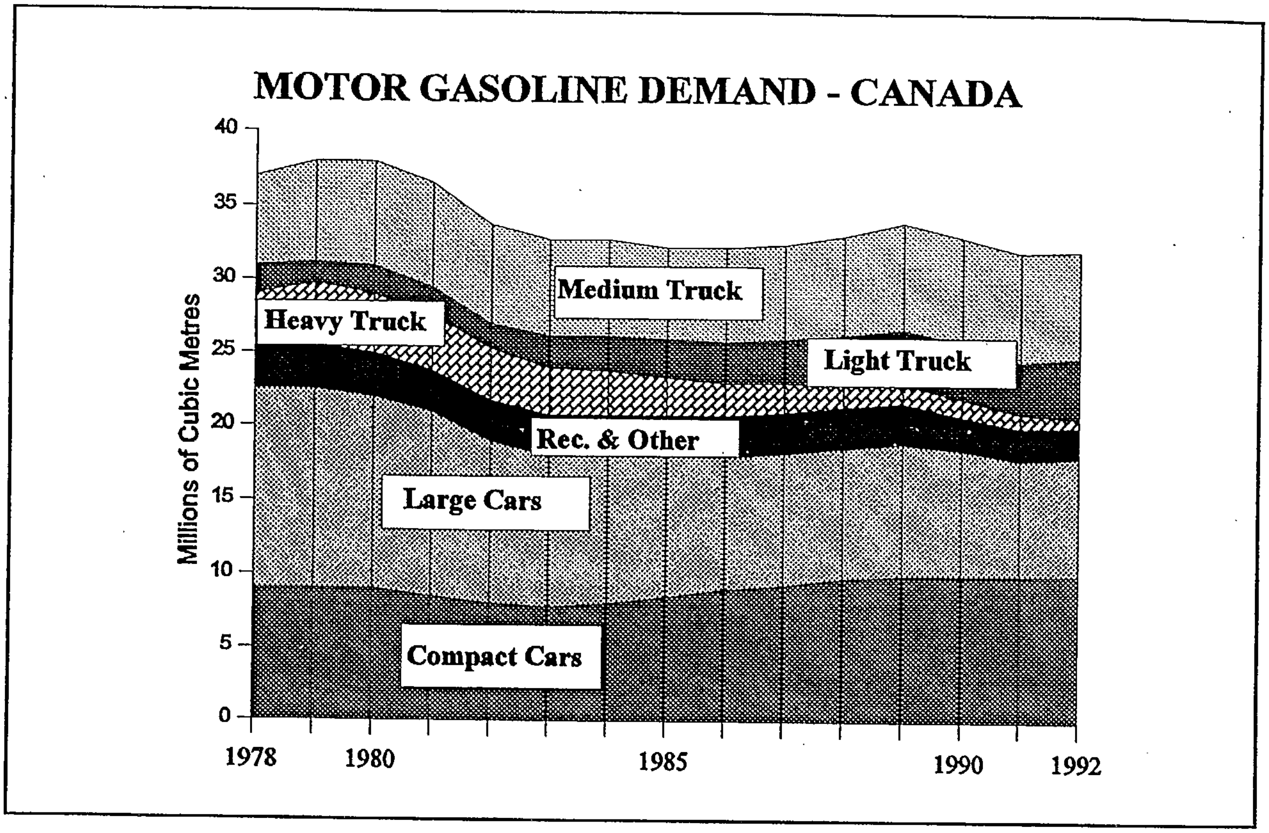
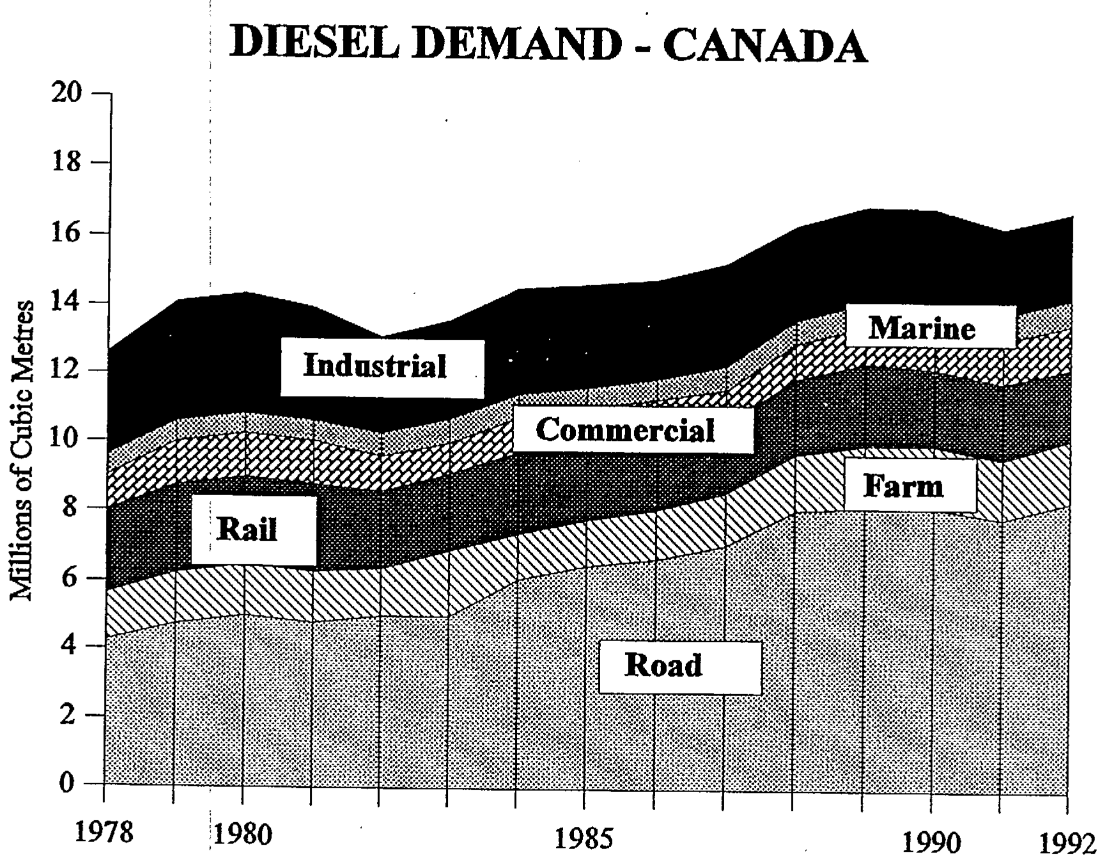

Daily Refined Petroleum Products Demand
(Thousands of Cubic Metres)
Canada
U.S.A.
320
300
280
260
240
220
200
3200
3000
2800
2600
2400
2200
2000
73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
U.S.A.
Canada
Canada
U.S.A.
Sources: Clayton Gilders (Canada); Monthly Energy Review (U.S.A.)

FIGURE 2



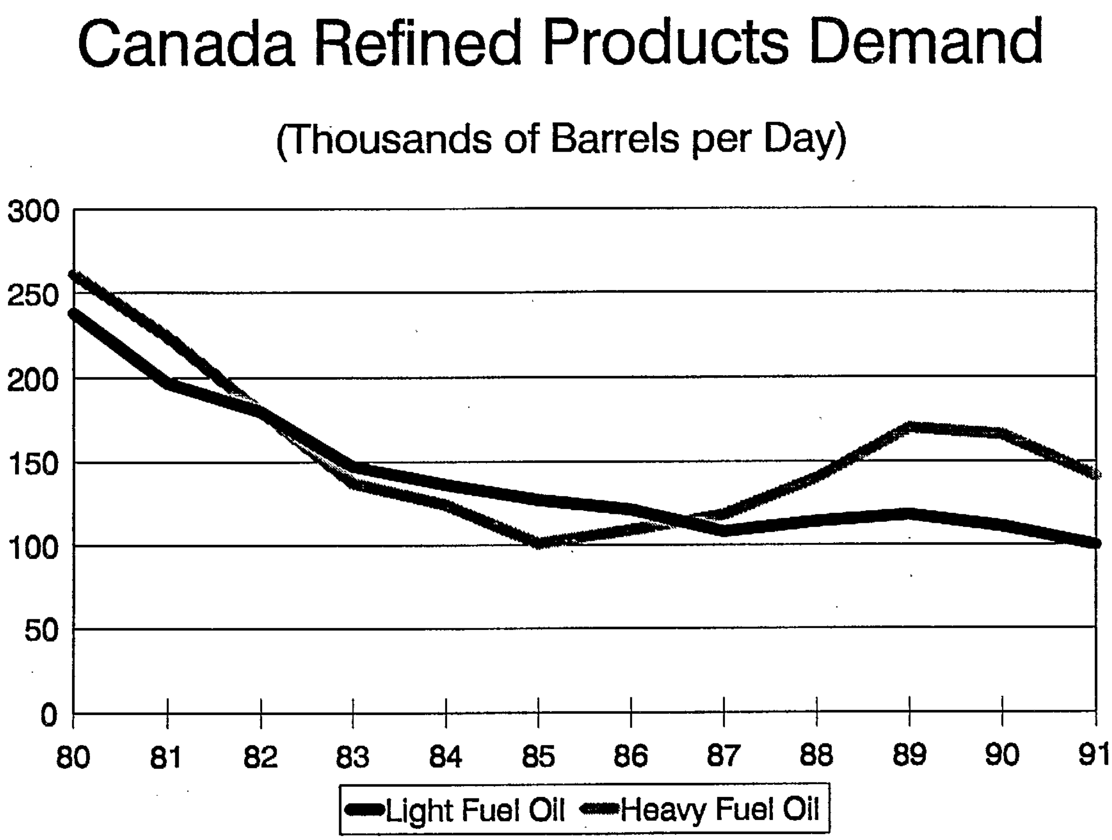
MOTOR GASOLINE DEMAND - CANADA
40
35
30
25
20
15
10
5
0
Millions of Cubic Metres
Medium Truck
Heavy Truck
Light Truck
Rec. & Other
Large Cars
Compact Cars
1978
1980
1985
1990
1992

FIGURE 3



DIESEL DEMAND - CANADA
20
18
16
14
12
10
8
6
4
2
0
Millions of Cubic Metres
1978
1980
1985
1990
1992
Industrial
Marine
Commercial
Farm
Rail
Road

FIGURE 4



Source: Purvin & Gertz Inc.

Product Supply

- The growth of product demand in the 1970's saw the closure of 11 smaller, less efficient refineries and the opening of 7 larger plants resulting in a net addition of 80,000 cu.m. per day of capacity, not including any processing capacity changes to other existing plants (see also Appendix D: Refining and Marketing Margins). This trend reversed in the 1980's as the sharp decline in demand resulted in the closure of 10 refineries, with 3 others opening. The net result during this period was to eliminate some 46,000 cu.m. per day of capacity from the system. Two of these new refineries were under construction when demand cratered in 1980, while the third was actually a restart of an export refinery in Newfoundland that was originally built in the early 1970's. Since 1990, 6 refineries have been closed or announced for closure with no new plants opening. These closures will take another 29,800 cu.m. per day out of the system.

- The Canadian refining industry is a net exporter of petroleum products. The largest volumes of exports come form the Atlantic provinces, where larger tidewater refineries can take advantage of the economies of marine transport to ship product to the US east coast markets. Petroleum products can also be imported without restriction and these import volumes, while relatively small, do play an important role in the economics of the industry (again, see Appendix D).

- The number of marketing facilities has also seen the effects of rationalization. While reliable data is hard to find, it is estimated that the number of service stations in Canada declined from about 24,100 in 1980 to about 17,000 by 1994.

Product Demand Forecasts: 1991 to 2010

- The most recent forecast available from the federal government is contained in the Natural Resources Canada (NRCan) publication "Canada's Energy Outlook, 1992 to 2020". This forecast uses generally quite conservative assumptions regarding economic growth and energy price changes. It is also a policy neutral forecast, meaning that no assumptions are made about possibly significant policy changes in the future. Essentially, this is a business as usual scenario. The resulting forecast predicts modest but steady growth throughout the period, averaging about 1% per year.

- The Task Force examined the NRCan forecast in detail. Industry members put forward differing views, particularly with respect to gasoline, aviation fuels and heavy fuel oil demands. The Task Force was in general agreement with the forecasts about diesel fuel demand, which is expected to grow substantially.

- For gasoline demand, the Task Force assumes that the rate of fleet growth will be lower as the automobile market in Canada becomes principally a replacement market. As well, the miles driven by the fleet are expected to moderate and then decline as the general population of drivers ages. Studies in the US have shown that older age groupsdrive less than younger populations.

- The Task Force also differed from NRCan in the important area of policy neutrality. The Task Force anticipates that further reductions will occur in the Corporate Average Feul Efficiency (CAFE) standards for new vehicles before the end of the decade. The result of these differing assumptions is a prediction that gasoline demand will recover modestly from the recessionary levels of 1991 and then remain flat from about 1997 to early in the next century, then begin to slowly decline. It is important to clarify that this is a prediction and not a forecast based on detailed modelling.

- For aviation fuels, the Task Force also sees a growth scenario, but at a slower rate that NRCan. The main variables are assumptions about the increase in passenger miles and improvements in the fleet efficiency.

- For heavy fuel oils, the NRCan forecast has demand quite closely paralleling economic growth. The Task Force expects that HFO demand will remain essentially flat, as a result of continuing shifts in fuel usage towards natural gas, no increases in HFO fired electrical generation and continued rationalization in the pulp and paper industry. These latter two industries are the prime users of HFO in eastern Canada.

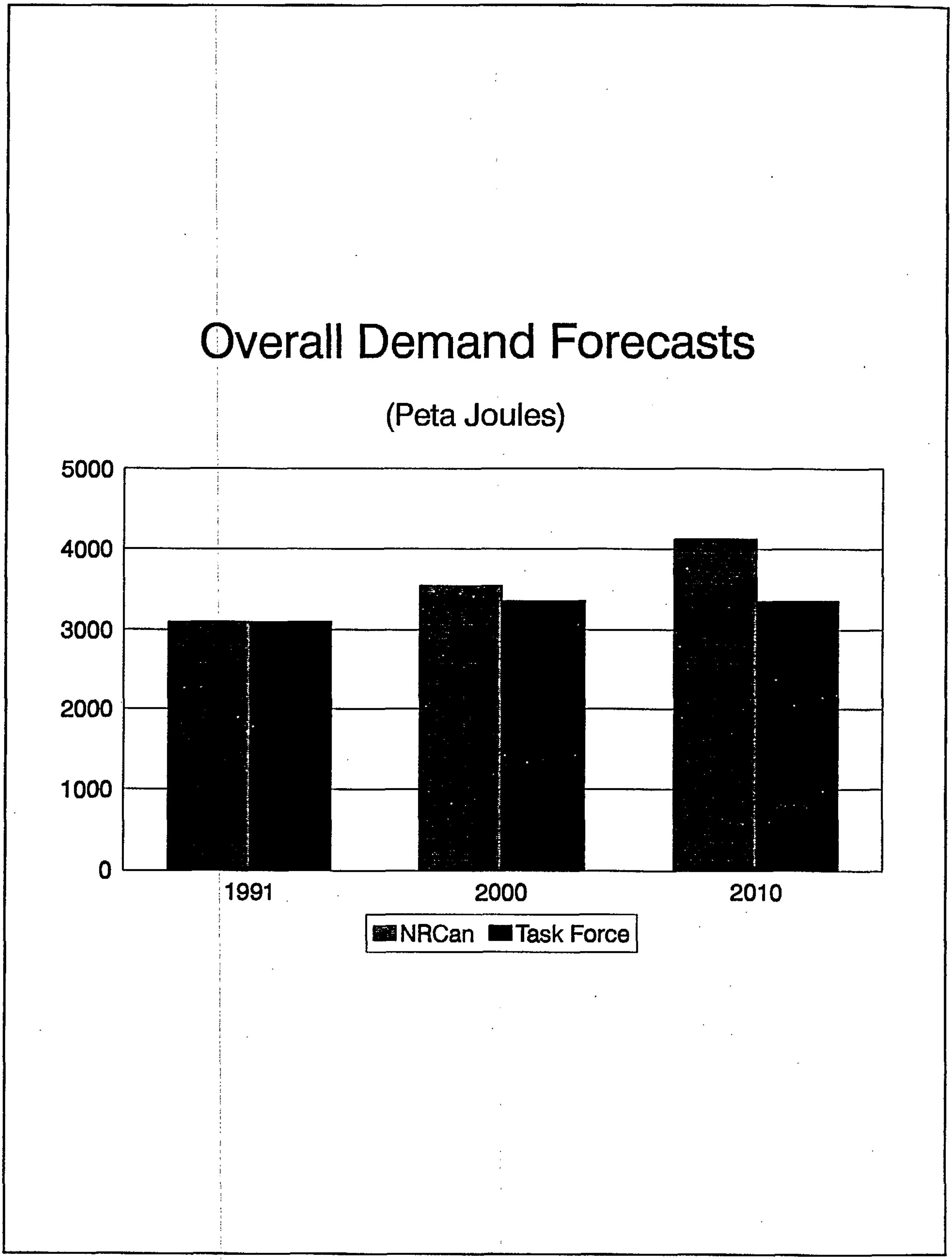
- When combined, the views of the Task Force would result in an overall product demand scenario that is about 5% lower than NRCan in the year 2000 and about 11% lower in 2010 (Figure 5). Some individual companies expressed a view that even this very modest rgowth scenario is optimistic. It should be noted, however, that preliminary information from the National Energy Board suggests that the next NEB forecast of supply and demand will show stronger growth than the NRCan forecast. This would support the NRCan view of their methodology as being quite conservative.

Supply Forecast: 1991 to 2010

- It is taken as a given that supplies of petroleum product for the Canadian market will match or exceed demand through a mix of domestic production and imports. It is necessary to take a regional approach to better understand what can be expected.

- In Atlantic Canada, refining capacity is greatly in excess of domestic demand. This extra capacity is targetted at export markets, primarily the US eastern seaboard. Net exports

FIGURE 5


Overall Demand Forecasts
(Peta Joules)
5000
4000
3000
2000
1000
0
1991
2000
2010
NRCan
Task Force

from this region are expected to continue, given the advantages of deepwater crude reception facilities at two of the refineries. At the same time, the open access to offshore imports will ensure that supplies will be readily available.

- In central Canada, excess refining capacity exists with export opportunities decreasing because of new US fuel standards that differ significantly from the fuels manufactured by Ontario refiners. This excess capacity situation is expected to continue, resulting in lower utilization rates than desirable. Imports from major US supply points will continue, but there is considerable uncertainty about the impact of new US fuel standards. One potential scenario could see dumping of "conventional" fuels which could be in oversupply in northern areas of the US. Another scenario would suggest that broader adoption of the new standards in northern states could reduce or even eliminate conventional fuels from the distribution systems, thereby reducing import availability. This is very much a wait and see situation.

- In western Canada, the refinery closures in the lower mainland will leave supply and demand in close balance. Access to imports exists both overland and by water in B.C. but environmental concerns can be expected to limit the latter. Overall demand in the prairie provinces is seen as flat at best but continued growth in B.C. is expected. This region will be most vulnerable to supply tightness, but there is no reason to expect shortages will occur.

Conclusions

- Demand patterns since the early 1980's show the petroleum products industry to be a mature industry with at best, modest growth potential. Diesel fuel is one product where demand is expected to grow significantly. Comparisons with the US show that Canadian demand patterns have been flatter since 1982, suggesting that the traditional relationship between economic growth and product demand may have changed.

- The effects of energy policy in past years is evident by comparing the US and Canadian demand curves. The impacts of the two price policy of the 1970s and the emphasis on conservation, higher taxation and fuel switching in the 1980s can be seen.

- Forecasts of demand vary significantly and this has major implications for public policy. For example, policies designed to cap CO_2 emissions could be much more intrusive if based on forecasts of increasing demand than forecasts of flat demand. There is a need for more open public debate on product demand forecasting, to better understand the variability between current forecasts.

- There are no reasons to expect that consumers will face supply shortages for any petroleum products within the time frame of this discussion paper.

Sector Competitiveness Framework
Refined Petroleum Products

Appendix A5

Refining and Marketing Margins

TABLE OF CONTENTS

REFINING AND MARKETING MARGINS

REFINING

Introduction

- Since decontrol in 1985, Canada has been open to international pricing and unrestricted imports.

- The constraints imposed by transportation economics have resulted in regional petroleum product markets in Canada. There is no single, unified "Canadian petroleum products market." Refiners compete within regional groupings and with adjacent U.S. markets. The price of imported products has a significant impact on refiners' economics.

- Ontario is the most complex and most vulnerable market in Canada. The principal feedstock source is domestic Canadian light crude oils from western Canada. Ontario refiners consider their crude cost to be among the highest in the world refining industry because of Ontario's position at the end of pipeline systems in the interior of a large net crude oil importing continent. Prices in Ontario product markets are particularly influenced by those in New York Harbour and on NYMEX. As well, Ontario refiners must contend with competition from the U.S. Great Lakes refiners.

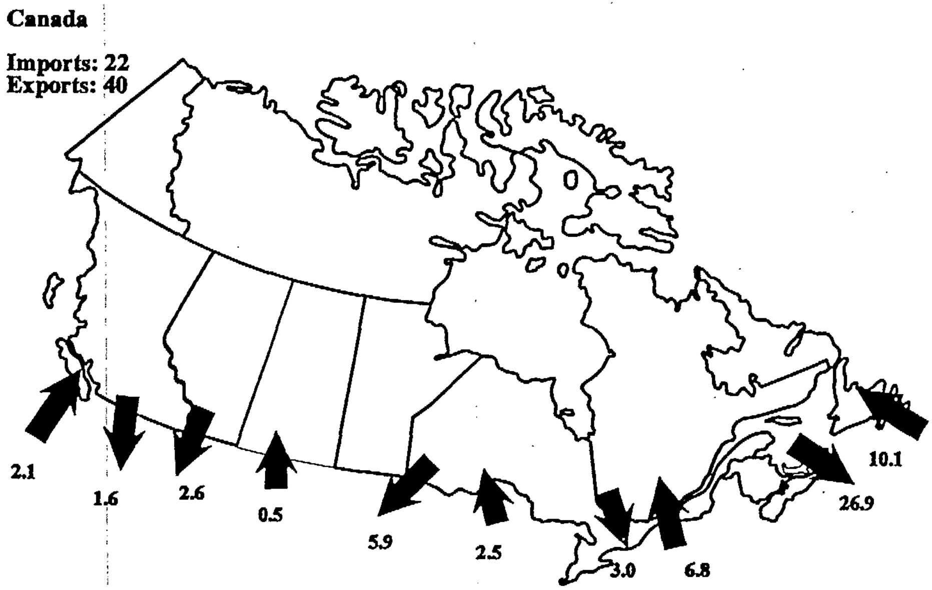
- The market setting for Atlantic Canada refineries is one in which there is active trade in water-borne bulk cargoes of both crude oil and the major refined products. Because of the relative ease with which refined product can be transported by ship, refiners in Atlantic Canada are exposed to competition from the Caribbean, U.S. Gulf Coast, Europe and the Mediterranean.

- The western Canada region is relatively self-contained and, while experiencing intense internal competition, is less exposed to external competition. Any attempts to capture significant market from another centre incur relatively large distribution costs. The significant exception has been the lower mainland areas of British Columbia. Refineries in the Vancouver area have been exposed to ongoing competition from imports from the Puget Sound area of Washington.

- When petroleum product imports flow freely into a market, it is the lowest price that will influence the entire market. Even one truckload of cheaper product from the U.S. can influence the retail price in a Toronto market, as marketers reduce their prices to match those of their competitors.

- The price of product imports to Canada relates to either New York Harbour or U.S. Gulf Coast prices, plus some logistic premium, regardless of where the product actually originates. To understand what is driving Canadian refinery margins, we need to understand the influences on refinery margins in the major price setting areas for Canadian margins.

Figure 1
1993 Petroleum Product Product Flow
(000 m3/day)



- Atlantic Canada accounts for 67% of exports and 46% of imports (due to HFO imports by Utilities).

- In Quebec, motor gasoline accounts for 25% of imports.

- In Ontario, middle distillate accounts for 34% of exports and motor gasoline accounts for 15% of exports.

- Quantities of product shown in Figure 1 are imported from or exported to external sources. However, significant quantities of product also flow from region to region within Canada and the port on entry is not always an indication of the province of consumption. Note that interregional trade is not reflected in the figure.

- This is particularly true for Quebec and Ontario where considerable volumes of product move across provincial borders.

- Large volumes of petroleum product move from Alberta to B.C. and transfers of product from the Prairies to Ontario and between the Atlantic region and Quebec are also regular occurrences.

U.S.A. and International Margins

- Individual product prices vary based on a large number of factors:
  a) international and local supply/demand balances
  b) logistics capabilities and constraints
  c) product quality specifications
  d) overall refinery balances
  e) seasonality
  f) trading activities using the futures market

- The other key component is the costs associated with making the product. These depend on numerous factors:

  a) refinery complexity (upgrading capability, feedstock flexibility)
  b) scale
  c) refinery utilization
  d) refinery efficiency
  e) feedstock availability, and costs

- Refining competitiveness depends upon access to low cost feedstock and the ease with which it can be processed into high value products. "Complexity" is the refinery characteristic that permits producers to increase the ratio of product slate value to feedstock cost. The average complexity of Canadian refineries is currently below that of competing U.S. refiners but it is increasing (as is that of U.S. refiners).

- However, complexity is not the only issue for Canadian refiners. Not all imported product comes from high-complexity refiners. Canada is also subject to competition from western Europe where refineries are less complex but are operating at high utilization rates. These refiners can sell marginal production at prices needed to cover only the low variable costs.

- To address overall refinery profitability, one needs to focus on the total refinery balance and the supply/demand balances of all products. Meaningful data on total refinery margins and profitability is limited, and key product indicators are frequently used as proxy for overall profitability.

- There are three key indicators of North American refinery profitability, all based on U.S. market conditions:

a) U.S. Gulf Coast Cracking Margin - summarizes "average" or "marginal" refinery economics in the U.S. Gulf Coast for a normal cracking refinery running an average crude slate purchased at spot prices and selling an average product yield at spot prices. A number of companies/organizations make estimates according to their own assessments of refinery crude slates and crude runs.

b) The New York Mercantile Exchange (NYMEX) calculation of a "3-2-1 crack spread." This indicator takes the futures market prices of 2 barrels of regular unleaded gasoline (RUL) plus one barrel of No. 2 heating fuel less 3 barrels of West Texas Intermediate (WTI) crude oil. While the method is simple, relatively easy to understand, and tracks quite well with U.S. Gulf Coast cracking margins in terms of movements over time, it is a relatively poor indicator for absolute levels of refinery profitability.

c) Gasoline and Heating Oil (No. 2) crack spreads, representing the difference between a barrel of product and a barrel of light sweet crude oil. This can be calculated based on futures prices, or at a specific refinery location. Again, however, it is a very poor overall indicator of absolute levels of refinery profitability, although it does offer some insights into the changes in refinery profitability over time. It is the simplest and easiest measure to calculate and understand.

<u>Crude Costs</u>

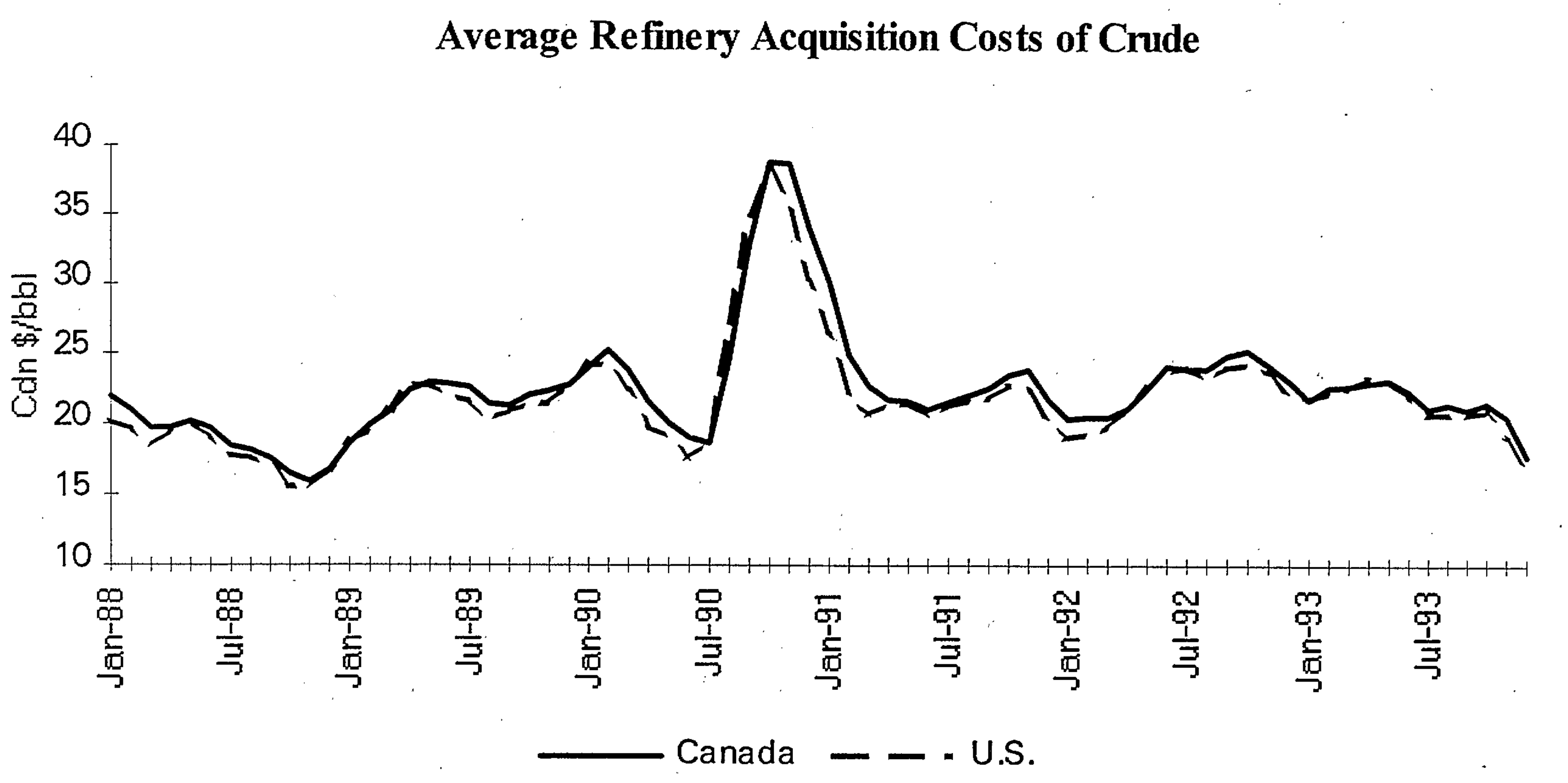
See Figure 2 "Average Refinery Acquisition Costs"

Canadian refineries are often said to be at a competitive disadvantage vis-a-vis their US counterparts respecting the acquisition cost of crude feedstock. The recent study of the Working Group on Competitiveness Issues supported this claim based on the expectation that Canadian refineries utilize a lighter and sweeter, and therefore more expensive, crude slate than do their US counterparts.

In Figure 2, the monthly average crude acquisition costs (in Canadian dollars) for both Canada and the US are presented for the period 1988 to 1993 inclusive. Canadian refinery acquisition costs are derived using data from the "Crude Oil Pricing Survey" collected monthly by the Canadian Oil Markets and Emergency Planning Division of Natural Resources Canada. U.S. acquisition cost data comes from the U.S. Department of Energy.

Clearly the aggregate acquisition costs, with no adjustments made for quality or transportation cost differences, are nearly identical throughout the period. The few divergences are small and of relatively short duration. Should the premise be correct that Canadian feedstock is of a

FIGURE 2


Average Refinery Acquisition Costs of Crude
40
35
30
25
20
15
10
Cdn $/bbl
Jan-88
Jul-88
Jan-89
Jul-89
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
Canada
U.S.

better quality than that of US refiners, then clearly Canadian refiners actually incur somewhat lower feedstock costs and not higher as has been asserted. Unfortunately, there is insufficient data on the quality of aggregate US oil feedstocks to undertake a quality adjusted comparison.

Similarly, it has been asserted that Ontario refiners pay higher crude acquisition costs than do refiners located in other regions of Canada. Given that Ontario refiners are located at the end of the pipeline from Alberta and they have limited options for alternate sources of supply, it is reasonable to expect that Ontario refiners will have somewhat higher acquisition costs. These higher costs should be, at a minimum, equivalent to the higher transportation costs. With respect to margins, this competitive disadvantage confronting Ontario refiners should be at least partly offset by their proximity to their large refined petroleum product market.

See Figure 3 "Refinery Acquisition Cost Differential - Ontario versus Canadian Average"

A comparison of Ontario acquisition costs to the average Canadian acquisition cost is presented in Figure 3 for the period mid-1985 to the end of 1993. Prior to 1990, Ontario refineries were clearly paying more for feedstock relative to the Canadian average. During this period there was considerable variation in the amount of the cost differential, which reached as high as $0.80 per barrel. The significant variations reflect for the most part the relative costs of imported vis-a-vis domestic crudes.

In the fall of 1990, immediately following the onset of the Persian Gulf crisis, the size of the cost differential decreased dramatically and for a short period Ontario refiners were paying significantly less than the Canadian average. Again, this primarily reflected changes in the relative cost of imported crude. Since 1991, Ontario refiners have in effect been paying the average Canadian acquisition cost give or take about $0.10 per barrel. Over the last two years, they have generally paid slightly less than the Canadian average.

To facilitate a more accurate interregional comparison of acquisition costs, it is necessary to account for quality differences. After adjusting for these, Ontario refiners generally pay more for their crude than do their western counterparts but, since the Gulf crisis, less than the import-dependent refiners of eastern Canada.

An interesting factor to note, however, is that the differential Ontario refiners pay, relative to western Canada refiners, has declined significantly over the last two years. There appears to be a strong correlation between apportionment on the IPL system and the decline in the size of the differential, which suggests that Ontario refiners have benefitted from the discounting of Canadian crudes in the Chicago market. In fact, discounting appears to have resulted in Ontario refiners now paying only slightly less, about $0.20 per barrel, than western Canadian refiners for delivered crude, quality adjusted.

In summary, the recent trend in slightly lower acquisition costs in Ontario compared to the Canadian average, appears to be explained by the discounting due to apportionment on the IPL line coupled with the relatively high cost of offshore imports into eastern Canada. The question remains whether Canadian crude will continue to be discounted after completion of the IPL expansion.

Refinery Margins

In discussion of refinery margins, the starting point should be the August 1993 report of the Working Group on Competitiveness Issues. This report indicated that with Canadian refiners being "price-takers", particularly in Ontario, the key elements of remaining competitive were deemed to be feedstock costs and refinery complexity. The discussion showed that to determine refinery margins a yield of finished products per barrel of crude oil needed to be calculated, along with the associated refinery operating costs.

In the methodology being followed, refinery margins would be calculated for the Edmonton and Sarnia refining centres. Both centres have well developed sets of posted crude acquisition costs and posted product rack (wholesale) prices. The next step would be to determine typical or representative refining centre yields of finished products for the mix of crude oil used in each region. Discussion in the Working Group indicated that the development of typical yields is subject to interpretation. The methodology used was to use the monthly yield data from the Statistics Canada RPP 45-004 to establish a yield of finished products for each of the major refining centres.

Having established the crude/product volumetrics on a monthly basis, the next step would be to establish refinery operating costs for each region. While a great deal of information on market prices of crudes and products and average refinery product yields, there is no public base of information for specific refinery cost structures. Differing cost accounting procedures and treatment of financial transactions within major corporations can create widely varying differences in allocated cost bases and net profit perceptions. Until such time as more detailed or accurate information can be made publicly available, our approach would be to determine only a gross refinery operating margin, that is crude costs minus product revenues.

As the Working group report established, differences in operating costs, between low and high complexity refineries, are totally overshadowed by the difference in crude costs for each of these operations. In the Working group report the ranges indicated in Table 1 were from 1.85 to 3.39 $/bbl for operating costs and 13.67 to 18.31 $/bbl for crude costs. A current published value for a medium complexity US Gulf Coast refinery gives a refinery operating cost of 2.80 $US/bbl, which would be approximately 3.73 $CDN/bbl. It should be noted that these operating costs do not include any portion of fixed costs or capital recovery. Given the accuracy of the data that is available the margins cannot be considered an accurate estimate of absolute margins but rather a good representation of a continuing trend in relative margins.
Refinery complexity is also a function of the mix of products that the end consumer purchases.

Initially in the United States, the need to install additional upgrading capacity was driven by the ratio of gasoline relative to other products. As a result of the need to install conversion capacity to produce gasoline, US refiners decided to install conversion capacity that would produce the required gasoline volumes using heavier, lower cost crude oils as feed stock. Canadian refineries did not have the need for the same level of gasoline conversion capacity and as a result installed conversion capacity adequate for their needs using light, sweet crudes as feed. The difference in conversion needs between Canada and the United States is summarized on the following table.

	United States		Canada	
	Thousand Barrels per day	%	Thousand Barrels per day	%
Mogas / Avgas	7755	57%	631	47%
Jet Fuel	1138	8%	79	6%
LPG	726	5%	41	3%
Kero / #1 FO	126	1%	6	<1%
#2 FO	1243	9%	150	11%
#2 Diesel	1726	13%	297	22%
Residual Fuel	919	7%	137	10%
Total	13633		1341	
Gasoline / Distillate Ratio		1.832		1.185

Basis: StatsCan RPP 45-004 December 1992 and US DOE/EIA-0380(93/03) publication for petroleum fuels prouction

Comparison of refinery complexity:

	Ontario			US Industry Average	
	Capacity	Avg.	%	Avg.	%
Crude Distillation	465.4	93.1	100.0	180.0	100.0
Vacuum Distillation	145.3	29.1	31.2	66.0	36.7
Catalytic Reforming	126.5	25.3	27.2	42.0	23.3
Distillate Hydrotreating	112.0	22.4	24.1	31.0	17.2
Gas Oil Hydrotreating	39.1	7.8	8.4	36.0	20.0
Fluid Catalytic Cracking	122.5	24.5	26.3	42.0	23.3
Alkylation	24.4	4.9	5.2	11.0	6.1
Coking	21.9	4.4	4.7	18.0	10.0

See Figure 4 "Ontario Region - Estimated Gross Refinery Margin"

Figure 3

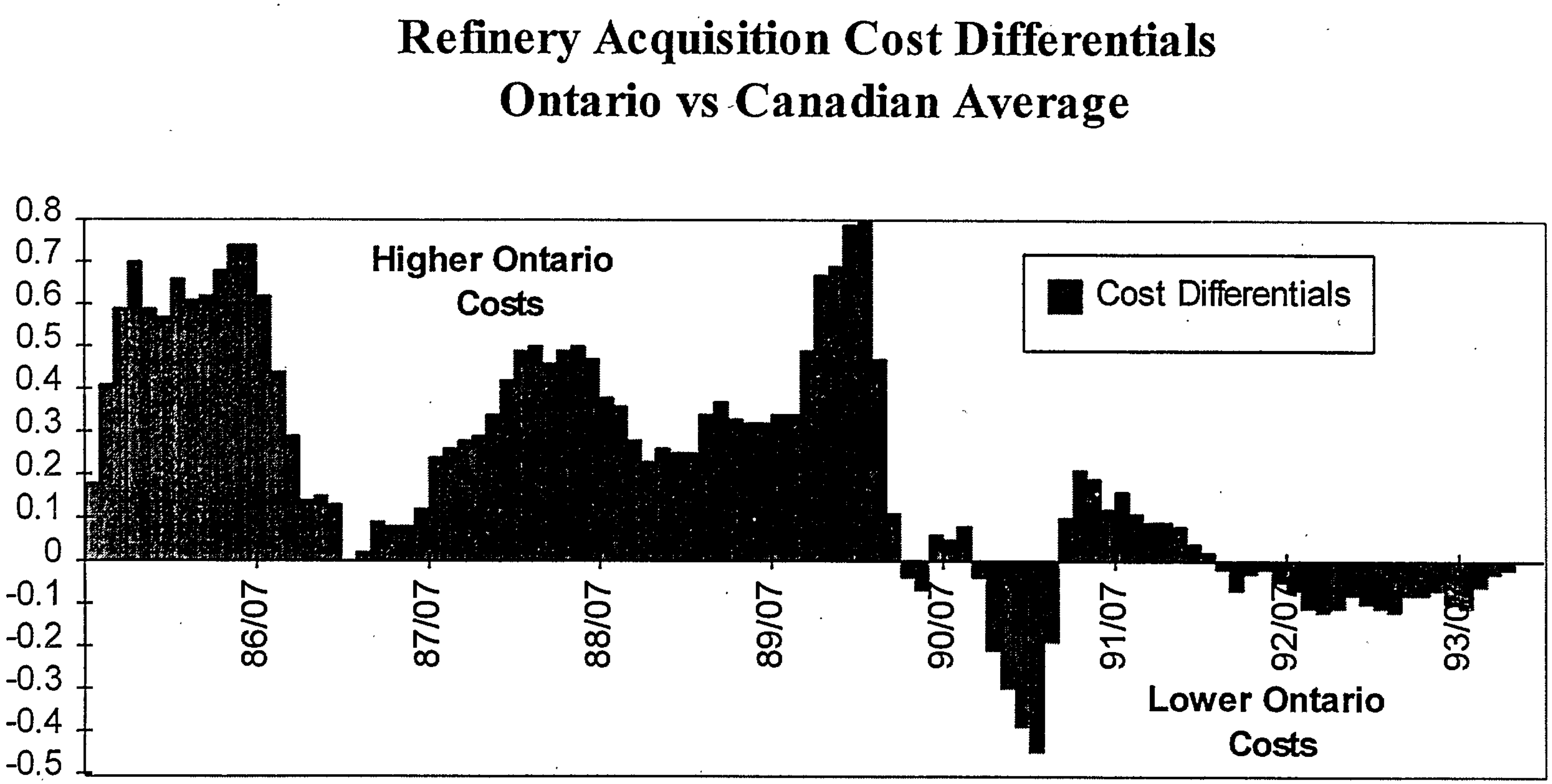
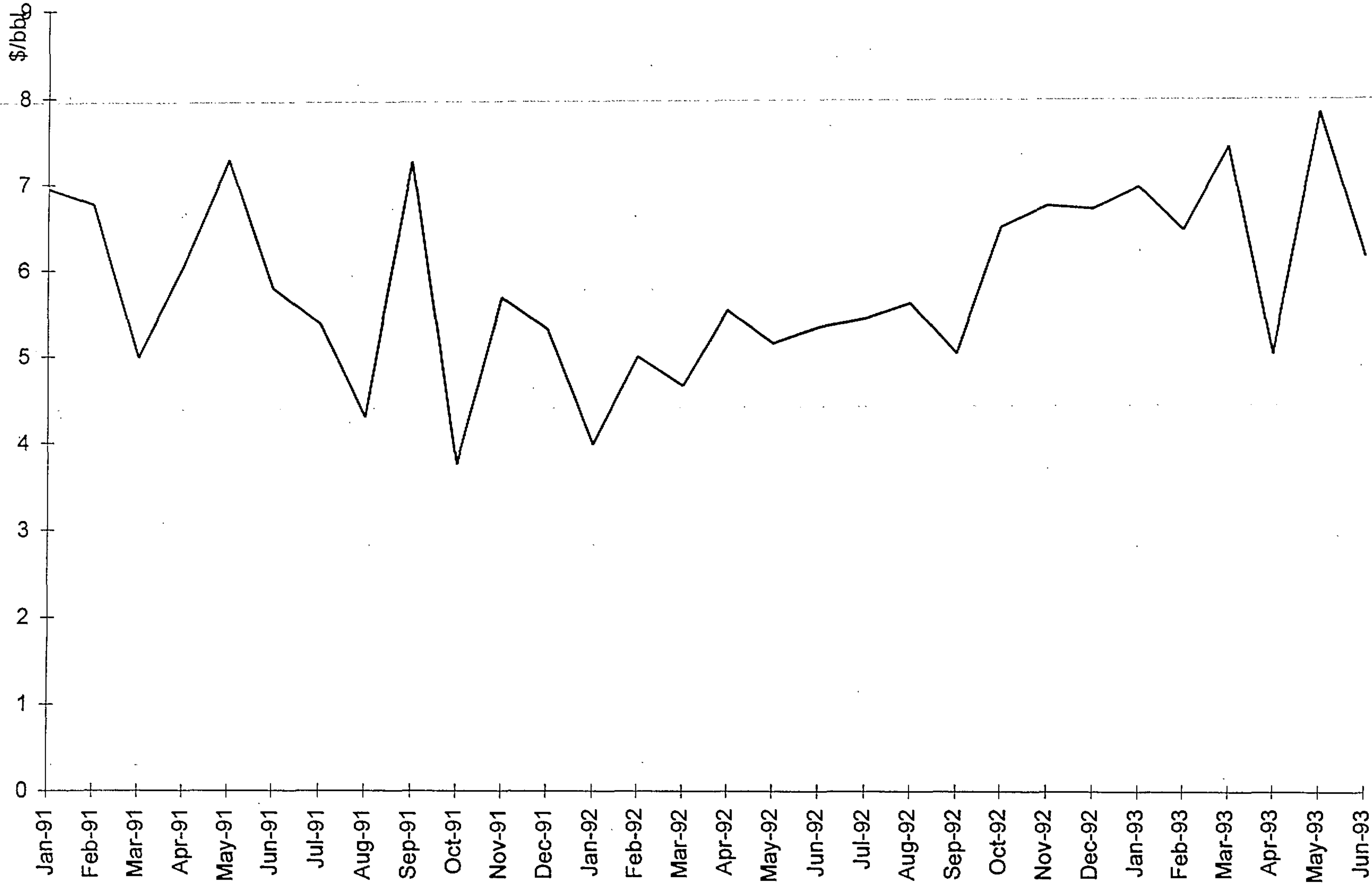

Refinery Acquisition Cost Differentials
Ontario vs Canadian Average
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
86/07
87/07
88/07
89/07
90/07
91/07
92/07
Higher Ontario Costs
Lower Ontario Costs
Cost Differentials

FIGURE 4

Ontario Region-Estimated Gross Refinery Margin



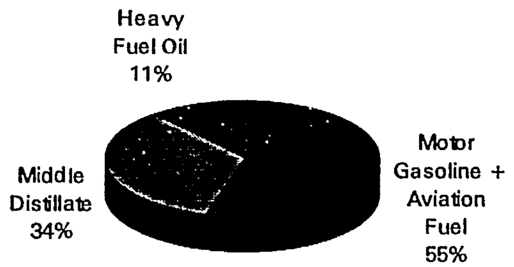
Cost and Revenue Drivers

1) Revenue

a) Product Slate

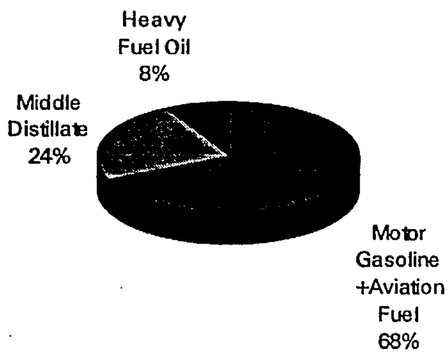
Figure 5
January - June 1993

Sales of main petroleum products in Canada



First six months of 1993

Sales of main petroleum products in U.S.



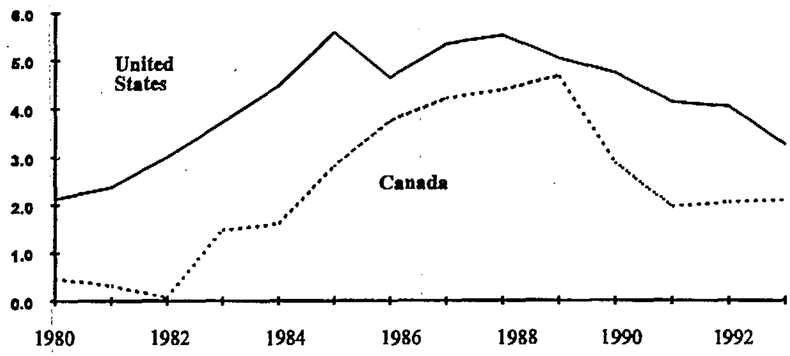
First six months of 1993

- U.S.A. has a higher proportion of high-valued product and a higher revenue base than Canada.

- Because of higher demand for heavier products in Canada, Canadian refiners have had less incentive to invest in more severe refining processes. Also, during the NEP era, there was little incentive for refiners to invest in these processes.

b) Imports

Figure 6
Ratio of Imports Vs Total Demand of Motor Gasoline



(First six months of 1993)

Source of U.S. data: Monthly Energy Review, Table 3.4. Daily volume *365 days/6.2898 barrels

- In Canada the dependence to imports of motor gasoline was the highest in 1989 at 4.7% of the total sales of that product. In the U.S., the same dependence was the highest in 1985 at 5.6% of the total sales.

- On average from 1980 to 1993, the American dependence to imports was almost double the Canadian one; 4.1% compared to 2.3% respectively.

- Refiners are driven by "make vs buy " decisions, using imports to balance supply and demand and optimizing refinery operations.

- In Quebec, refiners account for much of the imports.

- Independents use imports as alternate source to domestic purchases. Imports can impact on refiners' revenues through lost sales and by forcing wholesale prices down to compete with imported product.

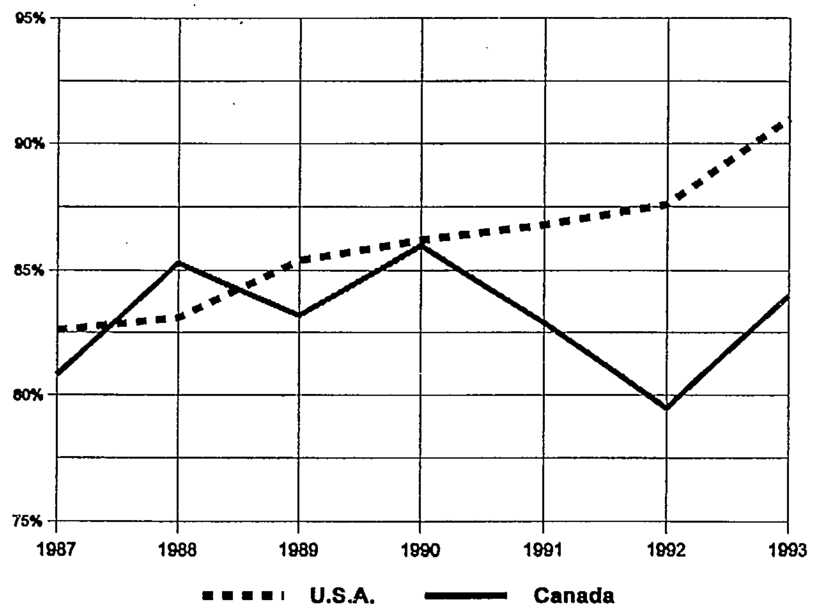
- In Ontario, independent marketers do most of the importing.

- Even small volumes of imports can impact on domestic prices.

2) Costs

a) Utilization Rates

Figure 7
Refinery Utilization Rates %



Refinery Capacity
000 cubic metres /day

	Canada			United States		
	Capacity	Charge	Utilization Rate (%)	Capacity	Charge	Utilization Rate (%)
1980	359	310	86.4	2,860	2,199	76.9
1987	298	241	80.8	2,475	2,044	82.6
1988	299	255	85.3	2,533	2,106	83.1
1989	303	252	83.2	2,495	2,130	85.4
1990	314	270	86.0	2,474	2,132	86.2
1991	315	261	82.9	2,436	2,115	86.8
1992	308	245	79.5	2,435	2,132	87.6

Source of U.S. data: National Petroleum News, Facts Book 1993, International section, World refinery capacities and throughputs.

- Refining operations include a large proportion of fixed costs.
- Need high volume to keep costs per unit down.
- Lower utilization rates therefore result in higher per unit costs. Except for 1990, Canada's utilization rate has been below 85% since 1987.
- Since 1989, U.S. has had consistently higher utilization rates.
- Traditionally, crude distillation has been used to measure refinery utilization rates. As refineries become more complex, this simple measure becomes less useful as a gauge for efficiency. The utilization rate of conversion capacity is emerging as another standard. At this point, public data does not yet exist for this calculation.

b) Refinery Complexity

Table 1 from the Working Group report gives a directional view of the effect of refinery complexity on economics. Note that the table does not reflect capital costs, which would be higher for the more complex refinery.

Table 1
The Effect of Refinery Complexity on Refinery Economics
(in dollars per barrel)

	Medium Complexity Light Crude	High Complexity Light Crude	High Complexity Heavy Crude
Product Value	20.55	23.70	23.47
Crude Cost	18.31	18.31	13.67
Operating Costs	1.85	2.39	3.39
Net Margin	0.39	3.00	6.41

Source: CPPI August 1993 report of the Working Group on Competitiveness Issues

While it is evident that crude costs are the largest cost factor in determining margins, they are the factor that refiners have the least control over. In attempting to improve margins the refiner will work at reducing the remaining operating costs.

c) Rationalization

A historical listing of Canadian refinery closures and openings is shown on the following page. The majority of the closures in the 1970s were a result of refiners opening newer, more complex refineries and closing older, smaller and less efficient facilities. Through the 1980s and 1990s the closures reflected the rationalization of refining capacity. The list indicates that refinery rationalization is not a new issue for the refining industry.

REFINERY CLOSURES/OPENINGS - CANADA
1970-1994

Year	Company	Location	First Year of Operation	Crude Oil Capacity M^3/D New	Crude Oil Capacity M^3/D Shutdown
1970	Husky Oil Ltd	Moose Jaw, Sask.	1954		560
1971	Ultramar Canada	St Romuald, Que.	1971	15 890	
	Gulf Oil Canada Ltd.	Point Tupper, N.S.	1971	12 700	
	Gulf Oil Canada Ltd.	Saskatoon, Sask.	1933		1 160
	Gulf Oil Canada Ltd.	Edmonton, Alta.	1951		2 000
	Gulf Oil Canada Ltd.	Edmonton, Alta.	1971	19 250	
1973	Newfoundland Refining	Come-By-Chance, Nfld.	1973	15 900	
1975	Imperial Oil	Edmonton, Alta.	1948		6 000
	Imperial Oil	Winnipeg, Man.	1951		3 400
	Imperial Oil	Regina, Sask.	1916		4 880
	Imperial Oil	Calgary, Alta	1923		3 370
	Imperial Oil	Edmonton, Alta.	1975	27 000	
1976	Newfoundland Refining	Come-By-Chance, Nfld.	1973		15 900
	Northern Petroleum	Kamsack, Sask.	1936		1 670
1977	Petrosar Ltd.	Corunna, Ont.	1977	27 000	
1978	Texaco Canada	Port Credit, Ont.	1938		1 200
1978	Texaco Canada	Nanticoke, Ont.	1978	15 100	
1980	Gulf Canada Ltd.	Point Tupper, N.S.	1971		12 700
1982	Texaco Canada	Montreal, Que.	1927		11 840
1982	Turbo Resources	Balzac, Alta.	1984	4 390	
1983	BP Canada	Montreal. Que.	1960		11 280
	Gulf Canada Ltd.	Calgary, Alta.	1939		2 050
	Gulf Canada Ltd.	Kamloops, B.C.	1954		1 510
	Imperial Oil Ltd.	Montreal, Que.	1916		13 200
	Shell Canada Ltd.	St. Boniface, Man.	1927		4 770

	Shell Canada Ltd.	Oakville, Ont.	1963		7 000

Year	Company	Location	First Year of Operation	Crude Oil Capacity M³/D New	Shutdown
1983	Ultramar Canada	Holyrood, Nfld.	1961		2 220
1984	Shell Canada Ltd.	Scotford, Alta.	1984	8 000	
	Texaco Canada Inc.	Edmonton, Alta.	1951		4 451
1985	Gulf Canada Ltd.	Montreal, Que.	1931		11 770
1987 (reopened)	Newfoundland Processing	Come by Chance, Nfld	1987	11 100	
1991	Petro-Canada	Taylor, B.C.	1960		2 860
1992	Turbo Resources	Balzac, Alta.	1982		4 390
1993	Petro-Canada	Port Moody, B.C.	1958		5 910
	Shell Canada Ltd.	Burnaby, B.C.	1932		3 800
	Petro-Canada	Clarkson, Ont.	1943		6 350
	(This site will continue to produce lubricating oils using intermediate feedstocks.)				
1994	Esso Petroleum Canada (announced)	IOCO, B.C.	1915		6 500

Centres of Excellence

In discussing centres of excellence, it may be preferable to refer to them as centres of efficiency, being refinery clusters in which sufficient "critical mass" of refineries and related petrochemical industries are located so as to achieve economies of scale beyond that available to a single refinery. Table 2 in the Working Group report gives this information.

North American Refining Centres

Centres of Efficiency

	Number of Refineries	Total Capacity (kb/d)	Average Capacity (kb/d)	Refineries of Size <80 (kb/d)	80-120 (kb/d)	>120 (kb/d)
US Gulf Coast	36	5923	165	11	6	19
Okla./N.Texas	17	918	54	13	3	1
Los Angeles	16	1499	94	9	3	4
Delaware Basin	11	1330	121	2	3	6
Puget Sound	7	526	75	3	2	2
San Francisco	6	579	97	2	2	2
Chicago	5	752	150	2	0	2
Wood River	5	601	120	3	0	2
Detroit/Toledo	5	502	101	2	0	3
Ontario	5	510	102	2	2	1
Edmonton	3	355	118	1	0	2

Note: Ontario refining centre includes Petro-Canada's Lake Ontario refineries as one refinery. Nova is not included with Ontario refineries.

