"The Behavior of Heavy Fuel Oil Prices in the Prov. of Quebec

ABSTRACT

Michel L. Lapointe

"The Behavior of Heavy Fuel Oil Prices In the Province of Quebec: A Short Analysis of the Past, a Look at the Future up to 1980"

Dept. of Economics, Master Degree

This thesis focuses on a price analysis of heavy fuel oils in the Province of Quebec. Part I deals with the factors, both direct and indirect, that caused disruptions and tightening of supply in 1970, including the attitude of OPEC and the bottleneck of marine transportation facilities. Part II represents an attempt to foresee and assess the major factors that could affect the production and cost of heavy fuel oil during the seventies: here I scrutinize the cost of alternate sources of energy such as coal, natural gas, and crude oil. I also examine the expected attitude of OPEC in the future, the technology and the impact of desulphurising oil based fuels, and the development in the field of marine transportation.

My analysis of these factors together with other assumptions outlined in the core of the study allow me to predict expected increases in the average landed price of heavy fuel oils between $2.00 to $2.40/bbl.

McGill University

"THE BEHAVIOR OF HEAVY FUEL OIL PRICES IN THE PROVINCE OF QUEBEC: A SHORT ANALYSIS OF THE PAST, A LOOK AT THE FUTURE UP TO 1980"

Thesis for Master of Arts Degree

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Michel L. Lapointe

PREFACE

Equally important as the wheel in the primary evolution of mankind is energy. History has demonstrated that economic progress and the abundant availability of energy are closely interwoven.

Because energy is therefore so important to the future welfare of Quebec, it is essential that as much as possible be known about the longer range outlook in terms of its energy needs, how they can be filled and at what cost to the people of Quebec. This thesis focuses on one aspect of the provincial energy picture, namely present and expected prices of heavy fuel oils.

Before getting into the core of the analysis I would like to extend my most sincere appreciation to Mr. Gordon Lindsey, Ian Campbell and Miss Nancy Woods of Imperial Oil Limited whose help has been most helpful and priceless. This appreciation extends also to Miss Noëlla Lampron who has been most cooperative and patient in typing numerous preliminary copies.

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INTRODUCTION

The intent of this thesis is twofold. The first purpose is a brief analysis of the behavior of the price of heavy fuel oils in Northern America and especially Quebec over the recent past. The second purpose is to assess future price trends and behavior over the next decade. This is a dual task and it involves an assessment of both future available supply and future needs.

Let us look briefly at the supply angle for one moment.

The search for new oil is a high risk venture and its magnitude together with capital dollar commitment rely heavily on the price level for petroleum products. More exploration and drilling can be initiated only by more attractive returns in the marketplace. But, in the oil industry (even more so than in other industries), the lag of response of supply to a given price change is considerably longer - 15 to 20 years.[1]

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[1]Petroleum Industry Research Foundation Inc., Oil Imports and the National Interest, (New York: March 1971), p. 3.

For Quebec, the problem is particularly difficult since the Province imports all of the petroleum products it manufactures and consumes. Heavy fuel oils are either made domestically from foreign crude or imported as such. The assessment of the future availability of heavy fuel oils in the Province would have to therefore take into account the volatility of international conditions as well.

On the demand side, the task is made easier by the fact that a relatively stable relationship exists between total energy requirements and economic activity.[1] (See Chart 1).

On the other hand, a study that focuses on a particular component of energy would have to take into account the intricacies of inter fuel competitions. The shares of the various fuels in total energy follow an evolutionary pattern whereby a fuel is gradually replaced by a more efficient one.

Again, the situation in the Province is more complex. This is so because the main economic decisions that influence economic activity in the Province are taken outside of Quebec.

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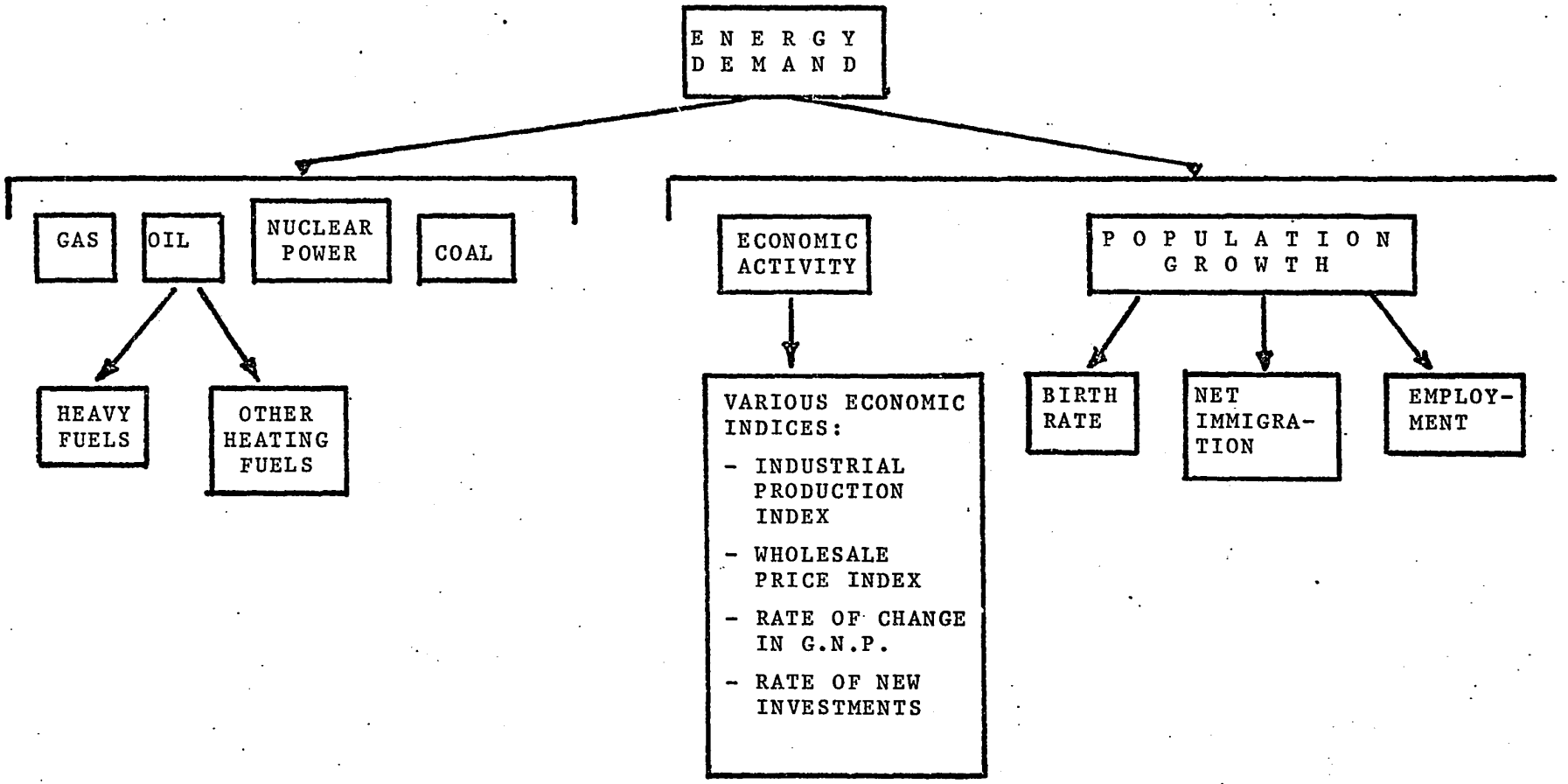
[1] See for example the work by A.W. Brown, A Model of Canadian Energy Demand, Toronto: Imperial Oil Limited, (Coordination and Economics Department, Toronto, April 1961). This is not to suggest that economic activity is the only factor to be looked at. Energy consumption is also influenced by changes in the age group structure of population. See the discussion in J.G. Winger, J.D. Emerson, and G.D. Gunning, Outlook for Energy in the United States (New York: Chase Manhattan Bank, Energy Division, Oct., 1968), p. 7 - 15.

CHART I

BREAKDOWN OF ENERGY DEMAND



For example, the Federal decision in late 1969 to float the Canadian dollar greatly impaired the competitive export position of the Canadian pulp and paper industry. This industry being heavily present in Quebec, the derived demand of petroleum fuels within the Province was also affected.

But in general, since it is relatively easier to asses anticipated needs of energy than future supplies, I will focus in this thesis mainly on the supply side to assess what are the main factors that could affect the price of heavy fuel oils in the future up to 1980.

For the purpose of this study, I make the following assumptions:

Political[1]

- Over the forecast period termination in 1980, there will be no major war but a high level of military preparedness in major countries will be likely.
- Over the period, overseas petroleum supplies (mainly from OPEC countries) will be available to North American markets despite possible temporary disruptions.
- There will be no important change in national or international trading conditions or the Canadian patterns of trade.
- The present involvement of provincial and federal bodies in economic affairs will continue and is likely to increase.
- Energy policies will remain basically unchanged.

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[1]NEB, Energy supply and demand in Canada (Ottawa: Appendix A, February 1966), page 75.

Economic

- Level of economic activity will catch up in Quebec and Gross National Product in real terms will grow between 6 to 7 per cent per year[1].

- Canadian and Quebec economies will continue increasingly to depend on service and manufacturing industries.

- Bulk of the Province's industrial production will continue to rely on primary goods and raw materials processing.

- Present Canadian inter-fuel price relationships will prevail, as will the relationship between various classes of services for each form of energy.

Technological

- No new energy form will come into use during the period. However, nuclear energy will begin to be economically feasible and operational. Its impact on inter-fuel share of total energy requirements will be small in the Province over the period.

- No new means of energy transportation will come into use. The numbers of super tankers will continue to increase but their size will forbid them access to many ports causing trans-shipping or pipelining.

- There will be intensified pressures for reduction of air and water pollution.

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[1] The Quebec economy slowed down after Expo '67 up to the beginning of 1970. I foresee an increase in economic activity for the 1970 decade due mainly to the realization of heavy construction projects such as James Bay Hydro Development, the 1976 Olympic Games to be held in Montreal and various highway construction projects.

Population

- Population is predicted to retain its actual growth pattern.[1]

- Population growth in Quebec through the seventies will be slightly lower than for Canada as net immigration will continue to slow down.

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[1]Between 1961 and 1966 the population of Canada increased at an average rate of 1.9%/year while it is estimated by the Economic Council of Canada to increase at an average annual rate of 1.7%/year through the seventies.

PART I

FACTORS BEHIND THE RECENT BEHAVIOR OF HEAVY FUEL OIL PRICES IN NORTH AMERICA AND QUEBEC

CHAPTER I

A GENERAL OVERVIEW OF THE SITUATION OF HEAVY FUELS IN 1970

During 1970 there was much talk about an energy shortage which could affect the main industrial sectors of the world. The Americans were the first to experience it in September 1970 when an unexpected period of hot weather caused power shortages in many industrialized states.

Here in Quebec there are many indications that heavy fuel oils, at one time a drug on the market, are now becoming more important as an energy source.

In January 1970 the heavy fuel oil market was as normal as it ever was. Competitive bidding was keen and the buyers were really having most of the edge in price negotiations. Most of the refiners had high inventories and were ready to sell at almost any price to liberate costly tankage. On the other hand,

purchasing agents were buying on price only and were pitting competitors against each other. Suddenly, the picture started to change. The import prices of heavy fuel oils reversed their previous downward trend and local prices eased upward. Unexpectedly they continued to climb reflecting a tight supply situation. During the three first quarters of 1970, the posted price of heavy fuel oils increased by almost 75 per cent reaching in September 1970 $3.00 to $3.50 per barrel from a low of $1.75 per barrel in January 1970[1].

Naturally, the causes of this sudden and unpredicted market change are not clear cut. They are, rather, the result of a number of factors, including rising standards of living in North America, the war in the Middle East, as well as the availability of other sources of energy supply. In the following chapter, these factors and others are briefly discussed.

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[1]Imperial Oil Limited, internal document.

CHAPTER II

FACTORS INDIRECTLY RESPONSIBLE FOR THE UPTURN OF HEAVY FUEL OIL PRICES IN NORTH AMERICA AND QUEBEC

The Shortage of Coal Production: Perhaps this mineral product has been a major contributor in this power dilemma. Coal has long been a primary source of energy and still fulfilled in 1970 respectively 20% and 14% of the energy requirements of the United States and Canada.[1] (We can visualize the rapid decrease of coal usage in Canada in the last decade by referring to Chart 2 which depicts the major components of total energy in Canada from 1950 to 1970).

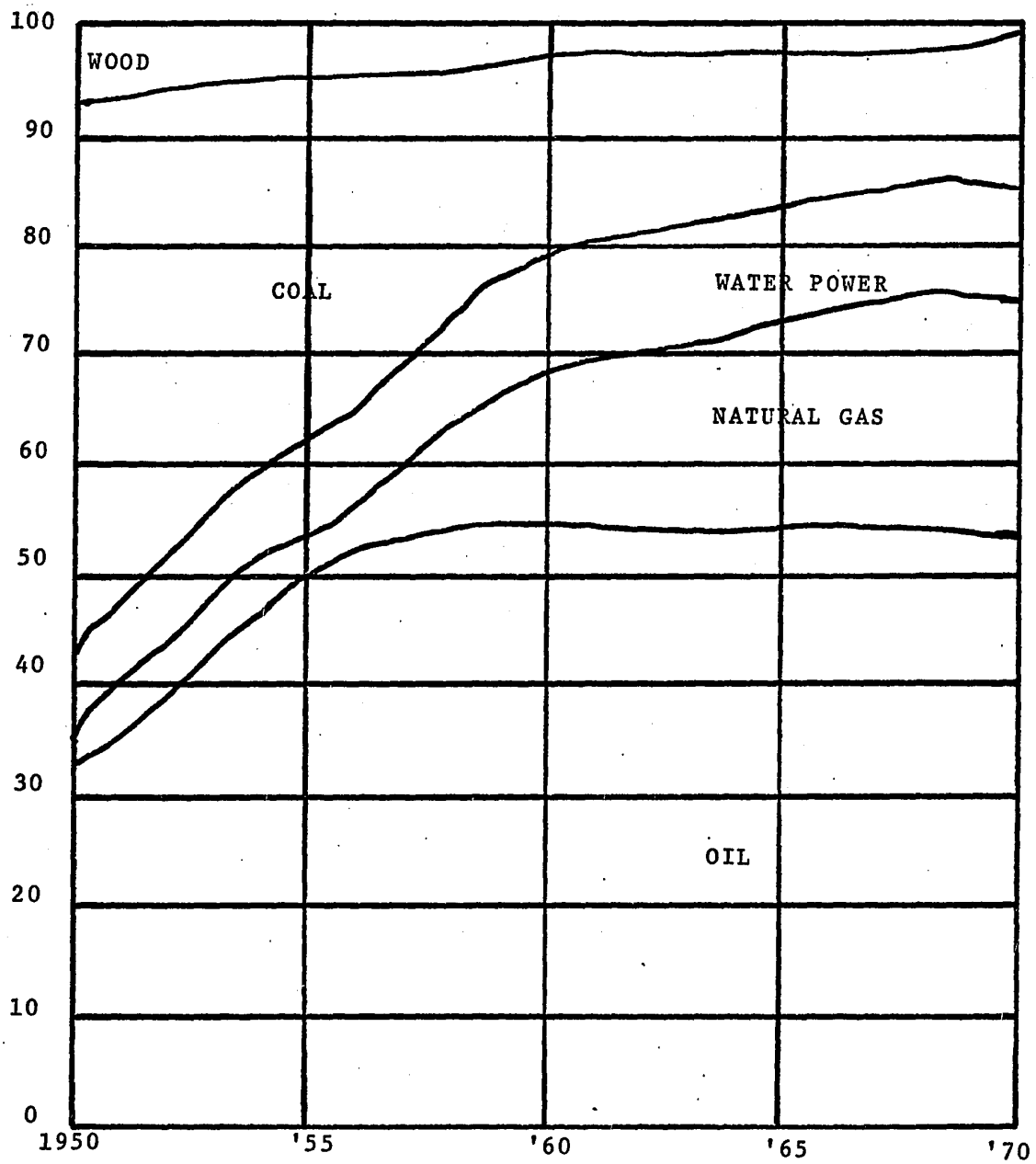
However, one should not get the impression that there is a shortage of coal reserves to meet today's and future demands. There is simply a shortage in the

[1] A.W. Brown, Coal in Canada (Imperial Oil Limited, Coordination and Economics Department), p. 1 and Winger, Emerson, Gunning, Outlook for Energy in the United States p. 19.

CHART 2

ENERGY PERCENTAGE DISTRIBUTION - CANADA

1950 - 1970



Source: Estimated from Statistics Canada, Energy Statistics Service Bulletin (#57-002) for years 1950 to 1970.

production of coal. Since World War II and up to the early sixties, coal production had remained higher than the consumption rate and coal prices stayed at the same level over a number of years due to the competitive fuel situation. Mine labor was plentiful, air pollution codes non-existent or, so minimal they were meaningless, so that any grade of coal could be burned regardless of its sulphur content.

After the 60's this situation changed rapidly with both the introduction of the nuclear power plant and the imposition of air quality standards and controls.

