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THE ENERGY GAME*

*POLITICAL BEHAVIOR AND THE ENERGY GAME: ANALYSIS OF OPTIONS FOR CANADA

for

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by

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PREFACE

It has been my view that a paper encompassing the total energy picture for Canada would yield beneficial results, particularly if it is constructed in a manner that would assist in providing simple visual communication.

Hopefully, the paper will be helpful in understanding the energy development requirements and problems we as a country face over the next several years.

It is with this purpose in mind that this research paper is written.

Although I am employed by the National Energy Board at the time of preparing this paper, the views expressed herein are mine and do not necessarily reflect those of the Board.

INTRODUCTION

It is the purpose of this paper to focus on the economic, financial, and technical problems facing Canada, particularly as they will effect energy requirements over the next several years. The various forces and pressures at work on and within Canada will be examined and identified including those of an international nature, which have and will influence Canada's needs and behavior.

In order to make certain forecasts and resulting observations and conclusions thereto, it will be helpful to examine the historical energy decisions taken in Canada and, in particular, to observe the trends flowing from such actions.

To assist in understanding the legal constitutional background of both the provinces and the central government, a chapter will be devoted to a review of the British North America Acts and the resolutions adopted at preceding Conferences as they influence present day political behavior.

In general, this paper is not confined to the Canadian energy situation alone. It will deal with Canadian-U.S. energy trade, U.S. energy requirements and supplies, and the international political and economic factors, particularly as they relate to and affect the North American energy supply and economic picture.

The interests[1], or "players" that have a bearing on the energy situation as represented in this paper and the various interrelationships between them, are illustrated (schematically) in CHART A. The broken lines represent lines of communication

1 In this paper, "players" are analogous to interests and are used interchangeably.

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between the various interests such as between governments, between pressure or interest groups and governments, and between various agencies and decision-makers such as the National Energy Board and the Cabinet.

During the entire 1970's, as newsworthy items attest, and particularly in recent times, matters relating to energy have reached public attention in ever increasing frequency. Provincial and federal governments, and private and industrial interests have been forced into a greater and greater adversary position(s). The conflicts that have reached public notice particularly in federal-provincial relations have sometimes acted to the detriment of industry and consumer needs and can be related almost entirely to the following:

(i) claims on (resource) ownership; and

(ii) royalties and/or revenue sharing.

What was to grow into a larger conflict involving the federal and provincial governments, initially surfaced in the early 1970's as a producing industry-consumer "dispute" over natural gas pricing. This pricing issue[1] and in particular, the interrelated factors was heard before the Alberta Energy Resources Conservation Board in 1972. This Board subsequently issued its report claiming that natural gas was underpriced by 20¢/Mcf at the wellhead.

Alberta's position with regard to resource ownership and particularly its share of revenues (i.e. royalties) and other

1 In the matter of field pricing of natural gas in Alberta.

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energy related matters, has always been rather jealously guarded (even if related provincial legislation has never been tested in the courts). Provincial revenues and/or royalties and resource ownership rights came into question by actions taken by federal decision-making bodies, particularly with regard to the exports of these resources to the U.S. Alberta's revenue requirements and the price demands of the oil and gas producers became closely related interests (at least at first). Eventually the actions of Alberta developed into a dispute between producing and consuming provinces[1], in particular between the provinces of Alberta and Ontario.

The Federal Government became increasingly involved in these issues because of the responsibilities given to it under the constitution and because of the seemingly unilateral actions[2] taken by some of the producing provinces against these federal responsibilities.

Recently[3], Canada was involved in discussions, consultations and negotiations with the U.S. on energy matters of mutual concern, particularly with regard to the pricing and

1 The First Minister's Conferences on Energy are the most recent domestic forums for this debate. This dispute and the issues involved are not unlike those between the Western industrialized nations and the Organization of Petroleum Exporting Countries (O.P.E.C.).

2 The Province of British Columbia, for example, took unilateral action in increasing the border price of its natural gas exports to the U.S. in 1973 and formed the B.C. Petroleum Corporation for the purpose of collecting these additional revenues for the province. The Federal Government finally got a share of these revenues in 1974 after some negotiations.

3 As recently as April 22, 1975, discussions were held between U.S. and Canadian officials with regard to the pricing of natural gas. An increase in the border price to $1.50 from $1.00 per Mcf was proposed (publically) by Canadian officials at this meeting.

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supply of natural gas and crude petroleum. Other discussions centered on pollution, pipeline treaties, and the search for mutually suitable vehicles for the exploitation of frontier supplies (for example, the Gas Arctic Pipeline proposal along the Mackenzie River as opposed to the El Paso all-Alaskan Natural Gas/LNG Project).

Until the Arab oil embargo of October 1973, the Western based multi-national oil companies effectively managed oil prices with their control over Middle East production.

The United States, the world's largest oil consumer, became progressively more energy deficient in oil and gas throughout the 1960's, and increasingly dependent on foreign supply sources. Beginning in 1967, that country entered a new era in natural gas when proven reserves of natural gas[1] peaked and subsequently began a decline as annual consumption outpaced annual additions to reserves (see Chart B).

Under these new conditions and as demand outpaced available supplies, the U.S. turned increasing attention towards Canada. There are several reasons for this attention. These include the following:

(i) The belief that Canada had enormous[2] or "unlimited resources";

(ii) The close geographic proximity to the U.S. (i.e. Canada was the only immediate outside option of pipeline natural gas supplies;

(iii) Canadian political stability (as compared to the turbulent Middle East climate of the late 1960's and the early 1970's);

1 Except for the Prudhoe Bay discovery, U.S. gas reserves have been decreasing since 1967 (see Chart E, page 2 of 5).
2 For example, see Table III.

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(iv) The rather dominant corporate ownership[1] of the Western Canadian producing industry by the U.S.;

(v) Pipelines from Canada's supply areas either already ran through U.S. markets to Canadian markets (i.e. the Great Lakes Pipeline Co.) or connected directly with U.S. pipelines (i.e. the Foothills division of Alberta Gas Trunk Ltd. connected with Pacific Gas and Electric Co. pipeline interests to Northern California); and

(vi) Canadian decision-makers believed Canada had enormous resources and encouraged the export of supplies.

As the U.S. became increasingly energy deficient, Canadian oil and gas production in the most accessible areas was accelerated rapidly in response to U.S. needs and finally, to the limit of Canada's proven conventional[2] reserves. Any slack field producibility was quickly absorbed from 1965 onwards (see the Charts of Set 1). In the early 1970's, oil and gas export controls were imposed by the Canadian Government as the decision-makers became convinced that Canadian requirements would not be satisfied by domestic production in the 1980's.

Meanwhile, government decision-makers were being reassured by powerful (producing industry) lobbyists[3] that discoveries would be made[4] to meet our requirements "as needed", not only in the Western Canadian sedimentary basin itself but in the

1 According to EMR's, An Energy Policy for Canada - Phase I, foreign ownership was 74% in 1973.
2 Western sedimentary basin reserves excluding any proven frontier reserves.
3 The most interesting and significant case is the one presented in an article by Eric Kierans, "The Day the Cabinet was Misled", published in the Canadian Forum, March 1974, p. 10.
4 The "unlimited resources" concept, see (i) p. 9.

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Mackenzie Valley Delta, and the Arctic Islands. As a result of this belief, the long-term protection formulas[1] designed to trigger or signal future shortages were allowed to go into disuse. In the 1970's, activities of regulatory agencies were devoted increasingly towards the "enforcement" of daily operating responsibilities.

In the early 1970's Canadian production capability from the traditional oil and gas sources also began to show signs of reaching its limits. This was particularly noticeable in oil producibility[2] during the 1973 Arab Oil Embargo.

In the late 1960's, the U.S. became increasingly preoccupied with avoiding a growing supply dependence on the "unstable" Middle East countries. It preferred to get its supplies from what it considered "reliable" or politically "stable" areas.

The resource pressures on Canada reached a peak with the passage of the Manhattan tanker through the Arctic Islands in 1969 and 1970. Some have suggested that this was a test of Canadian sovereignty in the Arctic Region, but in spite of these supposed "tests" on Canadian sovereignty, reality seems to be prevailing. Evidence was making it clear that the U.S. must face the Arab reality as the Canadian options to meet the rising demand of the U.S. were inadequate, particularly as Canadian production was reaching the limits of producibility and reserves from Canadian frontier areas were not being discovered in the time span required to meet the North American supply-demand deficiency. Recently, other questions have been raised, i.e. whether, in fact,

1. For example, $25A_4$ or 25 times the fourth year requirement for natural gas (see pps. 56-63 of this report).
2. In fact certain refineries, particularly that of Imperial Oil in Sarnia, showed signs of severe equipment corrosion due to unusual quantities of reservoir salts produced with the increased rates of production (and increased reservoir depletion).

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Canadian requirements alone could be met adequately to preserve historic growth trends in demand. This question is examined in a later chapter of this project.

In order to protect themselves against the severe inflation in the industrialized world and increase their real purchasing power, the O.P.E.C. nations took the opportunity, with the help of the oil embargo initiated during the 1973 Arab-Israel War, to increase their oil prices fourfold to levels well above $15.00 per barrel. Prices were designed to match those of alternate sources of hydrocarbon energy supplies in the U.S. (i.e. oil shale, synthetic natural gas, etc.) which in 1974 dollars were determined by O.P.E.C. to be $11.00 per barrel and up. Upon the removal of the oil embargo and their subsequent recognition of the West's severe economic problems, the O.P.E.C. countries froze their oil prices until late September, 1975.

Canada, meanwhile, in this highly fluid political and economic environment, took measures to satisfy its own longer term oil needs, first by way of export controls, then by an oil export reduction program related to its domestic producibility.

Following the O.P.E.C. price moves, Canada raised its export selling price to international levels in the winter of 1973-74, based on certain basing prices[1] (i.e. Chicago landed

1 Canadian oil in the U.S. became more than marginally attractive by 1970 in comparison with other feedstocks and some U.S. refineries, for economic reasons found it difficult to adhere to voluntary targets which forced the U.S. to place them under control in March, 1970. But the need for increasing imports of oil by the U.S. by then was apparent and by the end of 1972 Canada was producing at capacity and exporting 1.2 million barrels/day to the U.S.

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prices for oil from alternate offshore sources, etc.) while its domestic prices were controlled at lower levels under federal-provincial agreements[1]. The price mix at the consumer gates (i.e. city gates) stabilized at levels similar to those prevailing in the U.S. where "old"[2] oil and gas continued under U.S. federal control. Any difference in price was reflected by the transmission margin[3]. (The general inflation level as reflected in various price indices (Chart 5) generally rose at a uniform rate in Canada and the U.S., thus reflecting this governmental action).

Because of the overall energy supply-demand deficit in North America and rapidly rising inflation, investment decisions in alternate forms of energy have become particularly risky for Canada and the United States. One of the objectives of this research paper is to examine the "price stability" of O.P.E.C. oil in the international arena utilizing political (and economic) considerations.

The material used in this project is developed from basic information except where indicated and is referenced where applicable. The data is from published sources, including sources such as Statistics Canada, the Canadian Petroleum Association, daily newspapers, various periodicals, public/decision reports of federal and provincial regulatory agencies, submissions to the regulatory agencies at public hearings, and trade publications.

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1 The agreed price was $6.50 per barrel in 1973-74.
2 On April 9, 1975, the U.S. Senate voted to allow an increase in the price of "old" oil recovered by secondary and tertiary methods to $7.50/bbl., up from the $5.25 controlled price.
3 Refer to the Set 1 Charts, Sheets 1 and 2.

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Use is made of several time-related decision points and trend analysis to identify critical decision points from which subsequent events are analyzed and/or explained. For this purpose, composite supply-demand curves (Charts 7, 8 and 9 for Canada) have been constructed out of the individual supply charts projected to the year 1991. The basic supply chart is varied to include new elements for the purpose of discussion and also to determine whether in fact such public statements as the one appearing in the April 24, 1975 issue of the Globe and Mail predicting a "shortage of oil in five years" have any validity.

It is helpful to make some reference to administrative and consitutional law in this paper for the purpose of extracting a clearer understanding of Canadian decision-making practices and for making comparisons with U.S. practice.

In the main, this paper integrates the economic, financial, and technical[1] realities with the background aid of simple economic theory, supply/demand charts, forecasting models, trend analysis, cost-benefit analysis, basing point networks, a "modified" decision tree, and various scholarly techniques developed from standard literature for the purpose of analyzing political conflicts.

In general, the following concepts are examined and integrated into the dialogue of the paper:

(i) the concept of "unlimited (Canadian) resources";

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1 Engineering, geology, and construction.

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(ii) the usefulness of the Canadian approach in the matter of "proper accords" in the international forum to deal with the recycling of petro dollars, and

(iii) the concept of the "real approach" or "no nonsense" approach with compensating means as used by the U.S. with regard to reserves, politics, etc.

In the end, the project tries to identify the energy options open to Canada between now and 1990, and makes some attempt to determine which demand growth curve is realistic. Recommendations are made in the hope of minimizing the risk of failing to meet reasonable demand objectives.

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THE NATURE OF CANADIAN UNITY

This is an immense topic and is perhaps something an engineer should not undertake. Perhaps it may be more appropriate to leave it to one's legal brothers. However, judging from the various conflicts that have arisen in federal-provincial relations, self-confidence should not be a detriment in trying to do so.

There is no doubt that all Canadians should be familiar with the British North America Acts and the pre-1867 Conferences leading up to the B.N.A. Act of 1867. Such familiarity could only assist in fostering an understanding[1] of the nature of Canadian unity and the manner in which some of the problems facing Canada can be resolved.

Recent energy related events have shown that the Federal Government does not always have the power[2] to take unilateral action towards the resolution of problems of a national nature without facing the prospect of a counter-action by a province or provinces. The use of provincial counter-action in a federal-type of union can breed counter-actions (provincial or federal) which, unfortunately, result in national or regional tensions and cannot ultimately be in the best interests of the nation. More importantly, fundamental issues may have been over-looked in the heat of the conflict.

It is helpful to review the pre-confederation conferences and documents (i.e. resolutions) leading up to Confederation, or

1 Understanding, of course, does not necessarily eliminate confusion.
2 There is also the matter of "willingness".

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union reached with the signing of the B.N.A. Act in 1867, and some of the subsequent B.N.A. Acts relating to Provincial matters.

In the beginning of Canada, none of the larger provincial territories were what they are today. These enlarged provincial territorial boundaries came with union (i.e. Newfoundland and the Prairie Provinces) or were written into a constitutional statute sometime after Confederation (i.e. Ontario and Quebec). With union, the provinces and the central government each were given certain rights and responsibilities.

There seems to be some doubt as to whether the B.N.A. Act was in fact a pact or not. In some ways the Act is more of an understanding that had been arrived at between the different colonies in British North America leading up to Confederation. While it was an Act of the British Imperial Parliament, it cannot be amended without the consent of Canada. It has not been amended to this day because provincial agreement to do so has not been obtainable.

It is apparent from the various resolutions adopted at the Quebec and London Conferences[1] that lead up to the B.N.A. Act of 1867, that they constituted a compromise (in large part) or an understanding. The B.N.A. Act of 1867 is a re-edition of this understanding with very few changes. The Act of 1867 suggests some attempt was made beyond the earlier resolutions to provide the central government with the constitutional power to deal with problems concerning the "general advantage" (i.e. in the national

1 Resolutions adopted at the Quebec Conference had followed that of Charlottetown and were put in statute form at the London Conference.

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interest) should these involve any two or more provinces even if such "works" lie wholly within any Province. Natural resources may or may not fall in this category of "works"[1].

The final constitution[2] is a complex of compromises. This suggests that the different provinces or colonies in those days were rather anxious to protect their autonomy. This may explain why Canada became a federal union rather than a legislative one, though even this judgment is not without contradiction as the Imperial Statute seems open to legislative evolution in favour of the central government without the need of continuing governmental action by compromise[3] with the provinces.

The Federal-Provincial First Ministers' Conferences on Energy can be taken to reflect some of the more honourable intentions of nationhood with the provinces sitting down together with the federal government to resolve conflict for the broader purposes of the national interest or the common good and not for individual advantage alone. Later on in this context the price decisions taken are examined in comparison with average U.S. prices, relative price indices, as well as price action in relation to the longer term needs.

The B.N.A. Act of 1867 united Ontario and Quebec with Nova Scotia and New Brunswick in a federal union with various written understandings between them, and made provision for the coming in of other provinces. The principles set out in the Quebec Conference of 1864 allowed the central government general powers over all

1 It would seem that the courts have not interpreted "works" outside the categories set out, i.e. man-made works. (See Varcoe, Legislative Power in Canada, p. 146).
2 British North America Act of 1867.
3 This of course assumes that the federal government is always properly oriented towards the national interest. This may not be so, in fact.

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the members of the union and allowed governments control and management of certain matters naturally and conveniently belonging to them. The B.N.A. Act itself contained 147 sections, divided into eleven (11) parts dealing with, among other things, the distribution of legislative powers as between Canada and its provinces, and with the jurisdiction with revenues, debts, assets and taxation, and with miscellaneous provisions and the admission of other colonies into the union.

Section 91 of the B.N.A. Act for example gives to the Parliament of Canada the sole or exclusive right of making laws for regulating trade and commerce, for the raising of money by any system of taxation, etc., the residue of powers, and also for Works for the general advantage of Canada. Section 92 of the B.N.A. Act enumerates the provincial powers including the power to impose direct taxation within the province, to manage and sell its public lands and other resources, etc.

It is interesting to trace the evolution of some of the understandings at the conferences leading up to Confederation, particularly those related to the current energy issue. It goes without saying that oil and gas, and interprovincial pipelines as such were unknown commodities at the time of the drafting of the pre-confederation documents. The understandings therefore, as they would relate to these resource items of trade, would have to be interpolated.

At a Conference of Delegates from the Provinces of Canada (i.e. Ontario and Quebec), Nova Scotia, and New Brunswick, and the colonies of Newfoundland and P.E.I., held at the City of

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Quebec, October 10, 1864, a Report of Resolutions was adopted as the basis of a proposed Confederation of those Provinces and Colonies as they were then called. This Report of Resolutions was mentioned earlier and is known as The Quebec Resolutions.

Some of the Resolutions contained in the original Report of Resolutions that are beneficial to an understanding of the nature of Confederation are as follows:

(Resolution)

> "1. The best interests and present and future prosperity of British North America will be promoted by a Federal Union under the Crown of Great Britain, provided such union can be effected on principles just to the several Provinces."

(Resolution)

> "2. In the Federation of the British North American Provinces ..., - would be a General Government charged with matters of Common interest to the whole country,...."

(Resolution)

> "29. The General Parliament shall have power to make laws for the peace, welfare and good Government of the Federated Provinces (saving the Sovereignty of England), and especially Laws respecting the following subjects:-"

(note: Six of the total of 37 items contained in this resolution are selected as appropriate for the purposes of this research paper).

> "2. The regulation of trade and commerce[1].
>
> 3. The imposition of regulation of duties of customs on imports and exports, except on exports of timber, logs, masts, spars, deals, and sawn lumber, and of coal and other minerals."

1 The accentuation is the author's.

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"5. The raising of money by all or any other modes or system of taxation.

8. Lines of steam or other ships, canals and other works, connecting any two or more of the Provinces together, or extending beyond the limits of any Province.

11. All such works as shall, although lying wholly within any Province, be specially declared by the Acts authorizing them to be for the general advantage.

37. And generally respecting all matters of a general character, not specially and exclusively reserved for the Local Governments and Legislatures."

(Resolution)

"43. The Local Legislatures shall have the power to make Laws respecting the following subjects:

1. Direct taxation and the imposition of duties on the export of timber, logs, masts, spars, deals, and sawn lumber, and of coals and other minerals.

18. And generally all matters of a private or local nature, not assigned to the General Parliament."

(note: only two of the total of 18 items contained in the original resolutions have been selected for reproduction here).

(Resolution)

"45. In regard to all subjects over which jurisdiction belongs to both the General and Local Legislatures, the laws of the General Parliament shall control and supersede those made by the Local Legislature, and the latter shall be void as far as they are repugnant to or inconsistant with the former."

(Resolution)

"56. All lands, mines, minerals, and royalties vested in Her Majesty in the Provinces of Upper Canada, Lower Canada, Nova Scotia, New Brunswick and P.E.I., for the use of such Provinces, shall belong to the Local Government of the territory in which the same are so situated;"

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(Resolution)

"57. All sums due from purchasers or lessees of such lands, mines, or minerals at the time of the union shall also belong to the Local Governments."

A subsequent Conference of Delegates from the Provinces of Canada, Nova Scotia, and New Brunswick was held at the Westminster Palace Hotel, London, December 4, 1866. The Resolutions adopted became known as the London Resolutions. The resolutions related to the powers of the General Government are quite similar to those of the Quebec Resolutions with the exception of item 3 of Section 29 which appears to have been omitted. With regard to the powers of the Local Legislature, item 1 of Section 43 of the Quebec Resolutions appears to have been omitted and instead replaced by item 2 in resolution 41 of the London Resolutions as follows:

(Resolution)

"41. The Local Legislature shall have power to make laws respecting the following subjects:-

(2) Direct taxation, and in the case of New Brunswick the right of levying timber dues by the mode and to the extent now established by law, provided such timber is not the produce of the other Provinces."

The sixty-nine resolutions comprising the London Resolutions were signed by John A. Macdonald (the Chairman) and H. Bernard (the Secretary).

The powers attributed to the General Parliament and the Local Legislatures which were adopted first in the Quebec Resolutions and then in the London Resolutions, took on a slightly different form when they were finally written into the British North America Act of 1867. However, it remains uncertain whether the wording changes setting

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out the jurisdiction over mineral ownership, the powers of imposition or regulation of duties of customs and imports and exports, direct taxation on "coal and other minerals", and the clause dealing with "the general advantage", made the present day task of managing Canada any easier or more clearly precise. Nevertheless, the B.N.A. Act of 1867 was the document finally agreed to.

The B.N.A. Act of 1867 was drafted on the basis of the London Resolutions, 1866-67, by the London Conference of Delegates of the three provinces. The Act and the London Conference are therefore closely allied.

Regarding the distribution of Legislative Powers, Schedule VI, Section 91 deals with the Powers of the Parliament while Section 92 sets out the Exclusive Powers of the Provincial Legislatures. On matters related to the paper, subsections 2, 3 and 29 of Section 91 read as follows:

"Sec. 91.2. The Regulation of Trade and Commerce.

3. The raising of Money by any Mode or System of Taxation.

29. Such Classes of subjects as are expressly excepted in the Enumeration of the Classes of subjects by this Act assigned exclusively to the Legislatures of the Provinces."

With regard to exclusive powers of Provincial Legislatures, section 92, and subsections 10 and 16 are of particular interest. These read as follows:

"Sec. 92. In each Province the Legislature may exclusively make Laws in relation to matters coming within the Classes of Subjects next enumerated; that is to say,-

10. Local Works and undertakings other than such as are of the following classes:-"

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"(a) Lines of Steam and other Ships, Railways, Canals, Telegraphs, and other Works and undertakings connecting the Province with any other or others of the Provinces, or extending beyond the Limits of the Province;

(b) Lines of Steam Ships between the Province and any British or Foreign Country;

(c) Such Works as, although wholly situated within the Province, are before or after their Execution declared by the Parliament of Canada to be for the General Advantage of Canada or for the Advantage of Two or more of the Provinces.

16. Generally all matters of a merely local or private nature in the Province."

It appears from section 92, subsection 10(c) that the Founding Fathers clearly intended to limit Provincial powers should Provincial interests come up against the concept of "for the general advantage of Canada". Although this section is not specific to any particular "works", the general intent may not be construed to have any bearing on the trade of energy commodities, particularly those that are surplus to one province under some criteria of measurement but not surplus to Canada as a whole, and whenever other provinces are interested parties to the pricing and trade of these commodities particularly if they are affected in some way against previously mentioned principles. In the past, the courts have not interpreted "works" outside the categories set out, i.e. man-made works (Varcoe, 1954, p. 146).

On the matter of mineral ownership, Schedule VIII, Section 109 of the B.N.A. Act, 1867, reads as follows:

"Section 109 All lands, Mines, Minerals, and Royalties[1] belonging to the several Provinces of Canada,

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1 While Sec. 91.3 gives Parliament the power to raise "money by any mode or system of taxation", Section 109 states that "royalties belong to the several Provinces".

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> Nova Scotia, and New Brunswick at the Union, and all sums then due or payable for such funds, Mines, Minerals, or Royalties, shall belong to the several Provinces of Ontario, Quebec, Nova Scotia, and New Brunswick in which the same or situate or arise, subject to any Trusts existing in respect thereof, and to any Interest other than that of the Province in the same".

(Note: It is interesting to compare the wording in Section 109 with that originally stated in Resolution 57 of the Quebec Resolutions of 1864. The original intent may have been "limited" in scope).

The three Prairie Provinces joined Confederation in 1905. The Alberta Act, for example, was assented to on July 20, 1905, establishing Alberta as a Province. The B.N.A. Act of 1867 applied to the Western Provinces as if they had been one of the original Provinces with one notable exception, the Act held that minerals shall continue to be vested in the Crown and administered by the Government of Canada for the purposes of Canada.