The list of refining centres indicates that most of these have strategic alliances with other related industries, especially petrochemicals. The growth of the Sarnia refineries to a great extent paralleled the growth of the Sarnia petrochemical plants. This association is so closely linked that almost any kind of hydrocarbon stream can be transferred or sold freely throughout the Sarnia complex area.

Impact of Environmental Requirements

1) Environmental regulations on product quality will increase the costs of many products (gasoline, desulphurized diesel), potentially change product yields, and potentially change the product definition itself (for instance, regular unleaded gasoline becomes a higher cost/price reformulated gasoline).

2) Fragmentation of markets based on environmental regulations may make the particular products used less homogeneous. If there are different product specifications in certain regions of Canada and the U.S., historical price correlations may become less relevant in the future.

MARKETING

<u>Introduction - The Restructuring Continues</u>

- In some regions over-supply/capacity situation persists; one more refinery closure has been announced. International refined product supply/pricing into the Ontario and Quebec/Atlantic markets and growth of alternate "clean and green" fuels exacerbate over-supply conditions. Western Canadian markets are approaching supply/demand balance.

- For refiners, "buy vs make" decisions play the domestic market against imports. Buyers have more choices than refiners.

- Inefficiencies exist in retail networks. Majors/regional refiners continue to close low volume outlets. In some markets the larger independents are still expanding, partially offsetting closures by majors.

- In rural markets, stations are not usually company owned, so there is a tendency to debrand rather than close. What is the impact of this on rationalization?

- Environmental compliance costs are escalating and there are increasing problems with the availability of financing, erecting barriers to either enter or exit the market (see "Barriers to Exit", page 25), for example site contamination, clean-up, use of "double wall" for underground storage systems and eventual Stage I vapour recovery implementation.

- Flat/low demand growth profile means market share improvement will have to come at the expense of other retailers resulting in intense competitive rivalry.

- High structural costs in downstream have resulted in facility closures, organizational delayering and reductions in advertising/promotional costs and "general and administrative" expenses.

Gasoline Cost Components

See Figure 8 "Cost Components - Canadian All-Grades Average Retail Gasoline Price

Retail All-Grades Gasoline Price (Full-Serve & Self-Serve)

- Increased steadily through until the end of 1990 (the Persian Gulf Crisis) with a gradual decline since then.

Tax Component (federal and provincial)

- Relatively fixed.
- Increasing percentage (about 50% in 1993) of retail price as price declines.
- Industry has no control over taxes.
- Taxes can push retail prices closer to the maximum level that the market will bear, thus reducing the industry's flexibility to fully recover the cost of production.

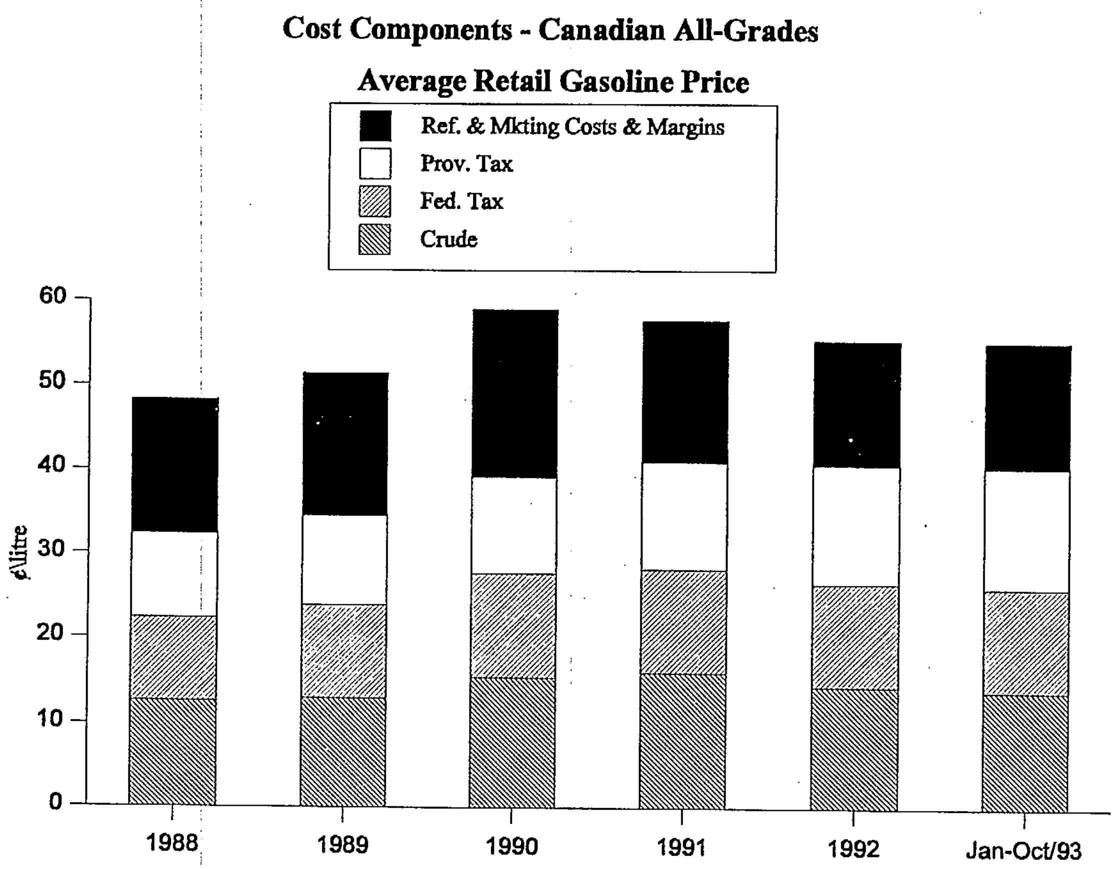
Crude Component (no lag 1992 & 1993)

- Peaked in 1991 as a result of the influence of the Persian Gulf crisis.
- Fairly stable since mid-1991.
- Retail prices have fallen more than crude costs since 1991.

Marketing and Refining Costs and Margins

- This is the residual revenue, after deducting crude costs, and federal and provincial taxes from the average retail price.
- This residual revenue may or may not be sufficient to recover all costs (such as the carrying costs of crude and product, refinery fuel and loss estimates, refining, marketing, transportation and distribution of the product) and provide a return on investment.
- Historically these margins have not been sufficient to produce an adequate rate of return on investment.
- Refining and marketing costs and margins are being squeezed in the face of lower retail prices and higher product taxes.

FIGURE 8



Cost Components - Canadian All-Grades
Average Retail Gasoline Price
Ref. & Mkting Costs & Margins
Prov. Tax
Fed. Tax
Crude
60
50
40
30
20
10
0
¢/litre
1988
1989
1990
1991
1992
Jan-Oct/93

Refining and Marketing Costs and Margins

a) From Refiners' perspective:

See Figure 9 "Canada vs U.S. - Refining and Marketing Costs & Margins (All Grades Average)"

- Higher in Canada than in the U.S.A. on a per unit basis.
- Closer now than they were.
- Relatively flat over 5 1/2 years. Refining costs have been increasing so margins have been decreasing. This is evident in low rate of return on capital employed in downstream.
- In Canada, both the peak in October 1990 and the trough in February 1991 were the result of the Persian Gulf crisis. The timing of crude oil price increases and the corresponding change in gasoline prices impacted on the refining and marketing component. During this period, refiners were still pricing their product under the FIFO accounting method, meaning that there was a 60 day lag between crude price changes and gasoline price movement. In the U.S., where the LIFO system is used, gasoline prices reflected crude oil price increases more quickly.

b) From Independents' Perspective:
(non-refiner marketers)

See Figure 10 "Toronto Rack to Retail Ex-tax Price Margins for Regular Unleaded Gasoline"

- Rack to Retail ex-tax margins in Toronto are an indication of independents' margins.
- There has been a downward trend in the last five years.
  In 1988 -1989 margins moved in the 5 -10¢/l range.
  In 1992 - 1993 the range was 2 -5 ¢/l.

- Import option is important to the independents who are seeking lower costs to increase their margin.
- Their ability to negotiate lower rack prices (volume discounts) can also improve margins.

FIGURE 9

Canada vs USA - Refining & Marketing
Cost & Margins - All - Grades Average

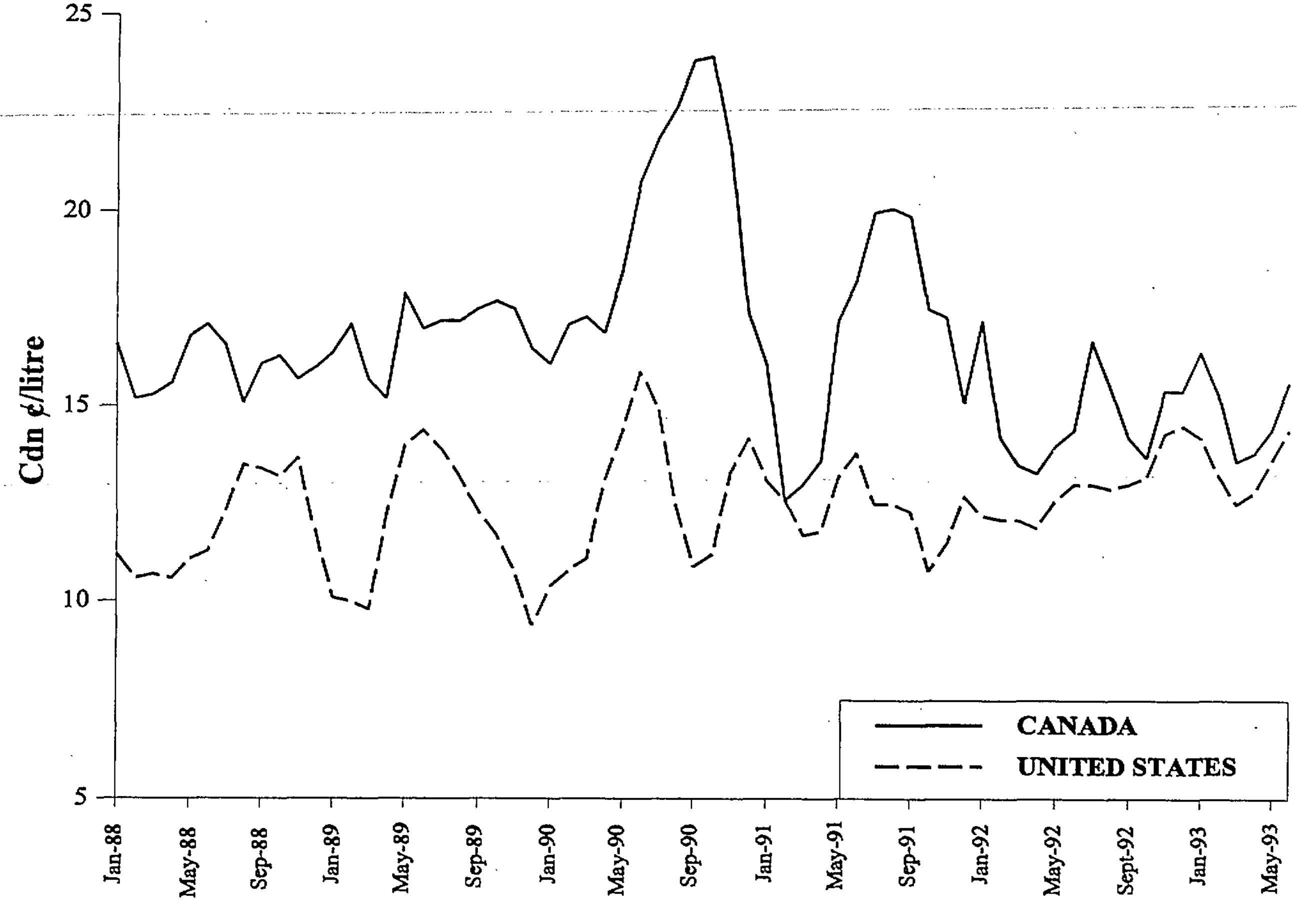
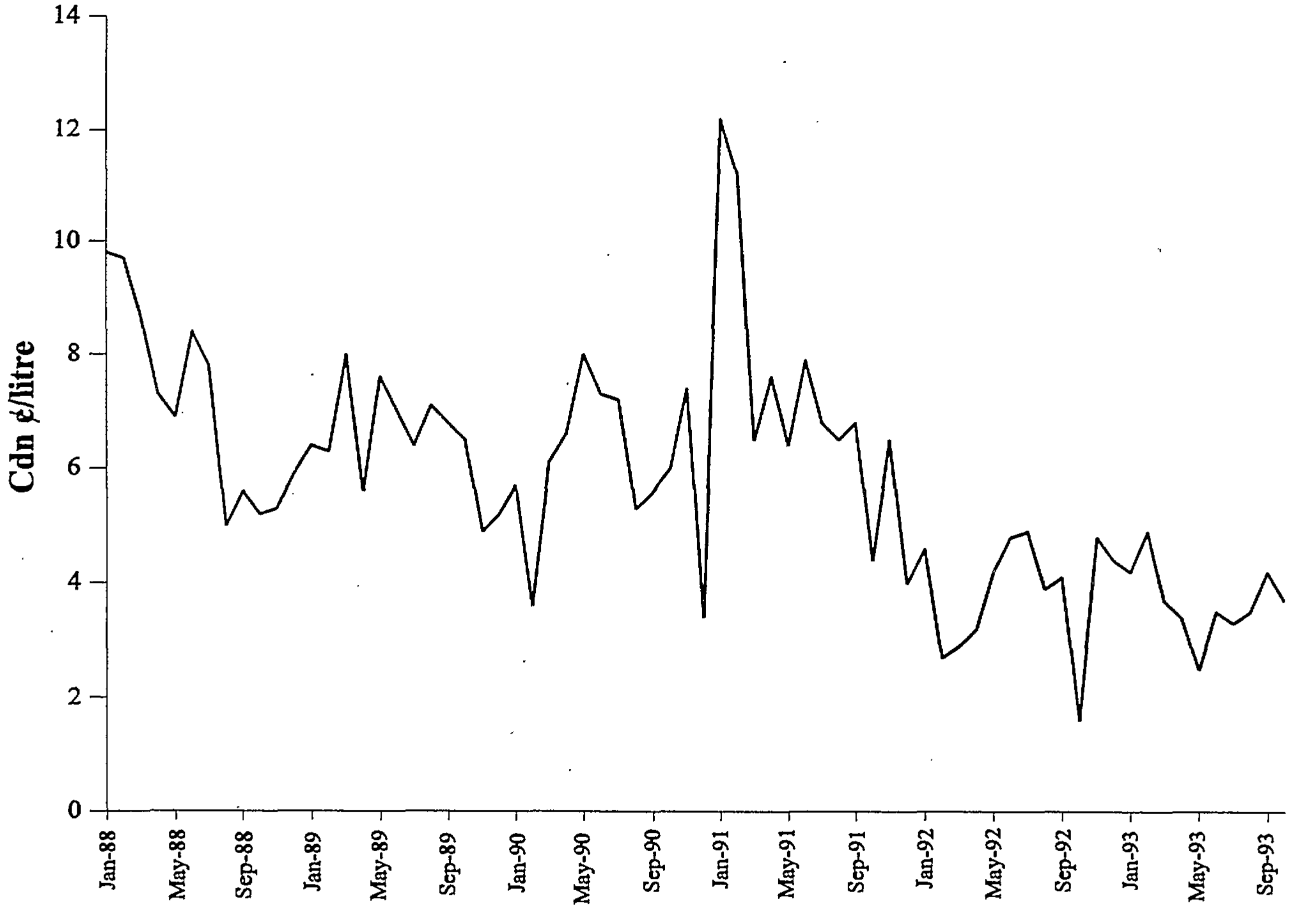


FIGURE 10

Toronto Rack Vs Retail Ex-Tax Price Margins For Regular Unleaded Gasoline



c) Retail Dealers' View:
(operating only on retail margins)

- Dealer margins are relatively stable, with very little movement from month to month.
- Since it is difficult to change the margin, dealers are very dependent on volume to increase profitability.
- Site productivity is very important.

Site Productivity

- Retail petroleum industry is overbuilt - resulting in low site productivity. The Octane magazine "Survey of Retail Outlets" reveals that in 1993, 1100 service stations were closed in Canada.

- Average sales per outlet in the U.S. is more than twice that of an average Canadian outlet. Average daily throughput per service station in Canada was 4.7 thousand litres per day for the period January to September in 1993. Operating and capital costs per unit of product sold are therefore much higher in Canada than in the U.S..

- Exit costs are escalating: costs of permanently closing a site may run from 0.5 to 2 million dollars.

- A sustained "squeeze" on the retail margin due to continuing competitive pressures on the retail price. Volume growth critical to cover escalating fixed costs to operate.

- More focused redeployment of capital funds is needed. Higher volumes through fewer sites needed to improve capital productivity.

- A move towards urbanization by the majors will result in structural changes in the marketplace. While the majors will attempt to maximize efficiencies of outlets by opening high-volume "mega pumpers" in urban areas, rural businesses will likely be left to small branded retailers and independents. The large urban outlets are geared towards further maximizing on returns on capital employed by incorporating ancillary non-gasoline businesses.

Ancillary/Non-Gasoline Businesses

- Petroleum marketers are continuously adapting their business strategies to improve their return on capital employed and efficiency of operations at the site.

- Changing consumer behaviour and growth of splintered customer groups will result in need to alter land-use strategies with focus on convenience retailing. Appeal to value-conscious, "busy" consumer for his/her one-stop shopping needs.

- The convenience store (C-store)/gasoline retail outlet is a rapidly growing phenomenon, while car-washes, fast lubes and marketing alliances with fast food retailers are a few of the other efficiency-improving strategies employed.

- In the past ten years, C-stores have tripled their share of Canadian gasoline sales (reported by Kent Marketing). In 1993, C-stores accounted for 20.6% of retail outlets in the Kent database, while in 1983, it was only 6.3%.

- The U.S. C-store population fell for the second year in a row, declining by 2.5% in 1992. Gasoline sales per convenience store, however, grew by nearly 11% . C-stores account for 22% of all motor fuel sold in the U.S..

- Fast food as a cross-merchandising option is increasing. For example, one major oil company and a fast food retailer have begun a pilot project to install drive-through doughnuts and coffee at some service stations (In some cases the service station is eliminating some of the pump islands to make room for the donut drive-through).

- Ability to generate significant net income before taxes (NIBT) from non-gasoline businesses is seen as the critical success factor for industry participants.

Barriers to Exit

The ownership structure of a large part of the marketing segment of the industry, combined with environmental requirements, have created a barrier to exit for some operators. The result is an obstacle to the process of rationalization.

The Canadian petroleum product marketing system is characterized by an excess of service stations. The average station in Canada sells about half the volume of product of a station in the United States. It is estimated that some 65% of service stations are owned and operated by small business people.

When a station closes, a variety of local and provincial regulations requiring very expensive cleanup procedures for the site come into play. These requirements often have costs that exceed the value of the site. Emerging environmental liabilities are making it virtually impossible to sell a site with any potential contamination. Most older service station sites have some degree of contamination. For small business owners, the site may be their only asset of value. As a result, they may face personal financial ruin by closing their uneconomic

business. The result is the continuance in operation of uneconomic sites, which has two negative consequences - it maintains excess capacity in the marketing of motor fuels and it heightens the risk of contamination as more older sites remain operating.

There are efforts now under way in the Canadian Council of Ministers of the Environment (CCEM) to establish common principles for environmental liability amongst the provinces. New equipment standards and operating procedures for service stations should reduce the probability of contamination in the future, particularly if the new standards are applied equally to both new and existing stations. The challenge is to rationalize the current inventory of service stations.

Prices

- Retail prices are set by competitive forces in the market place and are beyond the control of individuals retailers. Prices are not always sufficient to cover costs.
- When competition drives prices down, retailers must rely on volume to cover costs especially high fixed costs.
- The public is very sensitive to the retail price of gasoline and reacts quickly to price changes. A relatively small increase of 1 ¢/l can cause a public outcry.

a) Grade Differentials

See Figure 11 "Gasoline Grade Differentials* At Self-Serve Stations (Canadian cents per litre)"

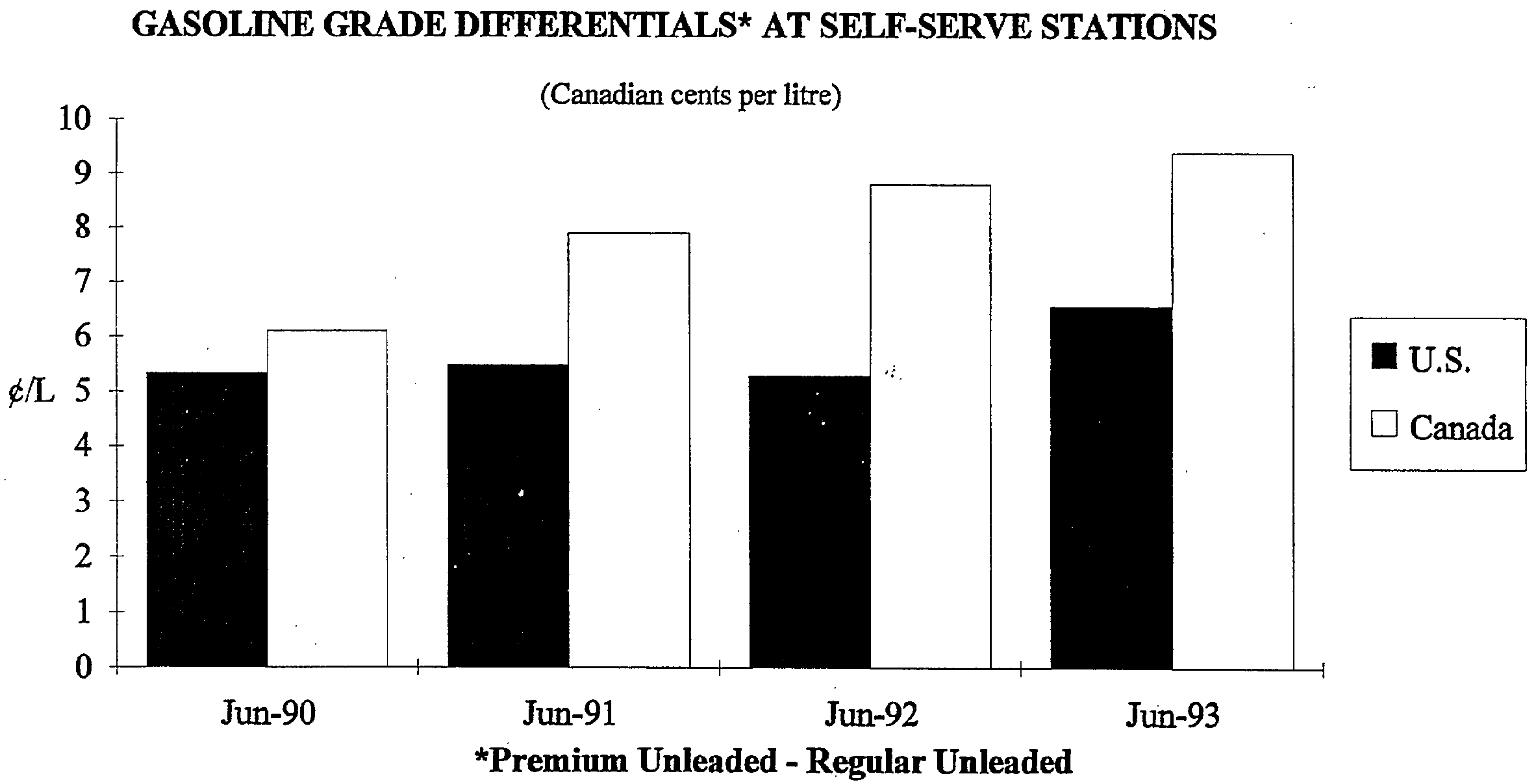
- There are strong supply/demand and price correlations.
- Higher volumes of premium unleaded gasoline in the U.S. (22% of total mogas sales versus 16% in Canada) lead to lower price differentials between regular and premium grades.
- When the costs of maintaining separate tanks and pumps for premium are spread over less volume the per unit costs rise. Since the regular grade accounts for most of the volume, it is the most price-competitive and retailers often increase the price of other grades in an effort to maximize revenues.

b) Service Differentials

See Figure 12 "Full-Serve vs Self-Serve Price Differentials"

- Canadian differential doesn't reflect full cost of providing service.
- Much lower full-serve/self-serve spread in U.S.
- Lower demand for full-serve in U.S. results in higher prices.
- There are also differences in actual services offered at full-serve in U.S. and Canada.

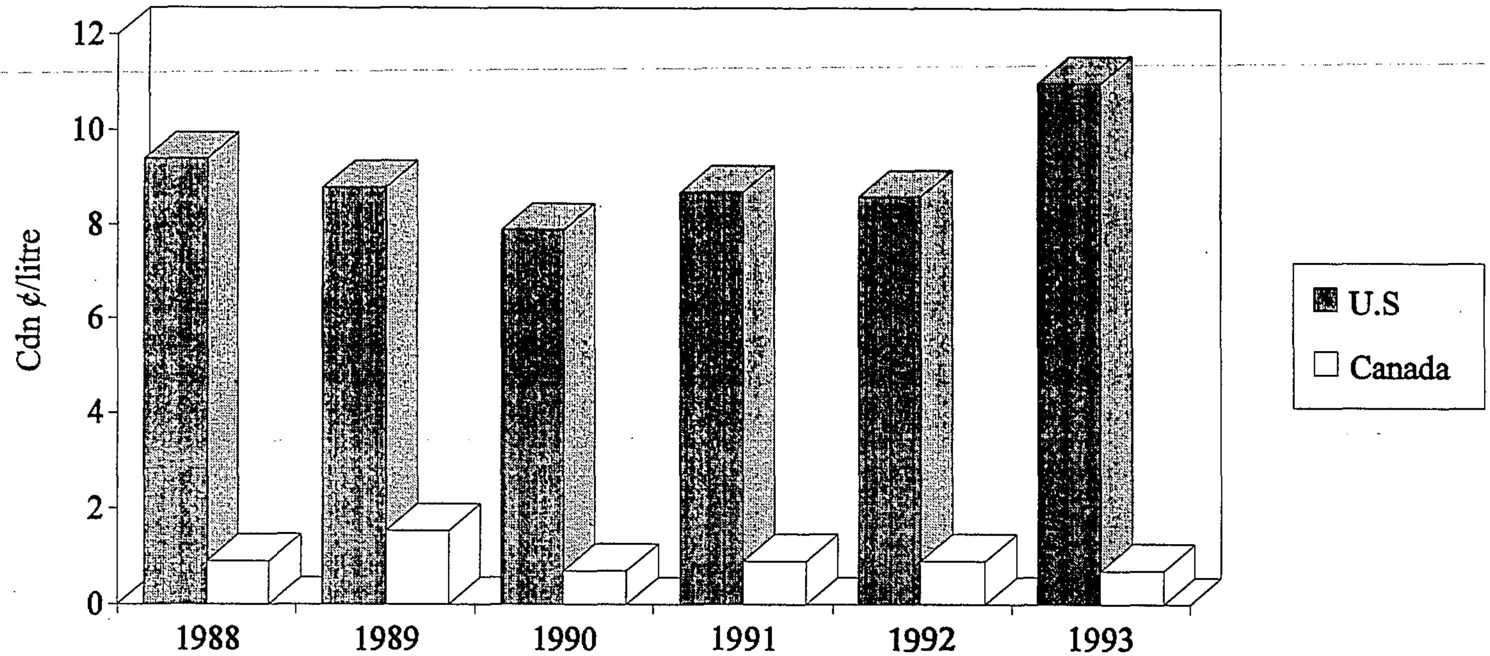
FIGURE 11



GASOLINE GRADE DIFFERENTIALS* AT SELF-SERVE STATIONS
(Canadian cents per litre)
10
9
8
7
6
¢/L 5
4
3
2
1
0
Jun-90
Jun-91
Jun-92
Jun-93
*Premium Unleaded - Regular Unleaded
U.S.
Canada

FIGURE 12

FULL-SERVE VS SELF-SERVE PRICE DIFFERENTIALS



SUMMARY

- Refinery competitiveness depends upon access to low cost feedstock and the effectiveness with which it can be processed into high value feedstock.

- Environmental regulations on product quality will increase the costs of many products (gasoline, desulphurized diesel) potentially change product yields, and potentially change the product definition itself (for instance, regular unleaded gasoline could become a higher cost/price reformulated gasoline).

- Ontario is the most complex and most competitive market in Canada. The principal feedstock source is domestic Canadian light crude oil from Western Canada. Ontario refiners are exposed to competition from eastern seaboard product imports.

- The market setting for Atlantic Canada refiners is one in which there is active trade in water-borne bulk cargoes of both crude oil and the major refined products.

- Petroleum markets are mature, with flat/low demand growth. Primary market focus is transportation fuels.

- Escalating site operating costs. Need to explore/pursue cost efficiencies, such as unattended retailing and point-of-sale technologies to contain/reduce operating costs.

- Environmental compliance costs threaten existence of small and undercapitalized independent retailers.

- Intense competitive rivalry will result in sustained pressure on margins.

- Ancillary/non-gasoline businesses essential to profitability/long-term health of independent fuel retailers.

Appendix A6

Environmental Challenges

TABLE OF CONTENTS

ENVIRONMENTAL CHALLENGES

EXECUTIVE SUMMARY

The industry has a history of environmental proactivity and has spent upwards of $2 billion since the early 1970's. Anticipated future environmental requirements are more numerous and potentially much more costly. This has led CPPI to initiate discussions on processes to help prioritize the agenda and ensure initiatives are both environmentally and economically effective.

This Sectoral Competitive Framework study has launched an examination of the comparative costs of a realistic scenario for Canada and the U.S. This examination has developed cost data sheets for about 50 initiatives, using the best information available from U.S. and Canadian sources. The compilation of that data can be seen in Figure 1.

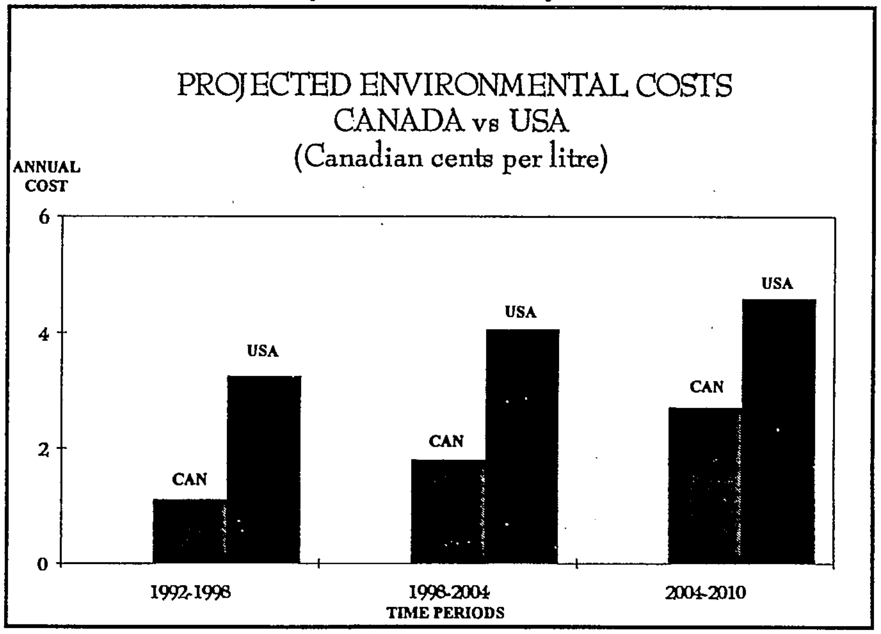
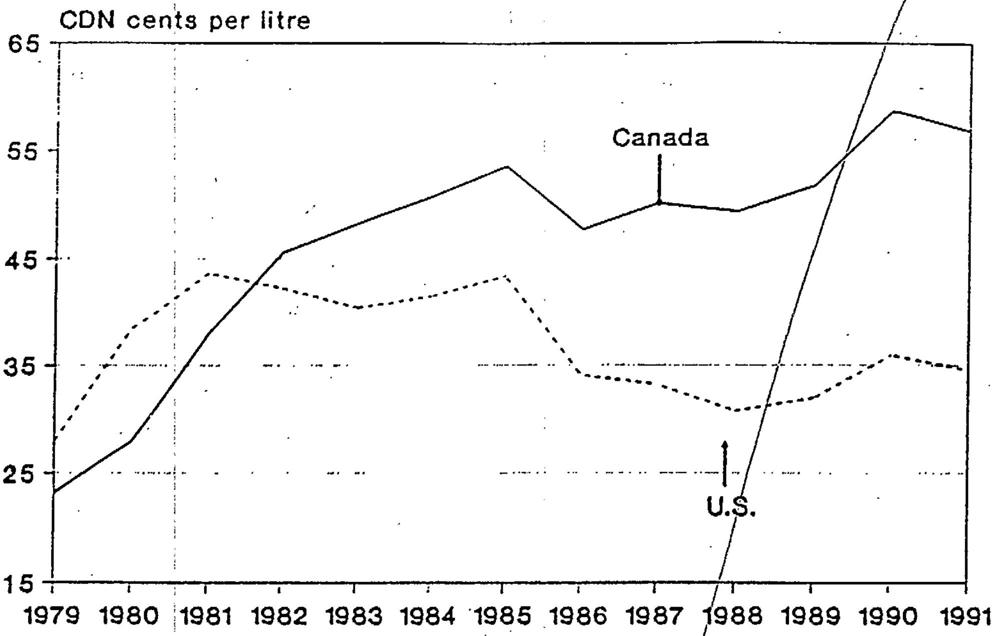


Figure 1

These early results indicate that a more flexible and less demanding Canadian approach to environmental control appears to be less costly than the system in place in the U.S. by a factor of two to three. Therefore, on the basis of environmental costs alone, Canadian refiners do not have a disadvantage versus their competition in the U.S.

Despite the lower relative cost, the annualized potential costs are still extremely large. They range from $CDN 1 billion for the high probability initiatives to 2.5 billion for the more exhaustive scenario which includes medium and low probability initiatives. As is the case in the U.S., these environmental expenditures are expected to exceed the current book value of the industry. Paying for those investments is a major concern given the current low returns and industry expectations of flat demand. The challenge is to develop a situation where the industry can recover incremental costs while the consumer continues to receive the lowest cost, highest quality and environmentally safe products.

FIGURE IV-13
REGULAR UNLEADED GASOLINE PRICES
CANADA VS U.S. INCLUDING TAX



The components of retail prices for gasoline are shown in Figure IV-14 for Ontario. These components are also compared below for Ontario, Quebec and Alberta:

COMPONENT PORTIONS OF UNLEADED GASOLINE IN 1991
(Cents per Litre)

	Ontario	Quebec	Alberta
Federal Tax	12.1	12.4	11.6
Provincial Tax	12.6	16.8	8.5
Total Tax	24.7	29.2	20.2
Crude Cost	16.1	16.9	14.6
Refining and Marketing Margin	10.4	14.1	10.0
Dealer Margin	3.5	4.2	3.7
Total	54.7	64.4	48.4

ENVIRONMENTAL CHALLENGES

INTRODUCTION

The current and future environmental challenges and opportunities are expected to have a greater impact on the profitability and competitiveness of the Canadian petroleum refining industry than any other issue facing it at this time. Meeting these challenges will require significant additional capital expenditures and result in higher operating costs, and higher product prices.

This section puts forward a Canadian environmental initiatives scenario. It also compares it to the United States scenario in order to assess that aspect of the competitiveness of the Canadian refining industry with its principal competitor, the U.S. refining industry.

CANADIAN ENVIRONMENTAL SCENE

During the past 20 years, the industry has invested approximately $2 billion in equipment, processes and procedures introduced to protect the environment. Examples include measures to reduce or eliminate the contaminants in the effluent released from refineries, the reduction of sulphur emissions, site remediation, the phase-out of lead from gasoline, voluntary measures to reduce emissions of volatile organic compounds in ozone-sensitive areas, and the increased collection and re-cycling of used motor oil.

Further initiatives currently being implemented include measures to reduce the level of sulphur in diesel fuel, decontaminate the soil at a number of former service stations and refinery sites, and further reduce atmospheric emissions from facilities.

Canadian environmental requirements often parallel U.S. requirements. Both industries are technically similar and both countries often encounter similar environmental problems. Therefore, they frequently require the same remedial measures. For example, agreements such as the *Canada/United States Air Quality Agreement* require both countries to meet the same standard on diesel engine emissions. Another example is the adoption of Stage I vapour recovery by both countries to reduce evaporative emissions from marketing facilities. As a final example, when the U.S. requires changes in fuels in order to reduce vehicle emissions, there is pressure in Canada to do the same.

Historically, Canada and the United States have approached environmental protection differently. In the U.S., the approach is more formal and relies heavily on direct regulation. In Canada, the Federal Government has focussed on consultation and cooperation with the industry to achieve its environmental goals. This is in part due to the concurrent or shared federal-provincial division of environmental responsibility. Co-ordination of environmental matters between the two levels of government is provided through the *Canadian Council of Ministers of the Environment* and *the National Air Issues Coordinating Committee* which is comprised of representatives from environment and energy ministries across Canada.

Given Canada's largely voluntary approach, regional variations, and competitive considerations, the exact requirements and timing of future Canadian environmental programs are difficult to forecast with any degree of certainty. CPPI and Environment Canada jointly developed an environmental scenario which presents the anticipated environmental requirements for the Canadian refining sector over the next 18 years. It is not currently accompanied by a regulatory program or an industry investment program.

The cost estimates for the Canadian scenario were developed from a number of reference documents. Wherever possible data from Canadian sources was used for the Canadian scenario. Where specific Canadian data was not available, costs were ratioed by an appropriate factor to the comparable U.S. program (e.g. crude capacity ratio). Annualized costs for the Canadian scenario assumed a 20 year period discounted at 10%.

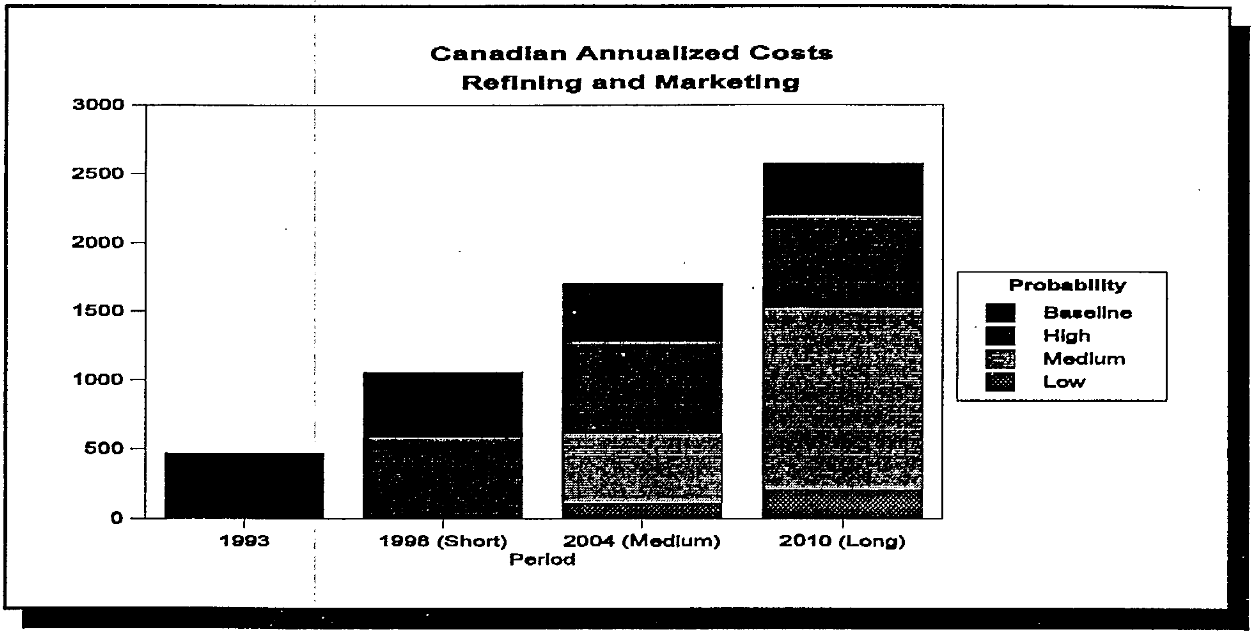
Canadian Environmental Scenario

Products RVP reduction MMT removal RFG 1 (Oxy<2.7%, Bz<1%,Arom<25%) LSD .05% on road (retail/cardlock) PAHs	**Products** HFO Sulphur RFG 2 LSD on road (non retail) Alternate Fuels	**Products** Diesel 55 cetane LSD off road
Refineries FHE LDAR NPRI VOC Tanks AST spills Permits NOx htrs/blrs CFCs Effluents Site remed`n 50% Waste red`n	**Refineries** PM 10 Greenhouse Gases Bz waste treatment water quality AST covers AST secondary containment NOX FCCU Landfarm restrictions	**Refineries** OCTW
Marketing Stage 1 VR AOC Site remed`n Waste oil recycle Marine spill response Stage 2 VR LFV VOC Tanks AST spills Double hull tankers	**Marketing** Marine vapour controls Stage 2 VR AOC Stage 1 VR National AST covers AST secondary containment	**Marketing** Stage 2 VR National

The Canadian environmental scenario presented in this appendix places anticipated initiatives into one or more of three time periods; short (1993-1998), medium (1999-2004) and long term (2005-2010).

Tables 1 and 2 of this appendix list the Canadian and U.S. environmental initiatives in the order of the accompanying fact sheets found at the end of this appendix. Fact sheets are provided for most of the environmental initiatives listed. They describe the initiatives, costs, scope of implementation, and the basis of the cost estimate.

Canadian Environmental Costs

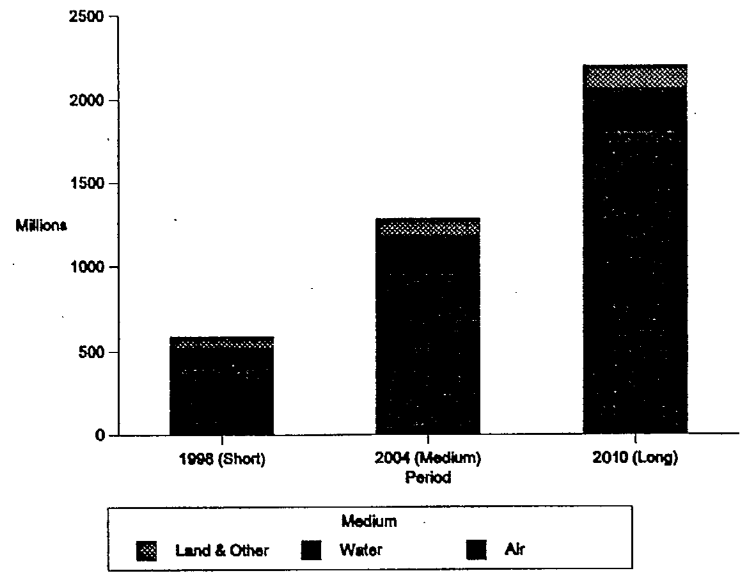


Source of Data -Table 3
Page 15

The figure above shows the total estimated annualized expenditures for the anticipated Canadian environmental initiatives. Cumulative costs are shown for the high, medium and low probability scenarios and for the short (1993-1998), medium (1999-2004) and long(2005-2010) time frames. The baseline cost represent pre-1993 annualized capital expenditures(based on the assumed expenditure of $2 billion over the past 20 years) and the annual operating costs associated with environmental initiatives(taken to be $200, $150 and $100 million in the 3 respective time periods).

The Canadian scenario cumulative annual expenditures for high priority initiatives reaches $1 billion by the year 2010. The total for all potential initiatives exceeds $2.5 billion by the year 2010. A rough calculation over the 1993 to 2010 time frame shows that the petroleum industry could face costs in the order of $19 billion in excess of the 1993 baseline expenditure. As pointed out earlier, the scenario does not show cost data for all possible initiatives. Greenhouse gases, waste reduction, land farming restrictions, and alternate fuels are examples of those exclusions. The scenario may therefore be underestimated.

Incremental Canadian Annualized Costs by Medium
Refining & Marketing



Source of Data-Table 4
Page 16

The figure above shows the Canadian annualized cost net of baseline costs broken down by medium - air, water and other (i.e. waste, soil & groundwater, emergency response, etc). Over 80% of the incremental costs are required for air quality protection. Water and other are approximately 14% and 6% respectively.

United States Environmental Scene

The U.S. government has brought a number of environmental laws into force over the past decades, resulting in a wide range of sometimes costly requirements on the U.S. refining industry. Principal among these are the *Clean Air Act* and its amendments, the *Resource Conservation and Recovery Act,* the *Clean Water Act* and the *Oil Pollution Act.*

In the U.S. a wide range of regulations, orders and other directives are used to impose environmental requirements. In a number of cases, the actual application of the legislation is left to the states, with the caveat that the federal government will impose measures if the states do not introduce acceptable equivalents.

The main legal framework of the U.S. environmental program is reasonably straightforward. Ultimately, the principle requirements of the legislation are implemented. However, the implementation of specific provisions can be complex. Regional or other waivers or releases from obligations are frequent and delays often occur.

The information on the U.S. refining industry's environmental regulatory scenario has been derived principally from two sources. The first, a report prepared by the *National Petroleum Council*[1] at the request of the U.S. Secretary of Energy, looks at the future of the U.S. refining industry, especially as it might be affected by environmental regulations. The second study, by the *American Petroleum Institute*[2], summarizes the costs that will be incurred by the industry in meeting existing and planned environmental regulations.

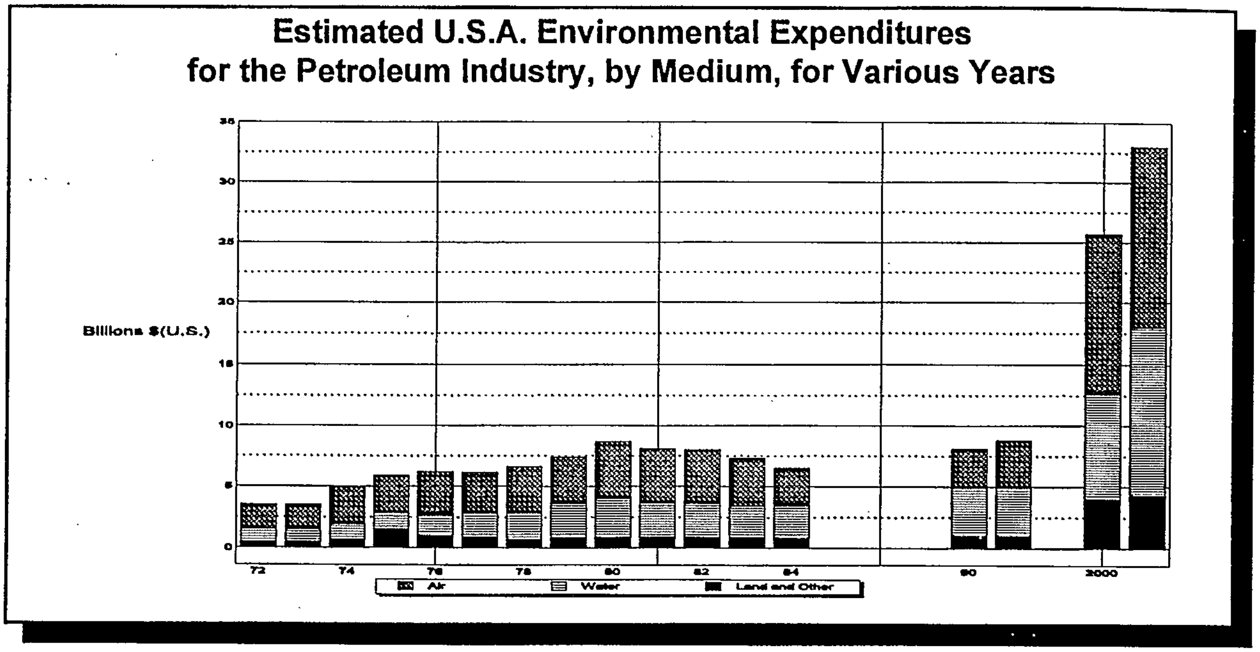
The U.S. environmental costs are given in U.S. dollars. However, whenever they are prorated on the ratio of Canadian to U.S. crude throughput, or are compared to Canadian environmental costs, they are given in Canadian dollars.

---

1 *U.S. Petroleum Refining: Meeting Requirements for Cleaner Fuels and Refineries,* National Petroleum Council, August 1993.

2 *Costs to the Petroleum Industry of Major New and Future Federal Government Environmental Requirements,* Discussion Paper #070R, October 1993, Jody Perkins.

U.S. Environmental Costs



Source: API Paper #070R Octobre 1993, p.43

The potential cost of U.S. environmental requirements is quite large. Current expenditures by the U.S. refining industry on environmental-related measures are estimated by the American Petroleum Institute to be more than $8 billion per year.

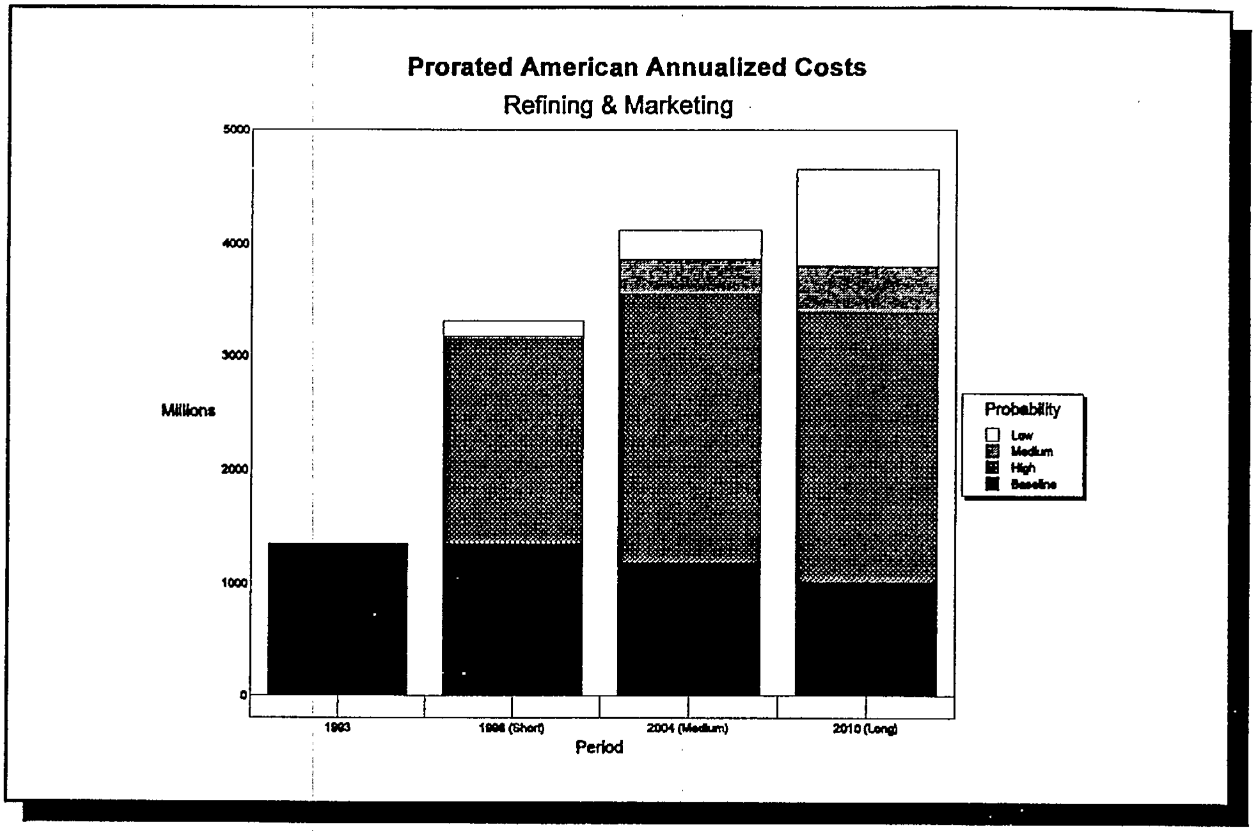
The expenditures are expected to rise by as much as $17 billion to $25 billion by the year 2000, to total some $26 billion to $33 billion, as shown in the figure above.

The figure would seem to indicate that the cost projections for the year 2000 are high by historical standards. However, the low estimate of $26 billion represents 13.5% of projected national expenditures for pollution control. This is roughly the same percentage as was spent by the petroleum industry in the mid-1970s and in 1980.

The range of the cost estimates for the environmental requirements is very large due to the uncertainties on the requirements and the extent of the applicability. For example, the price of a "clean" gallon of gasoline could increase by as little as 3 /gal. or as much as 27[3] /gal. (<1 to 7 /litre), depending on the season and local requirements. Typically, the absolute costs vary by a factor of three to four between the high and low estimates.

---

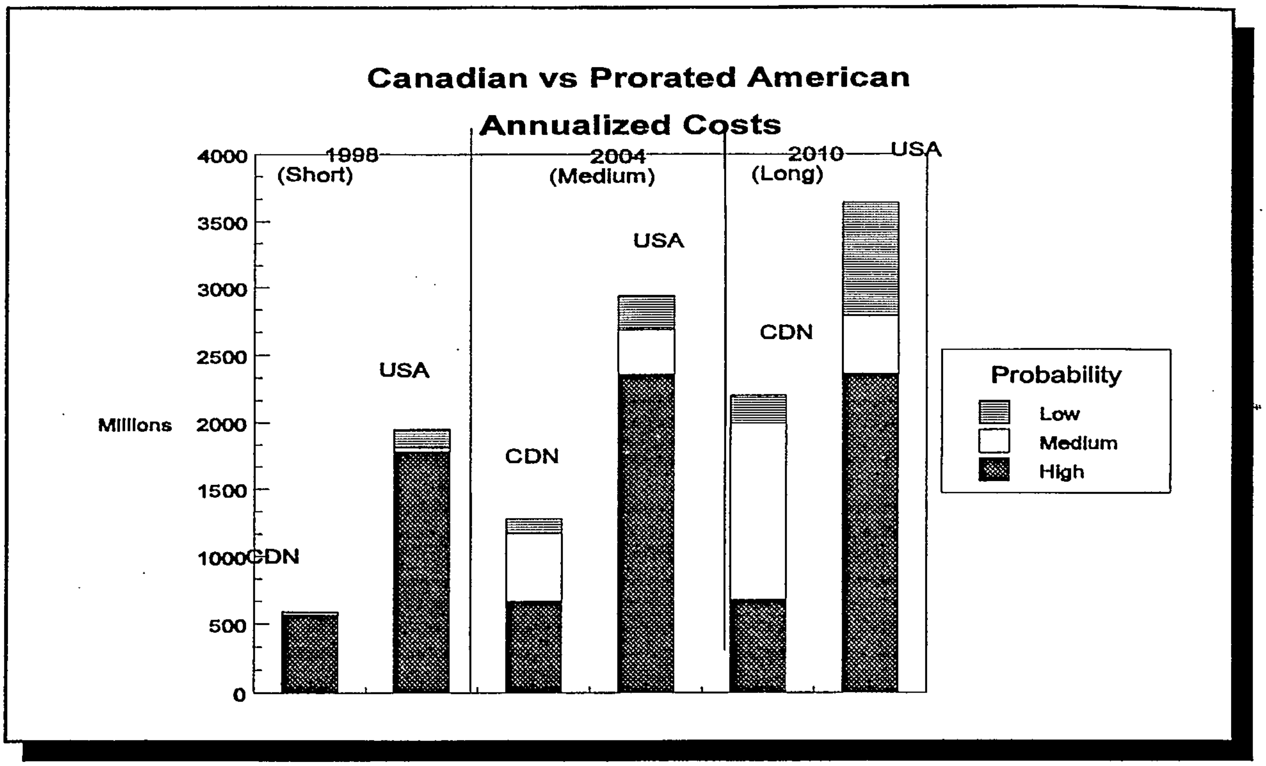
[3] The 3 ¢/gal. is the lower cost estimate for oxygenated gasoline, 27 ¢/gal. is the higher cost estimate for RFG II - API Discussion Paper #070R p. 50



Source of Data: Table 5
Page 17

The figure above shows the U.S. annualized expenditures for the downstream petroleum sector. The U.S. costs were normalized on the basis of the Canadian to U.S. crude capacity ratio (equal to 12.7%), to take into account the size of each industry. The costs were also increased by 33% to reflect a currency exchange rate between Canada and the U.S of 0.75 $CDN to 1.00 $US.

On the basis of normalized costs, the U.S. could spend over $3 billion on baseline plus high priority initiatives by the year 2010. Including all the initiatives increases this cost to more than $4.5 billion. A rough calculation over the 1993 to 2010 time frame shows total expenditures net of the baseline, of approximately $38 billion for the U.S. scenario (**note**: this cost has been normalized for direct comparison with the Canadian scenario. The actual total U.S. cost is approximately $CDN 300 billion). As was the case in the Canadian scenario, the U.S. scenario does not include all the potential costs, and may therefore also be underestimated.