> Nuclear plants, it was claimed, were the panacea of the power industry. They were clean, their fuel was inexpensive and they generally appealed to the industry as being the new breed of power plant especially suited for large central stations.[1]

As a result of the nuclear threat to coal, coal mine expansion for speculative production was drastically reduced. Producers refused to invest in coal production for which the market was uncertain. In 1970, the Office of Emergency Preparedness estimated 1970 total U.S.'s requirements for coal at approximately 583 million tons, 12 million tons over available production. In August of the same year, electrical utilities had an average of 50 days supply on hand when 90 days supply is considered normal. Some utilities were reported down to 5 days supply and thus had to pay

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[1] G.C. Gambs and A.A. Rauth, The Energy Crisis, Chemical Engineering, May 31, 1971, p. 60.

staggering prices for coal. Compounding the reluctance of producers in the early sixties to expand coal production, other factors as well contributed to slowing its development, mainly the shortage of skilled labor[1] and environmental laws placing restrictions on strip mining and new safety and health laws for underground mines.

The combined effect of those factors had caused the price of coal to greatly increase in the late sixties thus affecting adversely the profitability of existing and planned facilities of utilities. From June 1969 to June 1970, price of bituminous coal in the U.S. increased on average by 35 percent. As a result, coal burning power plants started

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[1]The labor shortage has seemed to be the number one problem. Over the past 15 years, the coal mine labor force declined from 400,000 to 120,000. This was the result of the mechanization process which enabled the mines to produce nearly enough coal to satisfy demand. But then, at the same time as coal demand rose, productivity in underground mines suddenly dropped. During the 1969-1970 period, productivity in some underground mines declined 20 to 30%. Much of this was due to the new Federal Mine Safety Act, which imposed certain constraints upon miners other than digging coal. Some of the low productivity was due to the use of new inexperienced miners. Some resulted from the turmoil in the United Mine Workers. But, the long-range problem has been the inability to attract new mine workers, or even to bring back those who have moved away into other industries. G.C. Gambs and A.A. Rauth, "The Energy Crisis", Chemical Engineering, May 31, 1971, p. 60.

depleting their stockpiles, old plants were being converted to burn oil or gas, and new plants designs were altered to counteract the coal shortage.[1]

The Delays in the Usage of Nuclear Power: In the middle of the 1960's nuclear energy offered good promise for generating electricity in terms of both economy and pollution control. However, these predictions for nuclear power to replace coal in electrical generation were out by at least two to three years. Today, most of those expected nuclear plants are still not on stream, running behind schedule because of equipment delays, higher than expected construction costs and the fear of thermal pollution in rivers and lakes.

This has caused older fossil fuel plants scheduled to be retired or placed in stand-by service to remain in use to meet base load requirements and sustained growth in demand for electricity. This put unexpected and unplanned requirements on fossil fuels and especially heavy fuels to fill the gap.

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[1]Some typical reactions were:
- Ontario - Hydro, the largest Canadian utility company, has announced it will construct four 750 megawatt power units designed to burn residual oil or crude oil. These will be the first oil fired power plants on the Ontario - Hydro system.
- A major electric utility company in the East Central Region (U.S.) was constructing an 800 megawatt coal fired unit but was unable to obtain a long term coal contract to supply the unit scheduled to start in the early 1970's.

The Shortage of Natural Gas: In the United States natural gas provides 31% of the total energy needs. But reserves have been dwindling more rapidly than the additions of new discoveries. Firstly, natural gas producers consider the rates too low, despite recent increases, to justify accelerated search for new reserves[1]. Secondly, present pipeline capacities are stretched almost to the limits. Therefore, even though some of the unexpected energy requirements could be met by increased natural gas sales, the major load fell back on oil and especially, heavy fuel oils.

The Bias of Present Technology Towards Light Oils Production: Historically heavy fuel oils have always been the least glamorous of petroleum products, the dregs from the refinery, looking for a buyer at almost any price. Refinery technology in the Western Hemisphere has greatly contributed in bringing about this recent shortage in heavy fuel oils. Refineries in North America are gasoline type refineries where the least consideration possible is given to the bottom of the barrel[2]; see chart 3.

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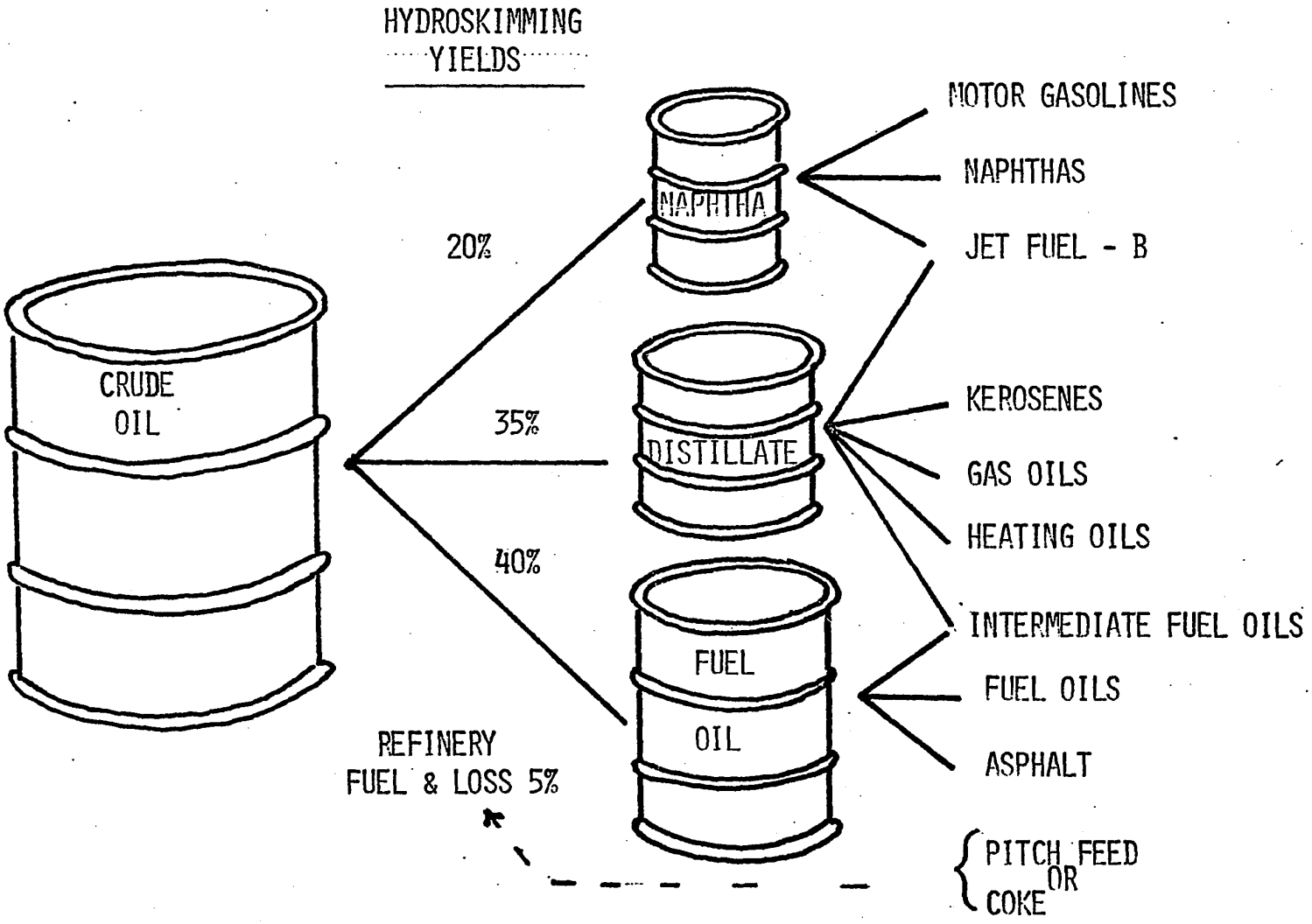
[1]Exploration is being hindered by governmental policy. The FPC still maintains control of producer returns while the National Environmental Policy Act is delaying lease sales and pipeline construction.

[2]For years, refiners have been spending money to make it disappear into more valuable products. The popularity of delayed coking has soared as a result.... The 38,000 tons per day of coke produced by U.S. refiners today is equivalent to 940,000 tons per day of residual fuels. Leo R. Aalud, "High Prices Send Refiners Scratching for more resid", Oil and Gas Journal, September 21, 1970, p. 47.

CHART 3

THE DIFFERENT PORTIONS OF A CRUDE BARREL



For example, Imperial Oil Limited's new coker unit at Sarnia (Ontario) can reduce a barrel of crude to distillates and coke (solid residual) without any heavy fuel left. Moreover, this trend in North American refinery technology has coincided with a downward trend in the price of imported heavy fuel oils, the result being (at least for the Eastern States of U.S. and Eastern Canada) an increased dependence on offshore sources of supply for that product.

The Requirements for Cleaner Fuels: But then along came another complication. The concern of the general public for cleaner air resulted into legislation which severely restricted the sulphur content of fuels being burned. In 1970, the squeeze was on and power plants industries, offices and apartment buildings usually burning high sulphur coal had to switch to natural gas or low sulphur heavy fuel oils in order to comply with the new local anti-pollution laws. But low sulphur coal or heavy fuel oils were not readily available and prices started to increase to reflect this tight supply situation. We will look, later on in our study, more closely at the impact and difficulties that could be created by clean air laws.

As we can see now at this stage of our research, the explanation for sudden increases in the price of heavy fuel oils are by no means clear cut. Some factors date back to decisions and forecasts of the past, as we saw briefly in the last chapter. Let us now, in the next chapter, analyze the more direct and sudden factors responsible for this situation.

CHAPTER III

FACTORS DIRECTLY RESPONSIBLE FOR SUDDEN AND SUSTAINED RISE IN PRICES OF HEAVY FUEL OILS IN NORTH AMERICA AND QUEBEC IN 1970

The Demands of OPEC

Certainly one of the most direct factors responsible for the sudden price increase of crude oil and its derivatives - including heavy fuel oils - has been the change of attitude of the oil producing countries grouped under OPEC. During 1970, the various countries making up OPEC, stopped fighting among themselves to present a united front in their negotiations with the international oil companies. Their first move as an oil producing cartel was to question the validity and equity of the oil industry - government's main agreement, the 50-50 profit sharing arrangement.

This requested reconsideration was based on two main arguments. First, oil is a non renewable natural resource. As it is used up, the oil producing countries are likely to experience diminishing revenues and therefore insist upon higher unit prices to preserve their total cash flow. It

is important to keep in mind that for most of those countries oil sales are the major source of income.

Secondly, they also claim that the revenues they derive from various petroleum products are far less than what the consuming countries get through heavy taxation of those products.

On the other hand, the consuming countries want low cost energy and secured source of supply. These countries counteract the demands of OPEC by arguing that it is the level of economic development of the industrialized countries that gives the value to oil, just like any economic good, its value relying on its usefulness. The consuming countries also argued that the tax issue is invalid once taxes are returned back to people through various means by governments.

To further complicate the problem, payments by consuming nations to producing nations add to substantial amounts and represent a permanent cost for consuming nations. Therefore, balance of payments difficulties are or could be magnified by higher payments to other foreign governments.

The core of the economic dilemma relies on a "give and take" type of approach. The increases in base rates for crudes and their derivatives were obtained quite rapidly

by the producing countries as they were put through at a critical time (when the "so-called" indirect factors were making their impact felt). Libya set the pace and to give more weight to its demands, it went as far as backing oil into the ground reducing by approximately 800MB the usual daily permissible flow of oil.

Libya was rapidly followed by other producing countries who went even further, as Venezuela obtained the right to unilaterally decide tax export values of crude oil and its derivatives while Persian Gulf countries gained increases in tax rates and further annual increases in posted prices for the next five years. For a complete summary of the history of recent negotiations between OPEC members and consuming nations represented by international oil companies, the reader is referred to Tables 1, 2, and 3.

To clarify the issue, let us look for a moment at the overall impact of the Venezuelan[1] Government's decision on the price of heavy fuel oils. The argument can be developed

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[1]For the Province of Quebec 65% of crude or heavy fuel oil imports are from Venezuela, 25% from Middle-East and 10% from Mediterranean sources. See Table 4.

TABLE I

HISTORY OF RECENT NEGOTIATIONS WITH PRODUCING GOVERNMENTS

(1970)

LIBYA	- SEPTEMBER 1970: POSTED PRICES UP BY 30 U.S.¢/BBL. TAX RATE UP BY 5% TO 55%.
PERSIAN GULF	- NOVEMBER 1970: POSTED PRICES OF SEVERAL PERSIAN GULF CRUDES UP BY 9 U.S.¢/BBL. POSTED PRICE OF EAST MEDITERRANEAN PIPELINE CRUDES UP 20 U.S.¢/BBL. MOST TAX RATES UP BY 5% TO 55%.
VENEZUELA	- DECEMBER 1970: TAX RATE UP BY 8% TO 60%. GOVERNMENT LEGISLATED RIGHT TO RAISE TAX EXPORT VALUES UNILATERALLY AT ANY TIME. (TAX RATE INCREASE EFFECTIVE FOR THE ENTIRE YEAR).

Source: Standard Oil Company, OPEC and the Oil Companies, (New Jersey: Jersey Background Series, October 1971). Much of this information was also published under one form or another in the financial and daily papers in 1970.

TABLE 2

HISTORY OF RECENT NEGOTIATIONS WITH PRODUCING GOVERNMENTS

(1971)

VENEZUELA	- MARCH 1971: GOVERNMENT EXERCISED ITS UNILATERAL CONTROL OVER TAX EXPORT VALUES. HEAVY FUEL OILS TAX EXPORT VALUE RAISED BY 0.75¢/BBL.[1]
LIBYA	- POSTED PRICE[2] OF LIBYA 40° GRAVITY CRUDE UP BY 91.7¢/BBL.
PERSIAN GULF	- FEBRUARY 1971: POSTED PRICES FOR MOST PERSIAN GULF COUNTRIES UP BY 35-40¢/BBL. ALL TAXES RATES AT 55%. FURTHER ANNUAL INCREASES OF 5¢/BBL PLUS 2.5% OF POSTING AGREED UPON FOR NEXT 5 YEARS (FIRST INCREASE TO BE 6 MONTHS EARLY ON JUNE 1, 1971).
ALGERIA	- STILL PENDING, BUT ALGERIAN DEMANDS ARE CONSIDERABLY HIGHER THAN EARLIER LIBYAN OR RECENT PERSIAN GULF SETTLEMENTS.

Source: Ibid.

[1]Beyond 1970, Canadian and American dollars are assumed to be at parity.

[2]Posted prices and tax export values are synonymous expressions.

TABLE 3

POSTED PRICES OF GULF AND MEDITERRANEAN CRUDES

($/BBL)

PERSIAN GULF (SELECTED CRUDES)	PRE-SEPT. 1970	POST SEPT. NOV. 15, 1970	POST 1971 SETTLEMENTS FEB. 15 OR MARCH 20	TOTAL INCREASE
KUWAIT 31°	1.59	1.68	2.085	+0.495
IRANIAN HEAVY 36°	1.63	1.72	2.125	+0.495
BACRA 35°	1.72	1.72	2.155	+0.435
ARABIAN LIGHT 34°	1.80	1.80	2.280	+0.480
ABU DHABI MARBAN 39°	1.88	1.88	2.235	+0.435
LIBYA 40°	2.23	2.53	3.447	+1.217
IRAQ 36° AT E. MED.	2.21	2.41	3.211	+1.001
SAUDI 34° AT SIDON	2.17	2.37	3.181	+1.011

Average weighted increase in posted prices for Persian Gulf selected crudes ex Libya = 75¢/bbl.

∴ 75¢/bbl x 55% (tax rate) = 41.3¢/bbl.
75¢/bbl x 12.5% (royalty rate) = 9.4¢/bbl.
Total average increase in company tax paid cost equals: 50.7¢/bbl.

Source: Ibid.

TABLE 4

QUEBEC REFINERIES - CRUDE SOURCE OF SUPPLY - MB/CD

REFINERY LOCATION	SOURCE OF CRUDE SUPPLY			
	VENEZUELA	MIDDLE EAST COUNTRIES	LIBYA - NIGERIA	U.S.A.
BRITISH PETROLEUM - MTL	6.0	50.0	15.0	-
GULF - MTL	25.0	16.0	30.0	-
IMPERIAL OIL LIMITED - MTL	96.0	-	-	-
PETROFINA - MTL	35.0	30.0	-	-
SHELL - MTL	85.0	-	-	-
TEXACO - MTL	23.0	24.0	-	20.0
ULTRAMAR - QUEBEC CITY	50.0	-	50.0	-
TOTAL	320.0	120.0	95.0	20.0
% OF TOTAL	58	22.0	17.0	3.0
LAST 5 YEARS AVERAGE % OF TOTAL	65	25	5 - 10	0 - 5

Source: Imperial Oil Limited, "Outlook for Energy and Petroleum", Toronto: (unpublished internal document, Corporate Planning Services, Jan. 1972).

in two parts: increased royalties and tax rates for a typical Tia Juana 25° API gravity medium crude, and increase in the tax export value of heavy fuel oils, (the reader is referred to Table 5 for a numerical assessment).

Over and above these increases, the Venezuelan Government established also a complement in terms of freight rates in recognition of the geographic position of Venezuela being much closer to North American markets than other OPEC members. This is calculated for the first day of the first of each quarter of the year 1971, and is in force for the quarter which follows the date used for the calculation. The complement is calculated according to the following equation:

$$0.33 \left[(\text{AFRA LR II} - 72.5) \quad 100\text{WRTR} - (\text{AFRA LR I} - 100.0) \quad 100\text{WRTR} \right]$$ [1]

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[1] Where AFRA LR II = Valuation of freight rates by the London Tankers Brokers Panel for large oil tankers II (between 80,000 and 159, 999 DWT) published the first day of each month, when equal to or more than 72.5 World Scale.