On July 10, 1930, with the proclamation of the British North America Act, 1930, the four Western Provinces were placed in the same position as the original provinces including the same mineral rights as described by Section 109 of the B.N.A. Act of 1867.

Transfer of the natural resources to Alberta, for example, was assented to on May 30, 1930. Legislation respecting the transfer is known as the Alberta Natural Resources Act.

Upon reviewing the preceding statutes and resolutions in relation to the energy game, it is observed that:

(i) the nature of Confederation as a federal union, and the powers thereof, leaves considerable room to facilitate negotiation and consultation between Federal and Provincial Governments (i.e. as a means of settling the principle "for the general advantage of Canada";

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(ii) While the Act specifically limits[1] the power of the Province(s) in certain fields (i.e. "works" in head 10 of Section 92), it is by no means certain that Parliament's power is limited only by what is assigned to the Provinces by Section 92, particularly when it regards a matter of such considerable national interest and importance as resource control[2] (and particularly as it involves the welfare of two or more provinces); and

(iii) The constitution seems to provide Parliament with the power to legislate instruments appropriate[3] to the resolution of the problem in the "national interest".

It is by no means clear by the Act that resource ownership, (i.e. "shall belong to") when considered in the principle of the "national interest" or "general advantage", is limited to a "beneficial interest"[4]. It would appear that Provincial (unilateral) action can be limited if any two or more provinces are affected and if so deemed necessary in the general interest. The problem is by no means simple, however, as a resolution of the short-term interest of the province with the long-term needs of the country may be necessary within the confines of the general economic principles to determine the "general advantage of Canada". The benefit of sound economic practice are after all, to the advantage of both the provincial and federal authorities.

1 If this was to be broadly interpreted beyond "man-made works", this would allow Parliament the power to overrule the province (within the confines of diplomacy) if it was in the national interest to do so in matters outside the categories set out.

2 There is no question that the provinces can probably best manage provincial resources on a "local" scale. However when it comes to control, control to administer natural resources for the purposes of Canada as a whole and not merely for the inhabitants of the area should prevail (Varcoe, 1954, p. 173).

3 Such an instrument is Bill C-32 which was passed by Parliament on April 30, 1975 and is designed to give the Federal Government (specified) power to control the domestic and export price of oil and gas (although the power to do so under this bill appears limited).

4 Available to the province as a "source of revenue", but the Act does not clarify to what amount. (Varcoe, p. 170).

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AT THE HUB

The game may be far too complicated and may involve far too many groups to place any one organization at the hub of things. However, having made this apology, the N.E.B. will be placed at the hub in order that we may proceed with the design of the rational and political models and facilitate a comparison between the two. Therefore for reasons of simplicity, ease of description and presentation of the remaining chapters, and for practical reasons, the National Energy Board is placed at the hub of the political/industrial model represented in Chart A, if not completely by personal choice, then with the help of existing legislative design and the natural interrelationships between the groups and interests involved in the energy game.

The National Energy Board is generally at the focus of much of the public attention on energy matters. It is a regulatory body where a good deal of representation is finally directed. It is a decision-maker acting alone or with other(s) (ie. the P.C.O., P.M.O., the Cabinet, E.M.R., etc.) and thus is an agency to which lobbyists direct their attention. It is a Court of Record by law. It is also, by law, a rational "player" which is required to investigate and undertake energy studies as requested by Parliament or by sister government agencies[1].

The National Energy Board by being "at the hub" of the "game" therefore serves the useful purpose of facilitating a comparative study between the rational model[2] and the political model[3]. These models and their measurement will be dealt with in the next chapter.

1 According to Part II of the N.E.B. Act.
2 Rational model is analogous to optimizing model.
3 The end result.

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The model presented in Chart A represents a dynamic model as it contains the necessary "players" to illustrate the entire decision-making process involving industry, government, and the parliamentary process. The overall "layout" in Chart A may in general, be instinctively realized if not common knowledge to the reader.

The National Energy Board was established in 1959 under the authority of the National Energy Board Act. The broad purpose of the Act was intended by Parliament to ensure that the "best interests" of Canada are served in the use of energy resources.

Originally, the National Energy Board Act was proclaimed in order to implement certain of the major recommendations of the Borden Royal Commission on Energy, and to incorporate the major substance of the Pipe Lines Act of 1949 and the Exportation of Power and Fluids and Importation of Gas Act of 1907, both of which were repealed when the N.E.B. Act was passed.

Operationally, the National Energy Board is a unit within the overall government system. While the N.E.B. reports to Parliament through the Minister of Energy, Mines and Resources or as agreed informally from time to time, it does have certain powers and responsibilities in its own right as set out in the statute. In recent years, the National Energy Board has come to "share" some of its advisory responsibilities[1] with the Department of Energy, Mines and Resources or as directed by Parliament.

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1 According to Part II of the N.E.B. Act.

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By "design" then, the National Energy Board is placed at the centre of the energy "game", beset with political, industrial, and various other interest/pressure groups. It is obligated to respond to various "inputs" to it including submissions or applications from the industrial sector, and to provide a public forum as required by law or need where the various parties are heard in a court environment with the right of appeal before the Federal Court of Canada.

The Board also has some of the powers vested in a superior court of record (i.e. the power of commissioners under Part I of the Inquiries Act). A decision or order taken by the Board can be appealed to the Federal Court of Appeal if the appeal is based on a point of law or of jurisdiction. In addition, the Federal Court of Appeal has the jurisdiction to review and set aside a decision or order made by the Board (upon certain grounds). Judgments of the Federal Court of Appeal may, with leave, be appealed to the Superior Court of Canada.

As the National Energy Board is a Federal Board, the Trial Division of the Federal Court has exclusive jurisdiction to issue an injunction, certain writs, or grant declaratory relief against it.

The National Energy Board Act confers two main responsibilities on the Board, advisory and regulatory. The advisory responsibility, detailed in Part II of the Act, is, in effect, now 'shared' (see Chart A) with the Department of Energy, Mines and Resources, in large part because the enabling legislation for that body recites, among other things, and almost word for word, the Board's advisory functions. In addition, it is 'shared' because

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of full ministerial responsibility, ministerial preference, managerial proximity, inherent and related abilities of the two departments and because of inter-personal relationships. Prior to 1965 EMR's role in the advisory area was not formalized.

Part II of the Act calls on the Board to study, report on and recommend to the Minister "such measures within the jurisdiction of the Parliament of Canada as it considers necessary or advisable in the public interest for the control, supervision, conservation, use, marketing and development of energy and sources of energy....within the jurisdiction of the Parliament of Canada." Under Part II, the Minister of Energy, Mines and Resources may require the Board to prepare energy studies and reports.

The Board's regulatory responsibilities fall into two rather broad categories. They include the following:

(i) those of a given judicial nature; and

(ii) those of an administrative nature.

An example of a Board's quasi-judicial function is its issuance of licences[1] authorizing the export of oil, oil products, natural gas, natural gas products[2], electrical power, or their import thereof.

The regulatory responsibilities of an administrative nature include the administration of the 'government's' oil policy and its natural gas policy. Many of the more specific regulatory administrative responsibilities fall into several over-lapping sectors. These are as follows:

(i) The most visible of these is the Board's responsibility for the safe construction and operation of inter-provincial oil and gas pipelines and power

1 Most of these licences are subject to Governor in Council approval. The licences not requiring such approval are those of a smaller and specified nature.

2 Manufactured derivatives such as propane, butane, liquefied petroleum gases (LPG's), and natural gas liquids (NGL's).

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lines subject to federal jurisdiction as set out in Part III of the Act. The Board issues certificates to construct and operate these pipelines and power lines;

(ii) The responsibility for regulating the rates, tolls, and tariffs of oil and gas pipelines under the Board's jurisdiction to ensure that such tolls are "just and reasonable" under Part IV of the Act; and

(iii) The responsibility for the control of exports and imports of natural gas, and more recently other hydrocarbons and their manufactured derivatives, either by licence or Board order, under Part VI of the Act.

The regulatory and advisory functions interrelate in the course of domestic supply, requirements, and reserves determination.

With regard to government oil policy, the National Energy Board was given operating responsibility by Parliament for carrying out the Federal oil policy in 1973. Prior to that time, responsibility in practice lay primarily with the government though the National Energy Board had some 'limited' and individual input as called upon by the government. The Board had responsibility for natural gas export and import licencing from the outset of its conception. (As part of the rational data base, the historic supply-demand charts for these two commodities is included, for Canada as well as the U.S.).

It was intended that there would be no intrusion by the National Energy Board upon any jurisdiction properly attributable to any of the provinces within the constitutional intent of a "federal" Canada (discussed in the previous chapter). As newsworthy items related to energy suggest, particularly in the area of

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federal-provincial jurisdiction, this intention may have proved to be difficult for the N.E.B. to side step without the rightful involvement of other government "players", namely E.M.R. and the Cabinet.

In addition to studies of Canadian markets including energy supply and demand forecasts, the N.E.B. would have to take the measure of foreign markets as Canadian fuels are traded internationally or are affected by international factors. The model represented in Chart A reflects some of these environmental (or external) factors, i.e. O.P.E.C., the F.P.C., and foreign governments.

Under the Act, the Board[1] has been allowed to staff an organization of support staff to include persons in the employ of the public service[2] and with expert/professional training from industry and government to assist the Board in its duties as called upon. The nine-member Board reserves all powers[3] under the terms of the Act. The overall authority for the co-ordination of branch staff activities lies with the Chairman of the Board which the Act in effect designates as the Chief Executive Officer.

In a still recent 1974 decision by the Federal Court of Canada, this appeal tribunal made a summary statement on the

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1 The Board is presently composed of nine members, not all filled, each member appointed by Parliament for terms of seven years subject to "good behavior" (Part I, Sec. 3(2) of the Act).
2 Under terms of the Public Service Employment Act.
3 It is interesting to compare the N.E.B. with the F.P.C. with regard to staff responsibility. In the U.S. where administrative law is institutionalized, the staff acts directly as an intervenor. The significance of this is discussed later.

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responsibilities of the National Energy Board. It is of interest because the National Energy Board's legal jurisdiction had just been tested before the Federal Court. The summary statement reads as follows:

> "Basically the National Energy Board was created by the National Energy Board Act, Statutes of Canada 1959, Chapter 46 as amended, to exercise a regulatory licensing and advisory supervision on matters relating to the manufacturing, processing, transmission, transportation, distribution, sale, purchase, exchange and disposal of energy within the sources of energy within and outside Canada over which the Parliament of Canada has jurisdiction. The paramount consideration is the public interest particularly that the export of energy or its sources will not deplete the supply before the requirements for domestic consumption is guaranteed and that the price to be charged therefore is just and reasonable."

It is important to note that while the National Energy Board Act names the Board as having advisory jurisdiction over all energy commodities, it is not until Parliament proclaims this jurisdiction that the Board has direct operating responsibility. For example, and to this date, the Department of Energy, Mines, and Resources has direct advisory responsibility for uranium[1] and coal resources (and not the National Energy Board). While the National Energy Board has had jurisdiction over natural gas and electric power since its formation, it was not until 1973 that the Board was given operating responsibility for the federal oil policy. While the National Energy Board is considered "at the hub" of the energy game, for the purposes of this paper, it is inappropriate to consider it as being there alone without allowing due consideration for the other 'voices' within the Government apparatus (see Chart A).

1 The Atomic Energy Control Board (AECB) has regulatory authority over uranium exports.

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LOBBYING AND PUBLIC POLICY

Policy formation is a principal task of government and lobbying by the interest or pressure groups can influence public policy to a varying degree. In our system of 'democratic government', the larger the interest group, in terms of economic power, the greater is its possible impact or influence on public policy. There are notable examples to substantiate this. Of course, this need not necessarily be so unless it is to the advantage of both. Having made this judgment we will examine it later in relation to the energy model.

A moral question is involved. Is this influence from the powerful economic groups "good" or "bad"? In the end, we can ask, was this influence beneficial and/or in our interest? It is not intended to moralize on this issue or the results of this influence on public policy. It will suffice to say that because we live in a democratic system, it is the nature of our open system that lobbying and/or representation from the various elements of our society is informally permitted. While pressure groups are generally representatives of the private sector, their influence and economic power should not excuse the government from acting with due consideration for the other elements in our society in formulating policy.

Government is made up of various agencies that have varying degrees of influence on decision-making and public policy. (In the previous chapter on the National Energy Board it was shown where decision-making may involve two or more agencies).

Furthermore, in today's world, Governments are very big. They have been allowed to grow large. This means that governments have

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tremendous influence on the citizen particularly with regard to the redistribution of income. This may be good or bad. It may be bad because the government[1] may be removing excessive revenue by way of taxation or royalties from the private sector at a time when this revenue is most needed for investment purposes. If the government realizes this and as a matter of government policy, redirects an equivalent amount into private or Crown Corporations (i.e. Petrocan, Panarctic and/or the CDC) for investment for the same purposes (i.e. energy development), then the investment momentum is not lost. It is when the government removes revenue from a particular (i.e. oil and gas development) private sector and diverts it into unrelated sector(s) that eventually a serious economic problem may result because the market-place has been distorted. A major change may be required[2] to correct the situation.

If investment funds are misdirected the result could be a lack of sufficient energy supply in the historical amounts that individuals or industry require in order to satisfy the demands (i.e. life style). More investment in oil and gas for example may not find sufficient oil and gas for our needs. A shrewd market-place (hopefully including the help of the government) will recognize that for a particular investment, it is not getting the new supply results in hydrocarbons it requires and will in time direct this investment into other geologically favourable areas or into other energy fields (i.e. coal, nuclear, etc.). This investment question will be examined in a later chapter.

1 Provincial or Federal.
2 A major change in demand, for example, because supplies are unavailable in historic quantities.

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Because governments thrive on bigness, they would seem to have a considerable mutuality of interest with large pressure groups. After all large corporations which have been allowed to grow large by governments have a lot of revenue which the government can tax to support itself.

Let us refer to the "model" presented in Chart A and consider some of these large interest groups. Several "players" or interest groups are represented but their numbers can be reduced by categorizing these into larger groups with similar but not necessarily identical interests as follows:

(1) The PRODUCING COMPANIES
   - ie. the "Independent" oil companies and the major producers (dominated by foreign interests).

(2) The PRODUCER LOBBY GROUP
   - ie. the Independent Petroleum Association of Canada, the Canadian Petroleum Association, and indirectly, the Canadian Association of Oilwell Drilling Contractors.

(3) The GOVERNMENT APPARATUS (FEDERAL)
   - ie. The Cabinet, the Privy Council Office, the Prime Minister's Office, the Department of Energy, Mines and Resources (and the Department of Indian and Northern Affairs for energy matters north of the 60th parallel), and the National Energy Board.

(4) The PRODUCING PROVINCES
   - ie. British Columbia and the Prairie Provinces (including Manitoba to a minor degree).

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(5) The CONSUMER APPARATUS

- ie. the NON-PRODUCING (ie. hydrocarbons) PROVINCES, and the DISTRIBUTOR COMPANIES (ie. non-producer aligned).

(6) The CROWN CORPORATIONS

- ie. Oil and Gas Exploration Companies and potential producers (ie. Panarctic and Petrocan) and investment and development companies (ie. C.D.C.).

(7) The CANADIAN MODERATORS

- ie. The Public, the CONSUMER GROUPS (ie. the Canadian Association of Consumers), Pollution Probe, the Canadian Arctic Resources Committee, the Office of Energy Conservation (which reports to the Minister of E.M.R.), the Department of Environment, the Foreign Investment Review Agency, the NDP (many will disagree), and others.

(8) The FOREIGN INTERESTS

(i) the Organization of Petroleum Exporting Countries which includes the Arab (Oil Embargo) Bloc, Iran (a non-participant in the 1973-74 Oil Embargo (against the West), and Venezuela.

(ii) the United States' interests including the U.S. Government, the Federal Power Commission, the major U.S. oil companies with Canadian interests, and the U.S. consumers and pipeline and distributor companies.

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If we take these eight (8) major groups and place them before us (as "chips" or "players" on a chess board), we can pretend to visualize a game. Actually there are several games (between individual "chips" and in combinations) including games between countries (i.e. the "foreign element") as well as within countries.

We can illustrate games between two players if we refer to the "Introduction" chapter on the energy related issues. Some of these games as follows:

(i) producers versus Alberta on the royalty question;

(ii) Alberta versus Ottawa on the revenue sharing question;

(iii) Alberta versus Ontario on the pricing question[1]; and

(iv) Ottawa versus Alberta on the resource "ownership" question.

Games between three players may be as follows: Ottawa versus Alberta versus Ontario on the price question or the resource "ownership" question. Games between several "players" would be represented by the "model" in Chart A or the question of resource "ownership" between several provinces (not all having the same interest or stand) and Ottawa. When two or more "players" act together in a common stand against others in a game then we have a coalition(s) of interests.

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1 Ontario wants the price as low as possible (or at the most, comparable to U.S. prices) yet sufficient to maintain investment to locate new supplies, and Alberta wants it as high as possible to maximize its return on what it calls "non-renewable" resources.

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In this paper these types of games are used instinctively, first by identifying the players' interest(s), then by examining the larger confines of economic criteria in which the player operates. We accept that a "player" may wish more but he may be precluded in reaching beyond a certain point by certain constraints or realities imposed by internal or external forces. When we examine these interests and constraints we then have some understanding of the realities and can then proceed in making some useful conclusions and recommendations.

With the use of the coalitions, the eight "players" ((1) to (8) earlier) can be reduced to (i) producers (including the producing provinces), (ii) the central government, and (iii) the consumers (including the consumer provinces). We would have to deal with the "environmentalists" and the "foreign elements" separately.

If the central government (i.e. the Cabinet, the National Energy Board, and the Department of Energy, Mines and Resources) can be considered as a "hub", fulcrum, or connecting link between the producers and consumers, we have a relation not unsimilar to a "scale of justice" with the producers and consumers on each side of the "fulcrum" and with each side trying to outdo the other and, hopefully, striking a balance (in the market-place), eventually.

Should either the producer "player" or the consumer "player" carry or win a greater influence on the central government decision-making team ("the government") than the other, then the

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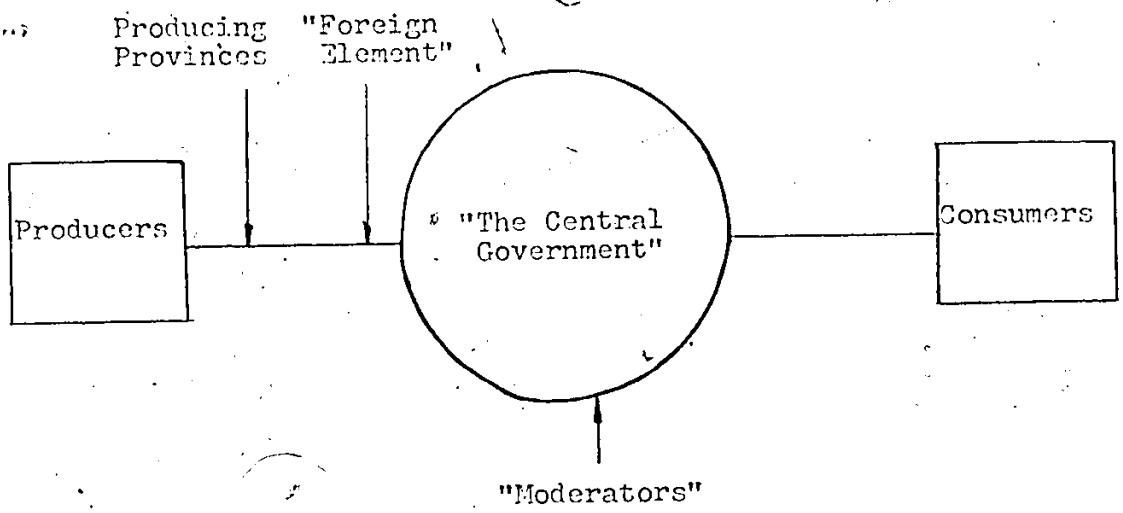
balance will tip in his favour and this may in effect distort the market place[1].

This process can be illustrated as a sort of see-saw game as follows:



Some of the elements trying to swing the "game" in favour of one or the other can be shown as placing their weight on the bars.

In the following chapter we review some of the published reports and data in order to identify distortions or deviations from an "ideal" type model or situation. Our primary purpose however, will be to analyze the "overall" energy problem and then consider individual game options for the "players". We can then suggest what the market place may do to

1. For example, if we have a given supply of energy and we have committed too much for export, then the domestic consumer either (i) reduces his demand, (ii) a new source is found (hopefully at a reasonable price), or (iii) the amount flowing to the export market is reduced (or some combination of (i), (ii) and (iii)).

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correct any distortions that are found. Identifying the distortions and delineating the supply blocks will be useful for the purpose of making predictions about the future (i.e. the years 1975 to 1991) as well.

We can now turn to the question: How is influencing or lobbying carried out on the Federal Government? Without getting into intimate details we can examine the available literature and articles by expert opinion for relevant observations.

The article by J.E. Anderson entitled "Pressure Groups and the Canadian Bureaucracy" (1971) is rather useful and interesting. He tries to trace lobbying through the public service, beginning for example at the professional group where information-gathering[1] for the lobbyists begins. He describes a type of soft (subtle) lobbying. This is not to suggest that it cannot have rather ferocious fangs as it, in the extreme, could lead to direct interference in the public service staffing process[2] by the individual(s) representing the interest group(s).

The following interesting quotations preface Anderson's paper:

> "When I see members of Parliament being lobbied, it's a sure sign to me that the lobby lost its fight in the civil service and the Cabinet."
>
> "The actual rate of fiscal protection (tariffs) has become, in effect, a matter of departmental rather than parliamentary politics... Thus, emphasis has tended to shift to influencing the policies and activities of government boards, commissions and department officials...".

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1 Anderson claims that this is the natural reason for the initial contact.

2 Hodgetts (1964) states that for all practical purposes, including appointments, classification, promotion, pay scales, and tenure, the civil servant appears to be a servant of the executive and therefore, by simple logic, a servant of the party in power. (This can be shown to be true with statistical evidence). So the public service is not unlike the private sector selection process and the individual who has to deal with these groups can be pre-selected on the basis of managerial prerogative.

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Anderson claims that detailed study on the influence of pressure groups has been both difficult and rare, as much information is kept secret or is unavailable because consultation between civil servants and officials of pressure groups is often informal (rather than institutionalized or formal). The premise of secrecy could bury[1] a good deal according to Anderson particularly when there exists a complex web of relationships between people, parties, pressure groups, political leaders and public servants.

According to Anderson, the importance which policy makers attach to the expertise of certain pressure groups depends on the extent to which they must take account of alternative political resources possessed by other pressure groups, for example, votes and money. He seems to feel it comes down to a calculation on the balance, between the effect on voting behavior of widely social and economic policies on the one hand and the impact of campaign contributions from disadvantaged interest groups on the other.

Donald S. Macdonald (June 19, 1969) put it another way when he said that "the strategy area where the interests of the politician, or bureaucrat, and the lobbyist effectively overlap is that which concerns itself with the sensitivity to the common good." In the pure sense there is considerable merit to both these arguments.

In Canada, Anderson (1971) suggests that the relations between civil servants and pressure groups are usually dominated

1 In the end though we need only have looked at the results to assess the weight of the influences.

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by civil servants. He claims that civil servants grant recognition to interest groups primarily because these groups possess valuable knowledge and experience. However, one of the consequences of this emphasis on expertise is that civil servants will interact most frequently with those interests which must themselves be most diligent in producing and acquiring information in the ordinary pursuit of their own affairs. The provision of this special knowledge may give the pressure group(s) an opportunity (i) to participate in policy formulation, (ii) to influence the selection of a candidate(s) to public service positions, and (iii) to receive the "benefit of the doubt" when information is not considered certain or where a range of values is possible.

Generally Anderson claims that the interaction of civil servants and pressure groups occurs in a context of other relationships, among these is the relationship between Government and its civil servants as it has developed over several years. This in turn governs the interaction of the public and private sectors. It is one which has a considerable bearing on the decision-making process but is perhaps too cumbersome to discuss fully in this paper.

There are many pressure groups in our system that are openly granted recognition and where public officials support it politically or maintain its mobility through direct government aid or governmentally determined status. Examples of these are the Canadian Federation of Agriculture, the Canadian Labour Congress, and the Consumers' Association of Canada (see Chart A).

A further form of "recognition" of pressure groups is the one where they are asked for advice on policy-making which

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occurs in the drafting and amendment of regulations. Sometimes the minister's speech will clearly signify this by indicating that civil servants and pressure group officials are "well known" to each other.

What can we say about policy formation in relation to some of the other PLAYERS? It can be said that while policy formation is a principal task of government, it is also a central concern of all citizens in their general capacity as members of the electorate, or in their particular capacities as members of (legitimate) interest groups.

The policy-making task of government is really quite complex. Unfortunately, the responsiveness of the government's bureaucratic apparatus is sometimes slow, particularly when changes are required in policy direction. Taking the necessary corrective action as the problem becomes vividly apparent may be more difficult as certain options may no longer be available. Of course, responsive action depends on many factors including leadership, prevailing attitudes, knowledge, competitiveness, and the interrelationships between various groups and individuals and even countries.