Source of Data: Tables 3 and 5
Pages 15 & 17

The figure above shows the Canadian and U.S. annualized expenditures side by side for the corresponding periods. The costs shown are incremental costs (i.e. net of the 1993 baselines) and are on a crude equivalent basis(i.e. U.S. costs are ratioed on the Canadian to American crude throughput capacity of 0.127 and increased to reflect an exchange rate of 0.75 $US to 1.00 $CDN)

High probability U.S. costs are between 2 and 3+ times higher than Canadian costs, on a crude capacity equivalent basis. When medium probability costs are added to the comparison, U.S. costs are approximately 1.5 to 2 times higher than Canadian costs.

U.S. costs are higher than Canadian costs in the last period of the scenarios covering all the probabilities due to: less numerous and costly historical Canadian requirements (700 millions), less demanding measures around soil disposal, secondary containment and for other waste related items (700 millions), a lesser number of measures for water quality improvements are expected partly because some are already applied in Canada and partly because some are not expected to be required (200 millions), the air quality is better in Canada and requires less demanding measures and a more flexible control approach will reduce the cost of the air quality measures (500+ millions)[4].

---

4 See tables 4 and 6 of Appendix D for numbers used in this comparison.

Regional Differences

Whereas differences in environmental requirements between Canada and the United States can impact the competitiveness of the Canadian refinery industry vis a vis its major competitor, the U.S. industry, there are also instances in Canada where differences in environmental requirements between provinces or even within provinces can impact competitiveness between Canadian refineries. Three specific examples demonstrate where different environmental requirements in Canada impact inter-company competition; sulphur emissions limits, NO_x/VOC emissions standards and liquid effluent standards.

Sulphur Emission Limits:

There are presently a wide range of requirements in Canada respecting the quantity of sulphur that can be released from refineries. Emissions limits impact sulphur released from fuel combustion as well as process emissions. Allowed levels of sulphur in refinery fuels range from a low of 1.0 percent for Montreal and similar limits for Ontario and Western Canada to levels in the 3.0 percent range for Atlantic Canada. An illustration of the importance of the impact of the level of sulphur in refinery fuel on refining cost has recently come to light in the CPPI application to the Montreal Urban Community. The CPPI estimated that some $12 million annually could be gained through a relaxation of the sulphur limit to 1.5 percent. This example demonstrates that refinery fuel costs can have a significant impact on refinery economics, and underlines the challenge of trying to balance environmental and economic pressures on the industry.

NO_x/VOC Emission Standards:

The NO_x/VOC management plan provides for preventative measures to be applied nation-wide and for remedial measures to be applied in the non-attainment areas - Lower Fraser Valley, Windsor - Quebec corridor and the South Atlantic region. In the context of an initiative now being designed (vapour releases from tanks) it was argued by a major Atlantic refiner that it would be unfair for competitive reasons to require a refinery in the non-attainment area (South Atlantic region) to upgrade refinery tankage when companies operating as close as Halifax would not be subject to the some requirement. Obviously, costs would be higher in the non-attainment areas.

Refinery Effluent Standards:

Baseline refinery effluent standards in Canada are set through the Refinery Effluent Regulations and Guidelines administrated by Environment Canada. More stringent regulations, notably in Ontario, have resulted in significant improvement in total effluent loadings for that province. Although we are not aware of costs estimates of improving effluent quality, it would appear that Ontario refiners are incurring costs higher than their counterparts in the rest of the country.

Industry, on the one hand, would like to operate with a level playing field - all players subject to the same rules. On the other hand, environmental responses are most efficiently applied where a problem can be demonstrated to exist. The two approaches are not compatible and therefore compromises are required. Where such compromises are made there are those who would give the benefit of the doubt to improving overall environmental performance and those who would favour minimizing costs. The debate will continue.

Observations

The Canadian environmental scenario developed in this chapter is highly speculative with respect to timing and costing. Cost estimates were not available for many initiatives and should be developed to give a better picture of the environmental challenges. The U.S, scenario is also incomplete although the timing of initiatives is somewhat clearer, because unlike Canada, the U.S. scenario is based on a legislative framework.

With these shortcomings in mind, the following observations are made:

Canadian environmental costs are high - $ 1 billion per year being highly probable with a potential to exceed $2.5 billion by the year 2010.

On a crude capacity equivalent basis the U.S. costs are roughly 3 times higher than the Canadian costs for the high priority initiatives.

The analysis indicates that the environmental costs on their own do not put Canada at a competitive disadvantage with the U.S. The issue appears to be more one of Canadian petroleum industry viability resulting from the large magnitude of the costs.

The challenge is to develop a win-win situation where the industry can recover incremental costs while the consumer continues to receive the lowest cost, highest quality and environmentally safe products.

The issue of the need for environmentally driven national product quality standards needs to be addressed. With standards in place, costs increase but they do so for everyone, and therefore tend to level the playing field both internally and with respect to imports. National standards also provide greater potential for incremental cost recovery. In the absence of national standards, costs will be lower, but lower quality imports especially from the U.S. may set the product costs and adversely impact Canadian competitiveness.

There will be continued pressure to improve or adapt the quality of the products to meet the environmental demands for cleaner fuels. This will challenge both the producers and users to assess the options and to reach agreement on what the cleaner fuels will be, how they will be produced and how the costs will be met.

Table

Canada - Environmental Requirements

Initiative	Ref No.	Costs (M$) Investment Short	Investment Medium	Investment Long	Operating Short	Operating Medium	Operating Long	Annualized Short	Annualized Medium	Annualized Long	Medium	Implmtn Problty	Sector	Cost Indices
All Previous Initiatives	0				270	270	270	470	420	370	All	0	R&M	0
Benzene - Waste Treatment	1	0	47	47	0	5	9	0	10	20	Air	2	R	1
Stage I - Vapour Recovery - AOC	2	68	0	0	-5	-5	-5	3	3	3	Air	1	M	1
Stage I - Vapour Recovery - National	2	0	656	0	0	-5	-5	0	72	72	Air	3	M	1
Stage II - Vapour Recovery - LFV	3	14	0	0				2	2	2	Air	2	M	1
Stage II - Vapour Recovery - AOC	3	0	135	0				0	16	16	Air	3	M	1
Stage II - Vapour Recovery - National	3	0	0	197				0	0	23	Air	3	M	1
RVP Reduction	4	11	0	0	81	81	81	82	82	82	Air	1	R	1
MMT Removal	5	50	0	0	25	25	25	31	31	31	Air	1	R	1
RFG I	6	1100			100	100	100	225	225	225	Air	1	R	0
RFG II	7		1400		0	135	135	0	300	300	Air	2	R	0
Fed Gov't Agmnt with Refiners	8	120	0	0	14	14	14	28	28	28	Air	1	R	1
On Highway Diesel - Sulphur	8	0	270	0	0	32	32	0	64	64	Air	2	R	1
Off Highway Diesel - Sulphur	9	0	0	582	0	0	67	0	0	135	Air	2	R	1
Diesel - Cetane/Aromatics	11	0	0	2109				0	0	669	Air	2	R	0
Fugitive Emissions	13	25	0	0	15	15	15	18	18	18	Air	1	R	1
NOx Controls on Burners	14	61	61	0	0	0	0	7	14	14	Air	1	R	1
NOx Controls at FCC	15	0	10	10	0	1	2	0	2	4	Air	3	R	1
Tank Covers	16	0	25	26	0	1	1	0	4	7	Air	3	R&M	1
PM 10	17	0	50	50	0	2	4	0	8	16	Air	1	R	1
Sulphur in Heavy Fuel Oil	18	0	540	0				0	63	63	Air	1	R	1
CFCs Replacement	19										Air	1	R	0
Control of VOC from Tankage	20	20	15	0	-1	-3	-3	1	1	1	Air	2	R&M	1
Marine Vapour Controls	21	0	22	0	0	5	5	0	8	8	Air	1	R&M	1
Alternative Fuels	22										Air	2	R&M	0
Greenhouse Gases	23										Air	1	R	0
Federal Permitting	24				6	6	6	6	6	6	Air	3	R	1
National Pollutants Reporting	25	2	0	0	1	1	1	1	1	1	Other	1	R	1
Revised Effluent Standards	26	50	0	0	8	8	8	14	14	14	Water	1	R	1
Great Lakes Water Quality	27	0	298	0	0	67	67	0	102	102	Water	2	R&M	1
Storm Water Quality	28										Water	0	R	0
OTCW Elimination	29	0	0	300				0	0	35	Water	3	R	1
Refinery Sites Remediation	30	150	0	0				18	18	18	Other	1	R	1
Sites Remediation - Marketing	30	300	150	0				35	53	53	Other	1	M	1
Waste Oil Recycle	31										Other	1	R&M	0
Fuel Wastes - Land Farm. Restrictns	32							0	0	0	Other	1	R&M	1
Sludge Wastes - Land Farm. Rest.	33							0	0	0	Other	1	R	1
50% Solid Waste Reduction	34										Other	1	R&M	0
AST - Spill Prevention	35	84	84	0	2	4	4	12	24	24	Other	2	R&M	1
AST - Secondary Containment	36	0	100	294	0	0	0	0	12	46	Other	3	R&M	1
Storage Facilities- Response Plan	37										Water	3	R&M	0
Double Hull Tankers	38	769						90	90	90	Water	1	R&M	1
Vessel Fin. Responsibility	39										Other	1	M	0
Marine Spill Response	40	40	0	0	9	9	9	14	14	14	Water	1	M	1
Marine Facilities	41										Water	1	M	0
Vessels - Spill Prevention	42										Water	1	M	0
							Total	1056	1703	2572				

Note: 1) Probability of Implementation: 0 = Complete, 1 = High, 2 = Medium, 3 = Low.
2) Cost Indices: 0 = Existing data, 1 = Calculated Annualized Costs.
3) See Fact Sheets for comments on numbers and source of data.

Table 2
United States - Environmental Requirements

Initiative	Ref No.	Costs (M$)									Medium	Implmtn Problty	Sector	Cost Indices
		Investment			Operating			Annualized						
		Short	Medium	Long	Short	Medium	Long	Short	Medium	Long				
Stage 1 - Vapour Recovery	2							94	94	94	Air	0	M	0
MMT Removal	5										Air	0	R	0
Sulphur in Heavy Fuel Oil	18										Air	0	R	0
Used Oil Collection	31							0	0	0	Water	0	R&M	0
All Previous Initiatives	0							8000	7000	6000	All	0	R&M	0
Benzene - Waste Treatment	1	522	34	0	50	52	52	110	117	117	Air	1	R	1
Stage II - Vapour Recovery	3	1812	0	0				212	212	212	Air	1	M	0
Phase II - RVP Reductions	4	200	0	0	1050	1050	1050	1076	1076	1076	Air	1	R	0
Oxygenated Gasoline & RFG I	6	11000	0	0	1050	1050	1050	2346	2346	2346	Air	1	R	0
Oxygenated Gasoline & RFG II	7	0	14000		135	1350	1350	300	3000	3000	Air	1	R	0
On Highway Diesel - Sulphur	8	2400	0	0				796	796	796	Air	1	R	0
Off-Highway Diesel - Sulphur	9	0	0	1100				0	0	472	Air	2	R	0
Diesel Aromatics Reduction - CARB	10	840	0	0				267	267	267	Air	1	R	0
Diesel Aromatics Reduction	11	0	0	8960				0	0	2844	Air	3	R	0
Total Distillate - Sulphur	12	0	0	1500				0	0	732	Air	3	R	0
Fugitive Emissions	13	2867	0	0	148	148	148	483	483	483	Air	1	R	0
NOx Controls on Burners	14	219	513	0	16	56	56	42	142	142	Air	1	R	1
NOx Controls - SCR at FCC	15	26	75	80	3	11	19	6	23	40	Air	1	R	1
Tank Covers - MACT/NESHAP	16	286	299	0	8	15	15	41	83	83	Air	1	R	1
PM 10 Controls - MACT/NESHAP	17	997	612	0	76	99	99	193	287	287	Air	1	R	1
CFCs Replacement	19										Air	1	R	1
Control of VOCs from Tankage	20	275	0	0	31	31	31	63	63	63	Air	1	R&M	0
Marine Vapour Controls	21	2818	0	0				715	715	715	Air	1	R&M	0
Alternative Fuels	22							0	0	0	Air	2	R&M	0
Greenhouse Gases	23							0	0	0	Air	2	R	1
Permitting	24				43	43	43	43	43	43	Air	1	R&M	1
Expansion of Toxic Release Report	25	211	0	0	133	133	133	170	170	170	Other	1	R&M	0
Revised Effluent Standards	26	0	7909	0	0	657	657	0	1586	1586	Water	2	R	1
Great Lakes Water Quality	27	0	224	0	0	50	50	0	90	90	Water	2	R&M	1
Storm Water Treatment	28	424	357	607	25	46	83	75	137	245	Water	2	R	0
OTCW Elimination	29										Water	3	R	0
Scope of Toxicity Char. Rule	30	12530	0	0				1466	1466	1466	Other	1	R&M	1
Land Disposal Restriction Mod	32	5000	0	0	181	181	181	768	768	768	Other	1	R	1
Land Disposal Restriction - Sludge	33				44	44	44	44	44	44	Other	1	R	0
50% Waste Reduction	34							0	0	0	Other	1	R&M	0
AboveGrnd TankSpill Prevention	35	2800	2800	0	88	175	175	416	830	830	Other	1	R&M	0
Secondary Containment	36	6950	6000	0				813	1515	1515	Other	3	R&M	0
Facil. with AbovGrnd Stor. Tanks	37	121	0	0	52	52	52	63	63	63	Water	1	R&M	0
Double Hull Tankers	38	4538	0	0				531	531	531	Water	1	M	1
Vessel Financial Responsibility	39	0	0	0	122	122	122	122	122	122	Other	1	M	0
OilSpill Response Vessel	40	1000	0	0	134	134	134	251	251	251	Water	1	M	0
Marine Transp-Related Facilit.	41	700	0	0				82	82	82	Water	2	R&M	0
Discharge Prevention Equipment	42	153	0	0				18	18	18	Water	1	M	1
							Total	19512	24328	27501				

Note: 1) Probability of Implementation: 0 = Complete, 1 = High, 2 = Medium, 3 = Low.
2) Cost Indices: 0 = Existing data, 1 = Calculated Annualized Costs.

ENVTABL.XLS 10/31/94

3

Canada - Sort by Probability

Initiative	Ref No.	Costs (M$) Investment Short	Investment Medium	Investment Long	Operating Short	Operating Medium	Operating Long	Annualized Short	Annualized Medium	Annualized Long	Medium	Impimtn Problty	Sector
Storm Water Quality	28										Water	0	R&M
All Previous Initiatives	0				270	270	270	470	420	370	All	0	R
Stage I - Vapour Recovery - AOC	2	68	0	0	-5	-5	-5	3	3	3	Air	1	M
RVP Reduction	4	11	0	0	81	81	81	82	82	82	Air	1	R
MMT Removal	5	50	0	0	25	25	25	31	31	31	Air	1	R
RFG I	6	1100	0	0	100	100	100	225	225	225	Air	1	R
Fed Gov't Agmnt with Refiners	8	120	0	0	14	14	14	28	28	28	Air	1	R
Fugitive Emissions	13	25	0	0	15	15	15	18	18	18	Air	1	R
NOx Controls on Burners	14	61	61	0	0	0	0	7	14	14	Air	1	R
PM 10	17	0	50	50	0	2	4	0	8	16	Air	1	R
Sulphur in Heavy Fuel Oil	18	0	540	0				0	63	63	Air	1	R
CFCs Replacement	19										Air	1	R
Marine Vapour Controls	21	0	22	0	0	5	5	0	8	8	Air	1	R&M
Greenhouse Gases	23										Air	1	R
National Pollutants Reporting	25	2	0	0	1	1	1	1	1	1	Other	1	R
Refinery Sites Remediation	30	150	0	0				18	18	18	Other	1	R
Sites Remediation - Marketing	30	300	150	0				35	53	53	Other	1	M
Waste Oil Recycle	31										Other	1	R&M
Fuel Wastes - Land Farm. Restrictns	32							0	0	0	Other	1	R&M
Sludge Wastes - Land Farm. Rest.	33							0	0	0	Other	1	R
50% Solid Waste Reduction	34										Other	1	R&M
Vessel Fin. Responsibility	39										Other	1	M
Revised Effluent Standards	26	50	0	0	8	8	8	14	14	14	Water	1	R
Double Hull Tankers	38	769	0	0				90	90	90	Water	1	R&M
Marine Spill Response	40	40	0	0	9	9	9	14	14	14	Water	1	M
Marine Facilities	41										Water	1	M
Vessels - Spill Prevention	42										Water	1	M
High Probability Initiatives								566	669	677			
Benzene - Waste Treatment	1	0	47	47	0	5	9	0	10	20	Air	2	R
Stage II - Vapour Recovery - LFV	3	14	0	0				2	2	2	Air	2	M
RFG II	7	0	1400		0	135	135	0	300	300	Air	2	R
On Highway Diesel - Sulphur	8	0	270	0	0	32	32	0	64	64	Air	2	R
Off Highway Diesel - Sulphur	9	0	0	582	0	0	67	0	0	135	Air	2	R
Diesel - Cetane/Aromatics	11	0	0	2109				0	0	669	Air	2	R
Control of VOC from Tankage	20	20	15	0	-1	-3	-3	1	1	1	Air	2	R&M
Alternative Fuels	22										Air	2	R&M
AST - Spill Prevention	35	84	84	0	2	4	4	12	24	24	Other	2	R&M
Great Lakes Water Quality	27	0	298	0	0	67	67	0	102	102	Water	2	R&M
Medium Probability Initiatives								15	502	1316			
Stage I - Vapour Recovery - National	2	0	656	0	0	-5	-5	0	72	72	Air	3	M
Stage II - Vapour Recovery - AOC	3	0	135	0				0	16	16	Air	3	M
Stage II - Vapour Recovery - National	3	0	0	197				0	0	23	Air	3	M
NOx Controls at FCC	15	0	10	10	0	1	2	0	2	4	Air	3	R
Tank Covers	16	0	25	26	0	1	1	0	4	7	Air	3	R&M
Federal Permitting	24				6	6	6	6	6	6	Air	3	R
AST - Secondary Containment	36	0	100	294	0	0	0	0	12	46	Other	3	R&M
OTCW Elimination	29	0	0	300				0	0	35	Water	3	R
Storage Facilities- Response Plan	37										Water	3	R&M
Low Probability Initiatives								6	111	209			
All Initiatives								1056	1703	2572			

Tabl[illegible]

Canada - Sort by Medium, Probability

Initiative	Ref No.	Costs (M$) Investment Short	Investment Medium	Investment Long	Operating Short	Operating Medium	Operating Long	Annualized Short	Annualized Medium	Annualized Long	Medium	Implmtn Problty	Sector	Cost Indices
Stage I - Vapour Recovery - AOC	2	68	0	0	-5	-5	-5	3	3	3	Air	1	M	0
RVP Reduction	4	11	0	0	81	81	81	82	82	82	Air	1	R	1
MMT Removal	5	50	0	0	25	25	25	31	31	31	Air	1	R	1
RFG I	6	1100	0	0	100	100	100	225	225	225	Air	1	R	1
Fed Gov't Agmnt with Refiners	8	120	0	0	14	14	14	28	28	28	Air	1	R	1
Fugitive Emissions	13	25	0	0	15	15	15	18	18	18	Air	1	R	1
NOx Controls on Burners	14	61	61	0	0	0	0	7	14	14	Air	1	R	1
PM 10	17	0	50	50	0	2	4	0	8	16	Air	1	R	1
Sulphur in Heavy Fuel Oil	18	0	540	0				0	63	63	Air	1	R	1
CFCs Replacement	19										Air	1	R	0
Marine Vapour Controls	21	0	22	0	0	5	5	0	8	8	Air	1	R&M	0
Greenhouse Gases	23										Air	1	R	1
Benzene - Waste Treatment	1	0	47	47	0	5	9	0	10	20	Air	2	R	1
Stage II - Vapour Recovery - LFV	3	14	0	0				2	2	2	Air	2	M	1
RFG II	7	0	1400	0	0	135	135	0	300	300	Air	2	R	0
On Highway Diesel - Sulphur	8	0	270	0	0	32	32	0	64	64	Air	2	R	1
Off Highway Diesel - Sulphur	9	0	0	582	0	0	67	0	0	135	Air	2	R	1
Diesel - Cetane/Aromatics	11	0	0	2109				0	0	669	Air	2	R	1
Control of VOC from Tankage	20	20	15	0	-1	-3	-3	1	1	1	Air	2	R&M	1
Alternative Fuels	22										Air	2	R&M	1
Stage I - Vapour Recovery - National	2	0	656	0	0	-5	-5	0	72	72	Air	3	M	1
Stage II - Vapour Recovery - AOC	3	0	135	0				0	16	16	Air	3	M	0
Stage II - Vapour Recovery - National	3	0	0	197				0	0	23	Air	3	M	1
NOx Controls at FCC	15	0	10	10	0	1	2	0	2	4	Air	3	R	1
Tank Covers	16	0	25	26	0	1	1	0	4	7	Air	3	R&M	0
Federal Permitting	24				6	6	6	6	6	6	Air	3	R	0
Air Initiatives								403	956	1806				
All Previous Initiatives	0				270	270	270	470	420	370	All	0	R&M	1
National Pollutants Reporting	25	2	0	0	1	1	1	1	1	1	Other	1	R	1
Refinery Sites Remediation	30	150	0	0				18	18	18	Other	1	R	1
Sites Remediation - Marketing	30	300	150	0				35	53	53	Other	1	M	1
Waste Oil Recycle	31										Other	1	R&M	0
Fuel Wastes - Land Farm. Restrictns	32							0	0	0	Other	1	R&M	1
Sludge Wastes - Land Farm. Rest.	33							0	0	0	Other	1	R	1
50% Solid Waste Reduction	34										Other	1	R&M	1
Vessel Fin. Responsibility	39										Other	1	M	0
AST - Spill Prevention	35	84	84	0	2	4	4	12	24	24	Other	2	R&M	1
AST - Secondary Containment	36	0	100	294	0	0	0	0	12	46	Other	3	R&M	1
Land and Other Initiatives								66	107	141				
Storm Water Quality	28										Water	0	R	0
Revised Effluent Standards	26	50	0	0	8	8	8	14	14	14	Water	1	R	1
Double Hull Tankers	38	769	0	0				90	90	90	Water	1	R&M	1
Marine Spill Response	40	40	0	0	9	9	9	14	14	14	Water	1	M	0
Marine Facilities	41										Water	1	M	1
Vessels - Spill Prevention	42										Water	1	M	0
Great Lakes Water Quality	27	0	298	0	0	67	67	0	102	102	Water	2	R&M	1
OTCW Elimination	29	0	0	300				0	0	35	Water	3	R	0
Storage Facilities- Response Plan	37										Water	3	R&M	0
Water Initiatives								118	219	254				
All Initiatives								1056	1703	2572				

ENVTABL.XLS 10/31/94

Table 5

United States - Sort by Probability

Initiative	Ref No.	Costs (M$) Investment Short	Investment Medium	Investment Long	Operating Short	Operating Medium	Operating Long	Annualized Short	Annualized Medium	Annualized Long	Medium	Implmtn Problty	Sector
Stage 1 - Vapour Recovery	2							94	94	94	Air	0	M
MMT Removal	5										Air	0	R
Sulphur in Heavy Fuel Oil	18										Air	0	R
Used Oil Collection	31							0	0	0	Water	0	R&M
All Previous Initiatives	0							8000	7000	6000	All	0	R&M
All Previous Initiatives Prorated to Canada on Crude Thoughput								1355	1185	1016			
Benzene - Waste Treatment	1	522	34	0	50	52	52	110	117	117	Air	1	R
Stage II - Vapour Recovery	3	1812						212	212	212	Air	1	M
Phase II - RVP Reductions	4	200			1050	1050	1050	1076	1076	1076	Air	1	R
Oxygenated Gasoline & RFG I	6	11000			1050	1050	1050	2346	2346	2346	Air	1	R
Oxygenated Gasoline & RFG II	7		14000		135	1350	1350	300	3000	3000	Air	1	R
On Highway Diesel - Sulphur	8	2400	0	0				796	796	796	Air	1	R
Diesel Aromatics Reduction - CARB	10	840	0	0				267	267	267	Air	1	R
Fugitive Emissions	13	2867	0	0	148	148	148	483	483	483	Air	1	R
NOx Controls on Burners	14	219	513	0	16	56	56	42	142	142	Air	1	R
NOx Controls - SCR at FCC	15	26	75	80	3	11	19	6	23	40	Air	1	R
Tank Covers - MACT/NESHAP	16	286	299	0	8	15	15	41	83	83	Air	1	R
PM 10 Controls - MACT/NESHAP	17	997	612	0	76	99	99	193	287	287	Air	1	R
CFCs Replacement	19										Air	1	R
Control of VOCs from Tankage	20	275	0	0	31	31	31	63	63	63	Air	1	R&M
Marine Vapour Controls	21	2818	0	0				715	715	715	Air	1	R&M
Permitting	24				43	43	43	43	43	43	Air	1	R&M
Expansion of Toxic Release Report	25	211	0	0	133	133	133	170	170	170	Other	1	R&M
Scope of Toxicity Char. Rule	30	12530						1466	1466	1466	Other	1	R&M
Land Disposal Restriction Mod	32	5000	0	0	181	181	181	768	768	768	Other	1	R
Land Disposal Restriction - Sludge	33	0			44	44	44	44	44	44	Other	1	R
50% Waste Reduction	34	0						0	0	0	Other	1	R&M
AboveGrnd TankSpill Prevention	35	2800	2800	0	88	175	175	416	830	830	Other	1	R&M
Vessel Financial Responsibility	39				122	122	122	122	122	122	Other	1	M
Facil. with AbovGrnd Stor. Tanks	37	121	0	0	52	52	52	63	63	63	Water	1	R&M
Double Hull Tankers	38	4538						531	531	531	Water	1	M
OilSpill Response Vessel	40	1000			134	134	134	251	251	251	Water	1	M
Discharge Prevention Equipment	42	153						18	18	18	Water	1	M
High Probability Initiatives								10542	13917	13934			
Prorated High Probability Initiatives								1785	2357	2360			
Off-Highway Diesel - Sulphur	9	0	0	1100				0	0	472	Air	2	R
Alternative Fuels	22							0	0	0	Air	2	R&M
Greenhouse Gases	23							0	0	0	Air	2	R
Revised Effluent Standards	26	0	7909	0	0	657	657	0	1586	1586	Water	2	R
Great Lakes Water Quality	27	0	224	0	0	50	50	0	90	90	Water	2	R&M
Storm Water Treatment	28	424	357	607	25	46	83	75	137	245	Water	2	R
Marine Transp-Related Facilit.	41	700						82	82	82	Water	2	R&M
Medium Probability Initiatives								157	1895	2475			
Prorated Medium Probability Initiatives								27	321	419			
Diesel Aromatics Reduction	11	0	0	8960				0	0	2844	Air	3	R
Total Distillate - Sulphur	12	0	0	1500				0	0	732	Air	3	R
Secondary Containment	36	6950	6000	0				813	1515	1515	Other	3	R&M
OTCW Elimination	29										Water	3	R
Low Probability Initiatives								813	1515	5091			
Prorated Low Probability Initiatives								138	257	862			
All Initiatives								19512	24328	27501			
Prorated All Initiatives								3304	4119	4657			

Note: 1) Probability of Implementation: 0 = Complete, 1 = High, 2 = Medium, 3 = Low.
2) Cost Indices: 0 = Existing data, 1 = Calculated Annualized Costs.

ENVTABL.XLS 10/31/94

TABL

United States - Prorated to Canada on Crude Capacity - Sort by Medium, Probability, Ref. no.

Initiative	Ref No.	Costs (M$)									Medium	Implmtn Problty	Sector	Cost Indices
		Investment			Operating			Annualized						
		Short	Medium	Long	Short	Medium	Long	Short	Medium	Long				
Stage 1 - Vapour Recovery	2	0	0	0	0	0	0	16	16	16	Air	0	M	0
MMT Removal	5	0	0	0	0	0	0	0	0	0	Air	0	R	0
Sulphur in Heavy Fuel Oil	18	0	0	0	0	0	0	0	0	0	Air	0	R	0
All Previous Initiatives	0	0	0	0	0	0	0	1355	1185	1016	All	0	R&M	0
Benzene - Waste Treatment	1	88	6	0	8	9	9	19	20	20	Air	1	R	0
Stage II - Vapour Recovery	3	307	0	0	0	0	0	36	36	36	Air	1	M	0
Phase II - RVP Reductions	4	34	0	0	178	178	178	182	182	182	Air	1	R	1
Oxygenated Gasoline & RFG I	6	2540	0	0	0	0	0	397	397	397	Air	1	R	0
Oxygenated Gasoline & RFG II	7	0	3387	0	0	0	0	51	508	508	Air	1	R	0
On Highway Diesel - Sulphur	8	406	0	0	0	0	0	135	135	135	Air	1	R	0
Diesel Aromatics Reduction - CARB	10	142	0	0	0	0	0	45	45	45	Air	1	R	0
Fugitive Emissions	13	485	0	0	25	25	25	82	82	82	Air	1	R	0
NOx Controls on Burners	14	37	87	0	3	9	9	7	24	24	Air	1	R	0
NOx Controls - SCR at FCC	15	4	13	14	1	2	3	1	4	7	Air	1	R	0
Tank Covers - MACT/NESHAP	16	48	51	0	1	3	3	7	14	14	Air	1	R	1
PM 10 Controls - MACT/NESHAP	17	169	104	0	13	17	17	33	49	49	Air	1	R	1
CFCs Replacement	19	0	0	0	0	0	0	0	0	0	Air	1	R	1
Control of VOCs from Tankage	20	47	0	0	5	5	5	11	11	11	Air	1	R&M	1
Marine Vapour Controls	21	477	0	0	0	0	0	121	121	121	Air	1	R&M	1
Permitting	24	0	0	0	7	7	7	7	7	7	Air	1	R&M	0
Off-Highway Diesel - Sulphur	9	0	0	186	0	0	0	0	0	80	Air	2	R	0
Alternative Fuels	22	0	0	0	0	0	0	0	0	0	Air	2	R&M	1
Greenhouse Gases	23	0	0	0	0	0	0	0	0	0	Air	2	R	0
Diesel Aromatics Reduction	11	0	0	1517	0	0	0	0	0	482	Air	3	R	1
Total Distillate - Sulphur..	12	0	0	254	0	0	0	0	0	124	Air	3	R	1
Air Initiatives								1133	1635	2323				
Expansion of Toxic Release Report	25	36	0	0	23	23	23	29	29	29	Other	1	R&M	0
Scope of Toxicity Char. Rule	30	2122	0	0	0	0	0	248	248	248	Other	1	R&M	0
Land Disposal Restriction Mod	32	847	0	0	31	31	31	130	130	130	Other	1	R	0
Land Disposal Restriction - Sludge	33	0	0	0	7	7	7	7	7	7	Other	1	R	1
50% Waste Reduction	34	0	0	0	0	0	0	0	0	0	Other	1	R&M	0
AboveGrnd TankSpill Prevention	35	474	474	0	15	30	30	70	141	141	Other	1	R&M	0
Vessel Financial Responsibility	39	0	0	0	21	21	21	21	21	21	Other	1	M	1
Secondary Containment	36	1177	1016	0	0	0	0	138	257	257	Other	3	R&M	0
Land end Other Initiatives								643	832	832				
Used Oil Collection	31	0	0	0	0	0	0	0	0	0	Water	0	R&M	0
Facil. with AbovGrnd Stor. Tanks	37	20	0	0	9	9	9	11	11	11	Water	1	R&M	1
Double Hull Tankers	38	768	0	0	0	0	0	90	90	90	Water	1	M	1
OilSpill Response Vessel	40	169	0	0	23	23	23	43	43	43	Water	1	M	1
Discharge Prevention Equipment.	42	26	0	0	0	0	0	3	3	3	Water	1	M	0
Revised Effluent Standards	26	0	1339	0	0	111	111	0	269	269	Water	2	R	0
Great Lakes Water Quality	27	0	38	0	0	8	8	0	15	15	Water	2	R&M	0
Storm Water Treatment	28	72	60	103	4	8	14	13	23	42	Water	2	R	0
Marine Transp-Related Facilit.	41	119	0	0	0	0	0	14	14	14	Water	2	R&M	0
OTCW Elimination	29	0	0	0	0	0	0	0	0	0	Water	3	R	0
Water Initiatives								173	467	485				
						All Initiatives		3304	4119	4657				

ENVTABL.XLS 10/31/94

Note: 1) Probability of Implementation: 0 = Complete, 1 = High, 2 = Medium, 3 = Low.
2) Cost Indices: 0 = Existing data, 1 = Calculated Annualized Costs.

FACT SHEETS

These fact sheets describe the initiatives, costs, scope of implementation, and the basis of cost estimates for those initiatives listed in Tables 1 and 2 (pages 13 and 14) of this Appendix.

Issue Type : *All* | U.S. Program : *1970-1992* | U.S. Initiative : *All Previous Initiatives* | 0

Downstream Sector : *R&M* | Compliance - Start date : | Compliance - Completion date : | Probability of Implementation: *C*

Costs - Initial Investment : | Costs - Annual Operating : | Costs - Annualized : *8000 7000 6000* | Unit Costs - Estimate average :

Source of Estimates :

API #70R

Extent of Applicability :

National

Comments :

API and the EPA report that US annualized expenditures had reached $8 billion (1991$) per year in 1991 for all the environmental measures in effect at that point in time. This study assumes that the depreciation period for a number of facilities will lapse in the time frame of this study. Lacking any better data, it is assumed that there is a reduction of $1 billion every 5 years in the depreciation portion of the annualized cost. The annualized cost from historical expenditures thus decreases from $8 to $7 to $6 billion in the time frame of this study.

Issue Type : *All* | Canadian Program : *1970 -1992* | Canadian Initiative : *All Previous Initiatives* | 0

Downstream Sector : *R&M* | Compliance - Start date : *S* | Compliance - Completion date : *S* | Probability of Implementation : *C*

Costs - Initial Investment : | Costs - Annual Operating : *270 270 270* | Costs - Annualized : *470 420 370* | Unit Costs - Estimate average :

Source of Estimates :

Speculative Estimate

Extent of Applicability :

National

Comments :

Estimates of capital and operating expenditures are not readily available for the period of 1970 to 1992 when most of the historical environmental expenditures were made. Using some specific company numbers reported in annual reports and other individual company information as reference points, a speculative estimate is presented here. For all downstream petroleum companies, a total of approximately $2,000 million has been spent on facilities reducing the impact of refineries on the environment.

The main items included in that total are water segregating and treating facilities ($1,000 million), sulphur plants and tail gas recovery units ($250 million), marketing site remediation (1500 retail and 150 distribution sites for $175 million), refinery site remediation (3 for 31 million), particulates emission reduction at catalytic crackers ($100 million), leaking underground piping replacement ($100 million) and other miscellaneous items($400 million). The annualized cost of that investment is projected at $200, $150 and $100 milion in the short, medium and long time frame respectively.

The annual operating costs are assumed at $ 270 million/yr based on extrapolated company numbers.

Issue Type : *Air* | U.S. Program : *Clean Air Act* | U.S. Initiative : *Benzene - Waste Treatment* | 1

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	*S*	*M*	*H*

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
522	*34*	*0*	*50*	*52*	*52*	*110*	*117*	*117*	

Source of Estimates :

NPC (National Petroleum Council) Vol III page 3-41

Extent of Applicability :

Site Specific - Benzene emissions from waste treatment and waste handling system

Comments :

To comply with EPA's* "NESHAP**; Benzene Waste Operations" FR 58 no 4, the National Petroleum Council (NPC) compiled estimates of required controls which will have initial costs of $556*** million with an annual operating cost of 52*** million dollars. The required controls consist of covers on primary seperation and activated sludge systems and of enclosures on waste handling systems.

* Environmental Protection Agency
**National Emission Standards for Hazardous Air Pollutants
***US dollars - US initiatives are quoted in US dollars

Issue Type : *Air* | Canadian Program : *Toxics* | Canadian Initiative : *Benzene - Waste Treatment* | 1

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	*M*	*L*	*M*

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	*47*	*47*	*0*	*5*	*9*	*0*	*10*	*20*	

Source of Estimates :

12.7% of U.S. cost

Extent of Applicability :

Site Specific - benzene emissions from waste treatment and waste handling system.

Comments :

There is no equivalent Canadian Program for the control of emissions from waste treatment systems.

Issue Type : **Air**

U.S. Program : **Clean Air Act**

U.S. Initiative : **Stage I - Vapour Recovery**

2

Downstream Sector : **Marketing**

Compliance - Start date : **1/1/73**

Compliance - Completion date :

Probability of Implementation: **C**

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized : **94 94 94**

Unit Costs - Estimate average : **US 335 $/tonne**

Source of Estimates :

EPA

Extent of Applicability :

Regional - Requirements vary by state

Comments :

Stage I requirements have been mandated by some states since the early 1970's. The requirements vary by state. For the United States this investment has already occurred and is part of the 8 billion annual environmental cost to the industry.

The annualized cost in millions of dollars and the unit cost in dollars per ton have been inflated from 1984$ to 1991$ by using the GNP deflation factor of 1.2674. The original numbers were 74 M$/yr and 264$/tonne respectively.

Data Source: EPA - Draft Regulatory Impact Analysis: Proposed Refuelling Emission Regulation.

Issue Type : **Air**

Canadian Program : **NOx/VOC**

Canadian Initiative : **Stage I - Vapour Recovery**

2

Downstream Sector : **Marketing**

Compliance - Start date : **S**

Compliance - Completion date : **M**

Probability of Implementation : **H**

Costs - Initial Investment : **68 0 0**

Costs - Annual Operating : **-5 -5 -5**

Costs - Annualized : **3 3**

Unit Costs - Estimate average :

Source of Estimates :

CPPI 93-3, NOx/VOC Management Plan, Ratioed Data

Extent of Applicability :

AOC - Quebec, Ontario and BC

Comments :

V604 - installation at new and existing service stations of vapour balancing equipment for gasoline delivery to underground storage tanks.

V603 - installation of vapour balancing equipment at marketing terminals and bulk plants.

The cost estimate assumes regional implementation in the 1993 to 1998 time frame and national implementation (on another data sheet) in the 1998 to 2004 time frame.

Issue Type :
Air

Canadian Program :
NOx/VOC

Canadian Initiative :
Stage I - Vapour recovery

Downstream Sector :
Marketing

Compliance - Start date :
M

Compliance - Completion date :
L

Probability of Implementation :
L

Costs - Initial Investment :
0 656 0

Costs - Annual Operating :
0 -5 -5

Costs - Annualized :
0 72 72

Unit Costs - Estimate average :

Source of Estimates :
CPPI 93-3, NOx/VOC Management Plan, Ratioed Data

Extent of Applicability :
National

Comments :
V604 - installation at new and existing service stations of vapour balancing equipment for gasoline delivery to underground storage tanks.
V603 - installation of vapour balancing equipment at marketing terminals and bulk plants.

The cost estimate assumes regional implementation (on another data sheet) in the 1993 to 1998 time frame and the national implementation in the 1998 to 2004 time frame.

Issue Type : Air

U.S. Program : Clean Air Act

U.S. Initiative : Stage II - Vapour Recovery

3

Downstream Sector : Marketing

Compliance - Start date : S

Compliance - Completion date : S

Probability of Implementation: H

Costs - Initial Investment : 1812 0 0

Costs - Annual Operating :

Costs - Annualized : 212 212 212

Unit Costs - Estimate average :

Source of Estimates :

API - Discussion Paper 070R - Oct. 1993, ratio data from NPC

Extent of Applicability :

Regional - Extreme, severe, serious and mod.(partly) non-attainment areas and Northeast Ozone Transport

Comments :

The 1990 CAAA* requires Stage II in extreme, severe and serious non attainment areas by 1993. The entire Northeast Ozone Transport Area must also implement Stage II or an equivalent in 1994. Now that on board canisters for vehicles have been mandated, Moderate non attainment areas may be subject to the requirements only if the states require it for their State Implementation Plan or for other reasons. All states have at least some counties which will require Stage II. California is requiring Stage II throughout the state to control benzene.

The Clean Air Act Amendment requires Stage II (where applicable) for stations with volumes greater than 10 thousand gallons(US) per month or, in the case of Independant Small Business Marketers, 50 thousand gallons per month.

The NPV of the Stage II requirements for extreme, severe, serious and moderate areas was estimated at $4,032 million (1992$) calculated from a 1992 to 2021 cashflow stream of 324 million dollars per year at a 5% discount rate. Assuming that none of the moderate areas require Stage II, the NPV ratioed on population affected would decrease to approximately $2,650 million and the cashflow stream to $212 million.

* Clean Air Act Amendment

Issue Type : Air

Canadian Program : NOx/VOC

Canadian Initiative : Stage II - Vapour Recovery

3

Downstream Sector : Marketing

Compliance - Start date : S

Compliance - Completion date : S

Probability of Implementation : M

Costs - Initial Investment : 14 0 0

Costs - Annual Operating :

Costs - Annualized : 2 2

Unit Costs - Estimate average :

Source of Estimates :

E.C. cost effectiveness study, CPPI comments

Extent of Applicability :

Lower Frazer Valley

Comments :

V605 - Vehicle refuelling vapour balance.

The estimate assumes Lower Frazer Valley implementation in the 1993-1998 time frame, Areas of Ozone Concern(AOC) implementation in the 1999 - 2004 time frame(other data sheet) and national implementation in the 1999-2004 time frame(other data sheet).

3

Issue Type : Air

Canadian Program : NOx/VOC

Canadian Initiative : Stage II - Vapour recovery

Downstream Sector : Marketing

Compliance - Start date : L

Compliance - Completion date : L

Probability of Implementation : L

Costs - Initial Investment : 0 0 197

Costs - Annual Operating :

Costs - Annualized : 0 16 16

Unit Costs - Estimate average :

Source of Estimates :
EC cost effectiveness study, CPPI comments

Extent of Applicability :
National

Comments :
V605 - Vehicle refueling vapour balance

The estimate assumes Lower Frazer Valley implementation in the 1993-1998 time frame(on other data sheet), Areas of Ozone Concern (AOC) implementation in the 1999-2004 time frame(on other data sheet) and national implementation in the 2005 - 2010 time frame.

3

Issue Type : Air

Canadian Program : NOx/VOC

Canadian Initiative : Stage II - Vapour recovery

Downstream Sector : Marketing

Compliance - Start date : M

Compliance - Completion date : M

Probability of Implementation : L

Costs - Initial Investment : 0 135 0

Costs - Annual Operating :

Costs - Annualized : 0 0 23

Unit Costs - Estimate average :

Source of Estimates :
EC cost effectiveness study, CPPI comments

Extent of Applicability :
AOC - Quebec, Ontario, BC

Comments :
V605 - Vehicle refuelling vapour balance.

The estimate assumes Lower Frazer Valley implementation in the 1993 - 1998 time frame(other data sheet), Areas of Ozone Concern (AOC) implementation in the 1998- 2004 time frame and national implementation in the 2005 - 2010 time frame(other data sheet).

Issue Type : *Air*

U.S. Program : *Clean Air Act*

U.S. Initiative : *Phase II - RVP Reductions*

Downstream Sector : *Refining*

Compliance - Start date : *S*

Compliance - Completion date : *S*

Probability of Implementation: *H*

Costs - Initial Investment : 200 0 0

Costs - Annual Operating : 1050 1050 1050

Costs - Annualized : 1076 1076 1076

Unit Costs - Estimate average :

Source of Estimates :

EPA and API

Extent of Applicability :

Regional - specific level depends on the region

Comments :

The purpose is to reduce air pollution by reducing gasoline volatility as measured by the Reid Vapour Pressure or RVP scale. The limits are 9.0 or 7.8 psi depending on the area where the gasoline is sold. Annualized cost converted to 1991$ vary between $483 million (EPA estimate) and $1,669 million (API - American Petroleum Institute estimate). EPA has introduced further requirements since the regulations came into force which could result in additional cost to refiners.

Issue Type : *Air*

Canadian Program : *NOx/VOC*

Canadian Initiative : *RVP Reduction*

Downstream Sector : *Refining*

Compliance - Start date : *S*

Compliance - Completion date : *S*

Probability of Implementation : *H*

Costs - Initial Investment : 11 0 0

Costs - Annual Operating : 81 81 81

Costs - Annualized : 82 82 82

Unit Costs - Estimate average :

Source of Estimates :

PACE - Report 89-7

Extent of Applicability :

Areas of ozone concern

Comments :

V602 - Gasoline volatility limit (RVP) of 62 kPa (approximately 9 psi)
The cost estimates are based on limits of 9 psi in June, July, Aug and 10.5 psi in May and September in areas of ozone concern.

Issue Type : Air

U.S. Program : *Clean Air Act*

U.S. Initiative : *MMT Removal*

5

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining			*C*

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

National

Comments :

MMT is not allowed in gasoline. An application has been made by Ethel to allow the use of MMT. The EPA is evaluating the application.

Issue Type : *Air*

Canadian Program : *Not defined*

Canadian Initiative : *MMT Removal*

5

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	*S*	*S*	*H*

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
50	*0*	*0*	*25*	*25*	*25*	*31*	*31*	*31*	

Source of Estimates :

CPPI

Extent of Applicability :

National

Comments :

The estimate is based on the CPPI response to the Joint Government Industry Committee on Transportation Fuels & Motor Vehicle Control Technologies - minutes of meeting of December 9, 10 1993.

Issue Type : *Air* | U.S. Program : *Clean Air Act* | U.S. Initiative : *Oxygenated Gasoline & RFG I* | 6

Downstream Sector : *Refining*

Compliance - Start date : *S*

Compliance - Completion date : *S*

Probability of Implementation: *H*

Costs - Initial Investment :			Costs - Annual Operating :*			Costs - Annualized :			Unit Costs - Estimate average :
11000	0	0	1050	1050	1050	2346	2346	2346	US 0.8 to1.2 c/l

Source of Estimates :

API - American Petroleum Institute

* Annual operating costs account for approximately 45% of annualized costs, while the remaining 55% represents initial investment costs.

Extent of Applicability :

NA Areas for CO and NA areas for ozone(top 9 cities)

Comments :

For the 39 carbon monoxide non attainment areas(market= 140,000 million liters/yr), winter gasoline (4 months actual - 5 months effective) must have a minimum of 2.7 weight per cent of oxygen starting in November 1992.

Beginning in January 1995, reformulated gasoline (RFG) must be sold in the 9 most severe non-attainment cities(96,000 million liters/yr) . RFG must meet oxygen(min 2% year around), benzene(1 %), heavy metal (none) levels as well as standards for NOX, VOC(summer ozone months) and toxic air pollutants(TAP) emissions limits(15% reduction from 1990 level - ie. gasoline RVP of 7.2 to 8.1 depending on location, aromatics at 25%)

In addition to the mandatory compliance on CO and RFG (which have 72,000 million liters/yr of overlapping volumes in the numbers above), it is anticipated that an additional volume of 98,000 million liters/yr of demand for RFG will come from areas that "opt-in" to the program.

The combined requirements for oxygenated fuels and RFG Phase I are estimated to be applicable to between 196,000 and 261,000 million litres per year. The estimates for annualized costs range from $1,571 million to $3,121 million depending on the mix of each mesure's volumetric assumptions and each measure's cost estimates on a cents per gallon basis. The averages from the above numbers range from 0.8 to 1.2 cents/liter while the average annualized cost is $2,346 million.

Issue Type : *Air* | Canadian Program : *Not defined* | Canadian Initiative : *RFG I* | 6

Downstream Sector : *Refining*

Compliance - Start date : *S*

Compliance - Completion date : *S*

Probability of Implementation : *H*

Costs - Initial Investment :			Costs - Annual Operating* :			Costs - Annualized :			Unit Costs - Estimate average
1100	0	0	100	100	100	225	225	225	CAN 1.1 to 1.6 c/l

Source of Estimates :

NPC unit costs

* Annual operating costs account for approximately 45% of annualized costs, while the remaining 55% represents initial investment costs.

Extent of Applicability :

Areas of ozone concern

Comments :

The volume of gasoline sold in areas of ozone concern in Canada amounts to 17000 million liters. Based on the U.S. costs of between 0.8 and 1.2 U.S. cents per liter, the Canadian costs would be between CAN$180 and $270 million per year. An initiative that would only reduce the benzene content of the gasoline to 0.6% has been estimated at $417 million capital and $22 million/yr of operating cost(CPPI 91-8). The estimate assumes that MMT has been eliminated. that all refineries except those currently producing aromatics would require reformate splitters and a means of saturating benzene such as a C5C6 isomerization unit will be needed. The benzene octane loss would be made up by more isomerization, more sever reforming or the addition of MTBE.

Issue Type :
Air

U.S. Program :
Clean Air Act

U.S. Initiative :
Oxygenated Gasoline & RFG II

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	*S*	*M*	*H*

Costs - Initial Investment :			Costs - Annual Operating*:			Costs - Annualized :			Unit Costs - Estimate average :
0	14000	0	135	1350	1350	*300*	*3000*	*3000*	

Source of Estimates :
API - American Petroleum Institute

* Annual operating costs account for approximately 45% of annualized costs, while the remaining 55% represents initial investment costs.

Extent of Applicability :
NA Areas - CO and Ozone

Comments :

Phase II reformulated gasoline standards are stricter than those in Phase I and are to come into effect in 1996 in California and in the year 2000 in other non-attainment areas. The specific requirements are still to be defined. The estimates for annuallized costs range from $600 million to $ 5.4 billion $/yr depending on the volume and quality requirements. The median figure of $3 billion is being used for this report.

7

Issue Type :
Air

Canadian Program :
Not defined

Canadian Initiative :
RFG II

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	*M*	*L*	*M*

Costs - Initial Investment :			Costs - Annual Operating :*			Costs - Annualized :			Unit Costs - Estimate average :
0	1400	0	0	135	135	*0*	*300*	*300*	

Source of Estimates :
U.S. costs ratioed

* Annual operating costs account for approximately 45% of annualized costs, while the remaining 55% represents initial investment costs.

Extent of Applicability :
Areas of ozone concern

Comments :
The requirements are not defined. American costs ratioed on canadian volume are used in the estimate.

Issue Type :	U.S. Program :	U.S. Initiative :
Air	***Clean Air Act***	***On Highway Diesel - Sulphur***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :	Costs - Annualized :			Unit Costs - Estimate average :
2400	***0***	***0***		***796***	***796***	***796***	***US 1.0 cent/liter***

Source of Estimates :

NPC

Extent of Applicability :

National for On-Highway use

Comments :

To reduce sulphur oxide and particulate emissions, current regulations require refiners to reduce the sulphur content from **on-highway** diesel fuel from a level of between 0.25% to 0.35% to 0.05% by October, 1993. It also requires a minimum cetane index of 40 or a maximum aromatics content of 35%. According to the National Petroleum Council, the United States 1993 demand for on highway diesel is 47% (79,269 km3/yr) and off highway diesel, railroad and farm diesel is another 18% (40,737 km3) of the total distillate pool of 168,229 km3/yr.

The annualized cost estimates vary widely. The Environmental Protection Agency estimates vary between $388 million to $895 million while the National Petroleum Refiners Association has one at $1,404 million in 1991$. We have retained the results of a National Petroleum Council sponsored study because of its depth, completeness and availability. It estimates investment costs at $2,400 million and the annualized costs at 1.0 cents per liter($796 million/year) to treat the on highway diesel pool(NPC Vol 1, p 297). The investments serve to upgrade distillate hydrotreating, install new hydrotreating, produce hydrogen and recover sulphur.

8

Issue Type :	Canadian Program :	Canadian Initiative :
Air	***Memo. of Understanding***	***Fed Gov't Agmnt with Refiners***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
120	***0***	***0***	***14***	***14***	***14***	***28***	***28***	***28***	

Source of Estimates :

CPPI - PACE 88-3 table 1.1

Extent of Applicability :

National

Comments :

A memorandum of understanding has been signed between Environment Canada and most of the major refiners to reach the level of .05% sulphur in fuel by October 1994. The Bantrel study estimated the initial investment cost at $972 million and the operating cost at $113 million for approximately 19,000 million liters. For lack of better data, the above estimate is ratioed on the retail and cardlock diesel volume of approximately 2,300 million liters (12% of the diesel pool). The portion of investment attributed to the on highway volume is $120 million while the operating cost is $ 14 million per year.

Issue Type : *Air*

Canadian Program : *Not defined*

Canadian Initiative : *On Highway Diesel - Sulphur*

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	*M*	*M*	*M*

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	*270*	*0*	*0*	*32*	*32*	*0*	*64*	*64*	

Source of Estimates :

CPPI - PACE 88-3 table 1.1

Extent of Applicability :

National

Comments :

The cost of reducing the sulphur in the diesel fuel for the balance of On Highway vehicles is ratioed from the Bantrel study having an investment of $972 million and operating costs of $113 million for 19,000 million liters per year. Based on approximately 7,600 million liters per year of On-Highway diesel less 2300 million liters of retail volume, the investment cost assigned to non retail On Highway diesel is $270 million(28%). The annual operating cost is $32 million per year.

Issue Type :	U.S. Program :	U.S. Initiative :	9
Air	***Not Defined***	***Off-Highway Diesel - Sulphur***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***L***	***L***	***M***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
0 0 1100		***0 0 472***	***US 1.1 cent/liter***

Source of Estimates :

NPC

Extent of Applicability :

National - Off highway, Farm, Marine, Rail, Const.

Comments :

No regulation has been enacted to reduce the sulfur content of off-highway diesel to .05%. However, the possibility exists that the on-highway regulations could be extended to off highway (including farm, construction, railroad, military and marine diesel). NPC has estimated this scenario at $3,500 million for 2,068 KB/CD. This is an investment increment of $1,100 million for an incremental volume of 40,732 million liters per year over the on highway diesel scenario only. It also produces an incremental annualized cost of $472 million per year.

Issue Type :	Canadian Program :	Canadian Initiative :	9
Air	***Not defined***	***Off Highway Diesel - Sulphur***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***L***	***L***	***M***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
0 0 582	***0 0 67***	***0 0 135***	

Source of Estimates :

CPPI - PACE 88-3 table 1.1

Extent of Applicability :

National

Comments :

The cost of reducing the total diesel pool sulphur to .05% is estimated from the Bantrel study on the basis of the volumetric balance of 11,200 million liters once the On Highway diesel has met .05% sulphur. The investment amounts to $583 million while the annual operating cost amounts to $67 million.

Issue Type :
Air

U.S. Program :
CARB

U.S. Initiative :
Diesel - Aromatics Reduction

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	*S*	*S*	*H*

Costs - Initial Investment :			Costs - Annual Operating :	Costs - Annualized :			Unit Costs - Estimate average :
840	*0*	*0*		*267*	*267*	*267*	*US 2.6 cents/liter*

Source of Estimates :
NPC

Extent of Applicability :
California

Comments :

Regulation has been enacted in California to have On and Off Highway diesel (excluding railroad and marine diesel) with a maximum aromatic content beginning in October of 1993. Alternative fuels that perform as well or better than 10% aromatics and .05% sulfur diesel can be certified for use. Tfhe investment cost for extending this regulation for the whole country for the whole distillate pool is estimated at $14,000 million for a volume of 168,210 million liters/year. The California portion of that cost is 6%. The incremental cost over the ultra low sulfur for all distillate scenerio is $4,444 million per year with the California part estimated at 6% of that amount.

Issue Type : Air

U.S. Program : Not Defined

U.S. Initiative : Diesel - Aromatics Reduction

11

Downstream Sector : Refining

Compliance - Start date : L

Compliance - Completion date : L

Probability of Implementation: L

Costs - Initial Investment : 0 0 8960

Costs - Annual Operating :

Costs - Annualized : 0 0 2844

Unit Costs - Estimate average : US 2.6 cents/liter

Source of Estimates : NPC

Extent of Applicability : National - All Distillate

Comments :

Regulation has been enacted in California to have On and Off Highway diesel(excluding railroad and marine) with a maximum aromatic content beginning in October of 1993. Alternative fuels that perform as well or better than 10% aromatics and .05% sulfur diesel can be certified for use. The investment cost for extending this regulation to the whole country for the whole distillate pool is estimated at $14,000 million for a volume of 168,210 million liters/year. The incremental annualized cost over the ultra low sulfur for all distillate scenario is $4,444 million per year. The diesel portion is 70% of that and 64% when California is excluded.

Issue Type : Air

Canadian Program : Not defined

Canadian Initiative : Diesel - Cetane/Aromatics

11

Downstream Sector : Refining

Compliance - Start date : L

Compliance - Completion date : L

Probability of Implementation : M

Costs - Initial Investment : 0 0 2109

Costs - Annual Operating :

Costs - Annualized : 0 0 669

Unit Costs - Estimate average : CAN 3.5 cents/liter

Source of Estimates : NPC

Extent of Applicability : National

Comments :

No program currently exists for a reduction in aromatics to 10% in diesel. Such a program, assuming a volume of 19,000 million litres of diesel and assuming the California costs of CAN 3.5 cents per liter, would have an annualized cost of $669 million per year. The investment ratioed on the basis of US$14,000 million for 168,210 milion liters gives CAN $2,109 million for 19,000 million liters.

A CPPI estimate for increasing the cetane index from 40 to 55 yielded a cost of $600 million to $900 million.

Issue Type :	U.S. Program :	U.S. Initiative :
Air	***Not Defined***	***Total Distillate - Sulphur***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***L***	***L***	***L***

Costs - Initial Investment :			Costs - Annual Operating :	Costs - Annualized :			Unit Costs - Estimate average :
0	***0***	***1500***		***0***	***0***	***732***	***US 1.7 cent/liter***

Source of Estimates :

NPC

Extent of Applicability :

National - All Distillate

Comments :

No regulation has been enacted for the case of total distillate sulphur reduction. However, the National Petroleum Council has estimated this scenario. Its incremental investment cost over the diesel sulphur reduction case is $1,500 million for an incremental volume of 48,218 million liters per year. The incremental annualized cost is $782 million per year.