AFRA LR I = Variation of freight rates by the London Tankers Brokers Panel for large oil tankers I (between 45,000 and 79,999 DWT) published for the first day of each month, when equal to or more than 100 World Scale.

100 WRTR: Basic freight rates published jointly by the International Tanker Nominal Freight Scale Ltd. of London, England and the Association of Shipbrokers

TABLE 5

SUMMARY OF VENEZUELAN GOVERNMENT'S DECISIONS

- IMPACT ON HEAVY FUEL OIL PRICE - $/BBL

1. INCREASED ROYALTIES AND TAX RATE:

		1970		1971
		ORIGINAL	DEC. 17/70	MARCH 18/71
1.	Tax Export Value[1]	2.00	2.00	2.64
2.	Operating Costs	.20	.20	.20
3.	Royalty	.34	.34	.44
4.	Imputed Taxable Base [1 - (2 + 3)]	1.46	1.46	2.00
5.	Tax Rate	52%	60%	60%
6.	Tax	.759	.876	1.20
7.	Producing Government Take (3 + 6)	1.099	1.216	1.640
8.	Change in Producing Government Take		$0.118/bbl.	$0.541/bbl. (total)

2. INCREASED TAX EXPORT VALUE:

		1971	
		PRIOR MARCH 18	EFFECTIVE MARCH 18
9.	Tax Export Value - Heavy Fuel Oil	1.73	2.48
10.	Increase	$0.75/bbl.	
11.	Increased Tax at 60%	$0.451/bbl.	

Source: Ibid. and J.R. Whelan, "Whatever Happened to Oil in Venezuela", World Petroleum, Jan. 1972, p. 26-33.

[1] For a typical 25° Tia Juana medium crude.

This calculation adds another 7¢/bbl (or 0.20¢/gal.) to the increase in costs for imported heavy fuel oils into the Province of Quebec.

The added costs brought about by Venezuelan Government's decisions for the period 1970-1971 can be summarized as follows:

Increased Royalties, Tax Rates and Export Values of Crude Oil (Row 8 - Table 5)	54.1¢/bbl.
Increased Export Values of Heavy Fuel Oils (Row 11 - Table 5)	45.1¢/bbl.
and Freight Complement[1]	7.0¢/bbl.

Table 6 summarizes the overall impact of all the decisions of OPEC. It must, however, be understood in the light of two limitations. First, since there is no published posted prices of Persian Gulf heavy fuel oils, we must accept that our calculations for crude oil apply equally for these

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and Agents Inc., of New York, U.S.A. for the voyage from Ras Tanura to Rotterdam via the Cape of Good Hope, expressed in U.S. dollars per barrel for a crude oil of 34° API. See: Gaceta Official De La Republica de Venezuela, Caracas lunes 8 de marze de 1971, #29.457 p. 220-166.

[1] Variable freight elements amounted to 8¢/bbl from January to March 31st, 1971. April - June quarter amounted to 5.9¢/bbl. Average therefore was 7¢/bbl.

TABLE 6

MAGNITUDE OF THE INCREASED PAYMENTS TO PRODUCING GOVERNMENTS

			INCREASE IN COMPANY TAX PAID COST[1]
PERSIAN GULF (WEIGHTED AVERAGE)			
SAUDI ARABIA	KUWAIT	=	
IRAN	ABU DHABI	=	50.7¢/bbl.
IRAQ	QATAR	=	
MEDITERRANEAN/AFRICA			
LIBYA		=	83¢/bbl.
VENEZUELA		=	61¢/bbl.
WEIGHTED AVERAGE INCREASED IMPACT ON PROVINCE OF QUEBEC HEAVY FUEL OIL PRICES			61.5¢/bbl.

Source: Standard Oil Company, OPEC and the Oil Companies (Oct. 1971), and United States Dept. of the Interior, Report #20 240 (Washington: Office of Oil and Gas, September 1971).

[1]This includes also the increase in royalty and freight complements where applicable.

countries to heavy fuel oils. Secondly, approximately 40% of the Province's heavy fuel oils are imported mostly, if not entirely from Venezuela, and this is reflected in the calculations for Venezuela.

Marine Transportation Crisis:

Another decisive factor in the recent worldwide increase in prices to consumers of both crude oils and heavy fuel oils has been the bottleneck of marine transportation facilities. This dates back to the closing of the Suez Canal in June 1967 which upset the tanker fleet by deeply cutting into its surplus of tankers. Industry overcame successfully the initial disruption by increasing the tanker fleet and normalizing movements of ships around Africa. The marine trade succeeded during the 1967 to 1970 period in keeping transportation costs at fairly constant levels despite increases in the order of 80 percent in ship building costs[1].

However, the harm was done as spare capacity was no longer available. Since 1967, the industry has been operating with approximately 50 to 100 T2's of reserve capacity out of a total fleet which had grown from 5,000 T2's in 1966 to

[1]For more information on ship building costs see: Chapter VII, p. 94, table 24 and for information as to the timing of addition of ships to the fleet see: Chapter VII, p. 89, Chart 9.

9,000 T2's[1] by mid 1970. As can be seen on Chart 2, since 1967 the industry has been in a very delicate balance with ½ to 1% of reserve capacity. But this delicate balance was abruptly thrown over board by the sabotage of the Tapline in May 1970, with the Syrian Government refusing to allow for repairs.

The already fully utilized fleet had to overcome this distortion in product movement patterns and to find ways of moving an extra 475MB/day of Saudi crude to the Mediterranean. The tonnage required by these lengthened trips was estimated to be about 6 times the amount required before the Tapline was damaged. Major rearrangements in trade patterns had to be introduced such as : diversion of marginal ships from other trades, minimization of routine tanker maintenance and redesigning of routes.

All these emergency measures translated into higher transportation costs in the tanker market. The picture can be better depicted by referring to Chart 5 - where we are showing the changes in freight rates over the last year. The left vertical axis shows the rates in World scale points while the right axis converts these World scale points into $/Can./bbl, for a typical voyage from Persian Gulf to Rotterdam (the standard voyage for basis of reference).

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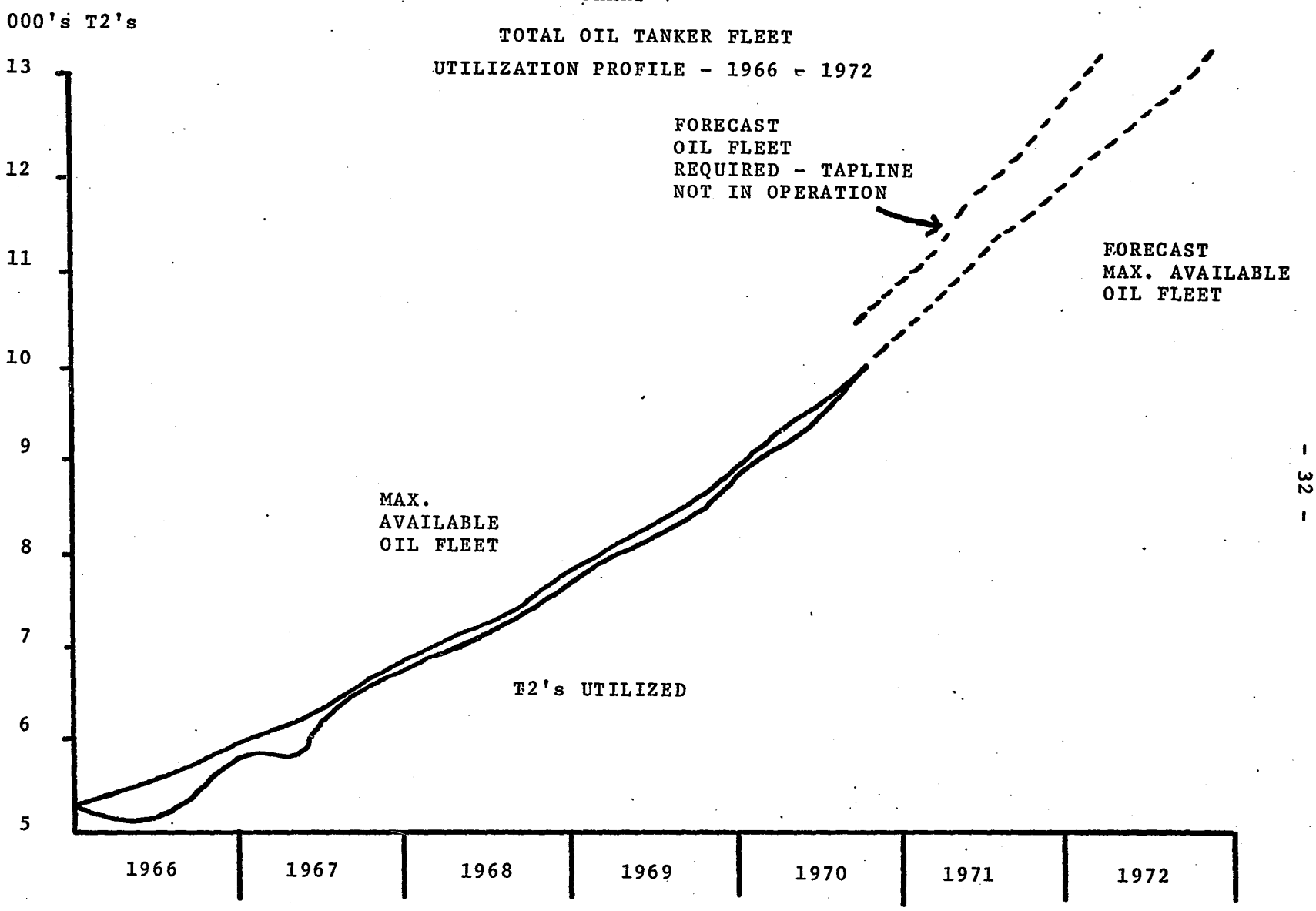
[1] A definition of a T2 is enclosed in the glossary of terms.

CHART 4

TOTAL OIL TANKER FLEET

UTILIZATION PROFILE - 1966 - 1972



Source: Petroleum Press Services - Oct. 1971.

We can see that at spot rates it was quite expensive to charter a ship in the second half of 1970. During the same time the AFRA rates went up also but more moderately and with a time lag compared to spot rates. This is due to the fact that a large portion of the tankers making up the AFRA average is at a pre-crisis low cost. To assess the impact on the world tanker fleet we must recognize that approximately 15% of fleet's requirements are fulfilled on spot market at spot rates[1]. In Table 7 we calculated the impact for a product movement from caribbean to Portland[2] for relevant ship sizes (we can see that it parallels the international situation of the time).

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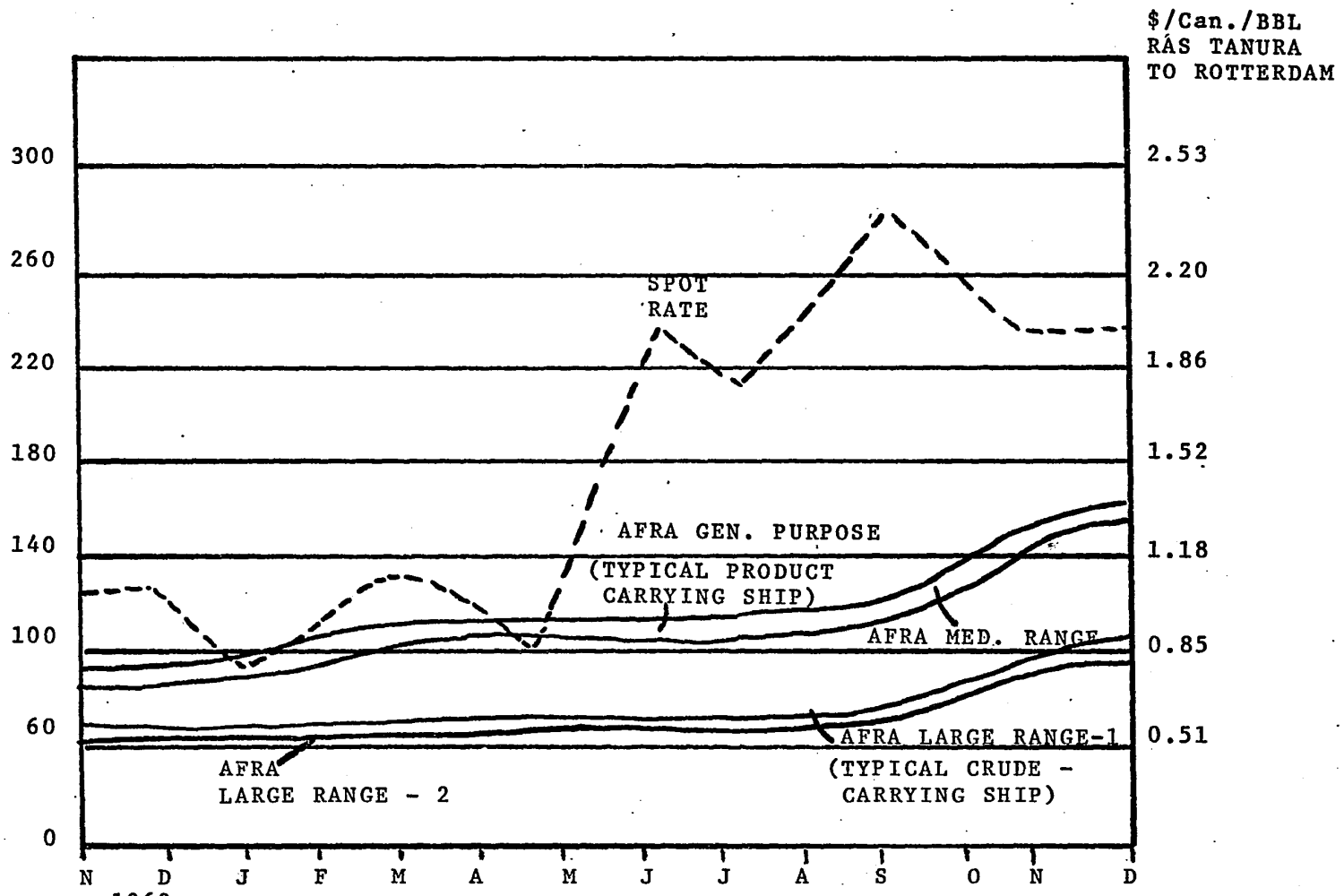
[1]The main reason for the industry to depend on spot market for 15% of its tonnage requirements is based on the fact that it is very hard to exactly assess.
- seasonality of demand
- to outline requirements that will not be over or understated
- the weather impact (how cold will winter be?)
- it also provides flexibility for contingencies as idle tonnage bears a heavy penalty.

[2]Based on Table 4, 80% of crude oil coming into the Province is transported by marine to Portland, Maine and then pipeline to Montreal. Golden Eagle requirements go directly to Quebec City while some heavy and waxy crudes cannot go through Portland pipelining system.

CHART 5

AFRA AND SPOT RATE PROFILE

1969 - 1970



Source: Petroleum Press Services, Jan. 1972, P. 39

TABLE 7

IMPACT OF MARINE TRANSPORTATION CRISIS
ON TANKER FREIGHT RATES
(CARIBBEAN TO PORTLAND)[1]

	WORLD SCALE POINTS[2]		VARIATION		
	(1)	(2)	(3)	(4)	(5)
			(3)=(2)-(1)		(5)=(4)÷35
VOYAGE CATEGORY	JAN. 1/70	DEC. 31/70	W.S.P.	¢/CAN./BBL.	¢/CAN./GAL.
SINGLE VOYAGE (SPOT RATE)	150.0	290.0	140.0	39.5	1.12
LARGE RANGE 1 TYPICAL CRUDE CARRYING SHIP	135.0	190.0	55.0	15.5	0.44
GENERAL PURPOSE TYPICAL PRODUCT CARRYING SHIP[3]	112.0	160.0	57.0	16.2	0.46
	Transportation costs weighted average[4] increase			20.3¢/bbl =	0.50¢/gal.

Source: Petroleum Press Services, Jan. to Dec. 1970

[1]An extra cost of approximately 12¢/bbl must be added on to take into account pipelining costs from Portland to Montreal.

[2]World Scale "100" base is as follows: 1970 = 2.06¢/point"per long ton and the following formula is used to calculate voyage costs: $\frac{2.06¢ \times \text{World Scale Index}}{7.309/\text{bbl per long ton}}$

[3]Heavy fuel oils imports come directly to Montreal from Caribbean or source of supply as no refined products flow through Portland pipeline system.

[4]Calculated as follows: 15% at spot rate (39.5¢/bbl) and 85% at AFRA rates (15.5¢/bbl).

PART I - SUMMARY

As we saw, factors underlying sharp increases in prices of crude oils and heavy fuel oils are numerous. The impact of some of those factors (OPEC demands and freight increases) can be numerically assessed, but their weight relies also on the "so-called" indirect factors of which the impact cannot be broken down to $/bbl in a meaningful way.

In the next section we will look at the future to 1980 and we will try to assess what could happen to prices of heavy fuel oils together with its meaning for the consumers of the Province.