Much has been written about policy-making through successive limited comparisons.[1] This seems to be a characteristic of our Western democratic system even though the effectiveness and the results of this type of policy-making vary widely.

1 For example, see Lindblom, C.E., "The Science of 'Muddling Through' ", Public Administration Review, xix, 2, 1959.

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This "characteristic" does not suggest that we should accept it and not seek out more data or new methods to bring to bear more effectively on important policy questions. However, we do have limits on human intellectual capacities and on available information. These limit the capacity to be comprehensive. Even if we do have "sufficient" information to act we may fail to do so for various reasons.[1] When faced with really complex problems we may tend to find ways to procrastinate or simplify.

There are things that could be done to improve policy-making. Improvements in up and down flows of information between bureaucratic levels can improve the communication process and responsive action. But these flows must be cultivated and encouraged. Another "tool" which should be encouraged is the use of technological forecasting. Several new techniques are available for forecasting. In developing sound technological forecasting techniques, the use of trend analysis can reduce forecasting errors.

There is of course, still the question of multiplying uncertainty as the distance into the future grows. Politicians or policy-makers, it is observed, are quite adept at compromise particularly when working under uncertainty or the chance of uncertainty. While the question is of real concern, it may be shown with trend analysis that an error of 5 or even 10% would not affect the conclusion or recommendation reached and corrective (policy) action can be initiated with a great deal of confidence.

1 Among the various reasons is the slow process towards a consensus among the decision-makers and the public. When the answer is apparent to all, the problem may be well in hand.

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Unfortunately, most models are static, that is, they represent a situation at some particular point(s) in time. By the use of trend analysis and graphic presentation through a successive (staged) introduction of new "blocks" and "elements", we can illustrate the search for equilibrium with a kind of dynamic relationship that can easily be adjusted by a non-expert as (i) circumstances or situations change, (ii) as uncertainty is reduced, or (iii) as new information becomes available.

Ritchie, in a study[1] prepared for the Government of Canada in 1969, has stated that "with whatever purity we can look at public policy research (and the policy implements), the particular techniques, however sound, would not be without influence by political and bureaucratic interests." Royal Commissions, for example, do get submissions from interest groups and, for that matter, so do Boards. Because of this process, he goes on record as saying: "It can be safe to say (also) that the end result usually suffers somewhat in the final implementation process." Somewhere along this road, the lobbyist has been heard and his work somehow accepted or incorporated.

So who is it that makes public policy? We have received some insight. In 1958, Mitchell Sharp stated that "civil servants do not make policy, that is the prerogative of the elected representatives of the people." The evidence suggests that while policy-making is the prerogative of the elected representatives, civil servants may indeed make policy.

1 Ronald S. Ritchie, An Institute for Research on Public Policy, Dec. 1969, pp. 1-20.

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POLICY AND DECISION MAKING

Thus far we have shown how the "heart" of the energy decision-making process operates. We have discussed the government organizations at the centre of this process and have shown how they function in relation to the particular nature of our democratic environment, especially in relation to the various forces around them.

In general we have discussed the role that lobbying plays in the various stages of the decision-making process and have suggested methods of analysis for evaluating their influence. Particularly, we have been drawing a format for the decision-making process in government, with regard to the energy game, and how it can be translated into a decision for action, if not into a comprehensive policy, with regard to political behavior and the law.

In the previous chapters we have touched on the various aspects of the decision-making process in government and on the various types of decision-makers. For the purposes of policy analysis, the various decision-making processes can be related more specifically to the type of decision-maker. These are as follows:

(i) The rational decision-maker:

Here the process used is "rational" in the sense that it is "optimizing". We will concentrate on this approach in this chapter in order to build our data base and then use the previously discussed tools to analyze the data.

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(ii) The decision-maker of "limited rationality":
The organization processes (or the Bureaucratic model) are included in this group. Earlier, we showed how a decision-maker may tend to "simplify" if a problem is too complex for easy or instant comprehension. We discussed lobbying in relation to this as well as other groups.

(iii) The decision-maker in conflict (with himself and others):
The political process falls into this "category". Earlier we reviewed the political process and the various conflicts that have surfaced (to public attention). To help us understand some of these conflicts in relation to the energy game and how they are being handled, we have reviewed appropriate sections of the Canadian Constitution and related Statutes.

(iv) The real-world decision-maker:
The "real world" will be discussed in a later chapter particularly with regard to (i) the analysis of (real) options for Canada, and (ii) the international political-economic game[1].

The Rational Decision-Maker

"Rational behavior" is defined as meaning "optimizing behavior" for our purposes. We have shown why, in a democratic

1 Using ordinary conversational techniques with the (background) aid of the "metagame analysis" techniques developed by N. Howard (see bibliography).

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country such as Canada, "optimizing behavior" is rather a difficult undertaking, in particular, because of the political process[1] and because of the "limited rationality" concept discussed earlier.

Nevertheless economic methods, operations research "models", cost-benefit analyses, and the "modified" decision tree methods are appropriate tools for analyzing the data and proceeding with our work.

HISTORICAL SUPPLY-DEMAND DATA: Rather than list the historical supply-demand data in tabular form, it is more useful to translate this data directly into chart form. This approach fits in with the criteria enunciated in the preface, that is, to provide simple visual aids to assist in the communication process.

The historical data from the various sources identified on each chart was used to construct the production-consumption charts for Canada and the United States for petroleum, natural gas, propane, liquefied petroleum gas (LPG's), and coal (for Canada only). (These are the charts labelled as Set 1, Sheets 1 to 5). These charts, particularly the first four sheets, have the following important characteristics:

(i) Each sheet represents a historical "block" of supply and a historical "block" of demand.

(ii) Each of the first four sheets contains the historical data for one energy commodity for both Canada and the United States.

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1 The interactions between conscious political beings.

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(iii) Each sheet is designed to reflect trends on a common horizontal time scale for both countries.

(iv) Each sheet is designed to reflect rates of change for each country as well as between the two countries. (This is accomplished in sheet 1 of Set 1, for example, by maintaining a vertical scale for Canada that is one tenth that of the United States).

Each of the historical supply "blocks" including the supply "block" represented by imports, and the nuclear and hydro supply, are then placed together to construct the total picture represented by the historical section of Chart 4 for the U.S. and Charts 7-9 for Canada.

If we examine each of the sheets of Set 1, we note the following:

Supply-Demand of Petroleum (Set 1, Sheet 1 of 5)-

(i) It was not until 1973 that domestic crude oil production equalled petroleum product consumption. Historically, Canada consumed more than it produced, however, the gap began closing from 1967 onwards.

(ii) Crude oil exports from Canada rose significantly beginning in 1967 over previous export trends. This was accomplished by a corresponding acceleration in our crude oil production to meet export requirements.

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(iii) The United States petroleum product consumption and crude oil production were equal in 1951. Since then annual consumption has increased progressively over production, with the exception of a period between 1965 and 1968.

(iv) With regard to prices, Canadian prices parallel those of the U.S. The difference is due to the transportation margin to move the oil to the U.S. basing point (for example, Chicago).
Average prices per barrel were stable for a long period (1955 to 1968) and then began moving up from 1968 to 1972, at an increasing rate in 1972 and at a considerable rate since the 1973 Arab oil embargo.

Supply-Demand of Natural Gas (Set 1, Sheet 2 of 5)

(i) U.S. net production fell below consumption in 1962 and permanently in 1967 onwards.

(ii) U.S. net production peaked in 1972.

(iii) U.S. consumption peaked in 1972 because no further exports were available from Canada.

(iv) Canadian net production responded to U.S. supply-demand requirements at all times before 1972.

(v) Canadian net production rose at an increasing rate since 1967 in relation to Canadian consumption reflecting the increasing U.S. supply-demand imbalance in natural gas, LPG, and ethane.

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(vi). While U.S. natural gas production lagged consumption consistently since 1967, a major change in wellhead price did not occur until 1972-73 shortly before and then after the Arab oil embargo, reflecting the increasing commodity value of natural gas in relation to oil in the U.S. This relationship suggests that some opportunity price was available to Canada in the U.S. since 1967[1]. As Canada had a surplus in production and because of F.P.C. influence on the basing point prices[2], these opportunity prices were not available in Canadian markets without a Canadian industrial cost penalty vis-a-vis the U.S. basing points (i.e. Chicago (Map 6) and Seattle (Map 5) were not yet reflecting a significant price movement back to the Canadian-U.S. border as oil prices, the comparable yard stick, were still relatively stable prior to the Arab oil embargo). However, there was an indication of a pending natural gas supply constraint in the U.S. as U.S. transmission companies began requesting and receiving U.S. Federal Power Commission approval in the early 1970's for larger average transmission depreciation charges. This initially allowed connecting U.S. carriers of Canadian and U.S. gas to absorb the increasing city gate[3] gas prices, reflecting

1 In 1967, U.S. natural gas reserves reached their peak. Since then annual additions to reserves fell increasingly short of annual consumption.
2 More on this later.
3 The main entrance to the city distribution system or the last exit point from the transmission company.

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increasing U.S. demand, but not as yet reflecting these prices back to the border or the wellhead in Canada. This suggests that Canadian prices for natural gas to the U.S. could have been increased since 1968 with some accommodation for mutuality of benefit.

(vii) The statements in (vi), the trends in Set 1, Sheet 2 of 5 for Canadian production and consumption and Chart 2 for reserves additions suggest that gas exports to the U.S. since 1968 may have been increased at the expense of even the short-term Canadian requirements (particularly the Quebec market) and certainly the longer term requirements.

In the case of natural gas supply-demand, the rapid acceleration in the average year end natural gas prices in Canada and the U.S. corresponds closely to the peaking in North American natural gas production in 1972 (see Set 1, Sheet 2 of 5). When taken in the total North American context, this in fact explains Alberta's position in part, for the need for higher natural gas wellhead prices for the purpose of maximizing opportunity, stimulating investment[1], and balancing provincial coffers. The natural gas prices rose rapidly in 1973, however, to reflect increasing O.P.E.C. prices for crude petroleum which were said by the Shah of Iran to be based on alternate North American sources of supply[2].

As North American consumption and production of petroleum have not been in balance since 1952, and there is at the present, a world surplus of petroleum production[3], the high petroleum

1 Investment monies had been flowing into Canadian frontier areas by this time suggesting rosier expectations and decreasing investment opportunities in Western Canada (see Charts 2, 3 and E).
2 The investment decision will be discussed in a later chapter.
3 Increasing newspaper evidence of this fact from both consuming and producing countries.

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prices reflect artificial price levels set by O.P.E.C. in retaliation for their loss of purchasing power in the Western world, particularly because of rising price levels since 1967 in the U.S. (see Chart 5 for a comparison of selected price indices to reflect this situation and Chart F(b) for crude oil price trends).

Miscellaneous Supply-Demand

The rapidly increasing production of natural gas in Canada since 1967 in response to increasing U.S. requirements for natural gas by-products afforded the Canadian entrepreneur the additional opportunity of maximizing his return by allowing him to extract increasing quantities of L.P.G.'s (i.e. propane, butane, and propane-butane mixtures) out of the natural gas stream in addition to the usual removal (but in increasing quantities) of natural gas condensates. (See Set 1, Sheets 3 and 4 for a reflection of the L.P.G. supply and Chart 3 for the N.E.B. estimate of natural gas condensate (pentanes plus supplies).

The rather large condensate and L.P.G. operating surplus in Canada was particularly instrumental in the start of construction in 1971 of the Marysville S.N.G.[1] plant in Michigan at a cost of $220 million with the commitment of Canadian raw feedstocks to the project. In addition, the surplus was responsible for a similar plant at Green Springs, Ohio. (See the National Energy Board Report, May 1973, on Dome et al).

The U.S. ethane import requirements increased as their natural gas production peaked. The U.S. ethane[2] demand is reflected in Set 1, Sheet 4 of 5. This became a further opportunity

1 Synthetic Natural Gas.
2 Ethane is stripped out of natural gas as a by-product. While this increases the return to the producer, ethane removal decreases the BTU heating value and shrinks the volume of the remaining natural gas slightly.

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for Canadian exports. However, before the project got off the ground, ethane became an issue in the federal-provincial confrontations of 1973. Alberta's expressed desire to industrialize and upgrade raw material before sale to the U.S. came in direct conflict with the Dow Chemical - Dome Petroleum ethane-ethylene pipeline and petrochemical project originally designed to serve Ontario and the U.S. This scheme appears to be stalled at the present and suggests that the lobbyists may have misdirected their attention.

FUTURE REQUIREMENTS: We have discussed the historical supply-demand data in the above section in retrospect. Let us review the criteria that was supposed to ensure that requirements for oil and gas would be met (as we move from decision point to decision point). For crude petroleum we have shown that historically Canada was in a deficit situation until 1973 when production finally equalled petroleum product consumption in response to U.S. requirements. As crude oil reserves from Western Canadian sources peaked in 1969 (see Chart B, Sheet 3 of 5), the increase in Canadian production since 1969 was accomplished at the expense of longer term Canadian requirements from this source. We can see from Chart 7 that Canada will again become a net importer of crude petroleum after 1977 and in increasing quantities, as payments will allow, until the time that alternate sources[1] come on stream or as demand shifts downwards to reflect new realities.

If we relate productivity to reserves, we can establish what is called a reserves life index. The question that could be asked then is: What reserves life index is a minimum for Canada for adequate protection of Canadian requirements, particularly

1 Athabasca tar sands and the Beaufort Sea.

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since reserves peaked in 1969? (A minimum reserves life index would have provided a signal to the decision-maker.) With the approval of Parliament, the National Energy Board moved to impose export controls on oil in 1973. Prior to this date, it was not enpowered by Parliament to so act.

Regarding natural gas, the National Energy Board Act states (since the proclamation of the Act) that in considering an application, the Board shall be guided by the principle that "the quantity of gas to be exported does not exceed the surplus remaining after due allowance has been made for reasonably foreseeable requirements for use in Canada, having regard to the trends in discovery of gas in Canada". This principle 'requires' the Board to make at least a current and a future surplus supply-demand balance calculation for Canadian gas at the time of each export application in order to properly assess the application and make its decision.

Without going into the equation or the calculations in any detail, we can examine some of the more important factors[1] that need to be considered. These are as follows:

(i) Natural gas reserves were traditionally assigned to two categories by the Board: available reserves and future reserves. Requirements were also divided into those to be met from current or available reserves and those to be met from future reserves. The differences (if any)

1 Reserves, supply, and requirements.

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between the respective reserves and estimated requirements are known as the current surplus and the future surplus.

Available reserves used in calculating the current surplus at a particular time or decision point, are usually the sum of contractable reserves[1] plus remaining authorized imports. The Canadian requirements to be met from available reserves were set at an amount equal to 25 times the annual Canadian requirements at the fourth year level, plus the remaining authorized and applied for export volumes. In the design of this "protection factor", it was intended that incremental Canadian requirements for gas, over the fourth year level, from the fifth to the twenty-fifth year, were to be met from future reserves. (Note: Chart C illustrates the equation with the difference between actual availability and requirements being met out of "future" reserves from the fifth year on. This Chart also illustrates the shortfall in supply that could occur if reserve finding rates fail to keep pace with historical trends necessary to maintain commitments with the subsequent implication to growing domestic require-

1 Established reserves less some fraction of those beyond economic reach and those deferred for reasons of conservation.

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ments and to the specified export commitments[1] for the term of the licence granted by the Board). A question then arises: Do export commitments take priority over domestic requirements (should future trends used as a criteria for export commitments not hold up in reality) or does Canada 'share' its shortfall with the U.S.[2]?

(ii) The future gas supply, used in the calculation of a future surplus is the sum of (a) available reserves, (b) established reserves, and (c) the additional reserves.[3]

(iii) Originally, the requirements that were to be met from the future supply were as follows:

(a) A full 30-year Canadian requirement for gas;

(b) Reserves to provide deliverability for peak-day Canadian requirements in the thirtieth year;

(c) The remaining volumes of all authorized export licences; and

(d) The volumes of the application being considered.

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1 Subject to Section 17 of the N.E.B. Act.

2 Because of supply constraints in the domestic market, the N.E.B. will have to rule on this question in its July 1975 Report. (see Chart 3(g)).

3 This is an estimate of reserves that will become established over "The next twenty years" based on historic trends in the increase in Canadian reserves. In the 1960's and in particular, prior to 1971, this was estimated as an average of 2.4Tcf/year over the 20-year period.

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To summarize the National Energy Board's historical decision criteria[1] (the "standard"), the Board would be prepared to give favourable consideration to an export application (to the U.S.) if it found the following:

(i) After allowing for prescribed Canadian requirements, previously authorized export volumes and the volumes applied for, a positive current surplus remains;

(ii) After making provision for 30 years of protection of Canadian requirements, previously authorized export volumes and volumes applied for, a positive future surplus[2] remains; and

(iii) The trend in growth of reserves remains in historic perspective.

NATURAL GAS DECISION POINTS: Thus far we have identified the decision criteria involved at each decision point for oil and gas. Having established the basic decision criteria, we can now proceed further with natural gas, particularly in the matter of trend analysis discussed in the introduction.

It has been shown that at each decision point we have essentially two simple models. In the broader context of operations research, a model delineates or puts a dimension on the data at a point in time. Without this delineation, the data may otherwise be a very meaningless maze of information. Generally, a model should allow the decision-maker and/or the interested persons to visualize the dimensions of the issue, including the system-wide interactions

1 These decision criteria represent the Board's original standard in the early 1960's for judging natural gas export applications.
2 For the detailed components of these supply-demand models, refer to appropriate N.E.B. reports.

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and ramifications of decision alternatives. If used with probabilities in the context of the decision tree approach, it should provide impetus to developing a full range of decision alternatives, and aid in focusing on the resolution of critical issues.

Events do not normally occur with certainty. They may occur under increasing uncertainty the further one moves into the future of the forecast. History, however, may tell us something about the future if reviewed from the historical setting. To minimize this uncertainty, trend analysis is a useful tool for gauging the future, particularly if it is used between decision points, with a consistent application of the components comprising the model.

Additions to reserves for Alberta were estimated to average 2.4 Tcf[1] per year over a 20-year period. It is possible to reckon the rate of additions which would be required in order to replace annual production and maintain a certain surplus situation. For example, historic criteria required that provision be made for exports to be increased at the rate of 100 Mcf per day in the future from 1973 to 1985 on account of earlier export commitments. To maintain this rate, it would have required Canadian gross additions to increase from 3.4 Tcf per year in 1973 to some 4.3 Tcf per year in 1985[2]. If the historical growth

1 See Oilweek, June 21, 1971.

2 Refer to the N.E.B. Report issued in July, 1965, for further details. In addition, N.E.B. Report issued August, 1970, p.4-41 measured the situation then as follows: "While the growth of reserves needed to protect Canadian requirements averages 3.6 Tcf per year over the ten-year period 1970 to 1980 and 4.1 Tcf per year over the twenty-year period 1970 to 1990, the annual growth rate needed increases from 2.8 Tcf in 1970 to 5.3 Tcf in 1990."

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rate of 3.4 Tcf/yr.[1] was held constant in the forecast of future surplus from decision year to decision year, then the decline or increase in future surplus would be a gauge of the finding trends in relation to the projected requirements. From historic data we know that the natural gas reserves in Western Canada reached a peak in 1971 (see Chart B, Sheet 4 of 5), after which annual reserve additions fell short of annual production (i.e. the ratio became less than 1) and the reserves began to decline. This means that the required trends to meet export commitments never did increase beyond the 3.4 Tcf/yr. and, in fact, went into decline[2].

The higher growth rates of reserves (i.e. over 3.4 Tcf/yr.) needed to protect Canadian requirements and maintain export commitments have not been achieved (see Chart 3(g)). This situation was instrumental in releasing the previously stable price levels (up to 1973), to levels (not yet stable) to generate sufficient investment to find alternate supplies in the higher cost frontier areas. To date, frontier discoveries are not translatable to ready supplies and as a result export commitments established under previous criteria may not allow any growth in Canadian requirements until 1982 at the earliest, or until such time as frontier supplies or alternate sources are tapped (see Chart 3(g)). (It was the purpose of the future surplus calculation to alert the decision-maker that the growth rates of reserves would not meet requirements in the period considered).

The current and future surplus models can now be reviewed in their historic settings to determine whether they gauged the future situation (as we now have it) correctly.

1 This was the traditional natural gas growth rate for Canada shown by the National Energy Board in its Reports.
2 See Chart 2 for Alberta which accounts for approximately 80% of the natural gas reserves in Canada.

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March 1960 Report[1]

In its initial report, the N.E.B. used a 21-year protection period levelled off in the fourth year with a variation for Alberta. This demand was combined with an existing export requirement of 2.1 Tcf and was applied to a formula to protect terminal peak day demand resulting in 21.0 Tcf being required for protection.

Reserves[2] were established as 30.3 Tcf leaving a surplus of 9.3 Tcf which was sufficient to cover approval for an export application of 6.7 Tcf to the U.S.

No future surplus calculation was carried out at this time as the N.E.B. considered that undiscovered future reserves would materialize to provide the increased future requirements throughout the 30-year forecast period.

July 1965 Report

The N.E.B. introduced some additional considerations in the calculation, however, a current surplus of 4.4 Tcf was available after providing for an export approval of 4.6 Tcf.

The future surplus calculation was revised using a reduced twenty years of trend gas additions to reserves as compared to 30 years of requirements in 1960. Terminal peak day protection was eliminated. This resulted in a future surplus of 19.4 Tcf[3].

1 This is a report issued by the N.E.B.
2 Marketable reserves which are related to engineering, investment, as well as geological considerations.
3 Reserves available of 41.2 Tcf plus trend gas additions of 48.0 Tcf (i.e. 2.4 X 20) for a total of 89.2 Tcf less the reserves needed to meet future requirements and applications of 69.8 Tcf.

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August 1966 Report

Available reserves included reserves contractible within four years plus remaining volumes under import licence. All reserves that were (i) beyond economic reach and (ii) deferred were deducted.

The $25A_4$ protection formula discussed previously to protect Canadian requirements was initiated.

The current surplus[1] as at December 31, 1965 was 4.9 Tcf after allowing for existing export licences of 10.4 Tcf and an export application of 0.8 Tcf.

With regard to future surplus, the N.E.B. continued the practice of comparing supply with 20 years of trend growth with a 30-year requirement period. The reserves that were beyond economic reach and deferred were considered as becoming available during the 30-year period. The future surplus as at December 31, 1965, was calculated to be 13.8 Tcf.

March 1967 Report

This report disposed of an application by Westcoast Transmission Co. Current and future surplus was determined in this report, however, a separate surplus calculation was computed for the Westcoast[2] supply area.

May 1967 Report

The same numbers as the March 1967 report were used.

1 Tcf at 1000 Btu/cf.
2 N.E. British Columbia and a portion of the Yukon and N.W. Alberta.

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August 1970 Report

The current surplus was determined in basically the same manner as was used in the 1967 report with two exceptions:

(i) ½ of the "beyond economic reach" reserves (or 1.8 Tcf) were considered as being available; and

(ii) "Processing shrinkage" appeared in this report in order to reflect the shrinkage to the gas streams at the Empress and Cochrane, Alberta plants.

According to the N.E.B., the current surplus calculation would have gone into a deficiency of 2.5 Tcf if the entire 8.9 Tcf requested was approved for export. Accordingly, the N.E.B. approved for export 6.3 Tcf, leaving a slight current surplus of 145 Bcf. Of the five applicants, only Westcoast Transmission received approval for the entire amount of 3.3 Tcf for which it had applied . A new buyer in the Canadian supply market, Consolidated Natural Gas Limited, received no approval.

A future surplus was not determined after the effect of this export approval and was instead replaced by a table showing the future relationship between requirements and supply which, in effect, was a repetition of the current surplus calculation for twenty years into the future. While it is cumbersome, it is possible to undertake a surplus calculation for 1970 consistent with those previously carried out. However, the following is a simpler approach.

The criteria used in the 1970 decision year for approval of reserves for export purposes appears to have deviated from criteria previously used. This statement is substantiated by

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the following observations:

(i) Earlier, it was determined that historical trends in the future surplus would indicate whether the historical reserves growth was maintaining the status quo. In the July 1965 Report, the future surplus was 19.4 Tcf. In the August 1966 Report, the future surplus decreased to 13.8 Tcf (with total export commitments remaining at 12.2 Tcf). In August 1970, export commitments rose to 18.3 Tcf. The rapidly decreasing trend in future surplus (4 years since the last report) suggests a positive balance did not exist in 1970 before the approval of additional exports (also see Chart 2). However, the Strachan-Ricinus gas discoveries in 1967-69 slowed the downward trend (see Chart 2) and may have provided some optimism. However, the combination of decreasing trends and the new export commitments based on higher rates of withdrawal (see (ii)) suggests that a deficit existed in future surplus in 1970. (Later observations substantiate this conclusion as it is shown that export commitments cannot be met and may have to be rolled back (see Charts 3(g) and 7 to 1969 and previous levels).

(ii) The supply-demand chart for natural gas in Canada (Set 1, Sheet 2 of 5) shows that net production rose rather sharply after 1967 and continued at this rate in August 1970. As the annual additions to reserves on the average did not increase beyond the 3.4 Tcf/yr. between 1966 and 1970, this rapid increase in net production could

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only have been made possible by increasing the reservoir withdrawal rates[1] to meet the increasing U.S. natural gas requirements from 1967.