Issue Type :	U.S. Program :	U.S. Initiative :	13
Air	***Clean Air Act***	***Fugitive Emissions***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
2867	***0***	***0***	***148***	***148***	***148***	***483***	***483***	***483***	

Source of Estimates :

NPC - Volume III page 3-41

Extent of Applicability :

National

Comments :

To control point source emissions from air pollutants considered hazardous, the use of Maximum Achievable Control Technology (MACT) will be mandated. Fugitive emission controls (from pumps, valves, compressors), and controls on pressure relief vents and coker vents are included in the estimates above.

Issue Type :	Canadian Program :	Canadian Initiative :	13
Air	***NOx/VOC***	***Fugitive Emissions***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
25	***0***	***0***	***15***	***15***	***15***	***18***	***18***	***18***	

Source of Estimates :

CPPI - verbal

Extent of Applicability :

National

Comments :
V607 - Fugitive emissions from refineries

The Canadian program is expected to cost $25 million initially for tagging, inspection and maintenance and $5 million annually thereafter for inspection and $10 million for repairs.

Issue Type :	U.S. Program :	U.S. Initiative :
Air	***Clean Air Act***	***NOx Controls on Burners***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***M***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
219	***513***	***0***	***16***	***56***	***56***	***42***	***142***	***142***	

Source of Estimates :

NPC - Vol III page 3-41

Extent of Applicability :

NA Areas for ozone

Comments :

The estimates above represent the costs to install ultra-low NOx burners on heaters and boilers to reach .08 lb NOx/MMBTU on boilers in severe Non attainment(NA) areas and to install low NOx burners to reach 0.2 lb NOx/MMBTU for boilers and 0.3 lb NOx/MMBTU for gas fired heaters in moderate and marginal areas. It also includes the use of Selective Catalytic Reduction(SCR) in heaters and boilers in extreme NA areas.

Issue Type :	Canadian Program :	Canadian Initiative :
Air	***NOx/VOC***	***NOx Controls on Burners***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***M***	***L***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
61	***61***	***0***	***0***	***0***	***0***	***7***	***14***	***14***	

Source of Estimates :

CPPI 91-1 table 1.3

Extent of Applicability :

Areas of ozone concern

Comments :

N306 and N603 - New Source Performance Standards and Retrofit Commercial/Industrial Boilers

The costs are derived from the implementation of low NOx burners, converting some natural draft to forced draft burners, flue gas recirculation and non selective catalytic reduction to reach the NOx/VOC plan requirements of 30, 50, 110, and 150 ng NOx/J for gas, light oil, heavy oil and coal burners respectively.

Issue Type : Air | U.S. Program : Clean Air Act | U.S. Initiative : NOx Controls - SCR at FCC | 15

Issue Type :	U.S. Program :	U.S. Initiative :	15
Air	***Clean Air Act***	***NOx Controls - SCR at FCC***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***L***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
26	***75***	***80***	***3***	***11***	***19***	***6***	***23***	***40***	

Source of Estimates :

NPC - Vol III page 3-41

Extent of Applicability :

NA Areas - extreme

Comments :

To comply with the .05 lb NOx/MMBTU limit prescribed for extreme areas of non-attainment requires the use of Selective Catalytic Reduction for FCCU regenerator flue gases.

Issue Type :	Canadian Program :	Canadian Initiative :	15
Air	***NOx/VOC***	***NOx Controls at FCC***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***M***	***L***	***L***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :		Unit Costs - Estimate average :
0	***10***	***10***	***0***	***1***	***2***	***0***	***2***	

Source of Estimates :

CPPI 92-5

Extent of Applicability :

Areas of ozone concern

Comments :
N605 - Retrofit Refinery Process

The cost estimate is based on the selective catalytic reduction of FCC regenerator flue gases.

Issue Type : **Air**

U.S. Program : **Clean Air Act**

U.S. Initiative : **Tank Covers - MACT/NESHAP**

16

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***M***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
286	***299***	***0***	***8***	***15***	***15***	***41***	***83***	***83***	

Source of Estimates :

NPC - Volume III page 3-41

Extent of Applicability :

National

Comments :

To control point source emissions from air pollutants considered hazardous, Maximum Achievable Control Technology will be mandated. This initiative estimates the cost of adding dome covers to crude oil and light hydrocarbon external floating roof tanks.

Issue Type : **Air**

Canadian Program : **Not defined**

Canadian Initiative : **Tank Covers**

16

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***M***	***L***	***L***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :		Unit Costs - Estimate average :
0	***25***	***26***	***0***	***1***	***1***	***0***	***4***	

Source of Estimates :

NPC - costs ratioed on the basis of gasoline sold in Areas of Ozone Concern

Extent of Applicability :

Areas of ozone concern

Comments :

The cost estimate is based on the relative gasoline volume in non attainment areas. Canada sells approximately 17,000 million liters per year(LFV @ 2.0 million liters per year, Ontario Windsor/Quebec City Corridor @ 11.0 and Quebec Windsor/Quebec City Corridor @ 4.4), the United States will sell approximately 261,000 million liters of RFG1/CO gasoline. Canadian sales are approximately 6.5% of US sales.

Issue Type : Air | U.S. Program : Clean Air Act | U.S. Initiative : PM 10 Controls - MACT/NESHAP | 17

Issue Type :	U.S. Program :	U.S. Initiative :	17
Air	***Clean Air Act***	***PM 10 Controls - MACT/NESHAP***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***M***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
997	***612***	***0***	***76***	***99***	***99***	***193***	***287***	***287***	

Source of Estimates :

NPC - Volume III page 3-41

Extent of Applicability :

National

Comments :

To control point source emissions from air pollutants considered hazardous, Maximum Achievable Contol Technology will be mandated. The estimates above cover the cost of installing new and redundant high efficiency electrostatic precipitators to collect FCC catalyst fines from FCC regenerator flue gases. It also covers the cost of portable facilities to control the catalyst fines during their loading and unloading from reactors and the cost of covered conveyors and enclosed storage for coke from the cokers.

Issue Type :	Canadian Program :	Canadian Initiative :	17
Air	***Not defined***	***PM 10***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***M***	***L***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	***50***	***50***	***0***	***2***	***4***	***0***	***8***	***16***	

Source of Estimates :

NPC costs ratioed at 12.7%

Extent of Applicability :

National

Comments :

The cost estimates assume the installation of electrostatic precipitators on regenerator flue gases. Based on US capital costs of $586 million and annual operating costs of $23 million prorated to Canada on the basis of 12.7 % and an exchange rate of 0.75, the Canadian investment becomes $100 million and $4 million. Contrary to the US cost estimate, redundancy of the units has not been assumed for Canada.

Issue Type : Air

U.S. Program : Clean Air Act

U.S. Initiative : Sulphur in Heavy Fuel Oil

18

Downstream Sector : Refining

Compliance - Start date :

Compliance - Completion date :

Probability of Implementation: C

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability : Regional

Comments :

The sulfur levels vary widely by region. Populated areas generally have stricter sulfur levels normally less than 1%

Issue Type : Air

Canadian Program : Acid Rain

Canadian Initiative : Sulfur in Heavy Fuel Oil

18

Downstream Sector : Refining

Compliance - Start date : M

Compliance - Completion date : L

Probability of Implementation : H

Costs - Initial Investment : 0 540 0

Costs - Annual Operating :

Costs - Annualized : 0 63 63

Unit Costs - Estimate average :

Source of Estimates : Informetrica

Extent of Applicability : Regional

Comments :

Canada is the fourth largest emitter of SOx among the 24 member countries of OECD according to the State of the Environment Report published by the OECD. A reduction of the level of sulfur in the fuel consumed by the refineries and sold in the Canadian market may be required to eliminate the acidification of lakes.

An Informetrica report has pegged the investment for hydrotreating the heavy fuel oil at $410 to $ 670 million. The data available as this is being written does not elaborate on the volume treated and the level of desulphurization.

Issue Type :	U.S. Program :	U.S. Initiative :	19
Air	***Clean Air Act***	***CFCs Replacement***	
Downstream Sector :	**Compliance - Start date :**	**Compliance - Completion date :**	**Probability of Implementation:**
Refining	***S***	***S***	***H***
Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

National

Comments :

Both the 1992 Montreal Protocol on Substances that deplete the Ozone Layer and Title VI of the Clean Air Act Amendment require the phase out of production of chlorofluorocarbons.

No cost data is available for this measure. Tahe cost is estimated to be low relative to most CAA measures.

Issue Type :	Canadian Program :	Canadian Initiative :	19
Air	***CFC's***	***CFCs Replacement***	
Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***S***	***S***	***H***
Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

National

Comments :

CFCs are no longer manufactured nor imported in Canada. They have to be replaced by HCFC in plant refrigeration units.

Issue Type : Air | U.S. Program : Clean Air Act | U.S. Initiative : Control of VOC from Tankage | 20

Issue Type :	U.S. Program :	U.S. Initiative :	20
Air	***Clean Air Act***	***Control of VOC from Tankage***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
275	***0***	***0***	***31***	***31***	***31***	***63***	***63***	***63***	

Source of Estimates :

EPA - CTG draft July 1992

Extent of Applicability :

NA areas

Comments :

The extension of Volatile Organic Compounds control requirements to Volatile Organic Liquids Storage Tanks with more than 0.75 psi of Reid Vapour pressure is estimated in this measure. Most of the volatile organic compound emissions from tankage from the petroleum industry have been covered by previous regulations and are included in the baseline costs.

Issue Type :	Canadian Program :	Canadian Initiative :	20
Air	***NOx/VOC***	***Control of VOC from Tankage***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***S***	***S***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :		Unit Costs - Estimate average :
20	***15***	***0***	***-1***	***-3***	***-3***	***1***	***1***	***<$100 / tonne***

Source of Estimates :

EC

Extent of Applicability :

National

Comments :

The control of emissions from aboveground storage tanks will be done mostly through floating roofs. The NOx/VOC Plan initiatives V302 and V606 will define the requirements. Tanks having a diameter greater than 4.0 meters and containing product with a vapour pressure greater than 10 kPa will be subject to those requirements.

The downstream sector is most likely to require the upgrading of approximately 400 tanks for an investment of approximately 32 million dollars, an annual operating cost of 0.06 million dollars and a product saving of approximately $4 million dollars. The above at 10% percent interest and a 20 year life provides an annualized cost of less than $1 million dollars per year and an emission reduction cost of less than $100/tonne.

Issue Type :	U.S. Program :	U.S. Initiative :	21
Air	***Clean Air Act***	***Marine Vapour Controls***	
Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***S***	***H***
Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
2818 0 0		***715 715 715***	

Source of Estimates :

Environmental Protection Agency

Extent of Applicability :

Marine terminals with possible extension to other petroleum product loading facilities

Comments :

Provide for the application of stage II service station-type controls to marine terminals to decrease VOC emissions. Other product loading facilities in the refining, transportation and marketing sectors may be affected. The EPA also has the authority to control unloading facilities more stringently.
Certain terminals may be excluded from the regulations.
The above cost estimates include marine and other onshore facilities.

Issue Type :	Canadian Program :	Canadian Initiative :	21
Air	***NOx/VOC***	***Marine Vapour Controls***	
Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***M***	***M***	***H***
Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
0 22 0	***0 5 5***	***0 8***	

Source of Estimates :

API - paper #70 R - prorated to Canada

Extent of Applicability :

National

Comments :

Provide for the application of stage II service station type controls to marine terminals to decrease VOC emissions. Based on the US estimates of $CAN 2 million per dock and 11 Canadian terminals gives an investment of $22 million. The annual operating costs, are estimated at $500 K for each dock.

Issue Type : **Air**

U.S. Program : **Clean Air Act**

U.S. Initiative : **Alternative Fuels**

Downstream Sector : **R&M**

Compliance - Start date :

Compliance - Completion date :

Probability of Implementation: **M**

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :

No information available

Issue Type : **Air**

Canadian Program : **Not defined**

Canadian Initiative : **Alternative fuels**

Downstream Sector : **R&M**

Compliance - Start date : **L**

Compliance - Completion date : **L**

Probability of Implementation : **M**

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability : **National**

Comments :
Alternative fuels such as compressed natural gas, propane, ethanol are likely to be marketed in the long term. This study assumes that the marketing would be done on a commercial basis. The cost of the production and marketing would be born by the sale of the products. Therefore, the net "environmental costs" of supplying the products are assumed to be zero.

Issue Type :	U.S. Program :	U.S. Initiative :	23
Air	***Climate Change***	***Greenhouse Gases***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining			***M***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :

The United States is committed, as a signatory of the UN Framework Convention on Climate Change to develop a national plan to limit emissions of greenhouse gases to the atmosphere.

Issue Type :	Canadian Program :	Canadian Initiative :	23
Air	***Climate***	***Greenhouse Gases***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***M***	***L***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

National

Comments :

The Canadian government is seeking to limit the possible impact of greenhouse gases in the atmosphere. Various measures such as energy efficiency standards and schemes for reducing the emission of carbon atoms in the atmosphere will be assessed. Canada's commitment as a signatory to the UN Framework Convention on Climate Change is to stabilize all greenhouse gas emissions at 1990 levels by the year 2000. Further reductions by as much as 20% will be considered

Issue Type :	U.S. Program :	U.S. Initiative :	24
Air	***Clean Air Act***	***Permitting***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***S***	***H***

Costs - Initial Investment : Costs - Annual Operating : Costs - Annualized : Unit Costs - Estimate average :

43 43 43 43 43 43

Source of Estimates :

Bechtel/National Petroleum Council

Extent of Applicability :

Refineries, some Distribution and most marketing facilities

Comments :

States are required to establish new operating permit programs meeting federal standards for sources of air emissions. Initial permit applications must be submitted to states by Nov. 15, 1994. They must be approved within three years and can be valid for a maximum period of five years. Federal permits will be issued where a state fails to establish a suitable program.
Pemitted facilities must monitor and report on emissions, and pay states an annual fee of at least $25 per item, index for inflation of all regulated emissions except of carbon monoxide.
Refineries, some transportation and most marketing facilities will be covered.

Issue Type :	Canadian Program :	Canadian Initiative :	24
Air	***Not defined***	***Federal Permitting***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***L***	***L***	***L***

Costs - Initial Investment : Costs - Annual Operating : Costs - Annualized : Unit Costs - Estimate average :

6 6 6 6 6

Source of Estimates :

10% of U.S. costs

Extent of Applicability :

National

Comments :

The American system involves forced permitting and imposes permitting fees. The Canadian approach is likely to retain the current provincial permitting system for new installations.

Issue Type : **Multimedia**

U.S. Program : **EPCRA***

U.S. Initiative : **Expansion of toxic release report**

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	**S**		**H**

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
211	**0**	**0**	**133**	**133**	**133**	**170**	**170**	**170**	

Source of Estimates :

API/DM - American Petroleum Institute/Danes & Moore

Extent of Applicability :

Comments :

Existing legislation requires that petroleum refiners report their annual emissions of certain chemicals and chemicals to land, air and water. The information is then released by the Environmental Protection Agency though its Toxic Chemical Release Inventory.
An expansion of the list is probable as a result of several congressional initiatives that, together, would add more than 600 chemicals. The Environmental Protection Agency is also considering an expansion.

*Emergency Planning and Community Right-To-Know Act

Issue Type : **Multimedia**

Canadian Program : **Toxics**

Canadian Initiative : **National Pollutants Reporting**

25

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	**S**	**S**	**H**

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :		Unit Costs - Estimate average :
2	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**$50 K/refinery**

Source of Estimates :

CPPI - verbal

Extent of Applicability :

National

Comments :
An initial investment of $100K per refinery is required. Thereafter, annual costs are derived assuming that each refinery has less than 50 chemicals to report (typical 25), that each chemical requires 30 manhours per year at 30$ per manhour. The rounded result for 24 refineries is a maximum of $1 million per year.

Issue Type : Water | U.S. Program : Clean Water Act | U.S. Initiative : Revised Effluent Standards | 26

Issue Type :	U.S. Program :	U.S. Initiative :	26
Water	***Clean Water Act***	***Revised Effluent Standards***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***M***	***L***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	***7909***	***0***	***0***	***657***	***657***	***0***	***1586***	***1586***	

Source of Estimates :

Betchel/National Petroleum Council

Extent of Applicability :

Refinery effluents subject to the clean water act

Comments :

A judicial decree is forcing the Environmental Protection Agency to review its guidelines for the discharge of conventional and toxic pollutants discharged into surface waters. This may result in stricter effluent controls. Rule proposal is scheduled for 1995 and guidelines issue for 1996.

A Bechtel study estimated the cost of treating effluents with the Best Achievable Technology to minimize organic content and toxicity as determined by acute and chronic biomonitoring. The equipment consisted of two stage activated sludge/powdered activated carbon treatment and filtration of the activated sludge/powdered activated carbon treatment effluent.

Issue Type :	Canadian Program :	Canadian Initiative :	26
Water	***Not defined***	***Revised Effluent Standards***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
50	***0***	***0***	***8***	***8***	***8***	***14***	***14***	***14***	

Source of Estimates :

MOE Ontario

Extent of Applicability :

Quebec

Comments :

A requirement similar to the US requirements is not in the current Canadian scenario. If it was, a 12.7% straightforward ratio of cost and an exchange rate of 0.75 would give a Canadian investment of $1,340 million and an annual operating cost of $111 million.

The estimate of the Canadian scenario is based on MISA equivalent requirements becoming required for Quebec. The source of the estimate is an MOE press release giving an investment cost of $57 million and an annual operating cost of $8 million.

Issue Type :	U.S. Program :	U.S. Initiative :	27
Water	***Clean Water Act/ GLWQTA****	***Great Lakes Water Quality***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***M***	***L***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	***224***	***0***	***0***	***50***	***50***	***0***	***90***	***90***	

Source of Estimates :

OHIO Petroleum Council - API #70R p.17

Extent of Applicability :

All waters in the Great Lakes basin with a possible extension to other areas

Comments :

EPA issued guidance for all waters in the Great Lakes Basin in 1993. They are one mean for meeting U.S. obligations under the Canada-U.S. Great Lakes Water Treaty Agreement. The guidance includes uniform minimum water quality standards, anti-degradation policies and implementation proceedures. One result could be a requirement for tighter effluent control standards. The capital cost estimates vary between $78 to $ 292 million for four Great Lakes basin refineries making up 83% of the capacity in the US side of the basin. The guidance could be extended to the Gulf Coast and some East Coast areas.

*Canada-U.S. Great Lakes Water Treaty Agreement

Issue Type :	Canadian Program :	Canadian Initiative :	27
Water	***CUGLWQA****	***Great Lakes Water Quality***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***M***	***L***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	***298***	***0***	***0***	***67***	***67***	***0***	***102***	***102***	

Source of Estimates :

Ohio Petroleum Council

Extent of Applicability :

All waters of the Great Lakes

Comments :

Canadian numbers assume the same cost as the US given that 6 Canadian refineries are situated on the Great Lakes while 5 US refineries are in the same situation.

* Canada-U.S. Great Lakes Water Quality Agreement

Issue Type :	U.S. Program :	U.S. Initiative :	28
Water	***Clean Water Act***	***Storm Water Treatment***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***L***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
424	***357***	***607***	***25***	***46***	***83***	***75***	***137***	***245***	

Source of Estimates :

NPC - Vol III page 4-15, Bechtel study

Extent of Applicability :

National

Comments :

The equipment estimated consists of the facilities required to build lift stations($53 million) and store and treat contaminated process water and storm water from a 10 year storm($1,144 million). Additional costs could be incurred through the installation of closed loop samplers ($38 million) and through paving of process areas to reduce the sediment loading of the runoff($154 million).

Issue Type :	Canadian Program :	Canadian Initiative :	28
Water	***Provincial***	***Storm Water Quality***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining	***S***	***S***	***C***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Regional

Comments :

The Canadian equivalent of this US initiative, which consists of facilities to store and treat contaminated process water and the storm water from a 10 year storm, has already been implemented. It is part of the $1,000 million baseline investment made in the 1970 - 1992 time frame.

Issue Type : **Water** | U.S. Program : **Clean Water Act** | U.S. Initiative : **OTCW* Elimination** | 29

Downstream Sector : **Refining**

Compliance - Start date :

Compliance - Completion date :

Probability of Implementation:

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :

No specific US initiative of this type has been flagged in either the API or NPC studies. However, the Great Lakes Water Quality initiative may end up having provisions that would encompass the elimination of once through cooling water.

Issue Type : **Water** | Canadian Program : **Provincial** | Canadian Initiative : **OTCW* Elimination** | 29

Downstream Sector : **Refining**

Compliance - Start date : ***L***

Compliance - Completion date : ***L***

Probability of Implementation : ***L***

Costs - Initial Investment : ***0 0 300***

Costs - Annual Operating :

Costs - Annualized : ***0 0 35***

Unit Costs - Estimate average :

Source of Estimates :

MOE - verbal CPPI

Extent of Applicability :

Ontario

Comments :

Four Ontario refiners were estimated to require $300 million of investment to eliminate OTCW usage. The estimate provides for additional cooling towers and their ancillary equipment.

* OTCW - Once Through Cooling Water

Issue Type :
Waste

U.S. Program :
*RCRA**

U.S. Initiative :
Scope of Toxicity Char. Rule

Downstream Sector :
R&M

Compliance - Start date :
S

Compliance - Completion date :
S

Probability of Implementation:
H

Costs - Initial Investment :
12,530 0 0

Costs - Annual Operating :

Costs - Annualized :
1466 1466 1466

Unit Costs - Estimate average :

Source of Estimates :
API - American Petroleum Institute

Extent of Applicability :
To underground storage tank & other petroleum contaminated sites

Comments :

Waste classified as toxic must be managed as hazardous waste. Several regulations concerning the scope of the final controls are still under consideration. If the proposed regulation includes underground storage tank wastes, the average cost of soil treatment from these stations would increase from $55 per cubic yard to as much as $1,060 per cubic yard and of cleaning up a service station site to $110,000.

*Resource Conservation and Recovery Act

30

Issue Type :
Waste

Canadian Program :
Provincial

Canadian Initiative :
Refinery Sites Remediation

Downstream Sector :
Refining

Compliance - Start date :
S

Compliance - Completion date :
S

Probability of Implementation :
H

Costs - Initial Investment :
150 0 0

Costs - Annual Operating :

Costs - Annualized :
18 18 18

Unit Costs - Estimate average :
$ 50 M/site

Source of Estimates :

Extent of Applicability :
National

Comments :
The restoration costs for 3 refineries closed in the 1970's amounted to approximately $10 million each. The sites of refineries closed since then have been significantly more costly to remedy. Costs between $50 and $ 75 million for each site are expected. Costs of about $150 to $200 million are included in the industry baseline environmental expenditures.

For the purpose of this study, it is assumed that an additional $150 million will be required in the short term and another $150 million will be required for the medium term.

Issue Type :
Waste

Canadian Program :
Provincial

Canadian Initiative :
Sites Remediation

Downstream Sector :
Marketing

Compliance - Start date :
S

Compliance - Completion date :
M

Probability of Implementation :
H

Costs - Initial Investment :
300 150 0

Costs - Annual Operating :

Costs - Annualized :
35 53 53

Unit Costs - Estimate average :
$ 100K /station

Source of Estimates :
CPPI

Extent of Applicability :
National

Comments :
Site remediation costs vary between $60 to $ 400 thousand. The average regional costs cluster around $100 thousand per site. Approximately 1500 retail and 150 distribution sites had been remedied by 1991 at a cost of $150 to $175 million. Those costs are included in the industry environmental baseline costs

A preliminary estimate suggests that another 4000 retail and 500 distribution sites need to be remedied. The cost of that work is estimated at $450 million. The cost has been arbitrarily divided between the short and medium time frame with an emphasis on the short time frame.

Issue Type :	U.S. Program :	U.S. Initiative :	31
Groundwater	***Not defined***	***Used Oil Collection***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***S***	***C***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
	0	***0***	

Source of Estimates :

Extent of Applicability :

National by company

Comments :

US oil companies have instituted voluntary used oil collection and recycling programs at all?/most of their service stations. No cost information is available.

Issue Type :	Canadian Program :	Canadian Initiative :	31
Waste	***Not defined***	***Waste Oil Recycle***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***S***	***M***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

National

Comments :

A voluntary waste oil collection and recycling program has been started by the Canadian Petroleum Products Institute members.

The investment and annual operating costs need to be reviewed/determined for inclusion in this study.

Issue Type : **_Waste_**

U.S. Program : **_RCRA*_**

U.S. Initiative : **_Land Disposal Restriction Mod_**

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	**_S_**	**_S_**	**_H_**

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
_5000_	**_0_**	**_0_**	**_181_**	**_181_**	**_181_**	**_768_**	**_768_**	**_768_**	

Source of Estimates :

API - American Petroleum Institute

Extent of Applicability :

Refinery, wastes classified as "hazardous" or "potentially hazardous"

Comments :

Regulations came into force in 1990 restricting the disposal on land of certain petroleum refinery hazardous wastes. Under these restrictions, specified wastes cannot be disposed of on land without prior treatment or specific approval. Fuel wastes are covered by this requirement. Other land disposal restrictions apply to refinery wastes found to be "characteristicly" hazardous though testing.
In 1992, a court decided that surface water impoundments falling under the clean water act also be subject to certain restrictions provided for by the Resource Conservation and Recovery Act. The Environmental Protection Agency is currently considering ways of dealing with this and the new requirements.

*Resource Conservation and Recovery Act

Issue Type : **_Waste_**

Canadian Program : **_Provincial_**

Canadian Initiative : **_Fuel Wastes - Land Farm. Rest._**

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
_R&M_			**_H_**

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :		Unit Costs - Estimate average :
		_0_	**_0_**	

Source of Estimates :

Extent of Applicability :

Provincial

Comments :

Current Canadian practice for fuel contaminated soil disposal appears to be similar to the requirements of this US initiative and are included in the baseline annual costs.

Issue Type :	U.S. Program :	U.S. Initiative :	33
Waste	***RCRA****	***Land Disposal Restriction -sludge***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Refining	***S***	***S***	***H***

Costs - Initial Investment : Costs - Annual Operating : Costs - Annualized : Unit Costs - Estimate average :

44 44 44 44 44 44

Source of Estimates :

Environmental Protection Agency

Extent of Applicability :

Refinery primary & secondary sludge

Comments :

Petroleum refining primary and secondary sludge were classified as hazardous waste in 1991 along with certain floats from impoundments and other units. Full compliance with the hazardous waste disposal requirements is mandated by June 1994 at the latest. The incremental cost of sludge disposal following the hazardous waste rule is estimated at $40 to $47 million per year excluding California.

*Resource Conservation and Recovery Act

Issue Type :	Canadian Program :	Canadian Initiative :	33
Waste	***Provincial***	***Sludge Wastes - Land Farm. Rest.***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Refining			***H***

Costs - Initial Investment : Costs - Annual Operating : Costs - Annualized : Unit Costs - Estimate average :

0 0

Source of Estimates :

Extent of Applicability :

Provincial

Comments :

Current Canadian practice for sludge disposal appears to be similar to this US initiative and is included in the cnadian baseline costs.

Issue Type :	U.S. Program :	U.S. Initiative :	34
Waste	***Not defined***	***50% Waste Reduction***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
			H

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
		0 ***0***	

Source of Estimates :

Extent of Applicability :

Comments :

No information available.

Issue Type :	Canadian Program :	Canadian Initiative :	34
Waste	***Provincial***	***50% Solid Waste Reduction***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***S***	***M***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :

Issue Type : Spills | U.S. Program : Clean Water Act*/SPCC** | U.S. Initiative : AboveGrnd TankSpill Prevention | 35

Issue Type :	U.S. Program :	U.S. Initiative :
Spills	***Clean Water Act*/SPCC****	***AboveGrnd TankSpill Prevention***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***M***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
2800	***2800***	***0***	***88***	***175***	***175***	***416***	***830***	***830***	***$US 16 K/tank***

Source of Estimates :

API - #70R p.25

Extent of Applicability :

A number of industries including petroleum refining

Comments :

The Spill Prevention Control Countermeasures**(SPCC) Program covers spill prevention procedures, methods and equipment requirements. Bills have been introduced in Congress that would require release detection, systems, inspections, secondary containment(discussed in another data sheet), corrosion protection and corrective action plans for AST's. In $1991, initial costs varied between $9,159 and $12,634 million while annual operating costs varied between $270 to $440 million. The estimated number of petroleum industry ASTs is 700,000. The downstream industry number is assumed at 350,000. The investment unit cost is $16 K per tank.

* Clean Water Act as amended by Oil Pollution Act

35

Issue Type :	Canadian Program :	Canadian Initiative :
Spills	***Provincial***	***AST - Spill Prevention***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***S***	***M***	***M***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
84	***84***	***0***	***2***	***4***	***4***	***12***	***24***	***24***	***$CAN 21 K/tank***

Source of Estimates :

API/EPA

Extent of Applicability :

National

Comments :

A Canadian Guideline for spill prevention has been devised but no costs are available for it. From US estimates of $US 16K per tank, a Canadian investment estimate of $CAN 21K per tank has been derived. For the approximately 8000 above ground tanks in the downstream petroleum industry, an investment cost of $169 million has been calculated and an annual operating cost of $4 million assumed based on 500 $ per tank.

Issue Type : **Spills**

U.S. Program : **Oil Pollution Act**

U.S. Initiative : **Secondary Containment**

36

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	**S**	**M**	**L**

Costs - Initial Investment :			Costs - Annual Operating :	Costs - Annualized :			Unit Costs - Estimate average :
6950	**6000**	**0**		**813**	**1515**	**1515**	**$US 37 K/tank**

Source of Estimates :

API - American Petroleum Institute

Extent of Applicability :

National

Comments :

The Environmental Protection Agency is required by law to study secondary containment measures and liners in above-ground storage tanks and to implement its findings within six months of completion of its report.
The estimate above is based on capital investments of between $12,900 to $26,900 million for tank liners and $6,280 million for dike secondary containment. The derived average cost per tank is $37 K. Given that the petroleum industry has 700,000 ASTs and the assumption that the downstream has half, the capital cost is $12,950 million split between the medium and long time frame.

Issue Type : **Spills**

Canadian Program : **Provincial**

Canadian Initiative : **AST - Secondary Containment**

36

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	**M**	**L**	**L**

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
0	**100**	**294**	**0**	**0**	**0**	**0**	**12**	**46**	**$CAN 49 K/tank**

Source of Estimates :

API - American Petroleum Institute

Extent of Applicability :

National

Comments :

The US is studying secondary containment measures for tanks and diked areas. The cost estimates generated by API and EPA indicate a cost of approximately $CAN 12 K per tank for the diking and $37 K per tank for the liners. Given 8,000 downstream petroleum tanks, the Canadian cost of the measures would be $392 million. That cost has been arbitrarily distributed between the medium and long time frame.

Issue Type :	U.S. Program :	U.S. Initiative :	37
Spills	***Oil Pollution Act***	***Facil. with AboveGrnd Stor. Tanks***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***S***	***H***

Costs - Initial Investment :			Costs - Annual Operating :			Costs - Annualized :			Unit Costs - Estimate average :
121	***0***	***0***	***52***	***52***	***52***	***63***	***63***	***63***	

Source of Estimates :

API - American Petroleum Institute

Extent of Applicability :

Certain above-ground storage at oil marketing, refining, transporation & production facilit

Comments :

Some oil marketing refining, transporations and production facilities will be required to carry out further oil spill response planning. Some not required at present to prepare plans will have to do so. Facilities affected include those that either store more than one million gallons of petroleum oil, or transfer oil by vessel.

Issue Type :	Canadian Program :	Canadian Initiative :	37
Spills	***Provincial***	***Storage Facilities - Response Plan***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***L***		

Costs - Initial Investment : Costs - Annual Operating : Costs - Annualized : Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :
There is no equivalent program in the Canadian scenario.

Issue Type :	U.S. Program :	U.S. Initiative :	38
Spills	***Oil Pollution Act***	***Double Hull Tankers***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Marketing	***S***	***S***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
4,538 0 0		***531 531 531***	

Source of Estimates :

U.S. Coast Guard

Extent of Applicability :

Tankers and barges operating in U.S. waters

Comments :

The U.S. Coast Guard proposed regulations in 1990. Final requirements are expected to be released by the end of 1993.

Issue Type :	Canadian Program :	Canadian Initiative :	38
Spills	***National***	***Double Hull Tankers***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
R&M	***S***	***L***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
769 0 0		***90 90 90***	

Source of Estimates :

U.S. Coast Guard

Extent of Applicability :

National

Comments :

A double hull tankers program is scheduled to take effect between 1995 and 2015. The cost of that program is not generally born directly by the downstream sector but will affect crude delivery costs. This measure is expected to affect not only tidewater refineries but also all other inland refineries through reference market crude pricing. The Canadian costs have been prorated on the US costs at 12.7% and with a currency exchange rate of 0.75.

Issue Type : **Spills**

U.S. Program : **Oil Pollution Act**

U.S. Initiative : **Vessel Financial Responsibility**

Downstream Sector : **Marketing**

Compliance - Start date : **S**

Compliance - Completion date : **L**

Probability of Implementation: **H**

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

122 122 122 122 122 122

Source of Estimates :

API/USCG - American Petroleum Institute/U.S. Coast Guard

Extent of Applicability :

Vessels over 300 tons operating in U.S. waters

Comments :

The U.S. Coast Guard has proposed that the owners and operators of vessels over 300 gross tons establish and maintain evidence of insurance or other means of meeting this potential liability for discharges or threatened discharge of oil or hazardous substances.
The final regulations could come into effect in 1994.

Issue Type : **Spills**

Canadian Program :

Canadian Initiative : **Vessel Fin. Responsibility**

Downstream Sector : **Marketing**

Compliance - Start date : **S**

Compliance - Completion date : **L**

Probability of Implementation : **H**

Costs - Initial Investment :

Costs - Annual Operating :

Costs - Annualized :

Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :

Part IV of the Canada Shipping Act Sections 673 to 727 set out the measures respecting civil liability and compensation in the case of marine pollution. No impact data for the Petroleum Industry is available.

Issue Type : ***Spills***

U.S. Program : ***Oil Pollution Act***

U.S. Initiative : ***OilSpill Response Plans-Vessel***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Marketing	***S***	***S***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
1,000 0 0	134 134 134	***251 251 251***	

Source of Estimates :

U.S. Coast Guard - API #70R p.20

Extent of Applicability :

Vessels and facilities handling oil

Comments :

The U.S. Coast guard will finalize requirements for response plans for vessels that carry oil in bulk as cargo in 1994. This estimate includes capital and operating expenses for shore based response capability such as that provided by the Marine Spill Response Corporation and regional cooperatives.

40

Issue Type : ***Spills***

Canadian Program : ***MEPP***

Canadian Initiative : ***Marine Spill Response***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Marketing	***S***	***S***	***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
40 0 0	***9 9 9***	***14 14 14***	

Source of Estimates :

CPPI

Extent of Applicability :

All Canadian waterways

Comments :

The estimate for this initiative is derived from the Marine Environmental Protection Plan (MEPP) Task Force Report revision which estimates the cost of the facilities and equipment needed at $52 million less $12 million already in place. The operating cost is an estimate of the net cost to the oil industry.

Issue Type : Spills | U.S. Program : Oil Pollution Act | U.S. Initiative : Marine Transp-Related Facilit. | 41

Issue Type :	U.S. Program :	U.S. Initiative :
Spills	***Oil Pollution Act***	***Marine Transp-Related Facilit.***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
R&M	***S***	***M***	***M***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
700 0 0		***82 82 82***	

Source of Estimates :

U.S. Coast Guard

Extent of Applicability :

Marine Transporation-Related Facilities

Comments :

Covers facilities that handle, store or transport oil in bulk such as deep water ports, marinas, tank trucks and railroad truck cars.

41

Issue Type :	Canadian Program :	Canadian Initiative :
Spills		***Marine Facilities***

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Marketing	***H***		

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :
The Canadian equivalent of this initiative is contained inthe MEPP program.

Issue Type :	U.S. Program :	U.S. Initiative :	42
Spills	***Oil Pollution Act***	***Discharge prevention equipment***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation:
Marketing	***S***		***H***

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :
153 0 0		***18 18 18***	

Source of Estimates :

U.S. Coast Guard

Extent of Applicability :

Oil-Carrying Vessels

Comments :

Vessels carrying bulk cargoes of oil would be required to have equipment to contain and remove on-deck oil spills, spill prevention coamings and emergency towing arrangements.

Issue Type :	Canadian Program :	Canadian Initiative :	42
Spills		***Vessels - Spill Prevention***	

Downstream Sector :	Compliance - Start date :	Compliance - Completion date :	Probability of Implementation :
Marketing			

Costs - Initial Investment :	Costs - Annual Operating :	Costs - Annualized :	Unit Costs - Estimate average :

Source of Estimates :

Extent of Applicability :

Comments :
No information available.

Sector Competitiveness Framework
Refined Petroleum Products

Appendix A7

Competitive Outlook for the Canadian Petroleum Refining and Marketing Industry

Prepared by Purvin and Gertz, Inc.

May 1992

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS

FIGURES (Continued)

TABLES

I
INTRODUCTION

The Canadian petroleum refining and marketing industry is in a deep crisis, following a decade of steadily deteriorating business conditions. Losses of over $500 million in 1991 were incurred by the industry, and it saw petroleum product demand decline significantly. The industry has embarked on a program to reduce its costs to improve its competitiveness. It is less competitive than the U.S. industry, the most relevant benchmark for the Canadian industry. Finally, major capital expenditures in the range of $5 to 6 billion, and possibly as much as $16 billion could be required to meet contemplated environmental regulations in Canada. Additional investment will be required to improve the competitiveness of the industry as well as to provide ongoing capital improvement programs.

The Canadian industry is at a major crossroads where it is confronting very critical issues. It must increase its profitability to survive. Its choices to recovery lie within the broad range of retreating (and continued down sizing) or major capital commitments to equip itself to be more competitive and enable it to install the necessary environmental facilities and other improvements. Combating these issues will require very difficult and strategically important choices and they will have important implications for the Canadian economy. Raising the required capital will be a major challenge. Not raising sufficient capital would put the future of the industry in jeopardy.

The Canadian petroleum refining and marketing industry is an important business in Canada. As shown in Figure I-1 below, it affects all Canadian consumers. In 1990, the

FIGURE I-1
DOWNSTREAM DISTRIBUTION OF REFINED PETROLEUM PRODUCTS

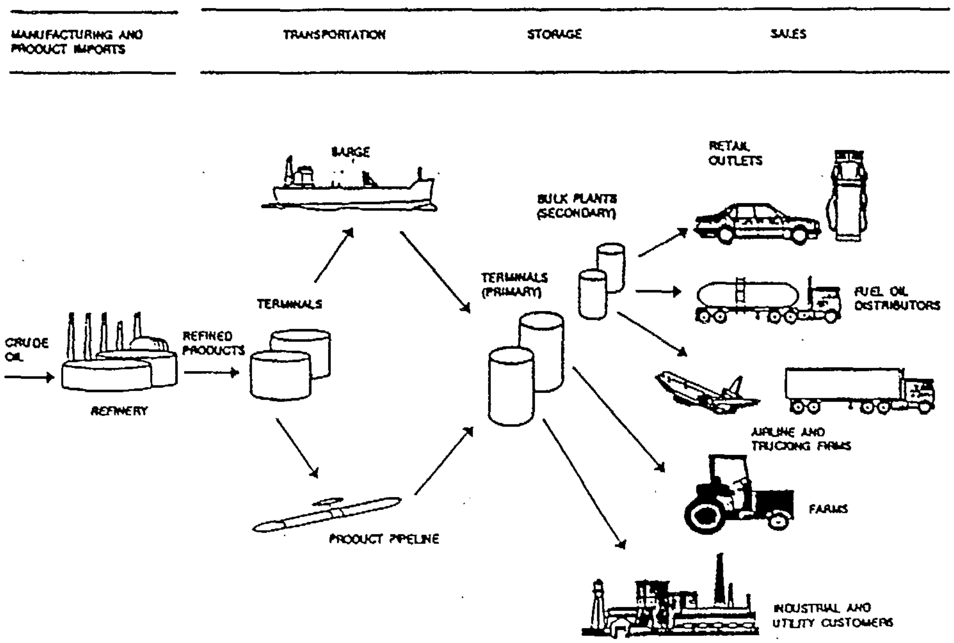
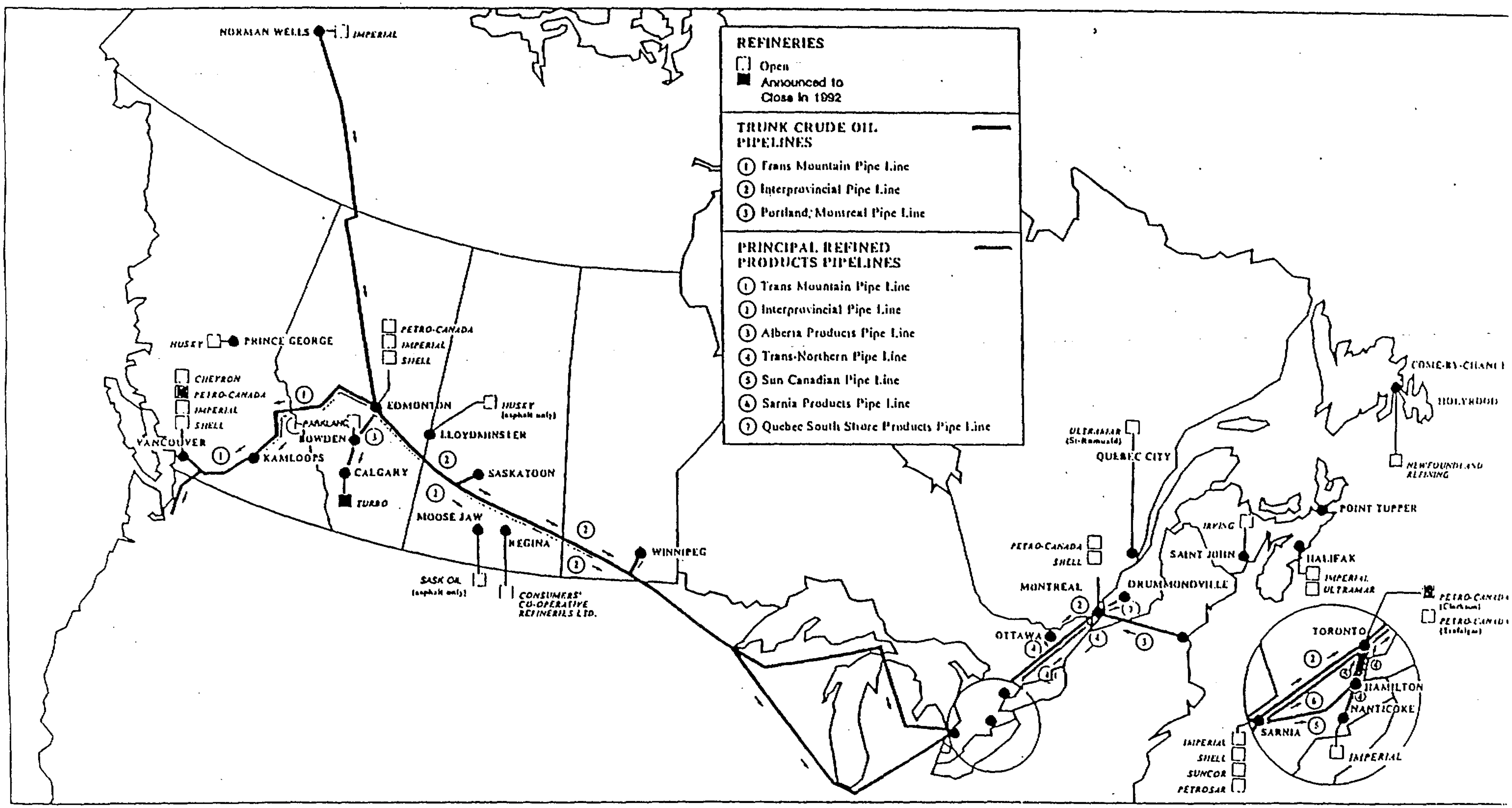


FIGURE I-2

CANADIAN REFINERIES AND MAJOR PIPLINES



value of oil product shipments was $24 billion. The industry employs around 12,000 Canadians in the refining sector, and close to 100,000 people including the marketing sector. In addition, there are thousands of jobs created in providing services directly to this industry.

The total demand for petroleum products in Canada in 1991 was 1,359,000 barrels per day (B/D), or 78.9 billion litres per year. The market is served by 28 refineries located across the country, see Figure I-2. A major infrastructure of product pipelines, terminals, and retail outlets enable refiners to supply products to their customers. It is a mature industry which primarily serves the Canadian market. It is not an export oriented industry except in the Atlantic provinces. Less than 10% of the total demand for products is served with imported products. The rest of the demand is served with products manufactured in Canada.

Purvin & Gertz, Inc. was retained by the Canadian Petroleum Products Institute (CPPI) to provide an independent assessment of the competitive outlook for the Canadian refining and marketing industry. This report covers a historical analysis of the industry, projections in certain areas through to 2000, a comparison to the U.S. industry, and a description of the challenges facing the industry.

In Section II, Conclusions and Recommendations are provided which highlight the findings of the study. In Section III, a perspective is provided of the international market. Particular emphasis has been given to those factors which directly or indirectly influence the Canadian market. After reviewing the world picture, some of the pertinent factors of the U.S. products market which influence the Canadian market are reviewed. Environmental issues, especially those which are directed at product quality in the U.S. market, are addressed in a later section. In Section IV, an analysis of the market outlook for the Canadian market is provided. This analysis includes petroleum supply and demand, refinery capacity utilization, pricing, and other analyses which form the basis for the Canadian industry competitiveness assessment.

The competitive pressures are discussed and compared in Section V. Certain areas are analyzed by comparing the U.S. and the Canadian industry. In Section VI, the environmental pressures are reviewed. A review of U.S. environmental measures is provided, along with an assessment of the likely impact of these changes on the U.S. market. Finally, Canadian environmental initiatives are reviewed, along with the likely impact on the Canadian industry.

In the undertaking of this analysis, Purvin & Gertz has drawn upon its worldwide expertise in petroleum refining and marketing and upon many analyses of the Canadian industry. Purvin & Gertz contacted several member firms of the CPPI for input on various aspects of this competitiveness study. However, the views in this report are based on an independent assessment by Purvin & Gertz, and are not necessarily representative of the views of some or all of the members of the CPPI.

II
CONCLUSIONS & RECOMMENDATIONS

From our analysis of the Canadian petroleum refining and marketing industry, many observations can be made about the overall health of the industry, and how it compares competitively to its closest benchmark, the United States refining and marketing industry. The U.S. industry has a strong influence on the Canadian industry, even though product movements between the two countries are small. Our conclusions and recommendations based on our analysis are provided below.

CONCLUSIONS

The Canadian industry is facing a major crisis. Its poor financial condition, uncertainty about the future, and the need to attract capital puts it in a precarious situation. The following conclusions are summarized based on our review of the Canadian industry.

1. **Canadian industry economic performance has been poor relative to other industries, and relative to the U.S. industry in recent years.**

RATE OF RETURN COMPARISON
(Percent)

	1988	1989	1990
Canadian Oil Products	8.3	5.8	4.8
Other Canadian Non-Financial	10.4	9.0	5.8
U.S. Oil Products	14.7	11.5	5.2

In 1991, Canadian oil refining and marketing companies collectively lost over $500 million. In relative terms, the Canadian industry has faired poorly compared to the U.S. and to other industry sectors in Canada.

2. **Government pressure resulted in major inventory losses experienced by the industry in 1991, and this has significantly harmed the industry.** Petroleum product prices around the world follow LIFO (last in, first out) business practices. However, Canadian businesses must use the FIFO (first in, first out) accounting method for income taxes. In line with FIFO principles, Canadian governments put pressure on the Canadian industry to lag product prices by some 60 days from changes in crude prices. When the crude price dropped in early 1991 during the Gulf War, world product prices dropped immediately, and forced Canadian product prices down before the Canadian industry could pass through its inventory of high cost crudes. Parts of the Canadian industry are now attempting to operate in a LIFO manner such that current revenue tracks current costs so as to avoid a repetition of this terrible loss, although they still must report their earnings on a FIFO basis for income tax purposes.

Under LIFO, industry losses would have been much less in 1991, but losses would have occurred in 1990. The Canadian industry's rates of return for 1988 to 1990 are overstated relative to LIFO inventory evaluations.

3. **The U.S. industry is responding to new regulated programs to produce environmentally cleaner diesel fuel and gasoline, and reduce stationary facility emissions.** If similar programs are adopted in Canada, it is expected that the costs of such programs could be $5 to 6 billion, and they possibly could reach $16 billion if all of the programs under consideration are implemented.

4. **Proposed environmental programs which are currently envisioned for Canada, and are underway in the U.S., provide a great dilemma for the Canadian industry.** The Canadian programs are highly uncertain. There is little hope of receiving a full return on such expenditures. The U.S. industry, because of its scale and complexity, will be better capable of meeting these changes than the Canadian industry. Expected increases in U.S. product prices will likely be less than what would be required in Canada to provide an acceptable rate of return on new environmental expenditures.. U.S. products specifications will provide barriers to imported products into their country, and it is quite possible that U.S. products not meeting U.S. standards could be dumped into the Canadian market with depressing consequences.

5. **In all of the following areas, the U.S. has an advantage over the Canadian refining and marketing business:**

   - Refinery Capital Investment
   - Crude Feedstock Costs
   - Refinery Operating Costs
   - Wholesale Margins
   - Refinery Utilization
   - Size of Refineries and Markets
   - Average Retail Throughput
   - Tax Levels (Income and Retail)
   - Planned Environmental Costs
   - Product Specifications
   - Profitability

6. **The utilization of refining capacity in Canada was too low in 1991, averaging 82% based on total production and only 73% based on domestic demand.** The industry attempted to increase exports in order to keep utilization levels high, but margins decreased. Announced refinery shutdowns should improve the capacity utilization, but there is still a need for further shutdowns of refining capacity in order to improve utilization to at least 85% based on domestic demand.

7. **The utilization of service station outlets in Canada is too low.** The average throughput in Canada is approximately half of the average gasoline throughput in service stations in the U.S.

8. **Canadian refining margins are strongly influenced by the U.S. market.** Canadian crude oil prices are established in the U.S. Midwest market and

Canadian wholesale product prices are strongly influenced by U.S. prices, adjusted for transportation costs.

9. **The Canadian refining industry suffers from a crude feedstock cost disadvantage.** Canada predominantly uses light sweet crude feedstock, giving the industry a higher cost feedstock slate. The U.S. refining industry has a more complex processing capability to process lower cost crudes, most of which are sour and heavier than what are used in Canada. By maximizing capacity utilization so as to improve refining margins, the feedstock cost disadvantage can be reasonably offset.

10. **Maximum refining margins are best attained if Canadian wholesale product prices are at least equal to U.S. prices in adjacent U.S., markets plus transportation costs.** This is particularly valid in Ontario and Quebec. If excess products must be exported into the U.S., wholesale prices have dropped reflecting netback values from U.S. market destinations.

11. **The Canadian refining sector has slightly higher operating costs than the current U.S. industry.** This is attributed to slightly higher labour and maintenance costs, some of which are weather related. However, this disadvantage is minor compared to the impacts of higher crude oil costs and inadequate wholesale prices.

12. **Higher marketing costs occur in Canada versus the U.S.** This is primarily a function of inherent higher distribution costs because of greater distances within Canada and lower population densities, and also because of lower utilization of service station assets.

13. **The cross border shopping problem has a major negative impact on Canadian petroleum marketing operations close to the U.S. border in many areas.** The large differences in taxes on products is a major component of this problem.

14. **The Canadian industry faces major capital investments to meet environmental regulations, improve its competitiveness, and to add the necessary ongoing improvement programs.** Prior to 2000, the following range of investments will likely be required. This staggering investment level represents a major challenge for the industry to raise the required capital.

REQUIRED CAPITAL EXPENDITURES OVER NEXT 5-7 YEARS
($ Billion)

Ongoing Captial Improvement Programs	5 - 10
Environmental Improvements	5 - 16
Improvements to Process Lower Cost Feedstocks	2 - 5
Total	12 - 31

In addition, the industry will be experiencing writedowns for plants and facilities which are rationalized during the next several years.

15. **In order for the refining and marketing industry to survive and be viable in Canada, it must improve its profitability.** In the short term, this can best be done by increasing margins and reducing costs. This will require reductions in refining capacity, shutting down less efficient operations so that utilization can improve. Shutting down marginal marketing assets will also be required. The industry has taken some such steps already, and more are required. If industry profitability can be improved, then the industry will be better prepared to raise the required capital to make expenditures to improve its competitiveness, as well as to meet environmental regulations. A healthy industry should be able to respond to selected market opportunities in the U.S.

RECOMMENDATIONS

The following recommendations are intended for both industry and government regarding the future welfare of the Canadian refining and marketing industry.

1. **The industry is fighting for its life to restore its viability. To do so it must retrench rather than retreat, and improve its profitability so that it can lead to long-term competitiveness.** Therefore, the industry must continue to rationalize its business beyond levels that have currently been announced. Such rationalization must occur within both the refining and marketing levels.

2. **Except for the Atlantic Provinces, Canada should consider reducing refining capacity such that it is in a slight net import position (i.e. 2 to 5% of demand) for each of the major products.** This is consistent with other industrialized countries such as the U.S., Europe, and Japan which import between 10% and 20% of their product demands. Some of the Atlantic refineries, with their close proximity to the U.S. East Coast which is product deficient, should be able to maintain an active export role.

3. **Longer term competitiveness with the U.S. should be an achievable goal assuming that rationalization is undertaken today to build a stronger and world class competitor.** Improved profitability will permit the industry to gain more efficient and sophisticated operations so that it can benefit from some of the rationalization steps underway over this decade in the U.S. There should be selected low sulphur diesel and reformulated gasoline export opportunities for certain Canadian refiners which can adjust to make these products. The Canadian industry should give consideration to using lower costs feedstock, or possibly synthetic crudes produced from heavy crude feedstock. Such adjustments should lead to more complex, larger scale refinery operations which would be more competitive relative to the U.S. industry.

4. **The Canadian refining industry must better explain its competitive position, and the importance that this industry has in the Canadian economy.** The industry is prepared to change, but it needs room and time to undertake the necessary rationalizations steps to improve its profitability so as to be able to

meets its environmental responsibilities and to take advantage of new business opportunities. This recognition will also enhance investor confidence in the industry.

5. **The Canadian industry takes its environmental responsibility seriously.** The industry needs to respond to future environmental requirements by participating in a strong environmental program that takes into account the economic state of the industry. A co-ordinated industry/government environmental program is recommended. This program is needed so that environmental objectives can be prioritized in a manner consistent with a viable industry and sustainable development.

6. **There are certain areas in which governments in Canada can assist the industry by attempting to achieve a level playing field.**

   - Governments must recognize that industry must operate with prices following international market responses without government interference.

   - Labour costs and labour legislation must remain comparable with the U.S. industry.

   - Governments must recognize that the industry must put its house in order, and should aid and not restrict the rationalization process.

   - Governments must enforce cross border regulations affecting the petroleum products industry. This would help the cross border shopping problem, and help protect a vital industry.

   - Recognizing that large differences in product taxes exacerbates the cross border shopping problem, such taxes should not be increased further. Consideration should be given to developing a revenue neutral proposal across the country to permit fuel taxes to be lowered.

   - Governments' product tax policies need to reflect the importance of this industry to the country. Petroleum product manufacturing is an essential business, and petroleum products are essential products for consumers. Therefore, these products should not be treated as non-essential, luxury oriented products such as alcohol and tobacco, nor as an expedient way to raise revenue without regard for the future consequences to the industry and its importance to the country.

III
INTERNATIONAL MARKET OUTLOOK

In this section, a broad outlook for demand, supply and pricing of petroleum is presented. It provides a framework for the Canadian analysis which follows in the subsequent chapters.

WORLD OVERVIEW

WORLD PETROLEUM BALANCE

World petroleum demand in the free world (excluding the centrally planned economies) declined significantly through the early 1980's as a result of the sharp increases in crude oil prices that occurred in 1979. Consumer demand dropped as the proportion of energy costs to disposable income rose sharply. In addition, fuel substitution and regulatory moves brought about conservation of energy, further depressing the demand for petroleum. Strong economic growth in the mid-1980's reversed the decline despite continuing relatively high prices, and demand recovered after 1983. The slow petroleum demand recovery and the rapidly growing supply of crude oil from non-OPEC regions resulting from the high prices eventually led to a major international price collapse in early 1986. This downward price move sharply increased the demand trend. From 1986 to 1990, though the economic growth in developing countries slowed from the previous high pace, petroleum demand increased to 52.7 million B/D for an average annual increase of 2.3%.

Demand for petroleum products in 1990/1991 decreased as a result of the world economic slowdown and the Gulf War. The demand for petroleum in 1992 is expected to increase by about 1.2% over 1991 levels as the world recovers from the current recession and the impact of the Gulf War. For 1993, world demand is projected to increase by 1% over 1992.

A long term demand forecast for petroleum in the free world is shown in Figure III-1. The overall rate of growth of petroleum demand over the forecast is projected at 1.4%. For the 1990 to 2010 period, the growth of petroleum demand in North America is only 0.7%, and slightly higher in Western Europe at 0.9%. A high rate of growth is forecast for Asia, with a forecast demand of 2.6% annual growth.