PART II

A LOOK AT THE FUTURE OF HEAVY FUEL OIL COST/PRICE RELATIONSHIPS UP TO 1980

CHAPTER IV

SPECULATION ON THE FUTURE ATTITUDE OF OPEC

The discussions that took place in late 1970 and during 1971 between oil producing governments represented through OPEC and oil consuming countries through international oil companies definitely reflected a shift in the balance of power in favour of the oil producing governments. In less than four months in 1971 there has been 4 main stages in the process of escalation in demands. Tables 8, 9, 10 contain a summary of the major agreements, while Chart 6 shows the freight advantage of the Mediterranean countries who are closer than the Arabian countries to the North American and West European markets.

However, all these agreements are expiring in 1975, and therefore for the purpose of my study I had to make speculative assumptions beyond 1975 to 1980. These various assumptions both for the Middle East countries and Venezuela can be summarized as follows:

TABLE 8

TEHRAN AGREEMENT FOR PERSIAN GULF COUNTRIES[1]
ON THE PRICING AND TAXING OF CRUDE OIL

FEB. 14/1971

- A 35¢/bbl increase in the posted prices of crude oils exported from Persian Gulf terminals effective immediately.
- Stabilization of income tax rate at 55 percent.
- 2½ percent escalation in the posted prices effective June 1971 and on January 1st of the years 1973, 1974, 1975.
- 5¢/bbl on same dates to compensate for assumed future increases in product prices and end markets, elimination of all allowances and the increase in the gravity scale.
- Establishment of new procedures for amending the posted price Gulf crudes between 40 and 30 degrees API gravity with each existing posted price increased ½¢/bbl for each degree such crude is less than 40 degree API gravity.
- Fixing of total royalty payments at 12½ percent of the published price of export sales.

Source: Standard Oil Company, OPEC and the Oil Companies (Oct. 1971).

[1]This includes Abu Dhabi, Iran, Kuwait, Qatar.

TABLE 9

LIBYAN AGREEMENT ON POSTED PRICE OF 40 DEGREE API GRAVITY CRUDE

MARCH 20/71

- General increase effective immediately of 35¢/bbl.
- 2½ percent escalation in the posted prices effective June 1971 and on January 1st of the years 1973, 1974, 1975.
- 5¢/bbl on same dates to compensate for assumed future increases in product prices and end markets, elimination of all allowances and the increase in the gravity scale.
- an increase of 9¢/bbl on future production up to 1975 as part of fall 1970 retroactivity[1] commitment by companies.
- 2¢/bbl/year sulphur premium.
- 24¢/bbl temporary freight adjustments.[2]
- Tax rate stabilized at 55 percent till 1975.
- Payments schedule changed from quarterly to monthly.

Source: Standard Oil Company, OPEC and the Oil Companies (Oct. 1971).

[1]This is to cover Libyan retroactive claims in respect to all crudes exported prior to that agreement. The government asserted that Libyan crude oil has been underpriced and payments had been too low from the very beginning of each companies operations.

[2]This is to reflect Libya's important geographic advantage relative to West European market with Suez Canal closed. It also takes into account changing tanker freight rates and provides for quarterly adjustments. (see Chart 6).

TABLE 10

EASTERN MEDITERRANEAN COUNTRIES' AGREEMENT
ON POSTED PRICES OF CRUDE OIL[1]

- General increase effective immediately of 35¢/bbl.
- 2½ percent escalation in the posted prices effective June 1971 and on January 1st of the years 1973, 1974, 1975.
- 5¢/bbl on same dates to compensate for assumed future increases in product prices and end markets, elimination of all allowances and the increase in gravity scale.
- 2¢/bbl temporary freight adjustment.[2]
- Tax rate stabilized at 55 percent till 1975.
- Payments schedule changed from quarterly to monthly.
- Fixing of total royalty payments at 12½ percent of the published price of export sales.

Source: Standard Oil Company, OPEC and the Oil Companies (Oct. 1971).

[1]This includes Iraq, Saudi Arabia and Algeria

[2]See footnote 1 - Table 9.

CHART 6

MIDDLE EAST AND EAST MEDITERRANEAN COUNTRIES

Middle East Countries:

- tax rate up from 55 percent to 60 percent by 1980,
- royalty rate up to 16 2/3 percent in 1975 and 20 percent by 1980,
- the escalation clauses of 2½ percent /year and 5¢/bbl/year are retained,
- the temporary freight clauses presently granted to the Mediterranean countries will not be applicable beyond 1975.
- In the case of Libya the 9¢/bbl retroactivity claim will terminate in 1975, but the 2¢/bbl escalation per year for sulphur premium will remain.

Tables 11 and 12 assess numerically the impact of the already accepted agreements plus my estimations beyond 1975 for the Persian Gulf and East Mediterranean countries. We can see that by 1980 it could mean increases in companys' cost over 1972 close to 90¢/bbl.

Venezuela:

It is very hard to assess presently the possible attitude of the Venezuelan Government in the future as it has gained the right to adjust unilaterally Minimum Export Prices of both crude oils and refined petroleum products. At this

TABLE 11

SAUDI ARABIA AGREEMENT ON POSTED PRICES AND TAXES
(VIA TAPLINE) 1970 - 1975 - 1980

$/BBL

		PRE SEPT. 1970	JAN. 1st 1972	1975	1976
1.	Base posted price (34° gravity)	2.17	3.19	3.58	4.28
2.	Temporary Suez Premium	-	0.12	-	-
3.	Temporary Freight Premium	-	0.08	-	-
4.	TOTAL POSTED PRICES (1+2+3)	2.17	3.39	3.58	4.28
5.	Royalty	.27	.42	.60	.86
6.	Average Producing Cost	.12	.12	.12	.15
7.	Tax Reference Price [4-(5+6)]	1.78	2.85	2.86	3.27
8.	Tax Rate %	.50	.55	55	60
9.	Tax Payment	.89	1.57	1.57	1.96
10.	TOTAL GOVERNMENT TAKE (5+9)	1.16	1.99	2.17	2.82
11.	Company Tax paid cost (5+6+9)	1.28	2.11	2.29	2.97
12.	Rise in posted price (1970 = base)	-	1.22	1.41	2.11
13.	Rise in Gov't. Take/bbl (1970 = base)	-	0.83	1.01	1.66

Source: For 1970 and 1971 my calculations are based on a similar study made for the American Government, see: United States Department of the Interior, Report #20240 (Washington: Office of Oil and Gas, Sept. 1971). However, no provision in their calculations is made for compensation in the devaluation of the American dollar. My estimates include an additional 25¢/bbl as all bills effective Jan. 1st, 1972 are to be inflated by 8.57%. Estimations beyond 1975 are based on the assumptions outlined previously, p. 43.

TABLE 12

SAUDI ARABIA AGREEMENT ON POSTED PRICES AND TAXES -
PERSIAN GULF SHIPMENTS - 1970 - 1975 - 1980

$/BBL

		PRE NOV. 1970	JAN. 1st 1972	1975	1980
1.	Base Posted Price (34° gravity)	1.80	2.49	2.83	3.43
2.	OPEC allowance and gravity adjustments	0.09	-	-	-
3.	Royalty	0.26	0.31	0.47	0.69
4.	Average producing cost	0.12	0.12	0.12	0.15
5.	Tax reference price [(1+2) - (3+4)]	1.32	2.06	2.24	2.59
6.	Tax rate (%)	50	55	55	60
7.	Tax payment	0.66	1.13	1.23	1.55
8.	Government take (7+3)	0.92	1.44	1.70	2.24
9.	Company tax paid cost (8+4)	1.04	1.56	1.82	2.39
10.	Rise in posted price (1970 = base)	-	0.69	1.03	1.63
11.	Rise in Gov't. Take (1970 = base)	-	0.52	0.78	1.32

Source: Ibid.

point of the study, the only realistic assumption is to assume that they will match any increase in Persian Gulf postings. Over and above these, I estimate their royalty rate presently at 16 2/3 percent to be at 20 percent in 1975 to 1980. Also, their tax rate presently at 60 percent will escalate to 65 percent by 1975 and stay at that level. Table 13 attempts to assess numerically the overall impact of these assumptions and it could mean by 1980 increases in companys' costs over 1972 of about $1.50/bbl compared to the present levels.[1]

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[1] I make the assumption that any increase in the company's tax paid costs will be passed on to customers. This is so for two reasons: first, because of the huge power of the oil industry and secondly because the oil companies argue that 1970-1971 increases in per barrel payments made by the companies are approximately equal to the average per barrel earnings for the oil industry in the Eastern Hemisphere. These earnings like the percentage return on net worth have been declining fairly steadily during the sixties and in 1968 dropped below the average for U.S. manufacturing companies in the Eastern Hemisphere. Therefore we can expect oil companies to put forward with great emphasis that their absorption of added costs would impair their financial position and their capacity to raise extra funds for future exploration and operations, see: First National City Bank, Energy Memo (Oct. 1970).

TABLE 13

VENEZUELA MINIMUM EXPORT PRICES[1]

1970 - 1975 - 1980

$/BBL

		PRE MARCH 18 1971	MARCH 18 1971	1975	1976
1.	Minimum Export Price (25° gravity)	2.00	2.64	3.80	4.53
2.	Royalty	.34	.44	.58	.91
3.	Average Producing Cost	.20	.20	.23	.30
4.	Taxable base [1 - (2+3)]	1.46	2.00	2.99	3.32
5.	Tax rate: %	52	60	65	65
6.	Tax payment	0.76	1.20	1.94	2.16
7.	Government Take per bbl (2+6)	1.10	1.64	2.52	3.07
8.	Company Tax Paid Cost (3+7)	1.30	1.84	2.75	3.37
9.	Total rise in MEP (1970 = base)	-	0.64	1.80	2.53
10.	Rise in Gov't. Take (1970 = base)	-	0.54	1.42	1.97

Source: Ibid. except that in the case of Venezuela the compensation for the devaluation of the American Dollar is 32¢/bbl effective Jan. 1st, 1972.

[1]Tia Juana medium crude.

The issues of devaluation and participation

Although the various factors which combined in late 1970 and early 1971 to bring about the aforementioned increases may not occur in the same manner, the success achieved by OPEC on the financial front has encouraged the organization to press for other changes in the arrangements between the member states and the oil companies, chiefly in the direction of greater participation and control by the governments in the oil operations. The two resolutions (XXV. 139 and 140, see Appendix I) adopted at the Beirut meeting in September 1971 are clear indications that OPEC is definitely decided to serve more demands on the industry.

The claim for a compensation of a "de facto devaluation" of the American dollar dates back to mid 1971 when the system of fixed exchange rates had been abandoned and each currency set free to move in response to market forces. Since then, the value of the American dollar has declined, but the extent varies considerably according to the currency in which the calculation is made. This confused pattern and the fact that the principal currencies fluctuate daily makes it very complex to estimate precisely the extent of the so-called dollar devaluation. Despite

these difficulties the OPEC went ahead in their resolution for compensation, Venezuela led the way on December 21st, 1971 when it announced new tax reference prices for crude oil and products effective January 1st, 1972. The average increase was around 32¢/bbl[1] - 12% - thus increasing the company's tax paid cost by approximately 20¢/bbl. At the same time the Venezuelan Government also introduced controls design to stabilize Venezuelan production. Companies will pay tax penalties if their production is more than 2 percent below their 1970 average, or more than 6 percent above it.

The Middle East countries filed also a similar request and finally obtained a compensation in the order of 8.57 percent.[2]

The issue of participation on the other hand is not at all a new idea as it was previously discussed at the OPEC's XVI conference in 1968 where extensive provisions for government participation and control of oil operations

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[1]The increases range from 20 to 75¢/bbl the highest being applied to low sulphur fuel oil.

[2]This raises on average the company's tax paid cost from 10 to 15¢/bbl.

gathered unanimous agreement. The resolution, justified on the basis of changing circumstances, called also at the time for acreage relinquishments, government determination of posted and reference prices and government responsibility for deciding on conservation rules.

Moreover, the participation issue is, at the same time, fraught with problems. A close examination of the wording of resolution 139 - re: Appendix I - reveals that confusion and even non-unanimity seems to be present amongst the OPEC members. In fact, only the broad objective is clear, which stipulates in essence the desire of the governments to have a working interest in the oil concessions. The Resolution itself gives no indication of the size of the stake which the governments propose to seek. The OPEC's secretary general, Dr. Nadim Pachachi, indicated however that the most plausible demand will be for a 20 percent participation[1], building up possibly to 51 percent by 1985.

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[1] In the meantime, it is indicated that oil companies in Iraq, Abu Dhabi and Qatar have informed the governments of those Middle East countries that they accept principle of negotiating a 20% direct government ownership interest in oil operations. This follows the acceptance earlier in the month of same by Aramco, the largest producing company in the Middle East. Aramco told Saudi Arabia it accepts the principle of participation but it set at the same time a long list of conditions pending negotiations. It is believed that Aramco-Saudi Arabia talks will set the pattern, see: Wall Street Journal, March 24, 1972.

Whatever the final outcome, it is hard to presently calculate what a 20 percent participation share in the multi-billion dollar oil concessions would amount to. OPEC may appear to have a winning hand but the oil companies are not quite in the weak position they seem to be in. There is today no close substitutes for their technical and commercial know-how and their already established markets. The Middle-East and Venezuela know it and it may influence their decisions and demands.[1]

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[1]At the present moment I wish not to make any estimation of the cost to the oil companies of such participation schemes mainly due to lack of reliable information and since a wrong approximation could have a heavy weight on my study. It is clear, however, that a 20 percent participation share by the various OPEC's governments in oil operations will result in a positive and significant cost to the oil companies. For the time being it is very difficult to numerically assess this cost since the negotiations just started between Aramco and Saudi Arabia and a long list of conditions are still pending.

CHAPTER V

AN ANALYSIS OF INTERFUEL RELATIONSHIPS

Heavy fuel oils are only one of the various means to fulfill energy requirements. Amongst the factors that could affect heavy fuel oils future prices we have to evaluate the potential competition from other major sources of energy, namely crude oil, natural gas and coal.[1]

Table 14 summarizes present and expected interfuel cost relationships landed in Montreal in ¢/MMBTU. Let us concentrate for a moment on its major components.

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[1] I do not mention nuclear power as an alternative source of energy because I do not consider its impact to be significant for the time period under study and terminating in 1980.

TABLE 14

PRESENT AND EXPECTED ENERGY FUEL COSTS

MONTREAL

¢/MMBTU

	1970-1971	1975	1980
OIL			
Domestic Whole Crude	71.0	80.5	90.2
Foreign Low Sulphur Crude	53.1	66.6	82.6
COAL			
Western Canadian	71.4	94.3	103.9
Apalachian	58.5	66.8	75.0
NATURAL GAS			
Industrial - Firm	67.6	71.6	81.6
HEAVY FUELS - 3% wt. SULPHUR	45.4	58.2	64.1

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NATURAL GAS			
Industrial - Firm	67.6	71.6	81.6
HEAVY FUELS - 3% wt. SULPHUR	45.4	58.2	64.1

Coal: The analysis attempts to isolate the present and future values at the minehead and to the ultimate customer in Montreal of both Canadian[1] and imported coal.

Substantial coal reserves exist in Western Canada - mainly in Alberta and British Columbia. They are largely bituminous and sub-bituminous deposits highly suitable for metallurgical coking processes thus increasing the opportunity cost of using them for heating purposes. Historically, metallurgical coal for coking end use has been in greatest demand in the United States and Western Europe. The entry of Japan in the steel producing industry has provoked a real shift in requirements to that area of the world. Steel

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[1] My analysis of Canadian coal does not take into account Eastern Canada coal - Nova Scotia, New Brunswick and Cape Breton Island. Maritime coal is of a high volatile rank (30 - 37 percent) and contains a high level of sulphur and ashes. The Maritime coal industry have only survived to date because of massive subsidies and transportation subventions (approximately $5.00/ton) granted specifically to alleviate the social problems of an economically depressed area. Since 1969 the federal government has put an end to these subsidies with the results that many old mines have closed down operations. On the other hand, most of the remaining Maritime coal is located in deep submarine mines thus greatly impinging on extraction costs due to extended underground haulage, ventilation and other factors.

Industry Task Force[1] in the U.S. estimates that by 1980 Japan's needs for coking coal will be the highest in the free world at over 130 million tons of which about 23 percent - 30 million tons - will be supplied from Western Canadian coal[2] and approximately 35 percent - 45 million tons - from Apalachian coal. Therefore, the price of Canadian coal will be greatly influenced by projected coal prices in the United States and Japan and it is safe to assume that a world pricing structure will be set by the value of coking coal from the Apalachian range.

In 1970 Apalachian coal imported to Canada - mainly for use in the Ontario steel mills - carried an average mine-head value of $9.25/short ton[3]. This represented an increase of $3.00/short ton over 2 years and, extended to Montreal it would have landed, including transportation charges from U.S. mining areas at $16.25/short ton.

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[1] Iron and Steel Symposium, Steel Industry Task Force Report to the Iron and Steel Symposium (Chicago: May 1971).

[2] These estimates are confirmed by another study see: H.P. Simon "Economic Impact of Coal Industry in Western Canada", The Western Miner, Jan. 1972.

[3] The U.S. price was $8.80/short ton, the difference in exchange rates accounts for the discrepancy. Beyond 1970, it is assumed that Canadian and American dollars are at parity.

On the other hand, the average current price of Alberta coal during the same period was $9.50/short ton,[1] it would have landed in Montreal, including transportation and other charges at $20.00/short ton (see Table 15 for a more detailed analysis) substantially higher than Apalachian coal (almost $4.00/short ton).