(iii) In effect, the August 1970 report states that "it is apparent that the historical rate of 3.5 Tcf per year will not be sufficient to permit the Board to approve all the current export licence applications for the full quantities and time periods requested and provide adequate protection for the future requirements of Canada."

November 1971 Report

The current surplus approach was re-organized but contained no basic changes from the August 1970 Report. The N.E.B. reported a current deficit of 1.1 Tcf as at June 30, 1971. Because of this, future surplus tables were not presented.

January 1974 Report

The N.E.B. showed the current surplus to be 0.2 Tcf before a requested ethane export requirement of 0.5 Tcf which was approved (but as yet not implemented), resulting in a deficiency of 0.3 Tcf. Remaining authorized export sales were 15.0 Tcf. Between November 1971 and January 1974, gas reserves were in decline (see Chart B, Sheet 4 of 5), however, there was some upward re-evaluation in (Alberta) reserves in 1973 as shown and explained on Chart 2.

The future surplus table was again not presented.

The rational model seems to have broken down in the decisions leading up to the August 1970 Report[2]. In line with our discussions

1 For example, from a slow speed production pattern of 1:10,000[3] in 1965 towards a medium speed production pattern of 1:7,300 by 1969. This would be consistent with an intermediate investment decision under the constraints of falling reserve additions and a declining dollar. (The learning curves in Charts 1 and 2 reinforce this point. More about this in the investment chapter).

2 See later in paper.

3 1 million cf/d production per 10 billion cf of reserves.

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prior to the presentation of the (rational) data, the article by Eric Kierans in the March 1974 issue of the Canadian Forum entitled, "The Energy Crisis: The Day the Cabinet was Misled", is useful in explaining the apparent departure in the August 1970 Report from past decision-making criteria. In this article, Kierans reviews the current surplus criteria presented and then states: "The C.P.A., etc., stated categorically (to the Cabinet through the N.E.B.) that Canada had potential reserves amounting to 725 Tcf[1]. In the Western Sedimentary Basin including the Mackenzie Delta, gas reserves were estimated (by the C.P.A.) at 270 Tcf and oil reserves at 45 billion barrels." (See Map 3 and Table III for comparative (Geological Survey initial and JLJ[2] current) estimates of actual (and possible) reserves located to 1975 in the "Best Bet" areas. Charts 1 and 2 yield some evidence as to the nature of the learning curve (for reserve additions by year of discovery) for Canadian hydrocarbon areas). Of course, final ultimate reserves for frontier areas will be somewhere between those of Table III and those of Map 4 at an indeterminate period in time and with an infinite amount of investment dollars.

It would seem then that the "unlimited resources" concept that was introduced earlier in the paper became a significant and perhaps overriding factor in the 1970 decision process instead of the historic[3] criteria. However, it would seem that at the

1 The August 1970 report issued by the N.E.B. reported established reserves of 57.4 Tcf while the January 1974 report issued by the N.E.B. reported established reserves of 64.2 Tcf. (This is a relatively small increase for such a length of time).
2 JLJ Exploration Consultants Ltd.
3 Current surplus, future surplus, and trends.

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earlier decision points, the "unlimited resources" concept was a factor when taken in relation to the forecasting of future trends, particularly the increasing trends necessary to meet domestic requirements and export obligations in the future.

Cost-Benefit Analysis

Prior to 1972, prices in North America were relatively stable. Since 1972 and particularly since the Arab oil embargo, price levels have risen rapidly in North America. An examination of the price indices (Chart 5), and the commodity prices (Set 1, Sheets 1 and 2) for Canada and the U.S., shows that these have been and still are quite similar.

If we take into account the considerable trade, the close geographic proximity and the similar life styles between Canada and the U.S., it would seem that decision-making in Canada would be conducted along lines that would not alter the price level relationships and the dollar exchange between these countries significantly. This, in fact, appears to be the case. Eventually, if Confederation holds, the federal-provincial relations reflect this economic reality. This reality should not preclude innovative action on the part of decision-makers, however.

Ontario is the most industrialized province in Canada and has the highest share of the Canadian GNP, but it is rather dependent on U.S. branch plant operations (with their lower economies of scale) in Canada and on the auto pact.

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The State of Michigan is in close geographic proximity to Ontario, and has similar though larger scale industrial installations including the automobile industry, largely based in Detroit.

Ontario, therefore, has to be price competitive with Michigan as well as the entire U.S. Midwest region bordering on the Great Lakes unless a protective tariff wall is instituted by the central government.

The gas transmission pipeline networks feeding both of these areas is shown in Map 6. The supply sources are approximately equi-distant from each of these industrial areas and in fact, the supplies from Western Canada interface with those from U.S. sources in the U.S. Midwest.

In its August 1972 report issued after an inquiry into the field pricing of gas in Alberta and held at the request of the Provincial Government, the Alberta Energy Resources Conservation Board found that the then current average field price for gas in Alberta of 16 cents per Mcf "was at least 10 cents per Mcf less than field value" (particularly because of the supply shortfall in U.S. Midwest and California discussed earlier in the report).

It will be recalled that the Province of Alberta announced new royalty taxation measures effective January 1, 1973 in order to increase its revenues by $70 million in 1973. This was half-way between $50 and $90 million which the Alberta Government had earlier indicated as the range of its goal for the oil producing industry's additional contribution to the provincial treasury (in lieu of any sales tax).

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At this juncture, it is useful to compare the gas prices to the industrial, commercial, and residential sectors in the Detroit market area and the Southwestern Ontario market area about the time of the 1972 Alberta hearing into the field pricing of gas, in order to determine the relative advantage of the market sectors they served. The comparative data at the time was as follows:

	Detroit Area Average Prices[1] ¢/Mcf	Southwestern Ontario Area Average Prices[2] ¢/Mcf
Industrial	54.46	55.3
Commercial	80.78	94.9
Residential	93.31	114.0

For these two competitive market areas then, just before the Alberta hearing, the industrial rates were competitive while the commercial and residential rates were considerably higher in Canada. This confirms the earlier observation that there was little room for price movement in 1971-72 while the opportunity for higher natural gas prices did exist in U.S. markets. By 1972, however, Canada had no further gas for exports[3] according to N.E.B. decision criteria.

The Arab oil boycott of 1973 was most instrumental in freeing the price loggerhead in North America. While the Alberta Board's August 1972 report recommended a then significant increase in price (most probably based on the U.S. supply situation[4]), the subsequent price adjustments in Canada and the U.S. have remained quite similar on the average (refer to the price data shown in the Charts of Set 1).

Following the November 1971 N.E.B. decision (not to allow further natural gas exports), federal and provincial actions and

1 Prices are according to Energy News, October 25, 1971, for the Detroit franchise area served by Michigan Consolidated Gas.
2 Prices were determined from data submitted by Union Gas Co. to the Alberta Energy Resources Conservation Board 1972 hearing for their Southwestern Ontario franchise area.
3 According to the decision taken by the N.E.B. in its Nov. 1971 report.
4 Refer also to the Stanford Research Institute Report prepared for the C.P.A. and I.P.A.C. in 1972.

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counter-actions followed in regard to ownership claims, royalties and taxation, and competing provincial aspirations at industrialization. As these are too numerous to relate, the review of the (Canadian) Constitution was undertaken to relate the ways, in broader terms in which the game[1] can be played.

To realize the $70 million revenue goal for 1973, the Alberta Government changed its oil royalty schedule from a sliding scale of 8 to 16 2/3% to a rate of 5 to 25%. Producers with freehold leases (20% of Alberta's production) had to pay a reserves tax. (Subsequent increases in the royalty schedule are reflected in Chart D, Sheet 1).

Oil prices were rising in 1972 so the new royalty schedule was able to provide additional revenues to the Alberta Treasury. On the other hand, average gas prices were quite low at 16¢/Mcf and with only small annual changes in price, increasing natural gas royalties without a major increase in price was not feasible at the time. It was already shown how the F.P.C. control over gas prices at the wellhead, under the authority of the Natural Gas Act, was reflected in the prices at the basing points (i.e. Chicago, Seattle and San Francisco, etc.). In addition, the F.P.C. had control over imports and, therefore, indirectly controlled the wellhead prices in Western Canada. The producers were forced to sell at border prices acceptable to the F.P.C. if they wished to sell at all[2].

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1 The game (except for the means) is not unlike the struggle between O.P.E.C. and the industrialized world which basically was caused by the rapid inflation (i.e. the monetary crisis) in the Western world, the stronger supply position of the O.P.E.C. bloc, and the development aspirations of the producers.

2 There are examples of F.P.C. intervention in export prices. On the other hand there is no evidence to show how the F.P.C. may have acted if Canada did not wish to sell.

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Before changing the royalty schedule[1] on natural gas, Alberta first had to increase its wellhead prices which the Alberta Board recommended in its August 1972 Report on Field Pricing of Natural Gas in Alberta.

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1 Effective January 1, 1974, royalties payable on natural gas and residue gas were increased according to prescribed formulae. To illustrate the magnitude of the royalties generated under the formulae, the following table gives the current royalty payable for various wellhead prices in percentage terms. (Alberta's stated goal is an average wellhead price of 72 cents per Mcf by 1975-76).

Wellhead Price (¢/Mcf)	Old Gas	New Gas
26 or less	22.0%	22.0%
27	22.1%	22.1%
29	22.5%	22.3%
31	23.1%	22.6%
33	24.0%	23.0%
35	25.1%	23.5%
50	26.3%	24.0%
80	38.2%	29.4%
100	41.2%*	30.9%

* Prior to January 1, 1975, this rate was 45.4% but was reduced to offset the impact of the federal budget on the oil and gas industry.

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It can be said that increasing prices and royalties benefit the producing province[1] at least in the short-run. On the longer run, it depends on how the increased revenue that is taken out of the economy is utilized or invested. Will it be eventually invested in the development of alternate energy supplies? Or will it be diverted to provincial industrialization[2]? The latter may do little to ensure adequate supplies in the future to satisfy existing industrial capacity.

The change in Alberta's oil taxation to yield $70 million in 1973 was accomplished at the time of rising prices. If we assume the producer take was not reduced (i.e. prices were passed on to the consumer to pay for the increased royalty, then the following table would be representative of the disposition. Refer to Map 2 for volumes).

	Millions of Barrels[3]	Percent of Total Production	Distribution by Markets of $70mm
Alberta Production	522	100	70
Alberta Consumption	58	11	7.7
Marketable Surplus	464	89	62.3
Sales to other Provinces			
B.C.	31	6	4.2
Saskatchewan	18	3	2.1
Manitoba	8	2	1.4
Ontario	122	23	16.1
Quebec	3	1	0.7
Total	182	35	24.5
Total Sales to U.S. (Districts I, II, III, IV & V).	282	54	37.8

1 Particularly when its own energy use is low in comparison to its exports.
2 The diversion of some energy supplies follows also. Industrialization may also duplicate services already available in other provinces.
3 Estimated from Oilweek, November 5, 1973.

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The tabulation shows that Alberta achieved at least a net gain of $62.3 million depending on final prices. This would be borne by the consumers in the "other provinces" in the amount of $24.5 million and by the U.S. consumers in the amount of $37.8 million (assuming that the return to the refiner stays the same as before the increase in royalty).

The other producing provinces followed Alberta's lead with innovative plans of their own[1]. As B.C. and Saskatchewan are producers, their added royalties on production offset some of this added cost on Alberta oil. These other producing provinces produced 114 million barrels in 1973 which translates into an added take of at least $17 million from the consumer.

The Prairie provinces claimed some discrimination against them in the past in justifying their actions, particularly with regard to transportation costs and the decreasing purchasing power of the dollar, with which they had to buy industrial goods produced in the U.S. or in the industrialized[2] provinces. These are difficult claims to evaluate. Certainly with regard to the shrinking dollars (inflation) over some years, they have a point particularly if they did not get their share of the inflated dollars in the past. Unfortunately, the increasing oil and gas prices have helped to shrink the dollar still further.

In addition to the net gain to Alberta and the other producers from increased oil royalties and prices, there is also

1 The Government of B.C. also formed the B.C. Petroleum Corp. which purchases gas from the producer and then re-sells at the higher border price to U.S. customers and at some lower price to the B.C. consumer.
2 Ontario and Quebec.

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the immediate net gain from the increasing gas prices (and increased royalties), as well as a longer term gain from the formation of provincial 'marketing' agencies such as the B.C. Petroleum Corp. and Pan-Alberta Gas Ltd. The B.C. agency was wholly owned by the Province while Pan-Alberta is a subsidiary of Alberta Gas Trunk Line, whose shares are traded on the open market, though not without influence by the Provincial Government (provided for in the incorporation).

The comparative revenue split between the federal government, provincial government and the producer on a barrel of Alberta crude oil is shown in Chart D, Sheet 2 of 3. If the 1975 schedule for the revenue split on a crude oil price of $6.50 is applied to the 1973 provincial production of 522 million barrels, the federal tax share was $850.86 million, the provincial tax share was $1920.96 million, and the producer share was $1665.8 million for a total of $4,437 million. In addition, the federal and provincial governments split the tax on U.S. exports of 282 million barrels or about $700 million each. Most of the federal take of approximately $1550 million on Alberta oil is used to 'subsidize'[1] the crude oil imports into the area east of the National Oil Policy Ottawa Valley Line which is supplied by O.P.E.C. priced imports.

In regard to natural gas, the process is quite similar to that for oil. In its August 1972 Report on Field Pricing of Gas

1 To maintain the same ($6.50) price per barrel east and west of the Ottawa Valley Line.

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in Alberta, the Alberta Board published a cost-benefit table reflecting the net gain to Alberta in 1975 of an increase of 10¢/Mcf (from 16¢/Mcf) in the field price[1] of gas. The analysis indicated that in 1975, total revenue benefits to Alberta will be $224 million as compared to total costs of $20 million, resulting in a very conservative net benefit of some $200 million. As an increasing proportion of the gas produced is consumed in Alberta and as the discovery rates decline, the Alberta Board estimated the net benefit will shrink to $80 million by 1985.

Considering the supply and disposition of natural gas for Canada for 1972 (see Map 1) and applying the 10¢/Mcf increase at the wellhead to all gas production in Canada, the following table is calculated to reflect the disposition of net revenues (to producing provinces) and net expenditures (by the consuming provinces and the U.S.) on the natural gas trade:

1 The average field wellhead price reached 26¢/Mcf by the end of 1974 (see Set 1, Sheet 2 of 5).

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	Billions of cubic feet	Gross Yield from 10¢/Mcf ($ million)	Net Revenues (Net Expenditures) ($ million)	% Yield Distribution by markets
Production				
B.C.	378	37.8	$ 26.0	
Alta.	1,854	185.4	158.5	
Sask.	54	5.4	---	
Ont.	12	1.2	---	
Total	2,298	229.8	184.5	
Less Pipeline Fuel and Losses	159	15.9	15.9	
Net	2,139	213.9	$168.6	100%
Sales				
B.C.	118	11.8	---	
Alta.	269	26.9	---	
Sask.	88	8.8	($3.4)	2%
Man.	60	6.0	($6.0)	3.6%
Ont.	537	53.7	($52.5)	31.1%
Que.	58	5.8	(5.8)	3.4%
Exports Total	1,009	100.9	(100.9)	59.8%
Total	2,139	213.9	($168.6)	100%

The primary beneficiaries of the revenues are Alberta and British Columbia while the largest "payers" are Ontario and the U.S. which together account for 90.9% of the natural gas revenues that go to Alberta and B.C.

On December 31, 1974, the border price was set[1] at $1.00/Mcf for all gas exports to the U.S. Because of the nature of the

1 By Order-in-Council based on recommendations in the July, 1974 National Energy Board Report.

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natural gas contracts between the transmission companies and the producers, the entire value of the U.S. exports, with the exception of the provincial royalties, went to the producer companies and/or the provincial marketing boards[1] for distribution. The federal government would eventually receive 'their share' through the taxation of the producing companies and the marketing boards.

Because of the budgetary implications for the federal and provincial governments and the producer, closer consultation between federal and provincial governments and regular federal-provincial Ministerial Conferences on energy and the economy are likely. These will be increasingly important as Canada becomes a net importer instead of a net exporter of energy. As this occurs, domestic energy commodity prices will likely move to meet O.P.E.C. price levels unless lower cost alternatives[2] such as coal[3] are developed rapidly. Frontier oil and gas supplies are unlikely to reduce prices below O.P.E.C. levels unless there is a severe economic recession in the West. As Canada becomes a net importer, its demand for oil will adjust according to what Canada can afford (see Chart G for the various (cost of import) scenarios for Canada and the U.S.).

Meanwhile, the producing provinces, particularly Alberta, have a rather tremendous leverage in boosting their purchasing power[4]. It seems that for the present the large increases in oil and gas prices have more than offset any effect on them by rising in-

1 B.C. Petroleum Corporation and, in part, Pan-Alberta Gas Ltd.
2 Without lower cost alternatives it is likely that natural gas prices will move towards parity value with oil (that is, the same price on a heat content (Btu)-burning efficiency basis).
3 Because of taxation, inflation and supply-demand considerations, coal (or coal gasification) may not remain long as a lower cost alternative, however, it is a viable and certain option (see Set 1 Charts, Sheet 5 of 5).
4 At the price of considerable inflation at home.

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flation as a result of their price action. We have shown how the taxation measures taken by the federal government have moderated the potentially disrupting influences on the industrialized provinces. Unemployment remains the lowest on the Prairie Provinces while it rises as we move eastward.

It is interesting to note that gross revenues of the oil and gas industry in Western Canada surpassed expenditures since 1965 (coincident with the acceleration of exports to the U.S.), and by a considerable margin since 1972 (prior to and since the Arab oil embargo). Income taxes and interest payments may account for some of this difference while dividends and the diversion of revenues into foreign investment opportunities (i.e. the North Sea) may account for the rest. On the whole, cumulative industry gross revenues and net cash expenditures are roughly in balance in the period 1947-73 ($21,321.8 million versus $21,479.9 (incl. interest))[1]. Industry, of course, 'owns' reserves in the ground for which they will receive their share of the revenues from future production. Historically, industry invested about 55% of its revenue in 1971 and 50% in 1972[2].

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1 See the Canadian Petroleum Association 1973 Statistical Year Book, pp. 64 and 69.

2 According to "Future Financial Requirements of the Canadian Oil and Gas Industry", a paper prepared by Aquitaine Company of Canada Ltd., May 2 - 3, 1972, p. 21.

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THE INVESTMENT DECISION

The output and energy use per capita for some selected nations in 1971 was as follows:

Nation	Energy Consumption Per Capita (in KG of Coal Equivalent)	Gross Domestic Product Per Capita (in U.S.$)
United States	11,000	5,050
Canada	9,300	4,300
Belgium-Luxembourg	6,100	3,000
Sweden	5,950	4,500
United Kingdom	5,500	2,450
Japan	3,200	2,200

In 1971, the total Btu demand of energy fuels in Canada was approximately 5.5 quadrillion (10^{15}) Btu's (see Chart 7). To achieve EMR's low growth energy forecast[1] in 1990 (based on 29 million[2] people by the year 2000 and historic energy consumption), Canada would require a total Btu supply of energy fuels in the order of 11 quadrillion (10^{15}) Btu in that year. This is twice the 1971 energy requirement (much of which will have to be replaced).

Because the supply availability from some traditional sources of oil and gas will have declined by 1990 (see Chart 7), new sources of non-renewable supply will be required to replace present producibility plus sufficient new supplies to provide for historical growth requirements. This would appear to be a rather difficult task.

Using data presented in E.M.R.'s "An Energy Policy for Canada - Phase I," 1973, it can be estimated that a new capital investment in energy of approximately $50 billion for the period 1971 to 1980 in

1 E.M.R., An Energy Policy for Canada, Phase I, 1973.
2 Recent pronouncements in the news media from government sources suggest 27 million people by the year 2000 (more on this in the last chapter entitled, "In closing").

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1974 dollars is required. In an earlier discussion in respect to the Wholesale Price Indices (Chart 5), it was suggested that the general price levels may double by the early 1980's. (This would explain the recent revisions in Athabasca Tar Sands investment requirements[1]). If we extrapolate the 1971 - 1980 new capital requirement (in 1974 dollars) of $50 billion on the assumption of a constant relationship between cost and production capacity, a total new capital requirement of $100 billion (in 1974 $)[2] for the period 1971 to 1990 may be required to achieve an additional 6 quadrillion (10^{15}) Btu per year in 1990 (over and above 1971 consumption levels). As existing producibility declines in oil and gas, additional funds will be required to replace pre-1971 supply capacity.

From historic evidence (see Tables IV and V) the assumption of a constant relationship between cost and capacity would appear to be valid in regard to oil and gas reserve results.

Will the money necessary for this huge investment requirement be available? In certain circumstances, if supplies do not come on stream as they are required, the total cost of petroleum imports could reach $40 billion (in 1974 dollars) by 1989 (see Chart 6). This is an extreme case and it is doubtful Canada would have the necessary means, unless O.P.E.C. money is recycled in equivalent amounts in energy investment in Canada.

Will the huge amounts of monies being taken by the provincial and federal governments and industry be available for investment in the necessary energy projects and in the time span required? It was shown what the various shares of revenues from the non-renewable hydrocarbon production are. Will industry and governments recycle this

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1 See next.
2 Refer also to public statements by the Minister of Energy, Mines and Resources, the Hon. Donald Macdonald.

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revenue back into energy investment? Or will governments divert these revenues into social and industrialization plans of their own and leave it to the general market to locate the funds for energy investment? The hydrocarbon producing industry may wish to transfer their revenues into more promising areas of investment opportunity, including foreign investment 'bets'.

Historically, it can be shown that a certain percent price increase at the wellhead in Western Canada resulted in a greater percent increase in investment (see Chart E(a), Step 1) and a significant increase in reserves based on the historic royalty and taxation structure. This seems to be no longer true in Alberta (see Chart E) as a rapidly increasing price is finding fewer new reserves. The new royalty and taxation structure is taking ever increasing amounts (in increasing percentage rates) out of the production revenues generated by industry.

While it is recognized that the governments may wish to decrease foreign participation in Canadian energy development, this should not preclude placing the same investment funds into domestic companies (Crown or private) for the same purposes.

Alberta's energy requirements presently are approximately ten percent of its production. It has a considerable energy surplus for its use. Does it then have an incentive to encourage development of alternate energy supplies for use elsewhere or is its incentive greatest in encouraging industrialization which contributes a larger 'value added' in the province? It seems the latter represents its greatest opportunity value.

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The historic development of oil and gas in Alberta will now be examined. To make the task of illustrating the points easier, several charts have been prepared. The applicable charts are Charts 1, 2, 3, 3(g), and E. Charts 1 and 2 indicate the cumulative discoveries to date. The bar charts on these represent the initial reserves by year of discovery. On each bar chart is superimposed what is described as a 'learning curve'. It was not fitted mathematically but it is a close (eye ball) estimate. This learning curve serves two purposes: (i) it gives us a 'feel' for the geological and reservoir characteristics of the Alberta sediments and its current potential, and (ii) it shows that the hydrocarbon-finding knowledge of the Alberta sediments reached a peak (of knowledge) in the late 1950's and have decreased since then (for both oil and gas). As finding rates in conventional oil and gas were declining during the 1960's, industry was increasing its designs (from a small base) on the development of the Athabasca Tar Sands. Two factors may have discouraged this momentum in the late 1960's. The first was the provincial government's plan whereby Tar Sands production was not to exceed a small percentage[1] of total crude oil production, and the second was the huge Prudhoe Bay crude oil discovery in Alaska. The latter turned the producing industry's attention northward even if the discovery was on U.S. territory.

A constraint on the eventual investment decision is the ultimate recoverable reserves forecast (Chart E illustrates the situation for Alberta and the information on this chart is self-explanatory). The ultimate reserve depends to a great deal on what

1 This had the resulting effect of limiting development to one plant (the Sun Oil Development).

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criteria is used to determine it. There are several methods and it is not the purpose to go into a discussion of these except for the purpose of making a point. (A mathematical relationship is included (Chart E(a) Step 2) for this purpose in addition to the visual aids). The mathematical equation for cumulative reserves (Y) shows that the ultimate reserves are reached (cumulative reserves become constant) as investment becomes infinitely large.

This relationship suggests that at some time, historical growth rates in a given geological area start lagging behind historical demand growth rates, even if very high levels of risk (investment) dollars should be available. These risk dollars then seek out other areas for more lucrative returns, for example, in newer forms of energy like nuclear fuel where the upward cycle is just beginning and supplies can be expected to at least double every ten years or in yet unexplored but potentially lucrative hydrocarbon areas. This process has in fact been occurring since the late 1960's.

It can be seen (Chart E) that the increasingly rapid natural gas price increases at the wellhead, while resulting in some new reserves in Alberta, are not causing a reversal in historic trends when a small price movement (or even a decrease) in price resulted in significant additions to cumulative reserves. This is not to say that at some point along the price trend (towards a price target of $2.00 which represents Arctic gas in Alberta), a huge investment boom in energy development will not occur in Alberta. Trends suggest otherwise, thus, the opportunities for "independent" oil companies

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are probably greater[1] in the U.S. unless they are given a proportionately larger incentive in Alberta than in the U.S.

