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THE CANADIAN PETROLEUM INDUSTRY EXAMINED IN A "STAPLES" FRAMEWORK

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PREFACE

This thesis was written in 1973. It deals with the Canadian petroleum industry in the period through to the end of 1972. Since then, remarkable changes have taken place in the value of the industry's production: wellhead crude oil prices have increased nearly three-fold and natural gas prices seven-fold. These higher prices represent a partial response to the greatly-increased international oil prices which have resulted mainly from actions of the Organization of Petroleum Exporting Countries. Most of the additional revenues have been appropriated by the provincial and federal governments. Nevertheless, the effects on the economic development of western Canada of this huge increase in the value of its petroleum resource will be profound. They are however outside the scope of this study.

Professor Irene M. Spry of the Department of Economics at the University of Ottawa supervised this work. Her patient guidance and encouragement are gratefully acknowledged.

R. Priddle

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GLOSSARY

Artificial Lift - The recovery of oil from a well by pumping, usually because the energy (pressure) in the reservoir is otherwise insufficient to bring the oil to the surface.

Barrel - The barrel of approximately 35 Canadian gallons, 42 American gallons, is the standard unit of volume measure for bulk petroleum in Canada and the United States.

Bonuses - A one-time payment to the owner of mineral rights to obtain the lease of such rights when these are opened to competitive bidding, e.g., at a provincial government's "land sale".

Butane - A hydrocarbon gas (C_4H_{10}) generally found as a component of natural gas. Used mainly as an oil refinery and petrochemical raw material.

Condensate - A mixture mainly of pentanes and heavier hydrocarbons that is recovered or is recoverable at a well and that is in the vapour state in the reservoir but is liquid at the conditions under which its volume is measured or estimated.

Crude Oil - Oil produced from an underground reservoir, through a well, freed of any gas which may have been dissolved in it in the reservoir, but otherwise unprocessed. In the oil industry, often simply termed "crude".

Crude Oil and Equivalent	Crude oil, condensate and synthetic oil.
Districts, United States Petroleum	Geographical definitions established by the Petroleum Administration for Defense during World War II and now widely used for statistical and regulatory purposes. The Districts are: I - East Coast II - Mid-West III - South IV - Rocky Mountains I-IV - East of Rockies V - West Coast
Ethane	A hydrocarbon gas (C_2H_6) generally found as a component of natural gas. Used mainly as a petrochemical raw material.
Exploration Permits	Permits conferring on the holder the right, which may or may not be exclusive, to carry out geological and geophysical exploration in a defined area.
Feedstock	Raw material for processing at a refinery or petrochemical plant. Principally crude oil and condensate, but including ethane, propane and butane.
Flowing Well	A well from which oil is recovered without mechanical assistance from the surface.

Gas-condensate Field	-	A petroleum accumulation in which a high proportion of the hydrocarbons are in the vapour state, the pressure and temperature of the system being such that a decrease in pressure leads to separation of liquid ("condensate").
Geophysics	-	The science which deals with the physical properties of the earth, that is, gravitational, electrical, magnetic and mechanical.
Gravity Surveying	-	The measurement of the gravitational properties of the surface layers of rock as a means to determine whether these might be favourable to trapping of oil and gas in commercial quantities.
Lease	-	The right granted by the owner of mineral rights to a second party for the exploitation of the mineral.
Lease Rental	-	The rent payable, usually annually, for the lease of mineral rights.
Marketable Gas	-	A mixture of gases, mainly methane, which meets specifications for use as a domestic, commercial or industrial fuel or as an industrial raw material.
Methane	-	A hydrocarbon gas (CH_4), generally the principal component of natural gas.

Natural Gas (Raw)	-	A mixture of gases which may include methane, ethane, propane and butane and, sometimes, gaseous compounds of sulphur, which is recoverable at a well from an underground reservoir and which is gaseous at the conditions under which its volume is measured or estimated.
Natural Gas Liquids	-	Propane, butane and pentanes plus that are recovered from raw natural gas as liquids by processes of condensation or absorption.
Oil-seep	-	The appearance of oil or bitumen at the surface of the ground as a result of prolonged erosion of formations overlying a petroleum accumulation.
Over-drilling	-	The drilling of more wells than are needed under sound engineering practice to efficiently drain a petroleum accumulation.
Pentanes Plus	-	A mixture mainly of pentanes (C_5H_{12}) and heavier hydrocarbons which ordinarily may contain some butane and which is obtained mainly from processing of raw gas.
Productive Capacity/ Productivity	-	The maximum rate at which oil or gas can be recovered from a reservoir taking into consideration i.a. limitations imposed by the physical characteristics of the reservoir.

Propane	- A hydrocarbon gas (C_3H_8) generally found as a component of natural gas. Used in agriculture, industry and for domestic lighting, heating and cooking.
Pro-rating (to market demand)	- The restriction, generally by a governmental regulatory authority, of total oil production in a particular area - a province, state or region thereof - to the volume which purchasers indicate they wish to buy in a specified forward period and the equitable apportionment of such production among all producers in that area.
Recoverable Gas, Natural Gas Liquids or Crude Oil	- The total quantity of crude oil, natural gas or natural gas liquids estimated to be ultimately producible from an oil or gas field as determined by an analysis of current geological and engineering data.
Rotary Oil Well Drilling	- A system of drilling in which the rock formation is penetrated by a rotary bit connected to a hollow drill pipe.
Secondary Recovery	- Improved recovery of petroleum by the supplementation of the natural energy (pressure) of the reservoir. Secondary recovery methods include the injection of gas and water to force greater quantities of oil to the surface than would be the case with natural recovery.

Seismography - The study of the earth's geological structure by recording the ground movements produced by man-made explosions. Seismic surveys are the most widely used method of oil exploration.

Sour Gas - Natural gas containing a high proportion of sulphur compounds.

Stripping - The removal of condensate, propane, butane and, sometimes, ethane from natural gas, generally near the point of production, to facilitate long distance pipeline transportation.

Synthetic Oil - A mixture of hydrocarbons that is derived from crude bitumen and that is liquid at the conditions under which its volume is measured or estimated.

Tar Sands - Occurrences of highly viscous bitumen mixed with sand which under normal conditions has a tar-like consistency and does not flow. Recovery requires mining techniques and/or the injection of solvents or heat to induce flow.

Unitization - The engineering development of an oil field or pool as one unit, even though ownership of the mineral rights in the field or pool is fragmented.

Wet Gas - Natural gas containing a high proportion of liquids such as butane, propane and condensate.

Wildcat — A well drilled on a structural feature which has not previously produced oil or gas. Such wells are generally at least two miles from the nearest productive area, and could be hundreds of miles removed from established production. Risk, however, rather than distance is the determining factor in the classification.

<u>Sources</u>: Canadian Petroleum Association. <u>Statistical Yearbook, 1972</u>. Calgary: Canadian Petroleum Association, August 1973.

British Petroleum Co. Limited. <u>Our Industry, Oil</u>. London: British Petroleum Co. Ltd., 1970.

ABBREVIATIONS

b/d	–	barrels per day
Btu	–	British thermal units
Mcf	–	thousand cubic feet
N/A	–	not available
Tcf	–	trillion (10^{12}) cubic feet
--	–	negligible
-	–	nil

Canadian currency and measure are used throughout this thesis.

RESUME

This thesis critically examines the argument of Hugh G.J. Aitken that oil and natural gas can be regarded as "staples of the new (Canadian) industrialism". The examination is conducted in a classical staples framework against the background of the continued importance of resource-based industries and the changing structure of North American energy requirements.

Western Canada's conventional petroleum potential uncovered in the past twenty-five years is of modest proportions in a global context but of significance on a North American scale. Development of the resource, disadvantageously located in relation to major markets, commenced about the turn of the century. Growth was however erratic until the Leduc discovery of 1947 which started a quarter century of generally-rapid resource development and exploitation.

Markets for expanding oil and gas production were found increasingly outside the western prairies, requiring the construction of long-distance pipe lines to British Columbia and Ontario which also supplied adjacent parts of the United States allowing economies

of scale to be reaped in transportation. The development of export markets for oil occurred with Canadian government encouragement against a background of American protectionism, which however favoured Canadian over other foreign oil. In the case of gas, the situation was in a measure reversed with Canadian federal and provincial policies being designed to protect the supply to domestic consumers against the pull of export demand.

The development of the western Canadian industry depended for the most part on technologies which had fairly recently been developed. Generally these technologies originated abroad but, once imported, were adapted to Canadian conditions. Peculiarly-Canadian contributions were made in the fields of overland access to resources and year-round field work.

Entrepreneurship was similarly of mainly foreign origin, but there are striking examples of native managerial contributions in a matrix of varied corporate endeavour.

Investment in the petroleum industry is characteristically risky and "lumpy" and as a result large firms enjoy some advantages. Until about 1960 investment was financed mainly by stock issues and other external sources but since then retained earnings seem to have become the leading source of capital. Foreign investment, particularly American, has been predominant and the proportion of foreign control is higher than in any other Canadian resource-based industry.

Development of western Canadian petroleum has had regional and national impacts - on the energy economy; on foreign trade and payments; and on income and employment. The "linkages" associated with petroleum resource development have been marked, particularly on a regional scale: goods and services are produced for petroleum exploration, production and transportation operations; and crude oil and natural gas processing has led to oil refining and some petro-chemicals manufacture. Other aspects of the industry's spread effects include consumer spending; government revenues and expenditures; and a continuing real-estate boom.

Western Canadian petroleum, it is concluded, exhibits many points of comparison, and some of contrast, with earlier staples in such areas as markets; technology; and the role of governments. However petroleum has not dominated the post-war Canadian economy and society in the way that wheat did in the first quarter of this century. Fundamentally, the difference in impact compared to earlier staples reflects the fact that the resource so far exploited is relatively less "massive" while the economy in which its exploitation has taken place is much larger and more complex. Nevertheless, western Canadian petroleum can reasonably be regarded as a regional staple of Canada's new industrialism.

Chapter I

INTRODUCTION

1. The Staples Framework

If Canada has made a distinctive contribution to the literature of economic growth, it is surely the staples concept. This is associated most prominently with the name of the late Professor H.A. Innis who developed and popularized this approach on foundations laid by W.A. Mackintosh and the American economic historian Guy Callender.

Innis' appreciation of the importance of the staples concept developed in part from his analyses of two great export-oriented resource industries of the past - the fur trade[1] and the cod fisheries.[2] Innis' concern was with the general impact of the great resource staples of the past on the economy and on society at large. He saw staple products as dominating Canadian economic history, triggering and supporting surges of growth and responsible in their decline for ebbs in economic activity. However, as M.H. Watkins

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[1] H.A. Innis, *The Fur Trade in Canada: An Introduction to Canadian Economic History* (Toronto: University of Toronto Press, Second Edition, 1956).

[2] H.A. Innis, *The Cod Fisheries: The History of an International Economy* (Toronto: The Ryerson Press, 1940).

has commented, "once solidly entrenched in Canadian studies, the staple approach has now fallen on more uncertain days as its relevance has come to be questioned by Canadian economic historians".[1] In this context Professor Watkins cites the views of Buckley, Easterbrook and Fowke.

Buckley considers that the staples approach is "practical and efficacious" as a growth theory to 1820 but that subsequently "other sources of national economic growth and change are impossible to ignore".[2] Fowke places much emphasis on the role of the expanding frontier of settlement and of agriculture serving the domestic market as a stimulus to investment and economic growth in central Canada prior to Confederation, thereby implying a belittling of the role of staple exports.[3] Easterbrook and Aitken concluded that [only] "as long as Canada remained simply a source of supplies for

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[1] M.H. Watkins, "A Staple Theory of Economic Growth", Canadian Journal of Economics and Political Science, Vol. XXIX, No. 2, May 1963, p. 142.

[2] Kenneth Buckley, "The Role of Staple Industries in Canada's Economic Development", Journal of Economic History, Vol. XVIII, December 1958, p. 442.

[3] V.C. Fowke, The National Policy and the Wheat Economy (Toronto: University of Toronto Press, 1957), Chapter 2.

more economically advanced regions, the fundamentals of her economic growth may be sought in the physical characteristics of a very limited number of key staples . . .".[1]

Watkins notes however that some, like Aitken, have remained satisfied with the staples approach, applying it in their analysis of the new resource industries of the present century. In the discussion following presentation of Buckley's 1958 paper, Aitken argued that ". . . fur was not the last of the staples . . . Timber and wheat followed . . . And in more recent times oil, natural gas, then ore and non-ferrous metals have been developed to serve as the staples of the new industrialism".[2]

This thesis seeks in effect to critically examine Aitken's argument that oil and natural gas may be regarded as "staples of the new industrialism". The approach is to review the development of the Canadian petroleum industry in a "staples framework".

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[1] W.T. Easterbrook and Hugh G.J. Aitken, Canadian Economic History (Toronto: The Macmillan Company of Canada, 1956), p. 22.

[2] Discussion of Buckley, op. cit., p. 451.

The balance of this introductory chapter deals in general terms with resource industries and economic growth and relates economic growth to demand for energy. In the second chapter attention is given to the extent and nature of the resource on which the Canadian petroleum industry is based. The classical determinants of the development of the staple resource - markets, technology, entrepreneurship and capital sources - are then dealt with successively in chapters three to seven. Analysis of the national and regional economic impact of this development follows in chapter eight. The concluding chapter nine considers the value of the staples approach to an understanding of the Canadian petroleum industry's development and discusses how far this industry can be regarded as a staple. In this connection, prominence is given to questions of the extent to which the petroleum industry has come to dominate the economy and of the degree to which its growth is attributable to exports.

2. Resource Industries and Economic Growth

Expansion of a nation's productive capacity, as distinct from utilization of that capacity, results ultimately from increases in the quantity of productive resources which can be put to use in the economy and from increases in the productivity of those resources.

Increase in the quantity of productive resources as a source of growth arises from changes in the available physical volume of possible inputs of labour and material resources. This latter category includes machinery, equipment, buildings, means of communication - and natural resources.[1]

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[1]The role of natural resources in economic growth has been recognized by political economists since the time of Adam Smith and the earlier physiocrats. However recent literature in the field devotes surprisingly little attention to natural resources compared to, for example, human resources and investment in man-made capital. Moreover very little has been attempted by way of quantification of the role of natural resources. Scott has argued that estimates of total national wealth "should give considerable attention to the extent of natural wealth" and that the national accounts should show annually changes in the value of natural wealth (A. Scott, "National Wealth & Natural Wealth", Canadian Journal of Economics and Political Science, Vol. XXII, No. 3, August 1956, p. 377). Kuznets has called for estimates of capital input to include natural resources (S. Kuznets, Modern Economic Growth [New Haven: Yale, 1966, pp. 75-78]) and Lithwick has tried to evaluate the contribution of selected resources (N.H. Lithwick, Economic Growth in Canada [Toronto: University of Toronto Press, 1970]). Lithwick nevertheless concludes that "work is badly needed in this area [of physical increase in discovered and usable natural resources] if the elements critical for Canada's economic growth are to be seen in accurate historical perspective" (Lithwick, op. cit., p. 16). The present thesis does not attempt to grapple with this problem on an integrated macroeconomic basis, but deals only with one sector and then on a basis of 'casual empiricism'.

Natural resources and their markets have figured prominently in studies of Canada's economic growth quite apart from a staples framework. Thus, economic growth in the early colonial period is characteristically dealt with in terms of fisheries and fur. From the late eighteenth century trade in forest products, first square timber then saw-mill products, rose to dominate the Canadian export picture into the mid-nineteenth century. Lumber was followed by another export-led expansion, the wheat boom, from the turn of the century until well into the inter-war period. Somewhat overlapping the wheat economy came a new forest resource industry, pulp and paper, and development of hard-rock minerals. Again, export markets were of critical importance and surges of economic growth accompanied the exploitation of these resources. Newest of the natural-resource, export-oriented industries are the mineral fuels, principally oil and natural gas, but with western Canadian coal increasing in importance.

The role of resource industries in Canadian economic growth and integration has been stressed by many writers. It has been argued, for example, that a large proportion of the expenditures made by the traditional natural-resource export industries was directed to home products with consequent favourable effects on national economic integration and the development of the secondary manufacturing and service industries. From the mid-nineteenth century, the protective tariff increased the proportion of export industry expenditures going to the domestic sector, but even without the tariff, home industries, sheltered by the nature of their products and by transportation costs, would have found enlarged markets in the export trades.[1] At the same time, processing of export raw materials - saw timber, pulp manufacture and ore-dressing - contributed directly and indirectly to economic growth.

Partly as a result of the export-oriented development of forest and mineral industries and processing of their products rapid expansion took place, particularly from the 1890's, in the nation's secondary manufacturing and service industries. In the judgement of W.W. Rostow,[2] subsequently supported

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[1]Summarized from W.A. Mackintosh, The Economic Background of Dominion-Provincial Relations (Toronto: McClelland & Stewart, Carleton Library Edition, 1964), pp. 49-51.

[2]W.W. Rostow, The Stages of Economic Growth (Cambridge: Cambridge University Press, 1967), pp. 8-9, p. 59.

by O.J. Firestone,[1] Canada as a whole had by 1950 reached the stage of industrial maturity.

Canada's endowment of natural resources and the surges of their development precipitated by favourable coincidences of market and technical conditions have resulted in the resource industries maintaining their position as a dynamic force in Canadian economic growth since the Second World War.[2]

O.J. Firestone has estimated that in the late 1950's the resource industries, agriculture, fishing and trapping, forestry, mining and electric power generation, broadly defined to include processing of primary raw materials, provided about 26 per cent of total employment, accounted for some 43 per cent of estimated business investment and earned about one-

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[1]O.J. Firestone, Industry and Education (Ottawa: University of Ottawa Press, 1969), pp. 114-115.

[2]This situation may be regarded as atypical if we accept O.J. Firestone's generalization that "A nation undergoing rapid secondary industrial expansion . . . will allocate fewer energies, comparatively speaking, to the expansion of primary industries". See O.J. Firestone, Canada's Economic Development 1867-1953 (London: Bowes & Bowes, 1958), pp. 24 and 183, see also S. Kuznets, op. cit., Part 3, "Trends in Industrial Structure", pp. 86-159. Expansion of primary industries can nevertheless have a "triggering" effect on economic growth in advanced economies.

quarter of Canada's gross domestic product.[1] Basically similar conclusions can be drawn from Table 1 and Appendix I-1 concerning the situation a decade later.

TABLE 1

THE ECONOMIC IMPORTANCE OF CANADA'S RESOURCE INDUSTRIES

	1950	1960	1961	1965	1969	1970	1972
Contribution to Gross Domestic Product			23%		22%		
Contribution to Capital Formation:							
- Business Capital Expend-itures	68%	49%				52%	49%
- Total Fixed Capital Formation	34%	29%				32%	29%
Contribution to Industrial Employment		22%		20%			19%

Source: Appendix I-1.

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[1]O.J. Firestone, "Natural Resources and the Canadian Economy", Lecture given at the National Defence College, Kingston, 29 September, 1959, p. 2. "Resource industries" were defined more broadly in Dr. Firestone's 1959 paper than "primary industries" in his 1958 book, where such industries are shown to have accounted for 15.1 per cent of value added in 1953 (Firestone [1958], *op. cit.*, Table 68, p. 189).

Professor Firestone's estimates did not take account of "linkage effects" (see p. 254 below). If full account is taken of these, the proportions attributable to the resource industries would be much greater.

Awareness of Canada's resource potential and confidence in its ultimate development has of course long been a cause for optimistic pronouncements regarding her economic future. However, obstacles to natural-resource development have been many. In some cases, exploitation posed serious technical problems, as with the tar sands of the Athabasca. Development of others, like Alberta's natural gas prior to the mid-1950's, was held back by lack of markets. Transportation difficulties still impose a constraint on the rate of exploitation of mineral wealth in the Canadian north, and availability of domestic capital and entrepreneurship has seldom been adequate to the needs of Canadian resource development.

In the post-war decades, however, some of these constraints have become less important. Thus, domestic markets have expanded with the progress of Canadian manufacturing industries and the growing affluence of consumers. Transportation developments have enabled

Canadian oil and gas to be transmitted to market through some of the world's longest pipe lines. There has been a greater volume of domestic savings and an increase in the proportion of corporate savings within the total. These changes and the greater willingness and ability of Canadian private savers to engage in risk ventures have enabled the economy to support larger investment in fixed capital, other than residential construction.

As well, liberal Canadian policies towards foreign investment, Canada's proximity to the United States, the similarity of business and market organization in the two countries and growing American awareness of the probable long-term inadequacy of their domestic supply of natural resources, in relation to rapidly increasing requirements, are some of the factors which have resulted in large inflows of risk capital and of the technology, entrepreneurship and managerial ability that go with it.

These changes in national economic circumstances occurring in the past twenty-five years have fostered the discovery, development and exploitation of Canada's natural resources, including petroleum.

Development of natural resources has, it is submitted, again become an important factor in Canadian economic growth, so much so that renewed attention needs to be given to the staples approach as a framework for interpretation of post-war Canadian economic development.

3. Economic Growth and Energy Demand

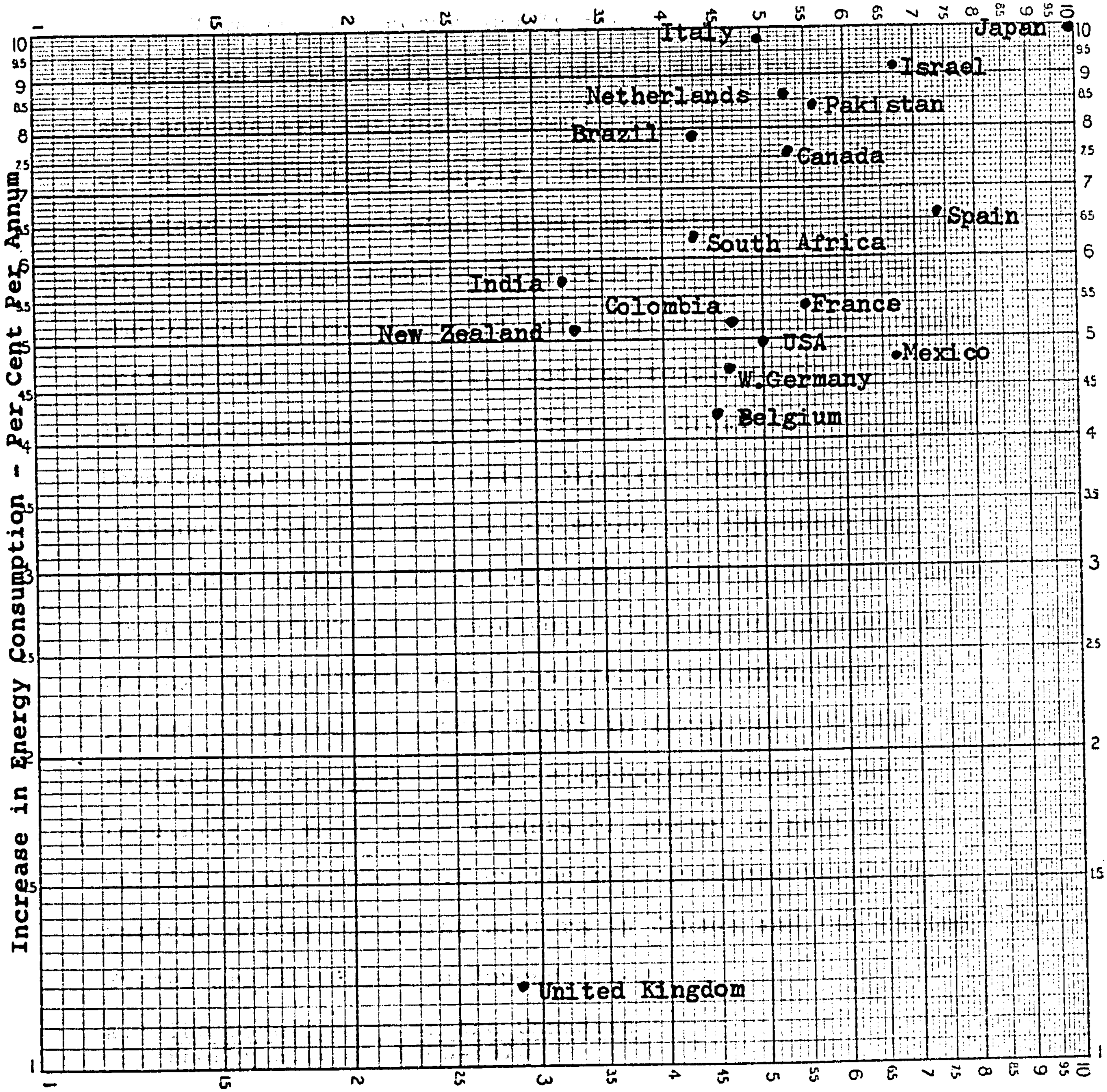
An adequate supply of inanimate energy is a *sine qua non* of modern economic growth. Economic growth in turn spurs demand for energy both as an input to economic activities and as a consumers' good. Advanced economies posing large energy demands present attractive markets for the development of reasonably-competitive supplies of indigenous energy in technically-suitable forms.

Energy fuels are perhaps the most pervasive commodities used by our economy and society - they are consumed in vast quantities as heat sources in industrial processes; to provide mechanical energy for space heating and cooling in industrial, commercial and residential premises; in cooking, refrigeration and domestic appliances; and for lighting, telecommunications and electronics.

The relationship between an increase in economic activity and an increase in energy consumption is well known and has been widely commented upon. The same is true of the related variation of energy consumption and income per head. Material illustrative of these points is given in Appendix I-2.

Whereas most economies, as their growth progresses, devote a smaller and smaller proportion of their incomes to purchase of raw materials, the relative importance of energy seems to be undiminished. Indeed energy demands of many countries are increasing relatively faster than the output of goods and services. Some data are presented in Figure 1. It should of course be noted that the relationships between economic growth and growth in energy consumption which are portrayed reflect as well changes in industrial structure, efficiency of energy utilization and income elasticity.

Figure 1--Change in Gross Product and Change in Energy Consumption, Selected Countries, 1961-1969[1]



Increase in Gross Domestic Product At Constant Prices - Per Cent Per Annum

[1] For Brazil, Greece, India, Indonesia, Israel and New Zealand terminal year is 1968; for Colombia and Mexico, 1967.

Source: 1967, '68 & '69 data - as Appendix I-2; 1961 data - United Nations, Statistical Yearbook, 1965 (New York, United Nations, 1967)

Nowhere has energy supply been of greater importance to economic growth than in North America and nowhere are national economies now more dependent on an adequate energy supply. Mechanical energy has replaced animal and human labour in agriculture, helping to release large numbers of workers for more productive employment in manufacturing and service industries. Space heating and, more recently, cooling requirements are large in a continent of climatic extremes. Great distances have been conquered by road, rail, pipeline, water and air transportation systems, all of which are dependent on inanimate energy. Mineral extraction, including the fuel-producing industries themselves, are large consumers of energy; and foremost among the energy-consuming sectors is manufacturing industry, based in large part on the replacement of human labour by mechanical energy and requiring as well large amounts of energy in process applications. Some data on the relative importance of various energy-consuming sectors in Canada and the United States are displayed in Appendix I-3.

a. The Development of the Canadian Energy Economy 1900-1970

Canada's consumption of energy has increased at an average annual rate of 3.5 per cent since 1900, a little less than the rate of growth of total economic activity. The increase has not been steady over the period. Wide variations have occurred from year to year and during periods of economic recession there were in fact actual declines in total energy consumption. Basic data relating to Canadian energy consumption are set out in Appendix I-4 and, for purposes of comparison, data for the United States are shown in Appendix I-5.

In 1970, Canada consumed the equivalent of some 5,400 trillion Btu's of energy in the form of wood, coal, hydrocarbons and water power, the latter as electricity. This was nearly double the consumption of twenty years previously and about four times the annual consumption of the 1920's.

b. The Changing Rate of Growth of Total Energy Use

During the first two decades of the twentieth century, overall energy consumption in Canada increased very rapidly. The use of coal expanded as industrialization of the country proceeded and the rail transportation network was extended. After slowing in the early 1920's, growth of energy demand accelerated in the period 1926-29. The first years of the great depression saw a decline in energy use and although consumption recovered in the late 1930's, at the outbreak of the second World War it was barely higher than in 1929.

The war- and the post-war years witnessed a steady increase in Canadian energy use. The rate of growth levelled out somewhat during the second half of the 1950's, but high energy growth rates were again observed in the 1960's.

c. Shifts Among Energy Sources

While wood and coal supplied about 98 per cent of Canada's primary energy requirements in 1900, by 1950 their share had fallen to 56 per cent. In 1970 these two fuels made up only 14 per cent of total energy supplies. Wood, as a heating fuel, has now become of such marginal importance that beyond the fact of recognizing that it is still used, it can be omitted from any end-use discussion. Coal remains of importance largely because of its continued application in the iron and steel industry and its growing use for electricity generation. In transportation uses it has diminished to the point of disappearance.

Oil, virtually non-existent at the beginning of the century, surpassed wood fuel in importance by the

1930's. Its use increased steadily until the second World War when it accounted for about 20 per cent of energy consumption. Thereafter, growth in oil use was rapid, in part at the expense of coal. The fast rise in the use of natural gas commenced in the 1950's.

All this time, electricity from water power had been increasing steadily in importance to become by 1960 the source of 13 per cent of all energy used in Canada.[1,2,3] Since then, its relative importance has declined, largely because in some areas there are now no more unused hydro sites available to be harnessed. These trends are illustrated in Appendix I-5 and summarized in Table 2.

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[1]The direct use of water power to furnish mechanical energy is no longer commercially significant. The historical importance of this use of water power was of course great from the French regime until well into the nineteenth century.

[2]In terms of inputs to the Canadian energy economy, the contribution of hydro-electricity is surprisingly small, although proportionately much greater than in the United States (Compare Appendices I-5 and I-6). It is, however, arguable that these data understate the importance of hydro-electricity to the Canadian energy economy and the economy at large. For purposes of these aggregations, hydro-electricity is expressed in terms of the heat value of electricity produced rather than in terms of its much greater "opportunity cost" in fossil fuels, i.e., the inputs of coal, oil or gas which would have been required to generate a like amount of electricity if hydraulic sources had not been available. Similarly, they cannot reflect the catalytic effect on the Canadian mining, forest products and secondary manufacturing industries of the availability of cheap electricity (see, for example, W.A. Mackintosh, op.cit., pp. 51, 92, 96; Irene M. Spry, "Hydro-electric Power", Encyclopedia Canadiana, V (1965), p. 211; and Irene M. Spry, "Energy Sources in Canada:

A further Comment", Canadian Journal of Economics and Political Science, Vol. XXIV, No. 4, May 1958, pp. 272-280). The effect of hydro-electricity on industrial development is dealt with by John H. Dales in Hydroelectricity and Industrial Development: Quebec 1898-1940 (Cambridge, Mass: Harvard University Press, 1957).

3 For purposes of aggregation and measurement of the contribution of electricity and fossil fuels to national energy supply, a gross input basis is generally employed. The various energy sources are expressed in terms of their theoretical heat contents, using a common denominator such as British thermal units. Other points of measurement than the stage of primary input to the energy economy are theoretically possible. Thus, by assigning a combustion efficiency factor to individual energy-using appliances - oil and gas furnaces; electric resistance heaters; internal combustion engines - it is possible to develop a picture of the contribution of fuels and electricity in terms of net usable energy inputs. These inputs, which are net of conversion losses, are of course much smaller in aggregate than the gross inputs and the shares of each fuel and electricity are different than those measured in terms of gross inputs because of wide variations in efficiency of use. Measurement of inputs could, at least in theory, be carried even further to the stage of effective consumption. At this stage, account would be taken of the efficiency with which energy available from a furnace or prime-mover is consumed. This would entail consideration of heat losses from buildings and of friction losses in the case of passenger- and goods-carrying vehicles. Net energy consumption would on this basis be further reduced in aggregate and the relative contributions of various fuels and electricity would be different again.

TABLE 2

CANADIAN ENERGY CONSUMPTION 1900-1970
AND SHARES OF VARIOUS ENERGY SOURCES

	Total Consumption (trillion Btu)	per cent of total supplied by:				
		Wood	Coal	Petroleum Fuels	Natural Gas	Hydro-electricity
1900	480	40	58	1	-------- 1 --------	
1920	1,145	15	74	9	--	2
1940	1,611	13	56	20	3	8
1960	3,073	4	18	53	12	13
1970	5,395	1	13	53	23	10

Source: Appendix I-4.

The dominance of the fluid fuels, petroleum and natural gas, in the Canadian energy economy is less complete than that which coal and wood together possessed at the turn of the century. Coal still supplies some 13 per cent of market requirements and hydro-electricity another 10 per cent. The rise in importance of the petroleum fuels is nevertheless the most striking change in the structure of the post second World War Canadian energy economy.

The swing to oil and gas was attributable to both supply and demand factors. On the supply side, large resources of indigenous hydrocarbons were developed in the western prairies, becoming available to consumers in Ontario and the western provinces from the early 1950's with the construction of long-distance pipe line systems. World oil resources, principally in South America and the Middle East, were available at constant or decreasing cost to eastern Canadian consumers, thanks in part to the progress of bulk marine transportation.

On the side of demand, changing consumer tastes and the availability of a new generation of heating appliances led to a wholesale switch from solid fuels to oil for space-heating in homes and commercial establishments. Subsequently, in the western provinces and Ontario, there was a further swing in consumer preferences away from oil and towards natural gas. This resulted in the latter fuel capturing most of the market provided by new construction and also in some conversions from oil to gas in these areas.

As to transportation uses, the remarkable rise in the number of automobiles since the second World War was a reflection of growing affluence of Canadians, of the progress of the automotive industry and of improvements in the road system. Demand for motor fuels was stimulated as well by agricultural mechanization and the growth of commercial aviation. In marine energy applications - ocean, coastal and inland - petroleum fuels quickly became dominant. Also affecting the demand for internal combustion engine fuels was the dieselization of the railways, completed by 1960; the post-war construction boom and the transportation and stationary power needs of natural-resource development. In the industrial energy market inter-fuel competition was keen, but for both technical and economic reasons petroleum fuels rapidly increased their share at the expense of coal.

These circumstances of energy demand meant that a ready potential market existed in Canada and adjacent areas of the United States for the competitively priced oil and natural gas which became available as a result of western Canadian petroleum resource development.

Summary

The staples concept, widely applied to the analysis of earlier Canadian economic history, has come to be questioned as an approach to the understanding of recent Canadian economic growth. The present thesis examines whether western Canadian oil and natural gas can be regarded as modern staple products. This analysis is carried out against the background of the continued importance in Canada of resource-based industries and of the changing structure of growing North American energy needs.

Natural resource development continues to be a dynamic element in Canadian economic growth, despite the rise of secondary and tertiary industries. The pace of resource exploitation has been speeded up in the post-war years by expanding markets, new technology, increased domestic savings and, particularly, inflows of foreign capital and entrepreneurship.

Rising energy demand is a concomitant of economic growth in all countries; in North America the relationship is particularly marked and energy demand is heavy in residential, commercial, industrial and transportation uses. The rate of growth of total Canadian energy demand during the twentieth century has been variable but has averaged about 3½ per cent per annum.

A striking change in the pattern of energy use has been the rise of oil and natural gas, explicable in terms of changes in availability from domestic and overseas sources; developing technology in transportation, space heating and industrial process uses of fuel; and changing requirements of a rapidly-growing domestic economy and increasingly-affluent consumers.

Chapter II

THE CANADIAN PETROLEUM RESOURCE AND ITS DEVELOPMENT

1. The Geological Setting

Oil and natural gas are compounds of hydrogen and carbon thought to have been produced by molecular changes occurring in the remains of marine plants and animals, mostly microscopic in size, which came to rest in the layers of sediment deposited at the bottom of seas during millions of years of geological time.[1] Some scientists believe that heat, generated by the tremendous pressure of additional sediment and shifting of the earth's surface caused this molecular breakdown. Others think that these changes occurred as a result of chemical action or of radioactivity within the earth. Yet another theory is that bacterial action caused the alteration of organic molecules.

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[1] This summary relates to the "organic theory", the most widely accepted theory of petroleum origin. According to the "inorganic theory", petroleum originated from non-living matter, and volcanic action is said to have been the agent which caused carbides within the earth to form acetylene and, ultimately, hydrocarbons. The evidence so far favours the organic theory.

Conditions for the creation of petroleum from micro marine-organisms have existed since the first animal life flourished on earth, supposedly more than half a billion years ago. Petroleum has been found in sedimentary rocks of all ages and there is reason to believe that it is still being formed even now as it was hundreds of millions of years ago. In Canada, rocks laid down in the Devonian period, the "age of fishes", have so far been found to be the most productive of oil and gas both in Ontario and in the western provinces.

The petroleum prospective areas of Canada, being those of sedimentary geology, are geographically separate from the highly mineralized areas of the Canadian Shield and parts of the western Cordillera where metal ores are found in ancient, highly metamorphosed formations. This geological differentiation results in geographical dispersion of mineral activity having important implications for regional economic activity and growth. Prior to the discovery and development of oil and gas there was little in the way of commercial mineral exploitation over a huge area of western Canada extending from the Shield to the Rockies.[1]

The Canadian Petroleum Association has identified eight sedimentary regions of Canada having potential for producing hydrocarbons.[2] These are the Western Canadian Sedimentary Basin extending from south-east Manitoba and south-west Alberta to the delta of the Mackenzie River and into the Beaufort Sea; the Arctic Islands; the Pacific and Atlantic offshore areas; the Hudson Bay region; the Gulf of St. Lawrence and Maritime region; southern Ontario and portions of the interior of British Columbia. The approximate coverage of these areas is outlined in Figure 2.

The total volume of sedimentary rock can be taken as a guide to the petroleum potential of a given region. The guide is a rough one because the depth of sediments and particular aspects of the geology have an important bearing on hydrocarbon generation per

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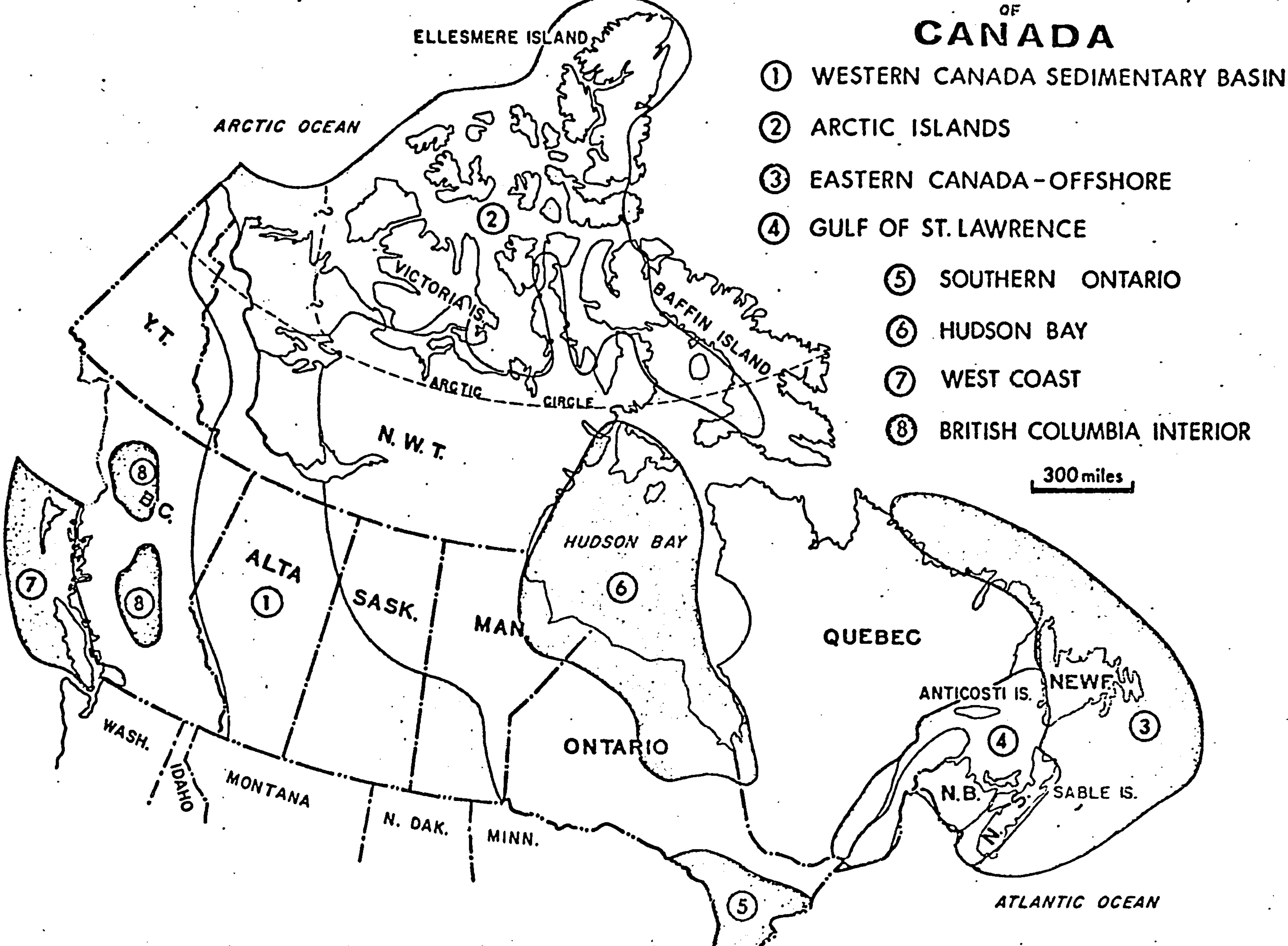
[1]Non-metallic minerals are scarce in the sedimentary areas of the Prairie Provinces. An outstanding exception is potash in Saskatchewan, which was discovered in the course of petroleum exploration (C.M. Bartley, "Potash", The Canadian Minerals Yearbook, 1962 [Ottawa: Queen's Printer, 1964] p. 469). Coal has of course been produced on the Prairies in small quantities for many decades.

[2]Canadian Petroleum Association, Geological Reserves Committee, Potential Reserves of Oil, Natural Gas and Sulphur (Calgary: Canadian Petroleum Association, April 1969), p. 3.

Figure 2--POTENTIAL HYDROCARBON PRODUCING AREAS OF CANADA



Source: Canadian Petroleum Association, op. cit..

unit of rock volume - witness the Canadian Petroleum Association's estimate of 55,000 barrels of potential oil per cubic mile of sediment in the Arctic Islands and Atlantic offshore regions compared with 10,000 barrels per cubic mile for interior British Columbia.[1] Nevertheless it affords an interesting perspective on Canadian petroleum potential to note that the volume of sediments in the United States has been estimated at approximately three million cubic miles[2] whereas the Canadian Petroleum Association has put the volume of sediments in the potential hydrocarbon areas of Canada at just over two and a half million cubic miles.[3]

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[1]<u>Ibid.</u>, pp. 19-25.

[2]M. King Hubbert, <u>Energy Resources</u>, A Report to the Council on Natural Resources of the National Academy of Sciences (Washington, D.C.: National Academy of Sciences, 1962), p. 60.

[3]Canadian Petroleum Association, <u>op. cit.</u>, p. 6.

2. The Extent of the Resource

Estimates of Canada's ultimately-recoverable petroleum reserves,[1] which estimates provide an order-of-magnitude indication of the amount of oil and gas present, were prepared by the Canadian Petroleum Association in 1969[2] and are set out in Appendix II-1. The total is some 242 billion barrels of oil equivalent[3] ("BBOE") in conventional crude oil, natural gas and liquid hydrocarbons associated with that gas, plus 301 billion barrels for recoverable reserves of oil from tar sands.[4] These aggregates compare with recent estimates of ultimately-recoverable conventional petroleum in the United States, including

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[1]For definition, see Appendix II-1, footnote 1.

[2]Canadian Petroleum Association, op. cit.

[3]Natural gas is converted to oil equivalent on the basis of calorific value at the rate of six thousand cubic feet of gas to one barrel of oil.

[4]The Canadian Petroleum Association's estimates of ultimately recoverable reserves were vigorously criticized as being over-optimistic by Professor F.K. North in an unpublished address to the Alberta Society of Petroleum Geologists, 24 September, 1971.

Alaska, of 733 BBOE.[1] Comparable estimates have not so far been prepared on a global basis, but one oil industry source has put forward a range of 1,950 to 4,400 BBOE.[2] These data suggest that Canada may possess a petroleum resource which is large in a North American context and may prove to be significant also in a global perspective.

Canada's proven[3] crude oil reserves as of the end of 1972 amounted to some eight billion barrels.[4] Almost all of these reserves were located in the Prairies and foothills regions of the Western Canadian Sedimentary Basin: reserves in southern Ontario were negligible in a national perspective and exploration

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[1]United States Geological Survey, quoted in S.H. Schurr, The Outlook for Energy Resources in the United States (Washington, D.C.: Resources for the Future, 1967), pp. 12-13.

[2]Anonymous major oil company. The Oil Demand and Supply Position in the Context of Future Energy Requirements (n.p., September 1971).

[3]For definition, see Appendix II-2, footnote 1.

[4]Report for 1972 of the Reserves Committee of the Canadian Petroleum Association (Calgary: Canadian Petroleum Association, 15 March, 1973), p. 2, and Appendix II-2.

of other potential hydrocarbon-bearing areas (Figure 2) had not proceeded to the point where any reserves could be credited to these areas. The ratio of proven reserves at the end of 1972 to production in that year was 15:1 and Canadian reserves amounted to about 1.4 per cent of the world total. By comparison, United States reserves at 37 billion barrels were larger in absolute amount but smaller relative to production, the reserves to production ratio being only 10:1. For the total world, this ratio is 35:1. In terms then of the developed petroleum resource, Canada is of some importance in a North American context containing about 18 per cent of the continent's proven reserves but is still insignificant on a global basis. For natural gas, the situation is broadly comparable. Canadian proven reserves of about 52.9 trillion cubic feet, located almost entirely in the western Canadian basin, are less than 3 per cent of world reserves but about 20 per cent of the North American total.

3. The Nature of the Resource

The location, producibility and unit cost of developing presently-known Canadian petroleum resources have a significant bearing on the extent and rate of their development.

a. Location

The western Canadian petroleum resource, focussed in west central and north-western Alberta, is nearly a thousand pipeline-miles distant from the limited markets of the lower mainland of British Columbia and the American Pacific Northwest and some two thousand pipeline-miles from the much larger markets of the lower Great Lakes area of Canada and the United States. Translated into transportation-cost terms these distances mean that the average barrel of Alberta crude oil reaching Chicago and having a well-head value in 1972 of about $2.75 had to bear pipeline charges aggregating 60 cents.[1] By contrast, crude oil from the Gulf Coast fields of the United States travelled some 800 pipe line miles

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[1] Gathering charges and provincial pipe line tariff: 15 cents, trunk pipe line 45 cents.

to Chicago at a total tariff of less than 40 cents and commanded a well-head value of more than \$3.25.[1] Shipment of Alberta oil to Montreal refinery markets would involve a tariff of some 75 cents from the well.[2] The cost of moving oil by sea from Venezuela to Portland, Maine, and thence by pipeline to Montreal is some 35 cents in normal tanker market conditions.

Remoteness from major markets has historically imposed an even greater proportionate handicap on western Canadian natural gas marketing: during the 1960's natural gas purchased in Alberta by TransCanada PipeLines[3] had an average well-head value of ten to fifteen cents per thousand cubic feet. Transportation to the Alberta/Saskatchewan border cost four to five cents and from there to the pipeline system of the Toronto area distributor 23 to 27 cents for a delivered

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[1]These and similar data in this thesis are obtained from oil trade publications and from the published tariffs of the trunk pipeline companies.

[2]Unpublished National Energy Board estimate.