A breakdown of the demand for petroleum products in the world market is shown in Figure III-2. Growth continues to be in the light petroleum product areas, primarily transportation fuels. Heavy fuel, asphalt, and other non-fuel uses are expected to be relatively unchanged over the forecast period.

The outlook for the supply of crude oil to meet the demand for products as discussed above is portrayed in Figure III-3.

FIGURE III-1
FREE WORLD PETROLEUM DEMAND

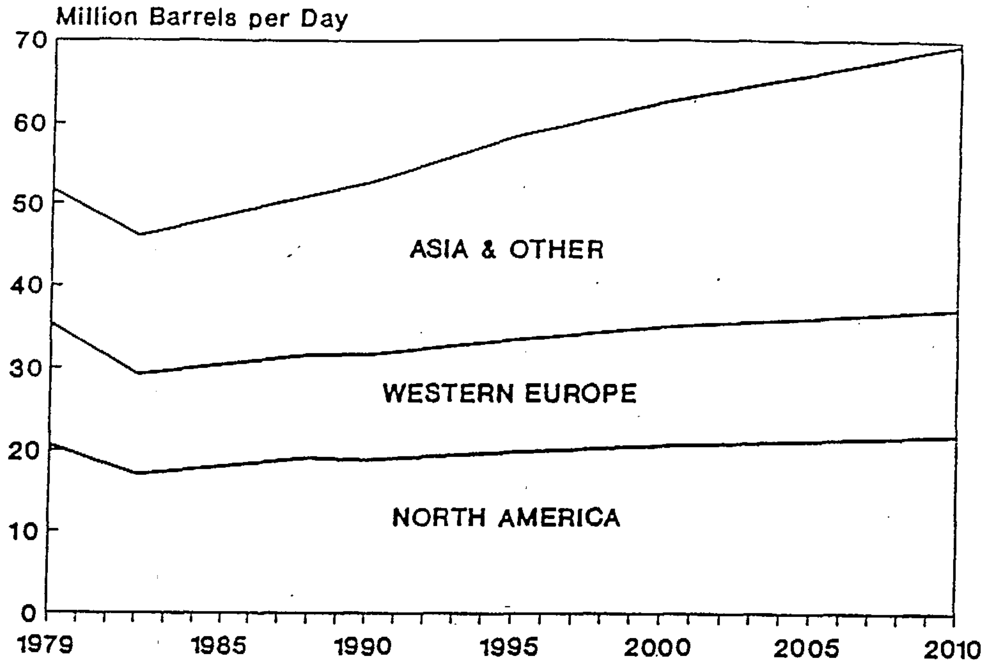


FIGURE III-2
FREE WORLD REFINED PRODUCT CONSUMPTION

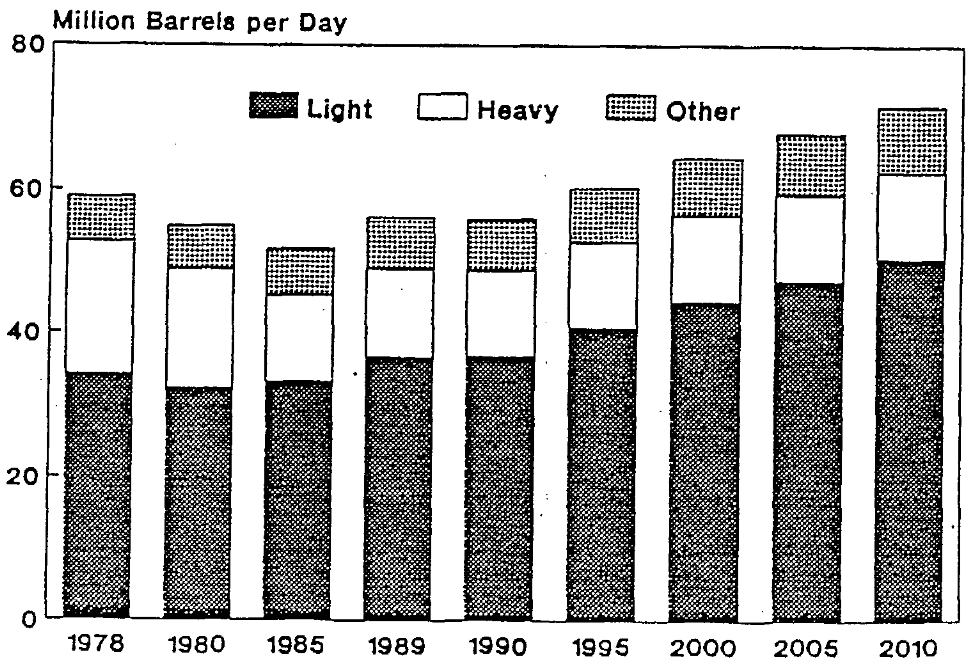
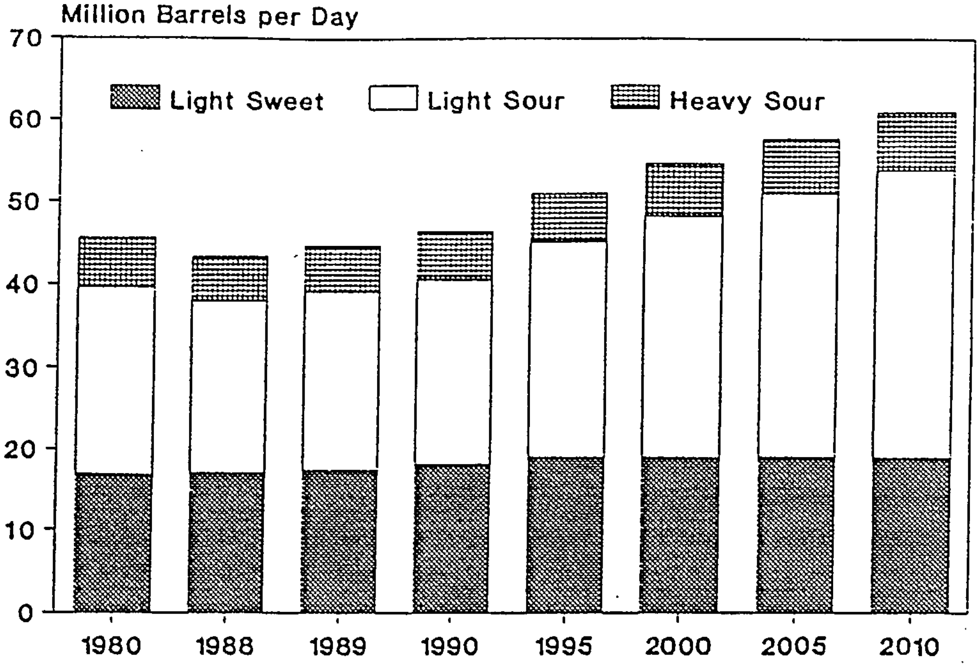


FIGURE III-3
FREE WORLD CRUDE PRODUCTION BY GRADE



Production of light sweet crude and heavy sour (higher sulphur content) crude is expected to remain relatively flat. Discoveries of both of these types of crude oil continue to occur, enabling the resulting crude production levels to remain relatively flat. However, the largest increase in production which will be required to meet the growing demand for petroleum will be light sour crude. Much of this crude will come from the Middle East, and it will tend to be the most influential crude affecting international crude oil movements, prices, and price differentials between various types of crudes.

PETROLEUM PRODUCT TRADE

Most industrialized countries do not manufacture all of their refined products, and instead rely on imports to balance the demand. Canada, however, is unique, as shown in the table below, because it is now a net exporter of products, similar to many oil producing countries.

NET IMPORTS OF PETROLEUM PRODUCTS(1)
(% of Domestic Demand)

	1986	1987	1988	1989	1990
Canada	-1.4	4.6	0.6	-9.6	-9.3
U.S.	7.5	6.1	7.0	9.0	8.2
Latin America	-18.7	-10.8	-9.7	-14.8	-16.3
Western Europe	10.6	9.9	10.8	8.3	3.2
Middle East	-47.4	-60.5	-61.9	-57.4	-68.1
Africa	-22.2	-24.7	-31.7	-25.0	-24.7

Note: (1) Includes natural gas liquids.

Canada's uniqueness stems from the fact that most of its exports are produced from imported crude oil, not domestic crude. Although Canada is a major producer and exporter of crude oil, it exports few products which are manufactured from domestic crude. In this respect, unlike most oil exporting countries which also operate export refineries, the Canadian petroleum industry is unique, as it is upgrading and adding value to imported raw materials for export.

CRUDE OIL PRICING

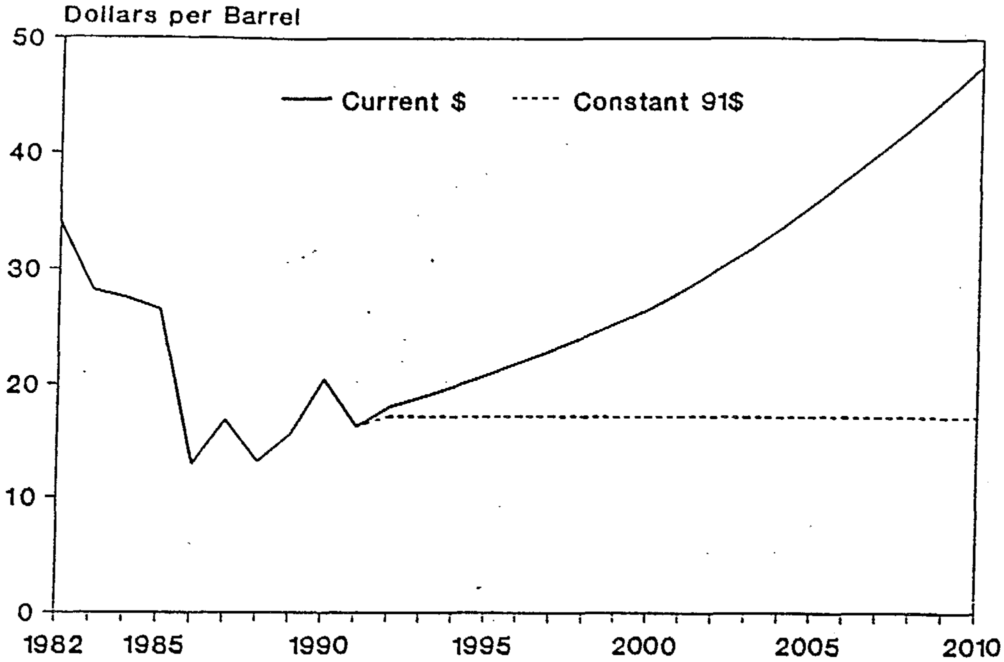
The world supply of crude oil is assumed to be consumed in the most economic manner subject to political and structural constraints. The price of crude oil is ultimately determined by supply and demand pressures. The patterns of world crude oil movements establishes the price equalization point for each crude oil and the crude oils with which it will compete in that market.

Differential prices for other types of crude oil are determined by the prices of products in a specific market, and products yields from each type of crude considered. Including processing costs, values of other crudes compared. to Dubai delivered to the same market can be determined.

Our analysis of these supply/demand pressures shows that a Middle East light crude oil price of about $16.50 F.O.B. (constant 1991 U.S. dollars) is a level at which a stable supply/demand balance should be possible through the forecast period to 2010. If prices are substantially above this level, demand for oil will decline because of conservation efforts and further displacement by alternative energy sources similar to the trend prior to the crude oil price decline in 1986. If prices are significantly lower, oil will begin replacing natural gas or coal in industrial boilers, and development of new energy supplies will be greater restricted. Either of these extremes will cause price corrections.

Our outlook for crude pricing is one which should foster increased crude supplies as required, and should also permit the demand for petroleum to grow at reasonable levels. Our crude oil price forecast for Dubai is shown below in Figure III-4. Prices of other crude oils are developed from the marker price based on their particular crude oil quality and logistical costs.

FIGURE III-4
DUBAI CRUDE OIL PRICE FORECAST



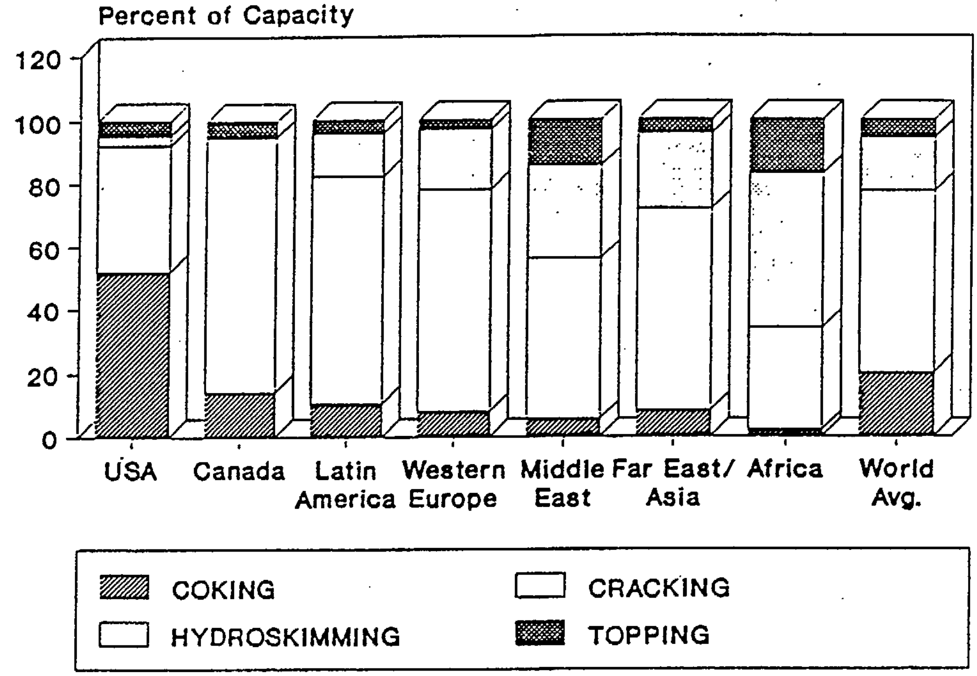
Light/heavy crude oil price differentials in the market are related to the total quantity and types of crude produced, as well as the demand for residual fuel oil and other refined products. Refinery conversion equipment is required to convert all of the non-residual fuel oil products into transportation fuel products in order for the demand to meet the supply. This will require the ongoing construction of conversion capacity throughout the world's refining industry, especially in Asia and other rapidly growing countries to correct the future imbalance between refining capacity and product demand. Price differentials between products and crude types have to be adequate over the long term to support the investments required to add the necessary refining conversion capabilities. Our forecast of product pricing is based on adequate pricing differentials to permit the necessary conversion capacities to be added to the world's refining industry.

WORLD REFINERY CAPABILITIES

In order to convert the available supplies of crude oil into the required petroleum products, the world's refining industry will have to increase its capabilities to process more sour crude oil and to increase its cracking capabilities. All crude oils contain some natural components which, in simple topping and hydroskimming refineries, can be processed into gasoline, distillates, and a high yield of residual fuel oil. Cracking refineries convert most of the crudes to gasoline and distillate products, with some residual fuel production. As crudes become more sour (containing more sulphur), the residual fuel oil becomes difficult to sell in many markets for environmental reasons. Therefore, cracking capacity within refineries further processes the residual portion (which can be a major portion of a heavy crude oil barrel) into lighter products. Even with cracking, some residual product will still be produced unless a refinery has coking or residual cracking capacity which converts the residual portion into lighter products. A coking type refinery upgrades essentially all of the crude to lighter fuel products.

The configuration of the world's refining industry is portrayed in Figure III-5. It compares the types of refinery capabilities as a percentage of a region's total refining capacity.

FIGURE III-5
FREE WORLD REFINERY CONFIGURATION

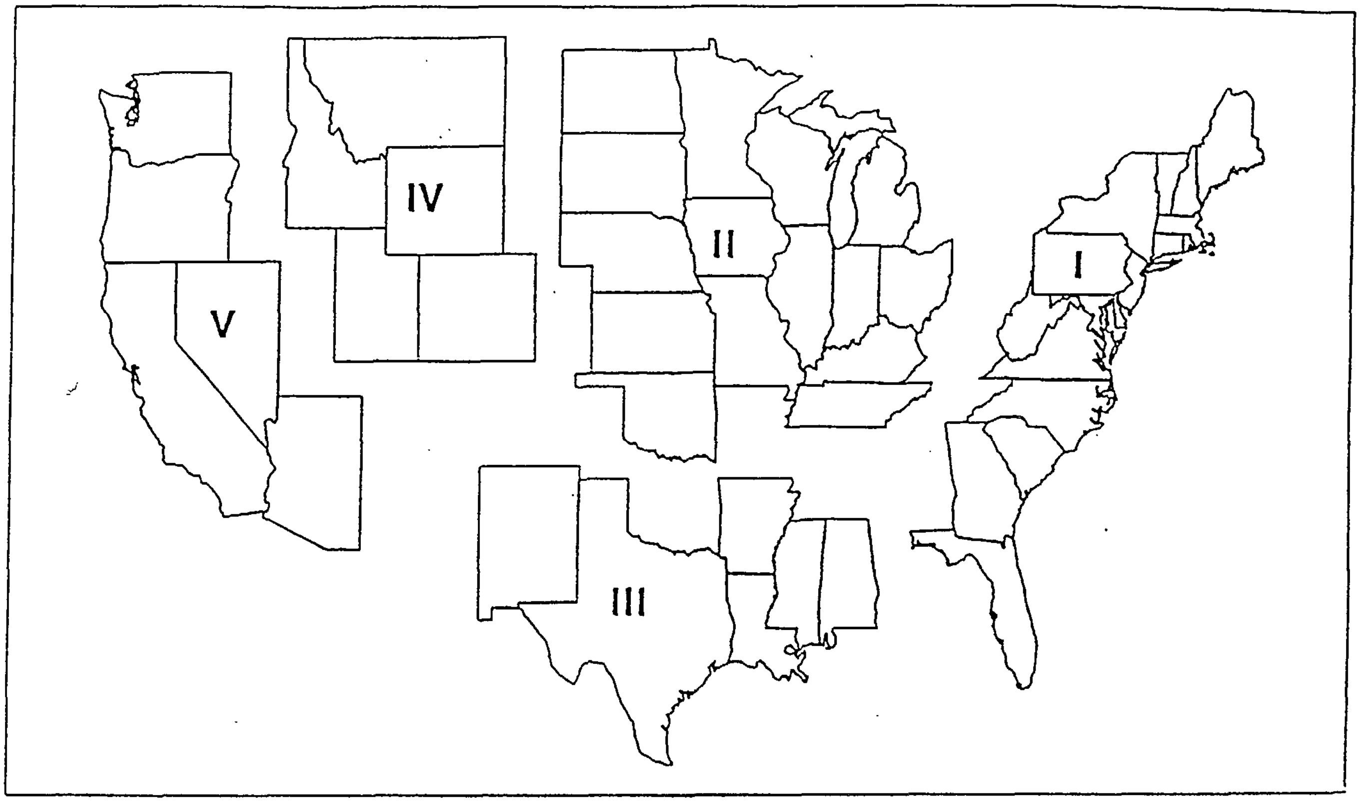


The U.S. is considerably advanced relative to the rest of the world with its capability of processing heavy sour crudes because of its coking and equivalent capacity. Canada ranks second in the world among its refining capabilities, but still lags far behind the U.S. The most important part of a modern refinery is its cracking capability, and the North American refineries have considerably more cracking capacity than refineries throughout the rest of the world. Therefore, considerable increases in cracking capacity will be required by refineries in other parts of the world as they respond to increase the production of transportation fuels from a gradually increasing sour crude slate. More coking or equivalent capacity will also be required throughout the world to process the heavier and sour crudes to keep the production of heavy fuel oil in line with demand (see Figure III-2).

U.S. MARKET OVERVIEW

The U.S. market is a very important market to Canada as it borders all of the major population centres across Canada. Whenever the U.S. market is discussed, it is often described by regions called Petroleum Administration for Defense Districts (PADDs). These regions are depicted below in Figure III-6.

FIGURE 111-6
PETROLEUM ADMINISTRATION FOR DEFENSE DISTRICTS (PADD)



U.S. PETROLEUM BALANCE

The demand for crude oil in the U.S. market was 13.3 million B/D in 1991. Of this volume, 5.8 million B/D or 45% was imported and 7.4 million B/D was produced domestically. U.S. crude oil imports are expected to exceed 50% by 2000.

U.S. crude oil production east of the Rockies (PADDS I-IV) is characteristically a mix of light sweet and light sour crudes averaging 36° API and less than .7% sulphur. Approximately 70% of the crude is light sweet, and 30% is light sour. The crude oil that is produced in PADD V (West Coast and Alaska) tends to be heavier crude and is primarily used in that region. As the demand for crude oil in the U.S. continues to grow while domestic supply declines, the U.S. will increasingly import more crude oil, and much of these imports will be light sour crude. This changing crude oil mix and the U.S. industry's strong ability to process sour crudes will become more important in the near future to its competitive refining position relative to the rest of the world including Canada.

U.S. petroleum product demand reached a high of 17.3 million B/D in 1989 before declining to 16.7 million B/D in 1991. A significant recovery is forecast to occur in 1992 with a further recovery in 1993 and thereafter. Our long term forecast indicates a growth rate in petroleum products demand of 0.6% per year. The expected demand for the major U.S. products are as follows:

MAJOR U.S. PETROLEUM PRODUCT DEMAND
(Millions of Barrels per Day)

	1990	1991	1995	2000
Motor Gasoline	7.2	7.2	7.4	7.5
Diesel/No. 2 Fuel Oil	3.0	3.0	3.3	3.5
Kerosene Jet Fuel	1.3	1.3	1.4	1.6
Residual Fuel Oil	1.2	1.3	1.3	1.3
	12.7	12.8	13.4	13.9

The above table excludes other products which are currently around 4 million B/D. These include petrochemicals, asphalt, LPG, lube oils, and other non-transportation fuel products.

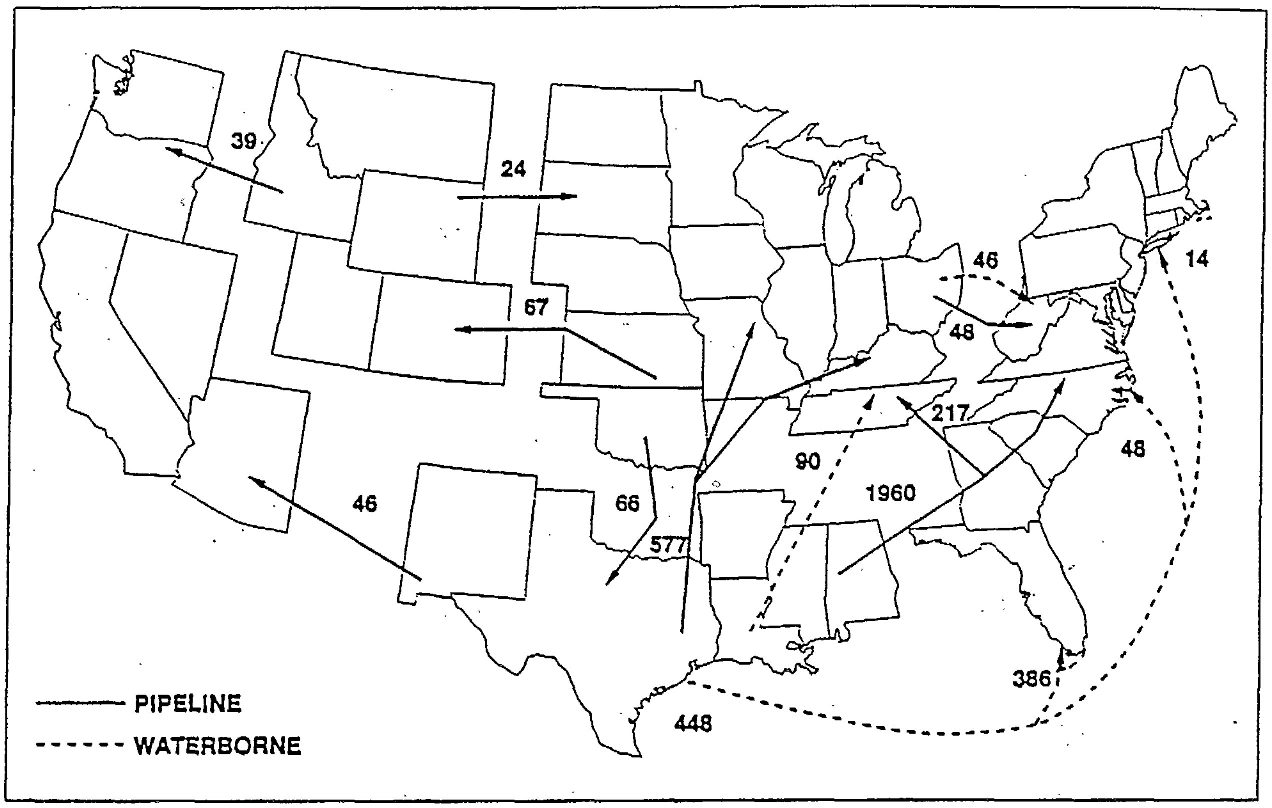
The U.S. industry is a net importer of petroleum products as shown below. Net product imports in 1990 were approximately 4% of the total product disposition in the U.S. Of the total imports in 1990, 1.1 million B/D of products were imported into the PADD I district on the U.S. East Coast. The other regions are far less dependent upon imported products.

U.S. PETROLEUM PRODUCT IMPORTS/EXPORTS
(Thousands of Barrels per Day)

	1989	1990
Imports	1,615	1,451
Exports	676	707
Net Imports	939	744

The bulk of the U.S. refining capacity is concentrated along the U.S. Gulf Coast. These refineries are connected to the major consuming areas by large product pipelines which move products from the U.S. Gulf Coast mainly into PADD I and PADD II. In addition, products move by barge from the U.S. Gulf Coast to PADD II via the Mississippi River, and by tanker from the U.S. Gulf Coast to the U.S. East Coast. These movements are portrayed in Figure III-7.

FIGURE III-7
ANNUAL AVERAGE LIGHT PRODUCT INTER-PADD MOVEMENTS 1985 - 1989
(Thousands of Barrels per Day)



U.S. CRUDE OIL LOGISTICS

With its large crude oil refining capacity, and the country's major reliance on imported crudes, the U.S. Gulf Coast is a major importer of foreign crude oil. Since 1986, Western Hemisphere crude oil prices are tending to equalize with Middle East crude oils delivered to the U.S. The level of imports are high enough to now permit a year round parity relationship between imported crudes and U.S. crudes, and this is expected to continue throughout the foreseeable future.

U.S. light sweet crude and light sweet imported crude from the North Sea and Africa are generally in price parity at the U.S. Gulf Coast as long as imports come into the U.S. Gulf Coast regularly. However, during the winter months when European demand is seasonally high, the parity relationship can be occasionally disrupted. North Sea crudes are currently delivered to the U.S. East Coast, the U.S. Gulf Coast, and to Eastern Canada. Similarly, Middle East and African imports also come into the same areas.

U.S. PETROLEUM PRODUCT PRICING

Crude oil price differentials, refined product prices, and the margins for different types of refinery processing tend to form an equilibrium relationship. Supply/demand for individual products, the availability of different types of refining capacity, and the supply of crude oils of varying quality grades are the important factors in determining the equilibrium relationship. The equilibrium relationships change over time as new refining facilities are built, new crude oil production is brought onstream or product demand patterns shift. Likewise in the short term, although prices may not be at equilibrium, the driving forces will restore the equilibrium pricing relationships. The development of the equilibrium price structure primarily involves determining the last increment of supply sources for major petroleum products. A source may be marginal because of its location, size, the crude oil processed, or type of processing configuration. The supply/demand analysis determines the marginal supply, and an analysis of its economics determines prices. The methodology used in developing margins, product prices and crude oil differentials is summarized below:

1. The margin of the light crude cracking refinery, the marginal producer of light products on the U.S. Gulf Coast, is forecast based on the outlook for refinery utilization.

2. The incremental return on coking is forecast based on the forecast of world conversion capacity utilization and the demand for residual fuel oil.

3. The gasoline/distillate price differential is forecast based on the demand outlook for these products and refining economics.

4. Price differentials between grades of similar products, e.g., unleaded gasoline and premium gasoline, are estimated based on refinery costs and yields.

5. Product prices are determined through an iteration process to satisfy all of the above conditions.

The overall level of refined product prices in market areas other than the U.S. Gulf Coast is a function of crude oil prices delivered to these markets and local supply/demand characteristics, including those related to the nature of the refining industry in the respective areas. These relationships apply to the international markets as well as to different U.S. areas and apply to all products. Product prices in different markets, provided there are no significant trade barriers involved, are almost always linked by logistical relationships which, on average, will not allow wide disparities for an extended period of time. When prices in one area become high enough to support physical movement from an area of lower prices, these movements will take place where feasible, and a rebalancing of market relationships will result. Also, certain structural flow patterns exist throughout the markets which maintain characteristic relationships between areas in accordance with the direction of flow and the respective costs of movement. Depending on the distance between the markets and the particular modes of transportation that must be employed, disparities between markets can often swing between fairly significant bounds. This is particularly true of isolated markets where local conditions will tend to control the short-term price movements.

As shown in Figure III-7, most of the U.S. markets are linked with the U.S. Gulf Coast. With its excess refining capacity, the U.S. Gulf Coast transports refined products by both pipeline and tanker to other markets. In major centers such as Chicago and New York, spot prices in these markets are related to U.S. Gulf Coast spot prices plus adjustments based mainly on transportation costs.

Similarly, as discussed in Chapter IV, eastern Canadian prices are also linked to product prices in Chicago, New York, and the U.S. Gulf Coast.

IV
CANADIAN MARKET

This section of the report addresses the demand for petroleum products in Canada, the supply of both domestic and imported crudes, and utilization of the Canadian industry's refining capacity. It also addresses both crude oil and petroleum products pricing in Canada.

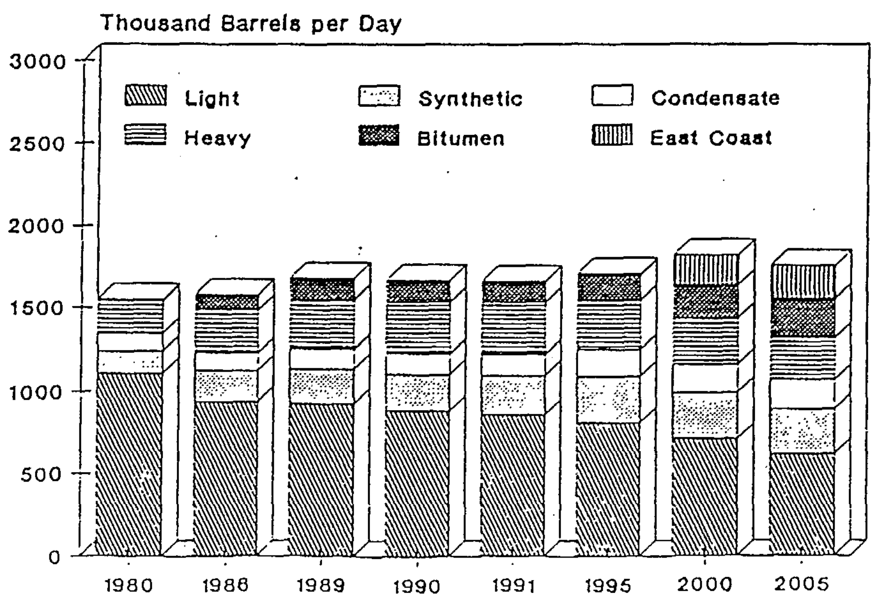
Most of the refineries in Western Canada and Ontario use primarily light sweet crude as feedstock. As Canadian light crude supplies decline, imports will have to increase to make up the deficiency. Thus, the availability of domestic light crude supplies at a competitive price is a major issue for the industry in Western Canada and Ontario. Most of the imports of crude oil into Eastern Canada are also light sweet crudes. The long term availability of offshore supplies of sweet crude at competitive prices is an equally important issue for the Eastern Canadian refineries.

CANADIAN PETROLEUM SUPPLY/DEMAND

PETROLEUM SUPPLY

Purvin & Gertz' forecast for Canadian crude oil production is shown in Figure IV-1 and detailed in Table IV-1. Canada's crude production is currently more than 1.6 million B/D, of which nearly all is produced in Western Canada. More than 50% is conventional light crude, with the rest consisting of synthetic crude, condensate and heavy crude. Conventional light crude is produced mainly in Alberta (85%), with the remainder in Saskatchewan, Manitoba, British Columbia and Northwest Territories as well as Ontario. Approximately 75% of the light crude is sweet (below 0.7% sulphur) and the remainder is sour. Conventional light crude production is declining in Alberta although production elsewhere has been steady.

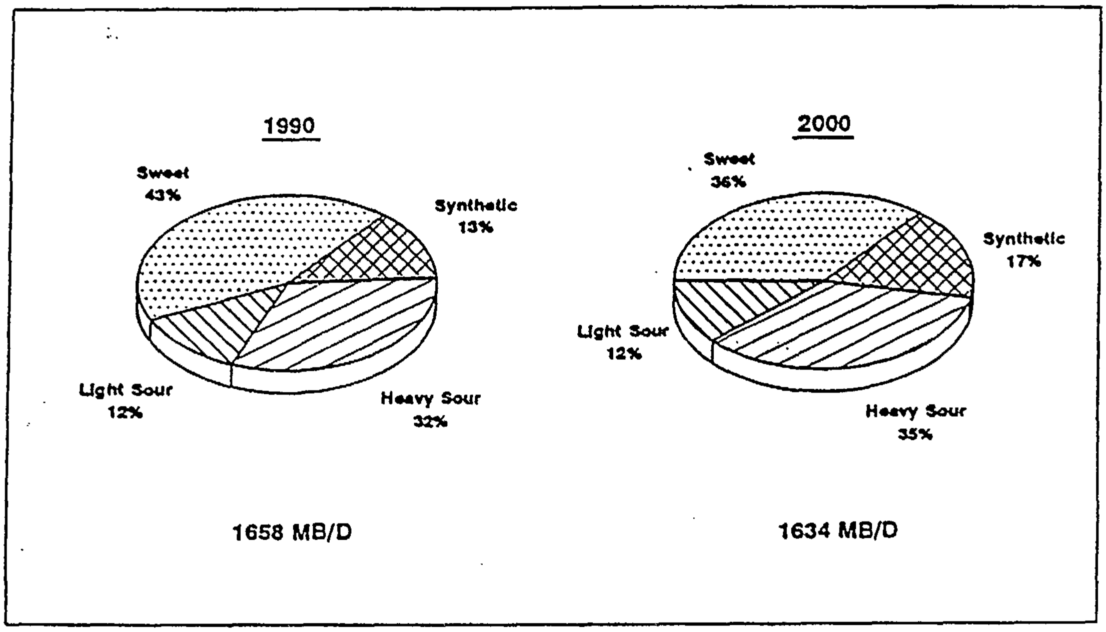
FIGURE IV-1
CANADIAN CRUDE OIL PRODUCTION



The Alberta decline slowed last year and would have been higher except that a pipeline restriction on the IPL/Lakehead pipeline system caused some crude to be shut-in. Since the pipeline tests, production has returned to higher levels and we expect light crude production to remain relatively steady with only a slight decline over the next two years. After that time, we expect production in Alberta to decline at about 3% per year. The availability of light crude is critical to the refiners' feedstocks options.

The quality of crude oil in Western Canada is expected to remain fairly constant between 1990 and 2000 with around 55% expected to be sweet crude as shown in Figure IV-2. However, the portion of synthetic crude is expected to grow and offset the decline of light conventional sweet crude from 43% to 36% of the production slate (Table IV-1). Some refiners may have difficulty processing more synthetic crude, so as conventional light sweet crude supply declines, they may be seeking more imported sweet crude to replace the declining supply of conventional light sweet crude.

FIGURE IV-2
CRUDE OIL QUALITY OF WESTERN CANADA DOMESTIC PRODUCTION



PETROLEUM DEMAND

The demand for crude oil in Canada has fallen over the last two years, primarily as a result of the economic recession. A modest recovery in product demand is forecast for 1992, with stronger increases expected in 1993 through 1995. The petroleum product demand forecast was based on an analysis of economic parameters including gross domestic product (GDP) unemployment levels, population and household trends, vehicle population and turn-over, and other econometric factors. Some structural changes in the economy were considered in the development of this forecast. Purvin & Gertz received assistance from Informetrica Limited regarding some of these parameters.

One of the key factors is GDP, and the forecast assumes a solid recovery in GDP in 1992 with a strong demand growth between 1993 and 1995 before leveling off at a slightly lower rate. The GDP growth rates used in the forecast are shown in the table below:

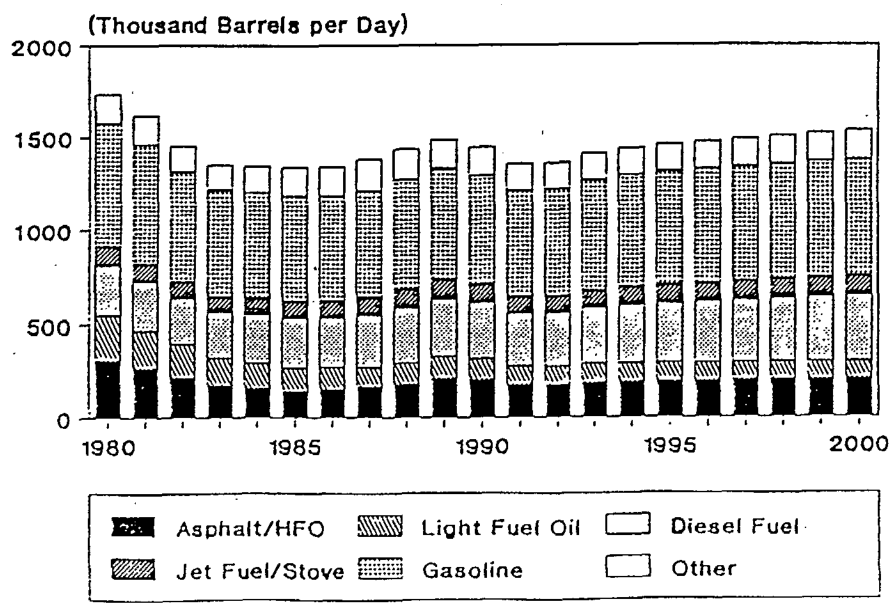
GDP GROWTH RATES
(Percent)

Year	Percent
1982-1990	2.9
1991	-0.9
1992	2.0
1993-1995	3.5
1995-2000	2.4

Purvin & Gertz recognizes that this forecast is based on petroleum product demand responses following traditional economic parameters, as has occurred historically. Although Canada's products demand has recovered in cyclical fashion in previous years following a recession, there exists some concern about whether the recovery following this current recession will be as strong as it was in previous cycles. Structural changes are occurring in the Canadian economy as Canada struggles to become more competitive in the international trading market. Also, constitutional concerns in Canada are having an impact on the economic recovery of the country, and could continue to be an irritant to a strong recovery. Although considerations were given to these structural changes, should these changes be more severe then anticipated and/or the constitutional difficulties have a more prolonged impact, it is possible that the demand recovery may occur at a slower rate than forecast. However, should the economic recovery be more robust, or the structural changes less than anticipated, demand growth would be higher than forecast in this study.

Purvin & Gertz' demand forecast for petroleum products is portrayed in Figure IV-3 for the whole country. The demand is broken down by region in Table IV-2.

FIGURE IV-3
CANADIAN PETROLEUM PRODUCT DEMAND



The resulting demand for crude oil by crude type throughout Canada is shown in Table IV-1. It is based on expected refining operations and yield of products from refineries in each region, and it assumes that the level of imports and exports will balance domestic production and demand. Atlantic refineries which have historically exported significant volumes were assumed to continue their historical level of exports.

The historical volume of product imports and exports are shown below.

CANADIAN REFINED PRODUCTS TRADE
(Thousands of Barrels per Day)

	Canada			Atlantic			Rest of Canada		
	Import	Export	Net Export	Import	Export	Net Export	Import	Export	Net Export
1986	118	147	29	31	45	14	86	102	16
1987	140	170	30	38	55	17	102	115	13
1988	153	231	78	41	125	84	113	107	-6
1989	177	214	37	55	112	57	122	102	-20
1990	143	241	98	52	134	82	91	107	16
1991	138	258	119	79	139	60	60	118	59

CANADIAN REFINING CAPACITY UTILIZATION

Refinery capacities for the Canadian industry are shown in Table IV-3. In our analysis, we have assumed that Petro-Canada's Port Moody, British Columbia and Clarkson, Ontario refineries, and Canadian Turbo's refinery at Balzac, Alberta will cease processing crude oil in 1992.

The utilization of refining capacity in Canada was quite low in 1991, at 82%. This level is much lower than the refining industry prefers to operate. In computing this utilization rate, we excluded the crude capacities of asphalt refineries, and have excluded the skimming capacity at Irving's refinery at Saint John, New Brunswick(1). Based on our forecast for crude oil demand recovering in 1993, and the shutdowns described above, the utilization rate should reach around 90% by 1993. A further shutdown of 100,000 B/D of refining capacity would increase the utilization rate to approximately 96%.

Canadian refiners exported approximately 258,000 B/D of products in 1991, which was 19% of Canadian demand. As shown in Figure IV-4, based only on meeting domestic demand, the refining industry would have operated at about 73% of capacity in 1991. The announced refinery closures should increase utilization (based on domestic demand) to close

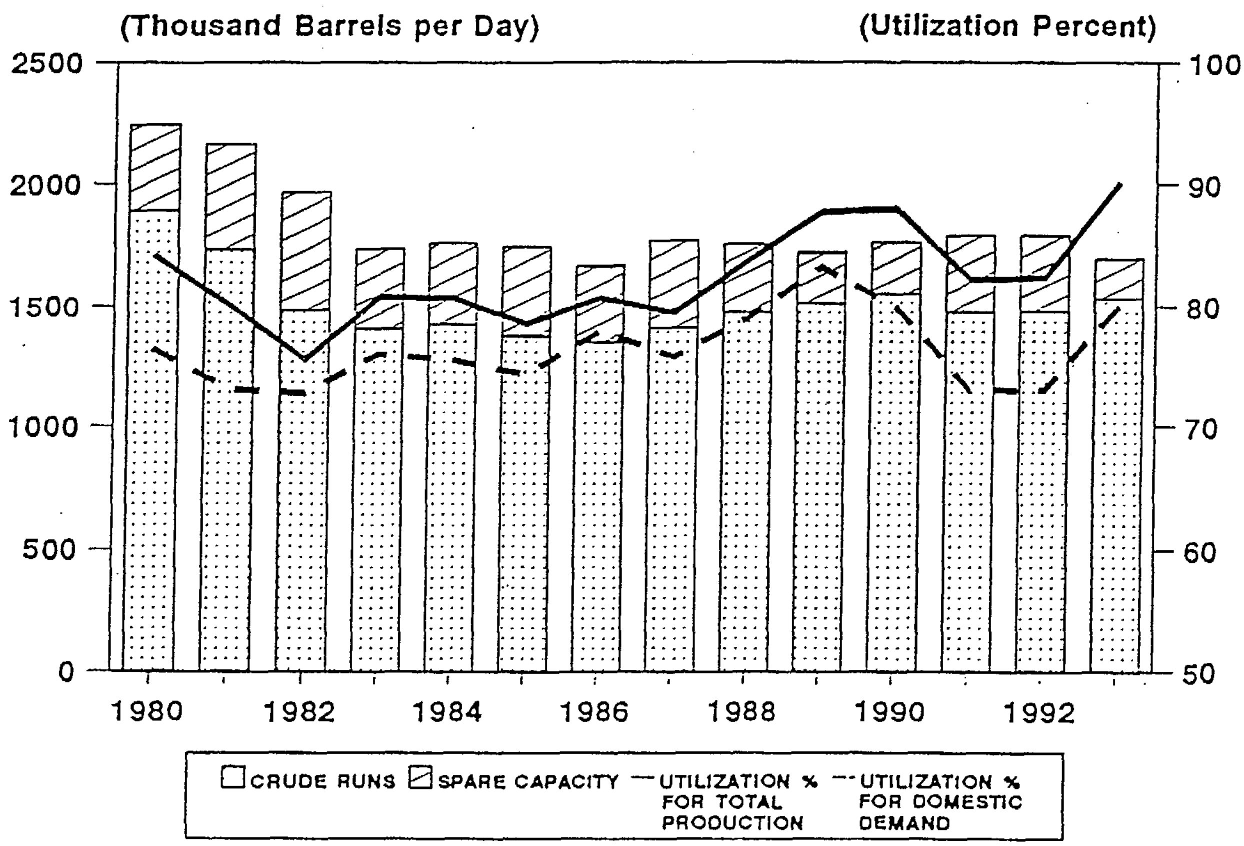
---

(1) If all of the skimming capacity is included, the utilization rate would have been less than 80%.

to 80% by 1993. If refinery capacity were reduced by another 100,000 B/D, the utilization would increase to 85% based only on Canadian domestic demand, which is about the minimum levels which the industry would deem acceptable.

Increasing refining utilization by exporting the surplus production may, however, not be as logical as it seems because it results in lowering the value of most of the production. As discussed later, this has happened in some regions and it has hurt the industry. However, it should be noted that some refineries in the Atlantic region are in a better position to capture export sales, and less vulnerable operating in an export mode than refineries in Ontario and Quebec.

FIGURE IV-4
CANADIAN REFINERY UTILIZATION RATES



The Canadian refining industry is currently considering the shutdown of additional refining capacity. Refineries in Vancouver and Ontario, and possibly in Atlantic Canada, have been identified in recent press reports as possible candidates for further rationalization. Current reviews are primarily being directed at those refineries which have high operating costs, poor economic performance or which duplicate more efficient capacity elsewhere.

REFINED PRODUCTS MARKETING

The petroleum products business involves both the refining and marketing chain, but this section of this chapter deals primarily with the movements and marketing of products from the refinery to the end customer.

DISTRIBUTION OF PRODUCTS

The distribution of refined products can be divided into two stages. The first stage involves the movement of product from refineries to terminals where product is stored until the final distribution to customers. Transportation is accomplished primarily by barge, tanker and product pipelines from the refineries to various terminals. The product distribution from these primary terminals, or into secondary terminals such as bulk plants, is usually shipped by truck from refineries or the major terminals. Bulk plants usually service rural or remote customers.

The second stage of distribution occurs from bulk plants or terminals to the actual customers. These customers can be service stations, wholesale customers, and other distribution facilities such as cardlock outlets. Products are normally moved by truck to these various locations.

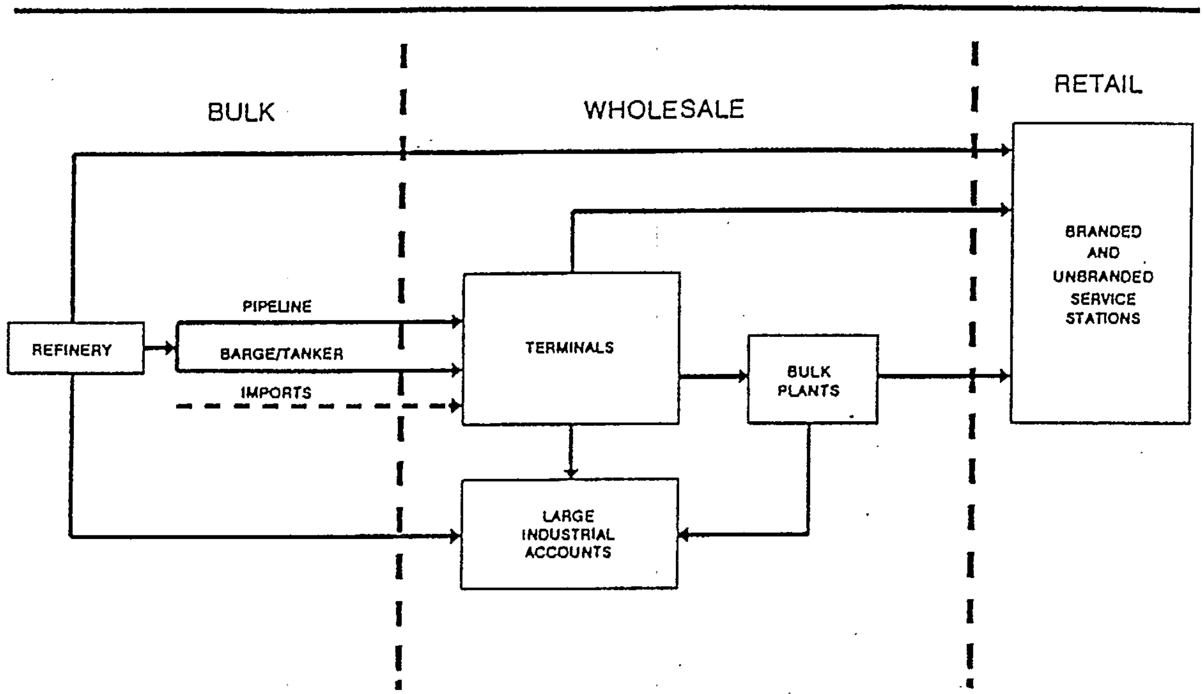
DESCRIPTION OF CLASSES OF TRADE

The primary classes of trade which exist within the marketing structure of petroleum products such as gasoline and diesel fuel are as follows:

1. Bulk
2. Wholesale, and
3. Retail.

These classes of trade are depicted in Figure IV-5 below:

FIGURE IV-5
PETROLEUM CLASSES OF TRADE



Bulk Sales

Bulk sales are characterized as direct sales of petroleum product from refineries in significant quantities. In the U.S., it is generally considered that bulk sales are in quantities of 20,000 barrels or larger. Such deliveries are usually made by pipeline, but sometimes a shipment is made from the terminals direct to an end-user's storage facilities. Most often, customers within this class of trade are other refiners who need incremental supplies of product, but they can also include large independent marketers or large end-users. Contrary to bulk sales, volumes from bulk plants as shown above in Figure IV-5 are smaller and are usually sold to rural or remote customers.

Wholesale

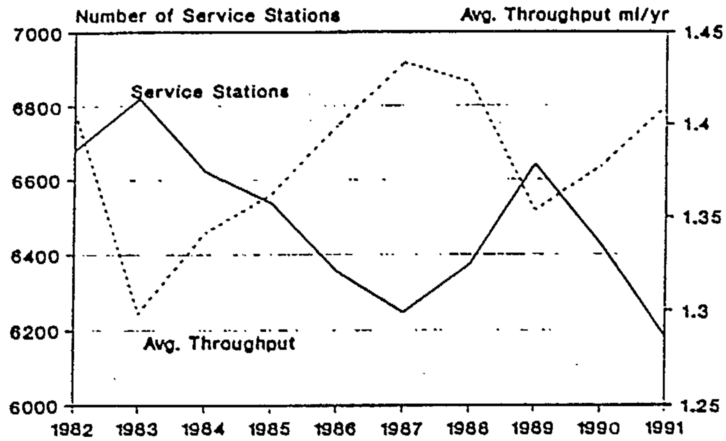
The wholesale class of trade is characterized by product sales from the terminal or bulk plant facility. Sales are usually made in truck size deliveries. As discussed above, contracts can vary from months to several years for this class of trade. Prices for these products will be based on contractual arrangements depending on the type of customer. The typical customers in this class of trade include wholesale distributors or jobbers, industrial end-users, large commercial or institutional end-users, and independent service station retailers.

Retail

The retail class of trade consists primarily of sales made through service stations to the motoring public. The retail operator may be an independent entity with its own brand (commonly referred to as an unbranded jobber), an operation aligned with a major oil company (a branded dealer), or a refiner/marketer (a company owned and operated outlet).

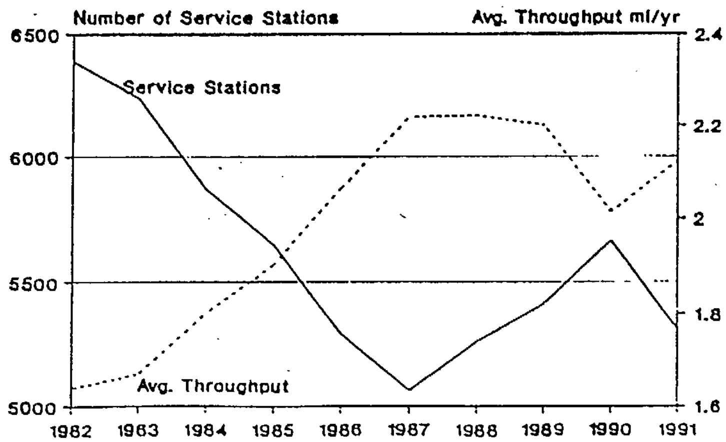
The number of retail stations in Canada has been declining in order to increase the volume throughput per outlet. In 1991, as shown in Table IV-4, the number of retail outlets in Canada was around 18,800. Utilization rates of Canadian retail stations are shown in Figures IV-6 to IV-9. Canadian throughput volumes are still much lower than in the U.S., as discussed in Chapter V, and Canadian companies are planning to further reduce the number of outlets in the next several years.

FIGURE IV-6
WESTERN CANADA'S SERVICE STATION POPULATION
THROUGHPUT TRENDS



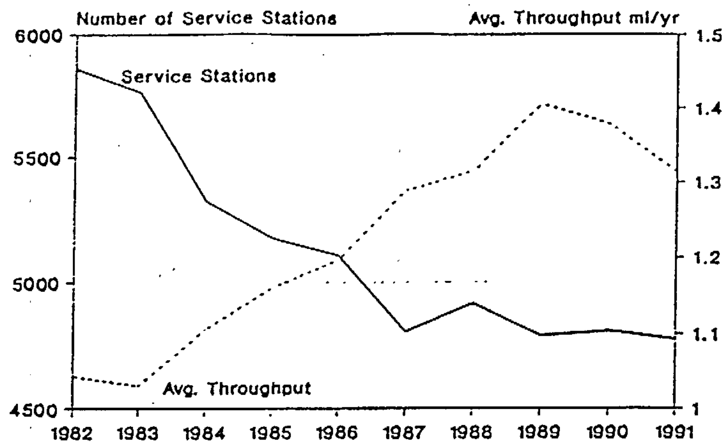
Source: Oilweek, Octane
Statistics Canada #45004

FIGURE IV-7
ONTARIO'S SERVICE STATION POPULATION
THROUGHPUT TRENDS



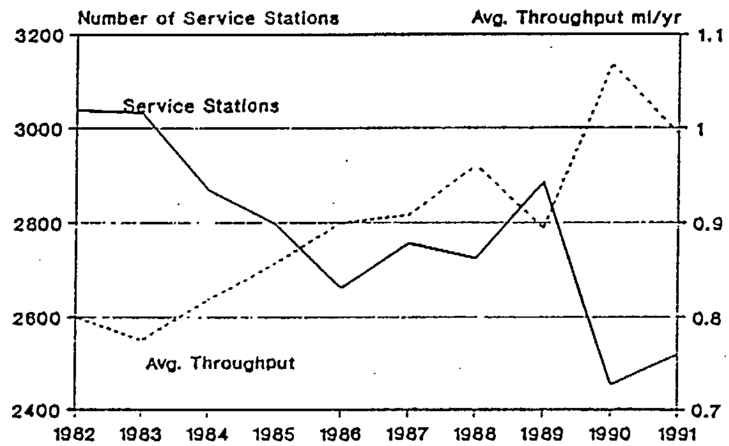
Source: Oilweek, Octane
Statistics Canada #45004

FIGURE IV-8
QUEBEC'S SERVICE STATION POPULATION
THROUGHPUT TRENDS



Source: Oilweek, Octane
Statistics Canada #45004

FIGURE IV-9
ATLANTIC'S SERVICE STATION POPULATION
THROUGHPUT TRENDS



Source: Oilweek, Octane
Statistics Canada #45004

Convenience Stores

In the U.S. during the late 1970's and early 1980's, convenience stores which sold gasoline began to increase dramatically. Traditional C-Store companies like 7-Eleven and Circle-K were the prime movers behind this trend, and then the major oil companies followed with similar stores. In the U.S., stand-alone C-Stores are now closing while oil companies continue to expand their C-Stores. C-Stores marketing is very attractive to oil companies because it attracts new customers through the store's merchandise. The merchandise sales itself generates attractive margins, and the revenues and profits of C-Store operations are much less volatile than if they relied strictly on gasoline.

In Canada, we have followed the same trend although we have lagged by a number of years. Although we did not see the same development of gasoline retailing at C-Stores initially as was seen in the U.S., the oil companies have recently expanded rapidly with C-Stores throughout Canada. Some have their own operations, while others involve a joint venture between the oil company and the C-Store. One of the attractions of C-Stores is that they allow a reduction in marketing overhead costs attributable to gasoline sales.