The problem with using ultimate reserves as a criterion in decision-making is that it requires an infinite amount of capital with decreasing returns to attain or approach them. Sometimes before this occurs, the general market will allocate the funds into more lucrative areas. It can be concluded that there will 'always' be some oil and gas left in the ground in a mature area but they would become so capital intensive that it would be very costly to get them out (i.e. perhaps run out of demand for them; that is, they would price themselves out of the market).

The eventual price target for natural gas from the Arctic, unless cheaper supply sources are exploited, is $2.50/Mcf which is roughly equivalent to $14.25/bbl. of oil (see Chart E). For oil, the largest known supply source capable of satisfying the market demand is the (Athabasca) tar sands. In 1974 dollars, the cost of the Syncrude plant was $1 billion. Inflation has doubled this estimate, and recently it was heard where among the major concessions granted Syncrude by the federal government, permission was given for it to sell production at existing world prices. At an investment of $2 billion, Syncrude needs $8.00/bbl.[2] to break even in 1983, before taxes. Adding royalties and taxes thus translates into a market price of $14.50/bbl. by 1983. The Department of Finance[3] has calculated that the price will be $14.00/bbl. by 1982

1 Evidence in the 1970's has shown this to be true as some "independents" have shifted their priorities to the U.S.
2 According to Energy Analects, March 14, 1975.
3 Same as footnote 2 above.

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when Syncrude will be producing about 100,000 b/d, $14.50 by 1983, $15.00/bbl. in 1984 by which time Syncrude should have reached its rated capacity of 125,000 b/d[1], and $15.55 per bbl. by 1985.

We now have an idea of prices in future years (these are comparable to estimates made with the help of Chart 5) and an idea of the rate at which the tar sands plants are being constructed. If this reality is compared with the number of tar sands plants required in a particular year to meet historic and various other demand requirements (see Chart 3a), it is difficult to envisage the construction of tar sands plants beyond the number suggested in Charts 3b and 7 to 9 if at that. Certainly some of the projections in Chart 3a may be beyond reach unless the tar sands development program is accelerated with the help of huge provincial and Middle East (i.e. O.P.E.C.) funds or a technological breakthrough occurs which will simplify the tar sands extraction process and reduce the unit costs accordingly.

1 Refer to Chart 7 for a "measure" of the portion of total Canadian demand this supply "block" represents.

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THE NEXT SIXTEEN YEARS

Historic data varies slightly from source to source. For this study, a small change will not affect the observations or the conclusions. Basically, except for possible variations due to conversion factors used, and for some differences in consumption records from one data source to another, the historical record (shown on Chart 4 for the U.S. and Charts 7 to 9 for Canada) is quite accurate and meets the intended purposes of this study.

CHART 4: This paper is designed primarily to focus on the Canadian energy game. However, it is helpful to show the Btu production and total demand of energy fuels for the U.S. (Chart 4) for comparative purposes. The historic data is a matter of statistical record. As for the supply estimates for the years 1974 to 1985, these have been given somewhat less attention than for the similar Canadian charts. However, the forecasts should not detract from the main thrust of the arguments. We are in a period of considerable supply uncertainty when historical performance is no longer a valid basis for forecasting. Some personal judgments formulated from various readings have been applied to the construction of the forecasts but in the main, published estimates[1] were utilized.

Because of changing circumstances and trends, most of which are documented, the use of supply "blocks" tempered against various[2] realities is more useful than the historical growth projections. In other words, domestic supply presents, for the foreseeable

1 In the Journal of Petroleum Technology, May, 1974.
2 Financial, economic, technical, and physical realities.

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future, a physical constraint on demand. Eventually, changing patterns in trade and national financial capability, resulting from the recessions in the Western World, may reduce demand to meet available supply.

It was shown where, because of the nature of geological oil and gas bearing horizons as they reach exploitation maturity, Canada could be faced at some time with committing so much capital to find reserves, extract, and distribute them (in the mature areas) in addition to the funds required for new areas, that the government could not sustain growth in other sectors of the economy. In the process, we would move into a general recession.

If we examine Chart 5, we see that there have been rapid periods of inflation before (i.e. 1945 - 1948) followed by long periods of price stability. As the price level moves to a new level, many new supply sources become economical. These new sources are then located and developed in the new price level horizon with decreasing success towards the end of the price stable period[1] (see Charts 1 and 2). As demand outruns available supply, the price level again rises to a new plateau. The present period of rapid inflation appears more deadly than previous ones, perhaps reflecting a longer period of money market distortions. The world's monetary system is having some difficulty coping with this period of rapid rise in the general price level probably because it is undergoing a fundamental change. If the monetary difficulties can be contained without massive disruption[2] then a new period of price stability

1 The price stable period is characterized by (i) a gradual erosion of the purchasing value of the currency and (ii) with gradually increasing efficiencies in order to maintain an adequate return on investment.

2 Currency collapse, massive unemployment, etc.

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should occur in the 1980's. At the present, a new period of price stability is far from evident and it may, in fact, be some time before it is, judging by the prognosis of domestic energy supplies in the forecast period (and their lack thereof).

Unless some large new energy sources come on stream as required (see Charts 7-9), it is likely that the rapid price rise may cause a large shift in the historical growth curve in this price level adjustment.

Turning to Chart 4, the historic demand curve projected to 1985 reflects pre-Arab oil boycott oil prices. As these oil prices rise, the energy demand is adjusted downwards to 'affordable' national levels (see Chart 6). Case 1 (Chart 6) for example, is probably not affordable for the U.S. so decreasing energy demand (certainly in Europe first, then Canada) per capita is likely to occur with the subsequent allocation of energy according to end use priorities.

Power plant boilers presently fired by gas will become fired by oil, then by coal as the supply and price situation changes rapidly. Fuel for power plant boilers is a low priority use for oil or gas except where rigid pollution standards and low prices in the past gave these an economic advantage over coal. If Canada chooses to restrict some of its gas exports to the U.S., power plant boilers may be the first to come off. Natural gas for interruptible[1] service and boiler fuel use in some U.S. market areas supplied by Canadian gas constitutes 25% of the entire market.

Crude petroleum production in the U.S. until 1985 can probably remain at 1974 supply levels because the U.S. has hydrocarbon potential in Alaska, offshore areas (i.e. Santa Barbara, Gulf Coast, etc.) and

1 Lowest priority seasonal uses for gas.

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Naval Reserve blocks that have been set aside for security reasons.

Natural gas production in the Continental U.S. reached peak levels in 1971, and except for the potential from Alaska production will probably decline. Synthetic oil and gas will forestall some of this decline. Alaskan gas from Prudhoe Bay will not be available before 1982 at the earliest.

The lead time for nuclear plants is currently ten years in the U.S. so plants committed to construction in 1965 will be coming on in 1975, etc. Unless the lead time can be reduced to six or seven years, plants committed to construction in 1975 would not come on much before 1985.

A commitment to massive coal development now as a source of solid and gaseous fuels seems the most likely bet. Research and development commitments in the U.S. are presently about $16 billion. Solar energy and the heat pump will play an increasing role in the U.S. but probably not in any significant proportions before 1985.

Because the U.S. controls "old" oil prices and natural gas prices at the wellhead, the average 1974 U.S. year end price[1] for all oil was $6.80 (see Set 1, Sheet 1) and for gas, 29.9¢/Mcf (see Set 1, Sheet 1). Average prices are rising towards price levels set by O.P.E.C. and, as stated, it may not be until the late 1980's before the prices reach stability. The optimum price targets for the U.S. are the same as those discussed for Canada. The question of price equilibrium in relation to economic growth will be discussed in a later chapter.

1 Both average year end oil and gas prices are according to the U.S. Bureau of Mines.

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The most immediate large U.S. gas option is natural gas from the North Slope of Alaska. Previous discussion with regard to gas prices for Canada in the investment section are valid for the North Slope gas except the price may be $2.50 to reflect the longer distance to transport it to the U.S. markets. The wellhead prices projected at 50¢/Mcf should be about the same for both the North Slope and the Delta.

As at December 31, 1974, Canadian gas destined for U.S. exports was priced at $1.00/Mcf. By September, 1975, the border price is expected to rise to $1.60/Mcf. The reason for pricing the Canadian export gas at commodity[1] value in the U.S. market place can be illustrated with the help of Chart 3(g). Simply, it reflects the Canadian supply-demand situation which, because of export commitments to the U.S., leaves little or no new gas available for growth purposes before 1982 unless gas exports to the U.S. are curtailed beginning in 1975 as needed, and eliminated entirely[2] by 1982 or sooner[3]. This would then slow the rapid price rise until 1982 as Canada would have a balanced supply-demand situation in natural gas. In 1982, it is possible that the Mackenzie Valley gas option may only be sufficient to fulfill Canada's needs at best. It is unlikely that this line can be built on the basis of presently proven Mackenzie Valley reserves alone unless it is built on speculation of future reserves or in conjunction with Alaskan reserves. If gas supplies for domestic growth remain unavailable until after 1982, this in effect, shifts the historic natural gas demand curve

1 On a Btu heat content alternate source basis, usually No. 2 fuel oil.

2 Unless demand decreases on account of external influences (i.e. decreasing trade, etc.).

3 A case for total curtailment of natural gas exports can be made in 1977 on the basis of the total energy supply (Chart 7) in relation to the low growth demand curve. This question, however, needs to be examined on the basis of U.S.-Canada trade and Canada's ability to pay for crude oil imports (after 1977).

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to the right until at least 1982. To minimize the risks to the economy of not having the options available when needed in 1982 and beyond, and to stabilize the upward price movement, coal exploitation should be accelerated. Historically, exploitation of coal (all types) in the U.S. has constituted a far larger percentage of the total energy demand than in Canada (see Charts 4 and 7). As a result, Canada may be less prepared[1] to handle the necessary chore.

How much the total U.S. demand line finally adjusts by 1980 (Chart 4), will depend on how much farther the general U.S. price level rises (refer also to the chapter entitled, "The International Game"). While there appears to be some lag (20%) in the U.S. wholesale price index, all commodities with the other indices, and a lesser lag in the Canadian W.S.P. index,[2] the selected price indices are generally rising at the same rate reflecting the general rise in North American inflation. As mentioned earlier, the U.S. 1974 year-end average crude oil price was $6.80/bbl. This relates to a U.S. crude oil price index of 214.2. If the O.P.E.C. oil price is $13.60 by 1980 (which compares with Syncrude's after tax needs), the U.S. crude oil price index has a potential of 400. Except for coal and solar energy, lower cost alternatives are not readily available in the U.S. (and Canada) so the general price level will probably rise to 400 unless increasing unemployment 'moderates' wage demands or the O.P.E.C. price declines.

CHART 7: The basis of constructing the Canadian total demand and Btu production (Charts 7 to 9 inclusive) for the period beyond

1 On account of provincial priorities, closed coal mining operations and development lag from a lower base of operations.
2 Wholesale price index.

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1974 was similar to that used for the U.S. except that far more detail was used to build up the Canadian supply 'forecast' section. This available supply is compared to the E.M.R. demand projections[1] and recommendations are made on the basis of attainable and/or what needs to be done to make the particular demand attainable.

It is readily apparent from Chart 7 that meeting historic demand (standard growth) is physically if not financially out of the question. The rate of finding new reserves in the frontier areas to meet threshold[2] volumes and the rate of tar sands development is too slow.

The threshold volumes for the Mackenzie Valley are generally taken to be 15 Tcf. Gas from this source is required at the market by 1982 (according to Charts 7 and 3(g)) unless coal fuels in equivalent quantities are provided. As this project requires a three to four year lead time, the threshold reserves of 15 Tcf are required by 1978-79. To date, 4-6 Tcf appears to be the best estimate for the proven reserves in this area (see Map 4). (They are in the lower end of this range according to C.P.A. 1974 year-end figures released recently).

The Polar Gas Project[3] (Arctic Islands) requires a threshold reserve of 25 Tcf. If the Mackenzie Valley area is exploited on target as required, the Polar gas would be required in Canadian markets by 1985. A four-year lead time is required, therefore, the threshold volume of 25 Tcf is required by 1981. To date, 9 - 12 Tcf[4] has been discovered in this area (see Map 4).

1 E.M.R., An Energy Policy for Canada, Phase I, Summary of Analysis, 1973.
2 The minimum proven reserves required to commit economic construction of a pipeline.
3 This is the pipeline option, however, Arctic exploitation can be commenced on the basis of present reserves if the liquefied natural gas option is undertaken with a combination of a pipeline to a year-round ice free port and LNG tankers.
4 Noel A. Cleland et al "The Economics of Developing Canadian Arctic Gas", J.C. Sproule & Assoc., Journal of Pet. Technology, Nov. 1974, pp. 1199-1205.

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Polar Gas may therefore be the best bet to reach the market first unless Prudhoe Bay gas is tapped along with the Mackenzie Valley Gas (i.e. Gas Arctic Project). Unfortunately, gas finds in the Arctic Islands with the exception of the Drake Field, are too scattered.

The Syncrude tar sands project (representing the supply "block" shown in Charts 7 to 9) was estimated to cost $1 billion, in 1974 dollars. The rapid rate of inflation since 1974 (see Chart 5) has forced a re-appraisal of this project. As discussed, the project was re-assessed to cost $2 billion by completion (1980). If completion is later, inflation will force a further evaluation. Increased costs may slow the momentum necessary to build the required (see Chart 3(g)) number of plants. Unless massive funds are made available, fewer plants will be built to meet historical demand (see Chart 3a).

As E.M.R.'s standard growth appears out of reach, the low growth demand line (a population of 29 million people[1] by the year 2000) becomes a useful demand target. The supply "blocks" have been placed to 'fit' this low growth projection. The petroleum supply "block" is shown in larger scale on Chart 3(b). It is highly unlikely that the historical growth (including the supply area marked N) will be achieved. It is highly probable, that the historic demand curve[2] will shift to the right by at least 9½ years based on present trends. (This means that it will take at least 9½ years before domestic supplies regain present levels (see Chart 3(b))).

1 The latest estimates suggest Canada's population by the year 2000 is expected to be 27 million (according to recent comments by government officials (i.e. Manpower and Immigration Minister, Andras) to the Globe and Mail).

2 The demand growth curve will become rather generally supply constrained on the basis of present inflation trends and O.P.E.C. price targets.

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The natural gas supply "block" on Chart 7 was built from the information found on Chart 3(g). Chart 7 indicates that Canada faces the prospect of having to curtail all gas exports to the U.S. by 1981 and beyond, even with the construction of two natural gas pipelines. However, if historic demand growth is reduced significantly for economic reasons by the time these pipeline projects come on stream, Canada may even have a 'surplus' on the basis of low demand.

Because of long lead times (9 - 10 years), the hydro and nuclear supply "block"[1] seems relatively certain to materialize. The solid fuels supply "block" is the same as the E.M.R. projection in the Phase I Energy Policy Study and is too narrow under the circumstances.

CHART 8: If the area marked, "Curtail(?) Gas Exports" is in fact not curtailed (Chart 7), this supply requirement[2] will have to be displaced with coal (solid fuels and coal gasification), with oil imports, and/or with severe self-enforcing conservation measures. In 1973, natural gas sales in Canada were allocated as follows:

Residential	22.1%
Commercial	20%
Industrial	57.9%

By the nature of the business, residential and commercial natural gas customers receive priority service. For growth purposes, industry would be left 'looking' for alternate supplies which may have to be coal derived. Unfortunately, even for coal[3], the lead time for new coal mine development is three or five years. Chart 8 illustrates the rather large supply "block" of solid fuels or coal gasification that would be required to maintain all natural gas export commitments

1 Taken from EMR's "An Energy Policy for Canada - Phase I, 1973.
2 Under the low growth demand assumption.
3 Ontario Hydro alone is forecasting a 6 - 7 MM ton coal shortfall by 1980, and could take the entire throughput of a 18" slurry line from Alberta to the Lakehead. (Globe & Mail, August 1974).

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and provide supplies to meet Canadian requirements even with the advent of Mackenzie Valley and Polar Gas.

CHART 9: This chart was constructed to illustrate the possible demand[1] in the period 1977 - 1989 given a combination of demand shifts in the component energy fuels (see Charts 3(b) and 3(g)), and the future uncertainties in timely availability of alternate energy supplies in the period 1976 to 1989.

In the next chapter possible O.P.E.C. pricing policies and international political behavior will be discussed and analyzed in an attempt to answer the question, "Where is the price equilibrium?" It may be useful to relate the discussion of Chart 9 with the comments in the next chapter before formulating a final judgment.

A strong probability exists that the demand shift suggested in Chart 9 can occur. This argument is based on projected development trends, considering the current rate of additions and known availability of other energy supplies, the large investment requirements which the governments are diverting elsewhere, and the fundamental change in world currency realignments (as expressed by Chart 5 for North America).

Recognizing this impending reality, industry and governments can take measures which will minimize the risk of this occurance. Unfortunately, Canada may be forced to travel along with the United States in a rather captive economic orbit, perhaps to the detriment of Canada as U.S. industrial manufacturing slack develops with an eventual damaging effect on the economies of Canadian branch plant operations.

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1 Supply constrained.

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THE INTERNATIONAL GAME (POLITICAL-ECONOMIC)

In turning our attention to the international political economic game, it is recalled that the U.S. became progressively more energy deficient in oil and gas in the late 1960's and thus more dependent on foreign petroleum supplies and related political realities. In 1967, U.S. proven reserves of natural gas reached a peak as annual consumption in the U.S. outpaced annual additions to reserves for the first time. By 1973, this reality was translated into declining natural gas production. In oil, the U.S. has been unable[1] to meet its domestic requirements in oil since 1952. The relatively stable U.S. dollar and "chronic" world surpluses coupled with the control exercised by the multi-national ("major") oil companies over offshore reserves, enabled the Western major producers to, in effect, control the price of international oil until the late 1960's.

As the U.S. became increasingly dependent on foreign oil, it first looked to 'politically' stable areas. The Middle East was perhaps the least politically stable area in the eyes of the U.S. so its corporations turned increasingly to Canada for energy supplies because Canada was (i) politically stable, (ii) in close geographic proximity to the U.S., (iii) U.S. oil companies dominated the Western Canadian producing industry, with ready pipelines running through or connecting with U.S. pipelines to certain U.S. markets, and (iv) Canada and the U.S. both believed that Canada had

1 The Prudhoe Bay oil discovery was a major exception in the rather flat U.S. oil reserve trends but this discovery, however large, was not able to reverse the long term reserve trends.

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"unlimited resources". Canada, for example, represented the only immediate outside option of pipeline natural gas, some spare oil and gas producibility, the vast Athabasca tar sands[1], and the huge Arctic and frontier 'potential'. By the early 1970's, Canadian oil and gas production in the most accessible areas was rapidly accelerated to the limit of the conventional reserves and slack field producibility was quickly absorbed in the period 1965 - 1971. In the early 1970's, oil production and oil and gas export controls were imposed by the Canadian Government when it became totally clear that Canadian requirements would not be satisfied. Meanwhile, protection formulas for gas designed to trigger or signal future shortages, were abandoned as governmental decision-makers were convinced[2] that discoveries would be made to meet Canadian requirements, particularly in areas such as the Mackenzie Valley and the Arctic Islands. In the interim, activities by regulatory agencies turned increasingly towards carrying out current (or short term) operating functions (particularly from 1969 onwards).

In the early 1970's, Canadian production capability from the traditional oil and gas sources began to peak. This was particularly noticeable during the 1973 Arab Oil Embargo.

In the late 1960's, the U.S. became increasingly pre-occupied in avoiding a growing dependence on "unstable" Middle East countries.

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1 The Athabasca Tar Sands reserves are compared with Middle East reserves in size, however, the cost of lifting Middle East crude is 10 - 50¢/bbl. while as we have seen, the Athabasca Tar Sands will require a producer take of $8 - 9.00/bbl. (in 1979).

2 There were various reasons for this but the most interesting points are presented in an article by Eric Kierans, "The Day The Cabinet was Misled", as published in the Canadian Forum, March 1974.

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It preferred to get its supplies from what it considered to be "reliable" or "stable" areas, but it became clear in the early 1970's that it must face the Arab reality as the Canadian options to meet its increasing demand were inadequate (i.e. Canadian production was reaching the limits of producibility and reserves from frontier areas were not being discovered in the time span required).

To meet severe inflation in the Western World and increase their real purchasing power, the O.P.E.C. nations particularly during the 1973 Arab oil embargo forced their oil prices up and eventually allowed the prices to settle at price levels that were designed to match those of alternate sources of energy[1] which in 1974 dollars were said to be $10.00 per barrel and upwards.

Meanwhile Canada, in this highly volatile political environment, however belatedly, tried to satisfy its own immediate oil needs first by export controls then by programmed oil export reduction. Concurrent with the above measures, it raised its export selling price to international levels based on certain basing prices (i.e. compared at Chicago with landed prices for oil from offshore sources, etc.) while its domestic prices were controlled at lower levels under provincial-federal agreements[2]. The latter allowed the price mix at the consumer gates to be controlled at levels similar to that of the U.S. where "old" oil and gas were under federal (i.e. F.P.C.) control. The general inflation levels reflected in various price indices therefore rose uniformly in Canada and the U.S.

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1 In the U.S. and Canada adjusted for inflation.
2 The constitutional basis for this was discussed earlier.

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Investment decisions involving alternative forms of energy have become increasingly risky for Canada and the U.S. as a result of external factors. It is thus helpful to examine the international political and economic game in the hope of achieving some further insight into the question of "price stability".

Earlier it was shown that the singular most important decision facing Canada is the large investment requirement for locating, developing/exploiting new sources of energy. For security reasons this requirement most preferably should be met from internal sources achieved by optimal management (i.e. cost-benefit effectiveness of imports and exports, domestic efficiency in the use of energy, etc.).

The O.P.E.C. funds could be a source of the necessary monies for energy development in Canada particularly for huge but minimum risk developments such as the tar sands. However, a "price" may come with these investment funds. (The price need not be unidirectional as the Arab bloc would then have a stake in Canadian stability to protect their investments). While today's nations are considerably interdependent (contrary to any recent suggestions on U.S. isolationism, etc.), there is nothing to suggest that "masters in our own house" is no longer a preferred national or individual goal, particularly in food, energy, and other basic needs such as shelter. In the end it is probably individual "freedom" that is at stake and the ability to withstand abuses on it. Hopefully, over the next 16 years Canada will be able to maintain at least its present political and economic posture.

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Canadian-U.S. conflicts can arise because of the rather large trade commitment in energy commodities between these two countries, and all trade for that matter. The net balance in energy trade rests with Canada (i.e., the outflow to the U.S. is not balanced with an equal inflow of energy from the U.S.). This historical relationship continued at an increasing rate in the late 1960's allowing distortions in energy supply-demand between Canada and the U.S. to develop because of untimely trends and influences and/or overly optimistic energy commitments due to such factors as:

(i) provincial demands and goals;

(ii) corporate conflicts of interest (i.e. multi-national interests);

(iii) corporate revenue and return on investment goals (in an environment of shrinking national currency values);

(iv) federal revenue requirements; and

(v) the "unlimited resources" factor in the decision-making process.

Canada and the U.S. are faced with 'similar' problems in the end. We have seen this from the charts (Charts 4 to 9) and the descriptive material. Self-sufficiency in energy in both countries may be a "distant" achievement. Federal-provincial conflicts and resulting slow moving policy evolution (for the short term at least) have done little to promote timely and sensible energy development within the national character[1] of Canada.

1 "Within the National Character" would include energy development that is cognizant of national needs, developing knowledge, physical and financial capability, physical resources, geographic factors, international monetary forces, and other pragmatic realities.

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Having examined the factors influencing Canadian and U.S. behavior in the narrower North American setting, it is worthwhile to look at some of the broader international forces and influences at work on North America.

Thus far it was seen where there are several games in this energy related political-economic issue. The end of the game never seems to come. Confrontation or unilateral action by one party may follow counter-action by another. Hopefully, at some point in time, stability will occur. What is this stability and when will it come? For an answer to these questions, a look at the international forces at work in the western industrialized world's market system in which Canada operates and in which the United States (and Europe to a lesser extent) is the chief "player", is needed.

An examination of the selected price indices (Chart 5 and Table VI), showed where North America was endowed with a long period of generally stable price levels (1948 to 1971). By super-imposing the bar charts (Charts 1 and 2) representing initial recoverable hydrocarbon reserves by year of discovery for Alberta on top of this price stable period, some idea is achieved of what hydrocarbon reserves this price stable period yielded in our most productive energy province. Coincident with energy supply shortages in North America, these price levels have been changing rather rapidly in the 1970's. As prices are of considerable importance in the 'free world' market system, what are these rapidly changing prices signaling and how high are they likely to go?

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Earlier in the discussions, the answers for both were suggested. For the first question, the long period of price stability in energy was due largely to the power of the multi-national corporations involved in the "energy game" to control prices[1], particularly prices of those countries that now represent the Organization of Petroleum Exporting Countries (i.e. O.P.E.C.). As for the latter question, this is examined later although it was already suggested what some prices required to develop our energy resources are in consideration of projected inflationary trends into the 1980's.

Before moving on to the Western industrialized world's 'conflict' with the O.P.E.C. block, it may be helpful and of some interest to say a few words about 'games' in general before proceeding. To make the points, reference may be made to now familiar situations in the domestic (Canadian) context.