[3]This orthography was adopted in 1971 and is used throughout in this thesis: the company was previously known as Trans-Canada Pipe Lines.

price of about 42 cents.[1] Clearly, then, the land-locked location of presently-known Canadian petroleum resources in the thinly peopled continental interior has handicapped their development by interposing heavy transportation charges between the point of production and the point of use. This characteristic is so familiar in Canadian economic history as not to require further development here.

b. Resource-Productivity

The term "productivity" is used in this section to signify the rate of output from a discovered resource by a specified producing unit, i.e., a well. This usage, widely accepted in the petroleum industry, is not of course the same as the economist's concept of "output per unit of input". It does, however, bear a crude relationship to the latter despite quite wide variances in the costs of discovering oil, of drilling and operating wells and in the unit values of oil output. The only readily-available measure of oil resource

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[1] William Kilbourn, PipeLine (Toronto: Clarke, Irwin, 1970), p. 203.

productivity is per well oil output[1] and the proportion of all wells on artificial lift. Rough as it is, however, it is the only yardstick available. The measure is less than satisfactory because it reflects a complex of technical and institutional factors - for example, ownership of mineral rights, leasing procedures, well-spacing regulations, unitization requirements and pro-rating of output to market demand - as well as the productivity of the resource.[2] The picture which emerges from international comparison is nevertheless a fairly clear one: well productivity is lowest in the United States with a 1970 average of 19 barrels per day (b/d). The Canadian average of 61 b/d is much higher, but still low in relation to Venezuela's 306 b/d. The principal eastern hemisphere producing areas, where geological conditions are possibly unique, display even higher rates - 2,280 b/d for North Africa and 4,450 b/d for the Middle East with individual countries scoring even higher - 11,800 b/d for Iran and 12,800 b/d in the case of Iraq.[3] Artificial lift,

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[1]Data on average per well gas output are not available on an internationally-comparable basis.

[2]An obvious distortion arises where over-drilling takes place, for instance because of fragmentation of mineral rights.

[3]Data derived from World Oil, Vol. 173, No. 3, 15 August, 1971, p. 52.

involving additional capital and operating expense in comparison with naturally-flowing wells, is employed in more than 90 per cent of United States oil wells. In Canada 80 per cent of wells require this device as do 79 per cent of Venezuela's producers. In North Africa and the Middle East as a whole the proportion is less than one third while in several major producing countries - Abu Dhabi, Iran, Kuwait, Oman and Qatar - all of the wells flow naturally.

c. Costs

Estimates of the capital investment required during the 1960's to obtain one additional daily barrel of oil production at source, therefore, neglecting the capital cost of related transportation and processing equipment, vary from $5,500 for the United States to some $4,700 for Canada, about $1,500 for Venezuela, $800-2,000 for Africa and around $300 for the Middle East.[1] Comparable data are not available in respect of capital coefficients in natural gas production. As to total costs of finding,

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[1]United States Cabinet Task Force on Oil Import Control, The Oil Import Question (Washington, D.C.: U.S. Government Printing Office, February 1970), pp. 276-280.

developing and producing a barrel of oil equivalent (including natural gas and natural gas liquids), industry sources put this at $1.24 for western Canada in the period 1966-70 compared to $2.04 in the United States.[1] These figures include local taxes and provincial royalties but not federal taxes on income. In overseas producing areas, technical costs are lower in Venezuela and Africa and much lower in the Middle East, but this difference is partly offset by much heavier government imposts on oil production.

Consideration of such further elements as comparative field size, concentration of output in large fields, average well depth, thickness of producing formation and the like would not alter the broad picture sketched here: the petroleum resources presently being exploited in western Canada appear to be somewhat more productive and rather lower in cost than United States resources currently undergoing commercial exploitation. However, the Canadian resources compare unfavourably on these scores with those of

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[1] Oilweek, Volume 23, No. 1, 21 February, 1972, pp. 79-80. These data were obtained by dividing gross new reserves of oil and gas, the latter expressed in terms of oil equivalent, into expenditures on exploration and development to yield exploration and development unit costs of $0.53 for western Canada and $0.91 per barrel for the United States. The unit production costs were derived by dividing production of oil and gas into the sum of production costs, royalties and taxes to yield unit amounts of $0.71 for western Canada and $1.13 for the United States. The royalties and taxes component of these figures was $0.44 and $0.60 respectively.

Venezuela and very unfavourably with the major eastern hemisphere producing regions.[1]

In contrast, in terms of geography, their remote land-locked location has put western Canadian resources at a disadvantage in competition against indigenous oil and gas sources in the United States market and against imported oil at the periphery of domestic markets for Canadian oil and gas.

4. The Development of the Resource

a. Ontario Beginnings

The nineteenth century genesis of the Canadian petroleum industry in Ontario is accorded some prominence in this study in part because it is often overlooked; in part because of the striking historical parallels with events in western Canada in the twentieth century; and in part because the Ontario industry acted as a "nursery" for Canadian oil men and gave rise to important entrepreneurial initiatives.

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[1]They probably also compare unfavourably with the Alaska North Slope resource. However the appropriate comparison in this case is not with the Canadian Prairies resource but with whatever oil may be discovered in the Canadian Arctic.

The North American petroleum industry was born in July 1858 at Oil Springs, Lambton County, in southern Ontario when James Miller Williams struck oil at a depth of sixty feet. This first commercial oil discovery in North America occurred fully a year before "Colonel" Drake's well was brought in, some sixty miles away in Venango County, Pennsylvania. Williams was attracted by the "gum beds" of Oil Springs, an area where occurrences of oil and natural gas had been noted since the earliest white settlement.[1] He was said to have been "familiar with the discovery of petroleum in the Old World, particularly in the Baku of Russia".[2] International experience, a continuing characteristic of the petroleum business, led Williams to follow the earliest method of well-siting -- location on an oil seep - a procedure which resulted in the discovery of many oil fields in the eastern United States and, later, some of the world's major fields in the Middle East.

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[1]North America's first recorded oil springs were discovered in this area in 1726 by Joseph Delaroche Daillon, a French missionary, who noted "a good kind of oil which the Indians call antonoutons". Cited in Earle Gray, <u>The Great Canadian Oil Patch</u>, (Toronto: Maclean Hunter, 1970), p. 18.

[2]Victor Ross, <u>Petroleum in Canada</u> (publisher's name not stated, 1917), p. 14.

Development of the Oil Springs field continued into the 1860's. Deeper wells, drilled this time, produced initial flows of 2,000 to 5,000 b/d with one reported to have exceeded 10,000 b/d.[1] In 1862 the much larger Petrolia field was discovered and the excitement which had been aroused in Pennsylvania following the 1859 Drake well spread to southern Ontario. In an early demonstration of the mobility of capital, entrepreneurship and skilled labour in the petroleum industry, investors and promoters came from the United States and many crossed from England to seek their fortunes in the new oil Eldorado.

As the oil boom developed in the 1860's, refining operations grew in complexity and importance. Initially refining was carried out in simple stills at the point of production. However the need to handle larger

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[1]These rates of production, which are impressive even by today's standards, were obtained through "open flow" of large-diameter wells. The productivity of the resource in Ontario was not such that these flows could be sustained.

volumes and to carry out more complex processes to separate and purify lubricating, illuminating and burning oils led to establishment of refineries at Oil Springs and Petrolia. The first of these was built for Williams and employed processes developed by Abraham Gesner, formerly of Halifax, Nova Scotia, a medical doctor and chemist who had pioneered methods of coal distillation for the production of lamp oil to which he gave the name kerosene.[1] Initially, more than half of the refinery output was exported to the United Kingdom and Europe.

Ontario held the world's oil spotlight only briefly. By the early 1870's its production was overshadowed by the much larger and more productive discoveries made in Pennsylvania and after prolific beginnings the Ontario wells proved to have very short lives as large producers. Small new pools continued to be found and production increased from about 10,000 barrels in 1860 to a peak of 829,000 barrels in 1894[2]

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[1]Gray, _op. cit._, pp. 24-25.

[2]Canada. Department of Energy, Mines and Resources, Geological Survey, _Geology and Economic Minerals of Canada_ (Ottawa: Queen's Printer, 1970), p. 345.

but the Ontario industry was completely outpaced by that south of the border. It is nevertheless striking that useful quantities of oil are still produced in Ontario; that a second production peak was reached in 1966 when 1,320,000 barrels were produced; and that in 1970 the Oil Springs field yielded 33,000 barrels of crude oil.[1]

Not only did the Ontario oil boom leave a still-viable oil producing industry, it also sired what was to become Canada's largest company, Imperial Oil Limited. Imperial was founded in 1880 by a group of London, Ontario, businessmen to exploit refining and marketing opportunities in the Petrolia-Oil Springs area and quickly became the most important refiner of Ontario crude oil. When local production became inadequate to Imperial's requirements, supplemental imports were drawn from the United States. The growing role of imported raw material led to the refinery being moved from Petrolia to Sarnia. Crude oil was supplied by a pipe line laid under the St. Clair river. It was

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[1]Canadian Petroleum Association, 1970 Yearbook (Calgary: Canadian Petroleum Association, 1971), pp. 91 and 101.

partly from this dependence on supply from the Ohio oil fields controlled by the Standard Oil Trust, partly because of a severe capital shortage, that in 1895 Standard acquired the majority interest in Imperial which its successor, the Exxon Corporation (formerly the Standard Oil Company of New Jersey) holds today (see pp. 148-149 below).

Finally, the mid-nineteenth century Ontario oil boom led to the birth of the Canadian natural gas industry.[1] Natural gas is very often found in association with crude oil, but it was not until thirty years after the discovery of oil that commercial quantities of gas were produced in Ontario. The first successful gas well was drilled in 1888 on the shore of Lake Erie in Essex County by Eugene Coste, son of a French immigrant, who had studied at the Ecole Nationale Supérieure des Mines and later worked for the

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[1]This and the following paragraphs are based on Victor Lauriston, Blue Flame of Service, A History of Union Gas Company and the Natural Gas Industry of Southwestern Ontario (Chatham, Ontario: Union Gas Company of Canada Limited, 1961).

Geological Survey of Canada.[1] The following year his brother Denis drilled a second successful well, discovering gas in the Niagara Falls area.

The Essex field was rapidly exploited, supplying gas markets in southern Ontario and by 1895 exporting to the United States where the cities of Detroit and later Toledo offered a much larger market than the small southern Ontario towns for the seemingly-inexhaustible supplies of Essex County. However in 1901 the Essex gas field experienced a sharp decline in pressure. Local consumers petitioned the Dominion Government to prohibit exports of natural gas and in 1901 the licence of occupation permitting the pipe line crossing of the Detroit River was revoked. This first action to protect domestic gas requirements against strong export demand was taken too late and supply continued to decline rapidly. By the end of 1904 the Essex field was practically exhausted.

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[1]Coste held the "inorganic theory" of petroleum origin (see above, p. 24) yet conducted his search operations mainly in sedimentary areas of Ontario and, later, Alberta.

The fields of the Niagara area too were initially developed mainly to supply export demand, in this case Buffalo, where gas from Pennsylvania had already opened a market. The first pipe lines were laid across the Niagara River in 1891 but exports were cut off in 1903 for the same reasons which had led to cessation of sales from the Essex field to Detroit.

The further development of natural gas in southern Ontario involved the discovery and exploitation of several new fields in the Niagara peninsula and in the counties of the extreme south-west of the province before the first World War and between the wars. This gas was marketed in the cities of Chatham (1907), Hamilton (1930) and London (1935) as well as Windsor, Niagara Falls and Welland. Today several depleted Ontario fields are experiencing a new lease of life as storage reservoirs for natural gas from western Canada.

b. Success and Failure in the West

The Canadian petroleum industry failed to achieve the pattern of geographically-progressive resource discovery and development which characterized the American industry almost from the Drake well onwards. There, oil was discovered in New York in 1865; Ohio and West Virginia in 1876; Missouri in 1888;

Illinois, Indiana and Kansas in 1889, on the Texas Gulf Coast in 1901 and in Louisiana in 1902. In California production started in 1876 and the potential of the mountain states was first discovered in Wyoming in 1894.[1]

A comparable "moving frontier" pattern of development in Canada was excluded by the facts of geology and economic geography. East of Ontario, the geological potential was poor. The only commercial petroleum development was the tiny Stoney Creek oil and gas field in New Brunswick discovered in 1909 and still producing. Westwards lay nearly a thousand miles of shield rock without petroleum potential. Not until the latter part of the century had the development of settlement and communications proceeded to the point where sporadic sub-surface exploration took place. Even then the surface geology did not yield many of the clues which were needed to assist the search in that pre-scientific period of petroleum exploration, while available entrepreneurial energy

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[1]Independent Petroleum Association of America, The Oil Producing Industry in Your State (Washington, D.C.: The Independent Petroleum Association of America, 1972).

and capital seemed to be fully absorbed by railway building, the wheat boom and real estate speculation.

In this environment, the first discoveries of hydrocarbons in western Canada were, unsurprisingly, accidental ones.[1] Drilling for water for the Canadian Pacific Railway disclosed natural gas in 1883 at Langevin (now Alderson) some 40 miles from Medicine Hat. This find was not put to commercial use, but a discovery made nearer Medicine Hat in 1890 by prospectors drilling for coal was eventually developed in the early 1900's for heating, lighting and industrial use in that city.[2] Interestingly, availability of this cheap fuel and the presence of clay deposits nearby led to the establishment in Medicine Hat before the first World War of factories manufacturing bricks, tile, pipe and flue linings, crockery and tableware. A glass container plant was also built. This was perhaps the first Canadian example of "forward linkages" associated with petroleum

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[1]The balance of this section is based on Gray, op. cit., and on Eric J. Hanson, Dynamic Decade (Toronto: McClelland and Stewart, 1958).

[2]The Medicine Hat gas field is currently undergoing a new phase of development.

development, other than the processing of oil which has already been mentioned.

The 1890's also saw some exploration initiative by the Geological Survey of the Dominion Government which drilled three wells at locations some 100 miles north of Edmonton. These were without commercial success, although natural gas was found in two of them. Similar results attended a search for natural gas in the Calgary area by the Calgary Natural Gas Company which had been organized in 1901, but commercial quantities of gas were discovered at Bow Island by Eugene Coste's Canadian Western Natural Gas Company in 1911 and the following year this gas was piped 170 miles to Calgary by what was then the world's longest transmission line. Lastly, in 1902 a minor oil discovery was made at Waterton in the extreme southwest of Alberta. Although the remote and mountainous location put great obstacles in the way of transportation inwards of heavy machinery and outwards of oil, several follow-up wells were drilled to depths of 1,500-2,000 feet but without success and exploration in the area was abandoned in 1907.[1]

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[1] It may be noted that large gas discoveries were later made in the same general area at Pincher Creek (1949) but at depths of ten to fourteen thousand feet.

The year 1914 saw the discovery at Turner Valley near Calgary of very large volumes of natural gas and disappointingly small quantities of oil to the accompaniment of a speculative boom and bust which was for decades to make mobilization of capital for the western Canadian search more difficult than even the risky nature of petroleum exploration warranted. Natural gas was later piped to Calgary, Lethbridge and intervening towns from Turner Valley. Production of liquid hydrocarbons - crude oil and condensate from the "wet" natural gas - was minimal.

The second stage in Turner Valley's development occurred in 1922 when the Royalite Oil Company, a subsidiary of Imperial Oil which had in 1920 bought the producing property from the discoverer, Calgary Petroleum Products, made a large gas and condensate[1] discovery at greater depth than the 1914 well. Production of liquids increased from a few barrels daily to over 4,000 b/d in 1932. Huge quantities of natural gas were burned off after recovery of this condensate.

The third step came in 1936 when an even deeper well was drilled by Turner Valley Royalties, which later became Home Oil, and tapped a large crude oil reservoir under the two gas-condensate producing formations. Hundreds of wells were drilled to develop this find, Canada's first major oil field.

Turner Valley had two notable side-effects. Firstly, it led to the construction in 1922 of western Canada's first modern oil refinery at Calgary by Imperial Oil. Secondly, the waste of natural resources through flaring of gas and also the damage that flaring caused to the Turner Valley reservoir which greatly reduced the ultimate recovery of oil, resulted in the establishment in 1938 of the Alberta Oil and Gas Conservation Board.

While these developments had been going on in southern Alberta, a thousand miles north of Edmonton Imperial Oil had in 1920 discovered oil at Norman Wells in the Northwest Territories. Exploration activity had been attracted to this remote area by indications of oil seeps which had been noted by some of the earliest travellers in the region. The Norman Wells field proved to be very small. A miniature refinery was built in 1939 to provide oil fuels for the transportation needs of the northern development which was just getting under-way in the 1930's. During the second World War Norman Wells was of course the origin of the Canol project designed to supply petroleum fuels for Alaska defence needs. This involved construction of a small-diameter pipeline across six hundred miles of most difficult terrain to a refinery at Whitehorse. Now, fifty years after its discovery, the Norman Wells field is getting a new lease of life as a result of the greatly enlarged oil demands associated with current northern development, mainly petroleum exploration. Some expansion has been undertaken and the refinery has recently been enlarged.

Several other oil discoveries were made in Alberta prior to 1947 but none were of any great significance. Heavy oil, difficult to produce and of small commercial value (the Turner Valley oil is a good quality light oil), was found in shallow formations in areas south of Lethbridge (Conrad, Del Bonita, Red Coulee and Taber); east of Calgary (Princess, a lighter crude but very modest in volume); and east of Edmonton (Dino, Lloydminster, Vermillion and Wainwright). Only the Lloydminster find, made in 1939, is of continuing importance. This crude oil is a valuable feedstock for asphalt manufacture and production expanded considerably in the 1960's when techniques were developed enabling it to be pipelined successfully by blending with condensate from natural gas as a diluent.

The picture as regards natural gas was different. In Alberta prior to 1947 sufficient gas had been found in the course of oil prospecting to provide a fairly abundant supply of this fuel for the province's larger urban areas. Reference has already been made to the Bow Island and Medicine Hat discoveries of pre-first World War vintage. In 1923 the large Viking-Kinsella field was found 75 miles south east of Edmonton to which city this gas was transmitted by twin pipe lines. By the early 1940's the process of conversion from coal to natural gas was almost complete in domestic and commercial uses in urban areas. Industrial users also swung over rapidly to natural gas. Simultaneously, several further important gas finds were made in the course of wildcatting for oil. Indeed, petroleum exploration had proven to be so "gas-prone" that in 1946 Imperial Oil was actively investigating the feasibility of synthesizing gasoline from Alberta natural gas in view of the decline of oil production from wartime production peaks.[1] In Saskatchewan the Coleville-Brock field was discovered in 1934 and the town of Lloydminster was supplied later that year. Since then a dozen other centres, including Prince Albert and Saskatoon, have been connected to the Coleville-Brock field.[2]

c. Leduc and a New Era in the West[3]

In February 1947 Imperial Oil discovered what soon proved to be a major oil field at Leduc some 13 miles south-west of Edmonton. It is difficult to exaggerate the importance of this find, located in an accessible area, close to a major city and producing high quality oil. There was an immediate rush by oil companies, principally American, to acquire petroleum exploration rights in Alberta and a phase of intensive

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[1] John Davis, Canadian Energy Prospects, A study for the Royal Commission on Canada's Economic Prospects (Ottawa, 1957), p. 159.

[2] This and succeeding material on petroleum development in Saskatchewan is based largely on Saskatchewan Department of Mineral Resources, Oil in Saskatchewan (Regina: Bureau of Publications, Government of Saskatchewan, various dates).

[3] This section owes much to the convenient historical summary in Hanson, op. cit., Chapters 5 and 6.

and well-rewarded exploration began which was to last for a decade. The second major discovery, that of the Redwater field in 1948, also near Edmonton and by Imperial, was much larger than Leduc and intensified interest in and the search for oil in Alberta. It gave the province recoverable oil reserves of more than a billion barrels, indicated the potential of the petroleum industry as a source of government funds and made it urgent to find markets for Alberta oil outside the province.

In 1949 the Interprovincial Pipe Line Company ("Interprovincial") was formed, with Imperial taking a one-third interest, to transport Alberta oil eastwards (see below, pp. 68-71). A pipe line was built from Redwater to Edmonton, Regina and Superior, Wisconsin, by the end of 1950. Oil was transported from Superior to Sarnia refineries by tanker for three seasons until in 1953 the pipe line was extended through United States territory to Sarnia and in 1957 it reached Toronto area oil refineries. En route, the Interprovincial system served oil refineries in Saskatchewan, Manitoba, in the United States at the head of Lake Superior, in upper Michigan and, via a spur line, at St. Paul-Minneapolis. There is also a spur from Ontario to Buffalo, New York.

The Trans Mountain Oil Pipe Line Company ("Trans Mountain") was formed in 1951 to build a line to the Pacific coast (see below, pp. 157-161). This was completed in 1953 simultaneously with the construction of new refineries at Puget Sound and some enlargement of plants in the lower mainland of British Columbia. Principal shareholders in Trans Mountain were a group of six Canadian and American oil companies, British American (later Gulf Canada), Imperial, Shell Canada, Richfield (later Atlantic Richfield), Standard of California and Union of California.

While these trunk pipe lines and smaller ones to feed them were being constructed, successful development continued in Alberta and extended to the other western provinces although Alberta remained the focus of exploration activity and discovery success. In Alberta oil discoveries were made and exploited at Golden Spike (Imperial, 1949);[1] Stettler and Fenn-Big

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[1]The fields mentioned by name accounted in aggregate for more than half of total 1972 oil production in each province. The name of the discovering company is included to supply an impression of the diversity of corporate activity in western Canadian oil development.

Valley (Gulf, 1949-50); Wizard Lake (Texaco, 1951), Bonnie Glen (Texaco, 1952); Pembina (Mobil, 1953), Swan Hills (Home Oil, 1957); and Judy Creek (Imperial, 1958). Annual additions to oil reserves, although variable from year to year, continuously exceeded production. While there was a lull in major discoveries for a while after 1958, extensions to fields already found sustained the increase in reserves (see Appendix II-3). Further major discoveries were made in the mid-1960's in the Peace River area (California Standard, 1962), Rainbow Lake (Banff Oil, 1965) and Zama Lake (Dome Petroleum, 1965). The fields of northwest Alberta were found to extend into north-east British Columbia where the principal fields are Boundary Lake (Imperial, 1961); and Peejay (Union, 1962).

Oil exploration in Saskatchewan, which had received some encouragement after the war when the Lloydminster field was found to extend eastwards across the provincial boundary, was greatly stimulated by the successes in Alberta. Important discoveries were made during the 1950's of medium-heavy oil in south-west Saskatchewan and of light crude oil in the south-eastern part of the province. These latter fields extended into south-west Manitoba where significant production was established in 1955.

The discovery and development of natural gas in very large volumes was associated with the successful exploration drive after Leduc. In some cases natural gas is a co-product of crude oil (as at Leduc, from which gas was early piped to Edmonton to supplement supplies from the Viking-Kinsella field). In others, natural gas is found alone (as at Jumping Pound, see above). Petroleum exploration soon identified a "gas-prone" area in the foothills of the Rocky Mountains where considerable and successful exploration took place after the construction westwards and eastwards of long-distance gas transmission lines.

Alberta natural gas, gathered by the provincially-sponsored Alberta Gas Trunk pipe line system, was shipped eastwards to Ontario markets by TransCanada PipeLines whose main transmission line was completed, with substantial federal financial support, in 1958 (see below, pp.162-169). A year earlier the line of Westcoast Transmission had been completed from the Peace River area of Alberta to Vancouver and the United

States border. Both of these systems were substantially expanded over the years and were joined by a third major gas export pipe line, that of Alberta and Southern, an affiliate of the Pacific Gas and Electric Company, which moves Alberta gas to the international border for onward transmission to the Bay area of California.

The growth of discovered reserves of oil and gas and of production from them, reflecting the resource-development described above, is shown in Appendix II-3.

Finally in this brief review of post-Leduc petroleum development, the Alberta tar sands, whose existence had been known since Peter Pond had in 1788 established what was to become Fort McMurray,[1] were brought into commercial use in 1967. A modest-sized plant was built near Fort McMurray to recover tar

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[1]Pond is credited with the discovery by Gray (op. cit., p. 299) but no reference is given. Alexander Mackenzie, who visited the area in 1789, gives a vivid description of the tar sands in his Voyages from Montreal on the River St. Lawrence Through the Continent of North America to the Frozen and Pacific Oceans (New York: G.F. Hopkins, First American Edition, 1802, p. 67).

from open pit mined sand and refine it into a synthetic crude oil which was shipped to refiner-customers via Interprovincial's pipe line from which a spur line was built to the plant. Again the principal was a United States company, Sun Oil of Philadelphia.

Summary

Petroleum is generally held to have had its origin in organic remains deposited in the seas of geological time. Sedimentary rocks favourable to its occurrence are found in many parts of Canada and adjacent continental shelf areas; eight discrete petroliferous regions have been identified. The total volume of sediments in Canada, which furnishes a rough guide to the extent of possible petroleum resources, is not much less than that in the United States. Similarly, Canadian ultimately-recoverable petroleum reserves, including oil from tar sands, may be about 70 per cent as large as those of the United States and could prove to be of global significance. Canadian proven oil and gas reserves are however small in a world perspective, though important in a North American context. The discovered petroleum resource of western Canada appears to be intermediate in terms of productivity and unit cost of development between United States and overseas resources but suffers the disadvantage of poor location in relation to markets. Ontario's comparatively meagre petroleum reserves were first discovered and developed in the nineteenth century. A short-lived oil boom followed the 1858 discovery at Oil Springs, involving an inflow of capital and entrepreneurship, technological innovation in drilling and refining and rapid market development, including overseas markets. Its legacy includes the refinery industry of Sarnia; Canada's largest company, Imperial Oil; and a modest continued oil-producing industry. Ontario natural gas development commencing thirty years later was notable for initial dependence on export markets which were cut off in an effort to protect a sufficient supply for Canadian requirements when production declines set in. The westward extension of the petroleum industry was held up by the geological discontinuity represented by the Canadian Shield and then by lack of success in early exploration of the western Canadian sedimentary basin.

Commercial development of natural gas succeeded from about 1890, with some locally-significant linkage effects, but liquid hydrocarbons were not developed in useful quantity until the Turner Valley finds of 1922 and 1936, the Norman Wells discovery of 1920 being too small and remote to have other than local significance until the war years. Turner Valley production was in decline and an intensified search during the early 1940's had disclosed only gas when in 1947 the Leduc oil discovery opened a new era of western Canadian petroleum development. A succession of important oil fields was located in Alberta and then in Saskatchewan, Manitoba and British Columbia. Natural gas discovery and development paralleled that of oil in Alberta and British Columbia. Pipe line systems were built first for oil, then for gas, from the new industry's Alberta heartland to reach markets across the prairies and into Ontario, supplying outlets in the United States Great Lakes area en route, and to the lower mainland of British Columbia and on into the American Pacific Northwest. Success of exploration kept reserves additions ahead of production of both oil and gas until 1970. During the late 1960's commercial development of the Athabasca tar sands was initiated.

Chapter III

MARKETS FOR OIL AND CIRCUMSTANCES OF MARKET ACCESS

In this and the four succeeding chapters, attention is directed to the salient factors which have determined the rate and character of the development of the Canadian petroleum resource which has been described in Chapter II. Among these determinants, markets for oil and gas, dealt with in Chapters III and IV respectively, receive the first and most detailed consideration. The rate, direction and terms of market-access for western Canadian oil and gas have been strongly influenced by government policies, United States as well as Canadian. For much of the time since 1947, the growth of the western-Canadian petroleum industry was restricted by a lack of market rather than by inadequacy of the discovered resource, although this situation has been dramatically reversed in 1973.

1. Pre-1947: Local Outlets for Local Production

Ontario's crude oil has, since the 1858 discovery, found its sole market at refineries in the extreme south of the province, although during the early period of its development a substantial proportion of the output of these plants was exported overseas.[1]

The crude oil and condensate production developed in the western provinces prior to 1947 was similarly of only local significance in terms of markets. Thus, Turner Valley oil was refined initially at Imperial's Calgary refinery and the products were sold in the southern Alberta market. Following the 1936 discovery, this refinery was enlarged and a new plant built by British American. Products from these refineries served markets in eastern British Columbia as well as central Alberta.

By the late 1930's and during the war years, Turner Valley crude was shipped by rail from Calgary to Regina; products refined there from it were sold as far east as Portage la Prairie, Manitoba. However, reserves at Turner Valley were found by a provincial Royal Commission[2] to be quite inadequate to justify

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[1]Ross, op. cit., pp. 22-46.

[2]Alberta, Royal Commission to Inquire into Matters Connected with Petroleum and Petroleum Products, Report (Edmonton, 1940), pp. 64-72. This Report was tabled by the Government of Alberta and subsequently published by Imperial Oil Limited.

construction of a pipe line to the Great Lakes. The heavy crude oils of the Wainwright and Lloydminster fields were processed at small, simple refineries located on or near the fields themselves.[1] A proportion of the heavy oil from these and other fields was burned directly as fuel, some of it by railway locomotives.

The only western Canadian oil which before 1947 moved long distances by pipe line between provinces or territories was Norman Wells crude which, for eleven months, from April 1944 to March 1945, flowed at a rate of nearly 3,000 barrels daily to a newly-built refinery at Whitehorse before the Canol

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[1]Hanson, E.J., op. cit., p. 143. Oil refining however tends to be market- rather than resource-oriented in its location. This characteristic is exhibited in the Canadian refining industry whose major concentrations are in Ontario and Quebec. The refineries referred to here were located on or near the oil fields because the quantities of crude oil available did not justify the building of pipe lines. Moreover, the viscous nature of the oil would have made pipe line transportation difficult. It was therefore more attractive to refine the oil on the spot and move the refined products to market, generally by railway.

project was abandoned and the Norman Wells field reverted to its pre-war role of supplier, via the Norman Wells refinery, of oil to the very small local market.[1]

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[1]It is misleading of K.J. Rea to suggest that the Canol project "proved conclusively that earlier development of the petroleum resources there had been limited not by the availability of the natural resource itself, but by the narrowness of the local market" (Rea, K.J., The Political Economy of the Canadian North (Toronto: University of Toronto Press, 1968), pp. 158-159). The Norman Wells field is not "sizeable" (ibid., p. 162) but tiny by almost any standard. Reserves were never adequate to support a commercial-scale pipe line: Canol was an emergency project, absurdly small and uneconomic. The essential limitation on extra-territorial marketing of Norman Wells oil was therefore the small size and low productivity of the resource. In this connection, Rea is wrong in implying that the Yukon market was lost to Norman Wells oil merely because the petroleum products which moved in from Skagway to Whitehorse "were produced in very large, highly efficient refineries" (ibid., p. 159). Refining is a minor element in the total cost of petroleum products; crude oil and transportation are much more important. For example, the value of total shipments of oil products from Canadian oil refineries in 1971 was $2,045 million while the cost of materials and supplies, principally crude oil, was $1,635 million and the "value added" came to $401 million (Statistics Canada, Petroleum Refineries, 1971. Catalogue 42-205, Annual (Ottawa: Information Canada, May 1973)), p. 4, table 1.)

2. 1947-1951: Enlarging the Local Market for Alberta Oil

Crude oil from the Leduc discovery was first shipped by rail to Calgary where most of Alberta's refinery capacity was then located. However, Imperial took immediate steps to provide a market for this crude by purchasing, dismantling and re-erecting at Edmonton the defunct Whitehorse refinery.[1] The re-built plant came on stream in mid-1948 during which year a pipe line connection was completed from the Leduc field. Three years later, British American opened a new refinery at Edmonton, having already enlarged its Calgary plant to handle increased quantities of local crude. Also in 1951, McColl-Frontenac, later Texaco Canada, built a new oil refinery at Edmonton. Between 1945 and 1951, refinery capacity in Alberta increased nearly four-fold to 63,050 barrels daily, of which more than half comprised new plants located at Edmonton.[2]

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[1] This and subsequent information about particular corporate activities is drawn mainly from companies' annual reports.

[2] Canada, Dominion Bureau of Statistics - Department of Trade and Commerce, The Petroleum Products Industry, 1951 (Ottawa: Queen's Printer, 1953), p. 5, table 3.

This growth of crude oil processing was possible for three reasons. Firstly, displacement occurred of imports of refined oil products from the United States, which imports had become necessary after the war because of the decline in Turner Valley production. Secondly, post-war economic expansion in Alberta was stimulated by the petroleum boom and consumption of oil products increased rapidly. An undefinable but probably significant proportion of this demand growth reflected the gasoline and diesel fuel requirements of the petroleum exploration and development industry itself. Thirdly, inter-provincial shipments of oil products out of Alberta grew rapidly and by 1951 accounted for 24 per cent of refinery output in the province.

3. The 1950's: Development of Extra-Provincial Markets

It had become obvious with the Leduc and Redwater discoveries that the Alberta market could not fully absorb all of the crude oil that was expected to be available in the province. Substantial markets had to be found outside the province and transportation systems developed to supply them. Rail movement was out of the question: the pre-war gathering, loading and rail freight charges from Turner Valley to Regina amounted to some 73 cents per barrel against a wellhead price of about $1.30 per barrel;[1] the rail freight on a barrel of Leduc crude to Sarnia in 1948 would have been of the order of $4.00, more than the competitive value of the oil at its destination.[2] The circumstances called for the application of the technology of long-distance large-diameter oil pipe lines and within a few years major systems had been built east and west from Edmonton (see pp. 54-55). Rapid market expansion ensued as Alberta oil, and later that from the other western provinces, became available to existing refineries in Saskatchewan, Manitoba, Ontario and British Columbia. The development of markets for Canadian crude oil and condensates from 1947 to 1958 is illustrated in Figure 3. Data on markets for Canadian oil at quinquennial intervals 1945 to 1970 and in 1972 are presented in Appendix III-1.

Expansion of markets for prairies oil was however achieved at some cost in terms of lower unit sales proceeds at the field. Initially, in its intra-

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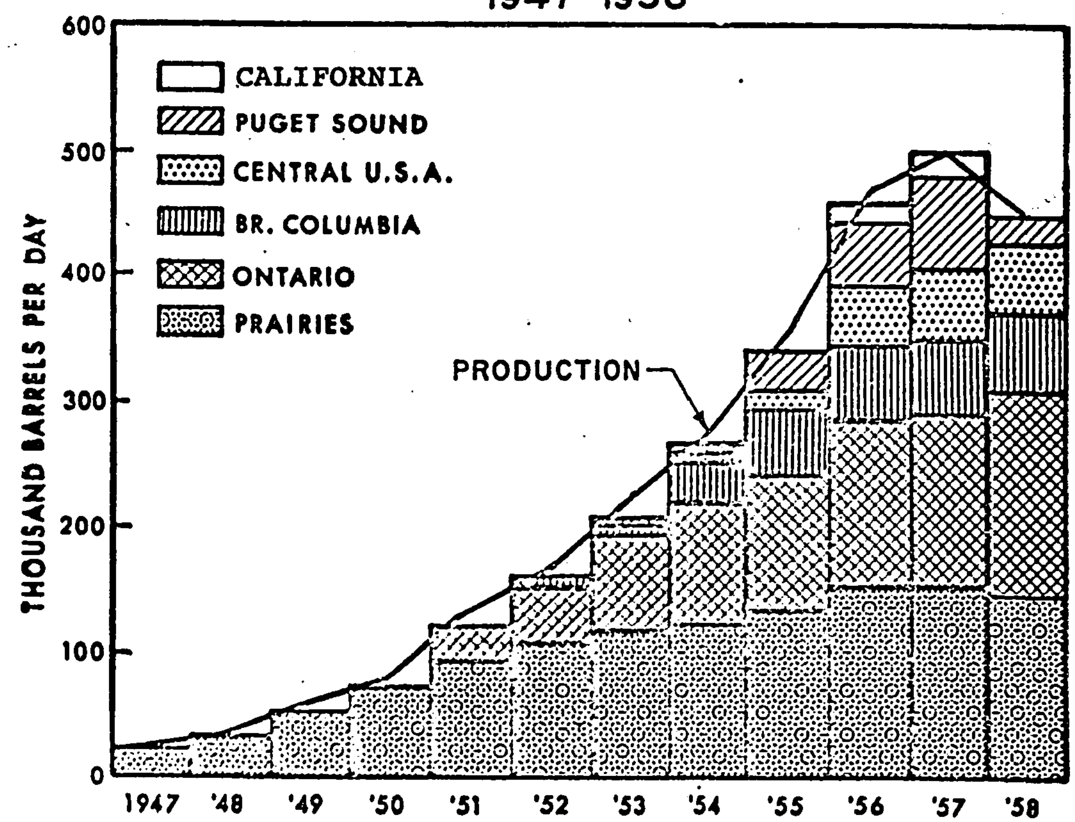
[1]Alberta, Royal Commission . . ., _op. cit._, p. 57.

[2]Hanson, _op. cit._, p. 155.

Figure 3

DISPOSITION OF CANADIAN CRUDE OIL

1947-1958



Source: Canada, Royal Commission, op. cit., p.38

provincial markets, Alberta crude had been able to command a relatively high wellhead price because of its more favourable location than the United States (Montana) crudes and refined products which determined its opportunity price. When more-distant market outlets were sought, wellhead prices had to be reduced to render Alberta crude competitive with alternative sources of supply, generally United States crudes, after allowance for transportation costs and changes in the exchange value of Canadian currency. This price development can be traced in the first entries in the price-history of Redwater crude oil displayed in Appendix III-2. Markets east and south-east of Alberta have since 1948 determined the price of Alberta crude oils and the prices of crude from other western provinces have been set with regard to the competition of Alberta oil in refinery markets.[1, 2]

a. <u>Ontario: The First Phase</u>

In the 1950's Ontario presented the largest oil market in Canada.

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[1] Canadian crude oil pricing has followed a typically "North American" pattern reflecting a condition of oligopsony: prices are "posted" by refiner-buyers and oil usually changes hands at these postings. This situation contrasts with that obtaining in overseas markets characterized by oligopoly: prices there are posted by producer-sellers and discounts off such prices are the rule rather than the exception.

[2] Alberta prices were the same for westward- as for eastward-shipment, notwithstanding the fact that the competitive situation in British Columbia and Washington markets may differ from that obtaining in markets east of Alberta.

It accounted for about one-third of total domestic oil demand and consumed about the same volume of oil as Quebec and the Atlantic Provinces taken together. This market was reached and penetrated by western Canadian oil in stages. Alberta crude first reached the Sarnia area refineries by tanker from Superior, Wisconsin,[1] in 1951 and then by pipe line in 1953. United States crude oil, which had nurtured these plants for more than half a century, was displaced by competitively-priced Canadian feedstock. In 1957 the pipe line was extended to the Toronto area where oil refineries were then drawing on United States crude. Even when these plants were connected to a pipe line supply of western Canadian oil, some foreign crude continued to be imported amounting in 1957 to about 15 per cent of the total provincial crude oil requirement. Apart from this direct competition as a refinery feedstock, western crude oil experienced competition in the Ontario market from imported

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[1]Superior rather than Fort William was chosen as the temporary terminus of the Interprovincial Pipe Line Company's facilities presumably because it lay on the shortest and easiest route to Sarnia, the principal Ontario refining centre, and one which offered possibilities of eventual access to United States refinery markets.

petroleum products and products refined in Quebec from imported crude oil, then shipped by the Trans Northern pipe line from Montreal to Toronto. Even though western crude had reached Ontario in 1951, this market was not by any means secured for Alberta oil by the late 1950's: as late as 1957 the products of western crude accounted for only about half of the petroleum product requirements of the province.

b. Exports: The First Phase

In the 1950's Canadian crude was competitive with United States crude in domestic markets. Its pricing basis also made it attractive as refinery raw material in areas of the northern United States remote from indigenous crude oil supply. By 1956 about 58,000 b/d of Alberta oil was being purchased by refiners on the United States west coast while nearly 50,000 b/d went from Alberta, Saskatchewan and Manitoba to mid-west refineries. These volumes accounted for about one-quarter of 1956 production in the western provinces. The growth of exports outpaced the increase in domestic demand for Canadian oil, contributing more than half of the 80 per cent increment in total sales of Canadian oil which occurred between 1954 and 1956.

The pattern of export market development was similar to growth in domestic markets in that it was based on service to existing refineries (in Michigan and in California, the latter reached by tanker from Vancouver), from which competing American or overseas crudes were displaced, and in part on demands posed by new refineries specially built to process Canadian crude (at the head of Lake Superior, at St. Paul, Minnesota, and on Puget Sound in Washington) whose output displaced in local markets products brought from distant refining centres by pipe line or by tanker.

The Middle East crisis of October 1956 which resulted in closure of the Suez Canal until May 1957 distorted the pattern of export market expansion for Canadian oil.[1] Shipments to Puget Sound refineries built up during 1956, in anticipation of a Middle East emergency, until by the early fall this market was saturated. Simultaneously, refiner-buyers in the

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[1]This and the paragraphs following is summarized from, Canada, Royal Commission on Energy (Henry Borden, Chairman), Second Report (Ottawa: Queen's Printer, July 1959), pp. 31-37.

San Francisco Bay and Los Angeles areas stepped-up their purchases of Canadian oil. Large increases in the price of overseas oil and very high rates for its carriage greatly enhanced the competitive position of Canadian crudes in the United States west coast market so that from November 1956 to May 1957 the Trans Mountain pipe line was used to its maximum capacity of 200,000 b/d and exports to Puget Sound and California refineries in excess of 100,000 b/d were recorded every month.

As the Suez crisis waned, Middle East and Far East crudes again began to move into United States Pacific Coast markets. Freight rates fell when re-opening of the canal cut demand for tanker tonnage to supply Europe from the Persian Gulf and as ships built during the emergency came into service. The existence of inventories of crude oil and refined products which had been built up against a possible period of scarcity contributed to the declining demand for Canadian oil. By the end of 1957 exports to the west coast had fallen to half of the April peak of 128,000 b/d and by the autumn of 1958, due in part to the introduction of United States import controls, exports of Canadian crudes to the Pacific Coast had decreased to some 11,000 b/d, all of which was moving into the Puget Sound area.

4. Post-Suez Crisis: Recession and a National Oil Policy

By the third quarter of 1957 the Canadian oil-producing industry was in recession. Exports to the west coast had fallen dramatically. Export growth had almost ceased in markets east of the Rockies. And the competition of overseas oil, accentuated by low ocean freights, had halted the seemingly-inevitable advance of western crude in Ontario. The result was a decline in production of crude oil and equivalent from a peak rate of 558,000 b/d in February 1957 to 447,000 b/d in the year 1958. This drop in output was in sharp contrast to the preceding rapid growth of production and, even more, of productive capacity which had previously been experienced. A more significant figure, the ratio of production to productive potential, fell in Alberta from 59 per cent in 1956 to 39 per cent in 1958.[1] Exploration activity declined sharply: well-footage drilled fell from 15.2 million in 1956 to 12.4 million in 1958; investment in all phases of the industry declined and provincial government revenues dropped.

In October 1957 the Federal Government appointed a Royal Commission under the chairmanship of Mr. Henry Borden to enquire into and make recommendations concerning policies with regard to the export of energy

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[1]Production had fallen short of productive capacity in Alberta almost from the start of oil producing operations in the province. During the 1930's the problem was dealt with by the refiners, principally Imperial Oil, who sought to allocate their purchases equitably among the producers. In the terminology of the industry this practice, which has at times occurred in more recent years in prairie provinces other than Alberta, is known as "purchaser pro-rationing". It was extensively reviewed by the Alberta Royal Commission on Petroleum and Petroleum Products (op. cit., pp. 15-45 and pp. 214-252). Excess productive capacity in Alberta of course disappeared during the war years but re-emerged quite soon after the Leduc and Redwater discoveries. By 1950 it was serious enough to require government intervention and since that time production of light and medium gravity crude oils in Alberta has been restricted to balance the quantities required each month by refiner-purchasers. This "pro-rationing to market demand" is enforced by the Alberta Energy Resources Conservation Board, formerly the Alberta Oil and Gas Conservation Board, which had been set up in 1938 as the Petroleum and Natural Gas Conservation Board ". . . generally to conserve gas and oil, or to prevent waste or improvident disposition thereof . . ." (Statutes of Alberta, Oil and Gas Resources Conservation Act, 1938, Section 3(1), paragraph W).

and sources of energy from Canada, the regulation of oil and gas transmission interprovincially and internationally and the authority which might be conferred on a National Energy Board.[1] An even more prompt response to the situation came in the form of a major report to Canadian clients by a leading American petroleum consultant.[2] This "Levy Report" concluded that Canadian oil resources, less substantial and prolific and therefore higher cost than those of, say, the Middle East, could not be expected to compete for overseas markets. It was argued however that they should be in a position to contribute substantially to North American requirements. This prospect however "involved an uncertain future"; it was held that demand from existing markets could not be expected to grow as fast as productive potential. Market expansion needed to absorb this potential would require some reduction in prices in order to make Canadian crude competitive at Montreal, the remaining large undeveloped domestic

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[1] Canada, Royal Commission on Energy, Report, op. cit., pp. 159-160.

[2] W.J. Levy, Market Outlets for Canadian Crude Oil, Problems and Prospects (New York: W.J. Levy Inc., December 1957).

market. As to export expansion, again price reductions appeared necessary to secure market growth but the report added with some prescience that "any substantially expanded market for Canadian crude in the United States . . . would hinge on the development of . . . import policy".[1]

The Borden Commission issued its Second Report, dealing mainly with oil, in July 1959. By that time the worst of the oil industry recession was over and production had started to increase. The United States had acted in March 1959 to protect its indigenous oil industry from the vigorous post-Suez competition of overseas oil by establishing a Mandatory Oil Import Program imposing quota controls on oil imports from all sources under the national security clause (Section 7b) of the Trade Agreements Extension Act of 1954.[2] In June of the same year, following Canadian diplomatic representations, oil entering the United

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[1] Ibid., Summary and Conclusions, paragraph 20.

[2] This and subsequent factual material on the Mandatory Oil Import Program is based largely on unpublished working papers prepared for the United States Cabinet Task Force on Oil Import Control (op. cit.).

States by overland means of transportation (pipe line, rail or truck) was exempted from these controls. In practice this "overland exemption", which was justified on national security grounds, accorded Canadian oil[1] the important preferential position in the United States import program, which it retains, albeit in a different form, today.

The Borden Commission was able to take a much more positive view of oil export prospects than had Levy, not only because, in the interim, the status of Canadian oil under the United States import program had been clarified, but because reductions had taken place in the price of Canadian crude oil in response to cuts in overseas oil prices occurring during the post-Suez recession (see Appendix III-2). In the

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[1]The "overland exemption" was not of substantial benefit to Mexico. Her oil fields were too distant from United States markets to make feasible the construction of pipe lines to export the small quantities of oil which were available after meeting domestic requirements. Small quantities of Mexican oil did however enter under the "overland exemption" thanks to a legal loophole which enabled an enterprising company to import the oil by sea to Brownsville, Texas, from where it was trucked across the border and immediately returned to the United States as quota-exempt oil.

words of the Royal Commission: "This had the effect of reducing the prices of Canadian crude substantially below the prices at which such crude would be competitive with United States domestic crudes in certain United States refining areas".[1] These factors led the Commission to express the expectation that the Canadian oil industry could pursue ". . . a vigorous policy of promoting the export of Canadian crude oil . . . so that Canadian crude can establish itself as a continuing source of supply in United States markets in sufficient volume to enable the industry in Canada to expand and maintain a high level of production".[2]

As to expansion in domestic markets, the Royal Commission was inclined to recommend against construction of a pipe line giving western crude access to the Montreal refinery market. It recognized that such a pipe line was unlikely to be built without some form of government action and it questioned

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[1]Canada, Royal Commission on Energy, <u>op. cit.</u>, p. 136.

[2]<u>Ibid.</u>, p. 137.

whether it was in the public interest "for the Government of Canada to intervene in order to assist in making available additional markets for Canadian crude consistent with the maintenance of a low energy cost to the Canadian consumer and a strong and healthy oil industry".[1] The Commission noted in this context that the marketing of Canadian crude at Montreal could result in increased consumer prices in Quebec and restricted importations of oil with possible adverse effects on Canada's foreign trade.

The Borden Commission's anticipation that "the time has come when it is desirable for Canada to reconsider and restate its national policy with respect to oil"[2] was not immediately fulfilled. However, in February, 1961, the then Minister of Trade and Commerce made a statement[3] to the effect that after an extensive review of all factors involved, the Government had adopted a policy which, briefly, was to seek the

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[1]Ibid., p. 127.

[2]Ibid., p. 129.