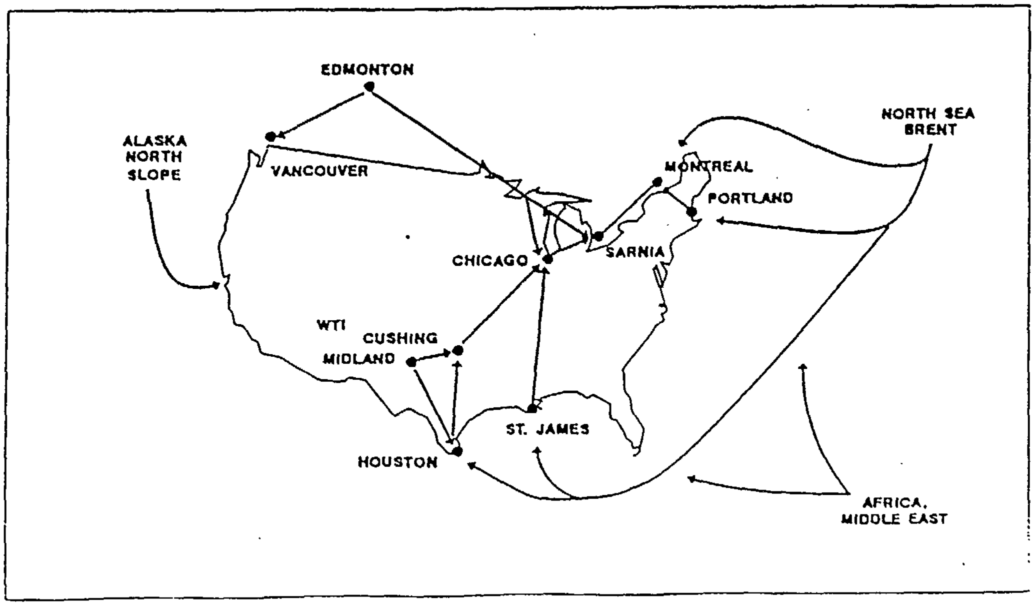
CANADIAN CRUDE OIL PRICING

Since crude oil prices were decontrolled in 1985, Canadian crude oil prices have been established by the world crude oil market. Canadian crudes serve the domestic market in Canada and the northern border markets in the U.S. The prices of competitive crude oils serving these markets are largely determined by crude oil and product prices in the major U.S. Gulf Coast and European markets. The analysis of the prices for Canadian crude oils is separated into light sweet, light sour, and heavy crude oils.

The Chicago market is a major clearing point for incremental crude produced in Canada. Although other centers such as Minneapolis and Detroit are also supplied with Canadian crude, Chicago tends to be the center where Canadian and U.S. crudes compete directly for market share. Canadian light crude is compared to WTI because it is a widely traded crude oil with excellent price transparency, and is of similar quality.

As discussed in Chapter III, Canada is directly impacted by international crude oil market pressures. Eastern Canada (Quebec and the Atlantic Provinces) is readily served by imported crudes. Refineries in Ontario and Western Canada use domestic crude, but the Ontario market currently obtains some imported supplies from the U.S. or through the U.S. Gulf Coast, although there are discussions underway to reverse the Sarnia/Montreal pipeline to permit imported crude to be shipped via Portland and Montreal into Ontario. If this reversal proceeds, it will increase the flexibility of delivering foreign crude into Ontario.

FIGURE IV-10
LIGHT CRUDE LOGISTICS



Imported crude into Ontario could also be delivered by U.S. pipeline systems (Figure IV-10). The primary route from St. James, Louisiana to Chicago is efficient but is close to operating capacity. Once this line is full, incremental imports into the Chicago area or into Ontario must be shipped via Cushing, Oklahoma which is a more costly transportation route. The cost of crude oil delivered into Chicago by this more expensive route could be as much as 50 cents U.S./B more than by delivering directly from St. James.

Since Canadian crude prices are directly related to U.S. crude prices at Chicago, any increase in U.S. domestic crude oil price is immediately reflected in an increase in Canadian crude prices.

As the availability of Oklahoma crude oil continues to decline, Texas crudes such as WTI will be more highly sought after by Mid-Continent refiners, and this will force refineries at both Chicago and the U.S. Gulf Coast to increase their reliance on imported crude. Canadian crude already is tied to the imported parity price of foreign crude delivered to Chicago for parts of the year, and to WTI at other times, depending on the various seasonal demand pressures. Within several years, we believe that Canadian prices will be tied to imported crudes delivered to Chicago as long as the pipelines to the U.S. Midwest from the U.S. Gulf Coast are not at capacity. If imports start flowing through Cushing to Chicago with a much higher tariff, this will increase the price of Canadian crude, and Chicago refiners should be willing to pay close to Cushing parity for Canadian crude. This could increase the price of crude oil in Chicago and in Toronto assuming that no imports come via Montreal and Portland. Thus, Canadian refiners in Ontario and Western Canada are vulnerable to paying higher prices for Western Canadian crude because of the bottlenecks in the U.S. pipeline systems. This is an important factor which could negatively influence the profitability of the Western Canadian and Ontario refining industry.

Historical prices and forecast values of Canadian crudes are compared in Table IV-5 against appropriate marker crudes using refining economics and product pricing at Chicago. At Chicago, Canadian light crude (Alberta Mixed Blend) competes against other light crudes delivered to Chicago including WTI and North Sea crudes (i.e. Brent). Canadian heavy crudes are compared with imported heavy crudes to the Chicago areas as well. Cold Lake Blend sometimes competes with imports of heavy Maya crude from Mexico.

The price of Mixed Blend has been close to WTI spot prices at Chicago, and we expect this to continue for several more years. However, by the mid-1990's, when the available West Texas crudes are needed by refineries in Oklahoma, WTI will not likely reach Chicago on an ongoing basis. Instead, foreign crudes such as North Sea (i.e. Brent) will likely become the light marker crude in Chicago.

Heavier crudes also compete against the delivered cost of Mixed Blend as well as similar crudes from the U.S. and offshore. We evaluate Canadian heavy crude prices relative to Mixed Blend and light sour crude on a cracking basis. Price differentials between heavy and light crudes will be established such that they continue to provide refineries with an incentive to process the sour and heavier crudes.

The prices of crude oils delivered to Ontario and Quebec are also shown in Table IV-5 for comparison purposes. The price of foreign light crude in Montreal compared to the price of Mixed Blend delivered to Ontario provides the Montreal refiners with a crude oil cost advantage. If the Sarnia to Montreal pipeline is reversed using an attractive tariff, Ontario refiners could see a reduction in the price of light crude oil in Ontario.

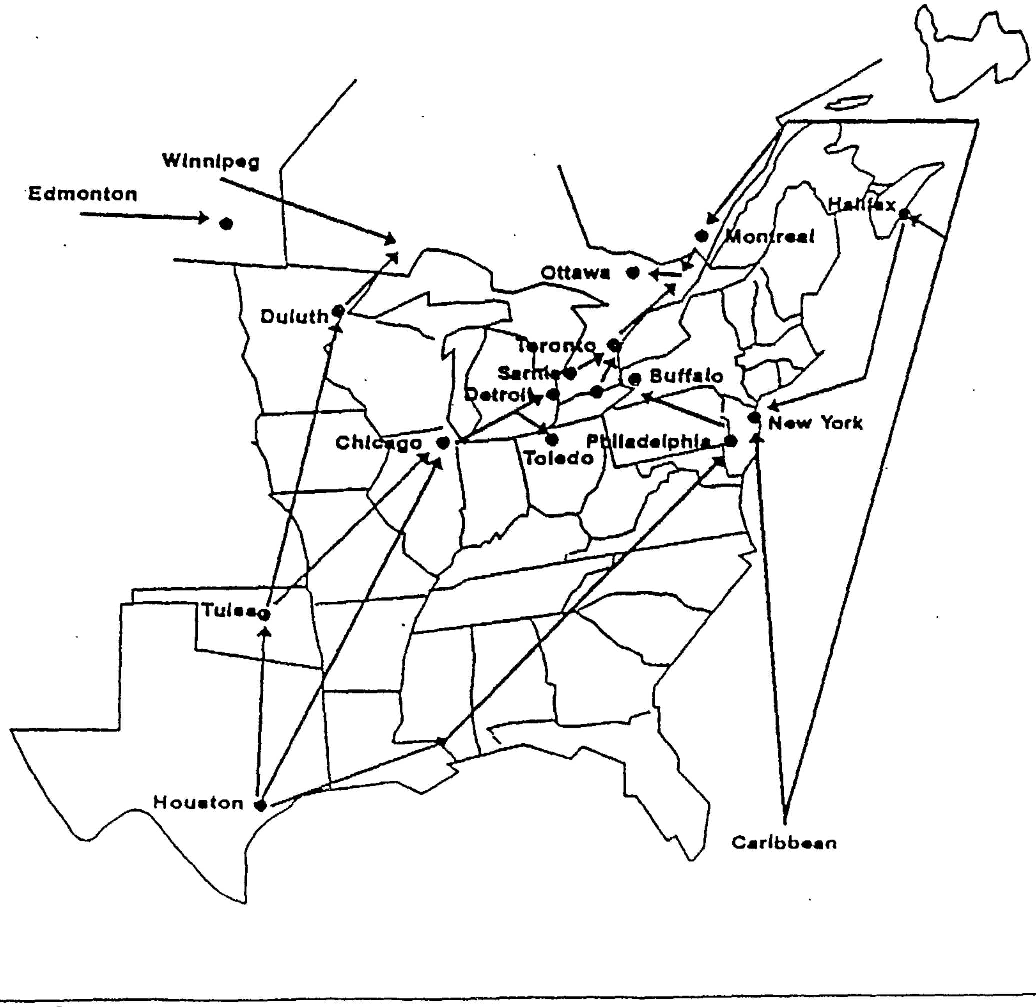
CANADIAN PETROLEUM PRODUCT PRICING

Generally, the industry refers to two levels of petroleum product pricing: (1) pricing at the wholesale level (at the terminal or refinery gate), and (2) prices at the customer level. The wholesale level of pricing refers primarily to the value of the petroleum products at the outlet of the refinery before any marketing costs are incurred. Product prices at the consumer level include marketing and distribution costs.

WHOLESALE PRICES

Canadian wholesale product prices are closely tied to product prices in the U.S. market. As shown in Figure IV-11, U.S. markets close to the eastern Canadian industry are linked to U.S. Gulf Coast product prices by product transportation costs.

FIGURE IV-11
EASTERN SPHERE WHOLESALE PRODUCT PRICING MECHANISM



Wholesale levels of pricing in Canada are not as transparent as they are in the U.S. Particularly in the U.S. Gulf Coast, and to some degree in New York and Chicago, spot petroleum product prices are well established. The spot trade has developed over the years, and the volumes and prices of such trades are monitored closely by the industry. Marketing businesses often value petroleum products at the spot price as their cost of supply, whether purchased from their own refineries or from the open market. Therefore, refining economics are usually based on product prices that are achieved in the spot market.

Canada has a much smaller market than the U.S., and a much lower and much less visible spot trade segment. Generally, the Canadian industry posts rack prices, although there has been some variation in wholesale prices at the rack level, depending on the size of the customer. For the larger companies in Canada, import parity pricing is often used as a comparison for wholesale prices in Canada. There are a number of large, well established independent marketing companies operating in Ontario and Quebec, and to some degree in other provinces. Some of these companies have import marine capabilities, as well as the ability to ship product by tanker truck from the U.S. Thus wholesale prices in Ontario and Quebec reflect product prices in adjacent U.S. markets adjusted for transportation costs. For Toronto, wholesale prices for large customers closely approximate Buffalo prices adjusted for transportation. In the Windsor-Sarnia area, wholesale prices are influenced by Detroit prices adjusted for transportation.

Wholesale prices of products in Eastern Canada are linked to U.S. Gulf Coast product prices, as is shown in Figure IV-11. Buffalo products are received by pipeline from refineries or terminals in the New York-New Jersey-Philadelphia area. Detroit products are supplied by local refineries and by pipeline from Chicago based refineries. Products in Chicago and New York compete with supplies delivered from the U.S. Gulf Coast.

In Quebec, wholesale prices relate strongly to spot product prices in New York adjusted for transportation. Since petroleum products are shipped by pipeline or by tanker from the Gulf Coast to New York, New York spot product prices are closely linked to spot prices at the U.S. Gulf Coast.

Wholesale prices in Ontario and Quebec tend to be higher when exports of products from Canada are low. As has been experienced frequently, higher volumes of product are being exported from these provinces and the price of the marginal product barrel becomes the price in the U.S. market less transportation. This reduces the wholesale price in Ontario and Quebec.

The Atlantic Provinces' wholesale prices also have a relationship with spot prices on the U.S. East Coast.

In Western Canada, petroleum product prices at the wholesale level also have a relationship to prices of petroleum products in the U.S. Midwest, but are less direct than in Ontario and Quebec. Changes in product prices more closely follow changes in crude prices, as the impact of U.S. product prices are not as strong. Because of the greater distances between customers in the Prairies and refineries in the U.S., import competition is not as direct, but it still influences the framework for refining economics in the region. Product prices in British Columbia tend to be related to Edmonton prices simply because a large amount of its product is refined in Edmonton and transported to British Columbia.

Similarly, British Columbia refineries process Western Canadian crude oils. However, product prices offshore British Columbia tend to be lower primarily because of the lower priced Alaska North Slope (ANS) crude which is refined extensively throughout the PADD V market. The influence of U.S. product prices is still evident on the West Coast of British Columbia, but is somewhat limited because the Puget Sound refineries are operating at capacity, and the British Columbia refineries are not equipped to process ANS crude.

In Table IV-6, petroleum refining gate product prices in Toronto and Montreal are provided based on product prices in Chicago, New York, and the U.S. Gulf Coast.

CONSUMER PRICES

Retail prices of gasoline in Canada are 40% to 50% higher than U.S. retail prices. The primary difference is the amount of tax on Canadian gasoline as depicted in Figure IV-12 and IV-13 which presents average Canadian and U.S. prices. In 1991, the average tax in Canada was 25¢ per litre, while in the U.S. it was 10¢ per litre. Prices closer to the Canadian border are slightly higher than the U.S. average.

FIGURE IV-12
REGULAR UNLEADED GASOLINE PRICES
CANADA VS U.S. EXCLUDING TAX

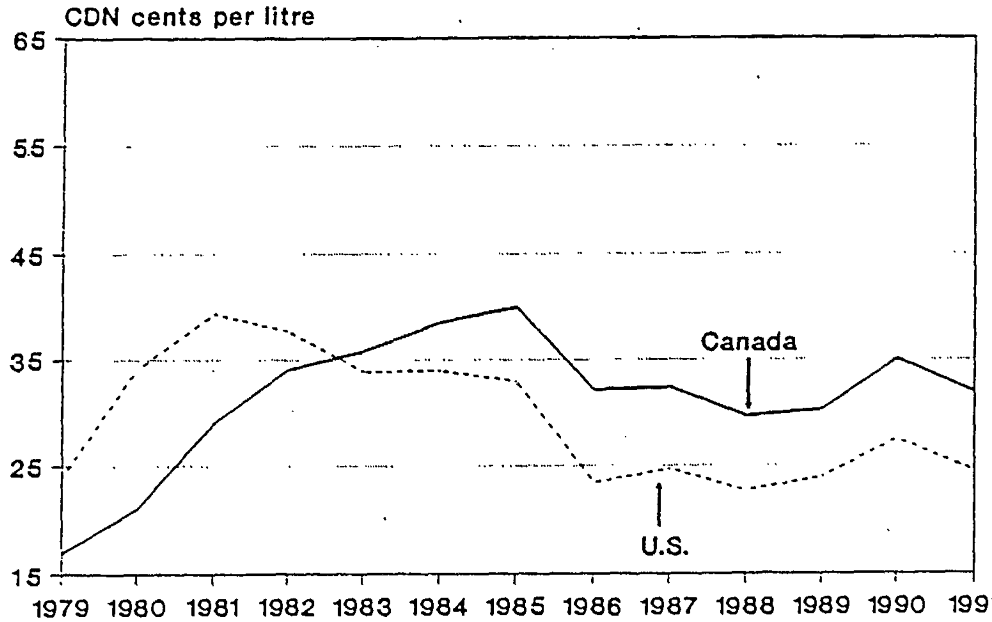
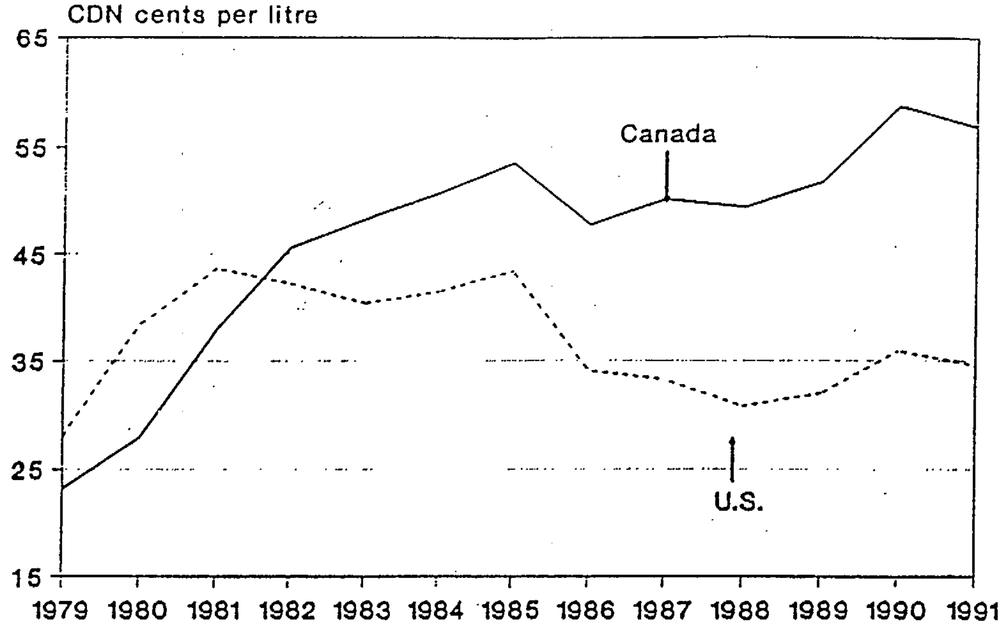


FIGURE IV-13
REGULAR UNLEADED GASOLINE PRICES
CANADA VS U.S. INCLUDING TAX

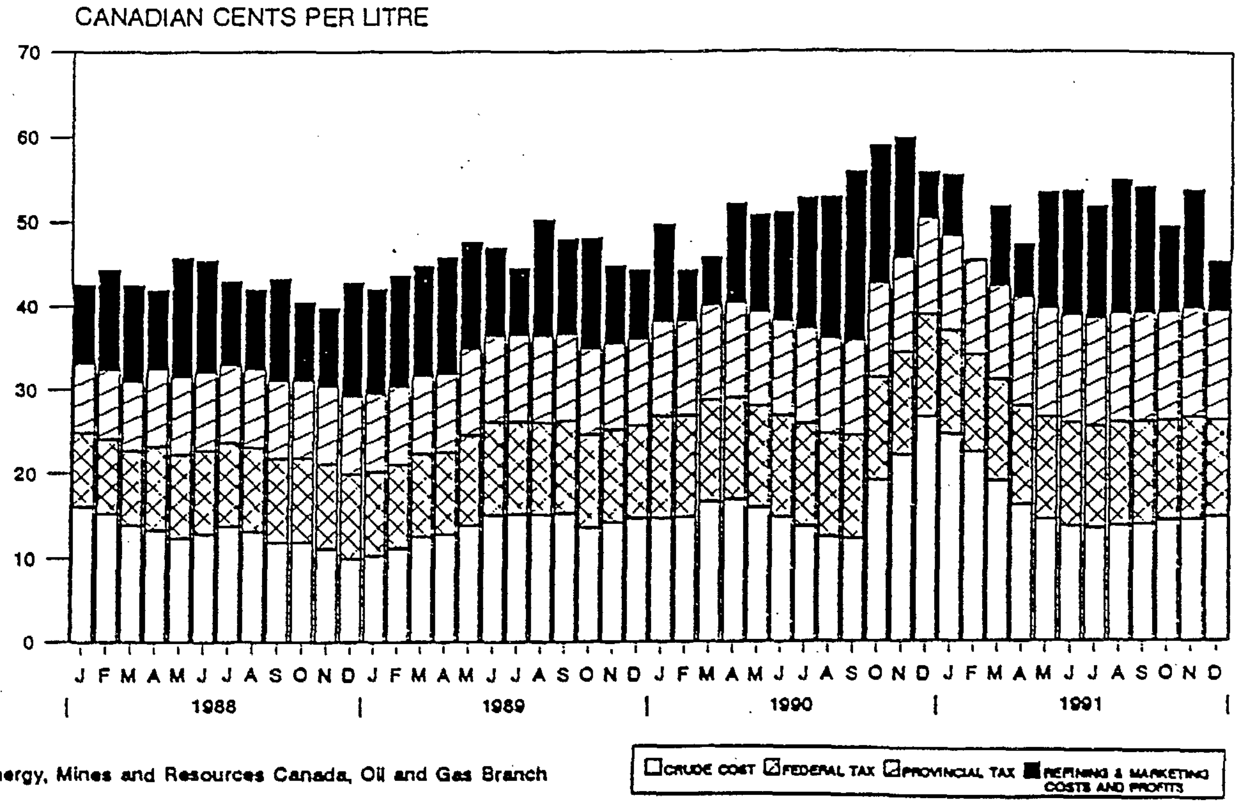


The components of retail prices for gasoline are shown in Figure IV-14 for Ontario. These components are also compared below for Ontario, Quebec and Alberta:

COMPONENT PORTIONS OF UNLEADED GASOLINE IN 1991
(Cents per Litre)

	Ontario	Quebec	Alberta
Federal Tax	12.1	12.4	11.6
Provincial Tax	12.6	16.8	8.5
Total Tax	24.7	29.2	20.2
Crude Cost	16.1	16.9	14.6
Refining and Marketing Margin	10.4	14.1	10.0
Dealer Margin	3.5	4.2	3.7
Total	54.7	64.4	48.4

FIGURE IV-14
AVERAGE RETAIL PRICE OF REGULAR UNLEADED GASOLINE
ONTARIO



Source: Energy, Mines and Resources Canada, Oil and Gas Branch

Governments in Canada are extracting significant revenue from the sale of petroleum products. It is very easy to add a small tax to gasoline, and because of normal price dynamics in the marketplace, the consumer is hardly aware when governments increase such taxes. However, and unfortunately, taxes have continued to be added to the price such that they are now the biggest cost component in gasoline. In Ontario in 1991, taxes represented 45% of the retail price of gasoline. Crude oil costs were only 29% of the retail price.

The tax burden is working against both the consumer and the refining and marketing industry. Taxes are applied to petroleum products as if they were luxury items, or injurious to one's health (i.e. tobacco), rather than essential products. This is a major problem along the U.S. border where shippers who live in border communities are buying more gasoline in the U.S. Oil companies are experiencing significant losses in sales in southern Ontario and in Vancouver due to cross border shopping.

TABLE IV-1

CANADIAN CRUDE SUPPLY/DEMAND BY TYPE
(Thousands of Barrels per Day)

	Historical							Forecast													
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CANADIAN CRUDE SUPPLY																					
Western																					
Light Sweet Conventional	802	754	778	794	735	684	663	653	650	631	614	597	580	564	549	534	514	495	477	459	442
Condensate	52	36	28	24	33	28	33	36	49	58	60	60	64	63	62	60	62	65	64	62	60
Synthetic	168	184	181	201	206	217	237	240	264	274	278	280	280	280	280	280	280	280	280	280	280
Light Sour	207	186	183	192	194	202	214	214	214	210	206	202	199	195	192	188	184	179	174	170	166
Beaufort Sea	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Heavy	276	281	304	320	324	340	345	344	334	326	324	320	316	311	307	303	297	291	285	279	273
Bitumen Blend	69	129	160	179	179	187	178	182	191	200	210	222	230	242	255	269	269	277	289	302	315
Subtotal Western	1574	1570	1634	1708	1671	1658	1660	1669	1701	1700	1692	1681	1669	1657	1645	1634	1606	1586	1569	1552	1537
East Coast	0	0	0	0	0	0	0	7	20	20	20	20	20	25	67	110	110	110	110	176	185
Total Domestic	1574	1570	1634	1708	1671	1658	1660	1677	1721	1720	1712	1701	1689	1681	1712	1744	1715	1697	1679	1729	1722
CRUDE DEMAND IN CANADA																					
Western Canada/Ontario																					
Domestic																					
Light Sweet Conventional	604	575	589	584	587	541	505	476	461	466	471	483	476	475	477	459	459	432	406	380	365
Condensate	21	22	20	23	24	22	26	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Synthetic	138	151	153	159	163	163	170	177	206	218	228	232	233	235	236	237	238	240	241	242	243
Light Sour	82	76	76	73	64	107	103	103	101	98	98	98	98	98	98	98	98	98	98	98	98
Frontier	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Heavy	67	41	41	48	56	63	53	67	75	84	85	86	87	88	89	90	91	91	92	93	93
Bitumen Blend	9	27	42	37	49	47	45	47	47	47	47	48	60	64	67	69	69	82	86	80	91
Subtotal Domestic	923	892	921	925	942	942	901	893	915	939	954	971	979	984	991	977	980	968	947	926	905
Import																					
Light Sweet	19	22	16	13	28	17	3	10	15	15	15	15	15	15	15	35	40	60	89	117	146
Light Sour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heavy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Import	19	22	16	13	28	17	3	10	15	15	15	15	15	15	15	35	40	60	89	117	146
Total Demand	942	914	937	938	970	959	905	903	930	954	969	986	994	999	1006	1012	1020	1028	1036	1043	1061
Total Light Sweet	783	770	777	779	801	743	704	687	706	724	738	754	748	749	752	755	761	756	759	764	769
Total Light Sour	82	76	76	73	64	107	103	103	101	98	98	98	98	98	98	98	98	98	98	98	98
Total Heavy	77	68	83	86	105	110	98	114	123	132	133	134	147	152	156	159	160	174	178	182	184

Cont'd . . . .

TABLE IV-1
(Continued)

CANADIAN CRUDE SUPPLY/DEMAND BY TYPE
(Thousands of Barrels per Day)

	Historical							Forecast													
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2006
Quebec/Atlantic																					
Domestic																					
Light Sweet Conventional	114	66	43	61	40	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Condensate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synthetic	6	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Light Sour	24	18	18	18	18	30	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frontier	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	40	40	40	40	70	70
Conventional Heavy	12	13	18	18	27	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bitumen Blend	0	3	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Domestic	157	103	84	104	85	75	13	0	0	0	0	0	0	0	20	40	40	40	40	70	70
Import																					
Light Sweet	158	217	284	340	346	401	391	400	400	400	400	400	400	400	380	360	333	302	274	215	187
Light Sour	41	61	60	56	76	87	85	87	90	98	104	105	107	108	109	110	138	171	201	230	260
Heavy	65	53	45	40	37	31	67	64	67	71	72	74	75	77	79	80	82	83	85	86	88
Subtotal Import	264	332	389	436	459	519	543	550	558	569	577	579	582	585	568	551	553	556	559	531	534
Total Demand	421	435	473	540	544	594	556	550	558	569	577	579	582	585	588	591	593	596	599	601	604
Total Light Sweet	278	287	330	404	386	420	391	400	400	400	400	400	400	400	400	400	373	342	314	285	257
Total Light Sour	65	79	78	74	94	117	98	87	90	98	104	105	107	108	109	110	138	171	201	230	260
Total Heavy	77	69	66	62	64	57	67	64	67	71	72	74	75	77	79	80	82	83	85	86	88
CANADIAN CRUDE EXPORTS																					
Light Sweet Conventional	84	112	146	149	108	124	148	177	189	165	143	114	104	89	72	75	55	63	71	79	87
Condensate	30	13	8	0	9	6	7	12	25	34	36	36	40	39	38	36	38	41	40	38	36
Synthetic	23	30	25	39	43	54	67	63	58	56	49	48	47	46	44	43	42	41	39	38	37
Light Sour	101	92	89	101	112	66	98	111	113	112	108	104	101	97	94	90	85	81	76	72	68
Frontier	0	1	0	0	0	0	0	7	20	20	20	20	20	25	47	70	70	70	70	106	115
Conventional Heavy	196	228	244	253	241	253	292	277	259	242	238	234	228	223	218	213	206	199	192	186	179
Bitumen Blend	60	99	116	137	130	141	135	137	145	155	165	176	172	180	191	202	201	196	205	215	226
Total	493	575	629	679	644	643	748	785	808	783	760	732	713	699	703	729	698	691	694	734	749
Light Sweet	137	156	180	188	160	184	223	259	291	275	249	218	211	199	201	224	205	214	220	262	276
Light Sour	101	92	89	101	112	66	98	111	113	112	108	104	101	97	94	90	85	81	76	72	68
Total Heavy	256	327	360	391	371	394	427	415	404	397	404	410	401	403	409	414	407	396	397	401	406
Net Heavy	256	327	360	391	371	394	427	415	404	397	404	410	401	403	409	414	407	396	397	401	406

TABLE IV-2

CANADA REFINED PRODUCT DEMAND
(Thousands of Barrels per Day)

	Historical												Forecast					
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000	2005
WESTERN CANADA																		
Gasoline	228	226	213	205	200	197	195	195	197	199	194	188	189	195	199	202	209	209
Jet Fuel/Stove	40	41	37	33	33	34	34	34	37	39	38	35	35	37	38	38	41	44
Diesel Fuel	130	125	117	117	121	127	121	126	130	134	133	127	128	133	136	140	158	175
LFO	24	19	19	15	14	13	12	11	12	12	12	11	11	11	10	10	10	10
Heavy Fuel Oil	27	30	27	18	15	14	16	17	18	20	23	22	17	15	15	15	15	15
Asphalt	23	22	18	18	15	18	19	19	16	18	19	16	17	18	18	19	20	22
Other (1)	32	33	33	28	29	29	31	40	36	36	36	37	31	33	33	34	36	38
Total	503	496	464	435	426	433	427	443	445	458	454	435	428	440	449	457	488	513
ONTARIO																		
Gasoline	229	222	207	202	203	204	207	211	218	224	216	214	216	223	226	229	236	236
Jet Fuel/Stove	29	26	24	23	25	27	27	28	31	30	27	25	25	27	28	29	31	33
Diesel Fuel	58	58	56	61	66	67	68	72	77	77	75	70	70	74	76	78	86	91
LFO	84	67	58	46	44	40	38	32	35	34	31	29	28	29	28	27	24	22
Heavy Fuel Oil	49	44	25	24	22	15	20	21	24	26	32	19	19	22	23	24	24	24
Asphalt	14	13	12	12	12	12	14	15	13	15	11	9	10	12	12	13	14	16
Other (1)	74	75	66	67	74	87	94	86	83	81	85	81	79	80	81	82	88	95
Total	537	506	447	435	446	451	467	466	481	487	477	447	447	466	475	482	503	516
QUEBEC																		
Gasoline	150	141	122	117	116	117	117	118	122	128	125	119	119	123	125	126	129	127
Jet Fuel/Stove	23	19	18	16	17	17	18	19	21	21	21	17	17	18	20	20	21	22
Diesel Fuel	46	46	37	37	41	41	43	46	52	55	51	49	50	53	55	56	63	69
LFO	90	76	69	57	49	45	42	36	38	40	36	32	32	33	33	32	27	23
Heavy Fuel Oil	101	89	74	57	48	34	33	28	37	48	46	37	37	39	40	40	45	42
Asphalt	12	11	9	10	10	11	11	14	12	13	13	11	11	12	13	13	15	16
Other (1)	44	42	35	34	32	29	23	34	36	29	21	20	18	18	18	18	19	20
Total	466	423	365	328	314	294	288	296	318	333	314	284	284	296	303	306	318	318

TABLE IV-2 (Continued)

CANADA REFINED PRODUCT DEMAND
(Thousands of Barrels per Day)

	Historical												Forecast					
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000	2005
ATLANTIC																		
Gasoline	56	53	50	47	47	47	47	48	50	49	50	48	48	50	51	52	55	56
Jet Fuel/Stove	13	12	11	11	11	11	11	11	11	12	12	11	11	12	12	12	12	13
Diesel Fuel	25	25	24	25	26	26	25	27	29	30	31	31	32	33	34	34	38	42
LFO	40	34	33	29	29	29	28	28	30	31	32	29	29	31	31	31	31	31
Heavy Fuel Oil	84	60	54	37	40	38	41	53	60	76	66	63	64	69	70	71	76	83
Asphalt	5	4	3	4	4	5	4	4	5	5	5	5	5	5	5	5	6	7
Other (1)	5	4	4	4	5	5	6	7	7	7	8	6	10	10	10	10	11	12
Total	228	193	178	156	161	161	161	178	191	210	204	194	199	210	213	216	229	242
CANADA																		
Gasoline	663	642	591	572	566	565	566	573	587	600	585	569	573	592	601	610	628	628
Jet Fuel/Stove	105	98	91	83	86	89	89	93	100	103	98	87	88	93	97	98	104	112
Diesel Fuel	258	254	234	240	254	261	258	272	287	296	290	277	281	292	301	310	346	377
LFO	238	197	180	147	136	127	121	108	114	118	111	100	100	103	102	100	91	85
Heavy Fuel Oil	261	224	180	137	124	101	109	118	140	170	166	141	137	145	148	150	160	163
Asphalt	54	50	42	43	41	46	47	52	47	50	48	41	43	47	49	50	55	61
Other (1)	154	154	138	133	139	150	153	167	162	152	151	144	138	141	142	144	153	164
Total	1,733	1,618	1,455	1,354	1,347	1,339	1,344	1,383	1,436	1,489	1,449	1,359	1,358	1,411	1,440	1,461	1,538	1,589

Note: (1) Other includes petrochemical feed, naphtha specialties, lubricants, coke, LPG and still gas.

TABLE IV-3

CANADA 1991 REFINERY CAPACITIES
(Thousand Barrels per Calendar Day Unless Noted)

Company	Location	Crude Capacity Effective	Crude Capacity Nameplate	Vac. Dist'n	Cat. Reform.	BTX	Isom.	Poly.	Alky.	Cat. Crack.	Hydro-Crack.	Vis. Break.	Coker	Asphalt	Lube	Dist. Hydro-Treat.	H2 MMSCFD	Sulphur t/d
BRITISH COLUMBIA																		
Chevron	North Burnaby	45.00	45.00	9.40	10.00	-	-	.60	2.00	13.00	-	-	-	-	-	-	-	10
Husky Oil	Prince George	9.50	9.50	3.80	1.40	-	.65	.90	-	3.30	-	-	-	1.30	-	4.85	-	-
Imperial	Ioco	44.20	44.20	24.20	6.70	-	-	1.80	-	13.10	-	-	-	.50	-	9.00	-	20
Petro-Canada	Port Moody	25.50	37.20	11.20	8.60	-	-	1.40	-	12.30	-	-	-	-	-	14.10	-	25
Shell	Burnaby	24.00	24.00	7.00	3.60	-	-	.72	-	6.10	-	-	-	2.90	-	9.90	-	15
Total B.C.		148.20	159.90	55.60	30.30	-	.65	5.42	2.00	47.80	-	-	-	4.70	-	37.85	-	70
PRAIRIE PROVINCES & NWT																		
Alberta																		
Husky Oil	Lloydminster	14.10	23.50	15.00	-	-	-	-	-	-	-	-	-	12.00	-	-	-	-
Imperial	Edmonton	164.80	164.80	62.70	20.50	-	-	-	12.60	47.50	-	-	-	5.80	3.20	14.20	-	32
Parkland	Bowden	6.65	6.65	-	3.00	-	3.00	-	-	-	-	-	-	-	-	-	-	-
Petro-Canada	Edmonton	115.50	115.50	27.00	9.00	-	9.10	-	9.50	39.33	18.20	-	7.10	-	-	35.80	31	45
Shell	Scotford	59.70	69.00	-	21.50	5.30	-	-	-	-	40.50	-	-	-	-	21.00	62	10
Turbo	Balzac	27.50	27.50	6.95	7.55	-	3.20	1.04	-	11.57	-	-	-	-	-	7.55	-	(1)
		388.25	406.95	111.65	61.55	5.30	15.30	1.04	22.10	98.40	58.70	-	7.10	17.80	3.20	78.55	93	87
Saskatchewan												(2)						
Consumers' Co-op	Regina	40.00	45.20	23.00	9.00	-	2.70	1.88	-	17.60	10.80	27.10	8.30	-	-	6.30	59	270
Saskoil	Moose Jaw	8.00	13.30	7.30	-	-	-	-	-	-	-	-	-	5.50	-	-	-	-
		48.00	58.50	30.30	9.00	-	2.70	1.88	-	17.60	10.80	(2) 27.10	8.30	5.50	-	6.30	59	270
Northwest Territories																		
Imperial	Norman Wells	3.50	3.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Prairies/NWT		439.75	468.95	141.95	70.55	5.30	18.00	2.92	22.10	116.00	69.50	(2) 27.10	15.40	23.30	3.20	84.85	152	357

Cont'd . . . .

TABLE IV-3
(Continued)

CANADA 1991 REFINERY CAPACITIES
(Thousand Barrels per Calendar Day Unless Noted)

Company	Location	Crude Capacity Effective	Crude Capacity Nameplate	Vac. Dist'n	Cat. Reform.	BTX	Isom.	Poly.	Alky.	Cat. Crack.	Hydro-Crack.	Vis. Break.	Coker	Asphalt	Lube	Dist. Hydro-Treat.	H2 MMSCFD	Sulphur t/d
ONTARIO																		
Imperial	Nanticoke	112.10	112.10	33.70	26.80	-	-	-	7.30	40.90	-	-	-	-	-	-	-	35
Imperial	Sarnia	118.80	118.80	28.50	27.00	3.80	-	-	7.00	25.70	10.80	-	19.80	-	6.20	41.40	23	168
Petro-Canada	Clarkson	41.50	41.50	35.50	9.80	-	6.30	-	-	-	10.30	-	-	4.60	4.90	5.90	13	41
Petro-Canada	Oakville	80.50	80.50	41.00	13.20	-	-	-	3.10	25.40	-	-	-	9.50	-	6.30	-	41
Petrosar	Sarnia	40.00	60.00	11.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shell	Sarnia	71.00	71.00	24.70	21.00	2.70	-	1.60	-	14.40	6.75	4.05	-	-	-	6.30	-	35
Suncor	Sarnia	70.00	83.40	17.20	26.10	10.25	-	-	5.10	16.30	20.50	6.70	-	-	-	5.50	46	52
Total Ontario		533.90	567.30	191.90	123.90	16.75	6.30	1.60	22.50	122.70	48.35	10.75	19.80	14.10	11.10	65.40	82	372
QUEBEC																		
Petro-Canada	Montreal	77.00	87.40	40.70	31.30	8.70	-	.80	2.30	17.20	14.40	12.60	-	14.30	-	9.00	43	(3)
Shell	Montreal	120.00	120.00	49.40	20.70	-	6.80	-	2.50	22.00	11.70	12.00	-	7.20	3.06	27.00	-	(3)
Ultramar	St. Romuald	114.00	120.00	55.00	17.10	-	10.50	3.90	-	40.00	-	-	-	35.00	-	14.50	-	38
Total Quebec		311.00	327.40	145.10	69.10	8.70	17.30	4.70	4.80	79.20	26.10	24.60	-	56.50	3.06	50.50	43	338
ATLANTIC PROVINCES																		
Imperial	Dartmouth, NS	84.40	84.40	41.00	10.00	-	-	3.20	-	24.70	-	-	-	4.20	-	32.40	-	90
Irving	Saint John, NB	122.70	237.50	61.75	34.65	-	9.50	1.71	5.00	17.10	29.70	18.00	-	11.70	-	40.50	40	200
Nfld Processing	Come By Chance, NF	100.00	105.00	56.00	24.00	-	-	-	-	-	32.00	-	-	-	-	17.00	66	200
Ultramar	Halifax, NS	20.00	20.00	8.60	3.60	-	-	-	-	7.20	-	-	-	-	-	5.20	-	-
Total Atlantic		327.10	446.90	167.35	72.25	-	9.50	4.91	5.00	49.00	61.70	18.00	-	15.90	-	95.10	106	490
Total Canada		1759.95	1970.45	701.90	366.10	30.75	51.75	19.55	56.40	414.70	205.65	53.35 +27.10(2)	35.20	114.50	17.36	333.70	382	1,627

Notes: (1) Sulfur recovery at Petrogas gas plant.
(2) Resid Desulfurization.
(3) Sulfur recovery at Sulconam plant (capacity = 300 t/d).

Purvin & Gertz, Inc.

TABLE IV-4

RETAIL GASOLINE OUTLETS BY PROVINCE(1)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
British Columbia	2,089	2,050	2,024	1,961	1,877	1,930	1,886	1,992	1,922	1,866
Alberta	1,882	1,813	1,838	1,903	1,817	1,900	1,884	1,978	1,949	1,857
Saskatchewan	1,507	1,651	1,572	1,516	1,483	1,383	1,457	1,499	1,435	1,340
Manitoba	1,183	1,265	1,145	1,111	1,146	970	1,080	1,100	1,081	1,064
Ontario	6,387	6,237	5,866	5,641	5,298	5,065	5,265	5,415	5,662	5,314
Quebec	5,861	5,765	5,325	5,179	5,107	4,809	4,918	4,792	4,810	4,778
New Brunswick	1,250	1,308	1,150	1,099	1,015	1,005	1,017	1,133	955	994
Nova Scotia	970	953	950	928	877	905	884	903	738	772
Prince Edward Island	197	159	146	139	132	145	135	135	119	125
Newfoundland	621	612	623	631	640	703	690	715	641	628
Yukon and N.W.T.	17	43	42	46	32	63	67	72	40	54
Total Canada	21,964	21,856	20,681	20,154	19,424	18,878	19,283	19,734	19,352	18,792
Western Canada	6,678	6,822	6,621	6,537	6,355	6,246	6,374	6,641	6,427	6,181
Atlantic	3,038	3,032	2,869	2,797	2,664	2,758	2,726	2,886	2,453	2,519
Quebec	5,861	5,765	5,325	5,179	5,107	4,809	4,918	4,792	4,810	4,778
Ontario	6,387	6,237	5,866	5,641	5,298	5,065	5,265	5,415	5,662	5,314

Source: 1982-1986 Oilweek, 1987-1991 Octane

TABLE IV-5

CANADIAN CRUDE OIL PRICES
(U.S. Dollars per Barrel, Unless Otherwise Noted)

	1987	1988	1989	1990	1991	1992[(1)] (Forecast)
World Price, WTI Cushing	19.16	15.96	19.64	24.45	21.47	20.85
Chicago Prices						
WTI Spot	19.76	16.50	20.15	25.03	22.07	20.65
Alberta Mixed Blend	19.13	15.98	19.56	24.69	21.40	20.05
Brent	20.24	16.91	20.25	26.03	22.54	20.45
Maya	16.67	12.30	15.75	18.54	14.57	14.06
Cold Lake Blend	15.71	11.39	14.87	17.93	12.73	13.74
Edmonton Prices						
Alberta Mixed Blend	18.07	14.90	18.48	23.50	20.16	18.83
Condensate	18.28	15.16	18.74	23.75	20.45	18.83
Cold Lake Blend	14.53	10.14	13.58	16.52	11.29	12.32
Cold Lake Bitumen	12.92	7.98	11.36	13.42	7.36	9.53
Sarnia Prices						
Alberta Mixed Blend	19.04	15.88	19.46	24.61	21.34	20.02
LSB	17.92	14.45	18.24	22.46	18.81	18.08
Cold Lake Blend	15.70	11.35	14.82	17.86	12.67	13.72
Montreal Prices						
Brent	19.82	16.64	19.85	25.48	21.73	19.97
Dubai	19.21	15.67	18.23	23.40	19.45	18.48
Maya	16.92	12.71	16.19	18.67	14.48	13.82

Note: (1) Constant 1991 dollars.

TABLE IV-6

REFINERY GATE REFINED PRODUCT PRICES

	1987	1988	1989	1990	1991	1992[1] (Forecast)
U.S. Gulf Coast (U.S. Cents per Gallon)						
Regular Unleaded Gasoline	50.34	47.22	55.51	70.39	63.01	57.54
Jet/Kerosene	51.21	46.08	55.15	72.40	60.36	56.65
Diesel/No. 2 Fuel Oil	49.54	42.95	51.81	65.35	57.70	53.67
Low S Diesel (.05%)						56.24
1% Sulfur Residual Fuel Oil ($/Bbl.)	16.71	12.93	16.25	18.43	13.47	14.09
3% Sulfur Residual Fuel Oil ($/Bbl.)	15.27	10.49	13.36	14.47	10.10	10.76
Chicago (U.S. Cents per Gallon)						
Regular Unleaded Gasoline	53.56	49.91	58.17	71.05	64.42	58.79
Jet/Kerosene	53.98	48.93	57.43	75.15	61.90	58.09
Diesel/No. 2 Fuel Oil	52.31	45.80	53.71	65.88	57.38	54.15
Low S Diesel (.05%)						58.17
1% Sulfur Residual Fuel Oil ($/Bbl.)	18.32	14.54	17.86	20.04	15.08	15.69
3% Sulfur Residual Fuel Oil ($/Bbl.)	13.66	8.88	11.75	12.86	8.49	9.16
Toronto (Canadian Cents per litre)[2]						
Regular Unleaded Gasoline	19.24	16.98	18.92	23.56	20.97	19.39
Jet B	18.66	15.92	17.76	22.38	18.33	17.56
Jet A/Kerosene	19.64	16.75	18.69	23.56	19.30	18.48
No. 2 Fuel Oil	17.91	14.79	16.59	20.10	17.38	16.52
Diesel	19.06	15.74	17.65	21.39	18.49	17.57
1.5% Sulfur Residual Fuel Oil ($C/Bbl.)	21.22	14.80	17.67	20.17	14.44	15.25
2.5% Sulfur Residual Fuel Oil ($C/Bbl.)	20.09	12.73	15.67	17.32	11.49	12.68
Montreal (Canadian Cents per litre)[2]						
Regular Unleaded Gasoline	19.50	17.25	19.17	23.70	21.15	19.66
Jet/Kerosene	19.56	16.28	18.42	22.42	19.69	18.63
No. 2 Fuel Oil	18.42	15.33	17.35	21.11	18.54	17.55
Diesel	18.99	15.80	17.88	21.76	19.12	18.09
1.5% Sulfur Residual Fuel Oil ($C/Bbl.)	23.22	16.80	19.67	22.17	16.44	17.12
2.5% Sulfur Residual Fuel Oil ($C/Bbl.)	22.09	14.73	17.67	19.32	13.49	14.54

Notes: (1) Constant 1991 dollars.
(2) Estimated by Purvin & Gertz, Inc.

V
COMPETITIVE PRESSURES

The Canadian industry faces many challenges in order to survive as a viable industry. The marketing end of the business will always have a future because consumers require transportation fuels and other fuels products. However, the future of the refining sector is not so certain.

The overall industry has experienced low rates of return. It is a manufacturing business which is highly capital intensive, and is badly in need of new capital to consolidate into more efficient operations and to meet new environmental pressures. Furthermore, it must compete against product from much larger refining centres in the Northern U.S. which are designed to process much lower cost feedstocks. At the same time, Canadian refineries face declining supplies of domestic feedstock which in turn will likely become one of the more expensive feedstocks in North America.

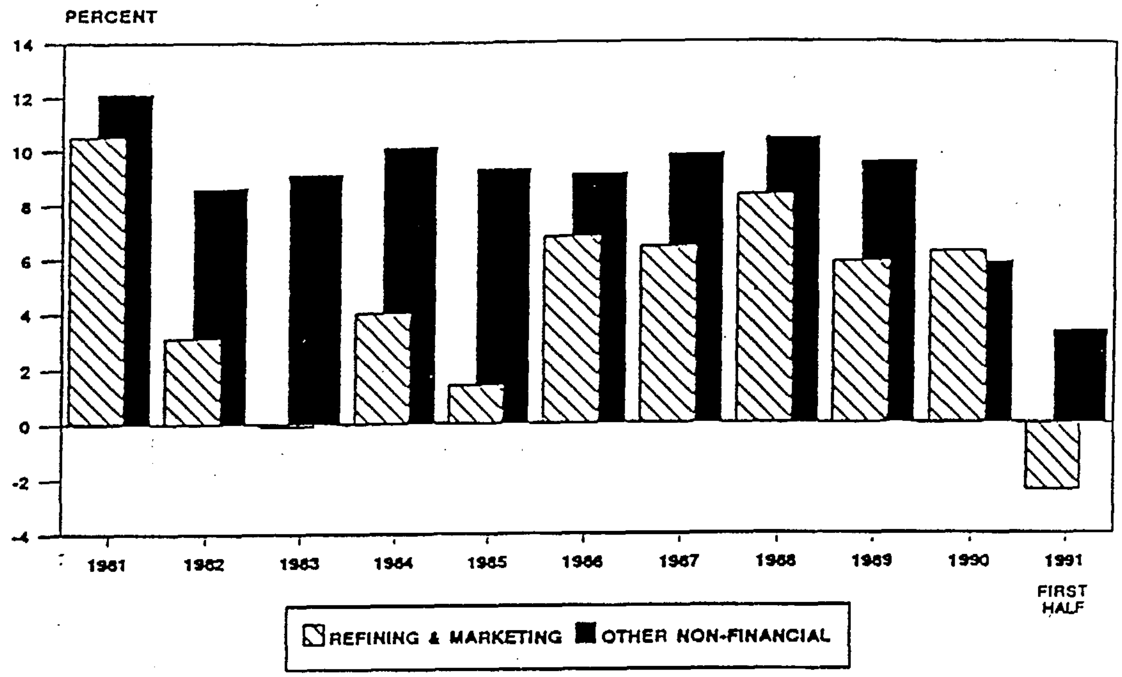
This chapter addresses some of the major competing pressures. It also provides a comparison with the U.S. industry which is the main competitor to the Canadian business.

CANADIAN INDUSTRY PROFITABILITY

The Canadian industry has performed at less than satisfactory rates of return. The Petroleum Monitoring Agency Canada reports that the Canadian oil products business has been significantly less profitable than other non-financial businesses in Canada, as shown in Figure V-1. Only in 1990 did the Canadian oil products business fare marginally better, and much of that improvement reflected inventory gains which were subsequently lost in 1991. Over $500 million was lost in 1991 based on FIFO accounting policies, and this is discussed further below. Had the industry reported its earnings under LIFO accounting principles, earnings in 1990 would have been much lower, and likely would have been negative. At a time when new capital must be raised, such poor rates of return are a significant hurdle to overcome if new capital is to be attracted to the business for major expenditures which need to be undertaken.

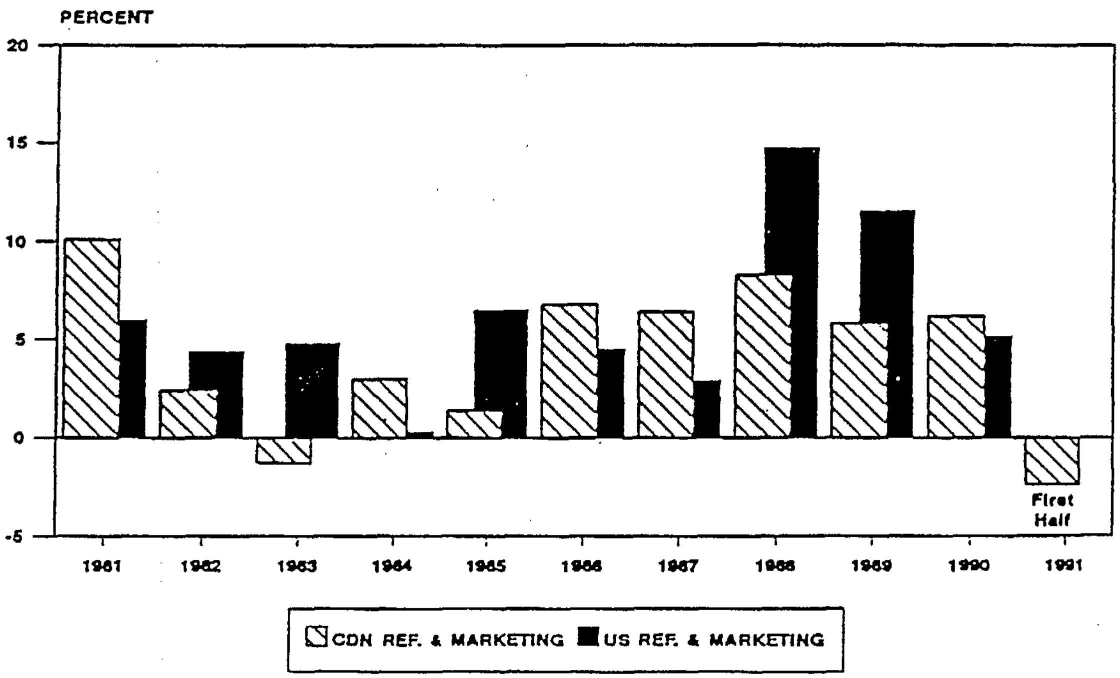
Compared to the U.S. industry, the Canadian industry has not fared as well over the last several years. However, the U.S. industry did not perform all that well either in the mid-1980's except that it undertook considerable rationalization so as to be in a better position today. A comparison of the Canadian and the U.S. industries' profitability is provided in Figure V-2. The sources of these comparisons use slightly different criteria. In Canada, a return on "capital employed" is used, which is defined as total assets less current liabilities. In the U.S., a return on "net investment" is commonly used, which is defined as total assets less current assets (cash, accounts receivable, and inventories). Since the amount of current liabilities are usually quite close to current assets in both countries, the rate of return comparison is still a valid and quite accurate comparison.

FIGURE V-1
RATES OF RETURN ON CAPITAL EMPLOYED:
PETROLEUM REFINING AND MARKETING VERSUS OTHER NON-FINANCIAL INDUSTRIES IN CANADA



Source: Petroleum Monitoring Agency Canada

FIGURE V-2
CANADIAN VS U.S. REFINING & MARKETING INDUSTRY PROFITABILITY



1) Source: Petroleum Monitoring Agency Canada (Return on Capital Employed)
2) Source: U.S. Department of Energy, Performance Profiles of Major Energy Producers 1990
(Return on net investment in place)

Complete data on the Canadian industry rate of return for 1991 was not available at the time this report was written. An examination of selected company rates of return (based on FIFO reporting as discussed further below) shows that 1991 overall was a very poor year for the industry.

RATES OF RETURN FOR OIL PRODUCTS SEGMENTS
(Percent on Capital Employed)

	1989	1990	1991
Imperial Oil[(1)]	6.0	4.6	-2.2
Shell Canada	6.6	6.9	-2.9
Petro-Canada	3.8	4.3	-18.9

Note: (1) Weighted average cost method rather than FIFO method.

The industry experienced significant losses during 1991 as a result of a difference in accounting and pricing practices in Canada and the United States. In Canada, all businesses must use FIFO (first in, first out) method of inventory accounting for income tax purposes. In the United States, and in most countries throughout the world, the petroleum industry utilizes the LIFO (last in, first out) method of inventory accounting for income tax purposes. Therefore, a change in crude oil price in the U.S. is immediately reflected in a change in product prices under the LIFO approach. In Canada, during the regulated pricing era of 1973 to 1985, changes in product prices usually lagged changes in crude prices by 60 to 90 days. Unfortunately, although prices have been deregulated since 1985, government officials still expect Canadian pricing responses to await an obligatory time period. Thus, in periods when crude prices increase rapidly, industry is expected to wait for a set period (usually 60 days) before product prices can increase, even though competing non-domestic supplies react immediately. On the other hand, when crude prices drop, U.S. product prices drop immediately, and Canadian product prices must drop quickly to compete with imported supplies. During the 1990 Gulf War, governments in Canada pressured the oil companies not to raise their prices of products when crude oil prices jumped upward until 60 days had passed. In January of 1991, when crude prices suddenly dropped, low U.S. product prices brought Canadian prices down quickly. As a result, the Canadian refining industry lost hundreds of millions of dollars.

Although companies would prefer to use the same accounting method for internal purposes as for income tax purposes, some Canadian refiners have moved away from the FIFO method to the LIFO method for financial reporting purposes so as to better follow world petroleum industry practices. However, it is not clear whether they will be able to eliminate the 60 day waiting period in the event of a sudden crude price increase. Moreover, for tax purposes, the LIFO method still cannot be used. The Canadian refining industry would prefer to see the same accounting method accepted by Revenue Canada as they must use for operating purposes.

With financial results reported under a LIFO regime, earnings would have been lower over the past three years. Besides, earnings were lower in 1991 due to the government price pressure. Imperial Oil made a comparison in its recent annual report showing the impact of accounting method on its petroleum products earnings. It should be noted that prior to 1991, Imperial Oil employed a combination of FIFO and weighted average cost method of inventory valuation. This approach offered an improvement over FIFO by dampening some of the price fluctuations. The comparison below highlights the differences of average cost (also applicable to FIFO) versus LIFO.

COMPARISON OF IMPERIAL OIL'S PETROLEUM PRODUCTS EARNINGS(1)
(Millions of Dollars)

Accounting Method	1989	1990	1991	1989-1991 Total
FIFO/Average Cost(2)	257	208	-100	365
LIFO	139	-42	123	220

Notes: (1) Imperial Oil Limited Annual Report to Shareholders 1991.
(2) Rather than using FIFO, Imperial Oil used a combination of FIFO and weighted average cost method.

Based on this time period, the FIFO approach overstated the rates of returns for the Canadian industry. By allowing the industry to price its products following LIFO responses is by no means a recipe for increased industry profits, and indeed in some years it can have the opposite effect.

It is clear that in the future, governments must recognize that industry must operate with prices following international responses without government pressures. Operating in this manner is vital because the Canadian industry operates in a North American market, and it needs to be treated on the same basis as its international competition. Similar to other Canadian manufacturing businesses which have commodity prices set by external markets and conditions, the Canadian refining industry is no different, and should be treated accordingly.