It has been shown in the domestic energy situation that the 'games' are never ending. This is because we have not reached "price stability" (i.e. inflation is continuing) as yet and are unlikely to do so as long as North America's prices have not reached equilibrium with international price forces still at work.

In real life political situations, for example, in relation to the domestic energy situation, final stability may be most evasive and difficult. Why is this so? It is probably so because this lack of stability in the political arena over time occurs

1 Besides control over prices we can also include control over costs, supplies, governments representing supplies (i.e. petroleum supply "blocks"), and over consumer behavior.

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because "players" have not kept to parts of an agreement, and/or they are unable to because circumstances have changed, or other forces are introduced which have outdated the original criteria.

It is helpful to examine political behavior in relation to the underlying economic forces (realities) at work (political behavior eventually[1] reflects these economic realities) thus economic knowledge can be used to forecast the nature of future (political) behavior. As economic forces are identified, an assessment can be made as to when we can expect to reach "stability" and determine what we can do to keep the end result as much in our favour as possible.

While it may be that over time, final stability has not been reached, it could be that at least for the time being, it may be rational for the "player" or "players" to remain at a stable position. For example, in the first half of 1975, prices in North America are fairly "stable" relative to those of the previous year or two. Several factors are involved in reaching this "stability for a time". Basically, the rapid increase in inflation due to the structural realignment in the world's currencies as reflected by the rapidly increasing O.P.E.C. petroleum prices, has resulted in rising unemployment in several countries of the western world (because of their slow or zero economic growth). As a result, O.P.E.C. has agreed to lower the prices it charges for petroleum slightly and to "freeze" these prices for the time[2]. These actions will be illustrated further when the political factors in the U.S.-Arab bloc-Russian conflict are discussed.

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1 But with some considerable time lag and lost national revenue.
2 Until September, 1975.

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In game theory, stability for any one "player" is questionable if this "player" has a strategy by which he can improve his position by acting unilaterally, assuming that the strategies of the "other" players remain unchanged. This change of strategy can be a unilateral improvement for him.

With regard to the domestic situation (conflict), it may be said that the last royalty increase by Alberta would have been a unilateral improvement for it (giving the "neutrality" of the petroleum producing industry) if the federal government had not increased federal taxes on the industry in turn, or if it had allowed provincial royalties to be made deductible from federal corporate taxes. From the outset of the federal-provincial conflict over the resource "ownership" issue, each of the "players" has had a number of options available to him as provided by the Constitution or inferred to do so.

While individual "players" have several options, it is within the economic framework that they are operable. In turning to the U.S.-Arab bloc-Russian political conflict, it is useful to keep in mind some of the earlier economic realities particularly those with regard to U.S. reserves, petroleum supply-demand, and the purchasing power of the currencies. Because there are differences in political interest and in economic strength (on account of the size of petroleum reserves) among the members of O.P.E.C., it is useful to consider the politically-active "Arab bloc" for the remaining discussion rather than the entire O.P.E.C. group. The reasons for so doing will become evident.

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The U.S.-Arab bloc-U.S.S.R. Conflict:

In this international political-economic conflict is the chronic cold war conflict between the United States and the U.S.S.R. Caught up in this conflict is the question of Israel's existence[1], the problem of U.S. inflation, and the energy question[2].

The O.P.E.C. block was formed by the petroleum exporters to counter-balance or counter-weigh the power exercised by the multi-national petroleum corporations (and/or their governments') control over prices. The loss of control over prices[3] by the petroleum multi-nationals resulted in a subsequent rise in prices reflecting economic realities, particularly the declining purchasing power of North American currencies in relation to O.P.E.C. currencies.

To assist in the discussions it is useful to tabulate the players and list a few of the options available to each. To maintain simplicity, the United States has been chosen as the 'key' representative of the western industrial world. It is recognized that interests and options vary from country to country in the western world but in the main, the options selected are representative. For reasons already disclosed, the Arab bloc[4] was chosen as a single player in the model as these countries particularly Saudi Arabia have the largest potential undiscovered reserves[5] of petroleum as well as the largest surplus necessary for supplying the huge requirements of a country such as the U.S.

1 Or expansion as some of the "players" would suggest.
2 The Western industrialized world has a deficit in petroleum supply-demand while the O.P.E.C. countries have a huge surplus (see Charts Set 2).
3 The loss of control was largely due to rapidly increasing U.S. government spending in the late 1960's and the lack of sufficient domestic energy supply options at prevailing price levels.
4 Excluding Iran.
5 Iran has reserves second to that of Saudi Arabia but for the purposes of an oil boycott against the Western world it has not participated in this type of political action. However, it has been very vocal and instrumental in establishing and defending the basis of O.P.E.C. price setting.

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Some of the reasons for selecting a particular option for a player will be immediately recognizeable. The purpose for selecting each will become evident in the course of the remaining discussions although it will not be the purpose to discuss each option separately.

PLAYER	OPTIONS
1. United States	(i) Maintain diplomatic pressure (ii) A military solution if (iii) Energy conservation[1] (iv) Wage and price controls[2] (v) Increase taxes[3] (vi) Tight money credit[4]
2. Arab Bloc	(i) Maintain price relationship (ii) Reduce prices if (iii) Oil and economic boycott if (iv) Maintain Soviet Arms (v) Blow up oil wells
3. Russia	(i) Supply arms if asked (ii) Support the Arab cause

While he was alive, King Faisal of Saudi Arabia, was said to "hate" both Zionism and Communism. Since Russia (i.e. Communism) was making inroads into the Middle East, particularly in the 'hard' Arab countries such as Syria, Egypt, Libya, and Iraq, Faisal's policy of supporting Egypt with funds against Israel was instrumental in lessening Egypt's financial obligations to Russia to pay for arms required against Israel. In effect, Faisal, by

1 To reduce upward pressures on energy prices and increase efficient use of energy.
2 Massive wage and price controls were not entirely successful during the early Nixon years.
3 To reduce demand and thus contain or stabilize the upward movement of prices (Government taxing more can be taken in combination with less spending). (Personal and/or direct taxes).
4 Maintain high interest rates to reduce (private) expenditures from the borrowing of funds. (Reduction of public expenditures is considered to be either unpopular or infeasible).

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providing political and financial support to those Arab countries which were directly effected by Israel's territorial expansion allowed the Arab world to be reasonably independent of subsequent obligations to Russia for arms shipments.

While Faisal was pro-Western, he was not about to upset O.P.E.C. pricing policy. However, he did favour some reduction in prices and a price "freeze" as unemployment and payments problems increased in the Western World. It seems Faisal[1] was worried that the high cost of energy (which was over $15.00 per barrel during the Arab oil boycott) would weaken the economies of the non-communist countries. Saudi Arabia was thus a major factor in the decision by O.P.E.C. to freeze oil prices at $10.15 per barrel until September 1975. This in effect was a drop of about $1 per barrel in the real price of oil in relation to other goods and services. In addition, the Saudis favoured a continuation of the O.P.E.C. freeze into 1976 in order to bring about a further drop in the real oil price followed by partial indexing of oil to other commodities, many which have dropped sharply[2] in price in the past year. Iran seems to prefer indexing in order to maintain its purchasing powers of goods from the industrialized world.

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1 With Faisal gone, Egypt's moderate President Sadat, may have to face pressures from the Soviet Union, Egypt's chief arms supplier, and from leftists in Syria and Libya, without the strong backing he had from Faisal (Riyadh). It remains to be seen what King Khaled will do although it is expected his policies will be unchanged. He may even be less indisposed towards Israel.

2 The price of copper dropped from $1.56/lb. to $0.65 per lb. in 1974-75.

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While the player most representative of the industrialized world is the U.S., Europe faces similar monetary and energy problems as will Canada[1] beginning in the year 1977 and until such time as sufficient alternate domestic energy sources come on stream or historical demand for energy changes[2].

Because of the military factor it may be difficult to assess the final price equilibrium. The U.S. has stated that it may find it necessary to undertake some military action in the event of a severe economic disaster to the industrialized world. Iran has observed (publically) that the United States has the military might, particularly the nuclear arsenal, to do so.

The question of Israel introduces another unknown. In this model, Israel is not considered as a separate player as it is not expected to do anything that will interfere with broader U.S. plans or actions. In effect, this suggests that the U.S. and Israel are in some sort of coalition though this need not mean that there is unanimity in their understanding and interests. The recent failure by Kissinger[3] to push Israel back from its Sinai position has shown that unanimity certainly does not exist. This March position is not expected to be permanent.

It is conceivable that an ideal solution may not be possible for either side in the rather fragile present day economic situation. The risk of a price collapse exists on the one hand and a runaway price on the other hand. It is a narrow line between the two.

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1 By May 13, 1975, the Canadian dollar had slipped to $0.968 in terms of U.S. funds. This decline was apparently on account of a pending deficit in trade later in 1975.
2 The historical demand curve may shift to the right.
3 March, 1975.

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Continuing debate and/or a periodic compromise arrangement may be necessary to maintain the status quo for some if not for all time. It is highly unlikely that even if Israel does pull back to 1967 borders, that the Arab bloc would permit O.P.E.C. prices to fall to pre-1972 levels unless the economies of the industrialized world faced imminent collapse. Where is the compromise then? While Faisal was alive, his and Kissinger's approaches seemed useful, appropriate, and responsible. Recent articles suggest King Khaled may be less indisposed towards Israel which can only result in further moves toward cooperation.

It has been suggested (i.e. by Kissinger, etc.), that it was the U.S. failure to hold the Communists to their peace pledges in South Vietnam and to supply the Saigon Government with ammunition and fuel that provided Israeli hawks with the argument that Washington cannot be relied on to underwrite peace agreements.

Recent articles suggest that Russia is undergoing a slowdown[1] in economic growth. The wage-price spiral in the economies of the west is raising the import prices of the goods the Soviets buy. This higher cost is being passed on into the Soviet cost structure and is resulting in a noticeable effect on growth. The final effect is still being determined.

The importance of remedial actions by governments can probably be ruled out while thin mistakes cannot be. For example, it was probably a combination of a mild winter and economic recession in Europe in 1974 that caused a 6% reduction in the

1 See Business Week, April 7, 1975.

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consumption of oil over 1973 and not the result of any particular government's conservation program. While the industrialized countries remain at the mercy of the oil-exporting countries, conservation may be a useful rallying cry. It is unlikely over the next several years that the industrialized countries can prevent the Middle East from being a strong economic partner in an enlarged political sphere. Their economic muscle will be too great to keep them out. Canada is becoming increasingly captive to this new international game[1].

It may be argued that we may be better off the more vulnerable we become on Arab oil pressures. The Arab bloc may become less militant and more responsible as their economic strength increases and their stake in the survival of the Western economies increases[2]. Not all of them need all the oil revenues for their development and these may be available for investment for a time, until the recession steepens.

The Arabs may be willing to reach an 'alternate' position with the west whereby they would reduce petroleum prices if the U.S. enacts wage and price controls[3] to control inflation. Wage and price controls have already been proven to be generally unworkable in a market economy. On the other hand, the Arabs could threaten a second oil boycott if the U.S. does not take some measure such as wage and price controls, conservation or a tax increase in response to Arab willingness at cooperation. The Arabs could accept Russian

1 The Canadian Minister of Finance, John Turner, is Chairman of the International Monetary Fund which has as its main problem the smooth recycling of Petro-dollars.
2 There is already evidence of this (i.e. according to Faisal, etc.).
3 A general tax increase may be a preferred and less disruptive option for the west but it is unlikely to reduce O.P.E.C. prices unless O.P.E.C. has an interest in doing so.

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diplomatic or military support of the Arab cause to help reach such an accommodation with the U.S. should the U.S. be unwilling to do so in some recognition of the Arab position.

This 'alternate' position may be a unilateral improvement for the Arabs since it would:

(i) help stabilize the risk to their investments;

(ii) reduce their oil production and thus conserve their oil reserves; and

(iii) help foster peaceful co-operation with the western industrialized nations.

In the end, the problem is an economic one. A "test" on the economies may still be necessary to resolve the question, "what price?" and only the test of reality will determine whether the price will hold up and at what 'intermediate' level between the highs established during the 1973 Arab oil Boycott and the pre-1973 price levels. Somewhere there may be room for a peaceful (status quo) solution. However, if the Western economies begin collapsing in disarray, the U.S. has said it has the option of attempting a military solution in order to control the oil price and production. This option in effect would interfere with the "general market" and is not expected to be favoured by either the Arabs or the U.S.

The Arabs represent one of the oldest civilizations on earth and it is doubtful that Arab irresponsibility would prevail given willingness to co-operate. However, it is recognized that influences on and preferences of some Arab regimes differ[1] from others. Should

1 For example, Libya a 'hard' Arab country, may prefer arms shipments from Russia in exchange for military bases.

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they be provoked by a common enemy, such as Israel, it is expected that they will act together if it is mutually beneficial to do so.

The Arabs could be deterred from breaking price agreements or not co-operating in producer-consumer price agreements by a U.S. military solution as long as some Arab countries prefer not to rely on U.S.S.R. support (i.e. King Khaled, the Shah of Iran, etc.). However, the growing Arab economic/financial muscle may be sufficient to deter the U.S. from acting militarily as it may in the end, be economically self-destructive for it to do so.

The U.S.S.R. is unlikely to leave the Arabs to the military mercy of the U.S., particularly since there is some suggestion in media reports that Russian oil production may now be peaking[1]. It is unlikely that there could be a big power arrangement over the Arabs between the U.S. and U.S.S.R. as it seems to be in the interest of the U.S.S.R. to have a volatile Middle East and, thus, her continuing presence and influence. Recent comments by some Western World leaders (i.e. Trudeau and Kissinger) suggest the contrary, that Russia is trying to stabilize rather than ferment the various international conflict spots.

There may be mutuality of interest on some basis for an Arab-Soviet coalition (against the U.S. and her interests). As long as Saudi Arabia and Iran remain pro-Western, this is an unlikely possibility, unless they are pushed otherwise. Some informal link may then be desireable in circumstances where the Arabs feel challenged by the U.S. or where the Arabs have an objective against

1 By the media (1975). The chart in Set 2, Sheet 4 does not substantiate this suggestion.

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the Western World which they cannot achieve by acting alone (i.e. not unlike the major price increase during the October, 1973, Arab oil boycott).

Qadhafi of Libya on speaking about the relationship with the industrialized world, has stated[1] that the "nature of our relationship will depend on the international conjuncture." He has suggested the following options are open to the Arabs (against the Western World):

(i) an oil and economic boycott;

(ii) the closure of the Suez Canal; and

(iii) a break in diplomatic relations.

Should an Arab-Soviet coalition occur, it will not necessarily be a stable match. The fluid economic situation in the Western Industrialized World may preclude any further (unilateral) raising of prices by the Arab bloc under the umbrella of U.S.S.R. arms. In the end, it could hurt all the parties. Rising O.P.E.C. prices are directly reflected in the price levels of the Western World as seen, and result in decreasing consumer demand and rising unemployment.

For North America, the worst possibility would be massive unemployment with energy demand falling off to meet available domestic energy supplies. On the outset, this would not appear to be a desireable situation for O.P.E.C., as this would result in a considerable decrease in demand for their petroleum supplies. Their capital on deposit in Western banks and treasuries would be risked and the development plans by countries such as Iran and Egypt would

1 Arab Oil and Gas, published by the Arab Petroleum Research Centre, March 1, 1975, p. 15.

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be in jeopardy due eventually to reduced revenues should a collapse occur and the possible unavailability of capital goods.

Can an Arab-Sovict coalition move to an outcome which they both prefer? It is realistic to suppose that the coalition can be of mutual benefit to both as the Arabs would then have the option of an oil boycott which may be possible only with the aid of Soviet arms. It is in the interest of the U.S.S.R. to supply arms to the Arabs if asked. The funds they receive for the arms can be used to buy industrial "goods". In addition, their leverage with the Arabs can influence U.S. behavior. It has been suggested that the U.S.S.R. may have to balance this advantage against the effect of the rising price levels (in the west) on their growth rate.

What 'reasonable' counter-actions could the U.S. take to deter any Arab-Soviet improvement?

Let us assume that Israel does not deter U.S. actions (i.e. Israel supports U.S. actions or remains a "neutral" observer) at a reasonable accommodation with the Arab World. Recall that Kissinger has warned[1] the Arabs (publically) that the U.S. may consider military action against the Arabs under certain severe economic conditions. At what measure (i.e. 10% unemployment, 15% unemployment, or 20% or worse) will the economic situation be considered severe by U.S. leaders? It is important to note that King Faisal went on record before he died that he did not wish to destroy the Western economies[2].

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1 President Ford reinforced Kissinger's warning.
2 See Business Week, April 7, 1975.

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The U.S. would probably prefer to maintain some military pressure on the Arabs in combination with domestic energy and fiscal programs[1] in order to lower demand and contain prices at some mutually satisfactory level (vis-a-vis the Arab bloc) and fund research and development of alternate sources of energy. A satisfactory price level would have to be sufficient to allow some growth in the industrialized world and encourage the development of alternate sources of energy. This satisfactory price level may vary from country to country. For example, the North Sea oil development may require a $7.00/bbl. floor price whereas the Athabasca Tar Sands development may require a floor price of $9.00 per barrel before taxes (in 1974 dollars).

There is the question of Petro-dollar recycling. On what terms and into what markets[2] are the Arabs willing to agree to? The question becomes quite complex and a World Energy Conference has been called to deal with these questions. The Conference is a further sign that cooperation is imminent.

The supply of arms by the U.S.S.R. to the Arabs would probably not deter the U.S. from a military invasion if it deems one is necessary. Any stronger Arab request for direct military assistance from the U.S.S.R. may result in a big power confrontation. The risk of such an event may not be desireable for the U.S. as direct U.S. military intervention would invite U.S.S.R. military intervention.

World Price Outlook: What should the equilibrium price level for energy be? If there is something more than a severe recession in

1 The 1974 Ford fiscal proposals with regard to crude oil imports were followed by congressional proposals and it was not until May, 1975, that Ford finally announced his second $1/bbl. tax on imported crude oil.

2 Into equity or debt?

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the Western World, current price levels of $10.25 for O.P.E.C. petroleum will not hold up. While difficult, current price levels could be made to work to everyone's benefit. Suitable price levels in the U.S. and Canada would bring on new energy supplies during a long period of price stability. Is this achievable and over what period of time? Evidence was shown that this cycle is like previous historical cycles. Getting sufficient new supplies may be a very difficult and lengthy undertaking.

Because of the steepness of the general price level climb (see Chart 5), the uncertainties in the domestic energy supply situation after 1977, and the considerable lead times required for their development and transport to market, it is difficult to comprehend a smooth transition. The charts and the various factors suggest the following:

(i) Canada could be in a relatively more difficult situation than the U.S. with regard to energy supplies; and

(ii) The present no growth situation in the industrialized world could deteriorate into a severe recession in the late 1970's which would eventually involve O.P.E.C. (and Russia).

Somewhere before this extreme, there is time for international cooperation. Canada for one, needs considerable new capital for energy development. After 1977, when Canada becomes a net importer of petroleum, the Petro-dollar recycling mechanism can be used to advantage to take care of the investment capital needs.

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To lessen the chances of a severe world recession, the price of O.P.E.C. oil should decrease. The energy development trends in Canada will move further into the future (beyond 1980), as the price levels rise. An energy investment requirement of $100 billion in 1974 dollars may very well be $200 billion in 1980 dollars if present inflation trends continue. It is difficult to envision such funds being available from the Canadian economy in those years.

Massive unemployment could cause a break in the general price level. Rising unemployment would prevent the price level from rising as far as present targets (in the early 1980's) suggest. Increased taxation would reduce historic demand and would control price increases, depending on the magnitude of the tax increases. This does not augur well for the future and our historic life style.

Now that the world has come to this point, it is difficult to envision a retraction. In 1969, North America consumed 37% of the world's liquid fuel and 37% of the world's total energy, with 6% of the world's population. Considering the trends (Charts of Sets 1 and 2), it is difficult to envision a continuation of historic trends over the near future(i.e. the next sixteen years). Increased North American energy awareness and the need for reasonable self-sufficiency is not likely to subside in the future.

For Canada, prices based on post-Arab oil boycott price trends of $15.00/bbl. perhaps $20.00/bbl. (depending on the drilling results in the Beaufort Sea over the next 3 years), may be required as a 1985 price target at current royalty and taxation levels in order to develop the tar sands.

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CHART F: Considering the entire free world, the oil demand in 1973 was roughly 48 million barrels per day at then prevailing prices of $2 to $3 per barrel. In 1974 the volume was the same but at an O.P.E.C. host country take of $9 or more per barrel. Based on past trends through 1973, the 1975 demand would have been 56 to 57 million barrels per day at a price of $3 to $5 per barrel. In the post-Arab oil boycott situation at an O.P.E.C. take of $10 per barrel, 1975 demand will likely be not much more than 49 million barrels which is just slightly more than a 2% growth over 1974, or about the same percentage as the free world economic growth over 1974. If the U.S. and some European countries have a zero or negative growth in GNP in 1975, demand will fall below 48 million barrels per day. This is a likely occurance.

What price then will result in a continuing decline in free world economic activity? If one is to consider all the evidence presented in this paper, present O.P.E.C. prices may already be sufficient to push some countries into a period of declining or negative growth. Certainly higher prices would cause an economic decline in a shorter period of time while present O.P.E.C. prices ($10 - $11/bbl.) may take a longer period of time. It depends to a large extent on how much new capital formation is undertaken by the U.S. to maintain present unemployment levels.

The curve shown for O.P.E.C. revenue (in Chart E) shows that O.P.E.C. could reduce their output by 30% and their revenue would be greater than if output was maintained at 1974 levels. It may therefore be in their interest to curtail output (by forcing further increases in their price) for revenue, conser-

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vation and political purposes. While O.P.E.C. may not take this severe step immediately, it would seem that they have the leverage to control their revenues and to maintain a 50 to 70 year reserve life index which they have stated is their goal[1] rather than raise output to drop them to a 20 to 30 year life index[2].

On the other hand, in the earlier description of the political realities, reasons were suggested why none of the players would want a severe recession. The O.P.E.C. bloc, as their responsibility in the world rises and in spite of Israel, would be expected to become less militant. O.P.E.C. itself may eventually not survive a severe decline in free world demand on petroleum. If demand continues to fall, the larger O.P.E.C. members may have to share revenues with the smaller members and/or accept production prorating below production capabilities. Even at today's prices, one or two smaller Arab countries have suffered rather severe cuts in production[3]. If O.P.E.C. receives help in developing their nuclear energy capability, they may be more willing to increase their production to allow western countries to regain a reasonable (i.e. 5%) growth rate.

The results later this year or in early 1976 should provide us with further insight into future price developments if the U.S. can reverse its economic slump (9% unemployment) under current (frozen) O.P.E.C. price levels.

Re-examining the discussions in regard to the international (political/economic) game and the broader forces at work, one can

1 They have stated that they would rather keep their oil in the ground. As alternate sources of energy may be slow in coming to meet historic demand requirements, this goal may be useful to us all in the longer run.
2 The North American reserves life index is less than 10.
3 Abu Dhabi, for example (Wall Street Journal, April 24, 1975, p. 1).

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readily appreciate some rather frightful consequences. There can be no doubt that the Arab World[1] has entered the larger free world orbit in full force and it is reasonable to suppose that nothing short of full cooperation by all parties is necessary to prevent unimaginable economic and military consequences to all the players over the next several years.

While the Western world may be in for an era of low economic growth, the inter-dependence of its members may result in considerable co-operation among its members and thus help preclude a severe economic disaster set off by a disaster to one member. Unfortunately, the alternative to a present day severe recession may be continued severe inflation (beyond 1975).

1 And O.P.E.C. for that matter.

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ANALYSIS OF OPTIONS

The many facets of the energy game (model) have now been discussed, the past (historical) record has been reviewed, and the data trends have been analyzed. As a result thereof, a scenario for the future has been developed (Charts 3 and 7). The next step is to proceed to upgrade or "solve" the energy decision model. Solving the decision model will consist of finding a strategy for action, of which the expected relative value is greater than the expected value of the scenario presented in the previous chapters.

Strategy will now be developed in order to upgrade the (future) energy model for Canada by maximizing the total expected (relative) value of the options available to the decision-maker under presently known factors or constraints. In other words, strategy will be developed to minimize the risk of having insufficient energy supplies available in the future to meet something less than the low growth demand curve in the period analyzed (i.e. the next sixteen years).

While it is acknowledged that other factors such as a major technological break-through or the discovery of a "major" new hydrocarbon bearing area could suddenly come into play, the strategy proposed will not take these into consideration and will not rely on these assumptions because the risk to the economy would be too considerable should these major presumptions not materialize. As hydrocarbon resources become depleted, greater and greater emphasis

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will be placed on research and development for new energy sources. While this research and development will most certainly result in new breakthroughs, the timing of these breakthroughs is an unknown entity, and in any event, should they materialize, considerable lead time may be necessary to impliment them.

The strategy proposed, therefore, is based on developing trends, on known reserves, and on the basis of reasonably known economic, financial, and technical factors and constraints as discussed in the earlier chapters.