[3]Canada, House of Commons Debates, 1960-61, Vol. 2, pp. 1641-2.

co-operation of the oil industry in achieving a series of target levels of production of oil, including natural gas liquids.

These targets were to be reached by the increased use of Canadian oil in domestic markets west of the Ottawa Valley and by expansion of export sales.

Growth in domestic use was predicated in particular on substituting, in certain Ontario markets, products refined from Canadian crude for those supplied from foreign crude. This would require, in Ontario, the displacement of small imports of crude oil and a progressive reduction in imports of foreign products and in transfers of products refined from foreign crude in Montreal. It was recognized that the refining capacity in Ontario would have to be increased over the period to enable the Ontario market west of the Ottawa Valley to be "substantially" supplied from Canadian crude by 1963.[1]

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[1]See Appendix III-3 for a definition of the "Ottawa Valley" and for some indication of the magnitudes of oil markets to the west and east of the Ottawa Valley line.

In announcing this policy, the Government of Canada indicated that it had had full regard to the interests of other countries which might be affected by this decision. Bearing in mind the interests of the United States, it was indicated that the expansion of exports during the next three years would be largely in existing markets which could be reached through established pipe lines. On the broader international basis, it was also stated that the program was designed to achieve Canadian national objectives with the least possible disruption of normal trade patterns.

While making it clear that it sought to achieve its objectives on the basis of voluntary co-operation between government and industry, the government made it known that measures would be taken if a voluntary program did not produce the desired results. The statement also indicated that the government had instructed the National Energy Board, which had been established in 1959 following a recommendation of the Borden Commission, to report periodically on the progress of the program and to evaluate the contribution of individual companies to the general effort.

This national oil policy was, in the words of one of its authors, "somewhat more profound and complex than this clear-cut and relatively simply statement".[1] It represented rejection of a policy of fostering the construction of a pipe line from western Canada to Montreal. It also reflected a decision to reject an extensive oil import control system with associated government intervention and disruption of international trade. Implicit in the statement was adoption of a continental rather than a nationalistic policy, directing the market flow of western crude south rather than east. Finally, primary reliance was placed on the initiative and drive of private enterprise to carry out the program, although government's preparedness to act by compulsion if need be was never left in any doubt.

Familiar themes of Canadian economic history were, therefore, repeated in the national oil policy. Thus, private, rather than state enterprise has been

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[1]R.D. Howland, "Canada's National Oil Policy", An Address to the Annual Meeting of the Canadian Institute of Mining and Metallurgy, Quebec City, 25 April, 1966.

the preferred vehicle for implementation of policy from the time of the Hudson's Bay Company while the theme of north-south pulls towards continental integration is recurrent in Canadian economic history.

5. The 1960's: Market Expansion Under the National Oil Policy

The national oil policy assumed that Canadian markets extending to the Ottawa Valley in Ontario, coupled with the prospect of a growing demand in the United States, would provide markets sufficient to ensure the viability of the Canadian industry. This assumption was justified. During the 1960's, demand from domestic and export markets, increasingly the latter, was sufficient to use an increasing proportion of an expanding known petroleum resource base.

a. Enlargement of the Ontario Market

The national oil policy announced in 1961 was intended in part to reserve the Ontario market, save in the extreme east of the province, "substantially" for Canadian oil. In 1960, some 74 per cent of the market was being supplied by Canadian-origin products. In 1964 the proportion had risen to 91 per cent. The statistical record of Ontario expansion is given in Table 3.

Table 3

OIL SUPPLY IN ONTARIO
WEST OF THE OTTAWA VALLEY 1960-1964

(thousands of barrels per day)

	1960	1961	1961	1963	1964
Canadian crude oil and equivalent received at refineries	198	222	232	262	285
Add refined products transferred from Prairie Provinces	--	3	9	12	10
Total Canadian-origin oil supply	198	225	241	274	295
Imports of crude oil and equivalent	10	8	2	2	1
Imports of refined products less exports of same	16	7	3	8	10
Transfers of refined products from Quebec and the Atlantic Provinces	43	43	40	39	17
Total Foreign-origin oil supply	49	58	45	49	28
Total oil supply (net of exports)	267	283	286	323	323
Canadian-origin supply as percentage of total	74	80	84	85	91

Source: R.D. Howland (1966), op. cit., table 3.

These figures conceal the fact that the movement of foreign-origin heavy fuel oils and of the heterogeneous group of "other products" ranging from asphalt to waxes was not subject to restraint by the National Energy Board. This meant that virtually all of the motor gasoline and middle distillates - diesel fuel and furnace oil - used in the area west of the Ottawa Valley were by the mid-1960's refined from indigenous crude oil. The resultant increase in use of western crude at Ontario refineries added some 60,000 b/d to the demand for domestic crude in the period 1961-1964.

To judge from information as to the price of imported crude oils at Quebec refineries compared to the price of domestic crude at Ontario plants presented in Table 4, enlargement of the Ontario market for western oil would not have occurred without the exercise of suasion by government through the National Energy Board on the six major Ontario petroleum products marketers.[1] By 1964 all of these companies had built new refineries in Ontario or

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[1]British American (now Gulf Canada), Cities Service (now British Petroleum), Imperial, Shell, Sun and Texaco.

expanded existing plants so as to be able to meet most of their market requirements west of the Ottawa Valley with products refined in the province from western crude oil.[1]

Table 4

AVERAGE COST OF CRUDE OIL AT REFINERIES IN QUEBEC AND ONTARIO, 1962-1966
(dollars per barrel)

	Ontario	Quebec	Difference (Ontario higher)
1962	3.06	2.84	0.22
1963	3.14	2.80	0.34
1964	3.13	2.74	0.39
1965	3.14	2.63	0.51
1966	3.12	2.57	0.55

Source: Canada, House of Commons, Evidence of the Standing Committee on National Resources and Public Works, Issue No. 4, 8 March, 1973, p. 4:35.

This refinery expansion was the major new investment required of the oil industry in implementation of the Ontario program of the national

[1]This matter was the subject of a dissertation by J.H. Dagher, "Effect of the National Oil Policy on the Ontario Refining Industry" (Unpublished Doctoral Dissertation, Montreal: McGill University, 1968).

oil policy. Accompanying changes included the partial reversal of the Trans Northern pipe line (see p. 72) so that instead of carrying products westwards from Montreal to Toronto, it pumped eastwards from Toronto to a point just east of Kingston, supplying indigenous-origin products in the area up to the Ottawa Valley line. The important flow of products from Montreal to Ottawa of course continued, that city being within the part of eastern Ontario which was to be supplied with foreign-origin material. As these investments and alterations in physical equipment were made, the oil industry had to bring about changes in the pattern of supply while ensuring that no shortages of products occurred.

In its Annual Report to the Minister[1] for 1965, the National Energy Board advised that the initial objectives of the program had been achieved: changes in Ontario supply had been effected; exports expanded and target rates of production of western Canadian oil had been reached (see p. 82).[2] However the Board went

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[1]The Energy Board then reported to the Minister of Trade and Commerce. Since 1966 it has been responsible to the Minister of Energy, Mines and Resources.

[2]National Energy Board, Annual Report, 1965 (Ottawa: National Energy Board, March 1966), p. 8.

on to note that "the policy continues in being as a means to ensure the continued growth and prosperity of the Canadian oil industry". This dictum summarized the attitude of successive governments which affirmed their support for the policy and took steps to uphold it.

The Pearson government indicated its acceptance of the national oil policy soon after taking office in the spring of 1963. Its position was confirmed in a speech to the Canadian Petroleum Association by the Honourable Mitchell Sharp, Minister of Trade and Commerce, in February 1964. Later that year, when imports of low-cost gasoline from Europe made inroads into the Ontario market, Mr. Sharp advised the House of Commons that ". . . the Government continues to support the national oil policy and will, if necessary, take steps to prevent the disruption of that policy by imports of gasoline from Europe at distress prices".[1] This undertaking was made good after imports were resumed in June 1965, the value for duty purposes of imported

[1]Canada, House of Commons Debates, Session 1965, Volume X, p. 10521.

motor gasoline was fixed for a 180-day period at artificially high levels by the Minister of National Revenue, pursuant to the anti-dumping provisions of the Customs Act.[1]

Similar action was taken in successive years[2] and proved reasonably successful in discouraging imports of motor gasoline to those parts of Ontario which were to be served by indigenous-origin product. However, by the spring of 1970 importers appeared to have found means to circumvent the purpose of these fiscal measures and the government therefore brought motor gasoline imports under the mandatory control of the National Energy Board. In announcing this decision, which received all-party support, the Minister of Energy, Mines and Resources, the Honourable J.J. Greene, told the House of Commons that "the (oil) policy has worked well on a voluntary basis since its inception.

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[1]Department of National Revenue, Customs and Excise. Memorandum D46-1, "Value for Duty of Gasoline" (Ottawa: Department of National Revenue, 30 June, 1965).

[2]For example, Department of National Revenue, Customs and Excise, Memorandum D46-1, "Surtax on Gasoline-type Fuels for Use in Internal Combustion Engines other than Aircraft" (Ottawa: Department of National Revenue, 24 January and 3 April, 1969).

However, it is now being jeopardized by the risk of increasing movements of foreign-origin product into Ontario west of the Ottawa Valley".[1] The National Energy Board was empowered to license motor gasoline imports on the basis of the area of their consumption within Canada, the basic criterion applied being the extent to which such imports would be "consistent with the development and utilization of Canadian indigenous oil resources".[2]

The national oil policy extended the marketing territory of the Toronto-area refineries but did not bring any new refining area within reach of western crude. For fifteen years (1957-72), therefore, there has been no major geographical market growth for Canadian crude oil, as distinct from products derived therefrom. Increased refinery raw material requirements in Ontario and the western provinces have of course resulted in a steady increase in domestic demand, but

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[1]Canada, House of Commons Debates, Session 1970, Volume VII, p. 6671.

[2]National Energy Board Act, Part VI Regulations, Section 20(2). These powers were revoked in June, 1973, the cost of overseas-refined gasoline having risen to such an extent that it could no longer compete against Canadian-origin product in Ontario.

since the Ontario expansion was completed in 1965 domestic markets have accounted for a diminishing share of increments to total demand.

b. <u>Development of Exports</u>

The Borden Commission in its second report and later the Diefenbaker government in its 1961 national oil policy attached great importance to the potential of the United States market for Canadian oil. At a meeting in Washington prior to the inception of the oil policy, Canadian officials indicated the expectation that growth of production would stem from approximately equal expansion in exports and in domestic use.[1]

These expectations were broadly fulfilled. Initially, export expansion was more rapid than domestic demand growth as Canadian sales in the Puget Sound refinery market almost tripled from about 50,000 b/d in 1960 to 143,000 b/d in 1965. The growth in the area east of the Rockies was nearly as impressive: shipments of crude and equivalent rose from 63,000 b/d in 1960 to 153,000 b/d in 1965 (Appendix III-1). The greater part of the expansion was in existing markets

[1]Howland, <u>op. cit.</u>, p. 12.

which were accessible through established pipe lines (see p. 83), but in 1962-63 new pipe lines were built from Alberta to supply the Billings area refineries in Montana and from Ontario across the Niagara River to reach plants at Buffalo, New York.

This export expansion did not go unprotested by United States interests which felt threatened thereby. These included the traditionally protectionist-minded "independent" producers represented by the Independent Petroleum Association of America, certain refiners who felt disadvantaged by competitors' access to lower-priced Canadian raw material, and even the National Coal Association.[1] In these circumstances, the contacts initiated between Canadian and United States officials were undoubtedly of value, although it is surely an exaggeration for A.R. Plotnik to

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[1]These criticisms erupted as early as the fall of 1961 and were aired at Congressional hearings. See United States Congress, Hearings on Small Business Problems Created by Petroleum Imports, 87th Congress, 1st Session (Washington, D.C.: United States Government Printing Office, 1961).

claim that the National Energy Board ". . . was [set up] to remain in continuous contact with the United States Department of the Interior".[1]

Successive Canadian governments in routine discussions emphasized the importance Canada attached to unrestricted access to United States oil markets and stressed the contribution which Canadian oil had made to the security of United States petroleum supply from the time of the Canol project and including the supply of Canadian oil to the Pacific north-west during the Korean War and Canada's oil-supply role in the 1956-57 Suez crisis. While Canada was successful in that its oil remained free from formal restriction, in the case of shipments to the area east of the Rockies ("Districts I-IV"), where substantial surplus producing capacity existed in the American industry, Canada was forced to exercise a degree of export restraint in most years from 1962 onwards in order to avoid a confrontation with the aims of United States import policy.

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[1]A.R. Plotnik, Petroleum: Canadian Markets and United States Foreign Trade Policy (Seattle: University of Washington Press, 1964), p. 133.

This restraint was formalized to a degree in an understanding of September 1967[1] between the two countries which provided for Canada to "ensure, short of imposing formal export controls", that certain target levels for shipments of refinery feedstock to Districts I-IV would not be exceeded in the period 1968-71. The understanding was entered into as part of a "deal" involving the granting of United States regulatory approvals for the construction of a "loop pipe line" on the Interprovincial system which would extend the American section of that system from the head of Lake Superior to Chicago, the largest refinery market in the northern United States, thence to re-enter Canada at Sarnia along with the original line which followed a northerly route via the Strait of Mackinaw.

Meanwhile exports continued to grow. Whereas in the years 1960-65 together, exports and domestic markets accounted for approximately equal proportions of demand growth, from 1965 export increases became

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[1]Canadian Embassy Note Number 303 to the State Department, dated 25 September, 1967.

progressively more important. A special factor in 1967 was the extra demands posed in the aftermath of the "second Suez crisis" which followed the June Middle East conflict. In the three summer months, exports to the United States west coast were 70,000 b/d above the normally-expectable level as Canadian oil displaced overseas imports.[1]

Despite existence of the 1967 arrangements with the United States, export growth in both 1968 and 1969 was larger, in the latter year accounting for 85 per cent of the total demand increase. The Energy Board reported that it employed "most vigorous efforts within the scope of these [1967] arrangements to restrain exports of Canadian feedstock . . . to the levels envisaged . . . [however] a changing industry environment, particularly an increase in United States crude oil prices, made it impracticable to limit exports to the target levels".[2]

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[1]National Energy Board, Annual Report, 1967 (Ottawa: National Energy Board, March 1968), p. 7.

[2]National Energy Board, Annual Report, 1969 (Ottawa: National Energy Board, March 1970), p. 9.

The year 1970 opened with accelerating sales of western oil in export markets, with large volumes moving for the first time to refineries in the Chicago area. This major geographical expansion in the United States market for Canadian crude put an intolerable strain on the 1967 arrangements and in March 1970 the United States imposed mandatory import controls on Canadian refinery feedstock moving into Districts I-IV.[1] The immediate consequence for the Canadian industry was a sharp fall in the rate of export, but in the event subsequent relaxation of United States controls affecting Canadian shipments resulted in an annual export rate nearly 20 per cent higher than that of the previous year.[2]

Although Canadian exports to the largest United States markets remained under quantitative control in 1971, exports nevertheless accounted for about 70 per cent of that year's growth in demand for Canadian oil. The geographical disposition of Canadian oil exports in 1965, 1968 and 1971 is illustrated in figure 4 which also indicates the pattern of oil supply to domestic markets in 1971.

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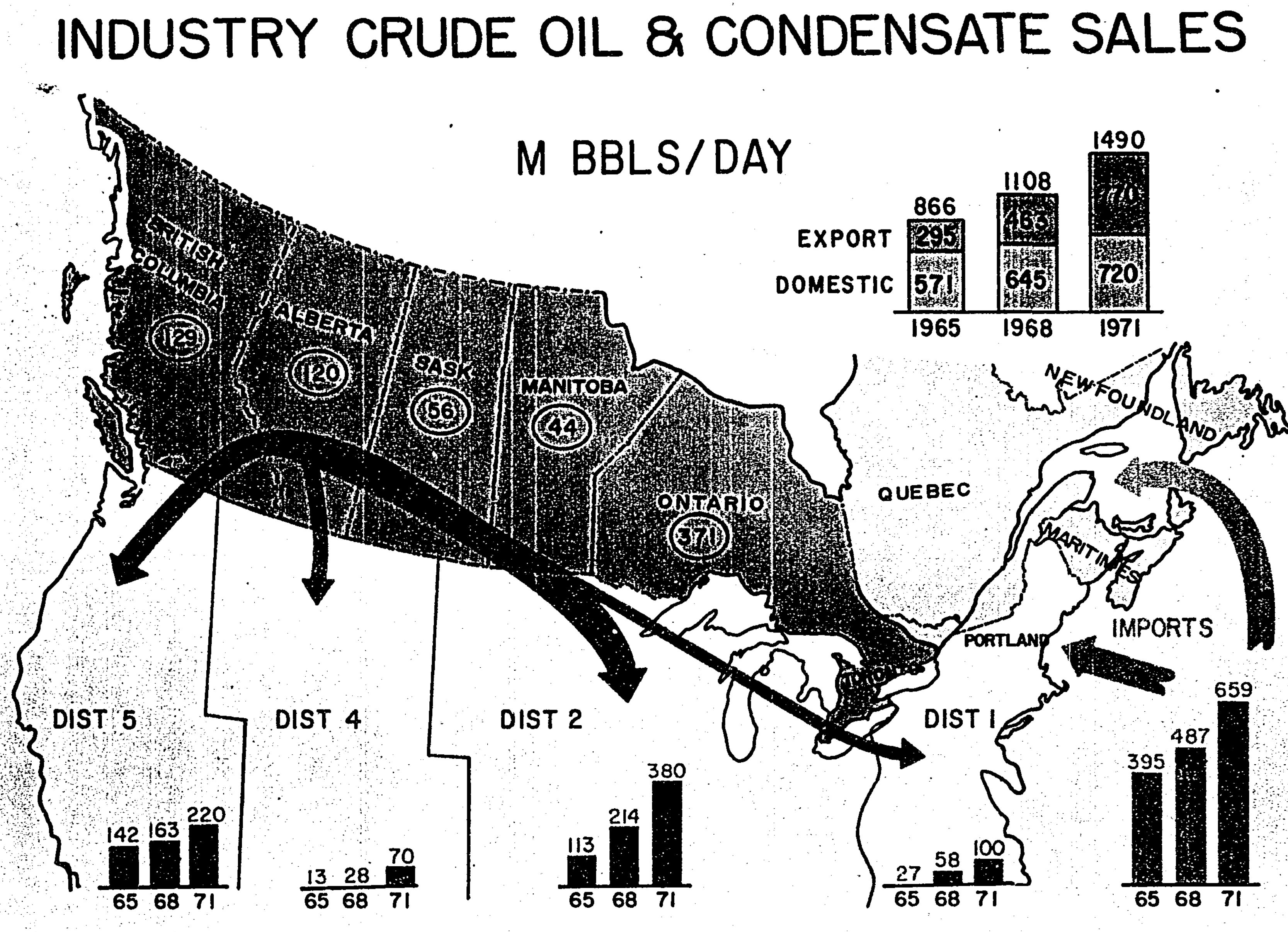
[1] United States, Presidential Proclamation 3279 of 10 March, 1959, as amended 10 March, 1970.

[2] National Energy Board, Annual Report, 1970 (Ottawa: National Energy Board, March 1971), pp. 19-20 and Appendix IX.

Figure 4



Courtesy of Gulf Oil Canada Ltd.

The United States authorities initially set the 1971 import quota for Districts I-IV at 450,000 barrels daily, but this figure was subsequently increased to 475,000 barrels daily, 20 per cent more than the previous year. Exports to the United States west coast, which had remained at high levels since the 1967 emergency, declined slightly as refiners at the Puget Sound found it advantageous to displace some Canadian oil with tanker-borne imports. Exports to California, which had re-emerged as a market for Canadian oil in 1967, after a break of nearly a decade, were also adversely affected by overseas competition by low tanker rates.

Despite the change in United States policy towards Canadian oil, marked by the imposition of quota controls in 1970, Canadian exports were growing at rates far in excess of those envisaged in the 1967 arrangements relating to Canadian export restraint. Favourable treatment has been accorded Canadian oil as compared with supply from any other foreign source with the result that the proportion of Canadian in total United States imports of refinery raw material has increased fairly continuously until the end of 1972, see Appendix III-5.

The favourable development of oil exports, despite the existence of United States import controls, may be attributed in part to the American desire to maintain good relations with Canada in respect of trade in raw materials, particularly energy, and in part to the strength of a growing United States "lobby" in favour of relatively unrestricted entry of Canadian oil.

As to United States policies, the desire of the American administration for greater access to Canadian energy resources was reflected in the following extract from a communiqué issued after the November 1970 meeting of the Joint Canada-United States [Cabinet] Committee on Trade and Economic Affairs:

> Members of the Committee reviewed the sharply growing energy requirements of North America and both the present availability and probable location of future sources of supply. They agreed that discussions should be continued to work out mutually acceptable arrangements, consistent with the responsibilities of the regulatory bodies concerned, for an increasing trade in crude oil, petroleum products and other fuels between the United States and Canada.[1]

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[1]Canada, Department of External Affairs, "Joint Canada/United States Committee on Trade and External Affairs", Press Release No. 82, 24 November, 1970, p. 3.

Similarly, in June 1971, President Nixon's "energy message" to Congress contained the following reference:

> Over the years, the United States and Canada have steadily increased their trade in energy . . . the major items of trade are oil and gas which are surplus to Canadian needs but which find a ready market in the United States . . . The time has come to develop further this mutually advantageous trading relationship. The United States is therefore prepared to move promptly to permit Canadian crude oil to enter this country, free of any quantitative restraints . . . We are ready to proceed with negotiations and we look to an early conclusion.[1]

Finally, the report of the United States Cabinet Task Force on Oil Import Control concluded:

> In our judgment, Canadian and Mexican oil is nearly as secure politically and militarily as our own, although complete realization of these security benefits will require fully understood and harmonized energy policies. We therefore recommend that, after an appropriate transition [from a quota to a tariff system of restricting oil imports generally] Canadian and Mexican imports be exempt from the program, if common energy accords can be arranged with those governments.[2]

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[1]President Nixon, Message to Congress on the Energy Situation, 4 June, 1971 (Department of State Press Release, 4 June, 1971).

[2]United States Cabinet Task Force on Oil Import Control, op. cit., Sections 335b and 427b.

As to the United States domestic lobby in favour of Canadian oil, the earliest and leading members are certain "independent" refiners in the northern United States who increasingly look to Canada for competitively-priced refinery raw material. Among the leaders of this lobby have been the Ashland Oil and Refining Company, with a large plant at Buffalo, the Koch Oil Company, which owns a refinery at St. Paul built in the 1950's especially to process Saskatchewan crude oils, and Clark Oil and Refining Corporation with a refinery at Chicago. These companies and several others have actively lobbied among United States officials, among Congressmen and with local trade organizations.

Among American politicians, support for Canadian oil has come from Senators William Proxmire (Wisconsin) and Edward Kennedy (Massachusetts), both of whom, it is fair to point out, have been highly critical of the United States Mandatory Oil Import Program generally.

Consumer groups did not actively support unrestricted access for Canadian oil, presumably because the direct consumer interest in removal of control on Canadian oil is not as large as, for instance, that in removal of quotas on heating oil imports to New England.

Certain influential newspapers - the New York Times, the Washington Post and the Journal of Commerce - have generally editorialized in favour of free import of Canadian oil.

Composition of Exports - Canadian oil exports have historically consisted almost entirely of crude oil and equivalent, that is of raw material for refining into finished products in the United States. This situation is fundamentally attributable to the structure of the United States tariff[1] which provided modest duties on crude oil (10½ cents per barrel on light crude oil and 5¼ cents on heavy crude) but substantial duties on finished petroleum products such as motor gasoline (51¼ cents per barrel). This tariff structure has effectively discouraged the export of gasoline. Some home heating oils are exported from Ontario and British Columbia refineries, the only Canadian plants favourably located to serve

[1]United States oil import duties were abolished on 1 May, 1973, and replaced by an import license-fee system which provides for a fee structure initially similar to the previous tariff structure.

American markets. Quota restrictions have not been a factor here because all products refined from Canadian crude oil have been exempted from control, formal or informal, since the start of the United States import control program.

Export Prices - Canadian export oil has been sold on the same basis of "posted prices" (see footnote on p. 70) as supplies to the domestic market. These prices have shown a degree of stability over time illustrated in Appendix III-4 which may be unusual compared to the price behaviour of some internationally-traded commodities such as non-ferrous metals and some agricultural products. It certainly does contrast strongly with the fluctuations in the price of Canadian sulphur (see Appendix IV-3). To attempt to properly explain this stability of crude oil and condensate prices would require an extensive digression. Its causes are probably to be sought in part in the oligopolistic nature of the North American oil industry in terms of both crude oil purchasing and oil products selling. Government policies in the United States and Canada also contributed to price stability by affording Canadian oil a degree of protection against the competition of overseas oil and by equating supply and demand through systems of "market demand prorationing" (see p. 76) which, in a measure, replaced price as an equilibrating mechanism. Canadian crude oil prices are also compared in Appendix III-4 with the prices of Venezuelan crude oil imported to Canada, a price series which may be taken to be broadly representative of international crude oil price trends.

Summary

Prior to 1947, Canada's small indigenous oil production served mainly local markets. Exceptions were Turner Valley crude shipped to Regina by rail and Norman Wells oil which for a brief period was transported to Whitehorse by pipe line.

Oil from Leduc and succeeding discoveries was first marketed at Alberta refineries but extra-provincial markets were soon needed. As distant markets were penetrated, some reduction in wellhead prices was required in order to meet competition from more favourably located import sources.

Ten years after Leduc, western Canadian crude was being sold to Canadian refiners from Vancouver to Toronto and exported in significant volumes to the United States mid-west and Pacific north-west. Exports, particularly to the latter destination, were first stimulated by the 1956-57 Suez crisis and then depressed by the subsequent world oil recession which also threatened Ontario markets for Canadian crude.

After receiving reports from a Royal Commission and from the National Energy Board, the Canadian Government in 1961 announced a national oil policy designed to stimulate western Canadian production by encouraging the use of indigenous oil in most of Ontario and promoting exports to the United States.

The Ontario program, involving refinery expansion and partial reversal of a pipe line flow, was implemented by 1964. This program ran somewhat counter to the flow of global oil supply economics and therefore brought products refined from western Canadian oil into sharp competition with foreign crude-origin oil products. It was nevertheless endorsed and upheld by successive governments, mainly by exercising suasion through the National Energy Board, but latterly involving also mandatory controls on gasoline imports.

Export market expansion contributed equally to demand for Canadian oil through about 1965, but has been the dominant element in subsequent growth. Until 1970, Canadian oil was exempt from the formal import control applied to overseas oil although a degree of Canadian export restraint was practised in regard to the sensitive Districts I-IV, latterly in connection with the geographical extension of markets in the Chicago area. Despite imposition of import controls on a large proportion of Canadian export oil, shipments have continued to increase rapidly, partly because of the imperatives of United States raw materials policy, partly perhaps because of the presence of an American lobby for Canadian oil. The United States' tariff structure has resulted in exports being composed almost entirely of refinery raw material. Export prices have shown remarkable stability, reflecting in part the influence of United States policies which in a degree protected North American oil against overseas competition and in part the oligopolistic nature of the international oil industry.

Chapter IV

MARKETS FOR NATURAL GAS AND ITS CO-PRODUCTS

The marketing of Canadian natural gas has followed a geographical pattern basically similar to that of oil. However, market development for gas has taken place under different institutional arrangements than for oil. Therefore, even though oil and gas are in a measure joint products, the marketing of natural gas requires separate discussion.

1. Pre-1957: Local Supplies for Local Markets

Though the first commercial development of natural gas in Canada occurred in southern Ontario as early as 1888 (see p. 43), the stage of essentially local marketing lasted almost seventy years.

In Ontario, local production, mainly from the Essex County and Niagara Peninsula fields, by the 1930's provided the basis for gas supply to urban markets across the southern part of the province from Windsor to Toronto. However, these supplies were small in relation to potential demand in markets just across the international border with consequences for government policy and for the development of gas supplies.

Exports were stopped in the early 1900's in an attempt to preserve supplies for domestic markets (see p. 44). Protection of indigenous supplies to meet domestic requirements has been a cornerstone of both federal and provincial gas policies ever since. At the federal level, this policy was formalized in the Electricity and Fluids Exportation Act of 1907 which prohibited natural gas exports unless the quantities concerned could be proved to be surplus to Canadian requirements.[1]

Even so, Ontario production was simply inadequate to meet potential demand with the result that important areas (for example, most of the city of Toronto) and major utilities (Consumers' Gas Company, the oldest in Canada) were effectively without natural gas supply and were forced to rely on the more expensive and less desirable gas manufactured from coal.

In Alberta, the resource situation proved to be more favourable (see pp. 49, 52, 57), so much so

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[1] R.D. Howland, "Some Observations on Canadian Energy Supply and Demand Outlook", A Paper presented at the 11th Annual Institute of the Petroleum Industry, Southwestern Legal Foundation, Dallas, Texas, 4 March, 1971, pp. 19 and 21.

that the converse of the Ontario problem obtained - local markets were small in relation to the resource potential. Because of the relative lack of markets, gas prices in Alberta were very low and gas became well established as the principal fuel in space heating and for industrial process applications in towns and cities almost throughout the province with the exception of the Peace River area. Enjoying the benefits of gas as an efficient, inexpensive fuel, many Albertans strenuously opposed its export on the grounds that they would then have to meet the higher prices that export markets were willing to pay.

Not until 1949, after careful review of the province's gas reserves, was the Oil and Gas Conservation Board (see p. 76) authorized by the passage of the Gas Resources Preservation Act of Alberta to consider applications to remove natural gas from the province. The first export permit concerned a very small volume and was granted in 1951 to the Montana Power Corporation, at the special request of the United States Government, for gas to supply a copper smelter at Butte, Montana, whose needs were regarded as essential to the Korean War effort.

Shortly after these exports commenced, the Consumers' Gas Company entered into arrangements with American pipe line companies for the supply of natural gas from United States sources to its Toronto market. There was concern on the part of the Government of Canada that the loss of potential markets for western gas in the Toronto area would render the construction of a pipe line from Alberta impracticable. As a consequence the Government made the importation of United States gas subject to licence of short-term duration.

In the mid-fifties, the gas situation in Canada still exhibited the pattern which had obtained for several decades, of local supplies serving mainly local markets. Natural gas supplied only 5 per cent of the national energy market compared to 22 per cent in the United States (see Appendices I-4 and I-5). About 8 per cent of total production was exported from Alberta but about 8 per cent of domestic requirements, an approximately equal volume, was imported to Ontario. Governments, federal and provincial, had longstanding gas policies, mainly concerned with safeguarding supplies to meet national and provincial requirements.

And the problem of the disposition of western Canadian gas, reserves of which were rapidly increasing in the wake of the successful search for oil,[1] was becoming a national issue.

2. From 1957: Western Reserves Reach Distant Markets

The marketing of western Canadian natural gas in distant domestic and export markets began in 1957 and was followed by fifteen years of very rapid expansion. All three long-distance gas transmission systems which dominate the Canadian natural gas marketing scene today by linking western Canadian resources to distribution systems here and in the

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[1]Various estimates were made prior to 1956 of natural gas reserves in Alberta. Because they were not mutually consistent they have not been included in Appendix II-3. However they do provide an interesting indication of the trend in resource development. Estimates made by Dr. G.S. Hume of the Geological Survey of Canada put proven reserves in Alberta at 1.4 trillion cubic feet ("Tcf") in late 1947 and early 1948 and at 2.8 Tcf in 1950. In January 1951 the Alberta Oil and Gas Conservation Board estimated remaining marketable reserves of gas in the province at some 4.4 Tcf and increased this to 6.8 Tcf at the end of 1951. By June 1953, the Board estimated Alberta reserves had reached 11.4 Tcf and by March 1954 to have increased to 13.4 Tcf, a nearly ten-fold increase from the Hume estimate for 1947 (Source: Charles Hay, "Post-War Development of the Natural Gas Industry", Dusters and Gushers, The Canadian Oil and Gas Industry, ed. J.D. Hilborn. [Toronto: Pitt Publishing Company Limited, 1968], pp. 183-188).

United States were conceived by their owners and were granted the necessary regulatory approvals by governments in the 1950's and were completed between 1957 and 1961, although important capacity expansions have of course taken place since then.

The policy key to this development within Canada was a decision of the Alberta Oil and Gas Conservation Board taken in March 1952 to allow the removal of large volumes of natural gas from the province under licence, this decision being subsequently approved by the Alberta Legislature after a heated and lengthy debate.[1] The technical key was the development and application of the mainly-American technology of long-distance high-pressure pipe line transmission (see pp. 142-143).

First to be completed was the Westcoast Transmission system which in August 1957 began delivering gas from the Peace River area of Alberta to the lower mainland of British Columbia and for export in the American Pacific Northwest. Although the distance was not great - 650 miles from the Peace

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[1] _Ibid._, p. 188.

River area to Vancouver - the mountainous terrain added an extra dimension to the costs of the line. Government approvals were granted for exports to the duty-free United States market in spite of an extremely low border price, because "To make such a project economically viable, at that time, an export component was essential . . .".[1]

TransCanada PipeLines Limited, a company formed in 1954 by the merger of two rival groups which had been competing for permission to remove Alberta gas, one to export, the other to eastern Canada, completed its line eastwards from Alberta to Ontario in October, 1958. Federal Government assistance, which was the subject of lengthy, bitter debate in the House of Commons, was required to enable TransCanada to implement government policy requiring that Alberta gas should reach Ontario markets via an all-Canadian route. This and other aspects of federal natural gas policy are summarized in Appendix IV-1, but the background to it has been outlined in the following terms:

> There were strong advocates in the mid-fifties, when the Alberta [gas] resources

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[1]R.D. Howland, op. cit., p. 22. The point is that the export component was needed to provide the volume of gas sales needed to support an economically-sized pipe line.

> were such as to require market outlets, of north-south trade, with Canadian gas going south and with equal quantities of United States gas moving north into eastern Canadian markets . . . but the policy considered appropriate was to have the gas move east, and the company [TransCanada] was required to construct its facilities through Canada. Once again, as in the instance of the construction of the first transcontinental railway in Canada . . . the Government provided some assistance to facilitate the scheme . . . [some] export was allowed[1] in order to assist the viability of the project, the Government being staisfied that the Canadian gas reserves were sufficient to allow the export and the prices to be received were satisfactory.[2]

TransCanada was subsequently authorized in 1966 to construct a second line to eastern Canada via the United States, which route afforded much improved export market opportunities, but only after agreeing to maintain its Canadian line as its main line.

The TransCanada system serves gas distributors in southern Ontario (Union Gas), the Toronto area (Consumers' Gas), eastern Ontario (Northern and Central Gas) and Montreal (Gaz Metropolitain). These markets

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[1]The point of export was Emerson, Manitoba, where connection was made with pipe line systems serving the upper mid-west.

[2]*Ibid.*, pp. 23-24.

had in some degree already been developed for natural gas by the import of United States supplies by Consumers' Gas (see p. 112) and by Union's long-standing use of Ontario gas, supplemented since 1947 by imports. Montreal was, and still is, effectively the easterly marketing extremity of western Canadian natural gas. Market penetration in the Montreal area has been disappointing to the utilities concerned. The poor showing of natural gas in that market is attributable to the cost of transportation which is marginally higher than to Ontario centres and to the stronger competition encountered in Quebec from fuel oils manufactured from lower-cost imported crude oil (see p. 88, table 4).

The third major gas transmission project, the Alberta-California system, serves only export markets in California and the Pacific Northwest. It was launched by the Pacific Gas and Electric Company, a long-established distributor of gas and electricity in California, in 1957. Construction of the system started in October 1960 and was completed a year later. Natural gas is purchased in Alberta by Alberta Natural Gas, a wholly-owned subsidiary of Pacific Gas and Electric, and exported by other subsidiaries for transmission mainly to the Bay area of California. Some gas is carried for the account of Westcoast Transmission for re-delivery by an American company to distributors in the Pacific Northwest.

The role of Canadian governments in marketing of natural gas includes Alberta's approval for removal of gas from the province and the federal government's regulation of interprovincial and international flows since 1959 under the National Energy Board Act, before then under the Exportation of Power and Fluids and Exportation of Gas Act (exports only). It has also embraced federal loan financing of one portion of the TransCanada project and construction of a second (see pp. 165-166). Another aspect of government initiative deserving mention is Alberta's requirement that all Alberta natural gas must be transported within the province by the Alberta Gas Trunk Line Company. This company was formed by special act in 1954. Its function is to gather and transport gas within the province, delivering it to both domestic and export companies. Thus, it links Alberta communities with reserves throughout the province. And it delivers gas to the three long-distance transmission companies at the provincial boundary. Alberta Gas Trunk is owned by the producers and the public.

Markets for Canadian natural gas have developed with extraordinary rapidity since the mid-1950's: domestic consumption has increased ten-fold and the share of the national energy market supplied by natural gas has risen from about 5 per cent in 1955 to 23 per cent in 1970[1] (see Appendix I-4). Export growth has been even more spectacular and nearly half of Canadian production is used in the United States. Imports have remained stable and have recently accounted for less than half of one per cent of total supply. These trends are summarized in Appendix IV-2. The geographical disposition of Canadian gas exports in 1965, 1968 and 1971 is shown in figure 5 which also illustrates the pattern of gas supply to domestic markets in 1971.

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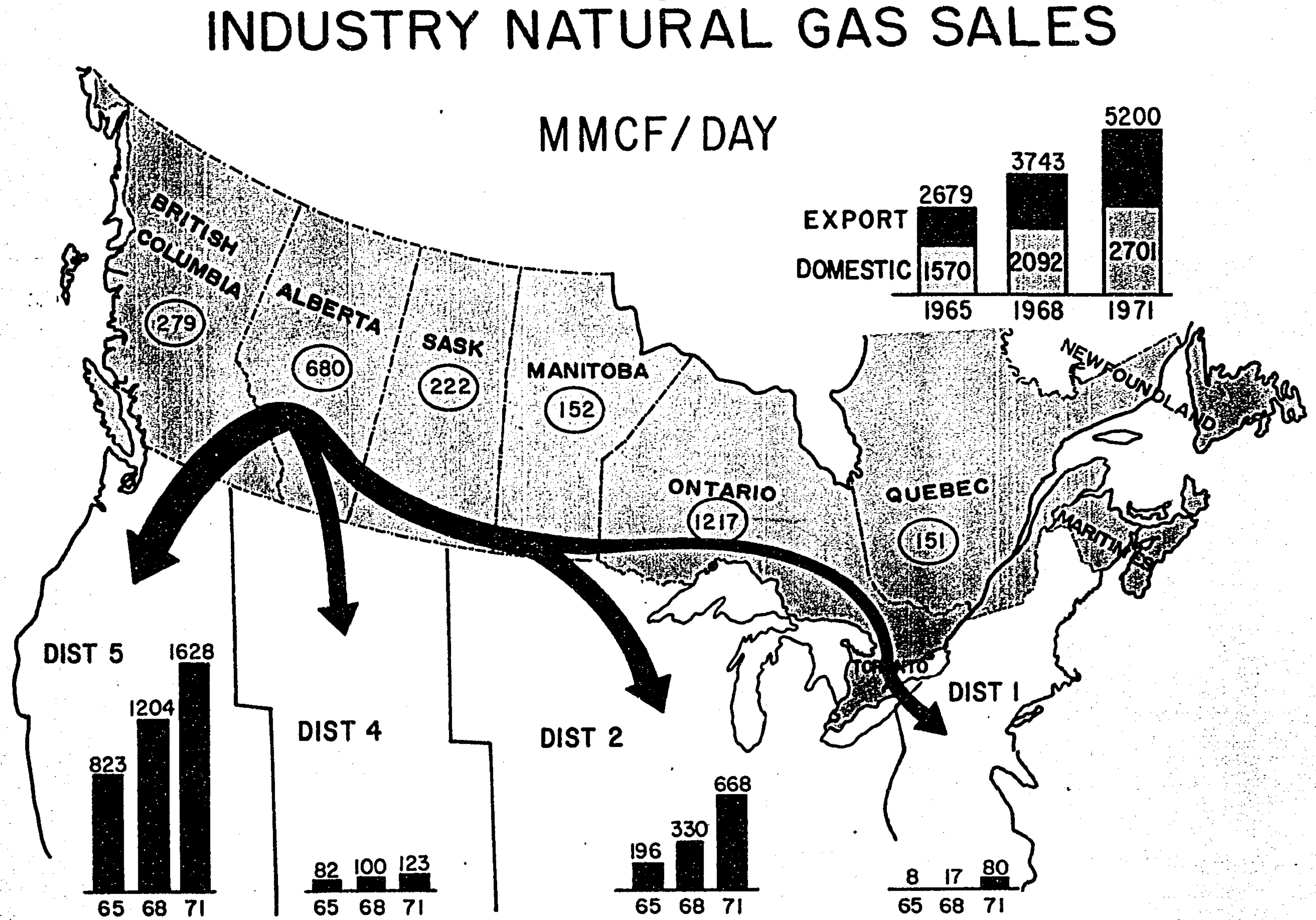
[1]This increase is the more remarkable when it is realized that natural gas service is presently available in only about two-thirds of the national energy market (i.e., Montreal, Ontario and the West). This point should be borne in mind in any comparison of the degree of market penetration achieved by natural gas in Canada compared to that in the United States where gas service is virtually universal in urban areas.

Figure 5



Courtesy of Gulf Oil Canada Ltd.

The rapid penetration by natural gas of domestic energy markets west of Quebec and outside of Alberta is attributable to the technical and economic advantages of this most desirable heating fuel.

The technical advantages of natural gas relate both to process and space-heating uses. In process applications, its salient attribute is the absence of contaminants, which particularly commends its use in the food industries, glass, ceramics and the smelting of some metals. In space heating, gas appliances are inherently cheaper than oil-burning equipment, slightly more efficient in thermal terms and can be used in combination with a cheaper flue and chimney, an important consideration for home developers with whom the choice of heating fuel in new homes and apartments effectively rests. An advantage enjoyed by gas over all other fossil fuels is of course that it does not involve investment or space for storage by the consumer.

Price has also been important. The transmission companies bought gas in western Canada on the basis of long-term contracts with limited provision for price-revision[1]. Gas was purchased by the distributors on a similar basis and priced by them generally to undersell competing fuels, taking account of its technical advantages. This resulted in gas winning most of the increment in space-heating demand in tract housing developments, apartments and commercial buildings. There has also been some conversion from oil to gas, generally for reasons of comparative cost, but also in the more recent past for environmental causes. Examples of the latter include conversion of Ontario Hydro's Hearn generating station in Toronto from coal to gas firing and the substitution of gas for residual oil as a refinery fuel by Gulf Oil Canada at its Clarkson, Ontario, plant.

It should be noted that, towards the end of the period under review, the petroleum industry was becoming less successful in finding natural gas in areas of western Canada within economic reach of

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[1]This is the principal factor in the long-term stability of gas prices at the point of production shown in Appendix IV-3. It is also the root cause of the current confrontation between, on the one hand, the governments of the gas-producing provinces and producers of gas and, on the other hand, the transmission and distribution companies and the Government of Ontario.

markets. The outlook in domestic markets meanwhile was for further large demand increments because of rising oil prices, caused essentially by increased tax "takes" in overseas producing countries, and because of the attraction of natural gas as the "cleanest" fuel in an increasingly pollution-conscious era. Rising demand and a disappointing gas discovery record in western Canada led the National Energy Board in November 1971 to conclude that ". . . no surplus presently exists in Canada for the Board to consider in respect of the applications made to it for further export licences".[1]

This development would appear to mark the close of nearly fifteen years' expansion as western gas resources, developed initially at least as a by-product of the search for oil, found expanding markets mainly in British Columbia, the American Pacific north-west, Ontario and the United States mid-west.

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[1]National Energy Board, Reasons for Decision in the Matter of Applications under the National Energy Board Act of Alberta and Southern Gas Co. Ltd. et. al. (Ottawa: National Energy Board, December, 1971), p. 6-1.

3. The Co-Products of Natural Gas

Natural gas consists principally of methane, the lightest and chemically the simplest hydrocarbon. However it generally contains other constituents in quantities such as to require their removal (or "stripping") prior to transmission to permit satisfactory transportation and use. The most common other constituents are the element sulphur in the form of hydrogen sulphide, and certain heavier hydrocarbon compounds, known collectively as natural gas liquids because they either liquefy spontaneously at atmospheric temperatures and pressures or can readily be liquefied by pressure-temperature manipulation. Where significant quantities of sulphur are present, the gas is described as "sour" (otherwise "sweet"). Where the proportion of natural gas liquids is important, the natural gas is termed "wet" (otherwise "dry"). The necessary removal of sulphur and natural gas liquids from Canadian natural gas has given rise to an important co-products processing industry (see Appendix II-3).

a. Natural Gas Liquids

These comprise ethane, propane, butane, pentane and heavier hydrocarbons.

Ethane, the next-lightest to methane, consequently the most difficult to "strip", is seldom removed from Canadian natural gas. In the United States, by contrast, ethane is used in large quantities in the manufacture of ethylene, a basic "building block" in the petrochemicals industry (polyethylene, ethylene glycol). The reason for the difference in treatment is that large volumes of wet natural gas are produced in the United States Gulf Coast area where a ready market for ethane and other natural gas liquids is presented by the large petrochemical industry. In western Canada, by contrast, local demand is small because development of petrochemicals manufacturing has been inhibited by distance from market for the products of such an industry. When the western natural gas reaches Ontario, where market-oriented petrochemicals manufacturing is located, its fuel value is too high in relation to alternative sources of petrochemical feedstock to make ethane extraction commercially attractive.

Propane and butane have to be removed near the point of production because their presence interferes with the satisfactory operation of high-pressure pipe lines. Production of these "liquefied petroleum gases" has grown very rapidly with the expansion of natural gas production and markets. Propane of course finds its principal market in the rural fuel economy of North America as "bottled gas". Its uses include heating, cooking, lighting and refrigeration in the home and in commercial establishments; a source of (low pollution) fuel for internal combustion engines including tractors, fork-lift trucks and buses and in certain process-heat applications where natural gas is not available and yet clean fuel qualities are essential. Butane is used largely as a refinery raw material in the manufacture of motor gasoline.

Propane and butane are both attractive chemical feedstocks for the manufacture of propylene (polypropylene) and butylene (butadiene and synthetic rubbers), respectively, the other important petrochemical "building blocks", but again distance from market has discouraged such use in Canada as compared to the United States.[1]

Despite the large production of liquefied petroleum gases in Canada, the volume shipped to specific geographical markets has hardly approached that required to support long-distance pipe line

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[1]The important petrochemical industries at Sarnia, Ontario (and at Montreal East) are based primarily on feedstocks supplied by neighbouring oil refineries.

transportation. While significant quantities are sent as a stream of "mixed natural gas liquids" from Alberta processing plants to Ontario via the Interprovincial pipe line, there to be again fractionated into discrete components, the bulk of western Canadian output reaches market by rail tank car. The relatively high cost of this method of transportation compared to pipe line shipment means that the value at the point of production is low compared to, for example, crude oil. Also, this value fluctuates much more than does that of crude oil because of the strong price influence of American markets where Canadian supplies tend to perform a balancing role and because the supply of liquefied petroleum gases is not price elastic. In total their supply is determined essentially by the production of processed natural gas, while individually they are available only in relatively fixed proportions to each other.

As production of propane and butane has increased, so export markets have had to absorb a growing proportion of output. Propane reaches the geographically widest markets of any Canadian liquid hydrocarbon. Tank car shipments reach eastwards into the New England states, southwards as far as Arkansas and California and a significant volume, about nine thousand barrels daily, has since 1967 been shipped by specialized tanker from Vancouver to Japan for use by a gas utility.

In terms of both volume and value the most important natural gas liquids are pentane and heavier hydrocarbons, also referred to as condensate. These compounds are liquids at normal temperatures and pressures. They are used almost exclusively as refinery raw material. Readily transportable by pipe line, they are shipped in solution with crude oil or in discrete batches in crude oil lines. Because of this low cost transportation, condensate can command a higher price at the point of production than the liquefied petroleum gases. Further, its use as an oil refinery feedstock means that its pricing is related to the stable crude oil price structure (see Appendix III-4).

b. Sulphur

The production of sulphur - a vital industrial raw material - from "sour" natural gas was started in the United States during the second World War as a means to develop a new source of high-purity sulphur and simultaneously to increase availability of sweet gas.