As for the future, a further increase of about $3.00/short ton is anticipated over the next 10 years[2] suggesting an average minehead value for Apalachian coal of approximately $12.00/short ton in 1980. An extra $12.55/short ton of transportation charges could result in a laid down cost to Japan of approximately $24.55/short ton. Now, based on this

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[1]The average minehead value for bituminous coal in Alberta was reported by Statistics Canada at $6.50/short ton in 1969. It appears based on Japanese export contracts that a current value for 1970 and 1971 would be around $9.50/short ton - an increase consistent with U.S. price increases over those years.

[2]This predicted increase reflects cost of desulphurizing high sulphur Apalachian coal, a buoyant Japanese market and some built-in inflation. These values are directional only and carry sensitivities of -10% to +20%. Imperial Oil Limited, internal document.

TABLE 15

CANADIAN COAL - IMPORT COAL

COMPARISON OF LANDED COSTS IN MTL.

1970

$ SHORT TON

	CANADIAN COAL			APALACHIAN COAL	
1.	MINEHEAD VALUE	9.50		9.25	MINEHEAD VALUE
	TRANSPORTATION:				TRANSPORTATION EASTERN U.S. MINING AREA TO MONTREAL
	- UNIT TRAIN (100 CARS TRAIN CROWNEST PASS			7.00	
2.	TO LAKEHEAD)	7.20			
3.	- TERMINALS	1.00			
4.	- MARINE LAKEHEAD TO MTL.	2.30			
5.	LAID DOWN COST - MTL. $/SHORT TON (1+2+3+4)	20.00		16.25	LAID DOWN COST - MTL $/SHORT TON
6.	¢/MMBTU AT 14,000 BTU/LB	71.4		58.25	¢/MMBTU AT 14,000 BTU/LB
7.	COMPARABLE HEAVY FUEL OIL (3% sulphur) ¢/MMBTU		45.4		

Source: Brown "Coal in Canada", p. 17, the landed costs in Montreal are based on a similar study with Toronto being the center of interest. I extended it to Montreal based on discussions with Imperial Oil Limited, Transportation Department staff.

landed price of Apalachian coal in Japan, we can derive the minehead value of Canadian western coal and the price in ¢/MMBTU[1] to the ultimate customers of the Province. As the analysis indicates Western Canada coal is not competitive at all in the Quebec energy market - see Table 16 and Chart 7 for a more detailed analysis - as heavy fuel oils is expected to land in Montreal in 1975 and 1980 respectively at 58.2 and 64.1¢/MMBTU, about 10¢/MMBTU lower than imported coal and 40¢/MMBTU cheaper than Canadian coal.

Crude-as-a-Fuel: In 1970 at times of restricted availability of heavy fuel oils, other alternate means of energy were looked at and one suggestion - which is still raising interest today - was to burn crude oil. In our analysis of this alternative we will concentrate on two types of crude - a typical western Canadian crude from Alberta and a low sulphur imported crude.

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[1] The BTU conversion factor of coal, crude oil, natural gas and heavy fuel oils are as follows:
Coal bituminous: 14,000 BTU/lb.
Crude Oil 38 to 40° API: 5.8MMBTU/bbl approximately
Natural Gas: 1,000 BTU per cubic foot.
Heavy Fuel Oils: 6.3 MMBTU/bbl approximately
For more details see: Imperial Oil Limited, Esso Fuel Oils, Technical Manual (Toronto: Technical Services, 1964), pp. 10 and 62.

TABLE 16

EXPECTED FUTURE VALUES OF APALACHIAN
AND WESTERN COAL: 1970 TO 1980
$ SHORT TON

APALACHIAN COAL:	1975	1980
1. MINEHEAD VALUE	10.50	12.00
2. RAIL TO TIDEWATER[1]	5.00	5.75
3. SHIPPING CHARGES (U.S. PORTS TO JAPAN)	7.65	6.80
4. LANDED COST JAPAN: (1+2+3)	23.15	24.55
5. LESS:		
- FREIGHT JAPAN TO CAN. WEST COAST	4.05	3.65
- UNIT TRAIN MOVEMENT WEST COAST TO MINING AREA	4.70	5.50
6. MINEHEAD VALUE OF WESTERN COAL: (4-5)	14.40	15.40
7. PLUS:		
- UNIT TRAIN MOVEMENT (CROWNEST PASS TO LAKEHEAD)	8.30	9.50
- TERMINAL CHARGES	1.10	1.20
- MARINE LAKEHEAD TO MONTREAL[2]	2.60	3.00
8. LAID DOWN COST MONTREAL: (6+7)	26.40	29.10
$/SHORT TON		
¢/MMBTU (at 14,000 BTU/lb)	94.30	103.90
9. COMPARABLE HEAVY FUEL OIL: ¢ MMBTU	58.2	64.1

Source: N.J. Wood, "Outlook for Canadian Coal" (unpublished internal document, Corporate Planning Services, Imperial Oil Limited, Toronto, Ontario, June 1971). Again, the study stops at Toronto and I extended it to Montreal based on discussions with members of Imperial Oil, Transportation Department staff.

TABLE 16

EXPECTED FUTURE VALUES OF APALACHIAN AND WESTERN COAL: 1970 TO 1980

$ SHORT TON

APALACHIAN COAL:	1975	1980
1. MINEHEAD VALUE	10.50	12.00
2. RAIL TO TIDEWATER[1]	5.00	5.75
3. SHIPPING CHARGES (U.S. PORTS TO JAPAN)	7.65	6.80
4. LANDED COST JAPAN: (1+2+3)	23.15	24.55
5. LESS:		
- FREIGHT JAPAN TO CAN. WEST COAST	4.05	3.65
- UNIT TRAIN MOVEMENT WEST COAST TO MINING AREA	4.70	5.50
6. MINEHEAD VALUE OF WESTERN COAL: (4-5)	14.40	15.40
7. PLUS:		
- UNIT TRAIN MOVEMENT (CROWNEST PASS TO LAKEHEAD)	8.30	9.50
- TERMINAL CHARGES	1.10	1.20
- MARINE LAKEHEAD TO MONTREAL[2]	2.60	3.00
8. LAID DOWN COST MONTREAL: (6+7) $/SHORT TON	26.40	29.10
¢/MMBTU (at 14,000 BTU/lb)	94.30	103.90
9. COMPARABLE HEAVY FUEL OIL: ¢ MMBTU	58.2	64.1

Source: N.J. Wood, "Outlook for Canadian Coal" (unpublished internal document, Corporate Planning Services, Imperial Oil Limited, Toronto, Ontario, June 1971). Again, the study stops at Toronto and I extended it to Montreal based on discussions with members of Imperial Oil, Transportation Department staff.

[1]All rail tariffs beyond 1970 have been escalated on the basis of a large volume contract (3.0 million tons) comparable to the current contract for movement of coal from Kaiser Mine at Eldview to Robert Banks, B.C. at $4.00/short ton.

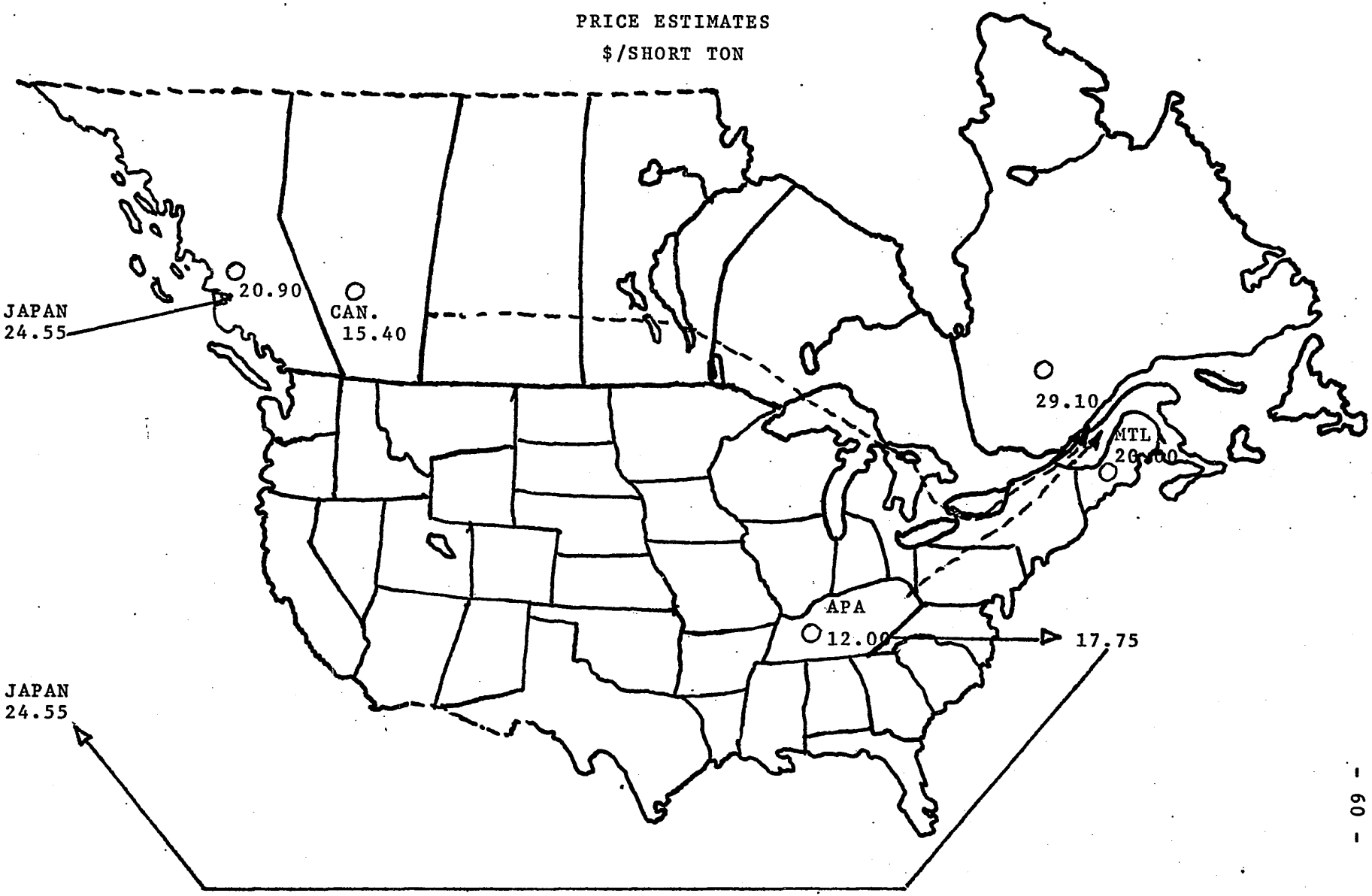
[2]For coastal and in lakes marine movements of coal, a rate of increase of 3 percent/year is provided for to reflect aging of smaller ships and thus increased operating costs. Also these small ships will be phasing out and when specifically required, they will be more costly to build.

CHART 7

1980 CANADIAN COAL & APALACHIAN COAL

PRICE ESTIMATES

$/SHORT TON



Canadian Crude: The 1971 average well head price at Edmonton, Alberta of a Bendina 38° API gravity is $3.00/bbl and it would land in Montreal at an approximate overall cost of 71.0¢ MMBTU - ($4.12/bbl). For the coming decade, inflationary pressures and increased costs of operations (mainly due to higher prices of imported feed stocks) are expected to result in price increases for domestic crude averaging 7¢-10¢/bbl/year starting in 1973 through to 1980.[1] Over and above these increases in operating costs, it is expected that Canadian crude will increase by another 15¢/bbl before 1974 to be at parity with U.S. domestic production[2] in the Chicago market which will be the true basis of comparison with the price of imported crude oils in Eastern Canada. Beyond these well head price increases, transportation costs both for pipeline and marine movements will have to go up to reflect higher operating costs and higher rates of

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[1] This level of price increases is consistent with expected price increases in United States for domestic production as a result of increased costs of new domestic reserves. Imperial Oil Limited, internal document.

[2] This parity would also suit the American Government which would not have any more to defend its oil import policy regarding Canadian crude. In effect, the control of exports to the U.S. would then be exerted by price pressure rather than arbitrarily - imposed volume levels.

returns granted to pipeline owners,[1] (see Table 17 for a numerical assessment of those assumptions).

Imported crude: As we already saw in Part I - under the OPEC demands section - the market of imported crude oil underwent massive changes in 1970-1971 resulting, for Libya as an example, in an increase in posted prices of $1.22/bbl. Taking into account freight charges, it landed in 1971 at Montreal at about $3.00/bbl or 52.1¢ MMBTU. The evolution of posted prices for imported Libyan crude are pretty well determined and date back to the agreement between international oil companies and Libya in early 1971. It provides for a sulphur premium, a retroactivity clause and other increases. Table 18 portrays this evolution of Libyan crude prices up to 1980 and basically relies on the same assumptions made in Part II - Chapter IV - as to the behavior of OPEC.

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[1] Trans-Canada Pipeline Ltd. succeeded in getting rate of return for gas pipeline facilities raised to 9 percent on the depreciated historical cost of the pipeline's investment. It is forecast to increase to a maximum of 10 percent by 1980 to reflect high debt charges and upward costs of labor. I feel it is safe to assume same guidelines for oil pipeline facilities. The only grey area is to convert these increases in terms of ¢/bbl. The impact was calculated as follows based on forecasts made by the Producing Dept. of Imperial Oil Limited for gas movements where they foresee an increase of 4¢/mcf in transmissions rates from 1970 to 1980:

Calculations

4¢/mcf = 4¢ MMBTU

1 barrel of crude $\approx$ 5.8 MMBTU

4¢ x 5.8 MMBTU = 23.2¢/barrel.

These pipeline costs do include over and above rate of returns on initial investment, cost of operations, cost of maintenance and cost of capital, see also footnote 1, p. 69.

TABLE 17

ALBERTA CRUDE LANDED - PRICE - MONTREAL

$/BBL

		1971	1975[1]	1980
1.	EDMONTON - WELLHEAD PRICE (BENDINA CRUDE - 38° API)	3.02	3.38	3.73
2.	TRANSMISSION COSTS EDMONTON TO TORONTO AREA	0.60	0.71	0.83
3.	MARINE MOVEMENT: TORONTO TO MONTREAL AREA[2]	0.50	0.58	0.67
4.	LANDED COST: MONTREAL - $/BBL (1+2+3)	4.12	4.67	5.16
5.	(5.8 MMBTU/BBL) ¢/MMBTU	71.0	80.5	90.2

Source: The wellhead price varies from well to well averaging about $3.00. The wellhead price at Redwater of Bendina crude is 2.85/bbl with a 17.5¢/bbl pipeline charge to connect with TCPL main line in Edmonton, Imperial Oil Limited, internal document.

[1]Transmission costs have been escalated on the basis of rates of return granted to TCPL and I assume it does also apply to oil. Over and above rates of return on the investment, transmission costs include costs of operation and costs of maintenance which are subject to inflationary pressures. See: NEB, Decisions in the Matter of the Application under Part IV of the National Energy Board Act - Rates Applications Phase I of TCPL (Ottawa: Nov. 1971). Also, for marine costs see footnote 2 p. 58 and footnote 1 p. 63.

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[2] No crude oil pipeline is in existence between Toronto and Montreal. To establish a comparison between imported crude and domestic crude both landed in Montreal, a marine movement was assumed from Toronto to Montreal. However, in reality, it would be unlikely that such a transportation scheme would be retained for quantity movements due to limited size of ships that can use the St. Lawrence Seaway. For a discussion of marine costs see footnote 2, p. 58 and footnote 1, p. 63.

TABLE 18

DETERMINATION OF THE FUTURE VALUE OF
LIBYAN LOW SULPHUR CRUDE

$/BBL.

		MARCH 20 1971	JAN. 1 1972	1975	1980
1.	BASE POSTED PRICE (40° API Gravity)	3.20	3.49[1]	4.18	5.05
2.	TEMPORARY - SUEZ PREMIUM	0.12	0.12	-	-
3.	TEMPORARY - FREIGHT PREMIUM	0.13	0.08	-	-
4.	TOTAL POSTED PRICE (1+2+3)	3.45	3.69	4.18	5.05
5.	ROYALTY	0.43	0.46	0.70	0.95
6.	AVERAGE PRODUCING COSTS	0.30	0.30	0.32	0.35
7.	TAX REFERENCE PRICE 4 - (5+6)	2.72	2.93	3.16	3.75
8.	GOVERNMENT TAKE: TAX %	55	55	55	60
9.	TAX PAYMENT	1.50	1.62	1.74	2.25
10.	RETROACTIVE BUYOUT	.09	.09	.09	-
11.	ROYALTY	.43	.46	.66	.95
12.	TOTAL GOV'T. TAKE (9+10+11)	2.02	2.17	2.49	3.20
13.	TOTAL COMPANY COST (12+6)	2.32	2.47	2.81	3.55
14.	TRANSPORTATION COSTS: MARINE TO PORTLAND, AND PIPELINE TO MTL.	0.77	0.75	1.05	1.22
15.	LANDED COST - MTL. $/BBL	3.09	3.22	3.86	4.77
16.	¢/MMBTU	53.1	55.4	66.5	82.6
17.	COMPARISON WITH HFO: ¢/MMBTU	45.4	45.5	58.2	64.1

		MARCH 20 1971	JAN. 1 1972	1975	1980
1.	BASE POSTED PRICE (40° API Gravity)	3.20	3.49[1]	4.18	5.05
2.	TEMPORARY - SUEZ PREMIUM	0.12	0.12	-	-
3.	TEMPORARY - FREIGHT PREMIUM	0.13	0.08	-	-
4.	TOTAL POSTED PRICE (1+2+3)	3.45	3.69	4.18	5.05
5.	ROYALTY	0.43	0.46	0.70	0.95
6.	AVERAGE PRODUCING COSTS	0.30	0.30	0.32	0.35
7.	TAX REFERENCE PRICE 4 - (5+6)	2.72	2.93	3.16	3.75
8.	GOVERNMENT TAKE: TAX %	55	55	55	60
9.	TAX PAYMENT	1.50	1.62	1.74	2.25
10.	RETROACTIVE BUYOUT	.09	.09	.09	-
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12.	TOTAL GOV'T. TAKE (9+10+11)	2.02	2.17	2.49	3.20
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16.	¢/MMBTU	53.1	55.4	66.5	82.6
17.	COMPARISON WITH HFO: ¢/MMBTU	45.4	45.5	58.2	64.1

Source: United States Dept. of the Interior, Report #20240 (Washington: Office of Oil and Gas, Sept. 1971). It includes also the assumptions made in Part II, Chapter I, p.43 . Also, my calculations provide for an upward adjustment in imported prices of 8.57% as a compensation of the American dollar.