CANADIAN VERSUS U.S. REFINING INDUSTRY ECONOMIC COMPARISON

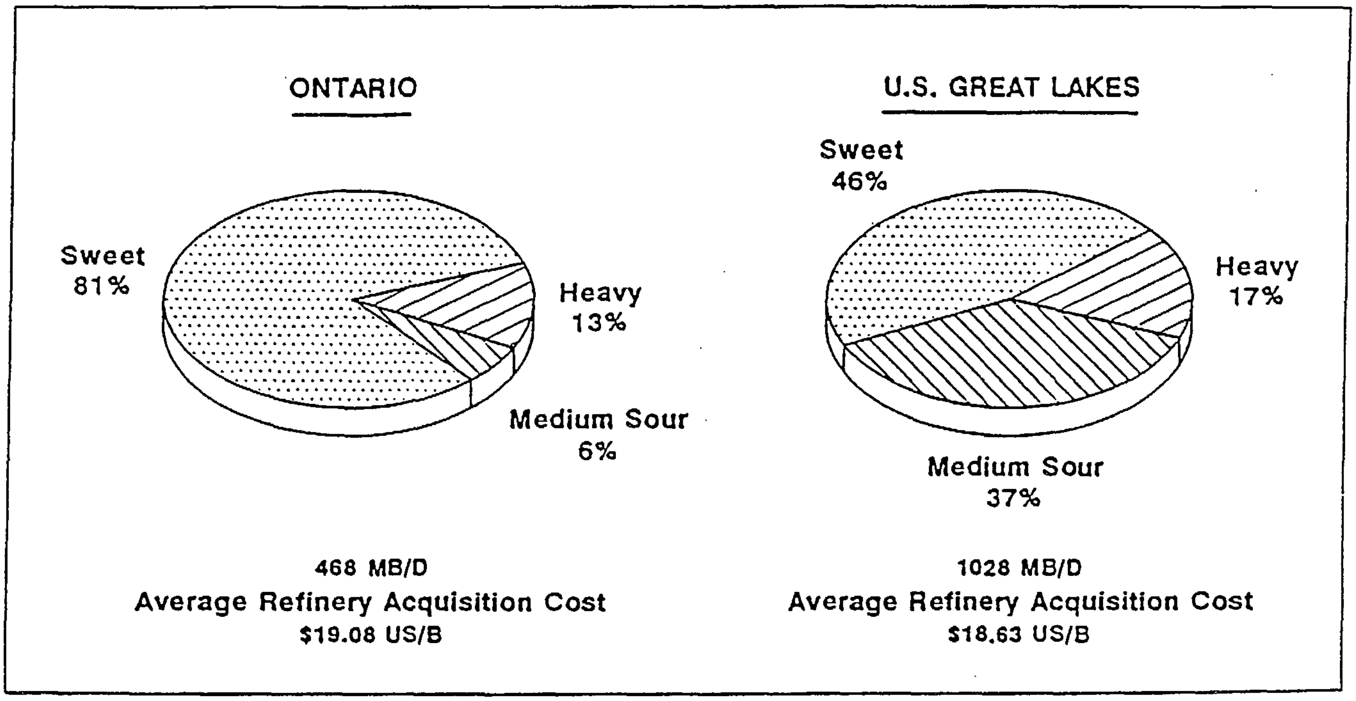
In the competitive analysis between Canadian and U.S. refineries, we concentrated on those refineries which are located in Ontario and Quebec, and those refineries which are located along the U.S. side of the Great Lakes. This marketing region has a very competitive interface between operations on each side of the border. Product supplies can be trucked into Ontario or into the U.S. at a number of border crossings. Similarly, product can be trucked into Quebec or brought in by tanker from the U.S. East Coast.

Our assessment covers feedstock costs, refinery capacity utilization, differences in refinery product slates between the two countries, and resulting refining economics in both Toronto and Montreal relative to the U.S. Gulf Coast and adjacent competing regions within the U.S. Finally, a comparison of Canadian and U.S. refining costs was undertaken.

FEEDSTOCK COSTS TO U.S. AND CANADIAN REFINERS

Although crude oil prices in Ontario and the U.S. Great Lakes region are set under the same pricing mechanisms, the average acquisition price to a refiner in each of these regions is quite different. As shown in Figure V-3, the average price of crude oil to a U.S. refiner in the Great Lakes region in 1989 was $18.63 U.S./B, as compared to an average price in Ontario of $19.08 U.S./B. This occurred because the U.S. Great Lakes refining area uses a much lower cost feedstock. Only 46% of its crude supply was sweet, and its processing capability was more suited to medium sour and heavy crudes. In the future, we expect proportionately more upward pricing pressure to occur on light sweet crude than on medium sour and heavy crudes, and there are generally more opportunities to obtain special deals on the lower quality crudes.

FIGURE V-3
COMPARISON OF ONTARIO AND U.S. GREAT LAKES REGION CRUDE SLATE - 1989

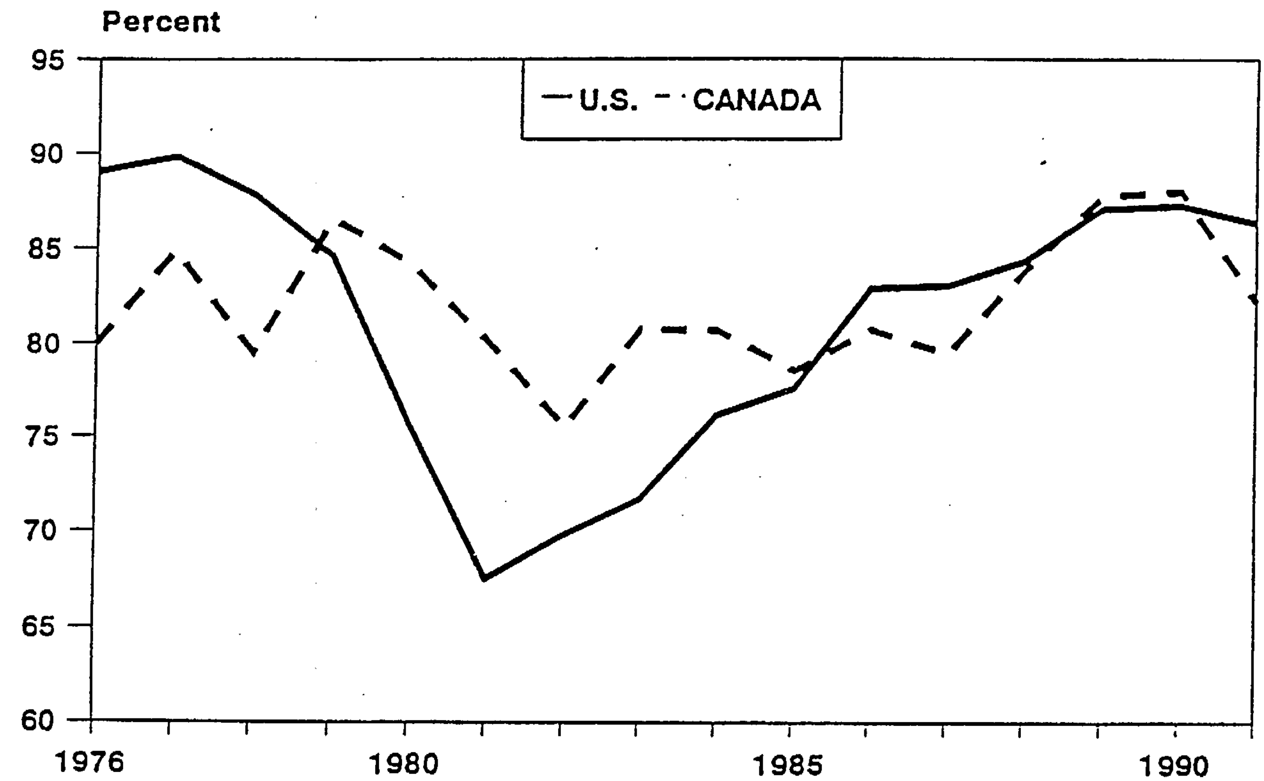


The vulnerability of Ontario refineries to sweet crude is very evident, and if future sweet crudes supplies become scarce, the Ontario refiners will experience considerable difficulty in their operations. Purvin & Gertz' forecast for Western Canadian light crude supplies shows a continuing decline, although this decline rate is less than forecasts developed by some industry representatives. There will also be competitive pressures offshore in the Atlantic Basin for North Sea light crude, and as its supply declines, Canada may have more difficulty importing as much as it traditionally has taken, or it may be required to pay a higher premium for North Sea crude in order to obtain adequate supplies. This vulnerability to light sweet crude price is a major disadvantage which the Canadian industry has relative to the U.S. industry.

CAPACITY UTILIZATION

As shown in Figure V-4 below, the Canadian refining industry utilization has seldom exceeded 85% except in 1989 and 1990. The U.S. industry operated at a rate of close to 90% in the late 1970s before a significant rationalization program was undertaken to counteract a major drop in product demand as a result of higher energy prices and conservation reactions. Canada also shut down considerable refining capacity in the early 1980s. The U.S. industry had a difficult adjustment, but has rebuilt capacity utilization so that it has exceeded 85% for the last four years. Unlike the U.S., Canada experienced a major drop in utilization in 1991 as a result of the drop in demand due to the recession.

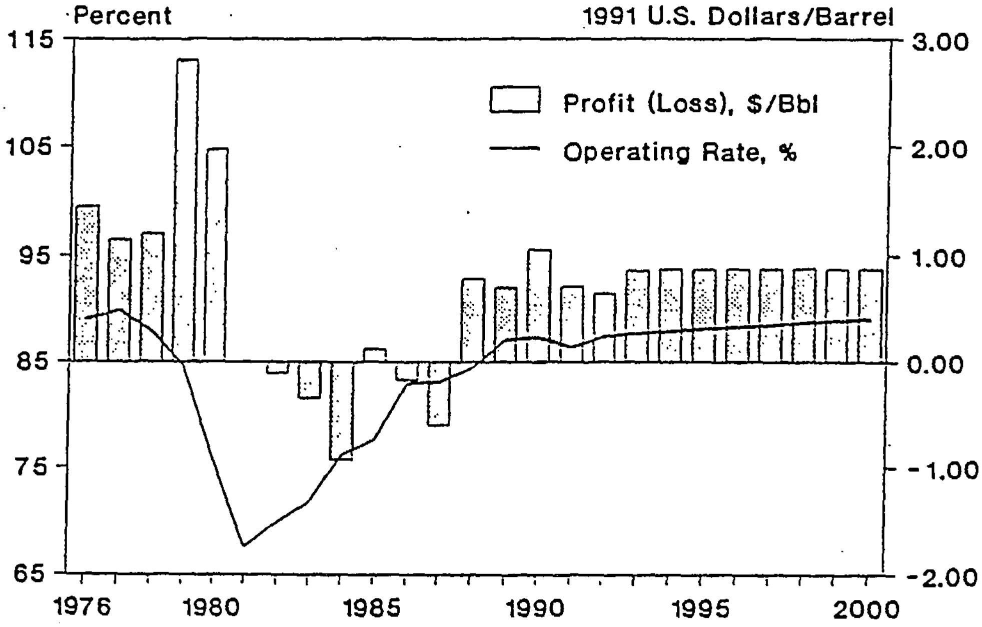
FIGURE V-4
CANADIAN VERSUS U.S. REFINING CAPACITY UTILIZATION



As was shown in Figure IV-3, the utilization of refineries in Canada would be much lower if it was based only on Canadian demand. The higher utilization allows for net exports of products. The U.S. industry, on the other hand is a net importer of products, and its utilization reflects meeting primarily domestic demand.

Based on our analysis of refining economics at the U.S. Gulf Coast, there is a close correlation between refining profitability, and refinery capacity utilization. As shown in Figure V-5, the economics of a cracking refinery processing light crude and selling product at U.S. Gulf Coast spot prices shows that when the utilization dropped below 85%, the profitability of the marginal cracking refinery was usually negative. As utilization recovered above 85%, profitability was again restored to this refining sector. It should be noted that this represents the marginal refinery, and other refineries which process lower cost feedstocks, or have greater refinery processing capabilities, would have been in a better financial position. Product prices throughout the U.S., however, are established primarily by these marginal cracking refineries which do not contain further residual or other cracking processing capabilities.

FIGURE V-5
GULF COAST CRACKING REFINERY
OPERATING MARGIN versus OPERATING RATE



Similar to many industries, it is apparent that the refining industry needs to operate at a high level of utilization in order to achieve a reasonable margin. Although the industry has difficulty operating much above 90% because of the usual refinery maintenance turnaround requirements and some allowances for unscheduled downtimes, there is essentially no incentive for the industry to maintain surplus capacity. Instead, the U.S. industry relies on imported product to balance out its requirement.

A comparison of the Canadian refining industry operating capacity utilization versus its return on capital employed shows a much less direct relationship than in the U.S., as shown below in Figure V-6. This lack of sensitivity to utilization is masked by several factors: inventory FIFO accounting and the fact that Canada has been a net exporter of product.

Canada's profitability has a much stronger relationship with the level of imports which come into the country, as shown in Figure V-7. This figure shows imports in all areas except the Atlantic Provinces, because the Atlantic Provinces do import significant volumes of products for specific customers, particularly heavy fuel oil for the power generation sector. For the other regions, though, as exports increase and imports decrease, the profitability decreases. This confirms that as long as the industry significantly exports products and continues to process high cost feedstocks, it will lower the refining margins in the country. In order to restore profits, there is a strong driving force to reduce refining capacity further; increasing refinery capacity utilization, reducing crude runs and decreasing product exports.

FIGURE V-6
CANADIAN REFINING INDUSTRY OPERATING RATE
VERSUS INDUSTRY RETURN ON CAPITAL EMPLOYED (ROCE)

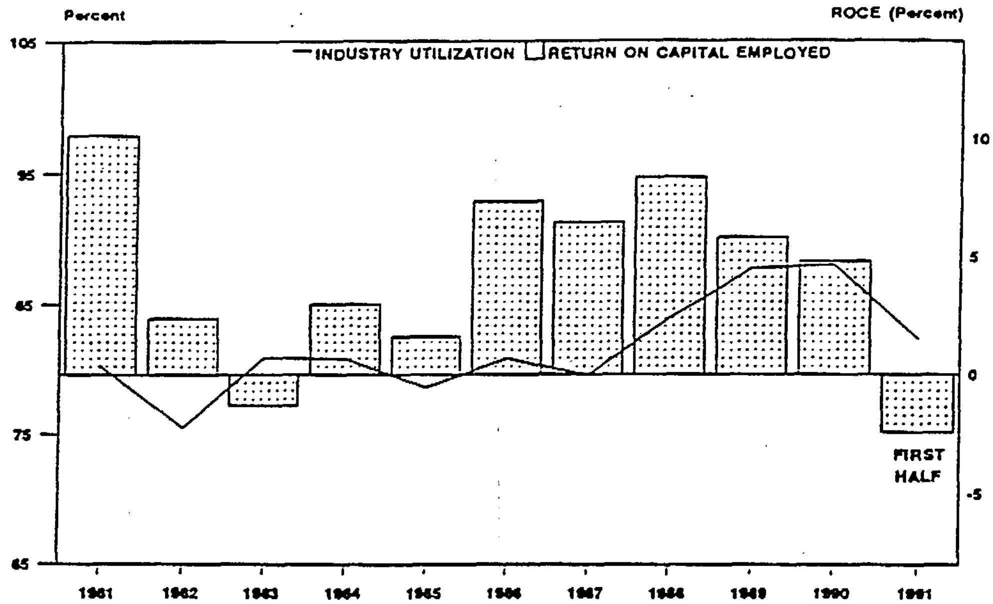
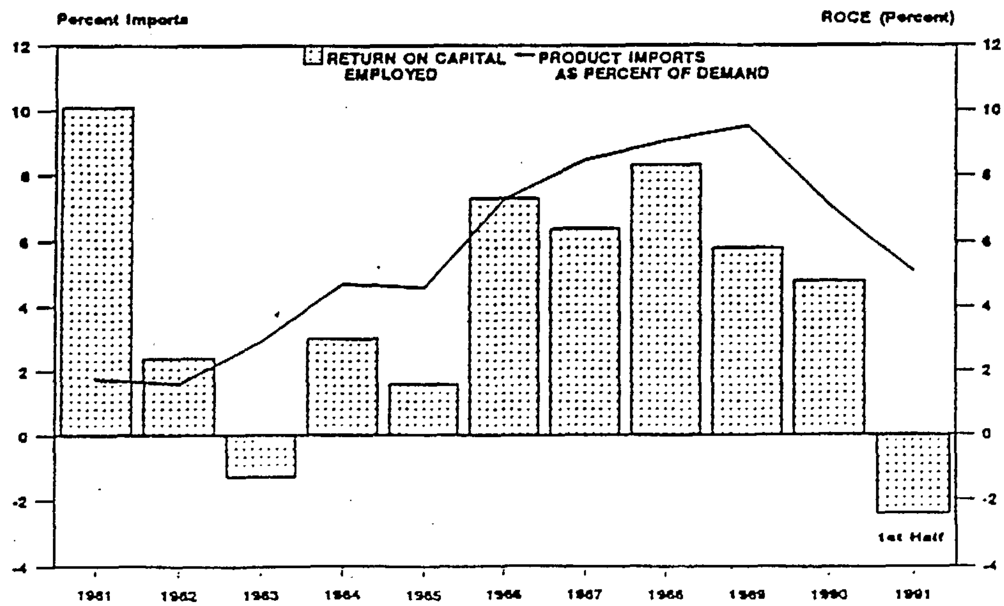


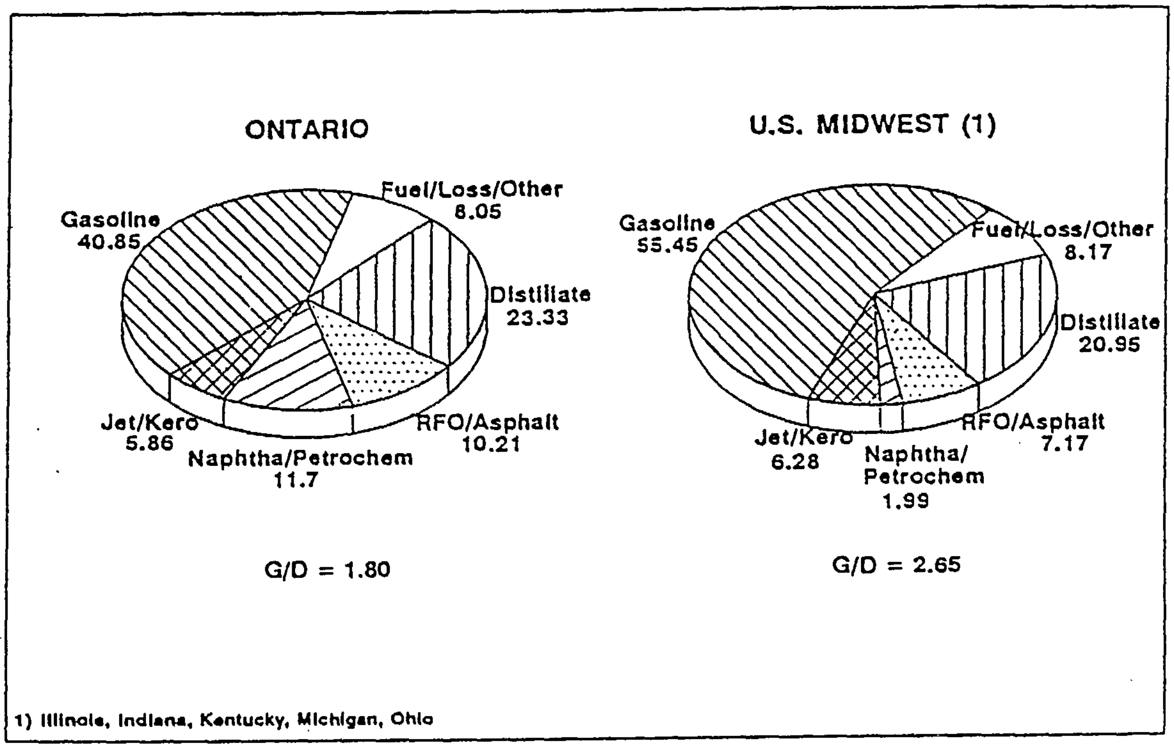
FIGURE V-7
CANADIAN REFINING INDUSTRY RETURN ON CAPITAL EMPLOYED (ROCE)
VERSUS PRODUCT IMPORTS (EXCLUDING ATLANTIC)



REFINED PRODUCT SLATE

The Canadian refining industry produces less gasoline but more of the other products than does the U.S. industry. Canada has traditionally not consumed as much gasoline per barrel of crude oil refined, and produces more distillate and petrochemical feedstocks than occurs on average in the U.S. industry. This comparison is highlighted below in the comparison between the Ontario product slate and the product slate occurring in the U.S. Midwest. The gasoline/distillate (G/D) ratios are considerably higher in the U.S., which reflects the production of a higher value products slate. It should be noted, though, that part of the petrochemical production in Ontario is also a high value operation and does offset somewhat the reduced G/D ratio. This comparison is shown below in Figure V-8.

FIGURE V-8
REFINERY PRODUCT SLATE - 1989



REFINING MARGIN COMPARISON

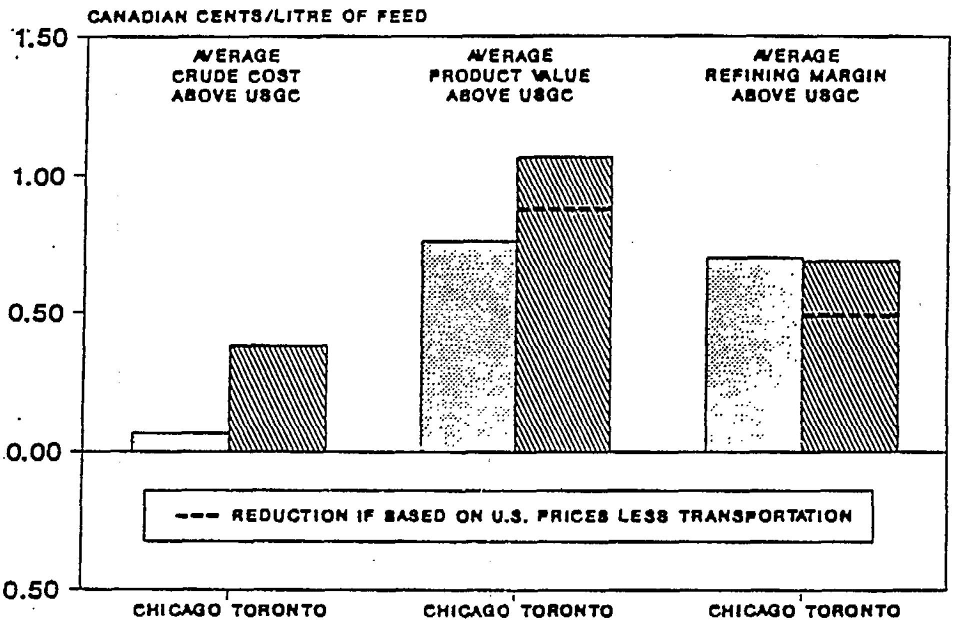
A comparison of refinery margins was undertaken for Toronto and Montreal compared to Chicago and Philadelphia based on gross refining margins. These margins are calculated as revenue from average product wholesale (rack) prices less the cost of feedstock. Margins should not be confused with profits because operating costs are not included in this comparison. This analysis incorporates actual yields and feedstock slates in each of these regions.

The Ontario refining industry benefits from a high yield of specialty products such as lube oils and petrochemical feedstocks. Furthermore, it benefits from processing synthetic crude which does not yield any residual products. The U.S. refiners also paid a $0.23 U.S./B duty and pollution charge which the Canadian industry did not have. Compared to the Great Lakes refineries, these extra capabilities and the pollution charge helped offset the disadvantage on crude oil prices. The feedstock cost differences are shown in Figure V-3.

For the Great Lakes refinery analysis, we used spot Chicago prices. For the Ontario refinery, we used U.S. prices at the appropriate locations plus transportation cost adjustments.

As shown in Figure V-9, the Chicago refinery has a significant advantage on the cost of crude supply relative to a Toronto refinery. However, if Toronto wholesale prices are based on U.S. prices plus transportation, the Toronto refinery should be able to overcome the crude feedstock cost disadvantage. However, if the prices of all Ontario products drop to U.S. prices less transportation because of an increased level of exports (as shown by the dashed line), this would reduce the margin of the Toronto refiner relative to the U.S. refiner.

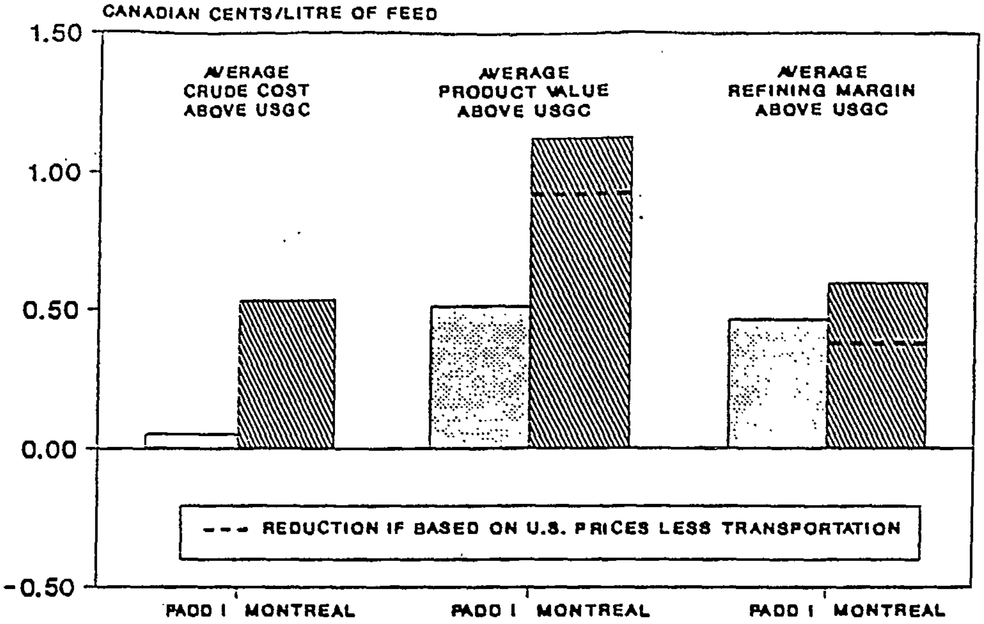
FIGURE V-9
TORONTO AND CHICAGO REFINING ECONOMICS
COMPARED WITH U.S. GULF COAST - 1989 (1)



(1) Revenue from average product wholesale (rack) prices less the cost of feedstock. No operating costs included in this comparison.

Similarly, an analysis was undertaken which compares the refining economics at Montreal and Philadelphia compared with the U.S. Gulf Coast as portrayed in Figure V-10. Actual crude oil costs were used. Spot prices based on New York prices plus transportation with some adjustments to reflect Ontario prices were used to represent refinery wholesale prices. The Montreal refiners have an even greater feedstock cost disadvantage, but are able to offset that with higher product prices, assuming that the Canadian wholesale prices are set by U.S. prices plus transportation. If Montreal prices drop because of high levels of exports from the region, this could reduce the Montreal margin to values that are equal or less than the refiners in the PADD I region, as denoted by the dotted line in Figure V-10.

FIGURE V-10
MONTREAL AND PHILADELPHIA REFINING ECONOMICS
COMPARED WITH U.S. GULF COAST - 1989 (1)



(1) Revenue from average product wholesale (rack) prices less the cost of feedstock.
No operating costs included in this comparison.

Based on the above analyses, as long as the Ontario and Quebec industry can keep its refinery capitalization utilization high, and preferably operate under a mode which minimizes the export of products, they should be in a position to maintain a relatively strong economic position vis-a-vis its competitors in the Northern U.S. markets.

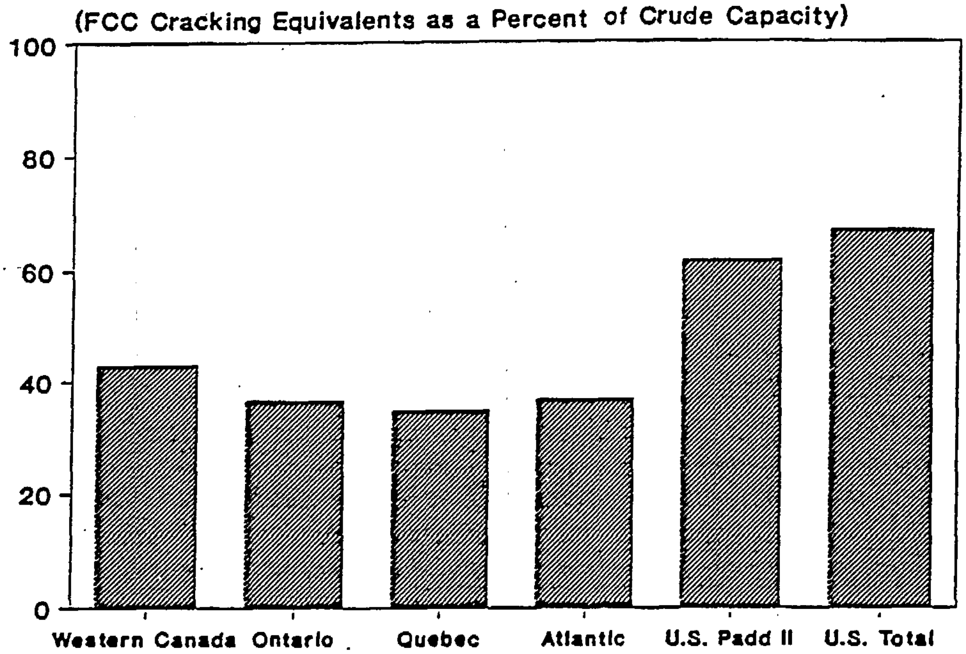
The above analyses do not include any operating costs which are discussed later. A slightly higher level of operating costs in Canada provides a minor disadvantage relative to the U.S. industry, but these are less significant than the crude cost disadvantage and whether Canadian wholesale prices can be maximized.

REFINING COMPLEXITY COMPARISON

Canadian refineries are not very complex compared to U.S. refineries, as was shown in Chapter III (Figure III-5). The more complex refineries have the capability to process heavier and higher sulphur crude oils, as well as produce primarily high value products such as gasoline, diesel fuel and jet fuel. Often, such refineries also can produce specialty products such as petrochemicals and lube oils from the lower value feedstock.

Another way of comparing Canadian refining capabilities is to consider the fluid catalytic cracking (FCC) equivalents as a percent of crude capacity. To undertake such an analysis, we examined the capacity of individual processing units in refineries throughout Canada (from Table IV-3). Any unit which serves the purpose of cracking gas oil material or heavier, similar to a catalytic cracking unit, was compared in terms of FCC cracking equivalents. A comparison of the Canadian refineries versus refineries in U.S. PADD II and total U.S. is shown below in Figure V-11. This further confirms that the Canadian refining industry is behind in its capabilities to process sour and heavier crudes. This poorer refining capability forces the Canadian industry to process lighter and higher cost crude oils. If the Canadian refining industry were to add extra processing capability to process heavier and sour crude oils, or to process more synthetic crude oil, it should improve its economic position relative to the U.S. industry.

FIGURE V-11
COMPARISON OF REFINING COMPLEXITY



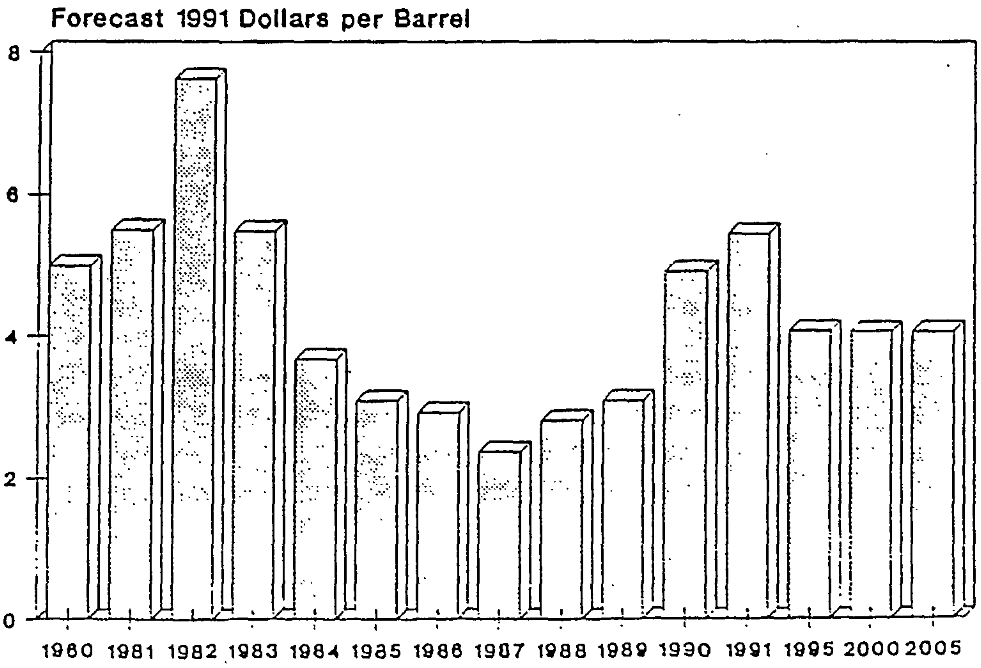
The Western Canadian refineries, especially those located at Edmonton and Regina, are more complex than other Canadian refineries on average. The Edmonton refineries have special processing capabilities to process significant quantities of synthetic crude. Although synthetic crude is quite sweet, it still requires further hydrogen addition in order to produce high quality products. In Regina, the Co-Op refinery was recently equipped with a heavy oil upgrading section which permitted the refinery to process 100% heavy crude, and it also produces some synthetic crude.

In Canada, with assistance from both Federal and Provincial Governments, synthetic crude production facilities were added in the Athabasca oil sands, and a new Bi-Provincial upgrader is being built near Lloydminster with completion expected in late 1992. Instead of being part of a refinery, they were developed as "upstream" or "resource" projects.

These facilities process heavy crude and bitumen and produce a high quality, sweet synthetic crude. Therefore, although little residual processing capacity was added to Canadian refineries, such capacity was added in facilities at the resource sites, and have usually been considered as upstream investments. Unfortunately, synthetic crude is not as compatible as light conventional crude, and most light crude refineries are limited to processing less than 20% synthetic blended with other crudes. Several refiners have capabilities to process larger quantities of synthetic (Sunoco at Sarnia and Petro-Canada at Edmonton), and Shell can process 100% synthetic crude in its Scotford refinery. Since upgrading utilizes low value heavy crudes, processing more than the minimum amount of synthetic crude achieves a similar objective as processing heavy crude directly.

The U.S. industry added considerable refining conversion capability in the late 1970s and early 1980s in response to changes in crude oil selling pressures. Those refiners which processed considerable quantities of Saudi Arabia crude oils were required in the late 1970s to purchase heavy crudes along with their purchases of lighter Saudi crudes. In order to increase their capability to process the crudes, U.S. refiners added over 1 million B/D of residual processing capacity, most of which was added in the U.S. Gulf Coast in the early 1980s. As discussed later, Canadian refiners did not see the same pressure and incentives to process heavier feedstocks, and did not make similar investments. Unfortunately, as the U.S. industry added capacity to process more heavy crude, Saudi Arabia began to cut back on heavy crude production to balance world crude oil supply and demand. As shown in Figure V-12, which shows heavy/light crude price differentials (using Isthmus and Maya crude oils from Mexico), these differentials reduced to very narrow values in the mid-1980s. As heavy crude supplies began to grow again, price differentials were restored in the late 1980s to more realistic values, and our forecast of long term light/heavy crude differentials shown in Figure V-12 reflects a balanced outlook. This level of price differentials should be adequate to encourage refineries to add additional residual conversion capacity.

FIGURE V-12
ISTHMUS/MAYA DIFFERENTIALS



Although the U.S. industry experienced low profitability in the early to mid-1980s following a major period of capital investment, this investment will now permit the U.S. industry to much more readily respond to changes in environmental standards for products. Low sulphur diesel can more readily be made by refineries which already have considerable hydrogen addition capacity to desulphurize sour feedstocks. Similarly, such refineries will have greater capabilities to add hydrogen to its product slate and this will help the industry better make reformulated gasoline compared to those refiners which do not have the same level of hydrogen addition.

The Canadian refining industry has little flexibility to improve its economic position. Its only recourse to improving refining profitability without incurring major capital expenditures to process lower cost feedstock is to increase capacity utilization to increase refining margins, and reduce operating costs. The industry is already in the process of reducing capacity and operating costs. Refining margins are primarily a function of the marketplace, and the Canadian industry must seek approaches which will generate the best margins.

In the previous chapter, it was shown that the maximum wholesale prices would likely occur when the Canadian industry is operating at a high level of capacity utilization, and not relying on exports in a significant way to achieve the high level of utilization. Therefore, further reductions in refinery capacity are recommended, namely shutting down high cost refineries and serving the market with lower cost facilities. The process will likely require supply agreements, transportation agreements, processing arrangements, and possibly even joint ownership of some facilities. For example, it is common for large refineries in Europe to have joint ownership, and the same approach could be attractive in Canada.

The refining industry needs to take similar steps in shutting down refinery capacity as it did in the 1982-84 period. It should consider shutting down more capacity then might be required in a few years, and rely on product imports to meet short-term imbalances. In the longer term, if demand recovers to the point where it encourages existing refineries to expand, at least it will be the more efficient refineries which will receive such expansions.

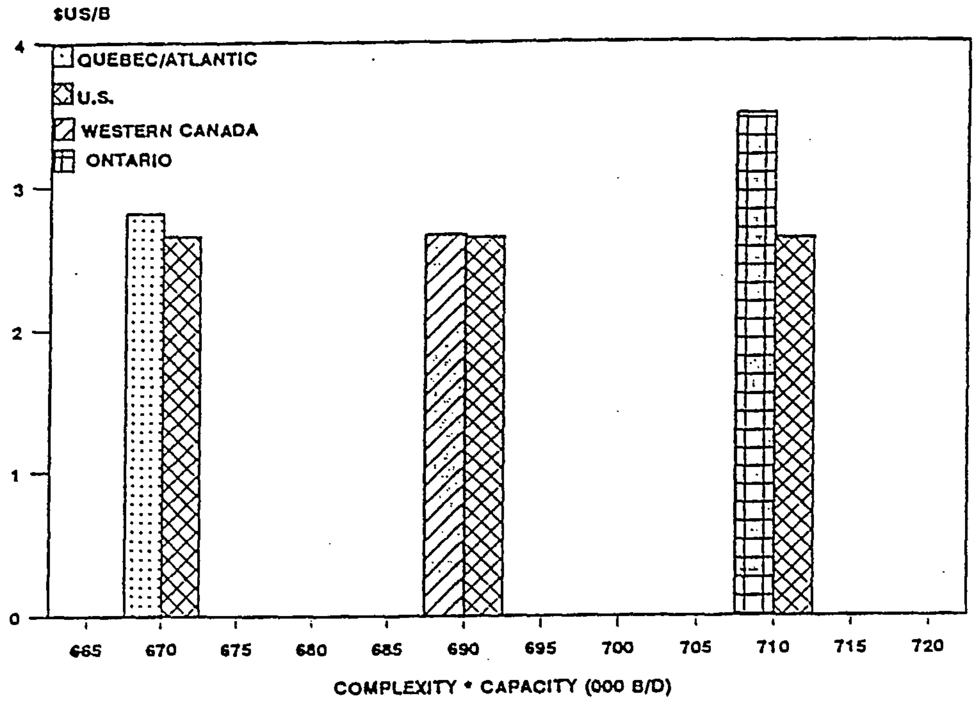
Increasing refining sector profitability will render the industry much more capable of raising the required capital to respond to environmental pressures and to adjust to using lower cost feedstocks. If it results in larger scale facilities, or facilities utilizing lower cost feedstocks, it then should be in a better position to compete with the U.S. market and to capitalize on limited high value export opportunities.

REFINERY OPERATING COSTS

There is a wide range of refinery operating costs, depending on the type of refinery and the type of crude oil processed. Simple refineries have lower operating costs than refineries which are designed to crack heavy feedstocks. Although the U.S. industry has more complex refineries, increases in operating costs have generally been offset by larger scale facilities.

Purvin & Gertz received information from some of the CPPI members on actual Canadian refining costs. The data has been aggregated in Figure V-13. It is shown relative to an index defined as "refinery complexity times the crude capacity". Refinery complexity is a measure of the complexity of processing capabilities developed by W. L Nelson, and is a standard comparison used commonly in the petroleum refining industry. A comparison to U.S. operating costs at the same complexity-capacity level is also shown in Figure V-13. All operating costs shown in this figure include fuel costs from both purchased and internally produced fuel.

FIGURE V-13
REFINERY OPERATING COSTS
(Per Unit of Feed Input)



The Canadian operating costs represent an average for each region. In some cases, some refineries had very high costs while others were quite low. The Western Canadian refineries had operating costs which were essentially the same as U.S. average levels. This reflects the modern, large refineries located in this region.

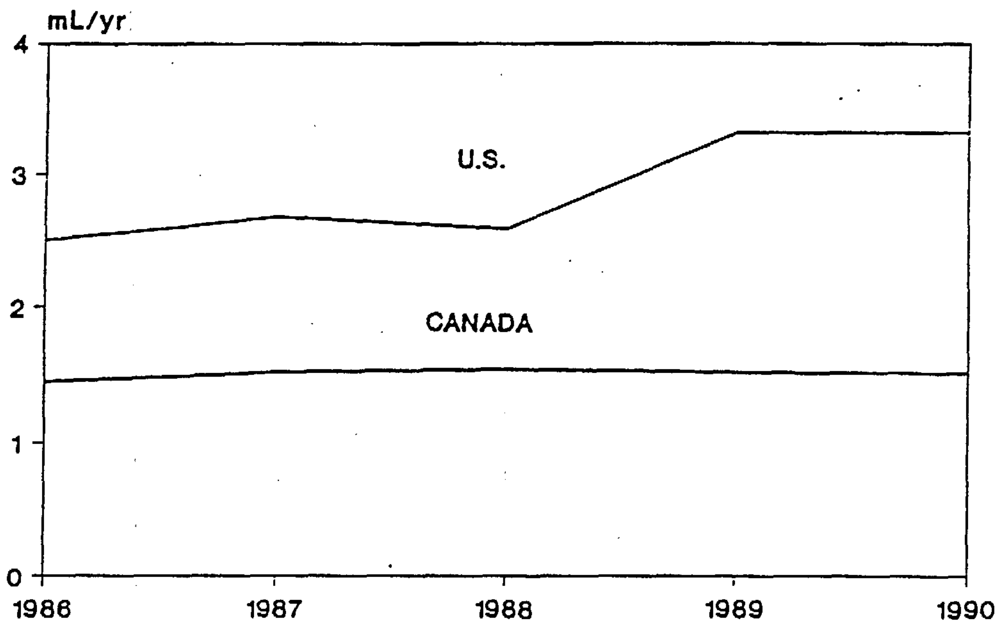
The range of the complexity-capacity index for Canadian refineries is relatively low, and they are grouped quite close together; however, the U.S. industry due to its large and more complex refineries, goes well beyond an index of 2000. For the same complexity level, Canadian refinery operating costs are higher than U.S. costs. The U.S. scale is based on Purvin & Gertz' U.S. operating cost correlation with refinery complexity and size. Based on the data supplied by the CPPI members, Canadian refineries on average have slightly higher labour and maintenance costs than would be expected for the same type of refineries in the U.S. The Canadian industry is already undertaking some reductions in operating costs, but the Canadian climate and location makes costs slightly higher than would be experienced in the southern portions of the U.S. Labour productivity is slightly lower, and fuel quantities will be higher for regions which have colder climates.

MARKETING SECTOR

The Canadian marketing industry experiences higher costs than in the U.S. market. This is not unexpected, because the Canadian market is more fragmented, and has a much lower population density. Only Southern Ontario has a population density which approaches the eastern half of the United States. Greater shipping distances are incurred to supply remote customers. In Eastern Canada, ice in the Great Lakes and St. Lawrence River disrupts product movements during parts of the winter.

Gasoline outlet utilization in Canada is considerably lower then it is in the U.S. market. This is depicted in Figure V-14, which shows that Canadian market outlets operate at around 50% of U.S. average levels. The industry is taking steps to reduce the number of service stations in Canada to improve the viability of this sector. Based on press reports, the major oil companies are considering shutting down close to 3,000 service stations, which will reduce the number of stations by over 15% if they are all taken out of service. Although some of these stations may be re-opened by an independent marketer, most are expected to be shutdown and the sites restored for other commercial uses.

FIGURE V-14
CANADIAN versus U.S. SERVICE STATION
ANNUAL VOLUMES PER STATION

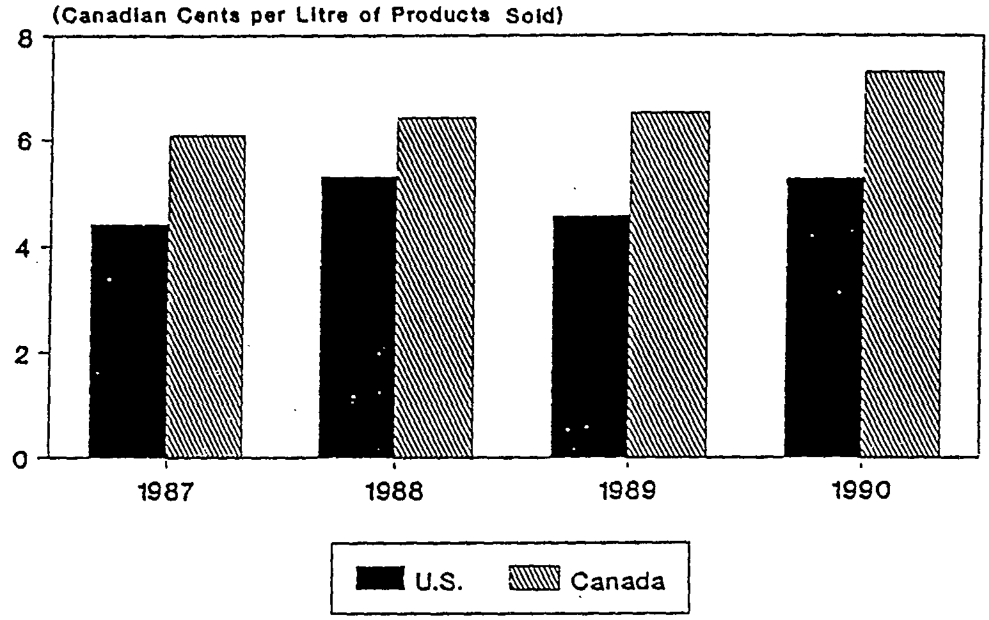


REFINING AND MARKETING PERFORMANCE COMPARISONS

GROSS REFINING AND MARKETING MARGINS

Gross refining and marketing margins are defined as revenue from end-user sales less the cost of feedstock. Canadian margins are higher than in the U.S., as shown below in Figure V-15, to overcome higher costs. Most of the difference occurs in the marketing sector, as the refining sector operating costs are only slightly higher than in the U.S.

FIGURE V-15
COMPARISON OF MARKETING & REFINING
GROSS MARGIN (1)



(1) Value of product sales to end consumers less cost of feedstock.

Higher operating costs are inevitable in Canada because of the distribution of products to a diverse and scattered market. Volume throughputs are much lower than in the U.S., and this has to be accommodated in the marketplace by higher prices to overcome the higher costs. As was shown in Figure V-2, Canada's higher margins have not usually led to higher profits.

UTILIZATION OF REFINING AND MARKETING ASSETS

A comparison of the assets utilized versus product sales in the U.S. and Canadian refining and marketing business is shown in Table V-1. The U.S. market, because of its vast market size, economies of scale, efficient distribution centres, and high density markets, is much more effective in utilizing its assets. According to the comparison below and in Table

V-1, Canada utilizes around three times the investment in assets per unit volume of product sold as does the U.S. market.

REFINING AND MARKETING ASSETS EMPLOYED PER UNIT OF SALES
(Canadian Dollars per Thousand Litres of Sales)

	1986	1987	1988	1989	1990
Canada	132	141	139	158	163
United States	47	46.	45	50	56

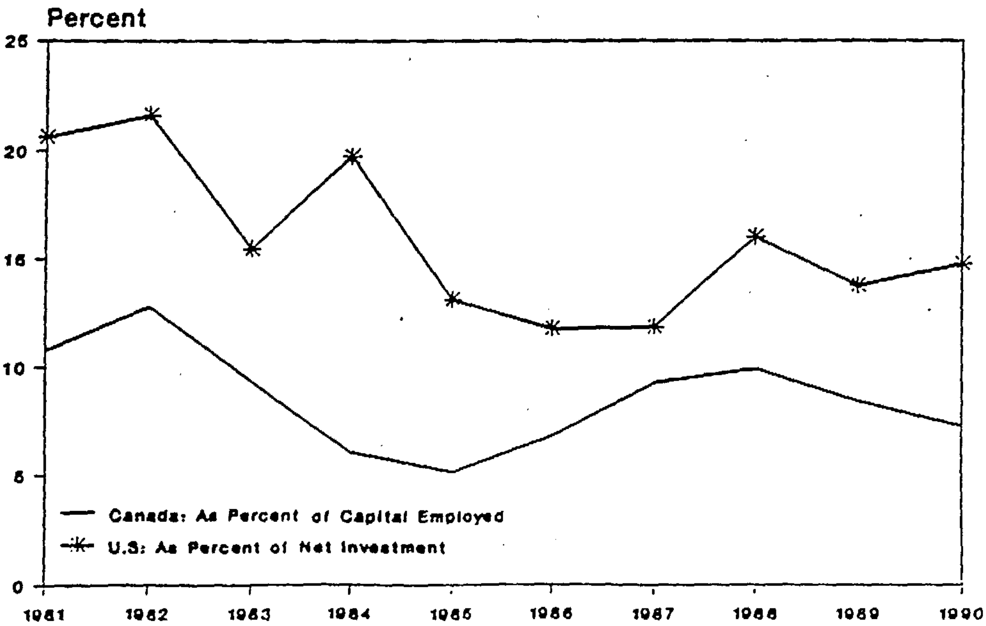
This gap may be narrowed as refining utilization in Canada increases and the more marginal plants are shut down. The marketing gap, though, will remain to some extent because of the size and characteristics of the Canadian market.

Thus, Canadian consumers need to understand the reality that Canada is a higher cost market than the U.S. For the same level of return on assets, Canadian prices will be higher just to reflect the lower scale and lower level of utilized assets in Canada.

CAPITAL EXPENDITURES

The Canadian refining and marketing industry has made considerably less investment in new facilities than the U.S. industry. As shown in Figure V-16, Canadian capital expenditures (as a percent of capital employed or net investment in place) have been only half of U.S. levels over the past decade.

FIGURE V-16
REFINING AND MARKETING CAPITAL EXPENDITURES
AS A PERCENT OF CAPITAL EMPLOYED/NET INVESTMENT



Over the 1981 to 1990 period, the capital expenditures averaged as follows.

REFINING AND MARKETING CAPITAL EXPENDITURES 1981-1990	
Canadian Industry	8.6% of Capital Employed
U.S. Industry	15.9% of Net Investment

Capital employed and net investment in place are Canadian and U.S. terms respectively, but as discussed before, they are very similar for comparison purposes.

U.S. capital expenditures were in the range of 20-30% of net investment in 1979 through 1982. As discussed before, much of this investment was incurred when the U.S. refining industry added a considerable amount of sour, heavy crude processing capacity so as to be able to process increasing levels of imported Saudi Arabian heavy and medium crudes. This major level of investment did not yield a good payout in the early years following construction of these units, but today, those refiners which made these changes have a much greater capability to produce low sulphur diesel fuel oil and reformulated gasoline.

Currently, capital expenditures in both countries are lower than in the early 1980s, and over 50% is being spent on marketing assets.

Lagging behind U.S. levels of capital expenditures has placed the Canadian industry at a greater disadvantage relative to the U.S., primarily on the refining side of the business. The Canadian industry operated under a regulated pricing regime prior to 1985, and this did not provide the Canadian industry with the same price incentives (due to narrower light/heavy crude price differentials) as was experienced by U.S. refiners. U.S. refiners could import Canadian heavy crude at a lower price (relative to light crude) than was available for sale within Canada. Thus, many of the U.S. Midwest refiners increased their competitive position relative to light crude refiners. Now, it is much more difficult for the weaker Canadian players to catch up.

Future capital expenditures for the Canadian industry could be immense. Environmental expenditures will be a major challenge, as they could range from $5 to 16 billion, as discussed in Chapter VI. Additional expenditures to increase the competitive position of the industry, as discussed below, could add considerably to the industry's need for capital. Finally, the shutdown of less efficient assets may result in considerable writedowns over the next several years.

Improving the competitive position of Canadian refineries will likely require additional investment. Some changes will be logical extensions of environmental responses, and others will be the results of separate strategies.

Eastern Canadian Refineries

Some of these refineries may need to take steps to be able to process higher sulphur crudes. Currently, they rely on primarily sweet crude from the North Sea. Although such supplies should continue to be available, they will be sought after by refineries both in Europe and the U.S. East Coast. Therefore, increasing the use of sour crude in these refineries appears inevitable. One of the major problems of processing sour crudes is the difficulty in disposing of the high sulphur residual fuel oil. Although timetables are not yet clear, it is most likely that residual fuel oil will need to have 1.0 to 1.5% sulphur content. Today, levels of 2.5 to 3% sulphur content are still seen in some regions of eastern Canada.

Residual desulphurization has not proven to be a popular refining step, but rather, a reduction in residual fuel oil yield along with increased cutter stock desulphurization is the most probable direction for the industry to consider. Desulphurization of cracker feedstocks and the addition of coking or residual cracking steps are likely processing options. Some of these steps could be undertaken simultaneously with changes to meet environmental requirements such as low sulphur distillate.

For example, the addition of a 20,000 B/D coker, distillate desulphurization, hydrogen plant and sulphur plant could cost in the range of $200 to 300 million. Converting a light cracking refinery to process heavy sour crude with a 50,000 B/D residual hydrocracker, a hydrogen plant, a delayed coker, desulphurization capacity, and sulphur plant capacity could cost in the order of $1 to 1.5 billion, depending on the costs of integration with existing facilities.

Western Canadian Refineries

The refineries located near Edmonton and at Regina are quite sophisticated. Still, the industry could equip itself to process more heavy crude, as such supplies are abundantly available in Western Canada. The costs of such facilities could be in a range of $200 million to $1.5 billion for similar facilities as discussed above. These investments could be part of other investments to equip these refineries to produce low sulphur diesel, and possibly reformulated gasoline.

For refineries located in Ontario and Western Canada, adding facilities to process a greater volume of synthetic crude is another option. Additional hydrotreating facilities would likely be required, and possibly a separate synthetic crude processing train. Synthetic crude may be attractive to produce low sulphur diesel, as it has a very low sulphur content but may require some hydrotreating to improve the cetane number so as to produce a high quality road diesel fuel.

If current rationalization steps result in most of the refineries in the Vancouver area being shutdown, there may be a need to add some extra investment in the Trans Mountain pipeline system in order to deliver specification products. This potential problem is not viewed to be major, but the pipeline will continue to deliver crude oil, and a shutdown of most of the refineries in Vancouver would reduce the ability to clean up any product contamination incurred within the pipeline.

Within a few years, if the Vancouver refineries are rationalized and product demand recovers, there may be some potential to expand refining capacity in Edmonton. Any such capacity additions would be most favourable if done at the same time that these refiners consider investments for improving their operations or for producing low sulphur diesel and reformulated gasoline.

Capital Requirements For Improvements

The extent of capital required by the Canadian industry to improve its competitiveness will vary extensively depending on the steps made, and depending on which industry members undertake such steps. Based on a cursory review, it is estimated that the industry could spend in the order of $7 billion if most of the major refineries in Canada were upgraded to process lower cost feedstocks or synthetic crude, and to reduce high sulphur heavy fuel oil production. Not all refineries will undertake such upgrading, but expenditures in the range of $2 to 5 billion are probable if the industry can maintain a strong profitable position.

Furthermore, major capital expenditures could be required as refiners retire high cost operations, upgrade their processing efficiencies and reduce operating costs. Refineries are usually upgraded over time as technology progresses, new catalyst developments occur, and in response to changes in market opportunities.

As noted above, the industry has been incurring capital expenditures in the range of $1 to 1.5 billion per year for ongoing improvements. This level would need to be maintained in addition to the other matters discussed above.

The capital requirements for the Canadian industry are staggering (as shown below) if the industry is to remain a competitive and strong industry. A strong profitability is needed immediately for the industry to attract the necessary capital.

POTENTIAL CAPITAL EXPENDITURES
IN NEXT 5-7 YEARS
($ Billion)

Ongoing Capital Expenditures	5 - 10
Environmental Improvements	5 - 16
Improvements to Process Lower Cost Feedstocks	2 - 5
Total	12 - 13

ADVANTAGES/DISADVANTAGES FOR CANADIAN INDUSTRY

ADVANTAGES

The Canadian industry has few advantages relative to the U.S. industry. The only advantage which it has is the natural barrier of location of its markets, namely the cost of transporting products from the U.S. or offshore into Canada. This advantage results in prices which can support the domestic refining industry. It is a more effective barrier in some regions, such as the Prairie Provinces than in Southern Ontario. If the industry is in a position to minimize its exports such that it is primarily a net importer, then this barrier should further strengthen wholesale prices.

DISADVANTAGES

There are many disadvantages which the Canadian industry faces that have been presented in this report, and some of the major ones are listed below.