This technology has been widely applied in Canada where a high proportion of discovered natural gas resources are in the sour category making Canada potentially the world's largest sulphur producer. It has been estimated that the potential recovery of elemental sulphur from sour natural gas in Canada is twice as great as that of all sources of sulphur in the four other principal producing countries - France, Mexico, the Soviet Union and the United States.[1]

Canadian production of elemental sulphur is almost entirely from natural-gas processing and is concentrated in Alberta which currently accounts for ninety-eight per cent of the national total. Production has grown from about 8,000 long tons in 1952, when Shell Canada first applied the technology of sour gas treatment at Waterton, Alberta, to some four million tons annually. Canada is the world's leading producer of gas-recovered sulphur.

Exports in 1971 accounted for some two-thirds of sulphur production and the United States market

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[1]H.W. Manley, "The Sulphur Industry" in J.D. Hilborn, op. cit., p. 120.

absorbs nearly forty per cent of the exported volume but Canadian sulphur is also sold in twenty countries overseas, a striking contrast with the situation in respect of oil and gas where the southern neighbour provides virtually the only export market. Transportation is almost entirely by rail[1] from the gas plant to the point of consumption in North America or to tidewater for ocean shipment in the case of overseas exports.

International sulphur markets have been characterized by sharp fluctuations in price reflecting supply-demand imbalances. Consequently the value of marketed Canadian sulphur has varied widely, recent extremes in the annual average value of Alberta sulphur being $33.19 per long ton in 1968 to $5.71 per ton in 1972 (see Appendix IV-3). Year-end inventories in Canada of gas plant sulphur have varied from about one-third of annual production in 1967 to nearly two-thirds, some two and a half million tons, in 1970.

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[1]The feasibility of pipe-line transportation of sulphur granules suspended in oil is presently under investigation by Shell Canada and the Canadian Pacific Railway. A jointly-owned company, Shellpac, is examining the possibility of such a pipe line from Alberta to Vancouver.

Summary

The history of commercial development of Canada's natural gas resources encompasses a lengthy initial phase in which local supplies, sparse in Ontario but relatively abundant in Alberta, were dedicated essentially to local markets. This period, extending from the end of the last century until the mid-1950's, saw the development and application of government policies designed to protect Canadian gas requirements against the "pull" of export market demand.

These policies underwent some modification when it became apparent after 1947 that western Canada's natural gas resources were very large in relation to local needs. During the 1950's three major long-distance transmission schemes were implemented to ship Alberta gas west, east and south to domestic and export markets. The largest and longest of them, TransCanada, was notable for the extent of government assistance it received and the public debate which surrounded the granting of this help.

The 1960's saw rapid penetration by western Canadian gas of energy markets in Ontario and a striking increase in export sales. By 1971 the growth of demand and a disappointing gas discovery rate led the National Energy Board to conclude that Canada no longer had a surplus of gas to support exports beyond those already contractually committed.

Large volumes of liquids are produced in association with natural gas. Condensate, the heaviest of them, can be transported like crude oil and finds a steady market as a premium refinery raw material. By contrast, the liquefied petroleum gases, ethane, propane and butane, are more expensive to transport and, in the absence of a substantial local petrochemical industry, have to be shipped long distances, mainly to American markets. Market price fluctuations tend to be pronounced, and high transportation costs are reflected in low net-backs at the point of production. The international market for the by-product sulphur, of which Canada is the world's largest producer, is similarly subject to large price variations.

Chapter V

TECHNOLOGIES OF CANADIAN PETROLEUM EXPLORATION, PRODUCTION AND TRANSPORTATION

The history of Canadian petroleum provides an example of the key role which technology has often played in the conjuncture of circumstances leading to rapid natural-resource exploitation. As was the case with some of the great staples of the past, foreign know-how was dominant in Canadian petroleum resource development. This chapter briefly identifies some of the technologies that have been of critical importance and deals with their origin and their adaptation to Canadian conditions. It is based mainly on personal observation and on discussion with people in industry and government having particular knowledge and experience of the various phases of the petroleum business.

1. Exploration and Development

The first phase is the search for oil and gas in commercial quantities. In western Canada, petroleum exploration has been facilitated by the programs of geological mapping carried out for nearly one hundred years by the Geological Survey. The initial commercial geological and geophysical examination is usually done for the oil companies by contractors who start on the base provided by the Survey.

Once petroleum has been discovered, a program of development may be undertaken if market prospects look favourable. Development involves drilling wells to demarcate the boundaries of the field and to tap the oil or gas in it economically and efficiently.

Geology began to be applied to petroleum exploration in the late nineteenth century.[1] Geophysical exploration techniques were first used in the period between the two World Wars. The most important development of each of these twin tools of exploration took place in the United States, the home of the world's largest oil industry. Significant advances were also made in Europe,[2] by companies operating

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[1] An interesting and important early Canadian contribution to the science of petroleum geology was the "anticlinal theory of (petroleum) accumulation" postulated in the 1860's by T. Sterry Hunt, an assistant of Sir William Logan, first Director of the Geological Survey of Canada. Hunt's basic concept, an outcome of studies of seeps in the eastern Gaspé, was almost immediately applied to find new oil fields in southwestern Ontario and in Pennsylvania. See Gray, _op. cit._, p. 12 and Hilborn, _op. cit._, p. 102.

[2] The most important European development was that of electric well logging by Schlumberger in France during the inter-war period.

there and overseas. Finds of commercial gas fields and near-commercial oil fields in western Canada were made either by sheer good fortune or through surface indications of the presence of oil or gas underground: in the words of an outstanding Canadian petroleum geologist, "Up to that time (the discovery of Leduc) . . . it must be confessed that most discoveries made were accidents rather than scientific achievements".[1]

The first large, comprehensive scientific exploration effort carried out by the Canadian oil industry was mounted in southern Saskatchewan in 1939-40 and in central Alberta in 1945-47 by Imperial Oil. This effort of course culminated in the Leduc discovery of February 1947. The technology required for this program, involving preliminary surface geological structure drilling and gravity and seismic work, was almost entirely imported from the United States. The mode of its application on the Canadian Prairies was not substantially different from that employed in the broadly similar geographical circumstances of the southwestern United States.

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[1] J.C. Sproule, "Exploration and Discovery" in J.D. Hilborn, op. cit., p. 15.

The critical technology in the Leduc discovery was the science of seismography[1] which, as applied to oil exploration, was then about twenty years old. Without this technique of identifying sub-surface anomalies having petroleum potential, it would simply not have been possible to locate, on a scientific basis, the great bulk of western Canadian oil and gas fields of which there are no surface indications. For this reason alone, large-scale development of the western Canadian petroleum industry could not have occurred much earlier.

The development of geophysical exploration methods took place outside this country. This is hardly remarkable in view of the small size of Canada's oil and gas industry between the world wars. Geophysical technology has been imported by Canadian petroleum companies of all kinds - "independents" as well as affiliates of international companies. The demand for geophysical services has been met either

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[1] Ibid.

through inter-affiliate oil-company channels or through foreign service-companies, many of which have established Canadian subsidiaries. While this service field is still dominated by American-owned companies (such as Dresser Olympic and Geophysical Services Incorporated) there have been notable cases of European initiative (Compagnie Générale de Géophysique and Schlumberger) and of native Canadian enterprise (Kenting Earth Sciences). In almost all cases, the equipment used is found to have been developed abroad but methods of applying it to Canadian conditions have of course been developed locally.

While geological activity in the actual search for petroleum has been exclusively the preserve of private groups, it is difficult to overestimate the role of the Geological Survey of Canada in providing a most extensive geological background for petroleum exploration.[1] The experience and capability of this old-established federal service, which pre-dates Confederation (1842), was of material assistance to the

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[1]H.R. Belyea and others, "The Geological Survey of Canada and the Oil Industry", in Hilborn, op. cit., pp. 99-104.

oil industry, in that its mapping of rocks and structures provided the essential data on which company geologists could base their search for petroleum. In addition, the Survey's library of well cuttings, thought to be the most complete of that of any country in the world, is another example of this inter-play. Without the Survey's long experience in basic geological research and without the services it has been able to provide the companies, the petroleum development of the past quarter century could not have proceeded so rapidly.[1]

2. Production

The second step in the petroleum business is the production of oil and natural gas.

This involves procedures to recover the maximum amount of oil or natural gas from underground reservoirs and to render these products suitable for

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[1]Although the subject of this chapter is technology, it is convenient to refer here to other government services which have facilitated the search for and development of Canadian petroleum resources. These range from the provision of topographical maps and access roads to airports, aerial navigation aids, icebreaker assistance for Arctic shipping and river transportation services on the Mackenzie.

transportation, generally by pipe line, to the intermediate markets represented by oil refineries and gas utilities.

Natural gas, whether produced in conjunction with oil or from wells yielding gas alone, requires treatment in gas plants to remove the natural gas liquids - propane, butane and pentanes (see pp. 124-128). The "dry gas", consisting mostly of methane, is then ready for pipe line transmission to market. Natural gas liquids are transported and marketed separately.

Optimum recovery of petroleum from the producing formation frequently requires artificial pressure maintenance, an operation involving the injection of water, gas or chemicals.

The basic production technology of well-drilling by means of rotary equipment which was applied in Canada after the second World War had been developed mainly in the United States and was well-established there.[1] It was imported to Canada by contractors, both

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[1]A notable post-war development of drilling technology in the Soviet Union was the "turbo-drill" in which the bit is driven by a motor which goes down with the bit. In conventional oil-well drilling the bit is driven from the surface by the "string" of drill-pipe with consequent high friction losses, particularly in deep wells. Turbo-drilling technology has however not proven suitable to Canadian circumstances.

Canadian and foreign. Drilling technology has not required to undergo particularly significant development or adaptation for use in western Canada.[1]

The technologies required to optimise recovery of oil or gas and to handle and store it after production are equally of foreign origin. Even their application to Canadian circumstances has sometimes been researched abroad by parent companies and consulting engineering firms, mostly in the United States but also in France and the Netherlands. Canada however has been the scene of important adaptation of processes developed in the United States during the war to handle "sour" natural gas (see pp. 128-129). In no other country are such gas resources so important proportionately or in volume terms. Even so, the bulk of Canadian sour gas could not have been developed commercially as they have been since the mid-1950's without the adaptation and application of foreign-developed processing technology.

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[1]A comparatively recent Canadian adaptation, which may be of future significance if the Arctic regions prove to contain large commercial petroleum resources, is the fully air-portable drilling rig.

While the exploration, development and production technologies critical to Canadian petroleum resource development originated outside Canada, it should be noted that their application in northern parts of the western Canadian oil province has been facilitated by Canadian-developed techniques of overland access and of year-round field work. For example, movement over unfrozen ground in the heavy muskeg areas of Rainbow and Zama Lakes in the extreme north of Alberta, where important oil and gas discoveries occurred in the late 1960's, was made possible by use of the "Foremost" and "Flextrac Nodwell" range of low ground-pressure vehicles designed and manufactured in Calgary. Tracked vehicles developed by the Bombardier company have also played an important role in difficult terrains. Similarly, Canadian-developed prefabricated air-transportable modular buildings made by Atco Industries have facilitated exploration and development work in remote areas. Canadian companies have pioneered many uses of helicopters in oil exploration and development. It is of interest to note that "Foremost" vehicles and "Atco" buildings have attracted the commercial interest of the oil industry in the Soviet Union, while Canadian techniques of "winterizing" drilling equipment have been extensively used on the North Slope of Alaska.

3. Transportation

Long-distance pipe lines provide the essential means of transportation for all Canadian natural gas and for the great bulk of Canadian crude oil and natural gas liquids.

The relevant technology involves the construction of large-diameter welded steel pipe lines capable of operating at high pressures and protected against corrosion to ensure safe operation and a reasonable life expectancy even when they are laid in unfavourable conditions of swamp or muskeg. This technology was developed largely in the United States during the 1930's and applied there on a major scale in the next decade. Oil from Texas was piped to New Jersey from 1943 onwards to avoid the submarine hazards of the coast-wise movement from the Gulf of Mexico. Texas natural gas reached California in 1945 and in 1959 a natural-gas pipe line was built from the Texas Gulf of Mexico coast to New York City.

Pipe lines were largely unknown in Canada when the Leduc discovery was made and American technology was essentially responsible for the design of the first major Canadian oil pipe line systems. The Trans Mountain pipe line (see pp. 157-161) was designed in the United States and built by the Bechtel Company of San Francisco. The first Interprovincial pipe line from Edmonton to Superior, Wisconsin, (see p. 54) was designed in Tulsa, Oklahoma, by an inter-oil-company consortium and built largely by American contractors. These circumstances were broadly repeated with the design and construction of the major long-distance Canadian natural gas transmission systems in the late fifties and early sixties.

Less in the way of adaptation to Canadian circumstances was seemingly required in the case of pipe line technology than for exploration, development and production. A notable exception was the use of gas turbines to replace electric and internal combustion prime movers to power gas pipe line compressors. This development, in which Orenda Engines played an important role, was not however of critical importance for natural-gas resource development.

Summary

Technologies of geophysical exploration, rotary well-drilling, sour-gas processing and long-distance pipe line transportation of oil and gas were critical to the large-scale commercial exploitation of western-Canadian petroleum resources. These technologies were developed between ten and thirty years prior to the 1947 Leduc oil discovery. Their development took place outside Canada, mainly in the United States. Oil companies doing business in Canada and companies supplying services to them imported these technologies to Canada where adaptations to local conditions took place. An outstanding Canadian contribution was in the technology of overland access to remote petroleum areas in northern parts of Alberta and British Columbia.

Chapter VI

SOURCES AND TYPES OF ENTREPRENEURSHIP IN CANADIAN PETROLEUM RESOURCE DEVELOPMENT

Entrepreneurship can be defined as "the undertaking of business activity, including the taking of business decisions, in the face of uncertainty"[1]. The uncertainty characteristic of petroleum exploration has been a dominant problem faced by enterprise in this industry.

The entrepreneurship that has typically been responsible for development of western Canadian petroleum resources has, with the possible exception of Mr. R. A. Brown's Home Oil Company (see p.147 and pp.155-157), been that of corporate managements rather than of the classical individual entrepreneur. In this respect, the industry has degenerated in Schumpeterian terms from the stage of rugged individualism in entrepreneurship to a stage where control is in the hands of hired managers. The loss of vitality which, in Schumpeter's theory of capitalist development[2], accompanies this process, is not evident in the case of the Canadian petroleum industry.

1. A Representative Sampling of Entrepreneurship in Canadian Petroleum

Examples of successful entrepreneurship in the Canadian petroleum business are presented in the following paragraphs. While each is necessarily distinct, they are, in this student's observation, broadly representative of major sources and types of

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[1] J.F. Due and R.W. Clower, Intermediate Economic Analysis (Homewood, Ill.: Richard D. Irwin, 1961, p. 7. Similar ideas could be found in almost any textbook on economic analysis.

[2] Joseph A. Schumpeter, Capitalism, Socialism and Democracy (New York: Harper and Bros., 1952).

entrepreneurship characteristic of the Canadian petroleum industry since the second World War.[1] Thus:

a. (i) The experience of a multi-national company's long-established Canadian subsidiary, locally managed and financed and having a significant Canadian minority shareholding, as typified by Imperial Oil, is broadly-similar also for such companies as Gulf, Shell and Texaco Canada.

(ii) The successful branch-operation which has grown into a large but still completely foreign-owned Canadian subsidiary company, here represented by Mobil Oil Canada is repeated by companies like Amoco (Standard Oil of Indiana), Chevron (Standard Oil of California) and

[1]To make an exhaustive survey of corporate activity, unsuccessful as well as successful, would be a task outside the scope of this thesis since hundreds of companies are active in the business of exploring for, producing and transporting oil and gas in Canada while thousands must have been so engaged during the past twenty-five years. The method of example is therefore followed here.

Cities Service and Texaco Exploration.[1,2]

(iii) Home Oil is taken as representative of independent Canadian entrepreneurship, initially successful but which, lacking the resources to maintain its growth, came under the control of a financially more capable company; Banff (bought out in 1968-70 by the French Aquitaine company); Central Del Rio (merged with Canadian Pacific Oil and Gas in 1971) and Triad (taken over by the British Petroleum group) furnish other examples of such a pattern.[1]

b. As to entrepreneurship in petroleum transportation,

(i) Trans Mountain's experience in the

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[1]In Appendix VI-1 an attempt is made to group companies, accounting for nearly 70 per cent of western Canadian oil production, according to the nature and extent of the external ownership-control to which they are subject.

[2]Texaco Incorporated of New York has two Canadian subsidiary companies, Texaco Canada (68 per cent Texaco owned) and Texaco Exploration (wholly owned). The latter company is engaged only in exploration and production operations. Texaco Canada is active in refining and in oil products marketing as well.

field of crude oil transportation is not dissimilar from that of the Interprovincial Pipe Line Company in terms of oil-company sponsorship and initial financial and technical backing.

(ii) The history of TransCanada PipeLines finds some points of similarity in that of Westcoast Transmission, the other major Canadian long-distance gas transmission company.

These five "sample" enterprises are examined as to sources and types of entrepreneurship in terms of project initiatives, managerial and technical advice and financing.

a. (i) <u>Imperial Oil</u>

Imperial is the prototype of the large, integrated, locally-managed, foreign-owned Canadian oil enterprise. The company had been formed in 1880 by a group of London, Ontario, businessmen to buy, refine and market oil from the fields of the southern part of the province (see pp. 42-43). By the mid-1890's Imperial faced severe competition from American oil companies, both in the buying of crude abroad and in the sale of products at home, and was badly short of money for expansion. Capital was sought unsuccessfully in Canada and Britain and in 1898 a controlling interest in the firm was sold to Imperial's principal competitor, John D. Rockefeller's Standard Oil Company.[1] In 1911, as a result of United States anti-trust legislation, the Rockefeller oil interests were broken up into more than thirty companies. The largest of these, the Standard Oil Company of New Jersey (The Exxon Corporation[2]), obtained the Standard Oil share of about 70 per cent in Imperial Oil's stock, a proportion which has remained unchanged.

Over the years Imperial has become Canada's largest company of any kind. Its operations extend to virtually every part of the country. With the exception of Bell Canada, its shares are the most widely held of any corporation operating in Canada.

Imperial's management, always overwhelmingly native-born Canadian, has strenuously maintained that, thanks to the Jersey group's application of the principle of decentralized management, its policies

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[1]In this respect, Imperial's early history is characteristic of the companies classed under heading a.(iii), see p.147.

[2]"Exxon" is both the new corporate name and the new world-wide trade mark of the Standard Oil Company of New Jersey. The old trade mark, and the one still used in Canada, is of course "Esso".

and actions are determined by Canadian conditions and interests.[1] The company claims that it is free to pursue energetically the opportunities in its field without the introduction by its principal shareholder of any external objectives.[2]

While Imperial's direction was, and is, in the

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[1]Imperial Oil Limited, Submission to the Royal Commission on Energy, May 1958, p. 4.

[2]It has been said that "Imperial . . . must be rated as representing the highest degree of responsiveness to Canadian sensitivity in that all of the Winters' [Federal Government's] Guidelines . . . [on foreign ownership] . . . were apparently satisfied". See I.A. Litvak, C.J. Maule and R.D. Robinson, Dual Loyalty - Canadian-U.S. Business Arrangements (Toronto: McGraw-Hill Company of Canada Ltd., 1971), p. 139.

hands of its Canadian management, circumstances arise where, unsurprisingly, recourse is had to technical advice of the Jersey group. One such occasion was the "final" review in 1946 of the western Canadian exploration scene before Imperial committed itself to the large-scale synthesis of gasoline from natural gas. A group of eighteen senior advisors, including the most experienced geologists of the parent company, reviewed geological prospects on a Canada-wide basis and decided on one last "play" in central Alberta.[1] This led to selection of the Leduc location for what turned out to be the discovery well.

Imperial had spent heavily on unsuccessful exploration activity in western Canada before Leduc. Between 1917, when its first Alberta wildcat was drilled, and 1946 it had drilled 133 dry holes and spent $23 million, more than half of it in the 1939-46 period. Imperial's established oil importing, refining and marketing operations had however provided funds

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[1]While this review was based on "imaginative geological thinking", later knowledge of the western Canadian sedimentary basin is said to have "largely demolished the theory" which led to selection of the central Alberta drilling targets. In other words, Imperial's advisors were right, but for the wrong reasons. See Gray, <u>op. cit.</u>, p. 101.

sufficient to finance these expenditures. Capital requirements for commercial development of the Leduc and subsequent discoveries were much greater. Imperial had been for many years headquarters and majority shareholder of the International Petroleum Company, operating crude oil production and exploration in South America. The discovery at Leduc held the prospect of reduced Canadian dependence on imported crude oil and greatly-increased capital requirements at home. In these circumstances Imperial sold its International Petroleum holdings to its parent company in order to help finance its development of western Canadian crude oil supplies.[1]

Imperial has remained the largest producer of Canadian crude oil since 1947; by contrast its role in natural gas production has been a relatively small one. In the face of severe competition representing the bulk of the international oil industry, Imperial has retained the leadership established by its discoveries of the late 1940's. Its technical capability has been progressively improved although understandably recourse

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[1]Imperial Oil, op. cit., p. 5.

is still had to the technical advice, based on world-wide experience, available from the parent. Imperial's managerial talent is probably among the best in the country and it has enjoyed the financial backing of the Jersey (Exxon) group directly, in that the parent has taken up most of the two new stock issues made since the war,[1] and indirectly in that the Jersey (Exxon) connection has given Imperial's bond issues a "gilt-edged" flavour. All this has been achieved with a personnel which is overwhelmingly Canadian. Indeed Imperial has supplied the Canadian-born present Board Chairman of the Exxon Corporation, J.K. Jamieson.

(ii) Mobil Oil Canada

Mobil is the third-largest (after Imperial and Gulf) producer of Canadian oil and was the company which discovered Pembina, Canada's largest oil field and the third biggest in North America in terms of the amount of oil originally in place.[2]

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[1]Standard Oil of New Jersey has subscribed to these stock issues in proportion to its shareholding in Imperial in order to maintain its equity position in the subsidiary company.

[2]The following paragraphs are based in part on Gray, op. cit., pp. 106-116, "Discovery of Pembina".

When the Pembina field was discovered in 1953, Mobil, one of the largest American oil companies, through a "Canadian division", ran a "branch-plant" type of operation which was common in the early years of the western Canadian oil boom. The decision to drill the discovery well was taken in Mobil's (then Socony Vacuum) New York headquarters. The technical advice regarding the location and geological "target" for the well was provided from the company's small Edmonton office headed by a young Canadian geologist, A.R. Nielsen, who was then less than three years out of university. The prior-organization of the particular exploration effort had been handled jointly by the Calgary, Edmonton and New York offices, negotiating for access to 100,000 acres of Alberta government reservation rights held by the Seaboard Oil Company of Delaware. Financing was presumably no great problem despite the $200,000 cost of the venture since Mobil's Canadian operations were conducted as part of its much larger United States domestic activities with an exploration budget running into tens of millions of dollars.

The entrepreneurship involved a blend of American capital and Canadian technical skills. The willingness of the parent company to back the judgement of its small and inexperienced Canadian staff is striking. Without such support in terms of funds and organization to acquire the land and drill the well these skills might well have been wasted. In the event they were effectively organized and supported by the parent company and continue to be so used. The branch operation has become Mobil Oil Canada of which Nielsen is now President, although the shares are entirely in parent-company hands. Mobil has had considerable subsequent success in areas as far apart as Rainbow Lake in northern Alberta and Sable Island off Nova Scotia where in 1970 Mobil made what may prove to be the first commercial petroleum discovery on Canada's continental shelf.

(iii) Home Oil Company[1]

Home was the largest Canadian independent oil company prior to its being brought under the control of the Consumers' Gas Company of Toronto in 1971.

Home was formed in 1925 to exploit the Turner

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[1]This section is based largely on Gray, op. cit., pp. 233-237 and on Charles S. Lee, "The Canadian Independents", in Hilborn, op. cit., pp. 53-60.

Valley gas-condensate field and in 1936 discovered the crude oil reservoir there (see pp. 49-50) through the medium of Turner Valley Royalties in which Home's principal shareholder, Robert A. Brown, Sr., was the prime mover. Revenues from its share of Turner Valley production provided a solid financial base which was enlarged by purchase in 1947 of Imperial's interest in Turner Valley and by Home's ownership of a producing property in the Redwater field. Five major oil discoveries were made by Home in Alberta during the 1950's. The company was also responsible for an important gas find and after 1957 Home purchased a large interest in TransCanada PipeLines. Also, it was the organizer and principal shareholder in two Alberta oil pipe line systems.

Home's management in the post-war years was dominated by the founder's son and principal shareholder, the late Robert A. Brown, Jr.. He enlarged the company by a series of bold acquisitions and seems to have had personal responsibility for most of its important successful decisions as well as for later mistakes. Brown succeeded in attracting innovative technical assistance from within Canada and from abroad and Home pioneered exploration activity based on exhaustive independent regional geological studies instead of merely following in the footsteps of the major companies. Home's financial resources were based on a substantial cash flow from successful production operations. Also the company was the first in western Canada to borrow extensively from commercial banks against future oil production.

During the 1960's Brown sought to diversify Home's operations into exploration for metallic minerals and marketing of natural gas liquids in the United States. Petroleum exploration was initiated in the United Kingdom, where a gas discovery was made onshore and large exploration acreage obtained offshore, and in Alaska, where Home undertook expensive drilling commitments in order to earn a share of mineral rights on the North Slope where the Prudhoe Bay field had been discovered in 1968.

These activities resulted in Home's becoming financially over-extended and control of the firm passed to Consumers' Gas in 1971.

b. (i) Trans Mountain Oil Pipe Line Company

Trans Mountain, established in March 1951, was the builder of the first and still the only commercial oil pipe line to cross the western Cordillera of North America.

It remains the owner and operator of that line which was brought into service in October 1953 and currently transports about one-quarter of Alberta's oil output. The 719-mile transportation link from Edmonton to Vancouver, with a spur pipe line across the international boundary to serve refineries on Puget Sound was built in one stage at a cost of some $93 million. By contrast the Interprovincial Pipe Line Company's facility from Edmonton to Superior, Wisconsin, a distance of well over 1,000 miles built in several stages, cost about $100 million: the difference in unit cost is largely attributable to the much more difficult terrain which Trans Mountain had to cross.

The Trans Mountain project was initiated by Canadian and United States oil companies with production in Alberta. They asked Bechtel Corporation of San Francisco whether it would "care to bring together the elements of the industry interested in such a project".[1] Bechtel agreed and undertook

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[1]Neill C. Wilson and Frank J. Taylor. The Building of Trans Mountain (Vancouver: Trans Mountain Oil Pipe Line Company, 1954), p. 3.

engineering studies and reconnaissance of alternative routes while the Stanford Research Institute carried out a series of economic evaluations.[1] Other studies were carried out by four committees of oil company executives following a meeting held in New York in February 1951 of representatives of Bechtel, Stanford Research Institute, two American financial houses and seven oil companies.[2] Of these seven, only three were Canadian even though the pipe line would initially serve a Canadian market with Canadian oil. Of these Canadian companies, only one, British American Oil Company Limited, was Canadian controlled.[3] The Steering Committee was composed half of American and half of

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[1]Stanford Research Institute. Economic Aspects of a Crude Oil Pipe Line - Edmonton, Alberta, to Vancouver, British Columbia (Menlo Park, California: Stanford Research Institute, March 1954). Subsequent reports dealt with California crude oil supply and demand (April 1951) and oil reserves in western Canada (November 1951).

[2]British American (now Gulf Oil Canada), Imperial Oil, Shell Oil of Canada (Canadian companies) and Gulf Oil Corporation, Socony Vacuum, Standard Oil of California and The Texas Company (United States companies).

[3]British American merged in 1955 with Canadian Gulf and in 1968 the organization, then 69 per cent owned by Gulf Oil Corporation of Pittsburgh, became Gulf Oil Canada Limited.

Canadian company representation. A majority of the members of the Economics, Engineering and Reserves Committee members was from the American companies.

Financing of the project was arranged early in 1952. Six major oil companies, four of them Canadian subsidiaries of foreign firms[1] and two of them American-based enterprises,[2] subscribed 670,000 or 44.7 per cent of the 1,500,000 ten-dollar shares then issued. These principal oil company shareholders in effect guaranteed the interest payments on the initial issue of first mortgage bonds subscribed in the United States ($35 million) and Canada ($30 million). These bonds supplied 78 per cent of the $84 million initial financing of the project.[3] Fourteen Alberta oil-

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[1]Canadian Gulf (which later absorbed British American), Imperial Oil, Shell Oil of Canada and Standard Oil of British Columbia (a subsidiary of Chevron Standard) took 130,000 shares each. All four companies, or their affiliates, were major Alberta oil producers. All but Canadian Gulf had refineries in the Vancouver area.

[2]Richfield and Union Oil of California, principal oil companies on the United States west coast but small Alberta producers and without refinery capacity at Puget Sound, took up 50,000 and 100,000 shares respectively.

[3]A large proportion of fixed-interest funding is a characteristic feature of oil pipe line financing.

producing companies were offered, and purchased, 250,000 shares, 16.7 per cent of the total.[1] The balance of 580,000 shares, 38.6 per cent of the total, was sold to the public.

The initiatives for the inception of the Trans Mountain pipe line project were taken very largely by foreign oil companies, directly through Canadian subsidiaries. The expertise they mobilized came from these oil companies themselves, from a very experienced American construction company and from a United States research institute. The major oil companies accepted most of the risk by providing the largest part of the equity and, more important perhaps, by guaranteeing the loan capital. When Trans Mountain reached the operations stage, the major oil company shareholders or their parents developed an appropriate organization by lending experienced personnel from their United States operations and by training in that country the Canadian personnel, only one in one hundred and fifty of whom had important previous pipe line experience.[2]

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[1]Shares were allocated among the applicants, but according to Wilson and Taylor, op. cit., p. 31, "all obtained substantially as much equity as they wanted".

[2]*Ibid.*, p. 56.

(ii) TransCanada PipeLines[1]

TransCanada, incorporated in April 1951, was the builder between 1956 and 1958 of a transmission system for the transport of Alberta natural gas to markets in Saskatchewan, Manitoba, Ontario and Quebec (see pp. 115-117). At the time of its construction, this system was the world's largest to have been built in one stage. It incorporated some important technical advances of which perhaps the most notable was the use of gas turbines to power the pipe line compressors. TransCanada's capacity has been expanded progressively in the last fifteen years and important export components added to the system. It has become the most important artery for the interprovincial and international movement of western Canadian gas, accounting for about half of such movements.

The project for an Alberta to Ontario gas pipe line was first conceived in 1930 by a Belgian-born Canadian mining engineer named Bilterijst. This scheme was outlined in a letter to Premier Brownlee of Alberta a year before the first American long-distance gas pipe

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[1]This section is based substantially on William Kilbourn, *op. cit.*

line was built between Texas and Chicago. However it seems doubtful whether the technology was then available to build Bilterijst's much longer line over far more difficult terrain.

Twenty years later two rival groups were developing proposals for the eastward movement of the Alberta gas, which had been discovered in large volumes since the Leduc oil find, the removal of which the Alberta government was shortly expected to sanction (see pp. 111 and 114). Western Pipe Lines, composed of the heads of three leading financial houses[1] and a major gas-distribution utility[2] had a project to pipe gas to Winnipeg and intervening urban markets on the prairies, and thence to export markets in Minnesota and neighbouring areas.[3] An American promoter named Murchison with a long background of experience in

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[1]Osler, Hammond and Nanton of Winnipeg; Wood Gundy of Toronto and Nesbitt, Thomson of Montreal.

[2]International Utilities of Edmonton.

[3]The possibility of building the pipe line across the Canadian Shield had been examined but rejected on the grounds that it would make the project impossible to finance.

United States gas production and transmission industry had a project to ship Alberta gas to Toronto and Montreal via an all-Canadian route.[1] This project of TransCanada PipeLines was pursued much more vigorously than the rival Western Pipe Lines scheme. It held the advantage of not being contingent on United States regulatory approvals. And it accorded with the Canadian government's national gas policy (see Appendix IV-1). There was room for only one major eastward gas transmission line and in early 1954 the rivals were forced to merge by C.D. Howe, the powerful Minister of Trade and Commerce.

The managerial and technical skills which were employed by TransCanada in bringing this initially-American enterprise to fruition were again largely obtained south of the border. An exception was the company's first president, Eldon Nathan Tanner, a former Alberta mines minister and later president of

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[1]No other route was ever proposed by TransCanada: the all-Canadian route was, Kilbourn says, "the essence of their policy" (Kilbourn, op. cit., p. 29). Nevertheless when the bill to incorporate the pipe line by Special Act was being discussed in the House of Commons, a rider was added stating that "the main pipe line or lines shall be located entirely in Canada".

a small American-backed Alberta oil and gas company, Merrill Petroleums. The executive vice-president during the critical phase of planning and construction was one Charles Coates who was recruited from a similar position with Tennessee Gas Transmission, the world's largest company in the field. Many of the technical staff down to the level of compressor-station operators were recruited in the United States, mostly on the basis of short-term contracts. External technical advice was supplied by Bechtel-Mannix-Hester, a company created specifically for the TransCanada project by three international design engineering firms. As had been the case with Trans Mountain, the line pipe for the project was manufactured in the United States and most of it was laid by American contractors.

The TransCanada project involved financing on a larger scale than Trans Mountain and posed much greater difficulties for its financially less-powerful promoters. Of the total initial cost of $370 million, $120 million was covered by construction of the line in northern Ontario by the Northern Ontario Crown

Pipe Line Corporation[1] (see p. 115). The sponsors of the project had already expended $16 million out of their own resources before construction was commenced. Some $124 million was raised by debentures and of this amount $34 million was sold in Canada, the balance being obtained in the United States, including $40 million from the Metropolitan Life Insurance Company, $20 million as a loan from a consortium of New York banks[2] against the security of an equal amount of TransCanada bonds and $9 million was put up by three American-controlled Canadian gas-producing companies which were to obtain some of TransCanada's equity.[3] The balance of about $21 million was taken by smaller institutional buyers in the United States.

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[1]This line was purchased from the Federal Government by TransCanada in 1963. It had been leased to the company on the basis of the Federal Government's borrowing rate plus one per cent. The Government also provided an $80 million short-term loan at the same interest rate in 1957-58.

[2]Canadian banks - the Royal and the Bank of Commerce - loaned TransCanada 50 per cent of the cost of constructing its Toronto to Montreal pipe line.

[3]Canadian Gulf (see footnote 3 on p. 159), Hudson's Bay Oil and Gas (see Appendix VI-1) and Tenneco Limited (Tennessee Gas Transmission). Kilbourn, op. cit., pp. 148-149.

The junior financing, equity and debentures, was set at $110 million, later increased by $2.5 million to cover possible extra construction costs. $81.25 million of the units (each $150 unit comprised a $100 debenture and five $10 shares) was made available in Canada and $31.25 million in the United States. The junior securities were offered in early 1956 in the wake of the successful bond financing. Special efforts were made to ensure a broad distribution and by the closing date allotments had been made to 35,000 individuals and corporations. In the history of financing in Canada this represented the largest number of individual shareholders to whom a new issue had ever been allotted. The sources of funds for TransCanada's initial financing are outlined in Table 5.

TABLE 5

SOURCES OF FINANCING FOR TRANSCANADA PIPELINES' INITIAL CONSTRUCTION, ALBERTA TO ONTARIO LINE

(millions of dollars)

Northern Ontario Crown Pipe Line Corporation (Federal)		120
Debentures (sold alone):		
in Canada	34	
in United States	90	
total	124	124
Equity and Debentures (sold together)		110
Pre-construction expenses, met by sponsors		16
		370

As a result of this operation, a substantial majority of TransCanada's stock has been in Canadian hands from the outset. This proportion had grown over time as the holdings of three American-owned gas producing companies - Canadian Delhi (then Murchison's company), Canadian Gulf and Hudson's Bay Oil and Gas - have been sold off. Presently the largest single blocks of shares are believed to be held by Home Oil and by the Power Corporation.

To conclude, the initiative for the TransCanada project was in the first instance a foreign one to which, as a result of federal government intervention, powerful Canadian support was given. The technical and financial expertise mobilized by the initiators of the project of necessity came mainly from the United States, but the risk capital for the venture was provided largely from Canadian sources, including a substantial direct contribution by the federal government. It is fair to add that from these partly foreign-origins has grown a large, technically proficient and financially successful natural gas transmission system now under Canadian managerial and financial control.

2. Conclusions on Entrepreneurship in Canadian Petroleum

The dominance of the foreign element in terms of project initiative and the assumption of financial risk is the striking feature of post-war entrepreneurship in the Canadian petroleum industry. The vehicle of such entrepreneurship has generally been the foreign direct investment company[1] rather than the individual entrepreneur. Foreign dominance reflects in part historically liberal policies of Canadian governments, provincial as well as federal, towards foreign investment and the other attractions of the Canadian business environment - similarity of language, common business practices, freedom of international financial transactions and, of course, geographical proximity. In part also it reflects the advanced stage of development of the petroleum industry abroad relative to that in Canada at the time the key petroleum discoveries in the western prairies were made. While supplying initiative and taking risk, the foreign investment company appears frequently to have skilfully mobilized and developed Canadian managerial capability and to have tapped Canadian financial resources for a proportion of capital requirements, frequently by means of fixed-interest securities. Canadian entrepreneurship has generally played a secondary role.

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[1]The foreign company which invests directly in Canadian branches, subsidiaries and controlled companies and to which the management of such Canadian operations is answerable, see pp. 197-198.

Rapid expansion and a resultant capital shortage together with a run of poor decision-making have resulted in some "independent" Canadian petroleum companies losing their independence to financially and/or technically stronger entities, often foreign-owned.

Summary

The five brief corporate case-studies presented highlight aspects of entrepreneurship in the Canadian petroleum industry. The first really large oil discoveries in western Canada were made in 1947-49 by Imperial Oil, the long-established, financially and technically competent affiliate of the Jersey Standard (Exxon) group which supplied technical advice for the crucial exploration effort and financial support for the subsequent expansion of operations. Mobil Oil later discovered the very large Pembina oil field through an imaginatively-run Canadian branch operation which was then heavily dependent on the parent for technical, managerial and financial support. The leading Canadian "independent" petroleum company, Home Oil, grew and prospered through a combination of entrepreneurial ability and technical pioneering but became financially over-extended as a result mainly of ambitious exploration ventures abroad and was "taken over" by a major Canadian natural gas distributor. The Trans Mountain oil pipe line project was initiated by American or American-owned companies operating in Canada and carried out on the basis of imported management and technology but drawing heavily on Canadian financial sources. American initiative was prominent too in the case of TransCanada PipeLines but vigorous federal policy forced rival Canadian and American entrepreneurial groups together and, although management and technology was necessarily in large part imported, financing was handled in such a way that a majority of the equity capital was raised in Canada. The examples of entrepreneurship considered in this chapter are almost all cases of foreign-owned or controlled firms. The general dominance of foreign entrepreneurship in Canadian petroleum development can be attributed to Canadian political and business environments generally favourable to foreign investment and to the strength of the foreign oil industry as compared to the Canadian industry in the early post-second World War period.

Chapter VII

DETERMINANTS OF CANADIAN PETROLEUM RESOURCE DEVELOPMENT - EXPENDITURE REQUIREMENTS, SOURCES OF FUNDS, OWNERSHIP AND CONTROL OF ASSETS

This chapter deals in aggregate terms rather than by example with other important aspects of corporate activity in western Canadian petroleum resource development, namely the character and amount of expenditures; sources of capital, with special reference to the experience of a group of eight companies during the 1960's; the changing pattern of ownership, by nationality, of invested capital and, finally, the matter of "control".

1. Objects, Characteristics and Amounts of Petroleum Industry Expenditures[1]

The development of western Canadian petroleum resources to the point where crude oil and natural gas are delivered by trunk pipe lines to oil refineries and gas distribution systems necessitates expenditures in three main areas of activity: exploration and

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[1]The expenditures referred to in this section include: those incurred in survey work, acquisition and rentals of mineral rights (but not royalty payments on oil and gas production); well drilling and the equipment of successful wells (but not the costs associated with operation of wells); and construction of natural-gas processing plants, secondary recovery projects and pipe lines (but not the costs of operation of these).

development; production; and transportation, almost entirely by pipe line.

Exploration and development activity is concerned with the discovery of oil and gas in commercial quantities and the proving up of such finds by further well-drilling. Thus, geological and geophysical examination, if it yields encouraging results, leads to the lease of sub-surface mineral rights, generally from the provincial crown. Exploration drilling can then take place and if a discovery is made, development drilling follows to delineate the find and add the necessary number of wells to produce the oil or gas in the pool.

Production expenditures are those concerned with the recovery of the maximum amount of oil or gas from underground reservoirs and to render these commodities suitable for pipe line transportation. Production equipment, valves, pumps and the like, is installed on the wells. Optimum recovery often requires artificial pressure maintenance or "secondary recovery", involving the injection of water, gas or chemicals. Equipment has to be installed to separate gas from the crude oil. Gas treatment plants are built to remove sulphur and natural gas liquids.

Finally, expenditures have to be made on oil and gas pipe line facilities, which include the pipe itself, pumping and compressor stations and, in the case of oil, storage at terminal and intermediate points.

a. Exploration and Development

The outstanding characteristic of petroleum exploration is the degree of uncertainty entailed.[1]

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[1]It may be argued that the statistical probability of success in exploration drilling (see Appendix VII-1) imparts a degree of certainty to this phase of the business. This argument has some validity in the case of operations by the largest companies, which each drill dozens of exploratory wells a year. However the western Canadian industry's "success ratio" of about one in fifteen has been established by drilling thousands of wells over a period of some twenty-five years. There are big year-to-year fluctuations in the success ratio and significant differences in the size of finds attributable to particular exploration wells. The latter point is important. In the period 1947-1970, 1,841 oil and gas fields were discovered in western Canada. But the 889 fields which each contained more than one million barrels of crude oil equivalent accounted for 98.6 per cent of the oil and gas found. And the 81 fields which each held more than fifty million barrels equivalent accounted for 72.5 per cent of the oil and gas which has been discovered. Profitable operation requires not merely the discovery of oil but also of a proportion of the significant finds in terms of field size. It may be worthwhile to produce oil from even very small discoveries because operating costs can be covered and some contribution made to recovery of exploration costs, but major finds are needed to reward a large and sustained exploration effort. Not all companies enjoy success in this respect. For example, British Petroleum and Shell each have a fairly long history of activity in the western Canadian industry. Their exploration drilling seems to have encountered average success, but neither has ever found a large oil field.

For example, prior to 1947, 567 exploratory wells were drilled in Alberta, of which only 27 found oil and 48 discovered gas.[1] Data illustrating the factor of uncertainty in western Canadian petroleum exploration 1947-1970 are presented in Appendix VII-1.

A second and related characteristic is the large minimum expenditure which must be incurred by the firm. The cost of a modest program of geological and geophysical exploration in the Alberta foothills can run into hundreds of thousands of dollars and the drilling of one exploratory well in a remote location of western Canada may cost in excess of a million dollars.

The combination of risk and high initial cost has led the industry to devise means to share uncertainties and expenses by a variety of joint-venture arrangements into which even the largest companies enter. However - and this is an important point in the context of the present study - large companies which enjoy a strong financial position based on successful, established operations have a

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[1]Hanson, op. cit., p. 33.

better chance of long-run success in oil exploration and development than do small concerns formed to participate in exploration activity in one area alone. Diversified exploration programs, which large companies can undertake, help to spread risks. Moreover, their financial strength enables them to persevere if initial exploration efforts are not attended by success leading to a cash flow from the production and sale of oil and gas.

Exploration and development expenditures, which have historically accounted for about three-quarters of total petroleum extraction industry expenditures in western Canada,[1] fall into four broad categories corresponding to the successive operations outlined above. These categories are: acquisition of exploration permits and subsequent expenditures for geological and geophysical surveys,[2] lease of mineral rights and

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[1]Canadian Petroleum Association, Statistical Yearbooks, 1951-1971 (Calgary: Canadian Petroleum Association, 1952-1972).

[2]Some case could be made for inclusion of government expenditures on, for example, geological mapping. It would not however be easy to decide on the proportion of these expenditures which should be charged to the petroleum industry as against other commercial users of such information.

payment of lease rentals;[1] exploratory drilling and development drilling.

Data on expenditures under each of these headings are set out in Appendix VII-2 for quinquennia in the period 1947-1971 while annual expenditures in total and under each of the headings exploration, development and production are plotted in Figure 6 for the period 1947-1972.

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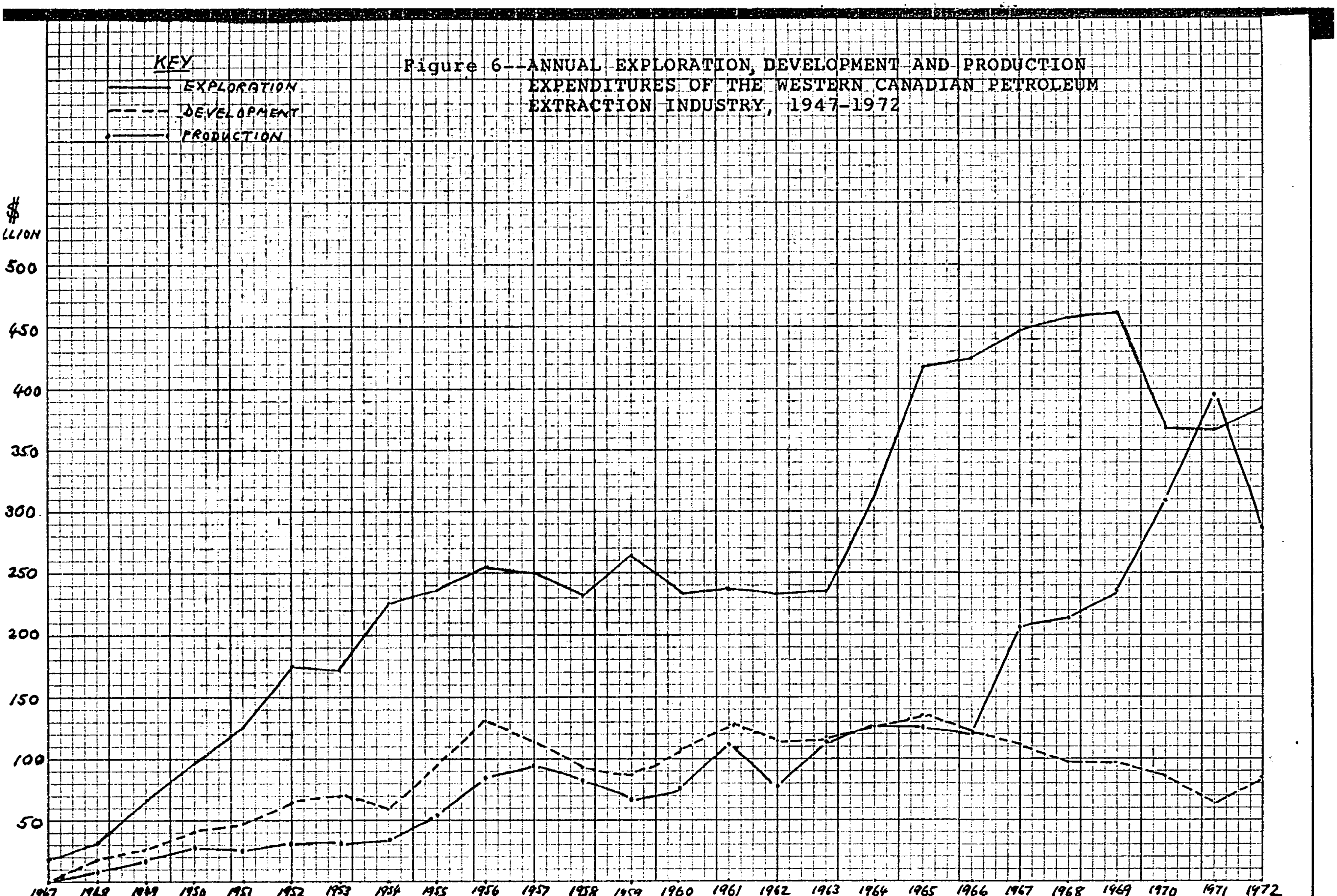
[1]It can be seen from Appendix VII-2 that bonus payments to the landowner, in western Canada generally the provincial crown, for acquisition of mineral rights, and rentals for exploration permits and leases are the largest single "cost" of petroleum exploration. Leases are generally acquired by competitive bidding. The bonuses offered reflect bidders' estimates of the value of these rights in terms of the difference between the discounted income stream which may accrue from successful operations and the cost of finding and developing petroleum resources thought to exist in the area, with appropriate allowance for the probability of finding such resources. Thus, a large bonus might be offered for lease of a property adjoining another on which a successful well had been drilled. By contrast, no bonus payment might be forthcoming in respect of a property remote from established production and pipe line transportation and the mineral owner would then have to be content with rental payments only. In a sense, the bonus represents the capitalized value of a Ricardian rent. In a paper submitted for publication in the Journal of Industrial Economics, C. Campbell Watkins, formerly Chief Economist of the Alberta Oil and Gas Conservation Board, has explored the extent to which the crown was able to appropriate this "rent" in bonuses paid for mineral rights in the Rainbow-Zama area of Alberta (see p. 56).