Before proceeding, it is worthwhile to note that human behavior enters the decision-making process to a considerable degree. This factor may provide a varied influence to the final solution. Without quantifying the impact, some of the 'human' considerations[1] which tend to influence the final result in the decision-making process may be as follows:

(i) individuals from more than one organization may be involved in the decision-making process;

(ii) individuals within the various hierarchies of the decision-making process may submit inputs influenced by their own values, goals, interests, prejudices, experience, knowledge and managerial style;

(iii) action undertaken may vary between individuals under the existence of unrealistic goals or objectives;

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1 - These human considerations are in addition to the political (i.e. lobbying) factors discussed in an earlier chapter.

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(iv) in the evaluation of future implications of an action taken at an early decision mode, results can vary from one decision-maker to another as uncertainty rises, the further into the future the evaluation is; and

(v) the motives or aspirations of a decision-maker may not be held mutually exclusive from a decision or action taken in his official role capacity (for example, personal goals or aspirations may have an influence on the decision taken).

Hopefully, these human factors are eliminated in any undertaking though a certain point of view may surface. The decision-maker is after all, a manager who decides from among alternative choices. He decides which choices he believes will lead to the desired objectives. While each decision-maker has his own style and his own criteria for making judgments, it is the purpose here to focus on pragmatic realities and to utilize these in formulating a strategy for action which, hopefully, will materialize in timely and beneficial results.

The goal of an action is seldom if ever unitary, rather it consists of a whole set of constraints which the action must satisfy. The provisions in the Constitution, particularly those centering on Section 109 with regard to "all Lands, Mines, Minerals, and Royalties belonging to the several Provinces of Canada, etc., and all sums then due or payable for such Lands, Mines, Minerals, or Royalties shall belong to the several Provinces, etc.," present such a constraint on action, should action be (required) in the

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national interest and be of national importance. It was shown that there can be a considerable difference between the interest of a province and that of Canada as a whole[1]. Hopefully in the wisdom of the decision-maker(s)[2], the constraints have been considered and weighed in light of both provincial and national implications. If they have not, history will not judge us kindly as a nation[3]. There are always several ways in achieving a required result. One or the other may be sufficient to satisfy many of the individual requirements if not all.

In the course of this paper, the energy game was dissected and viewed in its respective arena, such as the domestic arena, the Canada-U.S. arena, and the international arena. The factors and constraints involved in each arena were identified and considered. By so doing, the overall forces at work on the domestic situation are assessed and taken into account.

The economic-political game being played in the international arena is a rather dangerous game, the results of which are far from being certain. Because two of the three primary (and representative) players (i.e. the U.S. and the U.S.S.R.) have a nuclear capability, it is difficult to envision anything short of cooperation between the U.S. and O.P.E.C. to achieve mutually beneficial economic and political results suitable to both. Without cooperation, a political conflict may errupt (again) involving Israel. On the

1 Canada is comprised of the several provinces and territories.
2 For example, the First Ministers.
3 Refer, for example, to Frederick P. Varcoe, "Legislative Power in Canada", p. 13, beginning with "if Canada was to take its place in the international field as a full-fledged nation, etc."

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other hand, the military stalemate between the U.S. and the U.S.S.R. will probably allow economic and monetary forces to take their natural course. In a military stalemate, the international political games merely reflect incremental steps in the process of world economic and monetary evolution.

There is increasing evidence that the Free World petroleum consumption has been flat at best or has declined in the past two years for the first time since the Second World War. While the O.P.E.C. price has been "frozen" until September, 1975, primarily because of the position taken by Saudi Arabia, it is unlikely that O.P.E.C.[1] will reduce its prices even with falling demand for its petroleum because of rising U.S. inflation and the deteriorating purchasing power of the U.S. dollar. Eventually, however, the U.S. monetary situation (increasing inflation) may cause the entire process to come to a halt. It is difficult to envisage O.P.E.C. selling its product for any value below relative North American values (in present day dollars).

As inflation rises in North America (Chart 5), the increasingly large funds required for investment in new facilities may cause a postponement or even an abandonment[2] in the timely development of new energy sources, particularly as the governments take an increasing share out of the energy exploration and development streams and divert this money into services and investments other than energy.

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1 O.P.E.C. may have to prorate production among its members on the basis of some revenue formula in order to survive a considerable decrease in demand for its petroleum.

2 The Syncrude Tar Sands Project was a case in point. It was rescued financially by the Alberta, Ontario and Canadian Governments.

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The inflation factor, the supply trend of existing resources of oil and gas, and the "success" trend in developing new energy supplies (to date) when taken together, suggest that Canada may have some difficulty in achieving even the 'low growth demand' curve.[1]

Because the world economic situation is difficult, the demand for natural gas in Canada may not follow the longer term growth patterns of Chart 3(g). On the short term, however, the domestic requirement problem is imminent. Without a reduction in gas exports, little or no new gas is expected to be available for the domestic consumer until after 1982 or beyond (Chart 3(g)) or until such time as new supply sources come on stream. If natural gas is considered in the context of total energy (see Chart 7) the entire natural gas export commitments will have to be curtailed in order for supplies to meet the low growth demand curve.

Because of the declining trends in oil and gas reserves additions since the 1960's (see Charts 1 and 2), historical per capita energy requirements in Canada may have to remain unsatisfied for some time unless the National Energy Board rules that the domestic consumer has priority use over the export consumer (market). With the production decline in some northeast B.C. fields, exports to the U.S. have already been reduced by the amount of field production decline (see Table I).

In order to continue with the natural gas export commitments to the U.S., a massive coal (i.e. to provide solid and gaseous fuels) development program would have to be implimented almost immediately. The four or five year lead times required to place

1 The 'low growth demand' curve according to E.M.R.'s, An Energy Policy for Canada - Phase I.

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a new mine into production and build the auxiliary transport facilities may preclude this plan. Nevertheless, some combination of export reduction, coal development, and reduced demand (i.e. conservation) may provide a partial but alternative approach. Exports can be reduced by 1/3 to pre-1969 levels on the basis of end-use control and class of market (i.e. interruptible gas). It may be 'morally painful' to reduce exports beyond this level, having committed them in the first place. If timely frontier gas does not become available it may well be that LPG's[1] and NGL's[2] are eventually reduced as well. (See Supply-demand Charts of Set 1).

Alberta (and Saskatchewan) may have little or no interest in a massive coal development plan, particularly as it consumes only ten percent of its total natural gas production. Alberta has formulated a plan of industrial diversification and has encouraged petrochemical development in the province. Of course, as long as industrial development does not duplicate existing facilities elsewhere, industrial development should not be a detriment[3] to the country in the event of a serious economic slowdown. The lack of encouragement for coal development as an energy source, whether as a solid fuel or as coal gasification, will not preclude development eventually as the demand for coal will probably respond to natural economic forces. Should natural gas exports be maintained, the problem then is in the speed of development required and the related availability of huge investment funds (which the provinces are presently taking out and diverting elsewhere).

1 Liquified petroleum gas.
2 Natural gas liquids.
3 If it results in over-capacity.

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The reasons for recommending a coal development plan are as follows:

(i) Coal reserves[1] are a reasonably known entity. It is essentially a matter of financing and development;

(ii) To minimize the risk of having inadequate domestic energy supplies, solid fuels should be made available, particularly to industry;

(iii) Coal gas would be required to maintain pipeline viability in the event frontier gas supplies are not available on a timely basis; and

(iv) To maintain as much of the gas export commitments as possible.

By 1977, Canada will become a net importer of oil. This will make it impossible to continue the present financial transaction whereby the wellhead crude oil price is maintained at $6.50 per barrel[2] east and west of the Ottawa Valley oil policy line. The oil "subsidy" will cease and the price will rise the rest of the way to the world price whatever it is at the time. If the O.P.E.C. price is lower, then development of the tar sands and Beaufort Sea may require some form of tariff protection in order to encourage their development.

Because of the rising net crude imports after 1977, Canada should have increasing access to Petro-dollars for energy investment purposes after 1977.

MAP 4: Timely development of our 'best bet' energy options (Map 4) may not be possible to meet the low growth demand (Charts 7 to 9).

1 It is noteworthy that Canada's estimated all coal reserves are 0.9% of the world's total while U.S. coal reserves comprise 22.9% and the U.S.S.R.'s comprise 61.8% of the world total (per the 1973 Keystone Coal Industry Manual; Mineral Resources and the Economy of the U.S.S.R., A. Sutulov).

2 Or some large amount later in 1975.

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Various reasons may prevent timely development including the financial climate, slow reserves development, and/or physical and material limitations. In order to minimize the risk of this occurance, a massive coal development program should be undertaken in conjunction with a government program of research and development (i.e. in hydraulic mining, etc.).

To further reduce the risk of inadequate energy supplies in the future period, consideration should be given to building[1] a pipeline into one of the 'best bet' areas now, rather than at such time as the threshold reserves are reached before proceeding. Trends are available with which to evaluate the 'best bet' areas. Expertise from the likes of J.C. Sproule & Associates may be helpful in making such an evaluation if it is necessary in the national interest.

Coal, oil and gas supplies[2] could be made available from a programmed curtailment of exports to Japan and the U.S. should new energy "options" fail to reach timely development. The following tabulation represents a ranking of the 'best bet' hydrocarbon supply "options" (Maps 3 and 4), in the order of proven reserves potential, certainty of supply and timely importance:

(1) Coal, (solid fuel and coal gas)(i.e. Western Canada and the Maritime Provinces):

(2) The Athabasca Tar Sands (i.e. the Syncrude Project);

(3) The Arctic Islands (i.e. The Polar Gas Project)[3];

(4) The Beaufort Sea (i.e. oil and gas);

1 This may require government assistance.
2 Including LPG and NGL feedstocks that could be made available for synthetic natural gas plants.
3 As a natural gas pipeline project on the basis of threshold reserves of 25 Tcf or as a liquefied natural gas (LNG) project on the basis of a reduced threshold.

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(5) The Mackenzie Delta[1] (with Prudhoe Bay gas, it is called the Gas Arctic Project), and

(6) The Labrador offshore (i.e. oil and gas).

The Labrador offshore option may be the best of the 'best bet' areas on the basis of present geological knowledge and because of its proximity to Eastern Canada where the supplies will be required most. However, the Labrador offshore area may be the most difficult area to exploit because of immense technological requirements that will be required to surmount the 'iceberg alley' and ocean bottom ice scouring.

In the event that the El Paso natural gas line through Alaska is approved instead of the Gas Arctic Project through Canada and the U.S., the Mackenzie Delta proven reserves, based on present trends, may be insufficient for timely development to meet Canadian requirements. The Beaufort Sea may yield some gas reserves in the future and, in combination with the Mackenzie Valley, may eventually provide a sufficient threshold for a transmission line servicing Canada alone. A trade-off between present lower cost natural gas exports and the higher cost Mackenzie Valley gas with the U.S. in the event that the El Paso line should be approved, is not a good option since the Mackenzie Valley gas potentially represents one of two natural gas "choices" available to Canada in addition to the "curtailment" option (by 1982). A considerable change in the economic situation in Canada may be the only factor that could change the demand to accommodate this trade-off in the longer term (beyond 1980).

1 Because of the influence of the multi-national corporations on the model presented in Chart A, options (4) and (5) when taken together with the Prudhoe Bay gas may gain exploitation approval before option (3). The combination depends primarily on U.S. preference and self-interest on the means of exploiting Prudhoe Bay gas (i.e. LNG or pipeline natural gas).

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The domestic coal development program would require timely Provincial support. As provincial interests may not be the same as the federal interests, this support may not be available. Per capita consumption of coal is higher in the U.S. than in Canada, so Canada would be operating from a lower base of operations. In addition, the U.S. government has dedicated considerable money[1] for research and development into coal and coal mining methods (i.e. hydraulic mining).

A target for domestic coal consumption could be set at 1 quadrillion (10^{15}) Btu's per year by the year 1985. This is a large amount and it may be physically unattainable even if investment funds were available. It is mentioned however, because it is the amount that would be required to allow current gas exports to continue under the low growth demand forecasts.

At the present rate of tar sands development, it is doubtful whether the Montreal line (250 MB/D) can be filled[2] when it is scheduled to come on stream, particularly in the early 1980's (unless a program of rationing[3] west of the Ottawa Valley line is undertaken). Should the Beaufort Sea potential materialize into a viable oil pipeline project with minimal tar sands development (as shown on Chart 3(b)), it may be needed for the market west of the Ottawa Valley for a time. The scenario suggested on Chart 3(b) may be helpful in assessing the timing of the Montreal line project. Of course, various other scenarios can be designed as the state of knowledge progresses.

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1 An estimated $14 billion.
2 See Chart 3(b). As stated earlier, a case can probably be made for a reversible line.
3 By the Energy Supplies Allocation Board (i.e. ESAB).

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If Canada should allow a large portion of the natural gas exports to continue, the revenues derived for these will have to be sufficient to pay for the cost of imports to displace[1] the supplies exported. On such a parity price basis, it may be feasible to import oil for some uses that would have required the natural gas otherwise as long as the Canadian transmission companies can maintain deliverability[2].

The long lead times (i.e., 9-10 years) required for nuclear development (and to a lesser extent, hydro) make it highly unlikely that the demand portion served by hydro and nuclear can be increased by 1985. The demand served by hydro and nuclear is doubling every 9-10 years. A reduction in lead times from 6-7 years may eventually be feasible and could increase the projected demand portion.

An intimate familiarization with the construction of Charts 7, 3(b), and 8, can be helpful in understanding the developing energy situation. Variations to these charts may be possible depending on how fast projects proceed to completion, how additions to proven reserves proceed in the frontier areas, and how the developing international monetary situation is resolved. To recap, it is important to understand the elements that have gone into the construction of these charts (Charts 7 to 9). These are as follows:

(i) nuclear and hydro supply is as projected by EMR. Because of the long lead times, these projections have been left intact. Beyond 1985 nuclear is a 'best' option.

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1 On the basis of a Btu heat content, burning efficiency trade-off.
2 Until pipeline throughput begins dropping off due to a lack of sufficient gas supplies.

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(ii) the natural gas supply block (Chart 7) includes the projected supplies from Western Canadian sources, future pipeline projects (such as the Foothills line and the Polar gas line), and the total of the natural gas exports to the U.S. If any one of these supply elements are removed, for example, if natural gas exports to the U.S. are continued in total, then the total projected supply as represented (Chart 7), will have to be reduced by the amount of the particular supply element and the low growth demand reduced accordingly (unless the supply element is replaced by an alternative supply as has been done in Chart 8 where "coal" displaced the natural gas export supply element in order to continue same).

(iii) the petroleum supply block was constructed to reflect N.E.B. demand projections. Possible supply elements that may be available to fill this demand on the basis of present construction trends, reserve possibilities (i.e. The Beaufort Sea Project), and the monetary situation, were superimposed in order to get a reading on 'what is likely'.

Taking into account the construction of these charts (Chart 7), it can be said that, on the basis of total energy and the low growth demand curves (a population of 29 million people by the year 2000), the natural gas exports will have to be eliminated in total starting in the year 1977 unless the demand for this supply is reduced or

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satisfied by other energy "options" such as coal, or imports in addition to those shown as minimum net imports. The cumulative cost of these imports in 1974 dollars is shown on Chart 6.

Other energy options will certainly be available to meet the demand in future years (beyond the year 1990). While it is unlikely that these will make a significant contribution to the supply situation in the period studied, development of these will be well under way before the end of the century. Some of the 'future' options suitable for the different regions of Canada include solar energy, wind energy, tidal power, geothermal energy (power), non-tar sands synthetic oil, biomass, and eventually hydrogen (probably the most important "option" towards the year 2000 when considered with nuclear energy). An electric and/or a nuclear powered car and a nuclear furnace (for space heating purposes) may be viable beyond the year 1990. A technological breakthrough in storage battery design or alternative means would stimulate electric car development.

In the U.S., solar energy and the heat pump can play a rather large role in filling the energy supply-demand gap in the next sixteen years, particularly in states such as California, Arizona, New Mexico and Florida. In Canada, solar energy may play only a complementary role (i.e. assisting other sources only) for space and water heating as the equipment required may be cumbersome because of the cooler climatic conditions.

It has been the purpose in this paper to identify the major options available for resolving the supply problems in the immediate future, the supply development trends for which are already established.

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Summarizing then, the following should be given consideration in order to minimize the risk of future supply deficiencies on the basis of the low growth demand curve:

(i) A major domestic coal development program should be undertaken. Governments should provide the encouragement, fund the research and development costs, and provide tax write-off incentives in the Income Tax Act for the purpose of easing the cost of equipment changes to handle coal.

(ii) A regulatory decision should be taken with regard to the natural gas export question. If the regulatory body rules that the domestic consumer will receive priority to all the domestic natural gas production, then the extent of the export curtailment will depend on the evolution of several factors including (i) above and a combination of other factors such as conservation measures, the economic situation, and alternate supply choices.

(iii) Due consideration for an early[1] start on a 'best bet' (i.e. Polar Gas or Gas Arctic) energy project[4] in the "public interest" with appropriate assistance[2] from government if necessary.

(iv) A tar sands development corporation[3] for the purpose of soliciting provincial and O.P.E.C. funds.

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1 Immediate or before 1977.
2 Financial and Consultative.
3 An entirely new corporation is envisaged.
4 The author does not intend to suggest that a pipeline is the most economic and physically feasible means to transport energy. An evaluation as to the suitable means of transport is a matter beyond the purpose of this document.

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(v) An energy conference by federal and provincial governments to consider the "total" energy picture and an eventual plan to maximize the cost-benefit effectiveness for all Canada.

(vi) A re-evaluation of Canada's population (trends) to the year 2000 should be undertaken, if the low growth demand curve appears unrealistic in view of the domestic energy supply and monetary situation.

(vii) The federal government should ensure that a sufficient part of the present revenues (from petroleum exports, etc.) are used for investments in energy development to meet future domestic requirements. Any revenue sharing formula should have this element built into it. Of course, this option will have to be consistent with (i) the British North America Act, and (ii) the underlying constitutional intentions envisaged by federal and provincial authorities. Hopefully, the guiding principle for the authorities will be the longer term benefit or "general advantage" of all of Canada. If it is not, then the authorities will have failed to carry out their responsibility for the national good and history will not judge them kindly, even if present day beneficiaries do.

The alternative to success is a painful allocation of available energy supplies.

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IN CLOSING

We have reviewed and discussed the energy game at great length from several aspects, including the domestic, North American, international, the past and the future, and, hopefully, as this research paper is closed out, all of the initial objectives have been met. Much of the material contained in the preceding pages has undergone some critical and expert scrutiny for which the writer is indebted, undoubtedly it should undergo more scrutiny. Perhaps not all of the elements contained in this paper will meet universal agreement but as the energy game is not as yet played out, its greatest critic will be the 'test of time' for which it has no fear.

This has been, in total, a personal exercise and undertaking, enjoyable but often trying as it contains many complex elements encompassing several fields. Perhaps the paper should contain more of a point of view and far more discussion. Perhaps it should try to do a lot more or a lot less. This is a matter of human judgment. The writer is human and should be forgiven any human frailty.

After all, if the next sixteen years are difficult years and are something less than low growth years in man's energy re-orientation towards the twentieth century and the oceans[1], it is often only after great human effort that there is the greatest progress. It has been so throughout history. It has been so even if the change has been violent, and hopefully, the chapter on the international game illustrates that the cooperative solution is

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1 Towards a nuclear/hydrogen economy.

.../134

preferred to the military solution. If a military solution is used, there may be no winners. It is a thin economic line between the two extremes and either option is entirely possible. Economic realities will eventually determine the outcome of the free world economic balance whether or not the military option is used. While some Arab elements and leaders have been and perhaps still are militant, in general the dominant Arab leaders have displayed a great responsibility (i.e. King Faisal and the Shah of Iran).

Where is the eventual economic balance, that is "where is the equilibrium?" There are two price extremes to this question. On the one hand, there is the high price ($10 and up) reflecting high inflation in the Western World, high unemployment, and a decreasing demand for O.P.E.C. oil, and the possibility (i.e. 1979-80) of an eventual price break if demand for oil decreases considerably. On the other hand, the opportunity for high growth in the industrialized world and a relatively low price ($5-6) may now be lost as domestic price levels have surpassed the lower ($4-6) price levels. Domestically, at pre-Arab oil boycott prices, the large North American demand has quickly consumed or is consuming the easily accessible hydrocarbon reserves. As the O.P.E.C. reserves are easily accessible as well, a price of $4-6 per barrel at this time would quite readily allow the current low or negative free world economic growth to expand rapidly. But what happens in 'sixteen years' if the O.P.E.C. reserves are depleted in the process? Will the industrialized world be any more ready to cope or will their economic collapse for the lack of sufficient and timely options be that much more severe?

.../135

These are all-important questions and not without answers. While the scale is much greater in the international game and the players are different, the problems are not unlike those in the domestic situation between the producing and consuming provinces. O.P.E.C. has made and is making its decisions while Canada is equally responsible for hers, past, present and future.

With regard to the rational[1] model for Canada in relation to the U.S., it has been shown that elements related to political behavior, mixed corporate interests, lobbying, and human elements, such as limits to rationality, and inherent concepts such as "unlimited resources" can explain the 'breakdown in rationality' in the decision-making process (i.e. Canada faces the prospect of retracing a previous action and actions on natural gas exports).

The inherent concepts tabled in the introduction and discussed in the body of the paper are "unlimited resources" and "proper accords". It has been shown that the "unlimited resource" concept has little place in the decision-making process and is in fact, a negative factor. While Canada's approach in the matter of "proper accords" in the international forum may be of some considerable use (for example, in formulating the means and rules for Petro-dollar recycling), "proper accords" may not be sufficient in handling future problems facing Canada. The "real approach" as practised in the U.S. (with some recourse to "unlimited resources") may be of more immediate benefit in securing the necessary supplies in the period studied (i.e. the next sixteen years, 1976 - 1989).

1 Optimizing.

.../136

With regard to domestic federal-provincial relations, it has been shown that provincial interests and activities may not be in the eventual national interest even though the constitution may provide some basis for their position on legal grounds depending of course on the legal interpretation by authorities. Federal interests or leadership may require re-direction to help satisfy reasonable provincial grievances. In the end, however, both sides (namely the federal and provincial governments) will have to face the common problem which is the huge energy development and the large capital requirements needed to do the job regardless of who 'owns' the resources. It is in the provincial interest to do so because of the inter-relationships in merchandise trade. Energy is the primary building block required to sustain even industry's existing capacity to allow this trade to continue. O.P.E.C. particularly Saudi Arabia, seems to recognize this problem.

Both sides of the legal question have been shown in the chapter entitled, "The Nature of Canadian Unity". In practice, there has been split jurisdiction over resources and it is not entirely clear from the readings that this was the intent of the constitution. Intent certainly is not clear, and moreso, it is doubtful that the Founding Fathers intended Canada to remain in[1] a provincial mode and not progress consistently towards nationhood. What does 'belonging to'[2] entail? Does it involve total

1. Or revert to occasionally.
2. Per Section 109 of the B.N.A. Act.

.../137

ownership and control or responsible management and a 'beneficial interest'? In the context of nationhood it is difficult to envisage that the Founding Fathers intended the former without some 'limits'[1]. The analysis of past decision-making from the standpoint of provincial, federal, and international viewpoints, clearly shows that, 'might is not necessarily right, eventually'. Even compromise may not be right. National responsibility that some of the Arab countries appear to be moving towards may be more appropriate.

A period of low growth in North America appears to be imminent because of energy supply constraints. In order that life styles are preserved as much as possible, it may be necessary to re-evaluate Canada's population requirements to the year 2000. As immigration[2] not births is now the dominant factor in population, the population trend for Canada is quite flexible.

Political considerations have a considerable bearing on decision-making and the final resolution. In order that the "real approach" prevails, consideration should be given to the institutionalization of Canadian administrative law along American or French lines. While provision for the formalization of dissenting opinions in decisions taken by tribunals may lead to the encouragement of appeal action and may not be desirable by some, it may be helpful with the passage of time, to have provided for a formal staff record in the courts. The latter would enable the state to have recourse if it proves necessary.

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1 See Varcoe, p. 173, and the case, "In re Transfer of Natural Resources to Saskatchewan, (1932) A.C.28".

2 Refer to the article in the April 14, 1975, issue of the Globe and Mail and the statement by Immigration Minister Robert Andras. Most present day population estimates for Canada encorporate a historic annual immigration figure of 100,000.

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It is difficult to envisage why the state should not have this 'recourse' option.

In his work, Economics and Public Purpose, John Kenneth Galbraith in discussing regulatory bodies in the U.S., has stated[1] that:

> "Public regulatory bodies, it has long been observed, tend to become captives of the firms that ostensibly they regulate. This is because the rewards of cooperation between the techno-structure and the regulatory agencies normally outweigh those of conflict. The compliant regulatory body accedes to the needs of the technostructure; the latter supports or in any case, does not oppose, the continued existence and needed budgetary expansion of the regulatory body. The aggressive regulatory authority, by contrast, invites public scrutiny of its needs. And, since its conflict is with the technostructure, it will be widely regarded as being in conflict with sound public policy...Acquiescence, even if it risks criticism for being useless, may be better bureaucratic policy."