[1] The discussion of marine freight rates from Caribbean to Portland is delayed for the moment as it will be discussed at more length in the coming chapter. For pipeline movements it costs approximately 12¢/bbl from Portland to Montreal.

As the analysis shows crude as a fuel either from a domestic or offshore source does not represent a viable alternative. Canadian crudes[1] are too costly while imported crudes do not offer a margin big enough to cover the opportunity costs of using it as a fuel.[2]

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[1] One will notice that I do not mention frontier or East Coast crude. Prospects seem bright presently for major discoveries in these areas but I do not think their impact could be felt before 1980 as we will have to allow for construction of producing and transportation facilities.

[2] International oil companies are reluctant to sell crude as an energy fuel because of the loss of earnings derived from associated products in the barrel of crude. On the other hand, most customers are not equipped to burn crude and would have to undertake changes in their equipment.

Natural Gas: During 1970 - 1971 the selling price of natural gas for a firm[1] industrial customer was 60.0¢/MMBTU and 47.0¢/MMBTU for interruptible supply[2]. This would have compared to heavy fuel oils at $4.20/bbl and $3.00/bbl respectively. During the peak of the supply crisis, the delivered price of heavy fuel oils in Montreal never went over $3.85/bbl (60¢/MMBTU) and, some customers even further away enjoyed lower prices, discounts being granted because of their large size requirements.

As for the future prices of gas facing the consumers of the Province, any analysis would be very complex and fraught with uncertainties as to the future of United States gas pricing policies, the impact and cost of new discoveries, agreements on new pipeline construction and the availability of Arctic reserves. In order to establish an estimate of future "average" gas price for a mix of "old" and "new"

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[1] For basis of comparison with oil I retain only firm supply as being relevant.

[2] Calculated from Metropolitan Gas "Annual Reports" 1970 - 1971.

gas[1], it would be necessary to make an analysis of reserves and deliverability and to determine the quantity of "new" gas required to meet domestic needs and currently authorized export contracts[2]. This would therefore entail an in depth analysis that could be a thesis in itself. Since gas is presently not competitive in the provincial market to heavy fuel oils, I will concentrate on foreseeing the prices of "old" gas keeping in mind the possible impact of "new" discoveries. Presently, all contracts of utilities with Trans Canada Pipeline Ltd.[3] carry escalation clauses that automatically raise the price of gas by a minimum of ¼¢/Mcf/year in most areas going up to ½¢/Mcf/year for gas from the Strachan area. Over and above these, approximately one-third of the contracted gas is negotiable annually to an average Alberta field price. The

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[1]Old gas refers specifically to gas presently under contract while new gas refers to possible discoveries in Western Canada and Northern Frontiers. Other areas of potential discoveries exist also in the Arctic and the East Coast.

[2]Studies on the subject exist such as:
B.G. Pryce and N.J. Wood, "Canadian National Gas Price Forecast 1970 - 1980" (unpublished internal document, Imperial Oil Limited, Corporate Planning Services, Toronto, Dec. 1970).

[3]Though specifically for TCPL, it can be assumed that escalation clauses are similar with other transmission systems.

remaining two-thirds of the contracted volumes undergo as well some negotiations, especially if large reserves are involved.[1] It is estimated that the effects of these foregoing factors will cause increases in the price of gas already contracted for by about ½¢ annually between 1970 and 1973 and approximately 3/10¢ each year thereafter to 1980 resulting in a total increase of about 4¢/Mcf by 1980.[2]

---

[1]Renegotiations then take place in the 9th year after initial delivery and every five years thereafter. The information pertaining to these escalation clauses are derived from Trans Canada's application in 1970 to the National Energy Board that contained datas on volume, timing of price increases and renegotiations by field. See: NEB, Report in the matter of the Application under the NEB Act of TCPL, phase I, rates application (Ottawa: Nov. 1970) and related documents.

[2]Pryce and Wood Canadian Natural Gas Price Forecast 1970 - 1980 p. 14-15. These, however, appear to me on the low side in view of the determination of the Alberta Energy Resources Conservation Board to review natural gas marketing and pricing policies. Hearings opened February 23, 1972 on the above subject and some observers are quoted saying it will involve higher prices for gas consumers - and increased strain between Eastern and Western Canada. The crux of the problem is that Alberta wants more royalty revenue. If denied this right by NEB the Province may end up imposing a special tax on gas exported from Alberta. Also, despite being granted an increase rate of return of 9% on the depreciated historical cost of the pipeline investment's, Trans Canada Pipeline Ltd. did not get all it wanted from NEB. Phase II of the rates hearing will begin soon, with the TCPL submitting a plan for aportioning higher costs, over and above the automatic price increases, among its customers. Agreement may not be reached until fall, making 1973 the impact year.

Presently, due to limitations in the distribution system, natural gas is present in approximately only 20% of the provincial energy market (as we will see later on in the next chapter). Pipeline facilities and underground pipes are established only in Montreal and its surroundings up to 30 miles outward exception made for a small extension going from the Ontario border to the northern part of Abitibi. I do not foresee any major additions to the system to make gas available to remote areas. Forecasts are, and gas companies are well aware of it, that gas will be available on the East Coast by 1976 and marketable in Quebec by 1978 - 1980, therefore impeding any major investments in distribution facilities.

Therefore, as we briefly saw, it is easy to conclude that heavy fuel oils will remain the major source of energy in the Province, as the analysis shows other sources to be not competitive.[1] Despite the fact that the analysis was based on a 3.0 wt. % sulphur, heavy fuel oil, I will demonstrate

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Also, once Phase II is settled through, TCPL will undoubtedly need regular rate increases to meet rising costs and insure its 9% rate of return. Therefore the 4¢/Mcf by 1980 could well be attained by 1975 and another 10¢/Mcf from 1975 to 1980 is at all possible.

[1] See Table 14, p. 53 which compares alternate sources of energy with heavy fuel oils once provision is made for future increases in heavy fuel oil prices. We can see that throughout the period gas is not competitive in Quebec.

in the next chapter that the cost of desulphurization will not impede the competitive advantage of heavy fuel oils as only 28% of the market at the most is to be affected by clean air regulations raising the average landed cost of heavy fuel oils by approximately 5¢/MMBTU, see: Chapter VI.

CHAPTER VI

THE COST OF DESULFURIZATION

One of the major areas which presents economic problems and that is likely to influence the future prices of heavy fuel oils is the need to protect the ecology. There is little argument that this need is a real one, in spite of the absence of solid data in many of the areas involved. Universal worry about ecological matters is so recent that not enough real data is available and the subject is emmeshed with emotion and wild statements from all sides. The main concern is that the need to protect the environment is with us to stay. The more interesting question for economists is what is the effect of pollution and how to pay the bill.

From an economic standpoint pollution can be defined as:

> the addition by man of materials to the environment to such an extent that costs are imposed on other men and where no recourse exists to receive equitable compensation for these costs.[1]

Pollution is a "bad" as opposed to a normal good because it involves transference of costs from polluters to people who neither produce nor desire pollution[2] while creating at the same time misallocation of resources. The polluter imposes on society costs greater than the costs to the polluting firm. Such cases where the burden of social costs is greater than private firm costs are known as technological external diseconomies.

The present market price system is ineffective in handling the pollution problem because of the inappropriability of the ownership of air and of most other natural resources.

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[1] L. Waverman, Pollution: a Problem in Economics, in L.H. Officer and L.B. Smith, Canadian Economic Problems and Policies (Toronto: 1970), p. 321.

[2] All urban dwellers, for example, pay for the emission of unburned hydrocarbons in the air through higher cleaning costs for houses, cars and clothes, less lovely flowers and more irritated eyes and nose blowing.

But because a price does not exist, it does not imply that these elements are worthless. Pollution - the imposition of costs on others - exists only when the natural supply of an inappropriable factor is, at a zero price, less than the demand at that price[1]. Pollution will arise when this inappropriable factor or scarce resource (clean air for example) cannot be priced in a market.

In a Utopian solution, the market mechanism should operate to make polluting more costly to the offender than not polluting. This is not the case in the real world because a polluting firm does not itself bear the entire costs of its production. At any positive price for its product such a firm would therefore agree to supply a greater amount of output than if it paid all the costs of its production, including polluting. The existence of such external diseconomies will lead to an oversupply of goods produced by polluting firms at the expense of other goods. As a consequence, misallocation of resources is created. Polluting firms over produce and attract too many resources while non-polluting firms under produce and as a result, too few resources are committed for their production.

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[1]Waverman, Pollution: a Problem in Economics, p. 323

Once the necessity to fight pollution is established, means must be introduced to perform the work. The current answer, though imperfect it may be[1], seems to be government regulations which, at least, has the merit of placing everybody on an equal footing. In one way or the other, the community will pay for cleaning up the environment and it is likely that these social costs will be greater than the pollution costs to the firm.

Recent legislations in some of Canada's large cities restricting the sulphur content of fossil fuels being burned show that an increasing concern for the environment is in the making. At the same time these restrictions greatly increased the demand for low sulphur fuel oils. While the supply of naturally-occurring low sulphur fuels is fairly

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[1] It is an imperfect solution because jurisdiction is split among municipalities, provinces and the Federal Government. Some municipalities are reluctant to tax polluters while some provinces are equally slow. On the other hand, the Federal Government also has limited controls and even there, they are split among various departments.

limited, it is expected that the restrictions on the sulphur content of oils will become more and more stringent and widespread[1]. For these reasons, fuel oil desulfurization processes will become increasingly necessary, but they will bear a cost to the refiners and the consumers. This chapter represents a brief attempt to assess the magnitude of the desulfurizing costs and its implications on the price of heavy fuel oils in the Province.

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[1]The combustion of heavy fuel oil by the industry and electrical utilities in Canada contributed 80% of the total sulphur dioxide emissions into the air from combustion processes in 1966. While most electrical utilities in Quebec use hydro power, the 80% is in all likelihood applicable to the heavily industrialized parts of Montreal. The Montreal Urban Community By-Law 9, Article 14 (C) further specifies the limits of sulphur content in heavy fuel oils being burned as follows:

Oct. 1970	Oct. 1971	Oct. 1972
2.5%	2.0%	1.5%

They are similar to Toronto where regulations stop also at 1.5% by 1973.

It would help the analysis if we look first at the distribution of sulphur in a petroleum barrel. A typical case is shown in Chart 8, where a barrel of crude with an average sulphur content of 1.7% sulphur content (called technically 1.7wt.% medium sulphur crude) is fractioned into a slate of various fuel products by distillation. As shown, nearly one-half of the crude barrel boils below 560°F[1] and contains an average of 0.5wt.% sulphur while the bottom half of the barrel, material boiling over 560°F - the primary source of fuel oils - contains much more than half of the total sulphur.

> "The effect of sulphur concentration with boiling point can be easily seen by comparing the sulphur content of the light gas oil, heavy gas oil and residuum fraction."[2]

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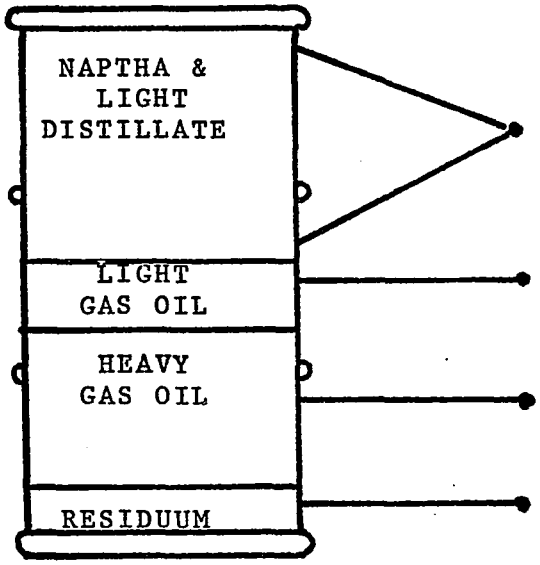
[1]This low boiling fraction will become, after refining, motor gasoline, diesel oil, jet fuel, etc.

[2]D.E. Blaser, A.L. Saxton, J.A. Rionda, Economics of Resid Processing (Florham Park, New Jersey: Esso Research and Engineering, Afternoon Paper 71-076, May 13, 1971), p. 3.

CHART 8

TYPICAL YIELD AND

SULFUR DISTRIBUTION FROM CRUDE PETROLEUM



	YIELD, VOL.%	BOILING RANGE, °F	SULFUR, WT.%
NAPTHA & LIGHT DISTILLATE	48	0 to -560	0.5
LIGHT GAS OIL	13	560/700	1.7
HEAVY GAS OIL	27	700/1100	2.3
RESIDUUM	12	+1100	4.3
		TOTAL CRUDE	1.7

Source: B.T. Fant, J.A. Rionda, "Modern Approaches to Fuel Oil Desulfurization, Abstract, (Florham Park, New Jersey: Esso Research and Engineering Co. May 1971), p. 14.

The residual fraction that makes 12% of the total crude contains in fact 4.3wt.% sulphur that is, more than 30% of the total sulphur in the crude barrel.

For the refiner this means that as the demand for low sulphur fuel oils increases, he will be forced to process ever increasing volumes of high sulphur fuels to meet required specifications. The deeper he cuts into the barrel, the more difficult and costly the desulfurization process becomes, because then, he has to remove increasingly concentrated sulphur as well as increasingly higher metal and asphaltene contents.

Several routes for the production of low sulphur fuel oils are available to refiners[1] depending how low they have to go in the process or how low they need to reduce the sulphur content. Regardless of which alternative route is followed, it is likely that major capital investments in

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[1]Esso Research and Engineering have 3 main processes available to their refiners that is: GOfining, RESIDfining and Flexicoking. GOfining and RESIDfining are hydro desulfurization processes while Flexicoking is a recent development integrating conventional fluid coking with gasification of the coke. See: Blaser, Saxton, Rionda, Economics of Resid Processing p. 3 - 10.

equipment and facilities will be required to manufacture the required volumes of low sulphur fuel oils. Amongst the major investments required is a vacuum pipestill, hydro-desulfurization units, a flexicoker, hydrogen generation facilities, plants to recover elemental sulphur as well as the necessary supporting utilities and offsite facilities[1]. Based on the required pre-investments, Table 19 provides a comparison of the costs of various desulfurizing schemes[2].

As can be seen, the cost today on a U.S. Gulf Coast basis of producing 1.0 wt.% low sulphur oil is approximately 42¢/bbl building up to almost 60¢/bbl for 0.3wt.% sulphur. These desulfurizing costs are specific to feed stocks of 1.7wt. % to 2.0wt. % sulphur[3] and, while including investments, they exclude tankage and other items peculiar to individual refinery situations.

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[1] For a more technical discussion together with flow diagrams see: Ibid: p. 12-14 and Fant Rionda, Modern Approaches to Fuel Oil Desulfurization, Abstract p. 18-22.

[2] The Operating costs are represented in terms of cents per barrel of low sulphur fuel oils. Also, capital costs are based on a 9% discounted cash flow return during a plant life of 15 years with 50% corporate taxes. See: Blaser, Saxton, Rionda, Economics of Resid Processing p. 15.

[3] This is typical of most of the crudes refined in Quebec, e.g.: Venezuelan, Lybian and some Middle-East crudes.