Figure 6--ANNUAL EXPLORATION, DEVELOPMENT AND PRODUCTION EXPENDITURES OF THE WESTERN CANADIAN PETROLEUM EXTRACTION INDUSTRY, 1947-1972



Source: As Appendix VII-2

In the oil industry, the total of these expenditures is loosely regarded as "investment" in the finding and development of the industry's principal "capital asset" - oil and gas in the ground.[1]

The Canadian Petroleum Association's data are the only source available for expenditures specifically on exploration and development. They indicate a sharp rise in spending from less than $100 million annually in the late 1940's to nearly $400 million in 1956, the

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[1]For purposes of Canadian national income accounting, only expenditures on construction, machinery and equipment are counted as fixed capital formation. In this narrower definition, the large oil-company payments to owners of mineral rights in the form of bonuses and lease rentals are excluded from capital formation, as are geological and geophysical expenditures. However, spending on machinery by drilling and geophysical contractors is treated as investment for national accounts purposes even though not added directly into the industry's exploration and development expenditures set out above. Exclusion of bonuses and lease rentals from the national accounts is correct as they represent a transfer rather than the creation of assets. But geological and geophysical expenditures and drilling expenses should be treated as "investment" if the latter is considered to be "that part of current outlay on goods and services which is made in order that an economic service may be rendered in the future". Such a broad definition of investment was advanced by O.J. Firestone in Private and Public Investment in Canada 1926-1951 (Ottawa: Department of Trade and Commerce, November 1951), Appendix A, pp. 211-213.

increase being associated with the growth of the industry's activity already described. From 1957, such expenditures fell to an average of $350 million annually until 1964 when they rose to $438 million and continued upwards to a peak of $560 million in 1969 falling to $422 million in 1971: expenditures on land acquisition and rentals and development drilling fell while exploration drilling expenditures increased.

Analysis of the relation between industry spending and its "outputs" in terms of exploration activity and the volume of oil and gas found is a frustrating task. For example, as the search for oil has spread into more remote parts of western Canada, the cost of exploration wells has increased because of the greater need for access roads and on-site housing and other facilities. This means that the unit cost of footage drilled is not too meaningful as a measure of the industry's efficiency. As to the "cost" of finding new oil and gas reserves, the uncertainties of exploration mean that the amount of oil found fluctuates widely from year to year and so therefore does the apparent "cost" of finding it in one year. The necessary use of arbitrary time periods is another complicating factor.

However, by dividing total new reserves discovered in barrels (natural gas being converted to oil equivalent on the basis of relative wellhead values) into total exploration and development expenditures for successive calendar years in millions of dollars, it is found that the cost per barrel discovered has varied from $2.31 in 1972, a very poor finding year, to $0.30 in 1964 and $0.34 in 1966[1], the two best-ever years for new reserves additions. These data are plotted in Figure 7.

The averages for periods of years are more enlightening. From 1947-1956, the ten-year average cost was $0.88 per barrel, for the next five years through 1961 it was $0.76. In 1962-1966 it fell again to $0.45 per barrel but rose to $0.96 per barrel in the five years ending 1971, the annual unit costs being as follows:

dollars per barrel				
1967	1968	1969	1970	1971
0.74	0.75	0.70	1.21	2.30

The average cost of finding and developing new oil and gas reserves in western Canada tended to fall slowly in the first fifteen years of post-Leduc

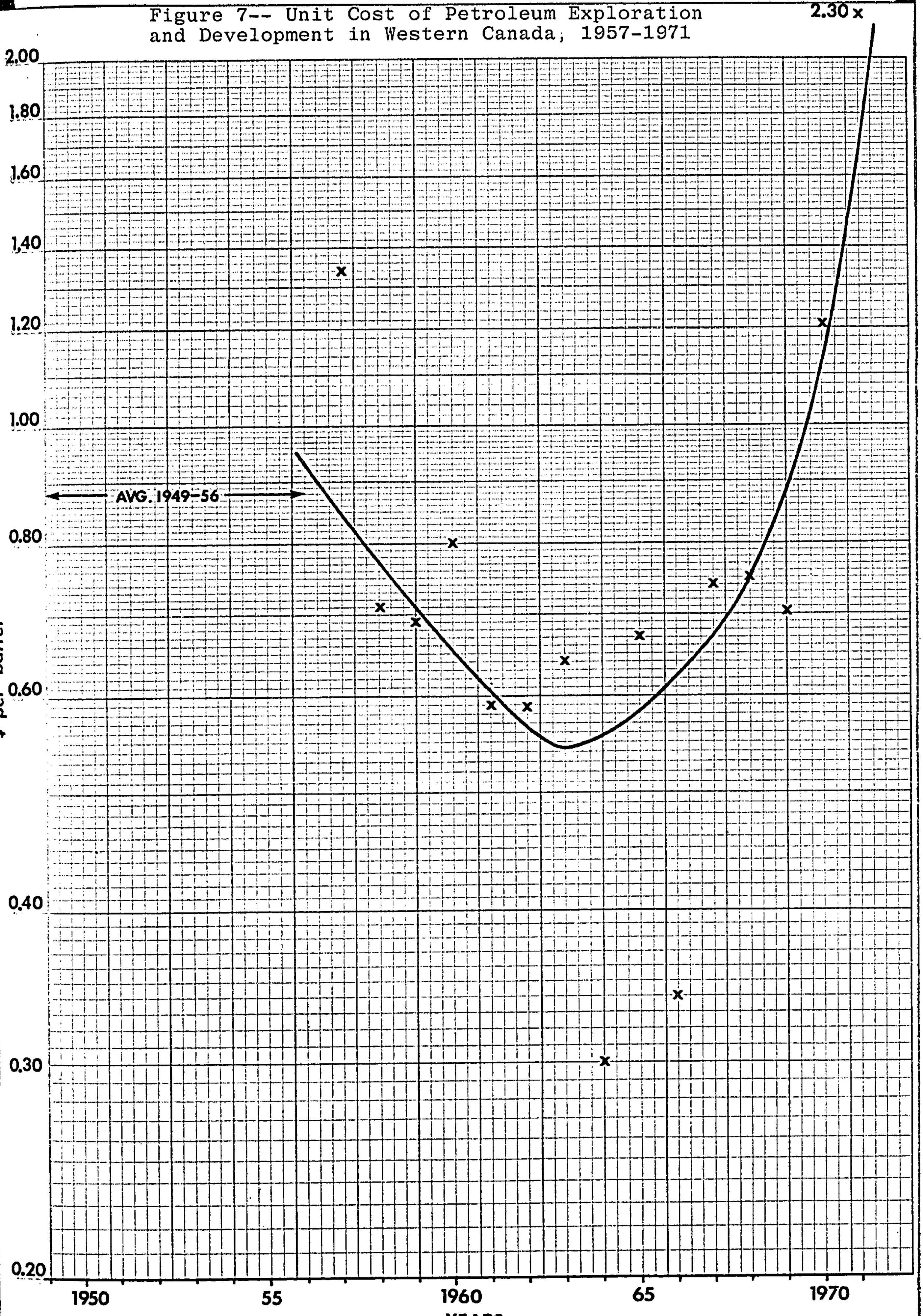
[1]*Oilweek*, Vol. 24, No. 1, 19 February, 1973, p. 41.

operations, then more rapidly, but has increased sharply since 1966 as expenditures have been maintained at high levels but discoveries of oil and gas have been disappointingly small.

The fall in unit costs experienced over the years 1947–1966 may be attributed to better knowledge of the geological environment making for less random exploration; to new seismic techniques; to improvements in technology such as resulted from the use of aircraft in geological and geophysical survey work; to acquired managerial experience; to external economies associated with the development in western Canada of a "petroleum industry complex"; and to improved provincial conservation practices resulting in elimination of wasteful over-drilling.

The striking increase in unit costs in the period 1967 to 1971 compared to 1962–1966 raises problems. The time span may of course be too short to establish a trend. But it would appear that the industry's exploration effort has been no more successful in 1972 and so far in 1973 than in the previous five years. This suggests that the petroleum industry in western Canada may now have reached a stage

Figure 7-- Unit Cost of Petroleum Exploration and Development in Western Canada, 1957-1971



where, the richest and most accessible resources having been discovered,[1] exploration expenditures are increasingly applied to less promising areas and to the development of smaller, hitherto marginal fields. In either case, a given exploration effort will tend to yield a rather smaller return in terms of oil or gas discovered and developed.

b. Production

Like exploration and development, petroleum production is a capital-intensive activity: a reflection of this feature is the very high value-added per person employed, illustrated in Appendix VII-3. Moreover, the capital investment required tends for several reasons to be "lumpy". Thus, economies of scale and considerations of technical efficiency require that gas-treatment plants should be built in large unit sizes. Indivisibilities are present - for example, producing wells must be drilled to the

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[1]Characteristically, when a concerted petroleum exploration effort is applied over time to a particular sedimentary basin or major geological sub-division thereof, the frequency distribution of oil and gas discovered is skewed with the biggest finds and largest annual reserves additions being made in the earlier part of the period (see pp. 55-57).

required depth and fully equipped, there is no half-way case. Economies can be reaped if several drilling operations in the same general area are serviced from a central point. Finally, for technical and economic reasons it is normal practice to develop an oil field for production at a certain minimum rate by installing at one time pumping, gathering and treating facilities to handle the potential output of all the successful wells in it. Each of these features contributes elements of rigidity and discontinuity in the production function which find expression in the corresponding capital requirements.

Single production projects can involve expenditures of the order of tens of millions of dollars. The result is that the large firm with substantial cash reserves or assets against which it can borrow is in an inherently advantageous position as compared with the small firm.

Expenditures associated with oil and gas production fall into three categories corresponding to the operations previously outlined. These categories are the installation of field equipment; the construction of natural-gas plants; and the undertaking of secondary recovery and pressure maintenance projects. Data on production expenditures under each of these headings are presented in Appendix VII-2.

Expenditures in western Canada for oil and gas production facilities, including natural gas plants, totalled some $2.7 billion over the period 1947-1971[1] and represented over these years about one-quarter of total cash expenditures, excluding taxes, royalties and operating costs, by the oil and gas extraction industry (i.e. exploration, development and production).

Production facilities have come to account for a generally higher proportion of total expenditures as development of the industry has proceeded. This reflects the fact that the call for production expenditures necessarily lags exploration and development expenditures: several years may elapse between commencement of an exploration program and

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[1]Canadian Petroleum Association, Statistical Yearbooks, 1961 and 1971 (Calgary: Canadian Petroleum Association, 1961, 1972).

completion of production facilities enabling newly-discovered oil or gas to be delivered to a trunk pipe line. In the ten-year period ending in 1956, production expenditures represented 14 per cent of total cash expenditures of the industry in western Canada; from 1962-1966 the proportion was 20 per cent; and from 1967-1971, 34 per cent of total expenditures represented spending on production facilities.

Incremental capital-output ratios have been crudely calculated with a view to assessing the apparent productivity of capital increments in the production segment of the petroleum industry. Aggregate production capital expenditures for successive quinquennial periods between 1946 and 1970 were divided by the annual increases in value added in the crude petroleum and natural gas industry for quinquennia during the period 1947 to 1971.[1] The ratio was 3.3 in 1947-1951 and fell to 3.0 in 1952-1956, rose to 11.0 in 1957-1961, declined to 6.9 in 1962-1966 but rose again to 7.7 in 1967-1972. These results are puzzling, particularly the high ratio for

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[1]See Appendices VII-2 and VII-3.

the period 1957-1961. One possible explanation is that the use of net output rather than capacity figures distorts the ratio in circumstances where productive capacity is under-utilized. This was the case from 1957 to 1961 when markets for western Canadian oil grew less rapidly than additions to the industry's productive capacity (see pp. 75-76). Unfortunately, capacity data for the western Canadian petroleum industry are not available on a uniform basis over an extended period of years.

A feature related to physical aspects of petroleum operations and to the capital-intensive nature of petroleum production is the significant time-lag between commitment of exploration expenditures, spending on production equipment and the return flow of income from the production and sale of oil and gas resulting from that spending. This "waiting" aspect is reflected in the comparison of the build-up over time of total expenditures compared with total revenues in the western Canadian industry presented in Appendix VII-4.

c. Pipelines

The characteristics of large size and "lumpiness" of expenditures in the petroleum industry are epitomized in the pipe line sector. The reasons are obvious: new projects generally have to be completed from origin to destination in one phase of construction and such projects, as distinct from expansions and modifications to existing facilities, do not arise in a continuous flow.

Capital expenditures[1] in petroleum transportation, essentially on oil and gas pipelines, for the period 1947 to 1971 are set out in Appendix VII-5. In Table 6 a different time series is presented for capital expenditures on oil and gas pipe lines alone.

TABLE 6

CAPITAL EXPENDITURES ON PIPELINES IN CANADA 1947-1969

(millions of dollars)

	1947-1951	1952-1956	1957-1961	1962-1966	1967-1969	1947-1969
Oil pipe lines	NA	NA	164	205	215	NA
Gas pipe lines	NA	NA	701	400	410	NA
Total	71	439	865	605	625	2,805

Source: Tabulation prepared for the National Energy Board by the Capital Expenditures Section, Business Finance Division, Statistics Canada.

[1]The expenditures referred to are fixed capital formation on a national accounts basis.

The cost of gas transmission pipelines has exceeded by a large margin expenditures on oil pipe lines. The figures reflect the heavy spending associated with the construction of the Westcoast and TransCanada systems in the late 1950's. Expenditures on oil pipe lines have fluctuated less than those on gas pipe lines, presumably because expansion of oil lines has proceeded on a piecemeal basis whereas gas pipe line systems and their expansions have been designed to add large blocks of capacity to serve new markets on the firm contractual basis characteristic of the gas industry's supply arrangements.

Cumulative investment in oil and gas pipelines in Canada exceeded expenditures for oil and gas production facilities by the western Canadian oil industry in the period 1947-1969 inclusive. The size of the required capital expenditures in pipeline development and the fact that interprovincial pipe lines are subject to federal rate regulation has posed unique financing problems, the solutions to which have had important consequences for the type and nationality of ownership of such lines. The magnitude of pipeline spending reflects the remote location of Canada's presently-discovered petroleum resource in relation to domestic and export markets and the high costs which therefore had to be incurred to market oil and gas. These costs have been magnified to the extent that it has been the federal government's policy to bring western Canadian oil and gas to eastern Canada, involving pipeline routes up to one thousand miles longer than those which would have been required to serve large markets in the Great Lakes area of the United States.

2. Sources of Funds

The Canadian petroleum industry as a whole has drawn on four principal sources of funds to finance its rapid expansion during the past twenty-five years, namely: common stock; retained earnings; long-term debt; and short-term borrowings. Since there are no extensive time-series data regarding these sources, it has been necessary to estimate their relative importance on the basis of an unpublished National Energy Board survey of the finances of a group of eight oil companies, supported by fragmentary published information and by observation of the industry over a period of eight years from a vantage point in the Oil Policy Branch of the National Energy Board.

Appendix VII-6 sets out on a cumulative basis the sources of invested capital during the period 1960-1971 of a group of eight Canadian petroleum companies. This group includes companies which are engaged in oil refining and marketing as well as oil and gas production. The coverage of activities is therefore broader than those discussed in the preceding section: this discrepancy is unfortunate but inevitable because the integrated companies which dominate petroleum refining and marketing in Canada also have important exploration, production and transportation interests which are not separated in their published corporate accounts.

Common or voting stock was probably the largest single source of capital in the exploration, development and production sector of the oil and gas industry in its early growth stage until about 1960. Common stock was subscribed by private investors in

Canada and the United States for new and expanding companies.[1] However, given the high proportion of total investment in the petroleum-industry investment owned by foreign companies that have made direct investment (see Appendix VII-10), it must be presumed that the bulk of the common stock has been subscribed by foreign parent companies.

During the past decade, retained earnings appear to have become the leading capital source. In most established businesses of all kinds, such internally-generated funds are very important and it was to be expected that this would come to be the case in the petroleum industry: taking the western

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[1]The general practice has been to earmark a proportion of new issues in foreign-owned companies for initial sale in Canada with any balance being subscribed directly by the parent company. It has not been usual for such companies to offer stock in the Canadian subsidiary for public sale in the United States. However, there is nothing to prevent American residents from subsequently buying publicly-traded stock in Canadian subsidiaries of United States corporations. In this way a portion of Imperial Oil's stock, for example, has come to be held by private non-resident interests.

Canadian industry as a whole the conditions for self-financing started to develop in the 1960's when, on a year-to-year basis, revenues began fairly consistently to exceed expenditures (see Appendix VII-4).

Long-term debt in the form of fixed-interest borrowings has never been a very important source of capital financing in the oil and gas production sector. In the case of pipe line companies, however, this is characteristically the principal means of raising funds (see, for example, pp. 160-161 and 165-168).

Conversely, oil and gas producing operations are often financed by short-term loans, generally from chartered banks, secured by discovered petroleum resources in the ground for whose development the funds are required (see p. 157). External borrowings by foreign-owned companies, whether made abroad or in Canada, have the effect of ultimately increasing the amount of assets controlled by such corporations. Conversely, where foreign capital is mobilized by Canadian-controlled companies, in the pipeline business for example, if the investment is successful the amount of Canadian-owned and controlled capital is increased.

The decreasing share of common stock and the rising importance of retained earnings and long-term debt are apparent from Appendix VII-6. Preferred stock has not been an important source of funds in this eight-company grouping. The role of short-term debt and other similar means of financing (for example, borrowings from parent companies) has been of variable but generally-decreasing importance.

In Appendix VII-7 information is set out on the sources of external and internal funds in 1965, 1967, 1968 and 1969 of foreign-owned companies with assets exceeding $5 million in the "gas and oil industry".[1] The bulk of these companies' funds in the second half of the last decade were increasingly internally-generated, mainly by depreciation. External sources accounted for a declining proportion - between one-third and one-quarter - of funds available to this group of companies to finance gross capital formation.

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[1] In the absence of a definition in the source of Appendix VII-7 as to their coverage, it must be presumed that these data relate to the total petroleum industry, i.e. refining and marketing as well as exploration, production and transportation.

3. Ownership of Assets

a. Total Investment

The (net) book value of total capital employed in the Canadian petroleum and natural gas industry[1] in 1967, the latest year for which data are available, was $9.7 billion (see Appendix VII-8). By way of comparison, capital employed in "manufacturing" was twice as great ($20.5 billion) while "other mining and smelting" used a little more than half as much ($5.2 billion).

b. Amount, Type and Nationality of Investment

In 1967, non-residents owned $6.0 billion[2] or 62 per cent[3] of the total capital employed in the

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[1]Except where otherwise indicated, the data presented in this section refer to all phases of the petroleum and natural gas industry, comprising companies engaged in exploration, development, transportation, refining, marketing and distribution. See "Investment in The Petroleum and Natural Gas Industry - Statistical Note" in Dominion Bureau of Statistics, The Canadian Balance of International Payments, 1957 and International Investment Position (Ottawa: Queen's Printer, 1958), p. 33.

[2]See Appendix VII-8.

[3]See Appendix VII-9.

petroleum and natural gas industry. Comparative figures for 1945 were 35 per cent and $110 million. The proportion of foreign ownership increased to 56 per cent in 1953, reached a maximum of 64 per cent in 1956-1957 and fluctuated between 61 per cent and 64 per cent until 1967.

The extent of foreign ownership of the petroleum and natural gas industry in 1967 was greater than in any other major sector of the Canadian economy and compares with 61 per cent in "other mining and smelting" and 52 per cent in "manufacturing". Foreign investment in petroleum and natural gas accounted for 2 per cent of total non-resident capital employed in Canada in 1945. By 1967 it represented 17½ per cent of a total which had multiplied about five-fold from $7.1 billion to $34.7 billion.[1]

Direct investment by non-residents[2] in branches, subsidiaries and controlled companies is the most important type of foreign investment in the

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[1]Statistics Canada, Canada's International Investment Position, 1926 to 1967 (Ottawa: Information Canada, 1971), p. 111, Table II.

[2]See footnote on p. 170.

petroleum and natural gas industry.[1] By 1967, the cumulative amount of such investment was $5.3 billion or 88 per cent of total foreign capital in this industry.[2] The proportion of direct investment in the total was 88 per cent in 1945, reached a post-war peak of 95 per cent in 1955 and then declined. In the period of rapid expansion following the Leduc discovery, the inflow of non-resident capital came largely from foreign firms already established in the Canadian petroleum industry or which moved into it. Such companies remain the most important foreign investors, but the figures quoted suggest that in the decade 1956-1965 there has been increasing opportunity for, and interest in, investment in Canadian oil and gas by private and institutional portfolio investors abroad, reflected in the increase from 5 per cent to 12 per cent in the share in total foreign capital of indirect investment by non-residents.[3]

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[1]See Appendix VII-10, columns (5) to (8).

[2]See Appendix VII-11.

[3]Indirect foreign or "portfolio" investment includes minority investment by non-residents in the capital stock of Canadian corporations and in bonds and debentures of such corporations, whether they are controlled in Canada or in other countries. The amount of such investment is derived by difference between the Statistics Canada data on total foreign capital and foreign direct investment, see Appendices VII-10 and VII-11.

The United States has always been the principal source of foreign investment in the Canadian petroleum industry. At the end of the second World War, American investment accounted for 95 per cent of total foreign capital in the industry. By 1951, this proportion was 98 per cent from which it declined to 90 per cent in the late 1950's and 80 per cent by 1965.[1] British and other foreign investors seem to have been either slow to appreciate the growth opportunities which Canada offered in this field or unable to participate in them. For whatever reasons, the amount of non-American foreign capital invested in the petroleum industry hardly increased between 1945 and 1951, during which time United States investors put $530 million into the industry. Since that period, however, the amount of other foreign investment has grown quickly and by 1967 totalled $1.1 billion. The proportion of direct investment within this total at 89 per cent in 1967 was marginally higher than in the case of United States-owned capital (87 per cent).

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[1]See Appendix VII-11.

c. Components in Foreign Investment, Sectors of Application and Profitability

Increase in foreign direct investment arises as a result of net capital inflows for direct investment; the accumulation of domestic funds by foreign subsidiaries retaining their profits instead of distributing them; and "other factors" (including new issues, retirements, borrowings, revaluations and other accounting adjustments).

During the period 1946-1967 net capital inflows accounted for 50 per cent of the increase in direct foreign investment in the Canadian economy as a whole. Undistributed earnings were responsible for 42 per cent and "other factors" for 8 per cent.[1] Published data do not provide a basis for such a breakdown in the petroleum industry. Information is available only on capital inflows from the United States to this industry for the period 1952-1967.[2] During each of the first seven years, except 1952 and 1956, the net inflow equalled more than half of the net increase in

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[1] Canada's International Investment Position, op. cit., p. 38 and p. 133, Table VII.

[2] See Appendix VII-12.

direct investment. The seven-year average was 52 per cent. Between 1959 and 1967, however, the inflow was less than half of the net increase in every year and averaged only 30 per cent of the rise in book value.[1] The decline in the importance of capital inflows as a means of financing United States direct investment coincided with a fall in the rate of increase of such investment, and with an increase in the importance of retained earnings, as investments made in earlier years started to bear fruit.

Information on the ownership of investment in various sectors of the petroleum industry is almost totally lacking. A special survey was made for the

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[1]United States data on net capital outflows for direct investment in petroleum in Canada reveal a different picture. Outflows from the United States represent a generally-higher proportion of the annual growth in value of United States direct investments in the Canadian petroleum industry and the tendency for the proportion to decline is less marked. These differences are partly to be accounted for by the fact that in the United States data, retained profits of branches are treated as an outward flow of new funds. The high proportion of branch-operations in the petroleum industry would therefore give an upward bias to the data for outflows of funds. See <u>U.S. Direct Investment in Canada as Reported by U.S. Sources, 1946-67</u> (Ottawa: Department of Industry, Trade and Commerce, June 1969), pp. 33-36.

years 1954 and 1955.[1] For the latter year, when 63 per cent of total investment in the industry was foreign owned, the survey showed that non-residents owned 70 per cent of investment in exploration and development companies, 60 per cent of that in refining firms, 16 per cent of merchandising and 67 per cent of the capital of transportation companies. A time series cannot be constructed as the survey was not repeated. The value of the figures quoted is reduced by the fact that the subdivisions of the petroleum group were corporate and did not reflect the division of operations within individual corporations (see p. 192).

There are few data on earnings accruing to foreign investment in the Canadian petroleum industry. The only time-series published relates to dividend payments - therefore to only a proportion of total earnings - and is presented in Appendix VII-13. Examined in relation to data on non-resident investment in the industry (Appendix VII-10), dividend payments

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[1]Dominion Bureau of Statistics, The Canadian Balance of International Payments, 1957 and International Investment Position (Ottawa: Queen's Printer, 1958), pp. 52-53, Table XV.

through 1964 are seen to have increased less rapidly than the accumulated totals of investment and to have represented a small and declining percentage of it.

4. Control of Investment

Control of assets and operations of a company results from ownership of its voting stock, regardless of the ownership of other stock and of the debt capital. The Canadian petroleum industry is characterized by a predominance of direct investment, that is "investments in business enterprises which are sufficiently concentrated to constitute control of the concerns".[1] The concept of "foreign control" as employed in Canadian official statistics is generally applied to all concerns in Canada which are known to have 50 per cent or more of their voting stock held in one country outside Canada. In some instances concerns are included where it is known that effective control is held by a parent firm with less than 50 per cent of the stock.[2]

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[1] Dominion Bureau of Statistics, Canada's International Investment Position, 1926-1954 (Ottawa: Queen's Printer, 1957), p. 21.

[2] A.E. Safarian, Foreign Ownership of Canadian Industry (Toronto: McGraw-Hill of Canada, 1966), p. 13.

The ownership ratios dealt with in the preceding section measure equity capital owned by non-residents as a percentage of total capital employed (see, for example, Appendix VII-9). The control ratios shown in Appendix VII-14 measure equity capital invested by residents as well as non-residents in those companies where voting stock is controlled by non-residents. For example, the typical integrated oil company operating in Canada - BP, Gulf, Imperial, Shell or Texaco - in each of which some 30 per cent of the voting shares is in the hands of private individuals and institutional investors resident in Canada, would be treated as 100 per cent foreign-controlled by virtue of the fact that the balance of the voting stock is held by the foreign parent company.

The proportion of foreign control is significantly higher than the proportion of foreign ownership in the petroleum and natural gas industry (in 1967, 74 per cent versus 62 per cent, compare Appendices VII-4 and VII-14). There are two reasons for this situation. First, the vehicle of foreign ownership in this industry has typically been the foreign direct investment company rather than the foreign portfolio investor.[1] Ownership of the foreign component is usually in the hands of one company, whereas Canadian residents' shareholding is fragmented. Secondly, the foreign-owned component characteristically comprises a majority of the voting stock while the Canadian-owned component is a minority of the voting stock.

Essentially, the difference in the ownership and control ratios for the petroleum and natural gas industry reflects the fact that foreign direct investors have on balance regarded it as good public and government relations[2] to provide for (minority)

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[1]This situation is in strong contrast to that obtaining in the railway industry where the proportion of foreign ownership, reflecting mainly foreign portfolio investment, has always been significant (57 per cent in 1939, 19 per cent in 1967) whereas the degree of foreign control has been negligible (2 - 3 per cent in both years). See Statistics Canada, Canada's International Investment Position 1926 to 1957 (Ottawa: Information Canada, 1971), pp. 150-151, Tables XVII and XVIII.

[2]The "Guiding Principles of Good Corporate Behaviour for Subsidiaries in Canada of Foreign Companies" enumerated by the Minister of Trade and Commerce, the Hon. Robert Winters, in March 1966 included the following:

> "10) To have the objective of a financial structure which provides opportunity for equity participation in the Canadian enterprise by the Canadian public."

Department of Industry, Trade and Commerce, Foreign-Owned Subsidiaries in Canada (Ottawa: Queen's Printer, 1970), p. 69.

Canadian shareholding in companies controlled by non-residents. The readiness of the Canadian public to invest in such companies, often in preference to Canadian controlled firms, has been variously explained as indicating that Canadians are "too timid" to invest in the generally smaller Canadian-owned companies or that the international companies' managements have been able to mobilize Canadian financing thanks to their technical capability and better credit ratings than most Canadian-owned companies.

Summary

Investment in western Canadian petroleum exploration and development is characterized by risk and "lumpiness". Large firms as a result enjoy some inherent advantages. The successful outcome of these activities is the proving up of commercial oil and gas reserves. Unit costs of finding such reserves in western Canada have fluctuated so much over time that firm conclusions cannot be drawn as to trends.

The importance of expenditures on production facilities, frequently involving large investment in individual projects, has increased as the development of western Canadian petroleum resources has progressed. But capital-output ratios in the production sector seem to have varied widely during the twenty-five years to 1972.

Pipeline investment requirements are even "lumpier" than those in the production phase. The distance of Canadian petroleum resources from large markets and government policies directing oil and gas flows into eastern domestic markets have magnified pipeline investment requirements.

Stock issues and other sources of funds external to the firm were probably the principal means of financing in the Canadian petroleum industry until about 1960. Since then, retained earnings appear to have become the leading source of capital.

The petroleum industry is generally characterized by "direct", as against "portfolio", foreign investment. American investment was and is predominant, but there has been a recent sharp increase in the amount of other foreign investment. Direct capital inflows were responsible for most of the increase in foreign investment until the late 1950's after which retained earnings become the principal source.

The proportion of foreign control is higher than that of foreign ownership by virtue of the fact that foreign-owned companies have successfully attracted Canadian minority equity participation. As well, foreign companies have successfully mobilized Canadian sources of fixed-interest funds, both long- and short-term.

Chapter VIII

EFFECTS OF CANADIAN PETROLEUM RESOURCE DEVELOPMENT

This chapter reviews the impact on the Canadian economy of the development of western Canada's petroleum resources, including the effects of the pipe line activity associated with that development. First it examines the effect on the Canadian energy situation. The economic impact is then considered, first nationally in terms of trade and payments; foreign investment; income and employment; and "spread effects" and then regionally, with particular reference to Alberta.

The subject matter has seemingly not received rigorous analytical treatment and is in a degree controversial. Thus, Caves and Holton concluded that the contribution to employment by the petroleum industry in Alberta during the 1950's was very modest. They suggested that "the pelf (booty) rather than the people caused the uproar associated with the petroleum boom".[1] Easterbrook and Aitken were more cautious

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[1]R.E. Caves and R.H. Holton, The Canadian Economy, Prospect and Retrospect (Cambridge, Mass.: Harvard University Press, 1959), p. 213. Professors Caves and Holton "have not touched the subject of Canadian regional development since our 1959 book" (private communication from Professor Caves, December 1971). In a later paper Caves has observed that ". . . both theoretical and empirical work has shown the variety of types of externalties that may spread from export-based development and the range of strengths that they may posses - all the way from negligible to vast" (R.E. Caves, ""Vent for Surplus" Models of Trade and Growth", Essays in Honor of Gottfried Haberler on the Occasion of His 65th Birthday, R.E. Baldwin and others [Amsterdam: North Holland Publishing Company, 1965]), p. 112.

when they wrote in 1956 that "The speed with which the discovery and development of western Canada's oil resources took place makes it difficult to appraise objectively what the opening up of this new area of growth means for the Canadian economy as a whole and for the three Prairie provinces in particular".[1] By contrast, Hanson, writing at about the same time, concluded that the contribution of the petroleum industry to both employment and income has been very large in Alberta.[2] This view has been maintained in his subsequent writing.[3] Examples of such statements could be multiplied. It may be sufficient in the present context to note that few generalizations of the sort quoted are supported by convincing factual evidence and that where supporting material is presented, it frequently relates to only a part of the problem (for example, the impact of particular petroleum developments

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[1]Easterbrook and Aitken, op. cit., p. 549.

[2]Hanson, op. cit., especially Chapters 21 to 24.

[3]E.J. Hanson, "Regional Employment and Income Effects of the Petroleum Industry in Alberta" being a paper presented to the Council of Economics, Annual Conference of the American Institute of Mining, Metallurgical and Petroleum Engineers, New York, N.Y.: 2 March, 1966.

on the city of Calgary[1] or on the province of Alberta;[1,2] the impact of a pipe line or refinery development alone[3]). There do not appear to have been published any studies dealing with the total impact of petroleum development. Certainly, none have treated the impact on the national energy economy, trade and payments in an integrated manner.

1. The Energy Economy

During the past twenty years, the export market has accounted for an increasing proportion of Canadian oil and gas production. By the early 1970's more than half of the western Canadian industry's oil, gas and sulphur production was destined for export, mainly to the United States (see, for example, pp. 99 and 120). At the same time, the industry continues to provide an important service function in the Canadian energy economy by meeting oil and gas needs from British

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[1] J.E. Weinrich, Economic Impact of the Canadian Gas Industry, Local, Provincial and Regional (Calgary: The Calgary Chamber of Commerce, September 1966).

[2] Hanson, op. cit..

[3] R.H. Frank and A.A. Kubursi, "Sectoral Characteristics of the Ontario Structure of Production", Special Supplement of the Ontario Economic Review, March 1972.

Columbia to Ontario and, in the case of gas, into Quebec as well. Indeed, it can be argued that the development of the western Canadian petroleum resource has profoundly and favourably affected the Canadian energy economy by making available to the Prairie region oil supply at lower cost than imports, whether from the United States or from overseas and, more important, by providing an abundance of low-cost natural gas to consumers from Vancouver to Montreal.

Oil Supply-Cost Savings - Canadian oil has been supplied to markets in eastern British Columbia and the Prairies at prices substantially less than import parity. For example, if Alberta oil reaches Vancouver refineries at about parity with overseas oil, such oil delivered to Alberta by a reversed pipe line system would have laid down in Edmonton at a price at least 80 cents per barrel more than it is presently sold for there, 40 cents being the current pipe line tariff for transportation from Edmonton to Vancouver via the Trans Mountain pipe line. In practice the pipe line charge for a Vancouver to Edmonton movement in a situation of "no Prairies oil" would have had to be more than 40 cents per barrel because Alberta's requirements are only about one-third of the present volume of south-westward shipments to British Columbia and Pacific Northwest markets and the economies of scale obtainable by the Trans Mountain system would simply not have been available.[1] A similar analysis can be applied to the situation of the other two Prairie provinces where the opportunity cost of oil supply might have been represented by overseas crude oil transported by pipe line from eastern Canada.

If the oil supply-cost saving for the Prairie provinces attributable to the development of local resources is assessed at about 80 cents per barrel, this is equivalent at current consumption rates in the three provinces to about $55 million annually and on a cumulative basis over the past 25 years to some $900 million. Of course higher prices, not to mention the absence of the economic impact of petroleum industry activity, would have resulted in reduced demand so these savings are notional maxima.

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[1]Overseas rather than United States sources are assumed to represent the alternative to indigenous supply for central Alberta. The oil resources of the northern part of the United States' Rocky Mountain region are not abundant and have long been fully utilized to supply refinery markets in the Mid-West to which they are linked by south and eastward flowing pipe lines.

Benefits of Natural Gas Supply - Natural gas is the most desirable of the fossil fuels for a wide variety of private, commercial and industrial applications. It is a notably "clean" fuel, non-polluting and convenient to use, imposes no storage problems on the consumer and makes possible very accurate temperature control. Gas-using appliances are generally less complex, and therefore cheaper in terms of first cost, than coal- or oil-burning equipment.[1,2] In a number of manufacturing applications - glass, ceramics and special steels for example - gas offers important technical advantages over all other fuels as was pointed out on p.121 above.

Pricing of natural gas in Canada, based on long-term contractual arrangements for supply and transportation, has been highly competitive with coal and oil, having regard also to its advantages in use.[3] In the Prairie

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[1] Schurr and Netschert, _op. cit._, p. 132.

[2] Davis, _op. cit._, pp. 152-154.

[3] A confidential report prepared in 1973 by E.C. Sievewright Associates Ltd. for the National Energy Board noted that coal had increased in price by 55.5 per cent in Ontario and fuel oils by 16.1 per cent between 1961 and 1972 while the price of natural gas for domestic purchasers rose by 2.9 per cent. The price of natural gas in Toronto, the report said, was substantially unchanged since 1957.

provinces, natural gas has significantly undersold fuel oils for heating and hydro or thermal electricity for cooking in almost all areas in which it is available.

Natural gas, virtually all of it from western Canadian indigenous sources, has rapidly increased its share of total Canadian energy supply since 1955 (see Appendix I-4). Consumption of natural gas is of course concentrated in cooking, space-heating and process applications. In contrast to oil fuels, gas is not extensively used as a source of mechanical energy. Natural gas is the principal source of fuel energy for space-heating, water heating and industrial process use in homes, industrial and commercial establishments in Ontario and the western provinces.[1]

Conclusion - The development of western Canadian gas resources has had a profound impact on the national energy economy. The choice of fuels available to consumers has been widened. The relatively low prices at which gas has been offered has been of direct benefit to its consumers and, by accentuating inter-fuel

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[1]National Energy Board, Energy Supply and Demand in Canada and Export Demand for Canadian Energy (Ottawa: Queen's Printer, 1969), Appendix C, Tables 7, 8, 9 and 10.

competition, to consumers of other fuels too. Aside from energy cost-savings the technical advantages of natural gas have been of benefit to particular classes of industrial users requiring a very clean-burning fuel and accurate temperature control.

2. Trade and Payments

The growth of the Canadian petroleum industry has importantly affected Canada's trade and payments situation. The discussion which follows of these effects is without particular reference to a "petroleum balance of payments" partly because the necessary data on some important "invisible" items - shipping and pipe line services and investment income - are not available[1,2]

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[1]A current account balance of international transactions of foreign-controlled companies in the oil and gas industry appears in the Statistical Supplement to "Foreign-Owned Subsidiaries in Canada" (Ottawa: Department of Industry, Trade and Commerce, August 1972) Appendix IV, p. 44. Although international transactions of most western Canadian oil and gas companies are covered, these data are not appropriate to the present purpose. Thus, exclusion of Canadian-controlled corporations, notably TransCanada PipeLines, the largest exporter of western Canadian gas, means that the merchandise export data are incomplete. But because oil refining and marketing companies are included, the merchandise imports data cover shipments of foreign oil to eastern Canada which can hardly be attributed to the activity of the western Canadian industry. Under "other current payments" are included shipping services in respect of oil imports, but pipe line revenues from oil exports are excluded because the Interprovincial and Trans Mountain pipe line companies are not included in the survey. Finally, the record of payments to United States residents in respect of non-capital equipment merchandise imports appears to include payments to parent companies in respect of oil imports from overseas.

[2]Since this section was written, a "Summary of Sectoral Balance of Payments for the Oil and Gas Industry" has been published in An Energy Policy for Canada - Phase 1, 2 Vols. (Ottawa: Information Canada, June 1973) Volume 1, p. 260. This is the most comprehensive attempt yet made to produce a "petroleum balance of payments". It deals with the years 1965 to 1970 inclusive and reveals a current account balance, including services, moving from a 1965 deficit of $249 million to a 1970 surplus, the first, of $83 million. The capital account balance is positive throughout with net inwards movements varying from $193 million in 1967 to $443 million in 1969. A sectoral deficit is recorded for 1965 ($38 million) but surpluses are indicated for succeeding years rising to $351 million in 1969 and $344 million in 1970. The data include imports of oil from overseas but appear to exclude trade in sulphur, a co-product of natural gas processing.

and partly because the balance of payments concept when applied to an arbitrarily-defined industry may not be particularly useful or meaningful. For example, examination of one industry in isolation implicitly abstracts from other monetary effects. Thus, large, domestically-financed investment projects of the petroleum industry could exert upward pressures on short-term market interest rates thereby inducing international capital flows. A simple measure of the industry's net foreign exchange earning position would not reflect this situation.

Petroleum industry activities have favourably affected the balance of visible trade, directly by large exports of oil and gas and indirectly by import-substitution, notwithstanding necessary initial imports of equipment such as pipe line pipe. A net outflow on invisibles, principally income on investment but also consultant and management services, patent rights and the like, partly offsets the favourable impact of merchandise trade in petroleum. As to capital account, there has of course been a large net inflow of foreign capital which in turn is reflected in Canada's foreign indebtedness.

Visible Trade - Data on Canada's visible trade in petroleum and sulphur are given in Appendix VIII-1.

Some impression of the place of petroleum in relation to other leading commodity exports can be gained from Table 7 below and Appendix VIII-2.

In terms of contribution to total Canadian exports, crude oil and natural gas had by 1972 surpassed two other "regional staples" - the iron ore of eastern Canada and the wheat of the Prairies, and ranked in the same order of magnitude as non-ferrous metals which might be regarded as a "national staple" by their geographical diversity.[1] At the same time, in Canadian export-trade terms, oil and gas were far less important than the products of the forest industry, Canada's other national resource-staple.

TABLE 7

LEADING COMMODITIES' SHARES OF CANADIAN MERCHANDISE EXPORTS, 1972

		Per Cent of Total Domestic Exports
"Regional Staples"	(Crude petroleum and (natural gas	6.7
	(Iron ores and concentrates	1.8
	(Wheat and wheat flour	4.2
"National Staples"	(Copper, lead, zinc and nickel	8.4
	(Lumber, woodpulp and (newsprint	17.1

Source: Appendix VIII-2.

[1]Such a distinction between "regional" and "national" staples is admittedly arbitrary. It is based primarily on the geographical distribution of spread effects associated with the staple. Another point of view, leading to possibly different findings, would examine linkages between the staple itself and other sectors of the economy. From this viewpoint, prairie wheat was a national staple par excellence in the early 1900's. After the second World War, however, its importance became regional rather than national.

The balance of petroleum trade has been progressively shifted from adverse to favourable as earnings from oil and gas exports to the United States have come to more than offset the value of oil imported from overseas to serve markets in the eastern provinces and the cost of small gas imports to Ontario. Had domestic-origin oil and gas not been available, energy would have had to be imported - mainly in the form of oil but also some American coal and gas to supply markets in Ontario and the western provinces which have been served by Canadian petroleum. The result would have been for 1971 to raise energy import requirements from some 1,030 thousand barrels daily of oil equivalent (bdoe) to some 2,325 thousand bdoe and to increase the 1971 national energy import bill from $920 million to $2,090 million.[1]

It would have been no easy task for Canada's other exporting industries, burdened in some cases by higher energy costs, to achieve additional earnings sufficient to meet these import costs.

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[1]This calculation assumes, probably wrongly, that energy consumption would have been as great in a "no domestic petroleum" case (see also p. 213 above).

Import leakage in terms of direct imports of American-made oil and gas production equipment appears to have been minimal in recent years - United States exports of oil and gas field equipment averaged about fourteen million dollars annually in the period 1970-71.[1] Leakages in terms of, for example, imported parts incorporated in Canadian-assembled machinery and imports of general-purpose equipment such as earth-moving machinery and tractors, may be important but cannot be traced with particular reference to oil industry operations. The writer has however formed the impression that at least by the 1960's, the backward linkages associated with Canadian oil industry operations (see below p. 255) were such that direct imports associated with petroleum exploration, development and pipe line activity were remarkably small. Indeed, the development of these linkages in recent years seems to have been such as to

[1] United States Exports (Washington, D.C.: Department of Commerce, Bureau of the Census), Schedule B, Commodity and Country. The Statistical Supplement to "Foreign-Owned Subsidiaries in Canada", op. cit., indicates imports of capital equipment in the years 1969-70 by the surveyed foreign-controlled companies averaging some $30 million annually, but included in this figure would be some imports by refining and marketing companies.

provide the basis for significant current export earnings from petroleum industry equipment.[1]

At this point two possible objections may be mentioned against this simplistic treatment of the trade and payments effects of petroleum development.

First, it can be argued that the value of exports must be measured net of the social opportunity costs of the domestic resources employed. It is of course true that, unless these domestic factor inputs cannot be employed elsewhere they do not have a zero opportunity cost. However, in the case of the petroleum industry, direct labour inputs have been small and there is a *prima facie* case for arguing that their alternative-use value in western Canada was much less than their value productivity in petroleum industry employment.[2] As to

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[1]The *Globe and Mail* (Toronto), 22 March, 1973, p. B-16, reported officials of the Federal Department of Industry, Trade and Commerce as saying that "Export sales of sophisticated oil field equipment and related services are now worth at least $40 million annually to Canadian manufacturers and suppliers, a tenfold increase in as many years".

[2]The following comment from the Federal Government's recently-published energy policy papers is relevant here. "Energy projects were successful (during the resource development boom of the mid-1950's) in competing for capital and Canadian factor inputs . . . The profitability criteria would suggest that there was a real economic gain to the country from a more efficient allocation of resources." (*An Energy Policy for Canada*, *op. cit.*, p. 223.)

capital inputs these have been very large but the greater part was supplied from external sources. In a sense, the most important input was the resource itself which, in the absence of export markets, would either have been less rapidly exploited or would have been channelled into import-displacement markets east of Ontario resulting in a lesser unit return to the producer because of the higher transportation costs[1] compared to those incurred in export markets and the lower value[2] obtainable once the market had been reached.

Secondly, it can be asserted that "all balance of payments effects net out to zero in the long run". This truism of course neglects the important contribution made by exports to domestic economic activity by virtue of the income flows that help to maintain high levels of internal economic activity and the dynamic impulses to investment and further growth to which they give rise.

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[1]The pipe line tariff from Edmonton to Chicago, the largest single market for Canadian oil east of the Rockies, is 45 cents per barrel. To reach the Montreal market would have required a tariff of at least 70 cents per barrel (Royal Commission on Energy, op. cit., pp. 102-105).

[2]At the end of 1972, light Canadian crude commanded a price of about $3.75 per barrel at Chicago. The average barrel of imported oil at Montreal cost about $3.00 per barrel.

<u>"Invisibles"</u> - It is understood that Canadian oil exports are generally valued for statistical purposes at the point of delivery to trunk pipe lines. In the case of Alberta oil this point is Edmonton. From there the weighted average tariff to export markets via Canadian pipe lines is some 40 cents per barrel; this average has changed hardly at all in the last decade. Applied to pipe line exports rising from 41 million barrels in 1960 to 108 million in 1965 and 345 million in 1972,[1] it implies gross earnings of $16 million, $43 million and $138 million respectively.

Against these earnings must be set dividend payments to foreign parent companies and other non-resident shareholders. In the period 1968-70 these averaged some $118 million annually for all foreign-controlled oil and gas companies.[2] Data for earlier years from a different but apparently-comparable source are set out in Appendix VII-13 which show dividend payments rising from a very low level in the early post-war years towards

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[1] National Energy Board, <u>Annual Reports for 1960, 1966 and 1972</u> (Ottawa: National Energy Board, 1961, 1966 and 1973).