- Pressures by Canadian governments to follow FIFO inventory valuation principles has at times prevented the industry from being able to recover changes in crude costs, resulting in losses to the industry. This has given Canada a major disadvantage relative to the U.S. industry.
- Lower refinery capacity utilization rates in recent years has hurt the Canadian industry by reducing refining margins.
- Canadian refineries are less sophisticated, have a smaller scale, and require more costly crudes than U.S. refiners.
- Domestic sweet crude supply is declining, and Canada will be increasing its reliance on imported crudes which will gradually become more sour. The U.S. industry is more capable of processing sour crudes than is the Canadian industry.
- Higher refinery operating costs occur in Canada for the same level of refinery complexity and size.
- If significant net exports occur, Canadian wholesale prices drop toward U.S. prices less transportation, especially in Ontario and Quebec.
- Utilization of marketing assets is much lower than occurs in the U.S. industry.
- The refining and marketing industry is smaller than the U.S. industry, with lower economies of scale and less ability to afford complex processing capabilities.
- The market is scattered, with problems of sourcing from a distance.
- Income taxes are lower in some U.S. markets (34% in Texas vs. 44% in Ontario).
- Significantly higher product taxes encourage cross border shopping, thus losing markets to U.S. suppliers in certain regions located along the U.S. border.
- High product tax burden provides incentives to break the rules. For example, it provides an incentive for cross border shoppers to re-fuel across the border. Also, different levels of taxation encourage the movement of heating oil across borders to be resold as diesel fuel.

CANADIAN INDUSTRY AT A CROSSROADS

The Canadian industry is in a very difficult position. It is fighting for survival. The industry could retreat by shutting down refineries in certain areas and import product supplies. However, no business wishes to idle assets and write off such investments, but if profitability levels do not improve, major portions of the industry could be threatened.

The following chart compares options for the industry.

CANADIAN INDUSTRY AT A STRATEGIC CROSSROADS

	Retreat	Muddle Along	North American Competitive
Industry Focus	Mainly Marketing	Weakening Refining Sector	Strong Refining Sector
Refinery Rationalization	Acute	Chronic	Strategic
Marketing Rationalization	Substantial	Substantial	Substantial
Product Trade	Net Importer	Balanced	Selective Exporter
Investment	Survival	Survival	Substantial
Employment	Major Decline	Slow Decline	Stabilized
Government Revenue	Major Decline	Slow Decline	Increasing
Government Role	No Change	No Change	Level Playing Field

It is recommended that the industry retrench in the short term to strengthen its profitability. The industry cannot continue to "muddle along". A retrenchment includes the shutdown of some assets, increasing utilization of existing refining and marketing assets, and reducing costs so as to improve its profitability. Then, if the profitability can be maintained, some refiners will emerge to become leaders in the Canadian industry and take advantage of opportunities which new investments will permit. Improving profitability today should prepare the industry to better respond to the competitive and environmental pressures, and the ability to raise the required capital.

TABLE V-1

REFINING & MARKETING ASSET UTILIZATION IN CANADA AND U.S.

	1985	1986	1987	1988	1989	1990
Canada (Total Market)[1]						
Total Capital Employed ($C Million)	14573	10564	11655	11915	13904	14266
Total Product Sales (Billions of Litres)	84.8	80.3	82.8	85.5	87.9	87.3
Assets Utilized Per Thousand Litre Sold						
Canadian Dollars/Thousand Litre	171.85	131.56	140.76	139.36	158.18	163.41
United States (Market Survey)[2]						
Total Capital Employed ($US Million)	34907	36462	36654	37078	39409	42584
Total Product Sales (Million Barrels)	4580	4901	5049	5152	4923	4826
Total Product Sales (Billions of Litres)	728	779	803	819	783	767
Assets Utilized Per Thousand Litre Sold						
Canadian Dollars/Thousand Litre	47.93	46.79	45.66	45.26	50.35	55.50

Notes: (1) Petroleum Monitoring Agency Canada, "Canadian Petroleum Industry 1990 Monitoring Report" and other previous issues.

(2) Energy Information Administration, "Performance Profiles of Major Energy Producers 1990" and other previous issues.

VI
ENVIRONMENTAL PRESSURES

The refining industry throughout the industrialized world faces many pressures to reduce emissions, produce more environmentally friendly products, and to restore old sites to acceptable conditions for re-use in other services. The environmental pressures will have an impact on the viability and competitiveness of industry participants, and this chapter addresses these issues as well as discusses the environmental outlook facing the industry.

Environmental regulations which will have an impact on the oil products business will affect the industry as follows:

ENVIRONMENTAL REGULATIONS

Mobile
- Product Specifications
- Vehicle Emissions Standards

Stationary
- Plant Emission Standards
- Water Quality Standard
- Site Abandonment Procedures

Regulations directed toward mobile sources will have a major impact on refinery competitiveness in both the U.S. and Canada. Obviously, stationary plant regulations directed at refineries in North America could weaken them relative to export refineries which have less stringent environmental regulations, and this is a concern to all North American refineries. Although it is a competitive threat, it is viewed less seriously than the regulations involving product specifications.

COMPARISON OF U.S. AND CANADIAN ENVIRONMENTAL PROGRAMS

UNITED STATES

The Clean Air Act was enacted in 1970 and was amended in 1977 and again in 1990. It set specific air quality standards for the U.S., and granted the Environmental Protection Agency (EPA) the responsibility to monitor each state's attainment and impose economic sanctions on states that did not meet federal targets. 81 metropolitan areas did not meet the December 1987 deadline for achieving the standards imposed by the Clean Air Act. The U.S. Clean Air Act Amendments of 1990 (CAAA) revised the Clean Air Act requirements for reaching and maintaining national ambient air quality standards. Individual states must devise and implement state plans to clean up air quality, and the plans are subject to EPA approval. Non-compliance would likely involve economic penalties. Plans for areas with dirty air, which are called non-attainment areas, must contain pollution control measures to achieve reductions in pollution and achieve attainment by deadlines imposed in the CAAA.

A major component of smog, ozone, is formed from volatile organic components (VOC's) and nitrogen oxides (NO_x). VOC's originate from industries, motor vehicles, and from products such as gasoline and solvents. NO_x are by-products of fuel combustion and are emitted by both stationary sources and motor vehicles. Carbon Monoxide (CO) is a by-product of combustion of fuel in motor vehicles. Particulate matter in the air is also a problem, and can be formed in the atmosphere from pollutants such as sulphur and NO_x, or can be emitted directly as it does in diesel exhaust.

Relevant provisions of the CAAA are summarized below.

U.S. CLEAN AIR ACT AMENDMENTS OF 1990 ESTABLISHES POLLUTION TARGETS

Mobile Sources

- Reduction in Gasoline RVP - Phase II by May 1992
- Low sulphur diesel by late 1993
- Oxygenates in gasoline by late 1992
- Reformulated gasoline by 1995; further reformulation by 2000

Improvements in Emissions from Stationary Sources

- Ozone; limits on emissions of VOC's and NO_x
- Stage II vapor controls at service stations (1994-1995)
- Marine vapor control commencing late 1992
- Carbon monoxide
- Particulate matter
- Air toxics

The CAAA identified non-attainment areas, and programs are required to put these areas into attainment. As a result of the non-attainment in key metropolitan areas, the CAAA stipulated the introduction of reformulated gasoline and/or alternate clean fuels in the nine worst ozone non-attainment areas by 1995. The nine worst ozone non-attainment areas comprise about 21% of the total U.S. gasoline demand.

In addition to the nine worst ozone non-attainment areas, there are 87 areas classified as severe, serious, moderate, and marginal non-attainment areas. The areas have the option to "opt-in" to the program provided that the EPA determines that there are sufficient supplies of reformulated gasoline and/or alternate certified fuels. The 87 other ozone non-attainment areas account for about 31% of the total U.S. gasoline demand. Most, if not all, of the 87 other ozone non-attainment areas are expected to "opt-in" to the clean fuels program during the second half of the 1990s.

The recent Clean Air Amendments set a maximum aromatics specifications of 25 volume percent, a maximum benzene content of 1.0 volume percent, and a minimum oxygen content of 2.0 weight percent for reformulated gasoline to be sold in the nine worst non-attainment regions beginning in 1995. In addition, fuels will have to meet emissions targets for VOCs and NO_x to be certified. The minimum oxygen content is expected to be maintained at the 2.0 weight percent level unless it can be demonstrated that it prevents the attainment of other standards.

There are 41 carbon monoxide non-attainment areas addressed in the current legislation. The CAAA specifies that all carbon monoxide non-attainment areas be supplied gasoline with a minimum oxygen content of 2.7% during the high carbon monoxide period, typically during the winter months. The regulation, to take effect beginning November 1, 1992, will apply for a period of not less than four months per year for each carbon monoxide non-attainment area.

The 41 carbon monoxide non-attainment areas in the United States account for about 31% of the total gasoline demand in the country. It should be noted, however, that 18 of these areas are also ozone non-attainment areas and are covered under the guidelines for the ozone non-attainment program. These areas represent large metropolitan areas in general and account for about 25% of the U.S. gasoline demand. The 23 carbon monoxide non-attainment areas that meet the ozone targets are generally smaller metropolitan areas and account for only about 6% of the U.S. gasoline demand.

REFORMULATED GASOLINE

In the past year, reformulated gasoline has moved from relative obscurity to the forefront of efforts to reduce automotive emissions in the United States. Reformulated gasoline is expected to be the predominant clean fuel of the 1990s and beyond. There are many uncertainties regarding the future composition of reformulated gasoline required to meet the emission standards established in the Clean Air legislation. The 1995 target was agreed to by a complex "regulatory negotiation" (Reg-Neg) process, and the final 1997 rules for reformulated gasoline are still under review. Considerable refinery investments are required to produce and distribute large volumes of reformulated gasoline to the ozone and carbon monoxide non-attainment areas. Based on an analysis by Purvin & Gertz, reformulated gasoline in CO non-attainment areas is expected to be around 30% of the gasoline market in these areas during 1992 to 1995, but still only 10% of the total U.S. market. After 1995, as the nine worst ozone non-attainment areas commence using reformulated gasoline, the total U.S. gasoline market is expected to be made up of 30 to 35% reformulated gasoline, and could reach up to 60% by 2000 as refiners and marketers expand the distribution of reformulated gasoline to other non-attainment areas.

LOW SULPHUR DIESEL

In late 1993, U.S. refiners will be required to produce diesel fuel with a much lower sulphur content when used in the on-highway market. These fuels will be required to contain 0.05% sulphur or less. Only about 45% of the distillate pool will have to meet these more stringent specifications. Though it is still quite uncertain what approach the industry in aggregate will use in meeting these new requirements, it appears that many refiners are moving to be able to produce the lower sulphur material as 100% of their pool. Surveys indicate the probability of more than adequate availability of the new fuel, making it difficult for the high cost refiner on the U.S. Gulf Coast to fully recover the investment to manufacture low sulphur fuel.

IMPACT OF ENVIRONMENTAL COSTS TO U.S. REFINERIES

The cost to U.S. refiners for these programs will be immense. The initial investment to produce low sulphur diesel is estimated at $4 billion (U.S.), and for reformulated gasoline (only to the 1995 level) at $3-4 billion (U.S.). Compliance with just these two CAAA programs could cost $5-6 billion (U.S.) per year. California is proposing a more restrictive reformulated gasoline program. The likely cost impact on the products is expected to be in the following range.

CONSEQUENCES OF U.S. ENVIRONMENTAL PROGRAMS
(Canadian Cents per Litre)

	Increase in Cost to the Industry
Reformulated Gasoline (1995)	2 - 3
California Reformulated Gasoline	5 - 8
Low Sulphur Diesel	1 - 1.3

Including other environmental costs which today can be quantified, the impact on refinery costs could be quite severe, as shown in the table below. Provisions for other environmental costs could cost the industry in the range of $20 to 40 billion (U.S.).

IMPACT OF ENVIRONMENTAL COSTS TO U.S. REFINERIES

	U.S. Cents Per Gallon	Cdn. Cents Per Litre
Gasoline		
Reformulated Gasoline, RVP, Stage II, Underground Tanks	6	2
Waste Control	2	0.6
Air Toxics/Marine Vapor	0.5	0.2
	8.5	2.8
Diesel		
Low Sulphur	3	1
Waste Control	2	0.6
	5	1.6
Other Products		
Waste Control	2	0.6
Air Toxics	0.5	0.2
	2.5	0.8

These increased costs will not likely be totally passed through to the customer. Whereas the large scale refiner with considerable hydrogen treating capacity will likely recover its incremental investment to produce low sulphur diesel and reformulated gasoline, refiners which process primarily light crudes and have limited hydrogen addition and conversion capacity may be less capable of recovering their incremental investments. Some may choose not to make such investments, and gear their products to areas which are in attainment, which have large offroad diesel fuel markets, or export some production to regions (such as Canada) which will either not have the same specifications or will be lagging behind the U.S. These high environmental costs may force the closure of some of the smaller and less efficient refineries in the U.S.

CANADIAN ENVIRONMENTAL PROGRAM

Environment Canada released its Green Plan in 1990, and through this plan, has identified major issues of smog, acid rain, toxics, and climatic change which will impact on the Canadian oil products industry. The Government of Canada made a commitment to reduce NO_x emission by 30%, and VOC emissions by 30%, and the Green Plan reflects these commitments. Reduction in both of these emissions are important in reducing ground level ozone problems. Plans are currently under development to reduce these emissions from internal combustion engines and motor fuels. The Green Plan has adopted an approach of working with industry to achieve its intended goals in a co-operative manner, although the Government has the right to use regulatory controls as it deems necessary.

The Canadian Environmental Protection Act (CEPA) provides the authority to regulate the components or properties of transportation fuels where the products of combustion contribute to air pollution. A Priority Substances List (PSL) was developed for assessment of the toxicity of suspected substances. Thus, Environment Canada's authority over transportation fuel pertains to the combustion products in tail pipe exhausts and to toxic components. It is therefore difficult for Environment Canada to adopt a reformulated gasoline approach, as they do not have a mandate over fuel quality beyond the toxicity criteria.

The members of CPPI have worked effectively at meeting their environment responsibilities. Close interaction with Environment Canada occurred on these issues. It actively participated in the development of a NO_x/VOC Management Plan. It voluntarily reduced gasoline volatility during the summer. Stage I vapor recovery controls in the Fraser Valley area were co-operatively undertaken.

Still, much needs to be done to address the problems of ozone and hazardous air pollutant problems. Environment Canada believes that changes in fuel specifications are required to meet tighter emission standards. Environment Canada has proposed that diesel sulphur be reduced to 0.05% by October 1995. This subject is still under review, and both the Government and industry are studying the implementation and timing.

Benzene, as a PSL substance, is currently under review by Environment Canada. There is enough concern about the toxicity of this component that reductions in benzene content in gasoline are probable, and this may apply to other aromatics in the near future. Other aromatics, which are quite relevant to the refining industry, including xylene, toluene, MTBE, and polycyclic aromatic hydrocarbons are currently under review.

The above programs, although proceeding in a somewhat different fashion than in the U.S., are still aiming at a similar objective. The impact to the Canadian refiner will be major. Depending on the extent of changes, the Canadian refining industry has identified capital expenditures in the range of $5-6 billion, with the possibility of these being as high as $16 billion, as shown below. Such expenditures are extremely high relative to the financial strength of the industry, particularly if they are to be implemented over a short time frame. The potential costs are not only staggering, but they are higher than for the U.S. industry on a per refinery basis because the U.S. industry is better prepared as it has undertaken major changes to process less costly crudes with greater conversion capacity and hydrogen addition capability, and has larger scale refineries.

ENVIRONMENTAL CAPITAL EXPENDITURE ESTIMATES THROUGH 2000[1]

	$ Billion
Low Sulphur Diesel	1.0
Reformulated Gasoline (Initial U.S. Standard)	1.1
Stationary Emissions, Remedial Clean-up	2.6
Other Contemplated Measures:	
Heavy Fuel Oil Desulphurization	0.7-11.0
Advanced Reformulated Gasoline	
CO_2 Reductions	
Toxic Disposals, Marine Vapour Control	
Total	5-16

Note: (1) Informetica Limited "Environmental Action and the Canadian Petroleum Refining Industry, Review of Relevant Costs and Implications for the Industry", prepared for the Canadian Petroleum Products Institute, February 7, 1992.

THE NEED FOR A JOINT INDUSTRY - GOVERNMENT ENVIRONMENTAL PROGRAM

The Canadian environmental requirements facing the industry are still uncertain, and the industry faces the bleak prospect of making changes to respond to environmental changes only to find that subsequent changes may nullify any benefits of previous investments. A co-ordinated plan with a reasonable time table is needed so that industry can better respond to the environmental needs of the country.

At the same time, the U.S. industry is proceeding with its own plans and is leading the world with adoption of specific plans to reduce pollution by modifying fuel quality. New U.S. product specifications will provide some barriers to imported products into their country. Surplus U.S. product not meeting U.S. standards could be dumped into the Canadian market, assuming Canada does not have the same quality standards, which could have a depressing effect on Canadian product prices. Therefore, choosing not to adopt some changes in product quality specifications could place the Canadian industry at a further competitive disadvantage. Under current trade laws, Canada would not be able to restrict other products coming into the country except if they did not meet Canadian specifications.

A CO-ORDINATED INDUSTRY-GOVERNMENT ENVIRONMENTAL PROGRAM IS RECOMMENDED

A new co-ordinated environmental program is recommended. A possible description of it is suggested below:

- A task force should be formed between industry and the Federal Government.
- A co-ordinated industry environmental strategy should be developed
  - need to prioritize environmental objectives
  - consideration given to maintaining a viable industry
  - to be environmentally responsible and responsive
  - a timetable drawn up with a long term program
  - regional considerations must be included
- Canada should establish its own environmental program for this industry which ensures its competitiveness
- Canada should not be pursuing programs in advance of other industrialized nations

The development of a sound environmental program on a co-operative basis should have much merit for both the industry and Environment Canada. It will require a great degree of co-operation, and some "give and take" by individual industry members. Such a plan should not be so weak so as to overly protect the weakest players, nor should it be used to give the strongest players an even greater competitive advantage. Much of the virtues of such a plan would be the focus on priorities and time horizons, and the introduction of specific standards (or barriers) to assist the industry against competition from U.S. products which do not meet U.S. quality standards and therefore could be dumped into the Canadian market with depressing consequences.

Sector Competitiveness Framework
Refined Petroleum Products

Appendix A8

The CPPI Task Force Report on the Working Group on Competitiveness Issues

August 1993

EXECUTIVE SUMMARY

The Petroleum Industry Task Force assigned the Working Group on Competitiveness Issues two tasks. It was to review selected issues affecting the industry's economic and competitive position and recommend actions to enhance all aspects of the industry's performance.

The Group found that there are a number of challenging issues facing both member firms and governments. The industry must respond to changing market and feedstock supply conditions. It must also deal with environmental demands. Governments must ensure that their environmental objectives are clearly articulated and that they are supported by measures which achieve the maximum benefit in a cost-effective way.

Industry members compete in both the broad energy market as well as the petroleum products market. While the period from the 1950s to the early 1970s witnessed increasing penetration of the market for energy by petroleum products, this has been reversed to a large extent since. The Canadian refining industry has come to depend on the market for transportation fuels. The success of other energy forms in non-transportation uses and the likelihood of flat or declining demand for automobiles promises no significant growth in demand for refined petroleum products in general.

The economics of refining and transportation are such that regional petroleum product markets have developed in Canada, but no single, unified "Canadian petroleum products market." Three major regions were identified. Ontario producers use mid-continent feedstock and compete with product imports based on offshore crudes. Atlantic Canada and Quebec use offshore crudes and compete with imported products based on the same feedstock source. Western Canada (with the exception of the B.C. lower mainland) is an "all-Canadian" market based on western crude.

Given the limited prospects for market growth, the Group recommends that governments consider carefully any measure that would negatively affect aggregate demand for petroleum products. This would only intensify competitive pressures on the industry.

Management of the technical components of refining is a critical success factor for the industry's competitiveness. The key elements are feedstock cost, refinery complexity and economies of scale. Remaining Canadian refineries are generally of a scale that should allow them to compete with imported products. However, areas relying on North American feedstock will experience rising costs in the future, which will increase competitive pressures.

Refining competitiveness depends upon access to low cost feedstock and the effectiveness with which it can be processed into high value products. "Complexity" is the refinery characteristic that permits producers to increase the ratio of product slate value to feedstock cost. The average complexity of Canadian refineries is currently below that of competing U.S. refiners but it is increasing (as is that of U.S. refiners).

The Group concluded that refinery scale is an important consideration but not a critical one. Scale economies contribute to competitiveness where a "critical mass" of refining installations are grouped in such a way as to share infrastructure costs.

The Group recommends that the industry be allowed to continue to rationalize operations to increase the average complexity and scale of the Canadian industry. These arrangements are commercial in nature. Governments should not provide support to maintain uncompetitive facilities.

It was also noted that if fuel standards are selected as a means of achieving environmental goals, a Canadian standard with rational regional variation would be preferred. The group recommends broad stakeholder consultations, clearly defined environmental objectives and a careful assessment of all possible alternative instruments.

The Group envisioned the industry's future challenges arising from a variety of sources. There will be requirements for; technological change, a response to the competition from alternative fuels, the management of a complex environmental agenda (including specific problems in the area of environmental liability) and, support, where appropriate, for governments in developing a coordinated approach to environmental issues affecting the industry. There will also be a continuing requirement to coordinate the evolution of product quality with changes in vehicle engine technology. The Group recommends that the CPPI work with motor vehicle manufacturers on this issue.

Alternative transportation fuels are currently positioned as "clean" fuels. It is important that government re-examine the rationale for supporting these fuels in the context of a full cycle analysis of their costs and benefits. The Group endorses the policy review of this issue being carried out by the Department of Natural Resources Canada (DNR Canada, formerly EMR Canada) and recommends that the CPPI and other stakeholders be consulted in this effort. The ideal approach is one that would allow consumers to choose, in the marketplace, among competing fuels whose prices reflect the full cost of their production and use (i.e., including environmental costs).

The complexity and pervasiveness of environmental concerns demand responses that include a mixture of different approaches. The establishment of a scientifically well supported, specific and durable environmental agenda for fuel/vehicle systems is a priority for the industry. The application of priority setting can provide competitive benefits to the industry. It would reduce one source of uncertainty affecting investment decision making. It would permit industry members to develop or select those technologies that will serve their business interests and the public interest. It would also set out clear ground rules by which competing fuels can be compared. The Group recommends that industry, government and other stakeholders work together to define the environmental agenda and identify initiatives that can produce the maximum environmental benefit for the least cost.

Environmental liability associated with site contamination has caused a problem for small operators who wish to sell or close their operations. The Group recommends that government encourage industry and the financial community to work together to find ways to clean up existing sites and facilitate the closure of uneconomic service stations.

Effective environmental regulation will require the coordination of all levels of government. The Group noted the recent establishment of the National Air Issues Coordinating Committee (NAICC) which brings together federal, provincial and territorial officials from both energy and environment departments. The Group recommends that governments continue to explore ways in which their actions can be usefully coordinated and to make use of the advice of other stakeholders where appropriate.

The Canadian petroleum products industry is in the process of an essential long term adjustment after having struggled through a decade of inadequate financial returns. Concurrently with this development, the industry is being called on to modify its practices and products so that its customers and the Canadian public generally can remain confident that the production and use of petroleum products lead to environmentally acceptable consequences.

The WGCI, having examined a range of technical, environmental and economic challenges which confront both the industry and government agencies, has concluded that these challenges can be overcome. A viable petroleum products industry can be an important contributor to the economy if two critical conditions are met - one of which depends on the industry and the other on governments. Industry members must identify trends in required product quantities and qualities, whether arising from customer needs, changes in vehicle technology or new environmental objectives. They must correctly apply technological solutions while continuing to compete vigorously to meet those needs. Governments must ensure that their regulatory activities are fair, consistent and effectively contribute to the accomplishment of clearly prioritized policy goals in the most economic way possible. By working together effectively in building mutual understanding in the work of the Petroleum Industry Task Force, both groups have made a sound beginning on this path

OVERVIEW

The Petroleum Industry Task Force assigned the **Working Group on Competitiveness Issues** (WGCI) two tasks. It was to review selected issues affecting the industry's economic and competitive position and recommend actions to enhance all aspects of the industry's performance.*

The Group has reviewed issues drawn from a variety of sources. The expertise of its members has been supplemented through presentations and submissions from industry members, the investment community and departments within the federal government. The WGCI examined a broad range of information and analysis. This report contains the Group's findings and recommendations.

KEY FINDINGS

The current state of the Canadian petroleum products industry presents straight-forward, but challenging, issues both to member firms and governments. The industry must operate in a way that reflects the principles of sustainable development and responds to the need to integrate environmental and economic decision-making. Existing refining and distribution assets are an important Canadian resource that can provide fuels and feedstock in a cost-effective and environmentally sound way for decades to come. Firms, however, must adopt evolving technology to stay competitive in the North American market. The industry must continuously improve processes and practices, in terms of both cost-effectiveness and environmental impact, to meet stakeholders' expectations. Product quality must continue to evolve to reassure customers that the industry's offering remains an environmentally sound choice.

The environmental demands on the industry are complex. Governments, consumers and the public at large all have expectations of the appropriate industry response to these challenges. In some instances, the certainty associated with regulation will make it the most attractive option. In circumstances where market forces incorporate environmental costs and benefits, a market-based approach will likely be the preferred alternative. In each case, a proposed solution should be rigorously evaluated on its effectiveness in attaining clearly articulated environmental objectives and on its relative cost-effectiveness in comparison to alternative instruments.

The industry presents neither the opportunities of an "engine of growth" sector, nor (except

*See Interim Report to Deputy Ministers of the Petroleum Industry Task Force - Appendix H, January 8, 1993.

on a limited regional basis) the adjustment problems of a sunset industry. It does face environmental challenges that can be met without large scale replacement of assets. Environmental issues are not the only ones in which governments have an interest. They represent, however, the area where government actions will have the greatest influence on industry investment decisions.

For governments, the returns on making careful policy choices are attractive. There is no need for incentives that make a claim on government finances. The guiding principle should be to avoid unnecessary complexity in regulation. By co-operating with stakeholders to establish clear, cost-effective practices, governments can accomplish their objectives. Industry members can then make investments that protect the environment, preserve valuable infrastructure and help sustain an important Canadian industry. Refined petroleum products producers can continue to generate highly skilled and challenging employment opportunities, substantial tax revenues, competitive returns for suppliers of capital and low-cost, high quality products for customers.

The WGCI's key findings have been grouped into three categories; **Market Conditions, Technical Aspects** and **Future Challenges.** They are discussed below.

MARKET CONDITIONS

Firms in the Canadian industry compete both in the broad energy market and in the petroleum products market. The industry's output is one of a number of alternatives for providing energy for transportation, space heating and industrial use. Among users of refined petroleum products, Canadian based firms compete with foreign firms for market share.

The Canadian industry continues to produce a positive trade balance. Firms participate in export markets because industry capacity exceeds actual production, which in turn exceeds domestic demand. In order to push capacity utilization rates higher, many firms rely on exports. Total production is about 1,480 kb/d, of which 270 kb/d (18 per cent) are exported, while imports have been 150 kb/d. Domestic refiners dominate the Canadian petroleum products market with 90 per cent of the total demand of 1,360 kb/d. Petroleum products accounted for 37 per cent of Canada's energy consumption and almost 84 per cent of transportation fuel requirements. Some regional producers, notably those in Atlantic Canada, are far more active in export markets than others.

The organization of petroleum products markets is primarily determined by the economics of transportation. Canadian geography is the principal reason why the Canadian industry is domestically oriented. Refineries stand between the source of the raw material and the marketing network both in terms of the processing stream and geographic organization.

Transportation economics dictate that refineries should, in most cases, be closer to customers than to the feedstock supply.

Transportation economics are critical because of the capital intensive nature of refining. Established plants cannot be easily moved or replaced by new plants closer to markets that change as demographic conditions change. The decision to add capacity may involve a choice between building a new facility closer to developing markets or adding capacity to an existing facility where economies of scale may overcome high distribution costs. The Sarnia area, for example, became a refining centre in the nineteenth century with the development of oil production in southern Ontario. The city was the logical terminus of the first crude oil pipeline from western Canada. It remains an important centre although it no longer enjoys a local feedstock advantage nor is it particularly close to its tributary markets.

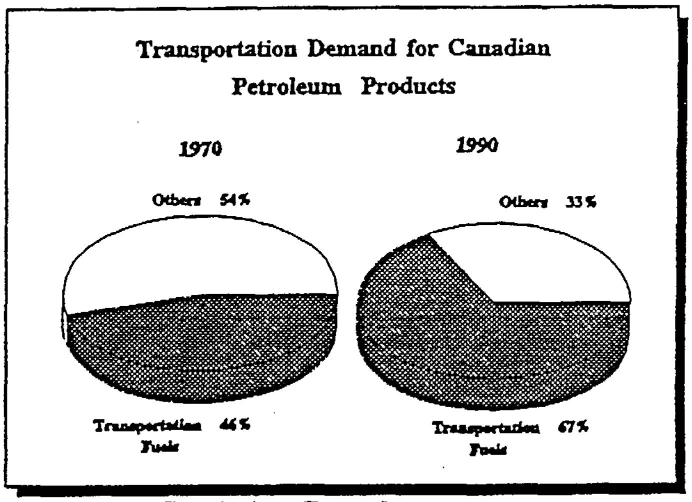
Despite the capital intensity and structural rigidity of refining operations, there is vigorous inter-firm competition within each market. Commodity pricing of petroleum products results in a strong incentive for individual firms to compete for market share. In addition, the industry's cost structure (i.e., high fixed cost and low variable cost) reinforces the intense competition among members. These factors have been noted in earlier investigations of industry performance. Although the investigations concluded that the refined petroleum products industry did exhibit vigorous competition and despite the fact that legal protection (i.e., the Competition Act) is in place to ensure that this continues, there remains a public concern on this issue.

Demand Overview

The industry in Canada and the U.S. enjoyed sustained growth in the 25 years immediately following World War II, but within the last two decades has become a mature industry. Canadian demand for petroleum products grew rapidly in the 1950s and 1960s based on expanding transportation markets and increasing market share for oil products in all energy markets. From the 1950s to the early 1970s rising personal incomes led to an increase in automobile ownership. Freight volumes grew with the pace of economic growth at the same time as trucks were displacing rail as the preferred mode of transport.

While transportation was the core market for refined petroleum products, oil was competing successfully across most energy uses. It developed important market shares in home and commercial heating markets, in industrial fuels and in power generation. The successful penetration of energy markets was largely due to the price advantage of petroleum products. The largest component in the cost of production of petroleum products is the price of crude oil. Throughout this period world crude prices were low in relation to competing fuels (and in relation to historic levels).

The world oil price shock of 1973 changed this pattern. The price of petroleum products increased significantly relative to other fuels on an energy equivalent basis. What followed was almost a reverse of the conditions prevailing in the 1950s to early 1970s period. Demand growth halted momentarily and then slowed to 2% per year until demand peaked at 1,750 kb/d in 1980. Petroleum product demand then fell by 5% per year through 1985. The overall volume decline from 1980 to 1985 was 375 kb/d.



SOURCE: Statistics Canada

In addition to the change in the relative price of petroleum products, government policy increased energy conservation, subsidized consumers' switching costs to "off oil" alternatives and encouraged the extension of the natural gas delivery infrastructure. The policy promoted certain fuels at the expense of others. Petroleum products began to lose market share in non-transportation uses. Other fuels successfully penetrated residential heating, commercial heating, industrial and power plant markets. All of these influences helped to curtail demand for petroleum products. In most of these markets petroleum products do not have the form premium (i.e., extra value attributed to their versatile handling and storage characteristics) that they enjoy in transportation markets. In the 1970s and early 1980s, they became simply "high-priced BTUs."

At the same time, transportation markets were beginning to mature as the shift to road transportation had largely been completed. There were also significant improvements in automobile efficiency. Petroleum products, however, continued to dominate this market because of their form premium. As a result of these developments, the Canadian refining industry is dependent upon trends in the transportation sector for its long-term prospects. The Canadian industry is, in fact, more heavily concentrated in transportation fuels than the refining industries of other industrial economies.

In 1986 world oil prices declined substantially and have not increased significantly in real terms since. Despite this, product demand growth has been modest and the recession of 1991/92 has further dampened demand. The Group reviewed an outlook that projected a continuation of this trend into the next decade in both Canada and the U.S. Petroleum products are not expected to recapture market share in non-transportation uses; share is, in fact, expected to decline further. The key road transportation market promises at best stable or possibly declining demand.

Geographic Markets

The constraints imposed by transportation economics have resulted in regional petroleum product markets in Canada. There is no single, unified "Canadian petroleum products market." Refiners compete within regional groupings and with adjacent U.S. markets, but only rarely across Canadian regions.

The Group identified three regional markets:

- i) Ontario and northern PADD II,
- ii) Western Canada,
- iii) Quebec, Atlantic Canada and the U.S. eastern seaboard.

Each of these regions has distinct competitive conditions. In Ontario, domestic refiners' feedstock is priced based on the North American crude oil market, while product imports are priced based on the offshore petroleum product market. In Quebec and Atlantic Canada, both domestic and imported products are based on offshore market prices. The Western Canadian region is the only one which is virtually a Canadian only market. With the exception of the British Columbia lower mainland, all of its products and crude oil feedstock are Canadian produced. A more detailed discussion of these markets is provided in Appendix B.

Government policy continues to have a significant influence on demand for petroleum products and the health of the industry. Greater reliance on market forces has been welcomed by the industry. In the upstream, the National Energy Board deals with long term feedstock supply and carries out its responsibilities under a clearly defined mandate. The downstream industry is, however, particulary sensitive to intervention. Government measures that reduce aggregate demand for refined petroleum products or put them at a relative disadvantage in one end use market only intensify competitive pressures on the industry.

Recommendation

The group recommends that governments carefully consider the full implications on the market for petroleum products of any proposed intervention.

TECHNICAL ASPECTS

The industry's ability to respond to competitive challenges is directly linked to the management of the technical aspects of the refining process. Refiners are, for the most part, "price takers." Their ability to generate operating earnings is a function of maintaining or increasing sales volumes and sustaining margins through cost control. In a mature industry, with limited or no market growth, operating margins and cost management are key success factors.

Key Elements of Cost Structure

The Group identified three central determinants of refining cost competitiveness; feedstock costs, refinery complexity and plant scale. While economies of scale are important in keeping costs per unit of output within manageable bounds, refinery complexity and feedstock costs are the key elements in the Canadian industry's competitiveness.

Feedstock Cost

Refining competitiveness depends upon access to low cost feedstock and the effectiveness with which it can be processed into high value products. Canada's refineries in Western Canada and Ontario are designed to process light, sweet (i.e., relatively costly) Western Canadian crude oil. Canadian refineries with access to Western Canadian crude oil (whose total capacity is approximately 1,240 kb/d) ran only 13.2 per cent heavy crude during 1992. Heavy crude, however, accounted for almost 32 per cent of total Canadian production (and this proportion will increase). About 60 per cent of the heavy crude refined in Canada is used for the production of asphalt, rather than high value products. The capability of conventional Canadian refineries to upgrade heavy crude oil to transportation fuels is limited.

As mid-continent crude production falls, costs in Ontario are expected to rise relative to tidewater refining centres, even if the Sarnia-Montreal pipeline were reversed. Western refiners' profitability will not be as affected in the near term. Since refineries in Quebec and Atlantic regions were designed to run a variety of imported crude, access to appropriate feedstock is not anticipated to be a problem for them. Their processing technology, however, makes them dependent on relatively light crude and even these producers could begin to experience competitive pressure from foreign refineries processing cheaper feedstock.

Refinery Complexity

A relatively greater degree of refinery complexity increases a refiner's ability to produce a higher value product slate from a given feedstock or to produce a given product slate from a lower cost feedstock. Complexity is measured by the relative amount of equipment and resources used in comparison with a standard crude processing unit. An investment in a more complex refinery configuration will improve competitiveness if it increases margins by

The effect of refinery complexity on refinery economics (in dollars per barrel)

	Medium Complexity Light Crude	High Complexity Light Crude	High Complexity Heavy Crude
Product Value	20.55	23.70	23.47
Crude Cost	18.31	18.31	13.67
Operating Costs	1.85	2.39	3.39
Net Margin	0.39	3.00	6.41

SOURCE: CPPI

TABLE 1

a greater amount than the added fixed costs.

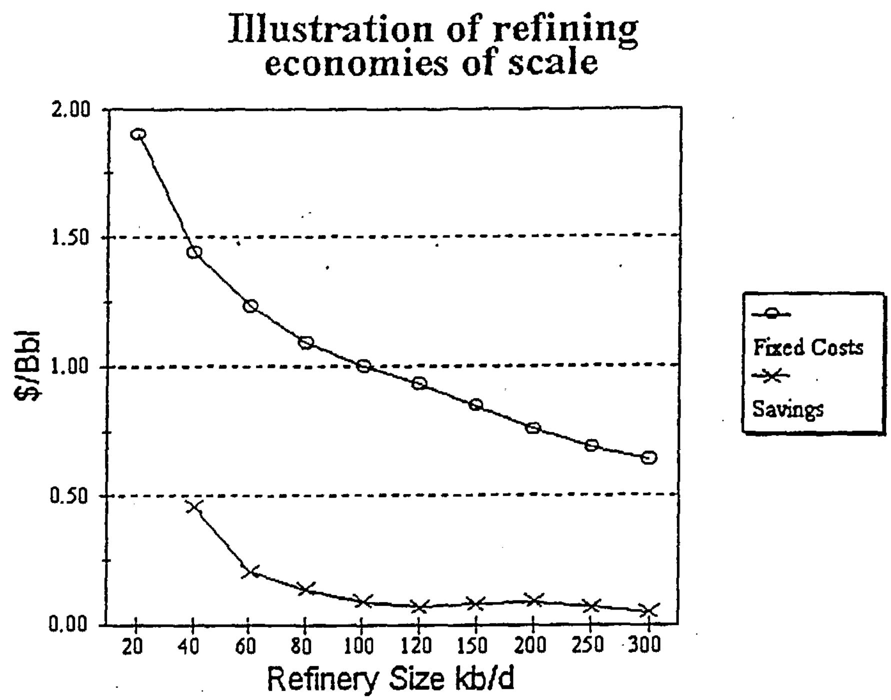
The average Canadian refinery complexity is below that of competing U.S. plants but it is increasing. As U.S. refineries continue to rationalize their facilities, their average complexity will rise and unit costs will fall. A study of North American refineries by Solomon Associates concluded that there was a significant correlation between the cash operating costs for refining and the corresponding level of complexity.

Economies of Scale

Larger refineries spread their fixed costs over greater throughput volumes, resulting in lower unit costs. For refineries with capacities greater than 80 kb/d, the effect of economies of scale is relatively minor (see graph following page**). Canadian refineries are generally within the mid-range of U.S. plants and are comparable in their efficiency. In some cases, however, Canadian refineries must often compete directly with U.S. refineries of considerably larger scale.

The Group concluded that refinery scale is a contributing factor to competitiveness, but its importance should not be exaggerated. Refineries with large production capacity do not

*******Illustration of refining economies of scale.*** The graph indicates that as refinery scale increases (horizontal axis) fixed production costs per barrel (vertical axis) of production decline. The top line illustrates the costs per barrel and the bottom line indicates the savings, or reduction in fixed costs, as larger scale plants are selected.



SOURCE: Department of Natural Resources Canada

always enjoy economic efficiency benefits. In some cases, the relatively large capacity is not provided by larger scale equipment, but rather it reflects the accumulation of small scale refining unit additions.

Scale is an important consideration where a "critical mass" can be established. In the United States there are several large population centres that support clusters of refineries. These clusters have evolved into refining centres made up of a number of large, complex refineries. Under these circumstances the installation of supporting infrastructure can be shared, with cost savings for all. Table 2 (following page) lists the main North American refining centres.

Canada's lower population density, and corresponding level of product demand, has prevented the creation of large clusters of refining capacity. There is, however, the potential for two such centres - in Edmonton and Sarnia. Other refining locations in Canada have no more than two refineries.

Increasing complexity is an inevitable trend for larger refineries. It usually results in higher product values or lower feedstock costs. These benefits far outweigh the economies of scale.

North American refining centres

	Number of Refineries	Total Capacity (kb/d)	Average Capacity (kb/d)	Refineries of Size <80 (kb/d)	80-120 (kb/d)	>120 (kb/d)
US Gulf Coast	36	5923	165	11	6	19
Okla./N.Texas	17	918	54	13	3	1
Los Angeles	16	1499	94	9	3	4
Delaware Basin	11	1330	121	2	3	6
Puget Sound	7	526	75	3	2	2
San Francisco	6	579	97	2	2	2
Chicago	5	752	150	2	0	2
Wood River	5	601	120	3	0	2
Detroit/Toledo	5	502	101	2	0	3
Ontario	5	510	102	2	2	1
Edmonton	3	355	118	1	0	2

Note: Ontario refining centre includes Petro-Canada's Lake Ontario refineries as one refinery. Nova is not included with Ontario refineries.

SOURCE: Department of Natural Resources Canada

TABLE 2

Recommendation

The Canadian industry can increase the average scale and complexity of its facilities through rationalization. Much of this has taken place, but further action is necessary through arrangements that are commercial in nature. Governments should not provide support to maintain uncompetitive facilities.

Fuel Standards

The development of Canadian environmental fuel standards could influence the industry's competitive position with respect to the U.S. industry. The U.S. regulatory regime developed in an uneven way, exhibiting some hesitations and "false starts." As a result, the investment program that the U.S. industry has undertaken to respond to fuel standards has not been as efficient as it might have been. Canada is just now beginning to deal with the same issues that were faced in the U.S. Canadian policy makers have an opportunity to learn from the American experience and to facilitate a more efficient industry investment program in Canada.

The U.S. Clean Air Act amendments of 1990 are beginning to be reflected in fuel quality standards in that country. They differ among regions and even localities. Rules have been established to police interstate product movements that might attempt to evade regional standards. There exists an incentive to move "below standard" products into the Canadian market, which would result in competitive pressure on the Canadian industry.

Canadian firms could find their competitive position strengthened relative to U.S. refiners, through the development of a Canadian standard with rational regional variation. A simple regulatory regime would achieve environmental objectives and eliminate the incentive to import products with inferior environmental characteristics. Canadian firms would then be able to develop, produce and market upgraded gasoline in the most efficient way possible.

Recommendation

The group recommends that a forum be established to draw in all concerned stakeholders. If fuel standards are to be developed, they should be done so in support of clearly defined objectives. Moreover, proposed standards should be tested against other instruments that could achieve the same objectives in order to select the most cost-effective approach.

FUTURE CHALLENGES

The Group has identified the following items as the most important challenges facing the refining industry's competitiveness in the years to come.

Technological Change

The industry will have to continue the advances that have been made in coordinating product quality with changing vehicle engine technology. Significant improvements in engine performance and emission levels have been made over the past twenty years (e.g., CO and HC down 96 per cent, NO_x down 76 per cent). There is more scope for improvements through joint efforts. Motor vehicle engine technology and fuel requirements need to be treated as an integrated system.

Canadian refineries are well positioned to implement technological change. New technology is readily available either from affiliated companies or from a multitude of technology and engineering companies worldwide. The industry has demonstrated in the past its ability to change.

Recommendation

The CPPI and motor vehicle and engine manufacturers should work together to deal with the engine/fuel issue and to position both industrial sectors to take advantage of market trends.***

Alternative Transportation Fuel Development

Refined petroleum products face competition from alternative transportation fuels whose appeal is generally based on perceived environmental benefits. A rigorous assessment should be made of the full cycle costs and benefits of all transportation fuels. The interests of the public and consumers will be best served only if they can make a balanced assessment of all of the offerings in the market place.

Gasoline and diesel fuel have been the prime transportation fuels for on and off road vehicles for decades. Alternative fuels have recently gained increased attention. These fuels include LPG (liquefied petroleum gases), CNG, methanol, ethanol, electricity and hydrogen. To the extent they penetrate their target markets, these fuels reduce the demand for gasoline and diesel fuel and exacerbate the over supply of refined petroleum products.

Alternative fuels are positioned currently as "clean" fuels. It is important to identify clearly the environmental benefits, or lack thereof, for each alternative in comparison with gasoline and reformulated gasoline. There are a variety of federal and provincial subsidies and incentives on alternative fuels. The rationale for each of these needs re-examination. Fuel subsidies can lead to inaccurate market signals that result in consumer decisions that are both economically inefficient and environmentally harmful.

It is the understanding of the working group that the Department of Natural Resources Canada (DNR Canada, formerly EMR Canada) is undertaking a policy review in this area. Such a review should include an examination of the desired government policy objectives and an assessment of the full fuel cycle costs and benefits of transportation fuel alternatives. We support broadly based consultation on this review.

Recommendation

***The group notes that a forum has been established in this area - the **Joint Committee on Transportation Fuels and Motor Vehicle Control Technologies.**

The policy review of alternative fuels that is underway in DNR Canada is fully supported. CPPI, as well as other stakeholders, should be consulted in this effort. The ideal approach is one that would allow consumers to choose, in the marketplace, among competing fuels whose prices reflect the full cost of their production and use (i.e., including environmental costs).

Environmental Agenda

The environmental agenda, as it affects the petroleum products industry, is becoming increasingly complex both from a technical and from an administrative standpoint. The Purvin and Gertz study, which preceded the work now underway, estimated the potential environmental and other costs that may be required to solve technical issues in the industry. Environmental accountability is being demanded not simply by governments, but increasingly by consumers and the public at large. To remain competitive in the long term, the industry must provide fuel products that meet society's environmental demands.

The complexity and pervasiveness of environmental concerns demand a mixture of different approaches. In some cases the certainty provided by regulation may make it the preferred policy option. However, in situations where the market signals take account of environmental costs and benefits, a market-oriented approach is preferred.

The most pressing problem for the industry over the next 10-15 years is to address the question of reformulated transportation fuels (gasoline and diesel). Technology exists for producing highly reformulated fuels, but certain reformulations may yield little environmental benefit relative to their costs. Decisions must also be made in the context of emerging North American vehicle technologies. The best solution will meet Canada's environmental requirements and be cost competitive.

The work of the Priority Setting Working Group should, as it develops, help to focus on those initiatives that can be undertaken at minimum cost but which maximize environmental benefits. It is important to assess priorities openly. The establishment of a scientifically well supported, specific and durable environmental agenda for fuel/vehicle systems is a priority for the industry. The establishment of clear priorities can provide competitive benefits to the industry. It would reduce one source of uncertainty affecting investment decision making. It would permit industry members to develop or select those technologies that will serve their business interests and the public interest. It would also set out clear ground rules by which competing fuels can be compared.

Recommendation

A key factor in the competitiveness of the industry is a proactive approach to addressing environmental questions from the point of view of the long term survival of the industry, how the environment is impacted and how the public perceives the impacts. It is also important for the industry, government and other stakeholders to work together in defining the environmental agenda and identifying initiatives that produce the maximum environmental benefit for the least cost.

Environmental Liability

Small business people own about 65 per cent of Canadian service stations. When a station closes, a variety of local and provincial regulations require expensive cleanup procedures for the site. The costs often exceed the owner's equity in the real estate involved. Moreover, environmental liabilities are making it virtually impossible to sell a site if there is any risk of residual contamination. For small business owners, the land may be their only asset of value. As a result, they risk personal bankruptcy if they attempt to close what is otherwise an uneconomic business.

The uncertain nature and extent of environmental liability has two important effects on marketing operations. The potential clean-up costs associated with the closure of a marketing site constitute a barrier to exit from the industry, which reinforces continuing overcapacity. This situation also frustrates the sale of operating sites to new owners who wish to continue the business as a going concern. In general terms, the uncertainty surrounding environmental liability impedes market forces from effecting the transfer of assets to their most efficient use.

There are efforts now underway in the Canadian Council of Ministers of the Environment (CCME) to establish common principles for environmental liability amongst the provinces. New equipment standards and operating procedures for service stations should reduce the probability of contamination in the future.

Recommendation

Industry, governments and the financial community need to work together to find ways to clean up existing sites and facilitate the closure of uneconomic service stations. The CCME should take a leadership role in bringing stakeholders together on this issue, as an extension of its work on environmental liability. It is the responsibility of industry and governments to cooperate to ensure that site cleanup criteria protect public health and safety on a cost-effective basis.

Federal-Provincial Co-operation

An effective government response to environmental issues requires the coordination of all levels of government. Environmental objectives and industry planning will be best served by avoiding administrative duplication and uncertainty about government objectives.

The Group noted the recent establishment of the National Air Issues Coordinating Committee (NAICC) which brings together federal, provincial and territorial officials from both energy and environment departments. The NAICC is a response to concerns raised about the need to coordinate approaches to air quality issues. The role of other stakeholders in this organization is under development.

Recommendation

The Group recommends that governments continue to explore ways in which their actions can be usefully coordinated and to make use of the advice of other stakeholders where appropriate.

CONCLUSIONS

The Canadian petroleum products industry is in the process of an essential long term adjustment. At one time, its growth supported and was supported by growth in the economy as a whole. The industry, while remaining large in terms of share of total economic activity, will no longer grow appreciably in terms of real output or employment. Because of the longevity of both refining and marketing assets, this transition will take some time to be accomplished. It comes after the industry has struggled through a decade of inadequate financial returns.

Concurrently, the industry is being called on to modify its practices and products so that its customers and the Canadian public can remain confident that the production and use of refined petroleum products lead to environmentally acceptable consequences. For this goal to be accomplished, new investments must be made on the basis of sound science, clearly defined objectives and confidence in the future marketplace.

The WGCI, having examined a range of technical, environmental and economic challenges that confront both the industry and government agencies, has concluded that these challenges can be overcome. A viable petroleum products industry can be an important contributor to the economy if two critical conditions are met - one of which depends on the industry and the other on governments. Industry members must identify trends in required product quantities and qualities, whether arising from customer needs, changes in vehicle technology or new environmental objectives. They must correctly apply technological solutions while continuing to compete vigorously to meet those needs. Governments must ensure that their regulatory activities are fair, consistent and effectively contribute to the accomplishment of clearly prioritized policy goals in the most economic way possible. By working together effectively in building mutual understanding in the work of the Petroleum Industry Task

Force, both groups have made a sound beginning on this path.

APPENDIX A - Digest of Recommendations

MARKET CONDITIONS

The group recommends that governments carefully consider the full implications on the market for petroleum products of any proposed intervention.

TECHNICAL ASPECTS

Key Elements of Cost Structure - The Canadian industry can increase the average scale and complexity of its facilities through rationalization. Much of this has taken place, but further action is necessary through arrangements that are commercial in nature. Governments should not provide support to maintain uncompetitive facilities.

Fuel Standards - The group recommends that a forum be established to draw in all concerned stakeholders. If fuel standards are to be developed, they should be done so in support of clearly defined objectives. Moreover, proposed standards should be tested against other instruments that could achieve the same objectives in order to select the most cost-effective approach.

FUTURE CHALLENGES

Technological Change - The CPPI and motor vehicle and engine manufacturers should work together to deal with the engine/fuel issue and to position both industrial sectors to take advantage of market trends.

Alternative Transportation Fuel Development - The policy review of alternative fuels that is underway in DNR Canada is fully supported. CPPI, as well as other stakeholders should be consulted in this effort. The ideal approach is one that would allow consumers to choose, in the marketplace, among competing fuels whose prices reflect the full cost of their production and use (i.e., including environmental costs).

Environmental Agenda - A key factor in the competitiveness of the industry is a proactive approach to addressing environmental questions from the point of view of the long term survival of the industry, how the environment is impacted and how the public perceives the impacts. It is also important for the industry, government and other stakeholders to work together in defining the environmental agenda and identifying initiatives that produce the maximum environmental benefit for the least cost.

Environmental Liability - Industry, governments and the financial community need to work together to find ways to clean up existing sites and facilitate the closure of uneconomic service stations. The CCME should take a leadership role in bringing stakeholders together on this issue, as an extension of its work on environmental liability. It is the responsibility of industry and governments to cooperate to ensure that site cleanup criteria protect public health and safety on a cost-effective basis.

Federal-Provincial Co-operation - The Group recommends that governments continue to explore ways in which their actions can be usefully coordinated and to make use of the advice of other stakeholders where appropriate.

APPENDIX B - Profiles of Canadian Regional Markets

The WGCI identified three regional Canadian markets:

- Ontario and Northern PADD II,
- Western Canada,
- Quebec, Atlantic Canada and the U.S. eastern seaboard.

The following is an overview of the critical features of each.

Ontario

Ontario is the most complex and most vulnerable market in Canada. Ontario refiners are concentrated in southern Ontario between Sarnia and Toronto. Their principal feedstock source has been domestic Canadian light crude oils from western Canada shipped from the West on the InterProvincial Pipeline.

Western Canada produces a surplus of crude oil for its own requirements and those of Ontario. The clearing market for western Canadian crude oil has, therefore, been the Chicago market. Chicago and the adjacent areas contain a large concentration of refining capacity supplying much of the U.S. northern mid-west and it is also the terminus of a number of crude oil pipelines from west Texas, Oklahoma and the Gulf Coast. The InterProvincial system also passes through the Chicago region on its route to Sarnia.

The price of Canadian crude has tended to reflect parity with the costs of other crudes landed in Chicago (adjusted for transportation). Since Ontario refiners must pay the additional transportation for the Chicago to Ontario leg of the IPL system, they start with a feedstock disadvantage to Chicago and Toledo refiners, should they try to compete in the U.S. Midwest.

Closer to the Toronto area, Ontario refiners are exposed to competition from east coast U.S. refiners and from eastern seaboard product imports. For example, Buffalo, New York, is the terminus of two product pipelines that can ship refined products from the New York harbour area. In addition, there has been an increasing trend to bring product imports into Ontario by ship through the St. Lawrence Seaway, which augments international competition for Ontario refiners.

The latter competitors use Atlantic Basin crudes as their feedstocks, unlike Ontario refiners which use inland North American crudes - principally Canadian. The relationship between the prices of crude oil on the east coast and in the interior of North America - particularly Chicago - is therefore a critical factor affecting the competitiveness of Ontario refiners.

Ontario refiners' crude cost is among the highest in the world refining industry because of Ontario's position at the end of pipeline systems in the interior of a large net crude oil importing continent. This competitive disadvantage is expected to worsen. As U.S. inland crude oil production declines, reflecting the general maturity of onshore Texas and Oklahoma as producing provinces, more expensive pipeline routings will have to be used to supply a growing volume of crude oil imports into Chicago. The marginal cost of crude oil landed into Chicago will increase relative to world crude oil prices generally.

For the Ontario refiner, this means an increase in the cost of feedstock as determined in the Chicago market relative to imported product competition derived from east coast crude oil not experiencing the same relative price increase. The Ontario refiner will probably come under an increasing margin squeeze as a result.

Western Canada

The Western Canadian region takes in the four western provinces and a portion of western Ontario traditionally supplied from western refineries - essentially the Thunder Bay area and west. This region is relatively self-contained and, while experiencing intense internal competition, is less exposed to external competition. Population distribution in most of Canada and the U.S. in this region is relatively sparse. Therefore, if a refining centre in one country attempts to capture significant market from another centre in the other country, it must expect to incur relatively large distribution costs to do so. Low market density means that a lot of ground has to be covered to sell reasonably small volumes of product.

The significant exception has been the lower mainland areas of British Columbia. Refineries in the Vancouver area have been exposed to ongoing competition from imports from large, efficient refineries in the Puget Sound area of Washington. Canadian refineries face further disadvantages in feedstock costs. Vancouver refineries have typically used B.C. and Alberta crude, the costs of which reflect market conditions in Chicago. Puget Sound refiners, on the other hand, have been able to use Alaska North Slope (ANS) among other crudes. This has given them a significant feedstock cost advantage. Under U.S. law ANS can only be sold in the U.S. and therefore its marginal outlet has usually been the U.S. Gulf Coast refining centre. The price of ANS has tended to be set by Gulf Coast prices. The prices in Puget Sound also reflect Gulf Coast levels, less the considerable freight charges associated with crossing Panama.

The Canada-US Free Trade Agreement did give Canadian refiners access to ANS but Vancouver area refineries were not configured to deal with this heavier, sour crude. In any case, it was unlikely to be acceptable environmentally to bring large quantities of crude oil into Vancouver harbour by ship.

The operators of all but one of the Vancouver area refineries have decided to supply British Columbia markets from Edmonton refineries, filling out available capacity in Alberta. This should enhance the competitiveness of the remaining western Canadian refineries.

Quebec/Atlantic Canada

Quebec has refineries located in both the Montreal and Quebec City areas. Quebec City has always relied on crude oil imported by ship from the Atlantic Basin as its feedstock and is open to competition from east coast product imports. Its situation is not unlike that of the Atlantic Canada refiners.

Following the completion of the Sarnia to Montreal extension of the Interprovincial system, Montreal refiners could use Canadian crude oil as a feedstock while exposed to product competition from east coast imports. That situation was similar to the problem described above for Ontario. Partly as a result, Montreal refiners gradually reduced their consumption of western Canadian crude in preference for imports.

The market setting for Atlantic Canada refineries is one in which there is active trade in water-borne bulk cargoes of both crude oil and the major refined products. The east coast of the U.S. and Canada as a whole does not have sufficient refining capacity for its own requirements and has limited local supply of crude oil. Crude oil is drawn from imports largely from Europe, Africa and South America. There are additional product imports from refineries in the Caribbean and even from Europe and the Mediterranean. Because of the relative ease with which refined product can be transported by ship, refiners in Atlantic Canada are exposed to competition from all these sources.