TABLE 19

A COMPARISON OF THE ESTIMATED COST FOR ALTERNATE
LOW SULPHUR FUEL OIL PRODUCTION SCHEME
IN A TYPICAL U.S. REFINERY ON THE GULF COAST

CASE	PRESENT	GOFINING	RESID-FINING	RESID-FINING	GOFINING FLEXI-COKING	GOFINING FLEXI-COKING
1. Regular Fuel Oil Sulphur Level-Wt.%	2.0	1.0	1.0	0.5	0.5	0.3
2. Additional Investments Necessary - MM$	None	31	36	46	56	67
3. Cost of Additional Refinery Fuel (at $3.50/bbl)	None	16.9	14.2	19.7	16.9	17.7
4. Additional Direct Operating Costs	None	11.6	15.1	21.5	15.9	20.4
5. Capital Costs at 9% D.C.F.	None	13.7	15.9	20.3	24.7	26.6
6. Total Increase in Operating costs (¢/bbl of LSFO) (3+4+5)	None	42.2	45.2	61.5	57.5	64.7
7. Sulphur Credit (20$/LT)	None	(3.2)	(3.2)	(4.5)	(4.5)	(5.7)
8. Net Increase Cost-¢/bbl (6-7)	None	39.0	42.0	57.0	53.0	59.0
9. Sensitivity[1] ¢/bbl	-	20.0	20.0	20.0	20.0	20.0
10. TOTAL EXPECTED COSTS	-	59.0	62.0	77.0	73.0	79.0

In actual practice, process selection and the cost of desulfurization will vary with the type of crude being processed and the actual refinery design capacity, and tankage facilities. Therefore, a sensitivity of 15¢/bbl to 25¢/bbl can be applied to reflect the impact of those non general factors.[1]

More important however is the fact that Mr. Blaser and Mr. Rionda are making their economic comparisons using the costs of a U.S. Gulf Coast refinery processing 275MB/CD. But as we recall from Table 4, a typical refinery in the Province of Quebec can process an average maximum of about 85MB/CD. Since the investment commitments[2] for desulfurization are almost the same, regardless of the size of the refinery, capacity of crude processing can be very important for capital costs recuperation. Table 20 portrays cost sensitivities to capacity limitations and, as shown, it could mean increases in the order of almost 70%. This would raise the cost of 1.0wt.% sulphur well over $1.00/bbl.

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[1]For a discussion of some of those factors, see: E. Gelus "Technology and Costs to Remove Sulphur from Oil Based Fuels" Chemistry in Canada, October 1971, p. 25.

[2]I assume that 80% of the investment costs required for a 275MB/CD refinery will still have to be undertaken for an 85MB/CD.

TABLE 20

A COMPARISON OF THE ESTIMATED COST FOR ALTERNATE
LOW SULPHUR FUEL OIL PRODUCTION SCHEME
IN A TYPICAL PROVINCE OF QUEBEC REFINERY

CASE	PRESENT	GOFINING	RESID-FINING	RESID-FINING	GOFINING FLEXI-COKING	GOFINING FLEXI-COKING
1. Regular Fuel Oil sulphur Level-WT.%	2.0	1.0	1.0	0.5	0.5	0.3
2. Additional Necessary Investments - MM$	None	25	29	37	45	54
3. Cost of Additional Refinery Fuel at $3.50/bbl	None	16.9	14.2	19.7	16.9	17.7
4. Additional Direct Operating Costs	None	11.6	15.1	21.5	15.9	20.4
5. Capital Costs at 9% D.C.F.	None	40.1	46.5	59.4	72.2	77.3
6. Total Increase in Operating Cost (¢/bbl of LSFO)(3+4+5)	None	68.6	75.8	100.6	105.0	115.4
7. Sulphur Credit (20$/LT)	None	(3.2)	(3.2)	(4.5)	(4.5)	(5.7)
8. Net Increase in Cost (¢/bbl) (6-7)	None	65.4	72.6	96.1	100.5	109.7
9. Sensitivity - ¢/bbl	-	20.0	20.0	20.0	20.0	20.0
10. TOTAL EXPECTED COSTS (¢/bbl) (8+9)	-	85.4	92.6	116.1	120.3	129.7

The magnitude of these desulfurizing costs together with the heavy capital dollar commitments will, as a consequence, lead the refiners of the Province away from such investment projects, and they will have to rely on imports (mainly from Venezuela where there is presently the only refinery equipped to produce LSFO[1]) for their low sulphur fuel oils requirements (1.0 wt.% sulphur and less)[2].

Presently, Montreal Urban Community regulations call for 1.5 wt.% sulphur by January 1st, 1975. Quebec City and Hull, two other major urban centres are expected to lay down regulations also - mainly for political reasons - similar to Montreal, starting in 1973 at 2.0 wt.% and building up also to 1.0 wt.% sulphur by 1973.

Based on a geographical study[3] of heavy fuel oil conducted previously to that thesis, I am able to predict

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[1]This refers to the Creole Petroleum Co. desulfurization complex at Amuay, Venezuela controlled by Standard Oil of New Jersey.

[2]The spread in the Minimum Export Value between 2.0 wt.% and 1.0 wt.% sulphur heavy fuel oils is presently approximately $1.00/bbl making the total import cost of low sulphur fuel oils cheaper than domestic production of same.

[3]M.L. Lapointe, "Heavy Fuel Oils - Land Market Analysis", (unpublished internal document, Imperial Oil Limited, Montreal, Que., Jan. 1970).

what section and share of the provincial market will be affected by clean air regulations and therefore how much imports of LSFO[1] will be required. The Province was divided in eight main zones plus an unzoned section - see Appendix 2 for a detailed description of zone boundaries - and Table 21 depicts the resulting market demand profile as of December 31st, 1970. Beyond 1970 to 1980, market growth of 6%/year is assumed for the regular industrial market while 2%/year is predicted for the marine market (which represents approximately 10% of the total market). Table 22 summarizes these assumptions beyond 1970 and their impact for the future. We can see that the share of total demand represented by LSFO is increasing rapidly during the decade from a negligible size to 28% by 1975 and levelling off at that level to 1980. This 28% may appear low but it takes account of the fact that only the major urbanized centres will lay down anti-pollution legislation as outlined in page 83 and Table 21. In any event, 28% still represents a sizeable share of the market and it implies that industries and commercial complexes located in these urban centres will have to pay approximately $1.00/bbl. more to burn cleaner fuels.

TABLE 21

QUEBEC HEAVY FUEL OILS - MARKET

DEMAND PROFILE - 1970 - MBS

ZONE IDENTIFICATION	ZONE #	CARGO CUSTOMER	LAND CUSTOMER	MARINE	TOTAL
M.U.C.	1	-	8,500	3,600	12,100
LAURENTIANS	2	-	4,200	-	4,200
TROIS-RIVIERES	3	2,000	1,800	-	3,800
QUEBEC CITY	4	750	900	-	1,650
HULL	5	-	2,700	-	2,700
LAC ST-JEAN	6	1,400	1,800	-	3,200
ABITIBI	7	-	900	-	900
EASTERN TOWNSHIP	8	-	1,500	-	1,500
UNZONED	-	6,000	8,010	800	14,810
TOTAL	-	10,150	30,310	4,400	44,860

Source: Statistics Canada, Refined Petroleum Products, Cat. #45-002 and 45-202 and M.L. Lapointe, Heavy Fuel Oils - Land Market Analysis, Jan. 1970.

My figures do reconcile with the data published by Statistics Canada less own consumption by refiners.

TABLE 22

QUEBEC HEAVY FUEL OILS
MARKET DEMAND BY SULPHUR LEVLES

MMBS

YEAR	SULPHUR LEVELS[1] 3.0wt.%	2.5wt.%	2.0wt.%	1.5wt.%	1.0wt.%	TOTAL ESTIMATED DEMAND
1970	42.8	2.1	-	-	-	44.9
1971	38.4	6.8	2.3	-	-	47.5
1972	40.6	-	7.1	2.4	-	50.1
1973	37.7	-	5.1	10.1	-	52.9
1975	42.4	-	-	-	16.7	59.1
1980	55.0	-	-	-	21.7	76.1

Source: Ibid.

[1] Only the part of the market qualifying as "land accounts" (where deliveries are made either by truck or rail movement) will be subject to the regulations. See page 83-84 for a discussion of market segmentation.

CHAPTER VII

THE FUTURE OF MARINE TRANSPORTATION COSTS

The assessment of future marine transportation rates is certainly one of the most hazardous tasks of this thesis as they vary widely almost from one end of the scale to the other. After unprecedented highs during the second part of 1970 and early 1971, marine transportation costs started to decline rapidly in the second semester of 1971 with the result that, in December 1971, a voyage from the Caribbean to Portland had decreased by approximately 30¢/bbl at spot rate. Reasons for such a softening of transportation costs are numerous and amongst the major ones we can list the reopening of the TAPLINE in March 1971, continuance of unusually mild weather in the Northern Hemisphere, reduced economic activity in Japan and Northern Europe during the March to October period and overflow of ships from other trades who wanted

initially to profit from the upward trend in freight rates during 1970[1]. Also another important factor was the suspension until July 1973 of the 11.7¢/bbl. Canadian Government duty on imported heavy fuel oils.

Over half of the world's seaborne trade in terms of tonnage now consists of crude oil and petroleum product movements, estimated last year at 1.3 billion tons[2], while oil's share of total trade measured in ton-miles was considerably greater[3]

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[1]This was particularly the case for combined carriers. As the name implies these cargoes are suited to haul oil and dry products in a two-way voyage. At the end of August 1971, as many as 49 of these ships - almost one-third of the total 171 operating during the year - were traded exclusively in oil. This was due to the attractive freight rates earned in oil, together with contractions in ore and coal shipments for the Japanese steel industry. See: The Research Division, H.P. Brewry, Shipping Consultants Ltd., Combined Carriers: Their Role in the Bulk Trade 87/91 New Bond Street, London WIY QLA.

[2]Petroleum Press Service, March 1972, p. 93.

[3]Thanks to the peculiar logistics of the oil trade and the continued closure of the Suez Canal.

at some 62%. Therefore anything that affects the world shipping fleet will bear great impact on oil movements.

Deliveries to the world's shipping fleet in 1971 totaled 38 million dwt of which 20 million were tankers, 5 million combined carriers, 7 million dry bulk tonnage and 6 million other types of cargo ship. The net overall increase in the fleet was 33 million dwt and, of this, tanker tonnage increased by almost 13% to 168 million dwt at year end 1971[1]. Together with an increase in the size of the fleet, we can also notice a tendancy to build ships of greater capacity. In 1959 the average tanker size was 20 dwt, but within 10 years, this doubled to 40 dwt, see: Chart 9. And, for the future, it is predicted to evolve even more rapidly as at the end of the same period all the ships in construction averaged to approximately 145 dwt. Some ships of 200 dwt were already on order while today the Japanese ship building industry is presently building 3 ships of 400 dwt. Based on these huge increases in ship capacity, many started in 1971 to predict a signficant and sustained decrease in future marine transportation rates. But some other factors other than

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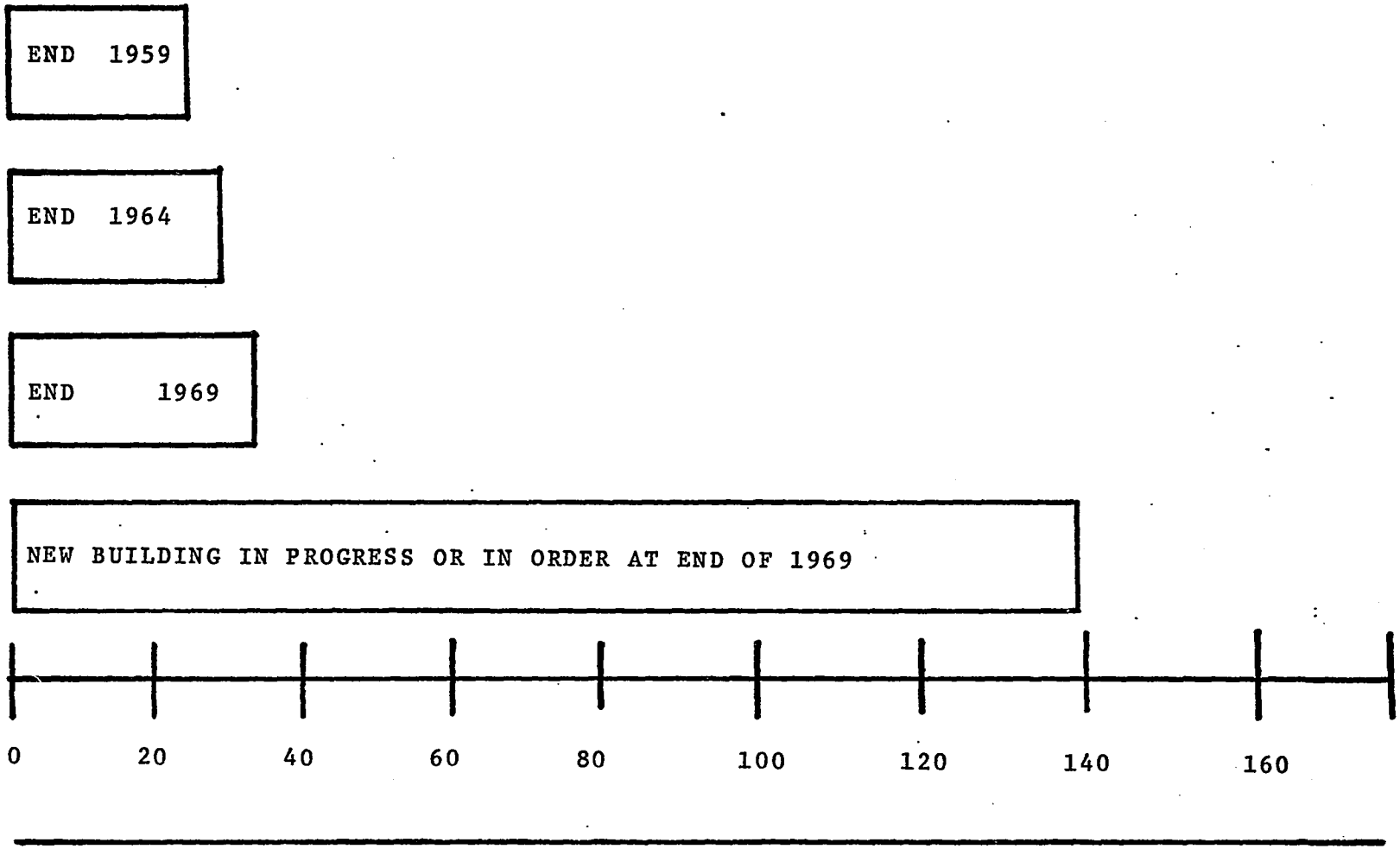
[1]Fearnly and Egers, Chartering Co. Ltd., Review 1971, Oslo: Norway, (March 1972).

CHART 9

AVERAGE SIZE OF WORLD TANKER FLEET



Source: Petroleum Press Services, August 1970.

size must also be taken into consideration. Presently, very few harbours exist that can accommodate tankers over 150 to 200 dwt thus necessitating transshipping or pipelining. Secondly the ecologists and people concerned with pollution hazards are again shouting the alarm. Ships operating in busy areas or near highly frequented harbours increase the danger of pollution by oil spills caused by collision or other mishaps and the impact of any such accident would be greatly multiplied with tankers hauling huge amounts of oil[1]. This concern is spreading rapidly in North America and is reflected in insurance premiums. Liabilities to cover ecological damages consecutive to oil spills are high and, in the case of very large tankers, go some way to cancel out the economies of scale.

Again any oil movement to satisfy provincial energy requirements will be closely influenced by the international situation of the time. However, some other realities will have also to be taken into consideration.

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[1] The seriousness of the situation was also realized by the Canadian Government who imposed in 1972 a special tax of 2.6¢/bbl (15¢/long ton) to any oil moving in Canadian waters. This was designed on the purpose of building a fund to pay for any costs involved with oil spills.

One of the main factors that limits the usage of greater ships to transport oil to the Province and hence that denies us the advantage of economies of scale built on size as to do with depth and width of harbours. Portland Harbour cannot accept ships over 100 dwt, while Montreal and Quebec cannot go over 80 dwt unless dredging the gulf of St. Lawrence and the harbours themselves. Keeping all these limitations in mind, the Federal Department of Transport made a study of the cost for dredging the St. Lawrence River between St-Jean (Orléans Island) and Cape Gribane. Deepening this section of the channel by 11 feet would allow 100,000 dwt tankers to reach Quebec Harbour during the $2\frac{1}{2}$ hours of maximum tide with a safety margin of 6 feet. The cost of dredging that distance of 20 miles was estimated at approximately $19 millions. However, this depth is still insufficient to take advantage of lower cost of transportation allowed by tankers over 200,000 dwt. Dredging would be again possible but at a very high cost. To dredge the St. Lawrence River up to Montreal would cost between 200 and 250 millions thus making such a project not economically viable.

Also the fact remains that, even if deepening the channel allowed 200,000 and 300,000 tons ships to reach Quebec Harbour and possibly Montreal, the channel width would

prevent such traffic. Tankers captains stated that the channel would be too narrow for these big ships: they need two miles to come to a stop and winds cause uncontrollable driftings.

Therefore, I assume that the world scale index for oil movements to the Province will be as shown in Table 23.

With the present size of the fleet and the average size of ships now in construction and in order, I can foresee that the handy size ships (between 35 and 75 dwt) that can be handled by Portland, Quebec and Montreal harbours will become more and more scarce while their replacement costs will increase as production of bigger ships will have to be halted and replanned to allow for construction of the smaller ships. These predicted increases in building costs will only reflect a tendancy that started some time ago and saw average prices of new ships increased by almost 70% over 3 years, see Table 24.

Therefore, based on those assumptions, I foresee that between 1971 and 1975, marine transportation rate increases will add up another 50¢/bbl to the cost of oil for the Province of Quebec and another 25¢/bbl from 1975 to 1980.