[2] Department of Industry, Trade and Commerce, <u>op. cit.</u>

$100 million annually by the mid-1980's. Expectably, in view of the small proportion of foreign portfolio investment[1] in the Canadian petroleum industry (Appendix VII-11), dividend payments in respect of this element of foreign investment are proportionately smaller, averaging about one-tenth the aggregate amount of dividends paid to parent companies.[2]

Finally, like other foreign-controlled sectors the petroleum industry is responsible for other current payments including such items as interest, management services, licensing and patent fees. The sparse published information available suggests that these are small in proportion to dividend payments - perhaps one-fifth as large.[3]

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[1]The acquisition by non-residents of shares in a Canadian company as a source of income and possible capital appreciation rather than with a view to obtaining control of the company. The investor may be an individual or a corporation, for example an investment trust. Characteristically, the foreign investor owns only a small proportion of the company's total equity and there is no business relationship between the investor and the company.

[2]Canada's International Investment Position, op.cit., Table XXVII, pp. 182-185.

[3]For the mineral fuels industry, i.e., oil refining industry; coal mining and coal processing; foreign interest payments and payments to non-residents for business services aggregated $25 million in 1968 and $27 million in 1969. (Annual Reports of the Minister of Industry, Trade and Commerce Under the Corporations and Labour Unions Returns Act - see sources to Appendix VII-14.)

Conclusion - Western Canadian petroleum development has enabled about half of Canada's energy requirements - almost all its natural gas and fifty per cent of its oil - to be met from indigenous rather than mainly import sources, as would have been the case had this petroleum development not taken place. Additionally, exports by the western Canadian industry have made a large positive contribution to the country's visible trade balance which has not nearly been offset by direct imports of petroleum equipment, remittance of dividends or by other payments to non-residents.

3. National Income and Employment Effects

Input-Output Analysis, the Oil and Gas Producing Industry - The obvious basis for an integrated picture of the national income effects of petroleum development is the input-output part of the system of National Accounts. Unfortunately, at the time of writing, these data are only available for the years 1949[1] and 1961[2]. The 1949

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[1]Dominion Bureau of Statistics, Inter-Industry Flow of Goods and Services, Canada, 1949 (Ottawa: Dominion Bureau of Statistics, Reference Paper No. 72, 1956).

[2]Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy, 1961, 2 Vols. (Ottawa: Queen's Printer, Catalogue 15-501, Occasional, August 1969).

data are not used in this paper because development of the western Canadian petroleum resource was at a very early stage in that year and because the 1949 data are not compatible with those for 1961. In the 1961 data, the oil and gas producing industry (industry No. 7 in the 65-industry aggregation) has included with it "services incidental to mining" which makes it impossible to identify oil and gas specifically (see Appendix VIII-3). It is separated from oil refining, which is grouped with coal products (under No. 48 "petroleum and coal products [manufacturing]"), and pipeline transportation (which is part of No. 56 "transport and storage"). A more fundamental deficiency, however, is that the inputs shown are only the 'current account' ones: the tables do not indicate the industry-origin of the 'capital account' inputs which in the case of the petroleum industry are very large.[1]

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[1]The items "machinery" ($13.0 million) and "construction" ($10.8 million) in Appendix VIII-3 are not 'capital-account' inputs but are understood to relate to repair and maintenance expenditures and other non-capital expenditures. Capital expenditures in the petroleum and natural gas extraction industries, as recorded for national accounts purposes in 1961, were much larger - for construction $243.1 million and for machinery and equipment $28.3 million. ("Capital Expenditures in the Petroleum and Natural Gas and Allied Industries in Canada, 1951-72" - tabulation prepared for the National Energy Board by the Business Finance Division of Statistics Canada. This tabulation deals separately with extraction; transportation; marketing; distribution; and refining. Data on the transportation sector are presented in Appendix VII-5.)

TABLE 8

VALUE OF INDUSTRY INPUTS AND FINAL EXPENDITURES OF THE PETROLEUM AND NATURAL GAS INDUSTRY, 1961

	$ Million
Commodity inputs	65.7
Service inputs	264.8
Indirect taxes	11.7
Wages and salaries	122.9
Surplus, including net income of unincorporated businesses	339.3
Total	804.4

Source: Appendix VIII-3.

The commodity inputs are small in relation to the total value of inputs of just over $800 million. Only $66 million are commodity inputs, the most important being oil and gas (used as fuel). Some $265 million comprise services of various kinds, seemingly the most important being the finance, insurance and real-estate category.[1] Wages, salaries and commodity and indirect

[1]Royalty payments on oil and gas production have been mistakenly included under the heading "finance, insurance and real estate". They should of course have been included under "others" as a separate item. This error arose because the compilers interpreted "royalties" to refer to payments for the use of patents. This is to be corrected in future input-output series.

taxes come to $135 million and the balance of $337 million is "surplus" defined as "the sum of the costs of or incomes accruing to capital employed in the form of profits and other investment income, plus the cost of the consumption of the stock of fixed capital employed, that is, depreciation".[1] The high proportion of "surplus" to the total, some 40 per cent, is to be expected having regard to the highly capital-intensive nature of the industry which has been commented upon above (see pp. 184 and 188-189).

The present inability to identify the industry-origin of capital inputs is an insuperable difficulty in attempting to use the 1961 input-output data, as published, to obtain the desired integrated picture of petroleum industry impact on the economy. Staff of the National Energy Board are currently working with Statistics Canada; the Canadian Petroleum Association; the Independent Petroleum Association of Canada; and Hu Harries Associates Ltd., consultants, to remedy this deficiency by collecting data on the amounts and industry-origin of petroleum industry capital expenditures.

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[1] Dominion Bureau of Statistics, op. cit., p. 13.

Input-Output Analysis, the Oil and Gas Pipe Line Industry - This work has progressed to a point where the desired integrated picture has been obtained for the oil and gas pipe line industry in 1961.[1,2] 'Current account' expenditures by the pipe line industry, according to the 1961 input-output data, aggregated $203 million and are summarized in Table 9. The largest single item was the "surplus" of $141 million,[3] again a reflection of a highly capital-intensive industry. Wages and salaries amounted to $16 million. The largest service item was payment of $11 million rent for land and structures while the principal commodity input was pipe line fuel - oil, gas and electricity - valued at about $9 million.

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[1]National Energy Board, Economics Branch, "Report on the Impact of the Oil and Gas Pipeline Industry Expenditures on the Canadian Economy in 1961" (unpublished, 1972 mimeo).

[2]The year 1961 saw important expansion of the TransCanada PipeLines and Westcoast Transmission companies' systems in connection with increased exports authorized by the National Energy Board in 1960.

[3]"Surplus" is a measure of the total return to capital employed in the industry.

TABLE 9

VALUE OF OPERATING EXPENDITURES OF THE OIL AND GAS PIPE LINE INDUSTRY, 1961

	$ Million
Commodity inputs	10.6
Service inputs	28.3
Indirect taxes	6.9
Wages and salaries	16.4
Surplus, including net income of unincorporated businesses	141.2
Total	203.4

Source: National Energy Board, Economics Branch, op. cit., Appendix I.

Data on the pipe line industry's 1961 'capital account' expenditures were obtained by direct survey of the pipe line companies' spending. Aggregate capital expenditure was $166 million. The principal inputs included $70 million of steel line pipe, $37 million of contracted construction work, $14 million in transportation, principally by rail, $8 million of pumps, compressors and motors and $6 million worth of valves.

The 1961 input-output model was "closed", subsequent to its 1969 publication, and an attempt has been made to calculate the effects of respending of personal incomes generated. The results of the National Energy Board staff study on the impact of pipe line current and capital account spending in 1961 are set out in Appendix VIII-4. Regrettably, detail as to the method of calculation is not available from the source document.

The total impact of pipe line industry current and capital expenditures on Gross Domestic Product (GDP) at factor cost was calculated to be some $505 million, representing 1.4 per cent of total Canadian GDP in 1961 which was $35,025 million. The multiplier effect of the initial expenditure of $370 million was therefore 1.37.[1] The interpretation is that the average dollar spent by the pipe line industry generates $1.37 in national income. For comparison, a recent unpublished study of Canadian defence expenditures using the Statistics Canada input-output model yielded a multiplier of 1.67.[2]

Employment generated in 1961 by pipe line industry operating and capital expenditures amounted to 29,000[3] man-years - again, see Appendix VIII-4. This represents the amount of employment that took place in industries directly or indirectly supplying the pipe

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[1]For operating expenditures, the multiplier was 1.32 and for capital expenditures 1.43. The difference presumably reflects the different composition of current and capital expenditures in terms of the input-supplying industries.

[2]Cited in National Energy Board, op. cit., p. 18.

[3]Total employment of 31,750 minus direct employment of 2,750.

line industry with operating supplies or capital goods. Additionally, the industry itself used directly 2,750 man-years of employment. The implied employment multiplier of more than ten is strikingly high.[1]

The Employment Impact of Petroleum and Other Energy Production and Refining - The foregoing studies have not yet been published. However the Statistics Canada 1961 input-output data have recently been used to derive estimates for publication of the employment impact of energy production and, for purposes of comparison, of the employment impact of production in other economic sectors.[2] Estimates, summarized in Table 10 below, were presented of direct and indirect (including induced) employment per million dollars of output and of the "multiplier effect" in terms of the ratio of total employment to direct employment.[3]

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[1]It will be noted from Appendix VIII-4 that the employment multiplier of pipe line capital spending is much greater than that of pipe line operating expenditures. This situation is probably typical of other oil industry operations and of capital-intensive economic sectors generally. However data are lacking to give quantitative support to such a conclusion.

[2]An Energy Policy for Canada, op. cit., Vol. 1, pp. 156-159.

[3]Ibid., p. 157, table 1.

TABLE 10

THE EMPLOYMENT IMPACT OF PETROLEUM PRODUCTION AND REFINING COMPARED TO OTHER SECTORS, 1961

	Employment per Million Dollars of Output			
	Direct	Indirect[1]	Total	Multiplier
Production/Mining				
Coal	98	30	128	1.3
Petroleum and gas wells	10	35	45	4.5
Uranium	19	24	43	2.3
Refining/Manufacturing				
Motor vehicle (manufacturing)	9	65	74	8.2
Pulp and paper (manufacturing)	46	97	143	3.1
Petroleum refining	5	37	42	7.8
Transportation				
Pipe line	8	24	32	4.0
Rail	67	46	115	1.7
Truck	46	48	94	2.1

Source: Ibid.

[1]Indirect employment includes employment induced by spending of wages and salaries but excludes that resulting from these industries' capital spending. The source provides no further explanation and no indication as to the methodology by which these data were developed.

Note.- These data are presented as a matter of interest. However, because the underlying methodology is unknown, a high degree of confidence cannot be attached to them.

In each category of activity - mining, manufacturing and transportation - the petroleum industry showed by far the lowest direct employment per unit of output of any of the industries examined. Conversely, in each category the petroleum activity showed either the highest or next-highest employment multiplier[1] - production 4.5, refining 7.8[2] and pipe lines 4.2.[3]

This sort of result is of course to be expected of an industry characterized by low direct employment and a large value-added (see Appendix VII-3). Disappointingly, however, no explanation as to how these estimates were obtained is given in the source document or its appendices.

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[1]The term is used loosely here - see footnote to Table 10.

[2]Frank and Kubursi, op. cit., concluded that petroleum refining in Ontario had a direct and indirect employment multiplier of 7.2 as compared to a range of 1 to 3 for most other industries in the province.

[3]This result is closely in line with that of the unpublished National Energy Board study already referred to (p. 230 above) in which direct operating employment in the Canadian pipe line industry in 1961 of 2,750 man-years was found to result in total direct and indirect employment of 11,750 man-years, implying a multiplier of 4.3. This latter factor should not be confused with the total direct and indirect employment multiplier of more than ten for operating employment and employment in capital-goods supplying industries (p. 233 above).

The study did point out that direct employment alone is not a very useful guide to an industry's economic impact: account must also be taken of the multiplier effect of direct employment;[1] of the industry's profitability; and of the outlook for markets for its products. In this connection the employment effects of eastern Canadian coal mining operations were compared unfavourably with those of petroleum refining.

Economic Impact of Petroleum Operations Calculated by Extrapolation of Income and Employment Data for One Company - Alternative approaches to estimation of the income and employment effects of petroleum industry expenditures have been advanced by Imperial Oil Limited.

In an address to the Chemical Institute of Canada on 1 April, 1971, V.C. Larson, Imperial's Coordinator, Business Environment, claimed that this company in 1969 accounted for about 0.8 per cent of Canada's Gross National Product (GNP) and that, since Imperial was responsible for about one-fifth of the total Canadian petroleum industry, the latter's contribution could be assessed at about 4 per cent of GNP. In subsequent correspondence with the writer,[2] R.A. Calvin, the

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[1]Admittedly, the data presented in the study did not take proper account of the multiplier effect of direct employment by virtue of their exclusion of employment created in capital-goods supplying industries.

[2]Letter of 23 April, 1971.

company's corporate economist, explained that the value of total company product had been estimated by summing wages, salaries and supplementary labour income; corporation profits before taxes; depreciation and amortization; net interest income; net dividend income and indirect taxes. In other words, the estimators were attempting to apply to the corporation certain basic concepts of national income accounting. The total of the items described was $666 million, which figure was put against 1969 GNP of $78.5 billion.

In attempting to apply the "income approach" to measurement of Imperial's contribution to GNP, Calvin and Larson may have taken some short-cuts and seem to have omitted some items such as an inventory adjustment, but the effects of these deficiencies is possibly small. For example, profits should only include earnings of Canadian factors and dividends paid to non-residents should have been excluded. On the other hand depletion charges, provincial mining taxes and charitable contributions should have been added back to profits or separately categorized. Possibly these adjustments would roughly offset one another. Imperial's methodology, which was said to have been checked with the (then)

Dominion Bureau of Statistics, may well constitute an acceptable approximation for the purpose in view.

As to employment effects, Imperial Oil has attempted a similar extrapolation based on its own employment data in an effort to overcome the difficulty posed by use of Statistics Canada data which reflect only the industry's direct employment[1] (see Appendix I-1). W.O. Twaits, Imperial's Board Chairman, claimed[2] that "the industry in all its branches offers direct employment to 184,000 Canadians[3] and that over another

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[1]In 1970, about 15,000 in oil and gas production, 3,000 in oil and gas pipe lines and 17,000 in petroleum and coal products manufacturing, i.e., mainly oil refining (see also Appendix I-1).

[2]W.O. Twaits, "Philosophy of Exploration", being an address to the 40th Annual Convention of the Prospectors and Developers Association, Toronto, 8 May, 1972.

[3]Twaits' figure includes oil and gas distribution and retail selling activities, i.e., transportation of oil other than by pipe line; service stations; heating oil sales and service; and natural gas distribution. These activities presumably account for the large difference between direct employment in production operations of some 35,000 (see footnote 1 above) and Twaits' figure of 184,000.

90,000 not directly employed in the industry depend on it for their livelihood". Mr. Twaits went on to say that of the industry's average annual expenditures for new plant and equipment of about one and a half billion dollars, some $1.2 billion "ultimately goes back to labour in the form of salaries and wages" which, given an average annual income of $7,000, "would mean that some 170,000 additional Canadians are dependent on the (petroleum) industry's plant and exploration expenditures".

These corporation efforts to demonstrate the income and employment effects of the petroleum industry may be lacking in analytical rigour but a more fundamental weakness from the standpoint of the present study is that they relate to the whole range of the industry's activity. Thus, as well as exploration for and production of oil and gas, operations such as refining and marketing are included which would be carried out, although possibly on a smaller scale, even if indigenous petroleum resources were not exploited and Canada's oil supply had to be totally imported.

Conclusion - The quantitative evidence so far available regarding the national income and employment effects of Canadian petroleum resource development is fragmentary, inconsistent as to coverage and generally out of date. Precise, supportable conclusions as to the national economic impact cannot be drawn. However, the data do not suggest that in the 1960's the western Canadian petroleum industry was a dominant factor in the national economy in terms of its contribution to national product or to employment, direct and indirect.

4. Regional Benefits

Hanson - The leading authority, in terms of published work, on the regional economic impact of Canadian oil and gas development is Professor E.J. Hanson of the University of Alberta.[1]

Hanson's 1958 book, Dynamic Decade,[2] was concerned with the evaluation of the effects of the oil industry in Alberta during the period 1947-1956. The last five chapters are concerned particularly with economic impact.

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[1]The discussion of regional economic effects which follows relates primarily to the Alberta economy and secondarily to the Prairies region. Petroleum resource development in British Columbia has so far been confined to the northeastern part of the province east of the continental divide. In terms of geology, this region is in the petroliferous western Canadian sedimentary basin. Politically part of British Columbia, it is economically part of the Prairies.

[2]Hanson, op. cit.,(see above, p. 210).

In regard to the general economic development of the province in this period, Hanson put forward provincial capital investment data adjusted to take account of the large petroleum industry expenditures for land acquisition, surveys and drilling which are excluded for national accounts purposes[1] but which, in Hanson's view, constituted for the most part a capital inflow having important effects on regional incomes.[2] This treatment results in "investment" attributable to petroleum operations more than one billion dollars larger over the decade than the figure arrived at using national income accounting concepts. From these revised investment data are derived estimates of Alberta income generated during the period under review by petroleum

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[1]Excluded, that is, from business capital formation in totals of Gross National Expenditure, see p. 180. Hanson's use of the terms "capital" and "capital investment" is inexplicit. The labour-income components of such expenditures would of course be included in Net National Income. Payments for land acquisition are simply payments for the transfer of assets and therefore are not a component of National Income. In western Canada these payments are made principally to the provincial crown for mineral rights rather than to landowners for rights of surface access. They therefore tend not to put speculative gains in the hands of individuals (see pp. 265 and 267).

[2]Hanson's view is surely correct in that, by increasing the total of consumption and investment expenditure intentions, such an inflow of funds would result in an increase of total income, always assuming the economy was not already at capacity.

investment and operations. The derivation of the income estimates is not clear; the implication, however, seems to be that for each dollar "invested", in Hanson's definition, slightly less than one dollar's worth of income was generated in the province. In the aggregate nearly $3 billion worth of Alberta personal income was found to have been generated in this way during the decade. Additionally, attention is drawn to the investment in other areas - from commercial and residential construction to pulp and paper - financed largely by non-resident funds and indirectly attributable to petroleum development. Finally, Hanson derives estimates of the income contribution of petroleum, agriculture and residual activities leading to the conclusion that in 1955-56 petroleum overtook agriculture as the principal source of personal income generation in Alberta.

In further elaboration of the income effects of Alberta petroleum development, Hanson makes estimates of personal income with and without petroleum development leading to an estimate of the additional per capita income "with oil" which is put at $375 in 1956. After inclusion of government services provided as a result of development of the industry, of royalties, cash bonuses and lease-fees received by government and by some residents and of an allowance for the income effect of differences in prices of petroleum products with local resource development,[1] the per capita value of benefits accruing to Albertans in 1956 as a result of petroleum industry development is assessed at some $400 (as against estimated actual personal income per capita in that year of $1,370).

This larger per capita income was enjoyed, in Hanson's analysis, by a population which in 1956 at 1,123,000 was some 320,000 larger than it would have been if there had been "no oil". Petroleum development, Dr. Hanson argues, spared Alberta from continuation of the near-stagnant population situation which the province experienced between 1931 and 1946. In this regard, the contrast between the Alberta situation and that in the other prairie provinces has been quite striking. As well, this province has experienced more rapid urbanization than Manitoba or Saskatchewan and is now more completely urbanized than Saskatchewan (see Appendix VIII-5).

Hanson's conclusion is that "just as the

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[1]See pp. 212-213 above.

development of the agricultural potential of Alberta's land led to rapid settlement and new employment and income opportunities half a century ago, so the petroleum potential has induced a great rise in population and income at mid-century. In both cases a high rate of economic progress was made possible by substantial inflows of capital and labour".[1]

Hanson's 1958 work contains extensive descriptive and statistical material but insufficient information is furnished on methodology to enable the reader to form an opinion as to the validity of the conclusions summarized above.[2] In a 1966 paper however he seeks in part to remedy this deficiency.[3]

In it, Hanson first up-dates the estimates of income and employment effects from his 1958 book, passing some critical observations on Caves' and Holton's

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[1]Hanson, op. cit., (1958), p. 290. This is a valid comment on the impulse-to-growth aspects of agricultural and mineral development. In the long-term however the economic impact of use of a renewable resource is bound to be different from the exploitation of a non-renewable resource.

[2]It was "editorial policy to leave out . . . detailed work and methodology . . ." (letter from Professor E.J. Hanson, 3 December, 1971).

[3]Hanson, op. cit., (1966).

conclusions, published in the interim, which pointed to a very modest contribution to employment by the petroleum industry.[1] Their statements "which need correction badly" were based, Hanson points out, on the application of an employment multiplier to a very small base of petroleum employment extracted from the 1951 Census of Canada.[2] It is Hanson's thesis, which seems to have been borne out by later work, that the employment afforded indirectly by, for example, the industry's capital spending and its requirements for services, is large in relation to its direct employment.

Hanson goes on to elaborate his "export base concept". This is a tool for analysis of economic growth in a region, defined as an area where growth is contingent upon exogenous factors manifesting themselves mainly as increases in demand for exports of the region, capital imports and cost reductions in local manufacturing.[3]

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[1]See footnote on p. 209 above.

[2]Hanson, op. cit., (1966), p. 8.

[3]Presumably cost reductions would be manifest in other primary industries, such as farming, and in the service industries as well.

An export base income model is developed and then applied to the Alberta petroleum industry case. While data deficiencies prevent the application from being as detailed and rigorous as the formulation, the approach is more explicit and generally more satisfactory than that in Hanson's 1958 book. The conclusion is reached that petroleum exploration and production were the prime generators of Alberta's economic growth from the post-war years through to the 1960's. Not only was petroleum-generated growth faster than that attributable to agriculture[1] and other export activities, it was also steadier. In Hanson's words, "It appears that the development of the petroleum industry has practically doubled the size [between 1946 and 1964] and multiplied the complexity of the Alberta economy"[2]. His quantitative estimates are summarized in Table 11.

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[1]The expansion-phase of agriculture in Alberta and the associated growth-stimulus was of course well past by the time the petroleum boom began.

[2]Hanson, op. cit., (1966), p. 30.

TABLE 11

PERSONAL INCOME GENERATED DIRECTLY AND INDIRECTLY BY EXPORT INDUSTRIES IN ALBERTA

(per cent of total personal income)

	1947	1952	1957	1964
Petroleum	5	28	45	47
Agriculture	75	56	37	35
Other	20	16	18	17

Source: Hanson, *op. cit.*, 1966, p. 26 and p. 37, table 6.

Hanson's latest effort in this field was a 1968 paper reviewing the economic bases and prospects of western Canada.[1] The conclusion was reached that the expansion of the western Canadian economy during the post-war period, particularly rapid in Alberta and British Columbia, was the result of a high level of investment in resource industries, particularly petroleum, forestry and mining. A large part of these investment expenditures was financed from sources outside western Canada, particularly the United States. The inflow of

[1]Hanson, "The Economic Prospects of Western Canada", in *Transactions of the Royal Society of Canada*, Volume VI, Series IV, Section II, June 1968, pp. 245-249.

capital, labour and know-how which, in Hanson's judgement, had profoundly important effects on regional income generation, depended fundamentally on the availability of export commodities and markets for them. Petroleum is the prime example.

Weinrich - The most recent and possibly most comprehensive study to be cited in connection with the regional economic impact of petroleum development was carried out in 1965-66 by J.E. Weinrich.[1] Despite his title, Weinrich dealt with the petroleum industry as a whole, presumably because he was unable to abstract the gas industry from the total.

As to the income effect of petroleum industry activity, Weinrich estimated its total investments, including related and ancillary industries, at $3 billion in the period 1951-1965 inclusive and calculated that these investment expenditures generated an additional income in Alberta of more than $8 billion, an average of more than half a billion dollars annually. This was equivalent to some 21 per cent of Gross Provincial Product during these years.

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[1] J.E. Weinrich, "Economic Impact of the Canadian Gas Industry - Local, Provincial and Regional" (Calgary, Alberta: Calgary Chamber of Commerce, 1966, mimeo).

Regarding employment effects, Weinrich pointed out that this measure of impact has several dimensions. Thus, the oil and gas industry, he noted, had played an important role in developing managerial and skilled labour talent. This was reflected in the higher-than-national-average proportion of managerial, professional and technical people in the Alberta labour force.[1] Secondly, employment in the petroleum industry tended to be better paid than comparable occupations in other industries. Finally, Weinrich expressed the view that, because of the high "services" content of petroleum industry inputs (see p. 228 above) the trend towards "service employment" in Alberta had been stimulated. Concerning multiplier effects of petroleum industry employment, Weinrich concluded that in 1964 this was 3.34 for the province of Alberta and 7.51 for the city of Calgary. The higher figure for Calgary was explained by the establishment in that city of the head offices of petroleum firms.

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[1]This component of the labour force showed a sharp increase in the period 1951-1961, presumably reflecting in part a large proportion of skilled-labour in the wave of immigration which occurred during that decennium.

Despite its length (214 pages) and the profusion of tables, charts and appendices (127 in all), Weinrich's quantitative work is a little disappointing. For example, the income multiplier of 2.5 for petroleum industry investment[1] is merely Hanson's figures of 2.0-2.3 "up-dated" to take account of a reduced propensity to import and "reinforced" by a National Industrial Conference Board study which put "the domestic multiplier in most nations . . . (at) 2.8".[2] Nevertheless, a review of Weinrich's carefully-assembled data on provincial petroleum industry activities, revenues, expenditures, taxation payments, direct and indirect employment data leave the impression that his conclusions,

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[1]An advertisement by TransCanada PipeLines which has appeared in recent trade-press publications ("Oilweek" for example) lists the purchases it has made in the province since 1958. It ends with the statement "Multiply these figures by 2½ times to get the full impact of our purchases in Alberta". This may be Weinrich's investment multiplier but the implication is that it can be applied to some items - gas purchases and royalties for example - which Weinrich surely never intended.

[2]Weinrich, op. cit., p. 90. The multiplier in the Conference Board study relates to the average of all sectors of the economy, not to the petroleum industry alone.

like those of Hanson to whom he gives a special note of appreciation for the insights and methodology of his 1958 book, are more firmly based in the evidence than those of Caves and Holton (see p. 209 above).

Hedlin Menzies - A study prepared in 1968 for the Federal Government contains some data on the contribution to the Prairies economy of various economic sectors in 1964.[1]

The authors first estimated Gross Provincial Income (GPI) for the three Prairie provinces by pro-rating Gross National Product in proportion to each province's share of national personal income. They noted that the Manitoba Treasury Department had found this simple technique gave results that were within three per cent of those calculated by an (unspecified) more sophisticated technique.[2] The value added by various sectors of each provincial economy was then

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[1]Hedlin Menzies and Associates, The Wheat and Oilseeds Economy in Canada, A Report Prepared for the Federal Task Force on Agriculture (Winnipeg: Hedlin Menzies and Associates, August 1968, mimeo), pp. 9-16.

[2]Ibid., p. 11. "Gross Provincial Income" is the Manitoba Treasury Department's term. In the Hedlin Menzies report it is used interchangeably with Gross Provincial Product.

calculated and compared to the data on GPI. Salient results are displayed in Table 12.

TABLE 12

PERCENTAGES OF GROSS PROVINCIAL PRODUCT ARISING IN LEADING SECTORS IN EACH OF THE PRAIRIE PROVINCES IN 1964

Industry	Manitoba	Saskatchewan	Alberta
Agriculture			
Wheat farming[1]	3.3	14.4	3.6
Oilseeds	0.9	0.7	0.5
Cattle and calves	1.2	2.6	2.4
Mining			
Nickel	2.9[2]	-	-
Potash	-	1.4	-
Petroleum			
Crude oil	0.4	7.9	12.1
Natural gas	-	0.1	4.3

Source: Hedlin Menzies, *op. cit.*, p. 14, table 3.

The regional importance of each of these sectors can be developed from the estimates of regional Gross Provincial Income, according to which in 1964 Manitoba accounted for 29.5 per cent of Prairies GPI, Saskatchewan

[1]Wheat is not of course the only grain crop on the Prairies - barley, oats and rye are also important, mainly as feed grains - but wheat is paramount, occupying a place in the agricultural business akin to that of crude oil in the petroleum industry.

[2]Similarly, nickel from Birchtree and Thompson is not Manitoba's only mining industry but it is the dominant one: in the mid-1960's, the value of nickel production was about three times as great as the value of copper and zinc, produced mainly in the Flin Flon and Snow Lake areas.

for 27 per cent and Alberta for 43.5 per cent.[1] On this basis, crude oil and natural gas together were the leading industry accounting for 10.5 per cent of GPI, the three agricultural sectors combined represented 9.3 per cent of the total and the two mining industries for 1.2 per cent. The growth of the petroleum industry since 1964 has been appreciably faster than that of the Prairies region economy as a whole. The relative importance of this industry must therefore now be appreciably greater than in the mid-1960's.

<u>Other</u> - The recently-published Federal Government energy study notes that the energy industries "create important employment effects in certain regions of Canada that do not presently benefit from a high degree of manufacturing concentration".[2] Alberta is taken as exemplifying this impact in the following terms.

> "Alberta has had the second fastest-growing population in Canada (second to British Columbia) over the last twenty-five years and there is no question that this growth is largely due to the development of the petroleum industry. Since the discovery of Leduc in 1947 it has been the petroleum industry which has changed an economy based almost entirely on agriculture to one having a much broader base."[3]

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[1] *Ibid.*, p. 13, table 2.

[2] *An Energy Policy for Canada*, *op. cit.*, p. 158.

[3] *Ibid.*.

Conclusion - The situation as to quantitative evidence for the regional economic impact of western Canadian petroleum resource development is not much more satisfactory than that in regard to the industry's national economic effects. However, it can reasonably be concluded that petroleum development strongly and favourably influenced the post-war growth of the Alberta economy and that by the mid-1960's this industry dominated the provincial economy and indeed had become the most important single element in the economy of the whole Prairies region. In the light of growth trends experienced in the intervening period, it is reasonable to assume that the industry's dominance in Alberta and its importance regionally are now even more pronounced.

5. "Linkages" and "Spread Effects"

The "broader base" which petroleum development has brought to the Alberta economy results from the appearance and development of "linkages" between petroleum and related new industries, whether resource-based, manufacturing or service industries, and the rest of the economy. "Backward linkages" involve the production of inputs for the new activity. "Forward linkages" result when the outputs of a new industry are subject to further processing or stimulate the development of entirely new areas of activity based only in part on use of these outputs.

The quantitative effects of petroleum development which have been touched upon arise because of linkages. They do not represent an effect separate from and additional to 'current account' and 'capital account' input-output effects previously discussed but are reflections of these input-output relations in terms of the generation of specific activity.

Backward Linkages - In the early years of western Canadian petroleum development the young industry had to depend almost exclusively on the skills, methods, knowledge and equipment of non-resident suppliers of services and equipment. Survey equipment and crews, drilling contractors, and even whole rigs, were transferred mainly from the United States to Alberta. Pipe lines were designed and the pipe and equipment manufactured abroad.[1] Oil and gas field-processing equipment was almost entirely imported.[2]

As it became clear that the western Canadian petroleum resource base was large enough to support a substantial producing industry for a lengthy period, so important backward linkages developed for the supply from domestic sources of the needed inputs of all kinds. The changeover from largely-imported to largely domestic-origin inputs appears to have occurred between the mid-1950's and the mid-1960's: this judgement is based on surveys by industry associations and the federal government in respect of a wide range of oil industry equipment and supplies.[3]

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[1]Pipe lines are properly regarded as a backward linkage because the production process of crude oil or natural gas cannot be regarded as complete until the commodity has been delivered to an intermediate buyer (an oil refiner or gas distribution system). Almost invariably this involves pipe line transportation.

[2]Weinrich, op. cit., pp. 75-80.

[3]Weinrich, op. cit., pp. 75-76 lists as "products which are now being manufactured in Alberta but which were formerly all, or chiefly, imported": sucker rods, rubber hose, welded fittings, pumping jacks, seismographic drilling bits, scrapers, scratchers, wire rope, pumps, oil rig drill bits, vessels, tanks, drums, compressors, condensers, heat exchanges, coolers, valves, special truck and vehicle chassis and oilfield electrical equipment.

Most of the capital and know-how for the Canadian manufacture of highly-specialized equipment - drilling machinery, valves, pumps and the like - was supplied by foreign companies, mainly American. Development of subsidiary manufacturing operations was in many cases a logical extension of businesses based initially on selling and servicing imported equipment. Most of these operations were established in Alberta,[1] but a few located in Ontario where the industrial base required to support complex manufacturing operations was of course much better developed.[2] Federal and provincial governments encouraged this tendency towards local manufacture of inputs by providing moderate levels of duty protection and by not putting barriers in the way of foreign investment.[3]

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[1]Examples: Cameron Ironworks (valves), Dresser Industries (drilling tools), Lufkin (oil well pumps).

[2]Example: Cooper Bessemer (compressors) at Stratford, Ontario.

[3]The activities of foreign-owned companies are of course another aspect of a "petroleum industry balance of payments".

Less-specialized equipment, which could be produced by established firms which were prepared to diversify, usually employing generally-available technologies and not requiring heavy research and development expenditures, was locally produced on an increasing scale and mainly by established Canadian companies. Examples of such equipment include tanks and boilers, electrical equipment, pipe line pipe and oil field tubular goods of all kinds.[1]

Over time, a third category of manufacture of equipment specialized to particular Canadian conditions has developed. Here domestic enterprise appears to have been remarkably successful. Examples include tracked vehicles for muskeg and snow conditions, air-transportable buildings for northern climates and winter outdoor work-clothing.[2]

As to services, there appears to be a strikingly high indigenous content to services as diverse as aircraft operations, consulting services in relation to processing

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[1]Examples: Canadian Westinghouse (electrical), Dominion Bridge (boilers), Interprovincial Steel (line pipe), Orenda (gas turbines), Steel Company of Canada (tubulars), Toronto Iron Works (tanks).

[2]Examples: Atco Industries (transportable buildings), Flextrac-Nodwell and Foremost Developments (tracked vehicles).

and interpretation of earth-sciences data, geological and geophysical surveys, pipe line construction, mapping and the like. A conspicuous remaining weakness is in terms of engineering services for large projects such as gas plants and pipe lines which are still dominated by foreign-owned enterprises, frequently relying heavily on senior staff "imported" to work on particular projects. The question of provision of Canadian-origin services in this area is currently engaging the attention of both the federal government (in connection with construction of northern pipe lines) and the Alberta authorities (in regard to the building of a second tar sands plant).

The manufacturing and service industries which have developed by backward linkage from petroleum resource exploitation have greatly increased the "Canadian content" of petroleum industry inputs. Not only has import leakage been reduced and the multiplier effect of petroleum expenditures increased but some of these industries have now developed to the point of doing a substantial export business. Canadian companies have recently provided consulting services to the European gas industry; drilled wells under contract in areas as widely separated as Alaska, Britain and

Australia; exported tracked vehicles to the U.S.S.R.; and supplied equipment for North Sea petroleum operations.[1]

Forward Linkages - Production of oil and gas involves certain processes which render these materials suitable for long-distance pipe line transportation. These include recovery of dissolved gas from crude oil, extraction of sulphur from sour gas and separation of natural gas liquids from natural gas. The substantial capital and operating costs of equipment required to perform these operations have been included in the foregoing material on economic impact. Although they are essential processes, they can be regarded as linkages and Weinrich appears to treat them as such.[2]

The exploitation of western Canada's petroleum resources has resulted in important development of oil refining and petrochemical manufacture.

Alberta has long been a net exporter (to British Columbia and Saskatchewan) of refined petroleum products

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[1] A Directory of Canadian Oil and Gas Equipment and Services (Ottawa: Department of Industry, Trade and Commerce, 1970). This document lists more than 300 Canadian firms offering a complete range of equipment and services to the oil and gas industries.

[2] Weinrich, op. cit., p. 41.

and has about ten per cent of Canadian oil refining capacity although the province accounts for only about six per cent of Canadian consumption of petroleum products (see Appendix VIII-6).

Nevertheless, about 97 per cent of the oil which leaves the province is in the form of refinery raw material destined for processing elsewhere in Canada and in the United States.[1] The major obstacles to a greater degree of "further processing" are distance from market, the difficulty of disposing of large volumes of co-products like residual fuel oil which are not readily transportable and the impact of United States tariff policy.

Petrochemical operations, which like oil refining are focussed on Edmonton, are of considerable local importance but their scale is small compared to those of Sarnia and Montreal (see Appendix VIII-7). Although

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[1]The Federal Government's recent energy study states that in 1972 Canada exported 422 million barrels of oil, of which 18 per cent was in the form of petroleum products (An Energy Policy for Canada, op. cit., Vol. 1, p. 171). It notes however that just over half of the exported products were derived from imported crude oil. This could give rise to the misleading impression that about 9 per cent of Canadian oil is exported as refined products. In fact the proportion is much less because the authors of the study have included as "oil products" the propane and butane co-products of natural gas processing.

raw materials are readily available at low cost, the western Canadian industry faces a major disadvantage in terms of long distances and high transportation costs of finished products to major markets of central Canada. United States markets are almost as distant, while Canadian finished chemicals face considerable tariff barriers. Similar comments apply to fertilizer manufacture based on natural gas of which there has been some development.

Enterprises in which petroleum is not the principal input but whose development may be indirectly attributable to the petroleum industry are difficult to identify. Mention has already been made of the development of earthenware manufacture at Medicine Hat before the first World War on the basis of low-cost local natural gas. More recent similar examples are hard to find.

It may be that, because fuel costs are a relatively small proportion of total costs in most manufacturing operations,[1] the savings which could be

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[1]The Federal Government's energy study discusses the role of energy costs and Canadian industry. It finds that direct fuel inputs per dollar of output vary from less than 1 cent in agriculture to 9.8 cents in the chemical industry. Direct and indirect fuel costs range up to 14 cents, with the chemical industry again near the top of the range (An Energy Policy for Canada, op. cit., Vol. 1, pp. 164-165).

achieved by locating near to the western Canadian petroleum resource have generally been outweighed by negative factors such as the relatively small and high-cost local labour market and the high cost of transportation to the mass-markets of eastern Canada and the United States. Certainly, Weinrich's list of new firm formations in Alberta between 1956 and 1965 encompassing some 140 enterprises and an aggregate investment total of $679 million[1] contains no obvious instance of an activity which might have been attracted to the province by considerations of energy cost. There are however half a dozen examples of firms manufacturing secondary plastics products whose existence must surely be attributable to the presence of a modest primary plastics industry based on petroleum-derived materials.

Mention must finally be made of government-, financial- and other business-services bearing on all phases of petroleum industry activity.

Governments, federal and provincial, provide for example geological and topographical information, transportation facilities and employee-recruitment

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[1]Weinrich, op. cit., pp. 53-59.

services as well as supplying a framework of regulation within which the industry carries on its operations. This "linkage" of course induces further employment in the economy.[1]

The western Canadian petroleum industry has a large requirement for financial services (see Appendix VIII-2, but note footnote). Examples include banking, stockbroking, underwriting of new equity and loan capital, investment advice and insurance services. Associated with this linkage are employment effects not only in the cities of western Canada, particularly Calgary, but outside the region as well - in Montreal, Toronto and Vancouver.

Lastly, the development of western Canada's petroleum resources has been accompanied by a strong real-estate and urban construction boom, particularly in Calgary and Edmonton. This development is reminiscent of that which accompanied the nineteenth century railway building. It has involved extensive office, hotel and other construction and has no doubt produced its own income and employment effects.

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[1] An Energy Policy for Canada, op. cit., p. 158 gives as an example of indirect employment ". . . public servants in duties related to the energy industry . . .".

<u>Other Spread Effects</u> - Consumer incomes have been favourably affected by employment - direct, indirect and induced - resulting from petroleum operations and by transfer payments made by the oil industry. In turn, higher incomes have been reflected in consumer spending. Aspects include housing development whether subdivisions in cities like Calgary and Edmonton or "new towns" such as Fort McMurray; retail merchandising, typified by the post-war development of the Hudson's Bay Company's department stores in Prairie cities; and entertainment and other consumer service industries, including travel and hotel accommodation.

In some areas - particularly Manitoba and parts of Saskatchewan - where mineral rights are held by the private-individual landowner,[1] there has been a large

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[1]Since 1887, rights to mines and minerals have been reserved to the crown upon the sale of crown land. From the 1890's, the railways and the Hudson's Bay Company (HBC) similarly reserved the mineral rights from the land they sold to settlers. As a result, mineral rights in western Canada belong to the surface-owners other than HBC and the railways only in the case of land purchased from the crown prior to 1888 and from the railways prior to the 1890's. In the petroleum-bearing areas of Manitoba, 15 per cent of the mineral rights are crown-owned, in Saskatchewan the proportion is 70 per cent, in Alberta 90 per cent and in British Columbia virtually all of the petroleum-bearing area is crown-owned (Earle Gray, <u>Impact of Oil</u> [Toronto: Ryerson/Maclean Hunter, 1969], pp. 31-32).

direct flow of non-employment income from the petroleum industry to the farm population by way of lease rentals and production royalties. As well, farmers throughout the petroleum-producing areas of western Canada have received incomes from the industry's lease of surface rights. Typically, however, mineral rights are vested in the provincial crown[1] and the related revenues have been diffused through the whole population: data on provincial oil and gas revenues are given in Appendix VIII-8. Particularly in Alberta these revenues have been very large. The provincial government has thereby been enabled to provide a high standard of public services while keeping direct personal taxation at very low levels. The absence of a provincial sales tax and the fact that in Alberta the gasoline road tax is the

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[1]Two principal corporate owners of large surface and mineral rights in western Canada are of course the Canadian Pacific Railway Company (CPR) and the Hudson's Bay Company (HBC). Canadian Pacific Oil and Gas Company was incorporated to develop the railway's rights. Despite the fact that the CPR's land holdings were generally located to the south of the principal oil and gas areas, modest success was achieved. The company in 1971 acquired another medium-sized petroleum enterprise and, as Pan Canadian Oils, became the largest Canadian-owned oil and gas producing company (see p. 147 and Appendix VI-1, sec. 4). HBC in the 1920's disposed of its petroleum rights in western Canada to the Continental Oil Company of the United States in exchange for a minority shareholding in what was to become the Hudson's Bay Oil and Gas Company (see Appendix VI-1, sec. 1), now one of the five largest oil and gas producers in western Canada.

lowest in Canada must be largely attributable to the size of the province's petroleum industry revenues.

Finally, and in contrast with United States experience, it may be observed that with some exceptions western-Canadian petroleum resource development has not been marked by the accumulation of large fortunes by individuals leading to personal social investment. This results in part from the short history of the western Canadian industry; from the mainly-public ownership of its mineral rights; from the regulation of competition in the petroleum industry; and from a different Canadian tax structure, but mainly from the predominance of the foreign direct-investment company as the principal source of investment and entrepreneurship in the Canadian industry.

A notable exception has been the philanthropic activities of Mr. Eric Harvie based on personal wealth which developed out of his fortunate (or shrewd) ownership of mineral rights in the Leduc and Redwater oilfields. Mr. Harvie's most important contribution is the Glenbow Foundation for archaeological and historical research which he established in 1955 and donated to the people of Alberta in 1967 through the Glenbow-Alberta Institute.

His public benefactions are said to have exceeded $20 million.[1] Philanthropy of a different kind - corporate and largely anonymous, as well as on a smaller scale - is represented by the Banff Foundation which is responsible for the Banff School of Fine Arts.

Conclusion - The development of western Canada's petroleum resources, besides adding its net output directly to the regional and national economy, has contributed important "spread effects". Opportunities have been created for investment in the production of services and commodities required as inputs for petroleum activities and in the further processing of petroleum outputs by way of oil refining, natural-gas processing and petrochemicals. These opportunities have been taken by local, other Canadian and foreign investors, resulting in the establishment, mainly in Alberta, of many new manufacturing and service industries. Apart from these linkage effects, petroleum development has added to government revenues and to private-consumer incomes resulting in successive rounds of spending, employment creation and income generation. The spread effects of petroleum development have been such that

[1] Gray, op. cit., p. 221.

the industry has been the most important single element contributing to the post-war growth of the Prairies economy. It is therefore concluded that, at least in a regional context, the western Canadian petroleum industry has had the role of a "leading sector" in a Rostovian sense.[1]

Summary

The development of western Canadian petroleum resources has had important national and regional effects.

The energy economy of Ontario and the western provinces has been transformed by the large-volume availability of indigenous natural gas at low prices while indigenous oil has resulted in substantial supply-cost savings particularly in the prairie provinces. Western oil and gas development has contributed to an improvement in Canada's external payments situation by displacing imports and by large export earnings which, at least until 1966, have not been nearly offset by direct imports of petroleum equipment; remittance of dividends; and fees paid for foreign consultant and management services.

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[1]Rostow, op. cit., pp. 52-57.

The national economic impact, in terms of direct income and employment generation, of the petroleum industry's current-account activities appears to be modest but when account is taken of the impact of its capital expenditures the effects are much more significant. This economic impact is concentrated in western Canada and the industry has had a profound effect on the post-war development of Alberta in particular. "Linkages" have occurred backwards to the supply of services and equipment for petroleum exploration, production and transportation operations. Forward linkages, as yet less vigorous, include oil refining and petrochemicals manufacture. Other aspects of the industry's "spread effects", which in total lead to the conclusion that petroleum has had the function of a Rostovian leading sector, include consumer spending, government revenues and expenditures and a continuing real-estate boom.

Chapter IX

CONCLUSION

1. The Staple Concept Defined

Innis' writings on the great staples of the past stressed the dominance, economic and otherwise, of large-scale production of the staple based on a massive resource. The main elements of his staples concept were summarized in The Fur Trade in Canada in the following terms:

> Energy has been directed towards the exploitation of staple products and the tendency has been cumulative . . . Large scale production of raw materials was encouraged by improvement of technique of production, of marketing and of transport . . . As a consequence, energy in the colony was drawn into the production of the staple commodity both directly and indirectly. Population was involved directly in the production of the staple and indirectly in the production of facilities promoting production. Agriculture, industry, transportation, trade, finance and government activities tend to become subordinate to the production of the staple for a more highly specialized manufacturing community.[1]

Buckley aptly sets out as follows the complementary themes of markets; technology to link the two and provide the basis for resource exploitation; capital sources to

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[1] Innis, op. cit., (1956), p. 385.

fund it; and resulting population growth:

> Essentially . . . the staple theory of economic growth . . . leads from the resources of a region to analysis of the markets for its staple production and through these to the determinants of market demand for its staple. It also leads to analysis of the effects upon capital formation and population growth induced directly and indirectly by the development of the resources of the region . . . It emphasizes the range of technology relevant to the production and marketing of the staple, whether . . . developed within or borrowed without . . . Resources are a function of technology and tastes; the emergence of successive staple-producing regions is dependent upon advances in technology and changes in tastes within the larger economy of which the regions become parts.[1]

To this listing of the essentials of the staple concept, Innis added the supply of labour, the role of governments and the conditions of competition in resource development and market disposition.

2. Petroleum as a Canadian Staple

Unlike earlier staples, the western Canadian petroleum industry had its first market impact on the local (energy) economy but quickly grew beyond meeting merely local needs as it began to serve extra-regional and international markets.[2] In a comparatively short time

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[1]Buckley, _op. cit._, p. 443.

[2]Wheat in central Canada is an exception to this generalization, see p.280.

the industry has stimulated the domestic economy and taken on a significance as an export commodity so as almost to assume the dimensions of a staple. However, despite its rapid growth between 1947 and 1972, the western Canadian petroleum industry did not, on the evidence so far available, dominate the Canadian economy in terms of its impact on income, employment and foreign trade. It therefore cannot be said to pass the essential test of a national staple.

There are two salient reasons for this. First, although Canada's petroleum potential is thought to be large by world standards, the resource so far discovered is of modest size, relatively low productivity and has a remote, land-locked location. There is an obvious contrast with the staples of the past which were generally characterized by the massiveness of the natural resource on which they were based and the relative ease, and therefore low cost, with which they could be produced. Fish, fur, white pine, and prairie wheat each exhibited, at the zenith of their exploitation, such a comparative advantage as to overshadow other Canadian primary industries. And each was in its turn of more than marginal significance to what Innis calls "the industrial areas of western civilization".[1]

Secondly, the national economic matrix in which the impact of western Canadian petroleum resource development is being felt is larger and altogether more complex than that in which the earlier staples developed. The lengthy phase of Canadian dependence on successive single staples has given way to a period in which an industrial economy, developed in part as a result of the spread effects of previous staples-induced growth, as well as exhibiting the characteristics of Rostovian maturity,[2] is experiencing the impact of parallel existence of several major resource industries. Of the earlier staples, wheat is of continuing importance and new national staples, the forest products industries of the Shield and western Cordillera and the non-fuel minerals industries, share with petroleum outstanding roles in the national economy.

In these circumstances, it may be doubted whether the Canadian economy could now be dominated by a single

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[1] Innis, op. cit., (1956), p. 386.

[2] See pp. 7-8 above.

staple. Contemporary cases of national dominance by a single staple must be sought in economies which possess only one important export resource in relation to current technology and markets - Venezuela, for example, where petroleum accounts for one-fourth of GNP and for over 90 per cent of merchandise exports.[1]

However, regions within Canada may be and are still dominated by a single resource product or product-group. Thus, in the western prairies, the petroleum industry has replaced wheat farming as the leading economic sector. Petroleum resource development occurred during a period when the wheat economy, although still important, was experiencing a relative decline. The growth of the petroleum industry was rapid and continuous, except for a pause in the period 1958-1961, whereas the value of wheat production showed very sharp fluctuations.[2]

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[1] William G. Harris, "The Impact of the Petroleum Export Industry on the Pattern of Venezuelan Economic Development", in Raymond F. Mikesell, Foreign Investment in the Petroleum and Mineral Industries (Baltimore: The Johns Hopkins Press, 1971), p. 129. Mikesell's collaborators provide several examples of the impact of staple exports, including petroleum in Iran and copper in Chile.

[2] The value of production in poor crop years (1954, 1957, 1958, 1961) was much less than half of that in good years (1952, 1963, 1964). Hedlin Menzies, op. cit., p. 13, table 2.

Although direct employment in the petroleum industry was and remains only a fraction of that engaged in wheat farming, the agricultural labour force has been declining, presumably with unfavourable effects on indirect employment.[1] By contrast, employment in the petroleum industry and in activities stemming from it has grown. Similarly, the "spread effects" of an expanding petroleum industry have been extensive, particularly in Alberta and Saskatchewan, while those associated with relatively stagnant agriculture have been adverse. Petroleum development essentially has accounted for the fact that Alberta's economic growth in the post-war period exceeded the national average. The petroleum industry has contributed to British Columbia's similarly favourable performance, while in Saskatchewan the development of this industry, and of the potash resources which were discovered in the course of oil exploration (see above, p. 26) has helped to offset the weak and unstable performance of the wheat economy. From Saskatchewan to

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[1]As Fowke has noted, "Wheat remains an important staple of Canadian commerce [and, it might be added, of employment and national product], but there is a great difference between a continuing commerce and an expanding one". Vernon C. Fowke, Canadian Agricultural Policy (Toronto: University of Toronto Press, 1947), p. 280.

north-eastern British Columbia, the petroleum industry has become the "leading sector" of new development by setting the pace of economic expansion, giving rise to new service and manufacturing industries, stimulating government and consumer spending and thereby encouraging business capital investment, creating a continuing real-estate boom in the cities of Alberta and freeing the area from over-dependence on agriculture and related activities.

On these grounds, the western Canadian petroleum industry certainly qualifies as a "regional staple". It has provided a new impulse to growth, restoring the western prairies as an area of investment opportunity and expanding population based on natural-resource development, a status which the area had lost between 1930 and 1947.[1] Moreover, as a "leading sector" of the post-war Canadian economy, the petroleum industry's development has had favourable effects on economic growth and development far beyond the geographical confines of the resource on which it was based.

The new investment opportunity has been taken chiefly by foreign entrepreneurs drawing on foreign capital funds as well as on domestic saving by means of borrowings on the Canadian capital market.

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[1]Fowke wrote in 1947 "The vital frontier of Canadian investment in fixed equipment since 1930 has been in the Pre-cambrian Shield instead of in the agricultural West, in newsprint and minerals instead of in wheat". Fowke, op. cit., p. 281. It is a contention of this thesis that petroleum has re-established a frontier of investment and economic growth on the western plains.

This is not a novel situation. The history of foreign capital in Canadian resource development goes back to the earliest days of the cod fishery, with striking and recurrent examples since then. Experience in the case of petroleum is therefore by no means unique whether in an historical perspective or in comparison with contemporary resource industries such as forest products or metallic minerals. What is distinctive is the overwhelming importance of the foreign direct investment company, although the obvious parallel case of the Hudson's Bay Company precedes the petroleum example by nearly three hundred years. However, foreign capital in Canadian staple development has, in a number of important instances, been organized and controlled by Canadian residents (the case of railways as an adjunct to the wheat economy) or its foreign entrepreneurs have eventually been absorbed into the Canadian economic and social matrix, although retaining some dependence on foreign capital sources (the Montreal fur trade and the agents of the square timber trading companies).

The preponderance of foreign capital and enterprise results in important investment decision-making powers being concentrated in the hands of outsiders, including the governments of countries in which the foreign investors are domiciled. It is arguable that the inhabitants of the resource-rich area have thereby lost economic initiative and control and that the economic maturity of the region is little advanced by development of the staple. This view appears to over-simplify reality. It necessarily discounts the rôle of Canadian management and of Canadian minority share-holding in foreign-controlled companies. And it assumes that, faced with a similar set of economic conditions and choices, the foreign investor will behave differently from the native one. Moreover, it neglects the fact that resource staples by definition are inextricably linked with external circumstances largely beyond the control of the resource-producing region. Foreign transportation routes, markets, technology and governments, as well as foreign investors, have historically shaped the rate and direction of Canadian staple resource development.

Markets have played the same critical rôle in the development of the western Canadian petroleum industry as they have for other staple products. There are, however, important contrasts.

The initial development of Canadian petroleum resources took place to supply domestic oil and gas markets, first in the Prairies, later in Ontario and British Columbia. With the important exception of wheat in central Canada, the staple products of the past were from the start developed to meet demand from an outside metropolis. Large domestic markets for these earlier staples emerged only after local economic activity and the growth of population had progressed, often under the influence of the staple itself and then never on a scale to compare with continued exports.

This contrast with the development of markets for earlier staples is explicable partly with reference to the stage of economic development which had been reached when the large-scale exploitation of the western Canadian petroleum resource began, partly by the nature of the demand for the petroleum resource.

Energy is among the most ubiquitous of resource commodities in terms of its demand patterns. All forms of modern economic activity require commercial energy sources; cheap and plentiful energy provides a stimulus to almost any productive activity, as well as improving amenities for households and institutions of all kinds.

The contrast, in terms of domestic market opportunities, with resource materials having more specialized uses - nickel for example - is obvious. A further contrast is that use of the staple in the domestic market has strongly modified the regional and national energy economy by making oil fuels cheaper and more abundant and by introducing a new fuel, natural gas. The energy economy has thereby been diversified and strengthened with economic and technical benefits for the economy and society as a whole. The consequent "thickening" of the economy by virtue of local consumption of the resource commodity may be unique to the petroleum case.

Concerning the stage of Canada's economic development, by the late 1940's several phases of growth had occurred under the influence of successive and diverse staples. The domestic economy therefore presented a large market for energy materials which new indigenous sources could enter by import displacement. Export markets in adjacent areas of the United States were developed after western Canadian oil had been brought to the most-accessible domestic markets. In the case of Ontario and the lower mainland of British Columbia, western oil was delivered by pipelines which also served adjacent foreign markets.

These foreign export markets came to play a critical role in the development of the petroleum resource. During the 1960's, export demand and the economies of scale associated therewith was responsible for most of the growth in production of oil and gas so that by the early 1970's about half of western Canada's petroleum was finding a market abroad.

If "export" is taken to mean use outside the resource-producing region's boundaries, however, rather than outside the country, then export markets have been dominant since the completion in the 1950's of the main interprovincial oil and gas pipeline systems.

Such an interpretation would be consonant with the conclusion already drawn that the western Canadian petroleum industry may be regarded as a regional rather than a national staple.

Moreover, the expectation that external markets would quickly be found for petroleum resources discovered on the Prairies was undoubtedly an element in the decisions of Canadian and foreign companies to invest in the search for and development of oil and gas in western Canada. It must have been clear that extra-regional markets in Canada could be entered by import-displacement.

Penetration of the large United States market would have appeared to involve displacement of indigenous oil and gas or of overseas imports: in practice, United States' requirements of all forms of petroleum were growing so rapidly from the 1950's onwards that Canadian oil and gas tended to supplement indigenous supplies and, in the case of oil, to involve only the relatively small displacement of imports.

While generally-favourable market expectations were a positive factor in entrepreneurial investment decisions, the prospect of being able to export to particular United States refinery markets was probably not a major factor in investment decisions by American oil companies which took part in the petroleum search in western Canada. In the case of oil, the system of pro-rating to market demand in Alberta assured all producers of equal access to the available market. In the case of gas, the companies which discovered and produced gas in Canada were not related to the United States utility companies which imported and distributed it in the export market.

Technology of resource-exploitation and transportation played the same key role in the case of

Canadian petroleum development as it had in the development of earlier staples. The applied sciences of petroleum exploration and production find earlier and cruder parallels in the metal tools which opened the beaver lodges and the steel ploughs, barbed wire, farm-windmills and reaper-binders which were critically important to the wheat economy. The long-distance, high-pressure pipelines which bring oil and gas to distant markets are today's equivalent of the sailing vessels in the Atlantic fisheries and the British square timber trade, the York boats of the Hudson Bay fur trade and the railways and steamships which made possible the development of prairies wheat. The technologies which were associated with petroleum development were generally imported, thus affording points of comparison with those which permitted fish, wheat, pulp and paper, and metallic minerals resource development and of contrast with some of the technologies which were critical for the fur trade and for the nineteenth century square timber trade.

The direct labour requirements of the western Canadian petroleum industry have been and are small, but the industry's employment multiplier is apparently large, and indirect employment is therefore much more substantial.

Both the petroleum industry itself and the industries which service it are characterized by a high proportion of professional and skilled manpower - managers, scientists, engineers, welders, mechanics and other skilled manual trades. The lack or even absence of a local pool of such skilled labour is of course a common circumstance when a new "frontier" of petroleum development is opened up. This is seldom an obstacle to such development because this industry has always been characterized by a high degree of skilled-labour mobility. The post-war growth of population in Alberta therefore reflected in part immigration from other provinces and from abroad. In particular there was in the early years after the Leduc discovery substantial immigration of professional and skilled labour from the United States, generally on a contract or "tour of duty" basis. However, the petroleum industry seems to have been able to meet an increasing proportion of its specialized labour needs by local recruitment. This writer is impressed by the large number of Prairie natives who have risen to senior management positions in western

Canadian oil and pipe line companies[1] and in related provincial government employment. This situation, which is repeated in the ranks of middle management, professional and skilled manual employees, reflects favourably on the educational system of the Prairie provinces where high standards were apparently maintained during circumstances of severe economic depression and war.

Government has played an important role in the development of Canada's staples from the earliest times. The petroleum industry is no exception. Governments, provincial as well as federal, have collected and disseminated basic geological information; provided topographical mapping; given access to crown-owned mineral rights on an orderly basis; regulated the conditions of competition in production; shaped and encouraged the development of transportation systems; helped to mobilize capital; provided tax incentives for petroleum exploration and production; and afforded a degree of protection in domestic markets and, under the

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[1]All six western-Canadian members of the National Advisory Committee on Petroleum are Canadian citizens. Four were born and educated in the Prairies. Two were American-born but have resided in Canada since the early years of the petroleum boom.

United States Oil Import Program, in export markets too. Parallels can obviously be drawn with the French regulation of the fur trade, with the role of government in railway development and with the importance of customs preferences related to national security objectives in the case of the British market for Canadian timber.

There are, then, grounds for concluding that the western Canadian petroleum industry exhibits, albeit in somewhat modified form, a number of the salient characteristics of the great staples of the past.

A substantial, remotely-located natural resource was developed, largely by foreign capital and entrepreneurship, employing new or specially-adapted mainly-imported technologies of exploitation and transportation, to serve, after an initial domestic phase, an export oriented market. The overall development of the resource was fostered by government policies directed to securing its rapid development and related economic expansion, regional prosperity and growth of population. The direction and rate of growth of markets for the oil resource was moulded by government policies of a protective nature related in part to security considerations. The petroleum resource development which occurred between 1947 and 1972 did not dominate the large and complex post-war Canadian economy, but the industry did have the function of a Rostovian leading sector in the growth of that economy. Moreover, the industry had a dominant regional impact in the western prairies. It is therefore concluded that oil and gas can legitimately be regarded as "regional staples of the new industrialism".[1]

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[1]Compare Easterbrook and Aitken, op. cit., p. 22 and p. 3 above.

APPENDIX I-1

THE ECONOMIC IMPORTANCE OF CANADA'S RESOURCE INDUSTRIES

This appendix is intended to provide some indication of the current and historical importance of resource industries in the Canadian economy.

a. Contribution to Gross Domestic Product

	per cent of total		
	1949[1]	1961	1969
Agriculture	10.714	4.525	3.795
Agricultural processing[2]	n.a.	1.535	1.393
Grain elevators	n.a.	0.211	0.143
Agriculture sub-total:	n.a.	6.271	5.331
Forestry	2.108	1.231	1.079
Wood products[3]	2.108	1.000	0.903
Paper and allied industries	2.649	2.701	2.316
Forestry sub-total:	6.865	4.932	4.298
Fishing and trapping	0.540	0.259	0.187
Fish products	n.a.	0.116	0.091
Fur goods	n.a.	0.059	0.041
Fishing and trapping sub-total:	n.a.	0.434	0.319
Mines	3.245	4.564	4.382
Primary metals	n.a.	2.207	2.260
Non-metallic minerals	0.794	0.882	0.835
Petroleum and coal products[4]	0.513	0.737	0.665
Pipe line transportation	n.a.	0.451	0.632
Gas distribution	0.166	0.329	0.491
Mines, minerals and processing sub-total	n.a.	9.170	9.265
Electric power	1.480	2.387	2.658
Total	n.a.	23.194	21.871
Total, excluding agriculture	n.a.	16.923	16.540

n.a. - not available or not applicable

APPENDIX I-1 continued

[1]The data for 1949 are not directly comparable with those for 1961 and 1969. They are included in the table to illustrate relative shares at that particular point in time. The data for 1961 and 1969 are based on the 1960 Standard Industrial Classification. The 1969 data were extrapolated by applying to the 1961 base the 1961-69 growth rates published in the same reference but which does not contain the 1969 sector contributions to Gross Domestic Product.

[2]Based on a limited definition covering meat and dairy products, fruit and vegetable canning, grain mills and leaf tobacco processing.

[3]Sawmills, veneer, plywood, sash, door and other mills.

[4]Includes some processing of imported coal and petroleum: "petroleum products" are not separable from "coal products" but petroleum (i.e., oil refining) is overwhelmingly important in this grouping.

Source: 1949 - Dominion Bureau of Statistics, Indexes of Real Domestic Product by Industry of Origin, 1935-61. (Ottawa: Queen's Printer, 1963, Catalogue No. 61-505), Table 1.

1961 and 1969 - Dominion Bureau of Statistics, Indexes of Real Domestic Product by Industry, 1961-1969. (Ottawa: Information Canada, 1971, Catalogue 61-510), Tables 5 and 6.

APPENDIX I-1 continued

b. Contribution to Capital Formation

	Capital Expenditures millions of current dollars			
	1950	1960	1970	1972[1]
Agriculture, fishing and food industries[2]	569	716	1,189	1,475
Forestry, wood and paper products	142	263	736	606
Mines, minerals and related processing[3]	240	855	2,100	2,456
Electric power	372	544	1,589	1,750
Totals:	1,323	2,378	5,613	6,287

	per cent of total			
	1950	1960	1970	1972
Totals as a proportion of:				
- Business capital expenditures, excluding housing	68	49	52	49
- Total private fixed capital formation	45	34	37	34
- Total fixed capital formation	34	29	32	29

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[1]Preliminary.

[2]Includes food and beverages, tobacco and products, grain elevators.

[3]Includes mining, quarrying and oil wells, primary metals, non-metallic minerals and gas distribution.

APPENDIX I-1 continued

Note: The above classifications are not comparable to those employed in Table (a.) above. For example, capital expenditures in pipe line transportation are excluded and food industries are defined more broadly.

Source: 1950 - Dominion Bureau of Statistics, Private and Public Investment in Canada 1946-1957. (Ottawa: Queen's Printer, 1959, Catalogue 61-504), various tables.

1960 and 1970 - Dominion Bureau of Statistics/Statistics Canada and Department of Industry, Trade and Commerce, Private and Public Investment in Canada, Outlook 1961, 1972 and 1973, Catalogue 61-205, various tables.

APPENDIX I-1 continued

c. Contribution to Industrial Employment

	mid-year employment (thousands)		
	1960	1965	1972
Agricultural processing[1]	92	107	128
Grain elevators	12	11	10
Agricultural sub-total	104	118	138
Forestry[2]	63	60	52
Wood products[3]	74	84	64
Paper products	95	105	117
Forestry sub-total	232	249	233
Mining	108	113	115
Primary metals[4]	67	78	114
Non-metallic minerals	39	46	48
Petroleum and coal products	15	17	17
Gas distribution	14	16	10
Mines, minerals and processing sub-total	243	270	304
Electric power	49	52	64
Total above	628	689	739
Total industrial employment	2,867	3,368	3,875
"Primary industries" as per cent of total industrial employment[5]	21.7	20.4	19.1

APPENDIX I-1 continued

[1]Based on a limited definition covering meat and dairy products, fish processing, fruit and vegetable canning, grain mills and tobacco products.

[2]Chiefly logging.

[3]Saw and planing mills and "other wood products".

[4]Primary iron and steel and non-ferrous metals.

[5]"Industrial employment" comprises total employment in the following industries: forestry, mining, manufacturing construction, transportation, communications and other utilities, trade, finance, insurance and real estate. This curiously-broad coverage is Statistics Canada's, not the writer's.

Source: 1960 and 1965 - Dominion Bureau of Statistics, Employment and Payrolls, June 1960 and 1965. (Ottawa: Queen's Printer, 1960 and 1965, Catalogue 72-002), Table 3.

1972 - Statistics Canada, Employment Earnings and Hours, August 1972. (Ottawa: Information Canada, February 1973, Catalogue 72-002), Table 2.

APPENDIX I-2

ENERGY CONSUMPTION AND GROSS NATIONAL PRODUCT (GNP) - MAJOR WORLD REGIONS

	Per Capita Energy Consumption (Kg. coal equivalent)		Per Capita GNP (U.S. dollars)	
North America	10,585	('69)	4,246	('68)
Oceania	3,901	('69)	1,940	('68)
Europe	3,525	('69)	1,860	('68)
World	1,640	('66)	820	('66)
South America	605	('66)	430	('66)
Middle East	514	('66)	370	('66)
Rest of Asia	437	('69)	200	('66)
Africa	291	('66)	160	('66)

Source: United Nations Statistical Yearbook 1970, 22nd Edn. (New York: Statistical Office of the United Nations, 1971), Table 138, Energy Consumption per Capita; Table 185, Estimates of per Capita Gross National Product at Market Prices.

APPENDIX I-2 continued

ENERGY CONSUMPTION
AND GROSS NATIONAL PRODUCT (GNP)
- SELECTED COUNTRIES

	Per Capita Energy Consumption (Kg. coal equivalent)		Per Capita GNP (U.S. dollars)	
United States	10,774	('69)	4,664	('69)
Canada	8,794	('69)	2,997	('68)
Belgium	5,429	('69)	2,372	('69)
United Kingdom	5,139	('69)	1,976	('69)
Germany	4,850	('69)	2,512	('69)
Netherlands	4,661	('69)	2,196	('69)
France	3,518	('69)	2,783	('69)
Italy	2,431	('69)	1,548	('69)
Spain	1,354	('69)	872	('69)
Greece	1,150	('69)	858	('69)
Mexico	1,044	('68)	566	('69)
Brazil	480	('68)	337	('68)
Colombia	360	('69)	591	(869)

Source: As previous table.

APPENDIX I-3

ENERGY CONSUMPTION BY SECTOR - CANADA AND THE UNITED STATES

(per cent of total energy consumption)

	Canada(1965)	United States (1972)
Residential	25	20
Commercial	14	11
Industrial	34	39
Transportation		
- automobile	15	16
- trucks & buses	6	7
- aviation	2	4
- marine	2	2
- rail	2	1
Total	27	30

Source: Canada - based on National Energy Board data.

United States - based on United States Federal Energy Administration data.

APPENDIX I-4

CANADIAN ENERGY CONSUMPTION 1900-1970

(trillion Btu and Per Cent of Total)

	Wood	Coal	Petroleum Fuels	Natural Gas	Hydro-Electricity [1]	Total	Per Cent Average Annual Increase
1900	194 (40)	280 (58)	4 (1)	- (-)	2 (-)	480	-
1910	250 (26)	682 (71)	20 (2)	2 (-)	10 (1)	954	7.1
1920	186 (15)	856 (74)	78 (9)	5 (-)	20 (2)	1,145	7.2
1926	200 (16)	863 (68)	125 (10)	20 (2)	44 (4)	1,252	1.5
1930	220 (16)	892 (62)	212 (15)	31 (2)	69 (5)	1,424	5.8
1935	189 (16)	675 (50)	211 (17)	26 (2)	93 (9)	1,194	3.0
1940	210 (13)	917 (56)	319 (20)	43 (3)	122 (8)	1,611	6.2
1945	225 (12)	1,105 (57)	397 (21)	49 (2)	156 (8)	1,932	3.8
1950	190 (8)	1,078 (48)	726 (32)	72 (3)	214 (9)	2,280	3.4
1955	145 (5)	884 (33)	1,249 (46)	140 (5)	292 (11)	2,710	3.5
1960	120 (4)	565 (18)	1,658 (53)	382 (12)	348 (13)	3,073	2.5
1965	100 (2)	644 (16)	2,216 (54)	747 (18)	403 (10)	4,110	6.0
1970	70 (1)	708 (13)	2,839 (53)	1,250 (23)	528 (10)	5,395	5.5
1900-1970							3.5

1 The contribution of nuclear-generated electricity was insignificant in the period covered by these data.

Source: 1900-1965 - National Energy Board, Long Term Energy Forecast, 1965-1985 (Ottawa, National Energy Board, 1967) Volume 1, p. 46, table A. (unpublished data by courtesy of the National Enerby Board).

1970 - National Energy Board (unpublished)

APPENDIX I-5

UNITED STATES ENERGY CONSUMPTION 1900-1970

(trillion Btu and Per Cent of Total)

	Wood	Coal	Petroleum Fuels	Natural Gas	Hydro & Nuclear Electricity	Total	Per Cent Average Annual Increase
1900	2,015 (22)	6,841 (73)	229 (2)	252 (3)	10 (..)	9,347	
1910	1,765 (11)	12,714 (79)	1,007 (6)	540 (4)	29 (..)	16,055	5.6
1920	1,610 (8)	15,504 (75)	2,676 (13)	813 (4)	67 (..)	20,670	2.6
1925	1,533 (7)	14,706 (67)	4,280 (20)	1,191 (6)	92 (..)	21,802	1.1
1930	1,455 (6)	13,639 (59)	5,897 (26)	1,932 (8)	128 (1)	23,051	1.1
1935	1,397 (7)	10,634 (54)	5,675 (29)	1,919 (9)	150 (1)	19,775	-3.1
1940	1,358 (5)	12,535 (51)	7,760 (32)	2,665 (11)	178 (1)	24,496	4.4
1945	1,261 (4)	15,972 (51)	10,100 (32)	3,871 (12)	298 (1)	31,502	5.2
1950	1,164 (3)	12,912 (38)	13,489 (40)	6,150 (18)	350 (1)	34,066	1.6
1955	1,067 (3)	11,763 (30)	17,524 (44)	9,005 (22)	410 (1)	39,769	3.1
1960	800 (2)	10,414 (23)	20,035 (45)	12,736 (29)	510 (1)	44,495	2.3
1965	600 (1)	12,358 (23)	23,241 (44)	16,098 (31)	660 (1)	52,957	3.5
1970	400 (..)	12,922 (21)	29,611 (45)	22,029 (33)	925 (1)	65,887	4.5
1900-1970							2.4

Source: 1900, 1910 and all estimates of wood fuels, S.H. Schurr & B.C. Netschert, Energy in the American Economy 1850-1975 (Baltimore: The John Hopkins Press, 1960) Appendix to Part I, Table VI.

1920-1970, United States Bureau of Mines, Minerals Yearbook, Various Editions (Washington: U.S. Government Printing Office).

APPENDIX II-1

ULTIMATELY-RECOVERABLE[1] CANADIAN OIL AND GAS RESERVES

Potential Hydrocarbon Area	Potential Crude Oil Reserves (billion barrels)	Potential Gas Reserves (trillion cubic feet)	Total Oil and Gas (billion barrels oil equivalent)
1. Western Canadian Sedimentary Basin	45	270	90
2. Arctic Islands	43	261	86
3. Eastern Canada Offshore	25	150	50
4. Gulf of St. Lawrence	2	11	4
5. Southern Ontario	--	2	--
6. Hudson Bay	3	17	6
7. West Coast	2	11	4
8. British Columbia Interior	1	3	2
	121	725	242
Oil Sands of Alberta[2]	301[3]		301
Total	422	725	543

Source: Canadian Petroleum Association, Geological Reserves Committee, Potential Reserves of Oil, Natural Gas and Sulphur (Calgary: Canadian Petroleum Association, April 1969), Tables I and II, pp. 9 and 12.

APPENDIX II-1 continued

[1]Defined as the total amount of oil and gas that can be recovered under present day technology and conventional methods of oil and gas production. Includes amounts already produced, amounts considered to be present in known accumulations and amounts yet to be discovered on the basis of geological predictions.

[2]Includes deposits of Athabasca, Bluesky-Gething and Grand Rapids.

[3]Expressed in terms of recoverable reserves of up-graded synthetic crude oil.

Note: The Canadian Petroleum Association's estimates are somewhat higher than those of the Canadian Society of Petroleum Geologists which estimates ultimately-recoverable conventional crude oil reserves in Canada at 83 billion barrels and ultimately-recoverable gas reserves at 578 trillion cubic feet (Oilweek, March 26, 1973, p. 14). A third set of estimates of ultimately-recoverable petroleum reserves was prepared in 1973 by the Geological Survey of Canada and published in the Federal Government's paper "An Energy Policy for Canada" (op. cit., Vol. I, p. 91 and Vol. II, p. 53). The Survey put Canada's oil potential at 99 billion barrels and its gas potential at 783 billion cubic feet. The substantial differences in magnitude between these estimates reflect essentially the uncertainties associated with estimation of the amounts of oil and gas which have yet to be found in Canada: differences in estimates of the amounts already discovered but not yet produced are insignificant in relation to the totals of estimated ultimately-recoverable reserves.

APPENDIX II-2

PROVED[1] CANADIAN OIL AND GAS RESERVES AT 31 DECEMBER, 1972

Province	Crude Oil	Natural Gas Liquids	Natural Gas - billion cubic feet -
	- million barrels -		
Alberta	7,103	1,655	41,378
British Columbia	220	39	9,146
Manitoba	49	--	825
Saskatchewan	594	9	--
Northwest Territories	43	--	1,337
Ontario	11	--	250
	8,020	1,703	52,936

Source: Report for 1972 of the Reserves Committee of the Canadian Petroleum Association (Calgary: Canadian Petroleum Association, 15 March, 1973), Tables 1 and 2.

[1] Defined as discovered resources which can be recovered by currently-utilized methods at current costs and prices.

APPENDIX II-3

PETROLEUM PRODUCTION AND RESERVES IN CANADA, HISTORICAL DATA

Production of Crude Oil (thousands of barrels per day)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1925	0.5	-	-	--	--	-	0.6
1930	3.9	-	-	--	--	-	4.0
1935	2.1	-	-	--	--	-	2.2
1940	22.5	-	-	0.3	--	--	22.8
1945	20.9	-	-	1.0	0.5	0.3	22.7
1950	74.4	-	-	0.5	0.6	2.9	78.4
1955	309.0	--	11.3	1.1	1.4	31.0	353.8
1960	356.6	2.4	13.0	1.2	2.7	141.8	517.8
1965	503.4	36.9	13.6	1.8	3.5	240.5	799.6
1970	892.0	69.5	16.2	2.3	2.9	245.2	1,228.1[1]
1972	1,160.1	65.1	14.4	2.4	2.4	236.7	1,481.1[1]

Production of Natural Gas Liquids (thousands of barrels per day)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1925)							
1930)							
1935)[2]							
1940)							
1945)							
1950	1.7	-	-	-	-	-	1.7
1955	6.4	-	-	-	-	-	6.4
1960	20.4	3.2	-	-	-	2.3	25.9
1965	114.7	5.0	-	-	-	3.5	123.2
1970	205.7	5.0	-	-	-	4.2	214.9
1972	289.6	5.3	-	-	-	4.1	299.0

Production of Raw Natural Gas (billions of cubic feet)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1925)							
1930)							
1935)[2]							
1940)							
1945)							
1950	72.0	-	-	0.1	8.0	0.8	81.3
1955	158.8	0.2	-	0.2	10.9	11.3	181.5
1960	410.7	84.9	-	0.3	17.0	52.5	565.4
1965	1,082.8	171.5	-	0.6	12.8	60.1	1,327.9
1970	1,941.8	339.3	-	0.9	17.2	79.1	2,378.6[3]
1971	2,138.8	336.8	-	2.1	16.4	87.3	2,581.6[3]

[1] Footnotes to this table appear on p.305.

APPENDIX II-3 continued

Proved Reserves of Crude Oil (millions of barrels)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1951	1,328	-	--	27	-	21	1,376
1955	2,170	-	45	54	4	237	2,509
1960	3,051	45	21	52	8	502	3,679
1965	5,720	232	41	48	9	662	6,711
1970	7,496	271	60	45	5	682	8,559
1972	7,103	220	49	43	11	594	8,020

Proved Reserves of Natural Gas Liquids (millions of barrels)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1955	247	--	-	-	-	--	247
1960	485	33	-	-	-	21	5,399
1965	952	39	-	-	-	8	999
1970	1,832	37	-	-	-	11	1,880
1972	1,655	39	-	-	-	9	1,703

Proved Reserves of Natural Gas (trillions of cubic feet)

	Alta.	B.C.	Man.	NWT	Ont.	Sask.	Total
1956	17.0	1.6	--	--	0.2	0.9	19.7
1960	26.0	3.1	--	--	0.2	1.3	30.7
1965	36.4	6.8	--	0.1	0.2	0.9	44.4
1970	41.6	9.6	--	1.0	0.3	0.8	53.4
1972	41.4	9.1	--	1.3	0.3	0.8	52.9

Source: Years to 1970: Canadian Petroleum Association, *op. cit.*

1972: Report for 1972 of the Reserves Committee of the Canadian Petroleum Association (Calgary: Canadian Petroleum Association, 15 March, 1973), Tables 1 and 2.

Data on natural gas liquids and natural gas reserves are not available on a consistent basis prior to 1955-56 (see p. 113). The data on natural gas reserves to 1965 relate to "recoverable gas", those for 1970 and 1972 are based on the more conservative measure "marketable gas". "Recoverable gas" means that portion of gas in place which is producible from a reservoir under anticipated technological and economic conditions, taking into account the geological and engineering characteristics of that reservoir. "Marketable gas" is defined as reserves available to the transmission line after removal of certain compounds present in the raw volumes produced from the reservoir and after allowance has been made for field and plant fuel and losses.

APPENDIX II-3 continued

Footnotes from p.303:

[1]Production of tar sands synthetic oil, not included here, commenced in Alberta in 1967 and averaged 33.1 thousand barrels daily in 1970 and 51.4 thousand barrels daily in 1972.

[2]Data not available on a consistent basis.

[3]Total includes small volumes from New Brunswick throughout the period and from Quebec in 1970 and 1972.

APPENDIX III-1

MARKETS FOR CANADIAN CRUDE OIL AND EQUIVALENT, 1945-1972

(thousands of barrels per day)

	Domestic[1]			Export (United States)		Total
	Prairies	Ont.	B.C.	East of Rockies	West Coast	Production[2]
1945	23	-	-	-	-	23
1950	78	-	-	-	-	78
1955	151	111	53	16	31	357
1960	144	198	66	63	50	532
1965	191	300	81	153	143	876
1970	220	370	120	451	218	1,382
1972	242	378	130	685	267	1,698

Source: 1945, 1950 and 1955 - Domestic and Exports: Canada, Royal Commission on Energy, op. cit., Table VI, p. 20, Table XI, p. 32 and Table XII, p. 37.

1960, 1965, 1970 and 1972 - Domestic: Statistics Canada, Refined Petroleum Products 1960, 1965, 1970 and January 1973 (Ottawa: Information Canada, Catalogue 45-204 [Annual] and 45-004 [Monthly]) Table 2; Exports: National Energy Board, Annual Reports, op. cit., various tables.

Production: Canadian Petroleum Association, Yearbooks, op. cit., various tables.

[1]Refinery receipts of crude oil and equivalent.

[2]Minor differences between "production" and "sales" reflect mainly changes in inventory at the field and in pipeline companies' stocks and oil used to fill new pipelines.

APPENDIX III-2

CHANGES IN POSTED FIELD PRICES FOR REDWATER CRUDE OIL

1948-1972

Year	Dates	Posted Price Dollars Per Barrel	Major Reason for Changes in Well-head Price
1948	Jan.-Nov.	3.20	
	Dec.	2.68	To make Alberta crude competitive at Winnipeg
1949	Sept. 24	2.88	Devaluation of the Canadian dollar
1950	Oct. 16	2.73	Alteration of exchange rate (freeing of Canadian dollar)
1951	Apr. 24	2.44	To make Alberta crude competitive with Illinois crude at Sarnia
	June 1	2.46	Reduction in local pipe line tariff
1952	Apr. 23	2.315	Alteration of exchange rate and meeting competition at Sarnia
	Oct. 15	2.325	A reduction in Inter-provincial Pipe Line tariff to the Lakehead, offset by currency adjustment
1953	Mar. 19	2.385	Alteration of exchange rate and meeting competition at Sarnia
	July 21	2.645	Increase in world crude prices reflected at Sarnia and an alteration of exchange rate

APPENDIX III-2 continued

Year	Dates	Posted Price Dollars Per Barrel	Major Reason for Changes in Well-head Price
1954	Oct. 15	2.555	Alteration of exchange rate
1955	Jan. 7	2.485	Price change in Illinois crude and some adjustment for alteration of exchange rate
	Feb. 1	2.49	Adjustment to local Alberta pipe line tariff change
1957	Jan. 16	2.67	General world price increase reflected at Sarnia
	Aug. 30	2.63	Alteration of exchange rate
1958	Apr. 12	2.56	Alteration of exchange rate and change in Illinois prices
1959	Mar. 24	2.42	Reductions in world posted prices and their impact on crude and product prices in Canadian markets
1961	Sept. 11	2.52	Alteration of exchange rate
1962	May 10	2.62	Alteration of exchange rate
1970	Dec. 15	2.87	Increase in world and United States crude prices
1972	Apr. 1	2.88	Decrease in pipe line tariff and adjustment for quality
	Nov. 1	2.98	Increase in world crude oil prices

Source: 1948-1959 - Canada, Royal Commission on Energy, *op. cit.*, Table IV, p. 16.

1961-1972 - Imperial Oil Limited.

APPENDIX III-3

THE "OTTAWA VALLEY LINE" AND THE OIL MARKETS TO THE EAST AND WEST OF IT

The "Ottawa Valley" of Ontario was defined by the National Energy Board for purposes of administering the National Oil Policy, as follows:

> "The Counties of Renfrew, Lanark, Carleton, Russell, Prescott, Glengarry, Stormont, Dundas, Grenville, and the Townships of Elizabethtown, Kitley and South Elmsley in the County of Leeds."

The "Ottawa Valley line" refers to the western boundary of the area which, under the National Oil Policy, may be freely served by products refined from foreign crude oil. The line follows the Ontario-Quebec provincial boundary from James Bay to a point near Pembroke, Ontario. From thence it is demarcated by county and township boundaries to a point on the St. Lawrence just west of Brockville, Ontario.

Source: National Energy Board, "Regulations and Procedures, Oil Imports and Transfers", January 1965.

APPENDIX III-3 continued

Demand for oil products (gasoline, heating oils, industrial fuel oils and the like) in the Ottawa Valley, Quebec and the Atlantic Provinces in 1972 aggregated about 700,000 barrels daily while demand in Ontario west of the Ottawa Valley, the Prairie Provinces and British Columbia totalled some 810,000 barrels daily (both figures net of exports).

During the period 1960-70, demand grew faster east of the line (6.8 per cent per annum) than west of it (4.6 per cent per annum). This difference in growth rates reflected, i.a., the competition of natural gas against fuel oils west of the Ottawa Valley, the displacement of domestic coal by fuel oil in the Atlantic Provinces and the faster economic and energy growth, from a lower base, in the eastern part of Canada.

Source: Statistics Canada, Refined Petroleum Products, op. cit., various tables and unpublished National Energy Board data.

APPENDIX III-4

AVERAGE UNIT VALUES OF CANADIAN CRUDE OIL AND CONDENSATE AT THE POINT OF PRODUCTION AND OF VENEZUELAN CRUDE OIL EXPORTED TO CANADA AT THE POINT OF EXPORT

(dollars per barrel)

	Canadian Crude Oil	Venezuelan Crude Oil	Canadian Condensate
1948	3.05	2.52	NA
1949	2.87	2.67	NA
1950	2.91	2.79	3.64
1951	2.45	2.76	3.26
1952	2.34	2.48	2.92
1953	2.48	2.54	2.98
1954	2.54	2.63	3.02
1955	2.36	2.61	2.89
1956	2.36	2.54	2.90
1957	2.49	2.74	2.81
1958	2.41	2.76	NA
1959	2.28	2.56	NA
1960	2.23	2.41	NA
1961	2.21	2.36	NA
1962	2.26	2.44	NA
1963	2.42	2.44	NA
1964	2.46	2.37	2.51
1965	2.46	2.34	2.51
1966	2.47	2.33	2.52
1967	2.46	2.23	2.49
1968	2.47	2.24	2.63
1969	2.47	2.22	2.62
1970	2.51	2.16	2.62
1971	2.75	2.37	2.86
1972	2.77	2.64	2.88

Sources: Canada: National Energy Board (unpublished), based on federal and provincial government statistics.

Venezuela: Dominion Bureau of Statistics/ Statistics Canada, Trade of Canada - Imports by Commodities (Ottawa: Queen's Printer/ Information Canada, Catalogue No. 65-007, Monthly, December issues, 1948-1972 inclusive).

APPENDIX III-5

SOURCES OF UNITED STATES' CRUDE OIL[1] IMPORTS

	per cent of total crude oil imports from					
	Canada	Venez.	Other Western Hemi-sphere	Africa[2]	Middle East	Other
1951	<1	60	17	-	21	2
1952	<1	58	12	-	27	2
1953	1	51	8	-	34	6
1954	1	54	7	-	33	6
1955	6	49	5	-	37	3
1956	13[3]	49	5	-	30	4
1957	15[3]	52	3	-	24	6
1958	9	45	3	-	35	8
1959	10	47	4	-	33	6
1960	11	47	4	<1	31	7
1961	18	41	4	<1	31	6
1962	21	41	3	2	27	6
1963	22	42	4	2	25	5
1964	23	40	3	4	25	5
1965	24	35	4	5	27	5
1966	29	33	3	7	24	4
1967	37[3]	32	5	5	16	5
1968	36	27	4	12	15	6
1969	40	22	4	16	12	6
1970	51[3]	20	2	9	13	5
1971	43[4]	18	1	11	20	7
1972	39[4]	11	2	21	19	8

Source: E.L. De Golyer and W.L. MacNaughton, *Twentieth Century Petroleum Statistics, 1972* (Dallas: De Golyer and MacNaughton, 1972), pp. 56 and 58.

APPENDIX III-5 continued

[1]The United States has long imported large volumes of refined products, particularly residual fuel oil to its east coast. Western Canadian crude oil does not compete, directly or indirectly, in this market.

[2]Large-scale crude oil production commenced in Libya in 1961 and in Nigeria in 1959.

[3]Overseas crude oil supply was disrupted in 1956-1957 and 1967 by the "Suez crises" and in 1970 by curtailment of Libyan production. In each of these years, United States' overseas imports were curtailed while imports from Canada increased and the proportion of Canadian oil in the total therefore rose sharply.

[4]Although imports from Canada increased substantially in 1971 and 1972, the rate of growth of total United States' import needs by then exceeded the rate at which production for export could be expanded in Canada. Consequently the share of Canadian imports in the total declined and continues to do so.

APPENDIX IV-1

CANADIAN NATIONAL GAS POLICY

Like Canadian national oil policy, current national gas policy relates essentially to allocation of supplies as between domestic and export markets and finds a basis in a House of Commons statement. Unlike oil policy, its roots go back more than sixty years (to the Electricity and Fluids Exportation Act of 1907, see pp. 110 & 118) and, also unlike oil policy, it found early expression in an Act of Parliament.

The House of Commons statement was made in March 1953 by the Hon. C.D. Howe, Minister of Trade and Commerce, who enunciated the following:

> ". . . the policy of the Government of Canada is to refuse permits for moving natural gas by pipe line across an international boundary until such time as we are convinced that there can be no economic use, present or future, for that natural gas within Canada."
>
> ". . . the only reliable supply of natural gas for the provinces of Ontario and Quebec must be from Western Canada by means of an all-Canadian pipe line."

The expression in law of the first part of Mr. Howe's statement is contained in the National Energy Board Act, Part IV:

APPENDIX IV-1 continued

Section 81

"Except as provided in the regulations, no person shall export any gas or power or import any gas except under the authority of and in accordance with a licence issued under this Part."

Section 82

"(1) Subject to the regulations, the Board may issue licences, upon such terms and conditions as are prescribed by the regulations

(a) for the exportation of power or gas, and

(b) for the importation of gas."

Section 83

"Upon an application for a licence the Board shall have regard to all considerations that appear to it to be relevant and, without limiting the generality of the foregoing, the Board shall satisfy itself that

(a) the quantity of gas or power to be exported does not exceed the surplus remaining after due allowance has been made for the reasonably foreseeable requirements for use in Canada having regard, in the case of an application to export gas, to the trends in the discovery of gas in Canada; and

(b) the price to be charged by an applicant for gas or power exported by him is just and reasonable in relation to the public interest."

APPENDIX IV-2

CANADIAN NATURAL GAS - SUPPLY AND DEMAND 1950-1972

(billion cubic feet per annum)

	1945	1950	1955	1960	1965	1970	1972
Supply							
Domestic Production[1])		58	124	436	1,017	1,813	2,295
)	48[2]						
Imports)	—	3	11	6	18	11	16
Total	48	61	135	442	1,035	1,824	2,311
Demand							
Domestic Consumption)		61	124	332	630	1,044	1,301
)	48[2]						
Exports)	—	--	11	110	405	780	1,010
Total	48	61	135	442	1,035	1,824	2,311

Source: 1945: American Gas Association, Historical Statistics of the Gas Industry (New York, N.Y.: American Gas Association, 1961), pp. 148 and 425.

1950: Dominion Bureau of Statistics, Gas Utilities, 1961 (Ottawa: Queen's Printer, 1964, Catalogue 57-205), Table 17, p. 42.

1955, 1960, 1965: National Energy Board, Canada, Energy Supply and Demand Tables 1955-1967 (Ottawa: Queen's Printer, 1968), Appendix B.

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[1] "Domestic Production" is calculated to be gross production less gas wasted, flared and reinjected (equals "net production") less processing shrinkage, field and plant use and loss (equals supply of "marketable pipe line gas") less net storage and line pack.

[2] Gross marketed production - imports were negligible.

APPENDIX IV-3

AVERAGE UNIT VALUES OF CANADIAN NATURAL GAS, PROPANE, BUTANE AND SULPHUR AT THE POINT OF PRODUCTION, 1948-1972

	Natural Gas (dollars per Mcf.)	Propane	Butane	Sulphur[1] (dollars per long ton)
		(dollars per barrel)		
1948	0.267	NA	NA	NA
1949	0.195	NA	NA	NA
1950	0.095	NA	NA	NA
1951	0.090	NA	NA	NA
1952	0.107	NA	NA	NA
1953	0.108	NA	NA	NA
1954	0.103	NA	NA	NA
1955	0.100	NA	NA	NA
1956	0.100	1.28	1.53	21.56
1957	0.095	1.50	1.52	25.40
1958	0.095	NA	NA	22.35
1959	0.095	NA	NA	21.80
1960	0.100	NA	NA	20.06
1961	0.104	NA	NA	20.26
1962	0.115	NA	NA	14.81
1963	0.125	NA	NA	11.60
1964	0.128	1.21	1.27	11.04
1965	0.129	1.24	1.24	13.88
1966	0.133	1.40	1.26	21.56
1967	0.135	1.60	1.37	30.42
1968	0.133	1.46	1.38	33.19
1969	0.133	1.22	1.22	22.94
1970	0.138	1.27	1.15	8.93
1971	0.137	1.57	NA	7.22
1972	0.133	1.57	1.43	5.71

Source: National Energy Board (unpublished), based on federal and provincial government statistics.

[1] Alberta only.

APPENDIX VI-1

A GROUPING OF SOME CANADIAN OIL-PRODUCING COMPANIES ACCORDING TO OWNERSHIP CHARACTERISTICS

1. Subsidiaries of Foreign Oil Companies but with Private Canadian Minority Shareholding

Subsidiary	Parent Name	Nationality	Parent's Shareholding (per cent)
Aquitaine of Canada	Societe Nationale des Petroles d'Aquitaine	French	75
Ashland Canada	Ashland Oil and Refining	U.S.A.	90
BP Oil	British Petroleum	British	80
Canadian Superior	Superior Oil	U.S.A.	54
Great Plains	Burmah Oil	British	70
Gulf Canada	Gulf Oil Corp.	U.S.A.	68
Hudson's Bay	(Continental Oil)	U.S.A.	55
Oil and Gas	(Hudson's Bay Co.)	British	22
Imperial Oil	Exxon Corp.	U.S.A.	69
Murphy Oil	Murphy Oil Corp.	U.S.A.	88
Petrofina Canada	Petrofina S.A.	Belgian	72
Shell Canada	Royal Dutch/ Shell	British-Dutch	79
Texaco Canada	Texaco Inc.	U.S.A.	68
Union Oil of Canada	Union Oil of California	U.S.A.	87

2. Canadian Majority Shareholding, Foreign Oil or Other Company Minority Interest Controlling

			Foreign Controlling Minority Interest (per cent)
Pacific Petroleums	Phillips Petroleum	U.S.A	47
Total Petroleum	Compagnie Francaise des Petroles	French	45
Western Decalta	Charter Consolidated (Anglo-American Corp. of South Africa Ltd.)	South Africa	38

APPENDIX VI-1 continued

3. Wholly-Owned Subsidiaries of Foreign Oil Companies

Amerada Hess	Amerada Hess	U.S.A.
Amoco Canada	Standard Oil of Indiana	U.S.A.
Atlantic Richfield	Atlantic Richfield	U.S.A.
Chevron Standard	Standard Oil of California	U.S.A.
Cities Service Canada	Cities Service Inc.	U.S.A.
Golden Eagle Canada	Ultramar	British
Marathon	Marathon	U.S.A.
Mobil Oil Canada	Mobil	U.S.A.
Sun	Sun	U.S.A.
Texaco Inc.	Texaco Inc.	U.S.A.