TABLE 23

ESTIMATED WORLD SCALE INDEX LEVELS
CARIBBEAN TO PORTLAND VOYAGE

	1974	1975	1976	1980
WORLD SCALE POINT	170	200	210	240
c/BBL	75.0	85.0	90.0	110.0

Source: Based on a series of interviews with various Imperial Oil staff at Toronto. Amongst the major ones:
D.Flannigan, private interview, Toronto, March 10, 1971.
N.J. Wood, private interview, Toronto, March 10, 1971.
I.K. Campbell, private interview, Nov.-Dec. 1970, March 8-10, 1971.

The same order of magnitude can be assumed for oil movements from the Caribbean area directly to Montreal re: for movements of refined petroleum products, waxy crudes and imported heavy fuel oils.

TABLE 24

AVERAGE NEW BUILDING PRICES
MILLIONS OF DOLLARS AT YEAR END

	1967	1968	1969	1970
BULK CARRIERS:				
18,000 dwt:	3.8	4.3	4.6	6.3
30,000 dwt:	4.9	5.4	5.7	8.7
COMBINATION CARRIERS:				
96,000 dwt OBO[1]	10.0	11.0	12.0	23.0
TANKERS:				
35,000 dwt	5.5	6.3	6.8	9.9
87,000 dwt	9.0	9.4	10.0	17.0
210,000 dwt	14.7	16.6	19.0	31.0

Source: Fearnly and Egers, Chartering Co. Ltd., Review 1971 Oslo: Norway (March 1972).

[1]OBO stands for: Ore-Bulk-Ore.

Over and above these estimated increases, there will also be another 2.6¢/bbl for pollution fee (15¢ long ton as imposed in January 1972 by the Federal Government), while the duty of 11.7¢/bbl on heavy fuels suspended by the Federal Government up to July 1973, will then be reimposed. Table 25 contains a summary of the expected marine transportation costs to Montreal to prevail in the future both for crude oil and heavy fuel oils.

TABLE 25

EXPECTED TRANSPORTATION AND RELATED COSTS FOR MOVEMENTS OF IMPORTED CRUDE OIL OR HEAVY FUEL OILS

¢/BBL

	1971	1975	1980
CRUDE OIL:			
CARIBBEAN TO PORTLAND	55.0	85.0	110.0
PORTLAND TO MTL: PIPELINE	12.0	12.0	12.0
POLLUTION CHARGE	-	2.6	2.6
TOTAL EXPECTED COSTS FOR CRUDE OIL MOVEMENT	77.0	99.6	124.6
HEAVY FUELS OILS:			
CARIBBEAN TO MONTREAL	60.0	90.0	115.0
POLLUTION CHARGE	-	2.6	2.6
DUTY	11.7	11.7	11.7
TOTAL FOR H.F.O.	71.7	104.3	129.3

Source: Table 23, p. 93.

CONCLUSION

Many aspects of future heavy fuel oil prices have been discussed in this thesis, the main ones being the future prices of both crude oils and heavy fuel oils, desulphurizing costs and transportation rates. It is now finally the time to put all of the assumptions and calculations together and assess the total impact. Table 26 represents such a summary and it shows us that increases of respectively 91.3¢/bbl by 1975 and another 69.2¢/bbl by 1980 are to be expected. These forthcoming increases are over and above the 81.8¢/bbl increase that took place in 1971 and 1972.

The impact of those higher costs will be particularly significant for the economic future of the Province. Heavy fuel oils are of the utmost importance for any economy which relies mostly on processing of natural resources and primary industries. The pulp and paper and mining industries who account for a sizeable share of our exports use significantly

TABLE 26

1970 - 1980 - INCREASE IN THE LANDED COST OF HEAVY FUEL OILS IN QUEBEC

¢/BBL

COMPONENTS	1972/1970	1975/1972	1980/1975
CRUDE OIL			
1. Middle East	50.7	25.0	62.0
2. Libya	83.3	34.0	74.0
3. Venezuela	61.1	91.0	62.0
4. Average Increase Crude Oil	60.7	68.8	63.2
5. Increase in Heavy Fuel Oils	63.7	62.8	23.5
TOTAL WEIGHTED INCREASE[1] (4 72% and 5 28%)	61.5	65.9	44.2
6. Increase in Transportation Costs[2]	20.3	25.4	25.0
7. TOTAL INCREASE IN EXPECTED LANDED COSTS OF HEAVY FUEL OILS	81.8	91.3	69.2

COMPONENTS	1972/1970	1975/1972	1980/1975
CRUDE OIL			
1. Middle East	50.7	25.0	62.0
2. Libya	83.3	34.0	74.0
3. Venezuela	61.1	91.0	62.0
4. Average Increase Crude Oil	60.7	68.8	63.2
5. Increase in Heavy Fuel Oils	63.7	62.8	23.5
TOTAL WEIGHTED INCREASE[1] (4 72% and 5 28%)	61.5	65.9	44.2
6. Increase in Transportation Costs[2]	20.3	25.4	25.0
7. TOTAL INCREASE IN EXPECTED LANDED COSTS OF HEAVY FUEL OILS	81.8	91.3	69.2

Source: Based on the assumptions and calculations outline in pp. 41 to 50 also I retain the same share of total market, namely Middle East supplies 25%, Libya 10% and Venezuela 65%.

[1] See Table 27, Appendix III for detailed calculations

[2] Expected increases in transportation were discussed in Chapter VII, especially Table 23, p.93 and Table 25, p. 96.

more heavy fuels than manufacturing and other types of industries and could be greatly affected by significantly higher energy bills[1].

Pulp and paper companies especially could run into serious difficulties. Potential increases in their energy costs will certainly not help their financial position already impaired by the floating of the Canadian dollar, their technological gap versus the American producers and anti-pollution equipment costs.

Of course, the calculations made in this thesis must be understood as being conditional. Short term deviations from my estimates are always possible but, pending further developments they should hold for the long term period to 1980.

Some other areas would also require further analysis such as the mechanics on how the OPEC and oil companies will settle the participation issue, the timing and costs of new discoveries and the possible disclosure by the Quebec Government of its energy policy and its entry in the oil marketing business through SOQUIP.

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[1] Pulp and Paper, chemical, cement and mining industries have energy bill totalling to approximately 20 to 25 percent of total costs compared to 3.5 to 5 percent for manufacturing and other industries.

Other developments that have to do with Federal Government policies would also have to be taken into account. Transport minister Jamieson indicated that reductions of a special levy on oil shipped through Canadian waters could be possible pending cooperation of the oil companies. He indicated that should Canada have access to any international pollution pool that might be established, he would be willing to withdraw the levy entirely[1]. On the other hand, it is possible that he may decide not to reimpose the 11.7¢/bbl duty on heavy fuel oil suspended in 1971 but due for re-consideration in July 1973. The levy was suspended specifically to lessen the burden on the pulp and paper industry. These developments could reduce the estimated increases by 14¢/bbl for 1975 and 1980.

Other factors could also affect my estimates. In the event of major discoveries in the Arctic, Northwest Territories and off the East Coast of Canada, the extent of Canadian dependence on imported oil will decrease. This means that there may be a change in the magnitude and the timing of

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[1] Globe and Mail, April 25, 1972.

the predicted increases, in posted prices, tax share and royalties to be intended by OPEC countries. To allow for these possibilities, I determined a lower range in taking 90% of the predicted increase in landed cost of heavy fuel oils (for a mix domestic production of +2.0% wt. sulphur and imports of less than 2.0% wt. sulphur). This, together with the aforementioned possible developments in the marine trade, could reduce the predicted increases in landed costs of heavy fuel oils by approximately 25¢/bbl by 1975 and 1980. Table 27 summarizes the results based on these alternative assumptions.

TABLE 27

1970 - 1980 - POSSIBLE CHANGES
IN THE MAGNITUDE OF INCREASES IN THE
LANDED COST OF HEAVY FUEL OILS IN QUEBEC

¢/BBL

	COMPONENTS	1975/1972	1980/1975
1.	Predocted Average Increase (Mix of crude oil and heavy fuel oils)	65.9	44.2
2.	Sensitivity (10%)	(6.6)	(4.4)
3.	TOTAL (1 less 2)	59.3	39.8
4.	Predicted Marine Transportation Costs increases	25.4	25.0
5.	Sensitivity (Drop of pollution levy of 2.6¢/bbl and non reimposement of 11.7¢ duty)	(14.3)	(14.3)
6.	TOTAL (4 less 5)	11.1	10.7
7.	TOTAL POSSIBLE ADJUSTMENTS	(20.9)	(18.7)
8.	Predicted increases in average landed costs of heavy fuel oils (allowing for adjustments) (3+6)	70.4	50.5

Source: Table 23 p. 93, Table 25 p.97 and Table 26 p.98.

APPENDIX I

OPEC's 25th CONFERENCE
(Beirut, September 1971)

RESOLUTION XXV. 139

The Conference

having considered the report of the Secretary General concerning the recent international monetary developments and the adverse effects on the purchasing power of the oil revenue of Member Countries; noting that these developments have resulted in a *de facto* devaluation of the United States Dollar, the currency in which posted prices are established, *vis-à-vis* the currencies of the major industrialized countries; recalling Resolution XXI. 122 which calls, *inter alia,* for adjustment in posted or tax-reference prices so as to offset any adverse effect resulting from *de facto* or *de jure* changes in the parity of monies of major industrialized countries;

resolves

1. that Member Countries shall take necessary action and/or shall establish negotiations, individually or in groups, with the oil companies with a view to adopting ways and means to offset any adverse effect on the per barrel real income of Member Countries resulting from the international monetary developments as of 15th August, 1971, and

2. that the results of negotiations shall be submitted to the next Conference. In case such negotiations fail to achieve their purpose, the Conference shall determine such action as necessary for the implementation of this Resolution.

RESOLUTION XXV. 140

The Conference,

recalling Resolution XXIV. 135,

having heard the statement of the Ministerial Committee established by said Resolution for the drawing up of the bases for the implementation of effective participation by Member Countries in existing concessions; reaffirming the determination of Member Countries to take immediate steps towards the implementation of effective participation in the existing oil concessions;

resolves

1. that all Member Countries concerned shall establish negotiations with the oil companies, either individually or in groups, with a view to achieving effective participation on the bases proposed by the said Ministerial Committee, and

2. that the results of the negotiations shall be submitted to the Conference for coordination. In case such negotiations fail to achieve their purpose, the Conference shall determine a procedure with a view to enforcing and achieving the objectives of effective participation through concerted action.

APPENDIX II

ZONE BOUNDARIES OF THE PROVINCIAL
HEAVY FUEL OILS MARKET

ZONE I - MONTREAL URBAN COMMUNITY

Including:

1. Montreal Sector - City of Montreal

2. East Sector - Town of Anjou
   Town of Montreal East
   City of Montreal North
   City of Pointe aux Trembles
   City of St-Léonard

3. Centre - West Sector -

   City of Dorval
   Town of Dorval Island
   City of Lachine
   Town of St-Laurent

4. West Sector - Town of Baie d'Urfé
   City of Beaconsfield
   Town of Dollard des Ormeaux
   Town of Kirkland
   City of Pierrefonds
   City of Pte Claire
   Town of Roxboro
   Town of Ste Anne de Bellevue
   Town of Ste Geneviève
   Parish of St. Raphael de l'Ile Bizard
   Town of Senneville

Centre Sector - City of Cote St-Luc
Town of Hampstead
City of LaSalle
Town of Mount Royal
Town of Montreal West
City of Outremont
Town of St-Pierre
City of Verdun
City of Westmount

plus following not included in Montreal Urban Community Act -

1. Longueuil (including former City of Jacques Cartier)
2. Ville Lemoyne
3. St-Lambert
4. Greenfield Park
5. Brossard

ZONE II - BORDER LINES

North-West Joliette and Sorel
North-East Lachute
Centre North St-Jérôme
South-West St-Jean
South-East Valleyfield

ZONE III - THREE RIVERS AREA

Including: Louiseville
Grand-Mère
Shawinigan
Champlain
Gentilly
Cap de la Madeleine
Nicolet

ZONE IV - QUEBEC AREA

Including: Lévis
Lauzon
Giffard
Montmorency
Ste-Foy
Cap Rouge
Charlesbourg

ZONE V - HULL AREA

Including: Hull
Vanier
Gatineau
Ottawa
Buckingham
Thurso
Masson

ZONE VI - LAC ST-JEAN AREA

Borders: North-East Dolbeau
North-West Chicoutimi Park
South-East Route 55
South-West Route 16

Main Cities:
Dolbeau
St-Félicien
Roberval
Alma
Jonquière
Kénogami
Arvida
Chicoutimi
Bagotville
Port Alfred

ZONE VII - ABITIBI AREA

From Ontario Border on south side to Senneterre on west side.

East Border - Route 59

ZONE VIII - EASTERN TOWNSHIPS AREA

North Border - Route 20
South Border - Eastern Townships Autoroute and Route 55
West Border - Route 22
East Border - Draw a line from St-Hyacinthe to Eastern Townships Autoroute

APPENDIX III

TABLE 28

METHOD OF CALCULATIONS OF EXPECTED
COSTS OF IMPORTED HEAVY FUEL OILS

I - PRESENT AND EXPECTED F.O.B. VENEZUELA PRICE

	1971 - 1972	1975	1980
3.0 wt.% Sulphur	2.48	2.65	2.80
1.5 wt.% Sulphur and Less	-	3.65	3.80

II - IMPACT OF INCREASE IN F.O.B. PRICES

3.0 wt.% Sulphur

a) 1975
- (2.65 - 2.48) x .65 — tax increase of 11.1¢/bbl
- (2.65 - 2.48) x .1666 — royalty increase of 2.8¢/bbl

b) 1980
- (2.80 - 2.65) x .65 — tax increase of 9.8¢/bbl
- (2.80 - 2.65) x .1666 — royalty increase of 2.5¢/bbl

1.5 wt.% Sulphur and Less

a) 1975
- (3.65 - 2.48) x .65 — tax increase of 76.1¢/bbl
- (3.65 - 2.48) x .1666 — royalty increase of 19.5¢/bbl

b) 1980
- (3.80 - 3.65) x .65 — tax increase of 11.1¢/bbl
- (3.80 - 3.65) x .1666 — royalty increase of 2.5¢/bbl

Then the calculations were weighted as follows: 48 percent of Heavy Fuel Oils estimated future requirements will be imported (approximately 28MMBS by 1975 and 36MMBS by 1980) of which 60 percent will be 1.5 percent sulphur and less and 40 percent +2 and 3 percent sulphur content.

GLOSSARY OF TERMS

AFRA:	(Average Freight Rate Assessment) is the weighted average of tanker freights actually being paid at any one time, including long and short term period charters as well as single voyage rates. It is calculated monthly by the London Tanker Brokers Panel for 4 tanker categories (General Purpose - 16,500 to 24,999 dwt; Medium Range - 25,000 to 44,999 dwt; Large Range 1 - 45,000 to 79,999 dwt; Large Range 2 - 80,000 to 159,999 dwt). It is widely reckoned by the industry as the historical record of the cost of operating the industry's tanker fleet.
BIRTH RATE:	Number of births per thousand people.
B.T.U.:	British Thermal Unit. It is the quantity of heat required to raise the temperature of a pound of water one degree F.
D.W.T.:	Dead weight tons.
D.Y.:	Disposable Income.
F.O.B. PRICE:	This stands for freight on board. It is the price of a product at a specific location. The price of heavy fuel at Montreal F.O.B. Caribbean is the customer's price at Caribbean if he picks it up himself. If delivered to Montreal, transportation charges would be added to it and borne by the customer.

PERIOD CHARTER RATE:	Cost of chartering a tanker for a specific period of time usually 1 to 5 years.
POSTED PRICES:	Posted price of crude oil outside U.S. and Canada has been defined as a publicly stated list price at which an oil company will sell crude without further negotiations. (In the U.S. and Canada "buy" must be substituted for "sell"). Today, in the Middle-East, Africa and Venezuela, posted prices are used primarily as tax reference values, rather than the actual selling prices to the crude customers, and are the basis on which tax and other payments to the government are collected.
MB/CD:	Thousands of barrels per crude running day.
MMB:	Millions of barrels
MMBTU:	Millions of BTU
NEB:	National Energy Board
SPOT CHARTER RATE:	The current daily rate being paid to charter a tanker for a single voyage.
S.S.U.:	Saybolt Second Universal.
TANKER:	Any vessel or ship chartered to move petroleum products either crude or refined.
TAPLINE:	(Trans Arabian Pipeline). It moves oil from the Persian Gulf to Mediterranean Sea at a capacity of 500 MBS per day. It goes through Jordan, Syria, the Israeli-occupied Golan Heights into Lebanon.
TAX EXPORT VALUE:	Reference prices that had been introduced for the assessment of taxable income in 1967 in Venezuela, to stabilize government revenues at a time when the price for crude oil on

the world market were weak and tax was assessed on realized prices. The tax export values were fixed in consultation with the companies for a period of five years, were to increase each year by agreed amounts, and were scheduled to be renegotiated after another five year period in 1972. (Note: At that time were referred to as tax reference prices).

T-2 EQUIVALENT: T-2 tanker (16,600 dwt operating at 14.6 knots on 50 tons of heavy fuel) is commonly used as a standard unit of measurement to express tanker capacity, taking into account speed as well as size.

WORLD SCALE: (Worldwide Tanker Nominal Freight Scale) is a schedule of rates used as a standard of reference for comparing the relative cost of moving oil between various loading and discharging ports around the globe with the nominal "flat rate" expressed as WS 100. It does not in any way represent an average or normal level of tanker freights.

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