4. Subsidiaries of Other Companies, Canadian or Foreign, with Private Canadian Minority Shareholding

			per cent
Alminex	Falconbridge Nickel	Canadian	51
Canadian Delhi	St. Joe Minerals	U.S.A.	90
Canadian Industrial Gas and Oil	Northern and Central Gas	Canadian	66
Home Oil	Consumers' Gas	Canadian	49
Pan Canadian	Canadian Pacific Investments	Canadian	87

Approximate Shares of Total Canadian Oil and Natural Gas Liquids Production Accounted for by Above Companies in 1970-72

	per cent
Group 1	32
Group 2	4
Group 3	27
Group 4	5
Sub-total	68
"Independent" companies	16
Royalty oil belonging to lease-granter	16
	100

Source: Based on company annual reports.

APPENDIX VII-1

UNCERTAINTY IN WESTERN CANADIAN PETROLEUM EXPLORATION 1967-70 - "WILDCAT" WELLS DRILLED COMPARED WITH FIELDS DISCOVERED

Year of Drilling	(A) New-field Wildcat Wells[1] Drilled	(B) Significant[2] Fields Discovered	(C) (B) as per cent of (A)
1947	75	5	6.67
1948	138	8	5.80
1949	218	12	5.50
1950	274	12	4.38
1951	380	29	7.63
1952	687	46	6.70
1953	615	52	8.46
1954	739	31	4.19
1955	718	31	4.32
1956	586	37	6.31
1957	696	40	5.75
1958	576	30	5.21
1959	694	32	4.61
1960	553	27	4.88
1961	493	26	5.27
1962	562	24	4.27
1963	636	29	4.56
1964	931	24	2.58
1965	891	34	3.82
1966	976	47	4.82
1967	945	94	9.95
1968	822	89	10.83
1969	770	75	9.74
1970	516	55	10.66
1947-70	14,491	889	6.13

Source: Canadian Petroleum Association, *Statistical Yearbook, 1970* (Calgary: Canadian Petroleum Association, 1971), p. 24.

[1]Defined as "exploration wells located far from producing pools and/or structures which have not been productive before".

[2]Fields with an ultimate probable recovery of one million barrels of crude oil equivalent or more. Such fields account for 98.6 per cent of all oil and gas so far discovered in western Canada.

APPENDIX VII-2

EXPENDITURES OF THE WESTERN CANADIAN PETROLEUM EXTRACTION INDUSTRY 1947-1971

(annual averages - millions of dollars)

	1947-1951	1952-1956	1957-1961	1962-1966	1967-1971	1972[1]
Exploration and Development						
Geological and geo-physical expenditures	22	62	52	59	107	90
Land acquisition and rentals	31	97	124	177	196	165
Exploratory drilling	16	54	70	92	108	130
Development drilling	29	84	106	118	93	84
Sub-total: exploration and development	98	297	352	446	504	469
Production						
Field equipment	8	23	32	46	86	120
Secondary recovery and pressure maintenance	..	1	6	16	19	38
Natural gas plants	2	6	34	38	141	117
Other capital expenditures	7	17	15	15	17	13
Sub-total: production	17	47	87	115	263	288
Total exploration, development and production	115	344	439	561	767	757

APPENDIX VII-2 continued

Source: 1947-1971 based on Canadian Petroleum Association, *Statistical Yearbook* (Annual) (Calgary: Canadian Petroleum Association).

1972 - Statistics Canada, "Energy Statistics Service Bulletin", Vol. 8, No. 27, May 1973, table 2.

[1]Preliminary.

APPENDIX VII-3

VALUE ADDED IN THE CRUDE PETROLEUM AND NATURAL GAS INDUSTRY AND IN THE MINERAL INDUSTRY EXCLUDING PETROLEUM AND GAS

	1947	1951	1956	1961	1966	1971
Crude Petroleum and Natural Gas						
Value added[1] ($ millions)	30.8	119.7	403.7	598.9	1,050.4	1,779.4
Employees[2] (thousands)	6.1	5.8	8.1	11.2	12.4	15.9
Value added per employee ($)	5,050	20,500	50,000	53,500	84,700	111,900
Mineral Industry (Excluding Petroleum and Gas)						
Value added[1] ($ millions)	338.8	655.1	831.0	1,153.5	1,577.1	2,046.9
Employees[2] (thousands)	68.1	93.5	95.0	85.2	89.0	94.5
Value added per employee ($)	4,980	7,000	8,780	13,500	17,700	22,230

Source: Statistics Canada, The Crude Petroleum and Natural Gas Industry, Annual (Cat. No. 26-213).

Statistics Canada, General Review of the Mineral Industries, Annual (Cat. No. 26-201).

In both cases, issues for the relevant years.

[1] 1947, 1951, 1956 - net value of marketable production. 1961, 1965, 1966, 1970 - value added.

[2] "Employees" include salaried, management, professional, technical and administrative personnel, plus production, field, plant and related workers which comprise both the producing and non-producing activities.

APPENDIX VII-4

EXPENDITURES AND REVENUES OF THE CANADIAN PETROLEUM EXTRACTION INDUSTRY 1947-1971 - THE "TIME LAG" EFFECT IN OIL AND GAS OPERATIONS

(millions of dollars)

	Expenditures	Revenues	Cumulative Deficit of Expenditures Over Revenues
	(1)	(2)	(3)
1947	31	21	10
1948	70	39	41
1949	137	63	115
1950	196	87	224
1951	246	123	347
1952	332	151	528
1953	350	208	570
1954	408	253	725
1955	494	318	901
1956	612	422	1,091
1957	622	475	1,238
1958	592	430	1,400
1959	602	467	1,535
1960	620	492	1,663
1961	710	597	1,776
1962	686	691	1,771
1963	773	806	1,738
1964	866	895	1,709
1965	978	972	1,715
1966	1,022	1,083	1,654
1967	1,153	1,217	1,590
1968	1,238	1,338	1,490
1969	1,365	1,446	1,409
1970	1,407	1,622	1,194
1971	1,603	1,877	920

APPENDIX VII-4 continued

Source: Based on David H.C. Stanley, The Financing of Oil and Gas Exploration and Production in Canada (Toronto: Wood, Gundy & Company Limited, 1962), p. 26.

Canadian Petroleum Association, Statistical Yearbook, 1957, 1968, 1971 (Calgary: Canadian Petroleum Association, 1958, 1969, 1972).

Note: (1) "Expenditures" includes operating and miscellaneous expenditures, royalties and taxes, excluding income tax. Also included are expenditures in the Territories and Arctic Islands which aggregated $611 million.

(2) "Revenues" is value of sales of crude oil, condensate, synthetic crude oil, natural gas, pentanes plus, propane, butane and sulphur.

Column (3) derived by difference between Columns (1) and (2). No allowance is made for interest charges on the "deficit".

APPENDIX VII-5

CAPITAL EXPENDITURES IN PETROLEUM AND NATURAL GAS TRANSPORTATION IN CANADA 1952-1971[1]

(millions of dollars)

	Construction[2]	Total[2]
1952	76	95
1953	73	80
1954	61	65
1955	44	46
1956	173	177
Annual average 1952-56	85	93
1957	304	310
1958	234	238
1959	55	59
1960	91	99
1961	148	165
Annual average 1957-61	166	174
1962	61	72
1963	99	108
1964	146	164
1965	97	112
1966	139	154
Annual average 1962-66	108	122
1967	151	205
1968	205	248
1969	190	221
1970	206	246
1971	360	372
Annual average 1967-71	222	258

APPENDIX VII-5 continued

Source: Tabulation prepared for the National Energy Board by the Capital Expenditures Section, Business Finance Division, Statistics Canada.

[1] Primarily pipe lines, but including rail and water transportation. In the period 1955-1969 capital expenditures by the Canadian petroleum industry on rail and water transportation averaged $2.1 million annually.

[2] The difference between "construction" and "total" reflects capital expenditures on machinery and equipment which, in the pipe line industry, are small in relation to construction spending.

APPENDIX VII-6

SOURCES OF INVESTED CAPITAL OF A GROUP OF CANADIAN PETROLEUM COMPANIES,[1] 1960-1971

	per cent of total				
	Preferred Stock	Common Stock	Retained Earnings	Long-Term Debt	Short-Term Debt and Other Financing
1960	0.4	31.1	30.5	15.9	22.1
1961	0.4	31.7	32.5	14.5	20.9
1962	0.3	27.4	31.3	14.6	26.4
1963	0.3	28.9	29.8	16.3	24.7
1964	0.6	27.5	31.5	16.3	24.1
1965	0.6	26.5	33.6	16.3	23.3
1966	1.0	25.0	38.5	15.8	19.7
1967	1.7	23.7	38.2	17.4	19.0
1968	1.2	22.9	37.7	17.4	20.8
1969	1.1	21.6	36.8	20.9	19.6
1970	1.0	20.7	36.7	20.6	21.1
1971	0.9	20.3	39.1	19.0	20.7

Source: National Energy Board staff study.

[1]The eight companies in the group are: Dome, Gulf, Home, Hudson's Bay Oil and Gas, Husky, Imperial, Shell and Texaco. The combined operations of these companies account for 43 per cent of Canada's crude oil production and 88 per cent of its refining capacity.

APPENDIX VII-7

CURRENT SAVINGS AND NET EXTERNAL FUNDS OF LARGER[1] FOREIGN-OWNED SUBSIDIARIES[2] IN THE CANADIAN OIL AND GAS INDUSTRY

(millions of dollars)

	1965	1967	1968	1969
(1) Current retained earnings	139	156	186	139
(2) Depreciation, etc.[3]	221	249	264	271
(3) Current savings (1) + (2)	360	405	450	410
(4) Long-term debt	NA	56	NA	184
(5) Short-term debt	NA	42	NA	-219
(6) Share capital paid in	NA	74	NA	158
(7) Net external funds (4) + (5) + (6)	176	172	136	123
(8) Total all sources	536	577	586	533

Source: Foreign-owned Subsidiaries in Canada (Ottawa: Department of Industry, Trade and Commerce, 1970 [for 1964-1967] and 1972 [for 1964-1969]) 1964-1967 edition, Summary Tables 23, 24 and 25; 1964-1969 edition, table 6, Summary Table 22 and Appendix VI.

[1]Assets exceeding $5 million.

[2]More than 50 per cent of voting shares held by a non-resident corporation.

[3]In corporate accounting terms, depreciation charges are regarded merely as a return of capital and are charged against receipts as a cost. At the same time, depreciation charges are an important source of liquid funds for expansion of the company. It is presumably in this latter sense that they are here treated as an item of corporate savings. There is an analogy with national income accounting practice: capital consumption allowances are one of the components of gross national product which are deducted to arrive at net national income, yet depreciation charges are a major contributor to the flow of liquid funds in the economy as a whole even though they do not represent net savings.

APPENDIX VII-8

TOTAL CAPITAL EMPLOYED IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY AND ITS OWNERSHIP

(billions of dollars)

		Owned in		
	Total Capital Employed	Canada	U.S.A.	Other Foreign Countries
1945	0.3	0.2	0.1	0.01
1953	2.0	0.9	1.1	0.05
1954	2.5	1.0	1.4	0.1
1955	3.0	1.1	1.7	0.2
1956	3.6	1.3	2.1	0.2
1957	4.5	1.6	2.6	0.2
1958	5.0	2.0	2.9	0.3
1959	5.7	2.2	3.1	0.4
1960	6.1	2.3	3.2	0.5
1961	6.4	2.4	3.4	0.6
1962	6.9	2.5	3.7	0.7
1963	7.6	2.8	4.0	0.8
1964	7.9	3.1	4.0	0.8
1965	8.4	3.2	4.2	1.0
1966	9.1	3.3	4.7	1.1
1967	9.7	3.7	4.9	1.1

Source: 1945 and 1953: Dominion Bureau of Statistics, *Canadian International Investment Position, 1926-1954* (Ottawa: Queen's Printer, 1958), p. 84, Table VIII.

1954-1959: Dominion Bureau of Statistics, *The Canadian Balance of International Payments 1963, 1964 and 1965 and International Investment Position* (Ottawa: Queen's Printer, 1967), p. 129, Table XVI.

1960-1967: Statistics Canada, *Canada's International Investment Position, 1926 to 1967* (Ottawa: Information Canada, 1971), pp. 156-159, Table XX.

Note: Figures may not sum due to rounding.

APPENDIX VII-9

OWNERSHIP OF TOTAL CAPITAL EMPLOYED IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(per cent)

	Owned in		
	Canada	U.S.A.	Other Foreign Countries
1945	65	32	3
1953	44	54	2
1954	40	56	4
1955	37	57	6
1956	36	58	6
1957	36	58	6
1958	38	56	6
1959	39	54	7
1960	38	54	8
1961	37	53	10
1962	36	54	10
1963	37	53	10
1964	39	51	10
1965	38	50	12
1966	37	51	12
1967	38	51	11

Source: Calculated from Appendix VII-8.

APPENDIX VII-10

TOTAL FOREIGN CAPITAL AND FOREIGN DIRECT INVESTMENT IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(millions of dollars)

	Total Foreign Capital			
	All Non-residents	U.S.A.	U.K.	Other Countries
	(1)	(2)	(3)	(4)
1930	150	147	3	-
1945	160	152	7	1
1951	693	682	7	4
1953	1,252	1,205	14	33
1954	1,488	1,426	17	45
1955	1,854	1,716	31	107
1956	2,275	2,063	72	140
1957	2,849	2,570	108	171
1958	3,187	2,866	134	187
1959	3,455	3,108	162	185
1960	3,727	3,184	270	273
1961	4,029	3,444	296	289
1962	4,384	3,662	355	367
1963	4,749	3,975	392	382
1964	4,854	4,016	451	387
1965	5,268	4,223	543	502
1966	5,719	4,656	542	521
1967	6,009	4,905	554	550

APPENDIX VII-10 continued

TOTAL FOREIGN CAPITAL AND FOREIGN DIRECT INVESTMENT IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(millions of dollars)

	Total Foreign Capital Derived from Direct Investment			
	All Non-residents	U.S.A.	U.K.	Other Countries
	(5)	(6)	(7)	(8)
1930	142	141	1	-
1945	141	141	-	-
1951	641	636	4	1
1953	1,164	1,130	9	25
1954	1,384	1,344	7	33
1955	1,754	1,637	23	94
1956	2,144	1,978	56	110
1957	2,559	2,380	64	115
1958	2,816	2,598	90	128
1959	3,082	2,836	116	130
1960	3,313	2,885	208	220
1961	3,534	3,060	234	240
1962	3,901	3,277	298	326
1963	4,158	3,489	335	334
1964	4,251	3,521	391	339
1965	4,600	3,653	488	459
1966	5,012	4,062	476	474
1967	5,267	4,290	477	502

Source: 1930 and 1953: Dominion Bureau of Statistics, The Canadian Balance of International Payments 1957 and International Investment Position (Ottawa: Queen's Printer, 1958), pp. 48-49, tables IX and X.

1951: Dominion Bureau of Statistics, The Canadian Balance of International Payments 1958 and International Investment Position (Ottawa: Queen's Printer, 1959), pp. 58-59, tables IX and X.

<u>APPENDIX VII-10</u> continued

1956 and 1957: Dominion Bureau of Statistics, <u>The Canadian Balance of International Payments 1961 and 1962 and International Investment Position</u> (Ottawa: Queen's Printer, 1964), pp. 130-131, tables IX and X.

1945 and 1958-1963: Dominion Bureau of Statistics, <u>The Canadian Balance of International Payments 1963, 1964 and 1965 and International Investment Position</u> (Ottawa: Queen's Printer, 1967), pp. 122-123, tables IX and X.

1963-1967: Statistics Canada, <u>Canada's International Investment Position</u> (Ottawa: Information Canada, 1971), pp. 157-159, table XX and pp. 128-131, table VI.

APPENDIX VII-11

TOTAL FOREIGN CAPITAL AND FOREIGN DIRECT INVESTMENT IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(per cent of total foreign capital)

	Total Foreign Capital			
	All Non-residents	U.S.A.	U.K.	Other Countries
	(1)	(2)	(3)	(4)
1930	100	98	2	-
1945	100	95	4	1
1951	100	98	1	1
1953	100	96	1	3
1954	100	96	1	3
1955	100	93	2	5
1956	100	91	3	6
1957	100	90	4	6
1958	100	90	4	6
1959	100	90	5	5
1960	100	86	7	7
1961	100	85	8	7
1962	100	84	8	8
1963	100	84	8	8
1964	100	83	9	8
1965	100	80	10	10
1966	100	81	10	9
1967	100	82	9	9

APPENDIX VII-11 continued

TOTAL FOREIGN CAPITAL AND FOREIGN DIRECT INVESTMENT IN THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(per cent of total foreign capital)

	Total Foreign Capital Derived from Direct Investment			
	All Non-residents	U.S.A.	U.K.	Other Countries
	(5)	(6)	(7)	(8)
1930	95	94	1	-
1945	88	88	-	-
1951	93	92	1	-
1953	93	90	1	2
1954	93	90	1	2
1955	95	89	1	5
1956	94	87	2	5
1957	90	84	2	4
1958	88	81	3	4
1959	89	82	3	4
1960	89	77	6	6
1961	88	76	6	6
1962	89	75	7	7
1963	88	74	7	7
1964	88	73	8	7
1965	88	71	8	8
1966	88	71	8	8

Source: Calculated from Appendix VII-10.

APPENDIX VII-12

CAPITAL MOVEMENTS FROM THE UNITED STATES TO CANADA IN RESPECT OF THE PETROLEUM AND NATURAL GAS INDUSTRY

	millions of dollars			
	Net Capital Flows[1] for Direct Investment	Plus Other Capital Movements[2]	Equals Net Capital Movements	Net Capital Movements for Petroleum and Natural Gas Industry as Per Cent of Total for All Industries[3]
	(1)	(2)	(3)	(4)
1952	177	6	183	40
1953	171	14	185	52
1954	183	17	200	59
1955	196	17	213	56
1956	232	130	362	49
1957	237	130	367	57
1958	201	47	248	51
1959	170	19	189	35
1960	158	-10	148	28
1961	106	87	193	31
1962	112	43	155	35
1963	56	44	100	37
1964	60	-37	23	19
1965	92	80	172	39
1966	169	56	225	27
1967	116	-24	92	16

Source: Statistics Canada, *Canada's International Investment Position, 1926 to 1967* (Ottawa: Information Canada, 1971), pp. 134-135, table IX.

[1]The net of gross inflows and gross outflows for direct investment.

[2]New issues, retirements, borrowings, investment abroad, etc.

[3]"All industries" including utilities, merchandising, financial and miscellaneous.

APPENDIX VII-13

DIVIDEND PAYMENTS TO ALL FOREIGN COUNTRIES BY THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

	Dividend Payments	Dividend Payments as a Proportion of Foreign-Owned Capital in the Industry
	(millions of dollars)	(per cent)
1946	10.9	6.8[1]
1950	12.8	..[2]
1953	18.8	1.6
1958	42.9	1.3
1960	56.5	1.5
1962	77.7	1.8
1964	91.2[3]	1.9
1966	94.0	1.6

Source: 1946-1960: Dominion Bureau of Statistics, The Canadian Balance of International Payments 1961 and 1962 and International Investment Position (Ottawa: Queen's Printer, 1964), p. 23, statement 9D.

1962-1964: Dominion Bureau of Statistics, The Canadian Balance of International Payments 1963, 1964 and 1965 and International Investment Position (Ottawa: Queen's Printer, 1967), p. 20, statement 13.

1966: Dominion Bureau of Statistics, Canada's International Investment Position 1926 to 1967 (Ottawa: Information Canada, 1971), p. 185, Table XXXVII.

[1]Dividend payments in 1938 totalled $29.0 million on a volume of foreign capital which cannot have been larger than in 1946.

[2]Total foreign-owned capital not available for 1950.

[3]In Foreign-owned Subsidiaries in Canada, A Report Published by Authority of the Minister of Trade and Commerce (Ottawa: Department of Trade and Commerce, 1967) net profit of reporting companies in the "gas and oil industry" in 1964 was given as $204.8 million with dividend paid $95.7 million (p. 9, Table 2).

APPENDIX VII-14

FOREIGN OWNERSHIP AND CONTROL OF THE CANADIAN PETROLEUM AND NATURAL GAS INDUSTRY

(percentages)

	"Petroleum and Natural Gas Industry"		"Oil and Gas Well Industries"	"Petroleum Refineries Industry"
	Non-resident Ownership	Non-resident Control	50 Per Cent and Over Non-resident Owned	
	(1)	(2)	(3)	(4)
1954	60	69		
1955	63	79		
1956	64	80		
1957	64	76		
1958	62	73		
1959	61	73		
1960	62	73		
1961	63	72		
1962	64	74		
1963	63	72		
1964	61	72		
1965	62	73	82	100
1966	63	74	78	99
1967	62	74	83	100
1968			81	100
1969			83	100

Source: Column (1) - Appendix VII-9.

Column (2) - 1954 to 1967: Dominion Bureau of Statistics, Canada's International Investment Position, 1926-1967 (Ottawa: Information Canada, 1971), p. 151, table XVIII.

Columns (3) and (4) - 1965 to 1967: Annual Report of the Minister of Industry, Trade and Commerce under the Corporations and Labour Unions Returns Act (CALURA), 1967 (Ottawa, 1969), p. 4, table 10 and p. 95, table 107.

- 1968 and 1969: Relates to mineral fuels industries and petroleum and coal products industries, respectively. Annual Report, op. cit., 1969 (Ottawa: 1972), p. 91, table 1.05 and p. 113, table 1.27 respectively.

APPENDIX VII-14 continued

Note: The "petroleum and natural gas industry", which includes all sectors, is not shown separately in the Dominion Bureau of Statistics' balance of payments reports for years prior to 1954.

CALURA reports have been issued for the years 1962 to 1964 but the data presented in columns (3) and (4) are not available on a consistent basis for years prior to 1965.

There are important conceptual differences between the Dominion Bureau of Statistics' and the CALURA series which invalidate comparison between the two. These differences are explained in Dominion Bureau of Statistics, The Canadian Balance of International Payments 1963, 1964 and 1965 and International Investment Position (Ottawa: Queen's Printer, 1967), pp. 81-84.

APPENDIX VIII-1

VALUE OF EXPORTS OF CRUDE OIL, NATURAL GAS LIQUIDS, NATURAL GAS AND SULPHUR

(millions of dollars)

	1946	1950	1955	1960	1965	1970	1972
Crude oil and condensate	5	2	36	94	280	649	1,008
Natural gas	-	-	-[1]	18	104	206	307
Propane	-	-	-[1]	-[1]	4	23	40
Butane	-	-	-[1]	-[1]	7	15	23
Sulphur	-	-	-[1]	3[2]	26[2]	43[2]	28[2]

Sources: 1945, 1950: Based on Gray, Impact of Oil, op. cit., p. 103.

1955-1972 : Dominion Bureau of Statistics/ Statistics Canada, Trade of Canada, Exports (Ottawa: Queen's Printer/Information Canada, Catalogue 65-004, monthly), various issues.

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[1]Although these commodities were exported in 1955 and 1960, no provision was made for their separate recording in Trade of Canada. It is understood that the value of natural gas, propane, butane and sulphur exports in 1955 was included under a catch-all item "non-metallic minerals N.O.P." (Class number 7690) in Trade of Canada for 1955 and that propane and butane continued to be so treated in 1960, by which time separate classes had been established for "gas exported by pipeline" and for "sulphur, crude and refined" (7630 and 7660, respectively).

[2]In each case, the figure for sulphur includes small proportions of elemental sulphur recovered from pyrites and of sulphur resulting from desulphurization operations at oil refineries processing imported crude oil. The great bulk of the sulphur exported was however derived from processing of "sour" natural gas.

APPENDIX VIII-2

SOME LEADING COMMODITIES' SHARES OF
CANADIAN MERCHANDISE EXPORTS, SELECTED YEARS

(per cent of total domestic exports)

	1946	1955	1960	1965	1970	1972
"Regional Staples"						
Crude petroleum and natural gas	-	--	2.1	4.5	5.2	6.7
Iron ores and concentrates	--	2.3	3.0	4.2	2.9	1.8
Wheat and wheat flour	11.7	9.7	9.0	10.6	4.5[1]	4.2[1]
"National Staples"						
Copper, lead, zinc and nickel[2]	5.9	11.4	10.8	10.2	11.2	8.4
Lumber, woodpulp and newsprint	22.2	31.7	27.2	21.7	15.6	17.1
Total domestic exports (millions of dollars)	2,272	4,258	5,256	8,525	16,474	19,500

Source: 1946, 1955, 1960, 1965 and 1970: Dominion Bureau of Statistics/Statistics Canada, *Canada Yearbook* (Ottawa: Queen's Printer/Information Canada), various issues and tables.

1972: Statistics Canada, *Trade of Canada, Exports by Commodities* (Ottawa: Information Canada, Catalogue 65-004, Monthly, December 1972).

APPENDIX VIII-2 continued

[1]1970 and 1972 were poorer-than-average crop- and export-years for Canadian wheat.

[2]Ores; concentrates, metal and alloys; but not end-products.

APPENDIX VIII-3

VALUE OF INDUSTRY INPUTS AND FINAL EXPENDITURES OF THE PETROLEUM AND NATURAL GAS INDUSTRY, 1961

	$ Million
Commodity Inputs	
Non-metallic minerals	1.1
Oil and natural gas	26.0
Other primary metals	2.6
Machinery	13.0
Petroleum products	7.0
Chemical products	3.6
Construction	10.8
Others	1.6
Sub-total	65.7
Service Inputs	
Wholesale and retail trade	6.4
Transport and storage	11.0
Communications	3.4
Utilities	13.0
Finance, insurance and real estate	152.1[1]
Business services	23.4
Other services	6.1
Office supplies	3.5
Advertising and travel	9.6
Operating supplies	36.3
Sub-total	264.8
Others	
Commodity taxes	2.3
Indirect taxes and government services	9.4
Wages and salaries	122.9
Net income of unincorporated businesses	2.1
Surplus	337.2
Sub-total	473.9
Total inputs	804.4

APPENDIX VIII-3 continued

Source: Dominion Bureau of Statistics, The Input-Output Structure of the Canadian Economy, 1961 (Ottawa: Queen's Printer, August 1969, Catalogue 15-501, Occasional, 2 Vols.), Vol. 1, Table 8, Aggregation 'M', pp. 305-307.

[1]Includes royalties on oil and gas production in the amount of $73.2 million which should have been stated separately under "Others". See footnote on p. 228 of text.

APPENDIX VIII-4

SUMMARY OF IMPACT OF TOTAL OIL AND GAS PIPE LINE INDUSTRY EXPENDITURES, 1961

(millions of dollars)

	Operating	Capital	Total
Industrial expenditure by pipe lines	203	166	370
Industrial output generated	231	538	769
Personal expenditures generated	97	153	250
Personal savings generated	3	5	8
Personal taxes generated	11	18	29
Household income	111	176	287
Corporation taxes	26	10	36
Indirect taxes	19	20	39
Government revenues	48	48	96
Surplus generated	42	80	122
Impact on Gross Domestic Product	267	238	505
Direct imports	-	22	22
Indirect imports	19	48	67
Employment (man-years)	11,750	20,000	31,750

Source: National Energy Board, Economics Branch, Report on the Impact of the Oil and Gas Pipeline Industry Expenditures on the Canadian Economy in 1961 (unpublished, 1972), Table 5, p. 19.

APPENDIX VIII-5

POPULATION OF THE PRAIRIE PROVINCES

	Alberta		Manitoba		Saskatchewan	
	Total (000's)	Rural (per cent)	Total (000's)	Rural (per cent)	Total (000's)	Rural (per cent)
1931	732	62	700	55	922	70
1941	796	61	730	56	896	67
1951	940	48	777	50	832	55
1961	1,332	34	922	41	925	54
1966	1,463	31	963	33	955	51
1971	1,628	24	988	30	926	47

NET MIGRATION[1] IN THE PRAIRIE PROVINCES

(000's omitted)

	Alberta	Manitoba	Saskatchewan
1931–1941	-42	-48	-158
1941–1951	-7	-61	-199
1951–1961	+127	-4	-79
1961–1966	-3	-29	-46

Source: Dominion Bureau of Statistics/Statistics Canada, *Canada Yearbook*, various issues (Ottawa: Queen's Printer, Information Canada).

Dominion Bureau of Statistics, *Census of Canada*, various (Ottawa: Queen's Printer).

Statistics Canada, *Population Estimates, 1970* Catalogue 91-206 Annual (Ottawa: Information Canada, May 1972).

[1]Net migration indicates the net movement of population arising partly from interchange of population between provinces and partly from persons entering and leaving the country.

APPENDIX VIII-6

THE PETROLEUM REFINING INDUSTRY IN ALBERTA

	1945	1950	1955	1960	1965	1970	1972
Number of plants	4	7	10	11	11	7	7
Total crude oil capacity (thousands of barrels daily)	18	47	78	95	93	112	174
Per cent of Canadian total	8	13	13	10	9	8	10[1]
Gross selling value of output (millions of dollars)	NA	60	116	110[2]	135	NA	NA
Per cent of Canadian total	NA	12	11	9	10	NA	NA

Source: Department of Energy, Mines and Resources, Petroleum Refineries in Canada, January 1972 (Ottawa: Information Canada, 1973).

Department of Mines and Technical Surveys, Petroleum Refineries in Canada, January 1962 (Ottawa: Queen's Printer, 1962).

Dominion Bureau of Statistics, Petroleum Refineries (Ottawa: Queen's Printer, 1962, Catalogue 62-205), Table 1.

Dominion Bureau of Statistics, The Petroleum Products Industry, 1951, 1956 (Ottawa: Queen's Printer, 1953, 1958), Tables 5 and 8 respectively.

APPENDIX VIII-6 continued

[1]The relative importance of Alberta oil refining in the Canadian total increased when Gulf Canada opened a large new plant at Edmonton in 1972. An even bigger refinery is under construction by Imperial Oil at Edmonton and will come on stream in 1974. It is expected that Edmonton will become the oil refining centre for the whole of the Prairies, refined products being supplied to the south and east by a new system of products pipe lines. Small refineries of Gulf Canada at Calgary and Moose Jaw have already been closed and it is planned to close the Imperial Oil refineries at Regina and Winnipeg in 1974.

[2]This apparent decline in "gross selling value of output" was due primarily to a change in the basis of valuation used by the refining companies in calculating the value of the products made. See source (3), note to table 1B.

APPENDIX VIII-7

THE PETROCHEMICAL INDUSTRY IN ALBERTA

Statistics Canada does not separately identify the petrochemical industry from the "chemicals and chemical products industry" in presenting data on, for example, employment, value added and value of output on a province-by-province basis.

According to the Federal Department of Industry, Trade and Commerce,[1] the bulk of the Canadian petrochemical industry is raw material- and market-located in the Sarnia area of Ontario (which accounts for about 50 per cent of production workers) and in Montreal East (about 40 per cent). In both these locations the production of petrochemicals is associated with oil refining. Edmonton is the third-largest Canadian petrochemical centre. The manufacture of chemicals there from natural gas liquids accounts for about 10 per cent of the national total of production workers in this industry.

The principal plants at Edmonton are those of Alarco (methanol); Canadian Industries Limited (poly-

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[1] Communication from Mr. Grant Taylor, Industrial Chemicals Division, 12 October, 1973.

ethylene); Celanese Canada, formerly Chemcell (olefins) and Dow Chemical (ethylene and derivatives).[1] Information is not available from published sources as to employment and value of output at these plants.

Ammonia, urea and related products are not normally regarded as petrochemicals. However the manufacture of these materials, from natural gas, mainly for use as fertilizers, is important in Alberta and becoming more so. The largest plants are those of Cominco (Calgary); Esso Chemical and Sherritt Gordon Mines (both at Redwater); and Western Cooperative Fertilizers (Calgary and Medicine Hat).[1] Nine applications to the Alberta provincial authorities for natural gas based ammonia-urea complexes are currently under study.[2]

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[1]Department of Industry, Trade and Commerce, "A Directory of Canadian Chemicals Available for Export and the Manufacturing Companies" (Ottawa: Queen's Printer, 1970).

[2]Communication from Mr. Grant Taylor, Industrial Chemicals Division, 12 October, 1973.

APPENDIX VIII-8

PROVINCIAL[1] OIL AND GAS REVENUES, 1947-1972

(millions of dollars)

Alberta[2]	3,641
British Columbia[2]	462
Manitoba	10
Saskatchewan[2]	386
Total	4,499[3]

Source: *Oilweek*, Volume 24, No. 1, 19 February, 1973, pp. 45-47.

[1]Data are not available on private revenues from oil and gas industry payments.

[2]The oil and gas industry was the largest single industry-source of revenue in Alberta, British Columbia and Saskatchewan in this period.

[3]Of the total, 38 per cent was accounted for by royalties on oil and gas produced; 37 per cent by bonus payments for acquisition of mineral leases owned by the crown and 25 per cent by rentals paid on such leases. As the petroleum industry has developed, the relative importance of bonus payments has declined because an increasing proportion of the petroliferous area is under lease. Conversely, the share accounted for by lease rentals has increased. The amount and proportion from royalties has grown with rising production of oil and gas.

BIBLIOGRAPHY

Alberta. Royal Commission to Inquire into Matters Connected with Petroleum and Petroleum Products. Report. (The Commission's Report was published by Imperial Oil Limited [in Toronto?] in 1940 ". . . in the interests of a more complete understanding of the oil industry and that it may be more readily available to all interested parties . . .")

Anonymous Major Oil Company. "The Oil Demand and Supply Position in the Context of Future Energy Requirements". September 1971 (mimeo, no facts of publication given).

Baldwin, R.E., et. al. Essays in Honor of Gottfried Haberler on the Occasion of His 65th Birthday. Amsterdam: North Holland Publishing Company, 1965.

Bartley, C.M. "Potash", The Canadian Minerals Yearbook, 1962. Ottawa: Queen's Printer, 1964, pp. 493-508.

British Petroleum Company Limited. Our Industry - Oil. London: British Petroleum Company Limited, 1970.

Buckley, Kenneth. "The Role of Staple Industries in Canada's Economic Development", Journal of Economic History, Vol. XVIII (1958), pp. 439-450.

Canada. Publications of Federal Government agencies and departments are listed hereunder in alphabetical order of the agency or department to which authorship is ascribed.

Canada. Department of Energy, Mines and Resources. Petroleum Refineries in Canada, January 1972. Ottawa: Information Canada, 1972.

Canada. Department of Energy, Mines and Resources, Geological Survey. Geology and Economic Minerals of Canada. Ottawa: Queen's Printer, 1970.

Canada. Department of External Affairs. Canadian Embassy Note Number 303 to the State Department, 25 September, 1967 (subsequently tabled in the House of Commons).

Canada. Department of External Affairs. "Joint Canada/United States Committee on Trade and External Affairs". Press Release Number 82 of 24 November, 1970.

Canada. Department of Industry, Trade and Commerce. Foreign-owned Subsidiaries in Canada. Ottawa: Department of Industry, Trade and Commerce, 1970 (for 1964-1967) and 1972 (for 1964-1969).

Canada. Department of Industry, Trade and Commerce. Statistical Supplement to Foreign-owned Subsidiaries in Canada. Ottawa: Department of Industry, Trade and Commerce, 1972.

Canada. Department of Industry, Trade and Commerce. "U.S. Direct Investment in Canada as Reported by U.S. Sources" (mimeo). Ottawa: Department of Industry, Trade and Commerce, June 1969.

Canada. Department of Mines and Technical Surveys. Petroleum Refineries in Canada, January 1962. Ottawa: Queen's Printer, 1962.

Canada. Department of National Revenue, Customs and Excise. Memorandum D46-1, "Value for Duty of Gasoline" (mimeo). June 1965; "Surtax on Gasoline-type Fuels for Use in Internal Combustion Engines other than Aircraft" (mimeo). January and April 1969.

Canada. Dominion Bureau of Statistics (now Statistics Canada). This agency issued its publications by authority of the Minister of Industry, Trade and Commerce. They were available directly from the Bureau or from the Queen's Printer.

Canada. Dominion Bureau of Statistics. The Canadian Balance of International Payments and International Investment Position. Catalogue No. 67-201 (Annual). 1958 (for 1957); 1959 (for 1958); 1964 (for 1961 and 1962) and 1967 (for 1963, 1964 and 1965).

Canada. Dominion Bureau of Statistics. Employment and Payrolls. Catalogue No. 72-002 (Monthly), 1960 and 1965.

Canada. Dominion Bureau of Statistics. Indexes of Real Domestic Product by Industry, 1961-1969. Catalogue No. 61-505 (Occasional), 1963.

Canada. Dominion Bureau of Statistics. Indexes of Real Domestic Product by Industry, 1961-1969 Catalogue No. 61-510 (Occasional), 1971.

Canada. Dominion Bureau of Statistics. The Input-Output Structure of the Canadian Economy, 1961. 2 Vols. Catalogue No. 15-501 (Occasional), 1969.

Canada. Dominion Bureau of Statistics. Inter-Industry Flow of Goods and Services, Canada, 1949. Reference Paper No. 72, 1956.

Canada. Dominion Bureau of Statistics. The Petroleum Products Industry. Catalogue No. 45-205 (Annual), 1953 (for 1951); 1958 (for 1956).

Canada. Dominion Bureau of Statistics. Petroleum Refineries. Catalogue No. 62-205 (Annual), 1962.

Canada. Dominion Bureau of Statistics. Private and Public Investment in Canada, 1946-1957. Catalogue No. 61-504 (Annual), 1959.

Canada. Dominion Bureau of Statistics or Statistics Canada (1972, 1973) and Department of Industry, Trade and Commerce. Private and Public Investment in Canada, Outlook 1961, 1972 and 1973. Catalogue No. 61-205 (Annual), 1961, 1972 and 1973.

Canada. Dominion Bureau of Statistics. Trade of Canada - Exports by Commodities. Catalogue No. 65-004 (Monthly).

Canada. House of Commons Debates. 1960-1961, Vol. 2; 1965, Vol. X; 1970, Vol. VIII.

Canada. House of Commons. Evidence of the Standing Committee on National Resources and Public Works. Issue No. 4, 8 March, 1973.

Canada. Minister of Energy, Mines and Resources. An Energy Policy for Canada. 2 Vols. Ottawa: Information Canada, 1973.

Canada. Minister of Industry, Trade and Commerce. Annual Reports Under the Corporations and Labour Unions Returns Act. Ottawa: Minister of Industry, Trade and Commerce, 1969 (for the years 1965-1967).

Canada. National Energy Board. Annual Reports. Ottawa: Queen's Printer/Information Canada, 1959-1972.

Canada. National Energy Board. Energy Supply and Demand in Canada and Export Demand for Canadian Energy. Ottawa: Queen's Printer, 1969.

Canada. National Energy Board. Reasons for Decision in the Matter of Applications Under the National Energy Board Act of Alberta and Southern Gas Co. Ltd. et. al. Ottawa: National Energy Board, December 1971.

Canada. National Energy Board. "Regulations and Procedures, Oil Imports and Transfers" (mimeo). Ottawa: January 1965.

Canada. National Energy Board. "Report on the Impact of the Oil and Gas Pipeline Industry Expenditures on the Canadian Economy in 1961" (mimeo). 1972.

Canada. Royal Commission on Energy (Henry Borden, Chairman). Second Report. Ottawa: Queen's Printer, 1959.

Canada. Statistics Canada. This agency issues its publications by authority of the Minister of Industry, Trade and Commerce. They are available directly from Statistics Canada, Ottawa, or through Information Canada.

Canada. Statistics Canada. Canada's International Investment Position, 1926 to 1967. Catalogue No. 67-202 (Annual), 1971.

Canada. Statistics Canada. The Crude Petroleum and Natural Gas Industry. For 1953 and succeeding years to 1971. Catalogue No. 26-213 (Annual), 1955 and succeeding years to 1973.

Canada. Statistics Canada. Employment Earnings and Hours, August 1972. Catalogue 72-002 (Monthly), October 1972.

Canada. Statistics Canada. General Review of the Mineral Industries. Catalogue No. 26-201 (Annual), various issues.

Canada. Statistics Canada. Petroleum Refineries, 1971. Catalogue No. 42-205 (Annual), 1972.

Canada. Statistics Canada. Refined Petroleum Products. Catalogue No. 45-204 (Annual) and 45-004 (Monthly), various issues.

Canadian Petroleum Association, Geological Reserves Committee. Potential Reserves of Oil, Natural Gas and Associated Sulphur in Canada. Calgary: Canadian Petroleum Association, April 1969.

Canadian Petroleum Association. Statistical Yearbooks (Annual from 1955). Calgary: Canadian Petroleum Association.

Canadian Petroleum Association, Reserves Committee. Report for 1972. Calgary: Canadian Petroleum Association, March 1973.

Caves, Richard E. and Holton, Richard H. The Canadian Economy, Prospect and Retrospect. Cambridge, Mass.: Harvard University Press, 1959.

Dagher, J.H. "Effect of the National Oil Policy on the Ontario Refining Industry". Unpublished Doctoral dissertation, Department of Economics, McGill University, 1968.

Davis, John. Canadian Energy Prospects. A study for the Royal Commission on Canada's Economic Prospects. Ottawa: Published by Authority of the Commission, Ottawa: Queen's Printer, 1957.

Due, J.F. and Clower, R.W. Intermediate Economic Analysis. Homewood, Ill.: Richard D. Irwin, 1961.

Easterbrook, W.T. and Aitken, Hugh G.J. Canadian Economic History. Toronto: The Macmillan Company of Canada, 1956.

Firestone, O.J. Canada's Economic Development 1867-1953. London: Bowes and Bowes, 1958.

________. Industry and Education. Ottawa: University of Ottawa Press, 1969.

________. "Natural Resources and the Canadian Economy". (Mimeo). Lecture given at the National Defence College, Kingston, September 1959.

________. Private and Public Investment in Canada 1926-1951. Ottawa: Department of Trade and Commerce, 1951.

Fowke, Vernon C. Canadian Agricultural Policy. Toronto: University of Toronto Press, 1947.

________. The National Policy and the Wheat Economy. Toronto: University of Toronto Press, 1957.

Frank, R.H. and Kubursi, A.A. "Sectoral Characteristics of the Ontario Structure of Production". Special Supplement of the Ontario Economic Review, March 1972.

Gray, Earle. The Great Canadian Oil Patch. Toronto: Maclean Hunter, 1970.

________. Impact of Oil - The Development of Canada's Oil Resources. Toronto: Ryerson/Maclean Hunter, 1969.

Hanson, Eric J. Dynamic Decade, The Evolution and Effects of the Oil Industry in Alberta. Toronto: McClelland and Stewart, 1958.

________. "The Economic Prospects of Western Canada", Transactions of the Royal Society of Canada. Volume VI: Series IV: Section II, June 1968, pp. 245-259.

________. "Regional Employment and Income Effects of the Petroleum Industry in Alberta". Proceedings, Council of Economics, American Institute of Mining, Metallurgical and Petroleum Engineers. New York, 27 March, 1966, pp. 276-313.

Hedlin Menzies and Associates. "The Wheat and Oilseeds Economy in Canada" (Mimeo). A Report prepared for the Federal Task Force on Agriculture. Winnipeg: Hedlin Menzies and Associates, 1968.

Hilborn, James D. Dusters and Gushers, The Canadian Oil and Gas Industry. Toronto: Pitt Publishing Company Limited, 1968.

Howland, R.D. "Canada's National Oil Policy". An address to the Annual Meeting of the Canadian Institute of Mining and Metallurgy, Quebec City, 25 April, 1966, (unpublished).

________. "Some Observations on Canadian Energy Supply and Demand Outlook". Paper presented at the 11th Annual Institute of the Petroleum Industry, Southwestern Legal Foundation, Dallas, Texas, 4 March, 1971.

Hubbert, M. King. "Energy Resources". A Report to the Council on Natural Resources of the National Academy of Sciences. Washington, D.C.: National Academy of Sciences, 1962.

Imperial Oil Limited. Submission to the Royal Commission on Energy. Toronto: Imperial Oil Limited, May 1958.

Independent Petroleum Association of America. The Oil Producing Industry in Your State. Washington, D.C.: The Independent Petroleum Association of America, 1972.

Innis, H.A. The Cod Fisheries: The History of an International Economy. Toronto: The Ryerson Press, 1940.

________. The Fur Trade in Canada: An Introduction to Canadian Economic History. 2nd ed. Toronto: University of Toronto Press, 1956.

Kilbourn, William. PipeLine. Toronto: Clarke, Irwin & Company Limited, 1970.

Kuznets, Simon. Modern Economic Growth. New Haven: Yale University Press, 1966.

Lauriston, Victor. Blue Flame of Service, A History of Union Gas Company and the Natural Gas Industry of Southwestern Ontario. Chatham: Union Gas Company of Canada, 1961.

Levy, W.J. Market Outlets for Canadian Crude Oil, Problems and Prospects. New York: W.J. Levy Inc., 1957.

Lithwick, N.H. Economic Growth in Canada. 2nd ed. Toronto: University of Toronto Press, 1970.

Litvak, I.A., Maule, C.J. and Robinson, P.D. Dual Loyalty - Canadian-U.S. Business Arrangements. Toronto: McGraw-Hill Company of Canada, 1971.

Mackenzie, Alexander. Voyages from Montreal on the River St. Lawrence Through the Continent of North America to the Frozen and Pacific Oceans. First American Ed. New York: G.F. Hopkins, 1802.

Mackintosh, W.A. The Economic Background of Dominion-Provincial Relations. Carleton Library Edition. Toronto: McClelland & Stewart, 1964.

Mikesell, Raymond F. Foreign Investment in the Petroleum and Mineral Industries. Baltimore: The Johns Hopkins Press, 1971.

Plotnik, A.R. Petroleum: Canadian Markets and United States Foreign Trade Policy. Seattle: University of Washington Press, 1964.

Rea, K.J. The Political Economy of the Canadian North. Toronto: University of Toronto Press, 1968.

Ross, Victor. Petroleum in Canada. Toronto: 1917 (no publisher).

Rostow, W.W. The Stages of Economic Growth. Cambridge: Cambridge University Press, 1967.

Safarian, A.E. Foreign Ownership of Canadian Industry. Toronto: McGraw-Hill of Canada, 1966.

Saskatchewan. Department of Mineral Resources. Oil in Saskatchewan. Regina: Department of Mineral Resources, 1956.

Scott, Anthony. "National Wealth and Natural Wealth", Canadian Journal of Economics and Political Science, Vol. XXII, No. 3 (1956), pp. 373-378.

Schurr, Sam H. The Outlook for Energy Resources in the United States. Washington, D.C.: Resources for the Future, Reprint Number 68, October 1967.

Schurr, S.H. and Netschert, B.C. Energy in the American Economy 1850-1955. Baltimore: The Johns Hopkins Press, 1960.

Spry, Irene M. "Hydro-electric Power" in Encyclopedia Canadiana. V (1965), pp. 211-222.

Stanford Research Institute. Economic Aspects of a Crude Oil Pipe Line - Edmonton, Alberta, to Vancouver, British Columbia. Menlo Park, Calif.: Stanford Research Institute, March 1954.

Stanley, David H.G. The Financing of Oil and Gas Exploration and Production in Canada. Toronto: Wood, Gundy, 1962.

Twaits, W.O. "Philosophy of Exploration" (Mimeo). An address to the 40th Annual Convention of the Prospectors and Developers' Association, Toronto, 8 May, 1972.

United Nations. Statistical Yearbook, 1970. New York: Statistical Office of the United Nations, 1972.

United States. Bureau of Mines. Minerals Yearbook. Various editions.

United States. Cabinet Task Force on Oil Import Control. The Oil Import Question. February 1970.

United States Congress. Hearings on Small Business Problems Created by Petroleum Imports. 87th Congress, 1st Sess., 1961.

United States. Department of Commerce. "United States Exports - Schedule B, Commodity and Country". Washington, D.C.: Government Printing Office.

United States. Department of State. "The President's Message to Congress on the Energy Situation". Press release dated 4 June, 1971.

Watkins, M.H. "A Staple Theory of Economic Growth". Canadian Journal of Economics and Political Science, Vol. XXIX, No. 2 (1963), pp. 141-158.

Weinrich, John E. Economic Impact of the Canadian Gas Industry Local, Provincial and National (Mimeo). Calgary: The Calgary Chamber of Commerce, September 1966.

Wilson, Neill C. and Taylor, Frank J. The Building of Trans Mountain. Vancouver: Trans Mountain Oil Pipe Line Company, 1954.