If this is a universal law and there is no basis to suggest it is not, then if it is applied to the Canadian spectrum it will reflect all of the dominant elements and interests discussed in this work. This is why it may be important to institutionalize Canadian administrative law along the lines proposed particularly if the national and "public interest" should require policy retraction in the future.

In so far as the national and political process is concerned, it will suffice to say - that the rational process should give man the means to avoid his potential self-extinction. There of course is a difference between what one wishes to believe and what really is. The latter may be difficult to ascertain thus giving rise to the political process. Certainly the two may often not be in tune.

1 J.K. Galbraith, Economics and the Public Purpose, p. 160.

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CALCULATION SHEET

SUBJECT

PROJECT

LOCATION

SUPERSEDED

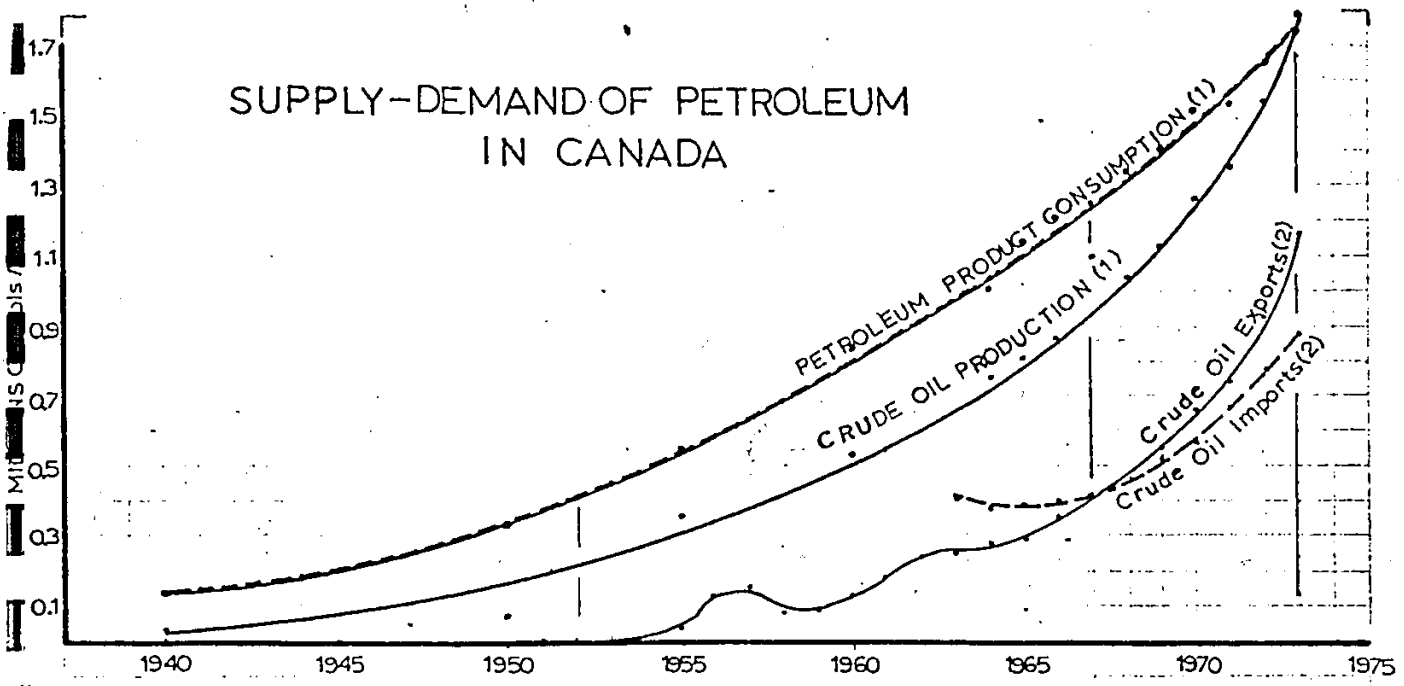
SHEET 1 OF 5 SET 1

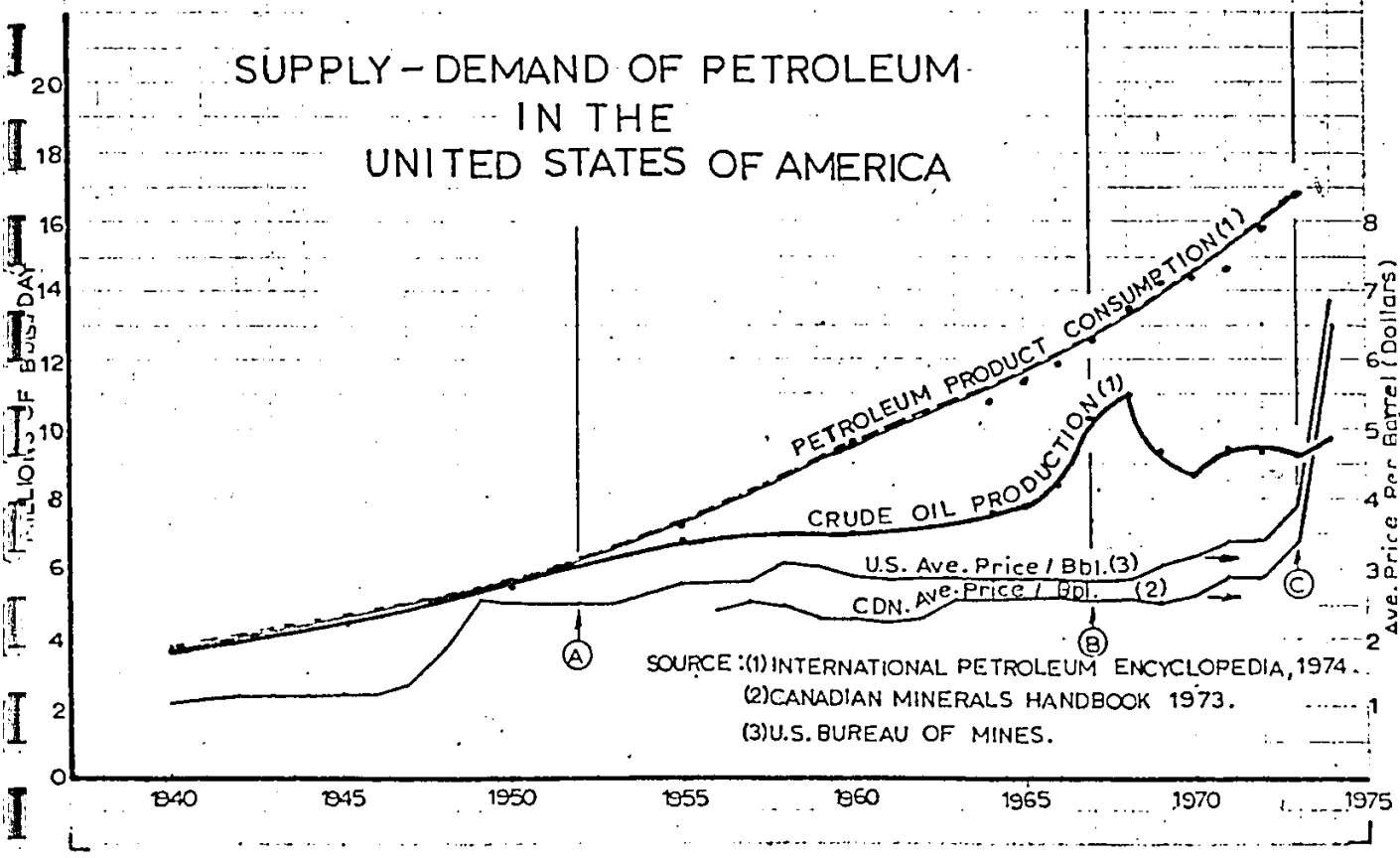
DATE Feb. 1975

BY L. Zarysky

CHECKED

APPROVED





SOURCE: (1) INTERNATIONAL PETROLEUM ENCYCLOPEDIA, 1974.
(2) CANADIAN MINERALS HANDBOOK 1973.
(3) U.S. BUREAU OF MINES.

CALCULATION SHEET

SHEET 2 OF 5 SET 1

DATE Feb., 1975

BY L. Zarysky

CHECKED

APPROVED

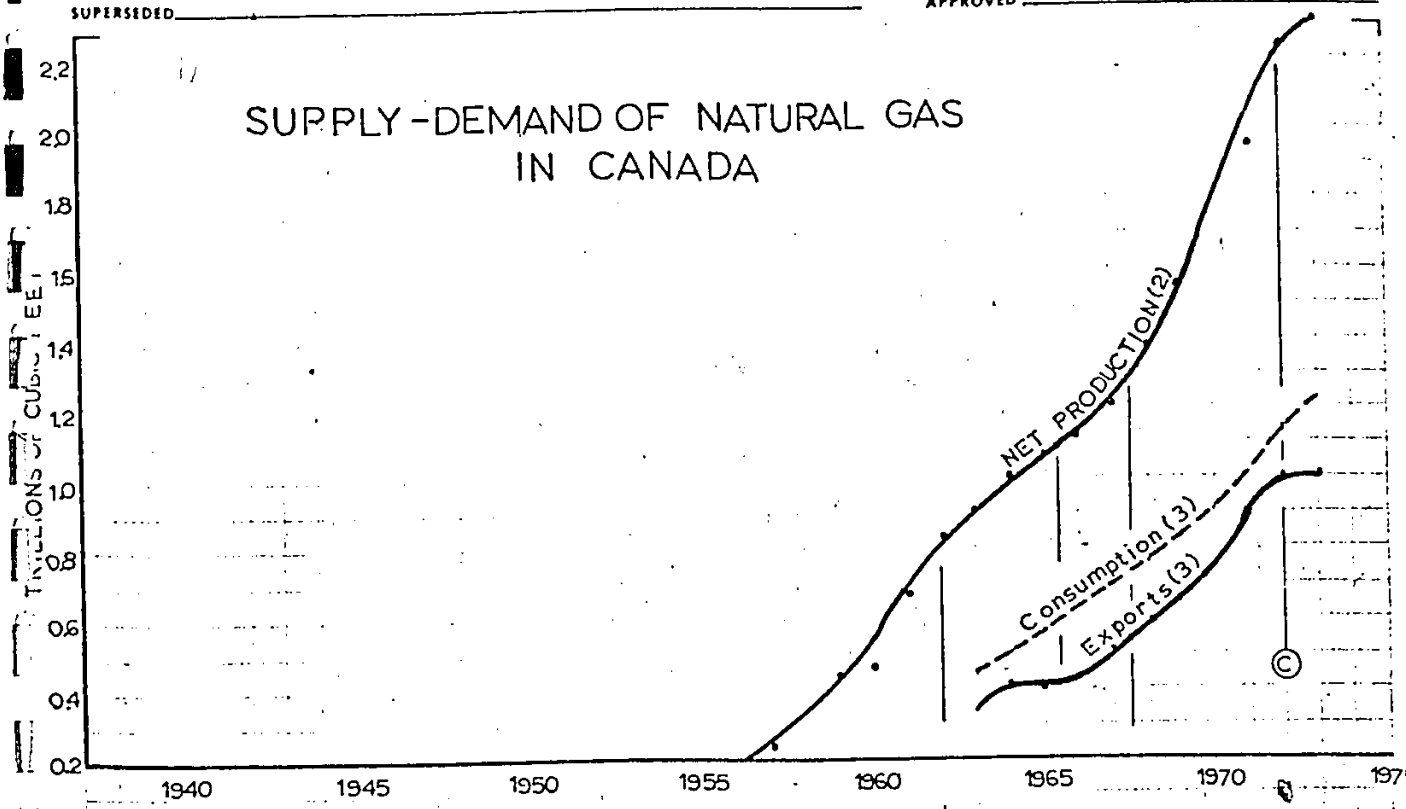
SUBJECT

PROJECT

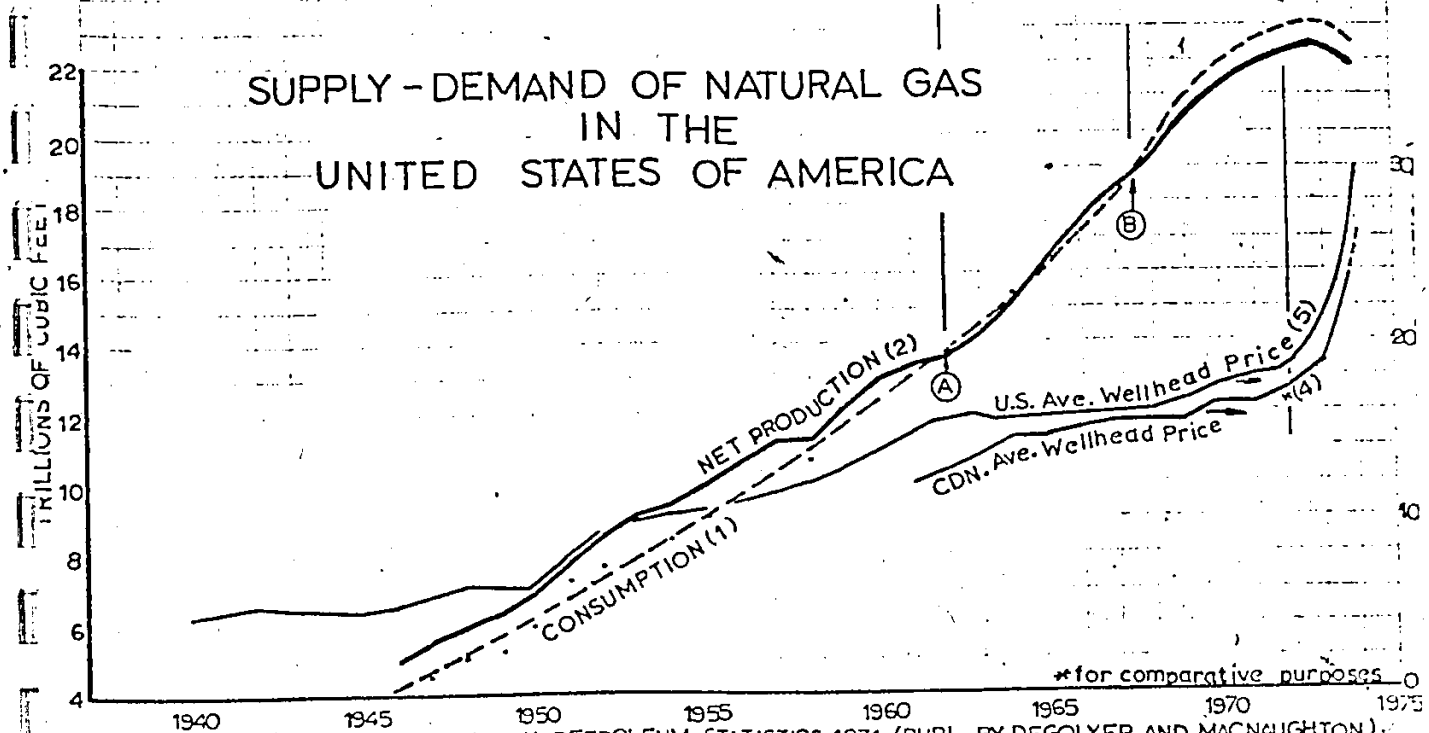
LOCATION

SUPERSEDED

SUPPLY-DEMAND OF NATURAL GAS IN CANADA



SUPPLY-DEMAND OF NATURAL GAS IN THE UNITED STATES OF AMERICA



SOURCE: (1) TWENTIETH CENTURY PETROLEUM STATISTICS, 1974. (PUBL. BY DEGOLYER AND MACNAUGHTON).
(2) A.P.I., A.G.A., AND C.P.A. YEARBOOK AS AT DECEMBER 31, 1973.
(3) CANADIAN MINERALS HAND BOOK, 1973.
(4) STATISTICS CANADA.
(5) US BUREAU OF MINES.

CALCULATION SHEET

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SUPERSEDED

SHEET 3 OF 5 SET 1

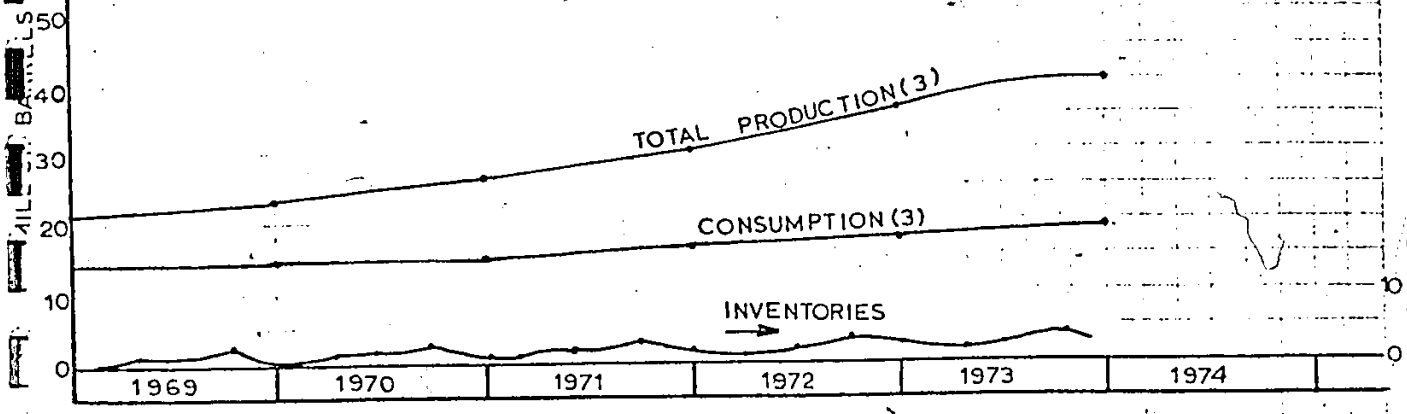
DATE February, 1975

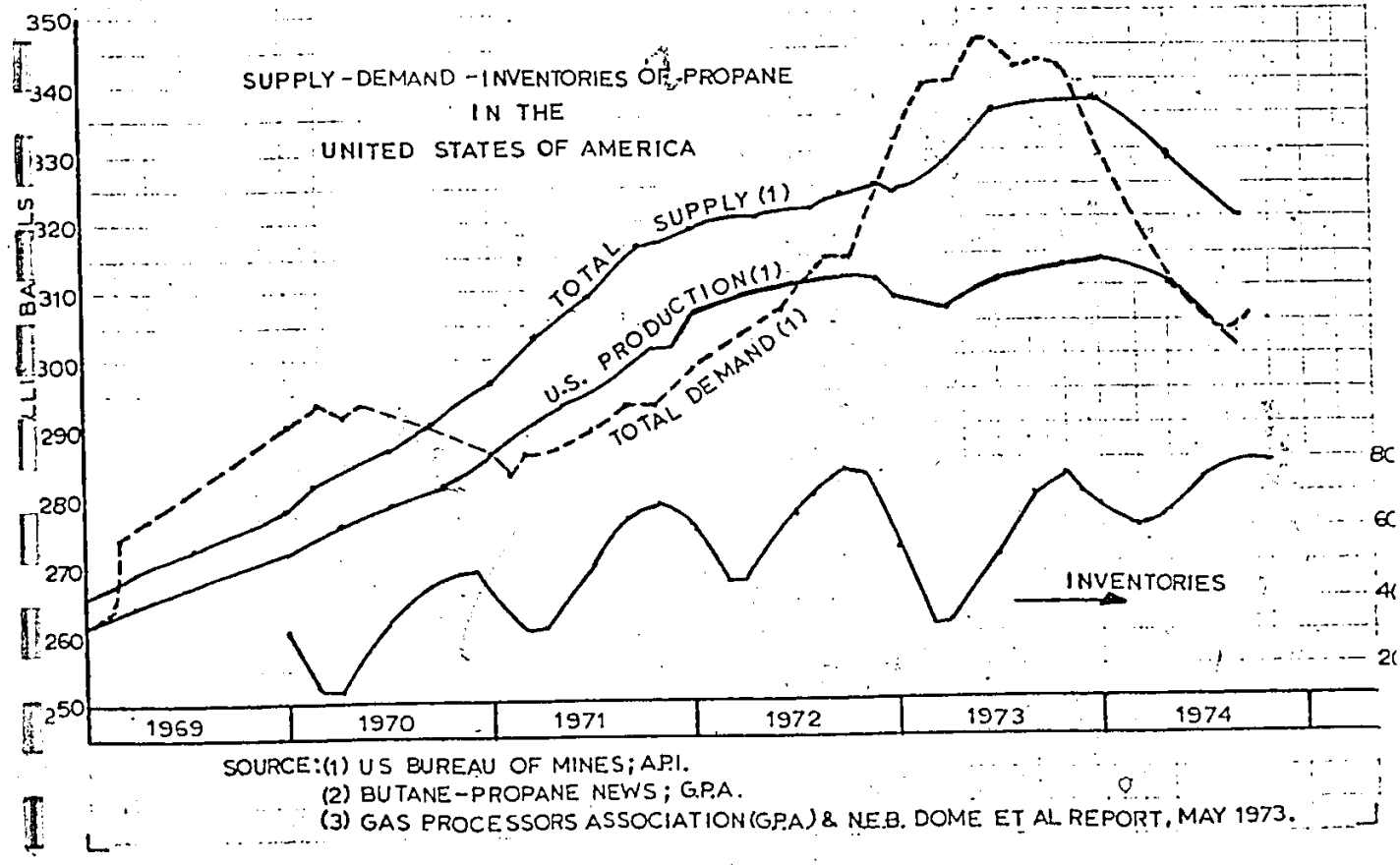
BY L. Zarysky

CHECKED

APPROVED

SUPPLY-DEMAND-INVENTORIES OF PROPANE IN CANADA





SOURCE: (1) US BUREAU OF MINES; API.
(2) BUTANE-PROPANE NEWS; GPA.
(3) GAS PROCESSORS ASSOCIATION (GPA) & N.E.B. DOME ET AL REPORT, MAY 1973.

CALCULATION SHEET

SUBJECT L.P.G. * SUPPLY-DEMAND

PROJECT

LOCATION

SUPERSEDED * PROPANE BUTANE AND PROPANE-BUTANE MIXTURES

SHEET 4 OF 5 SET 1

DATE February, 1975

BY L. Zarysky

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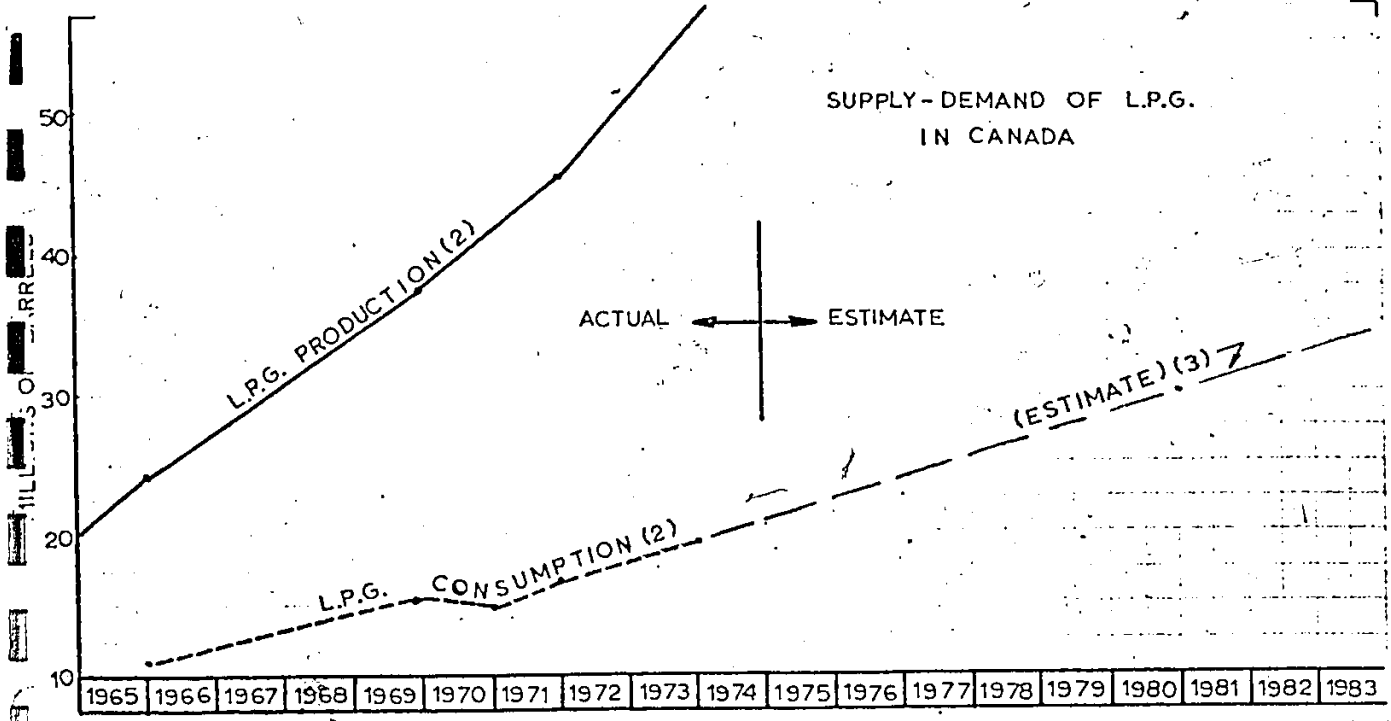
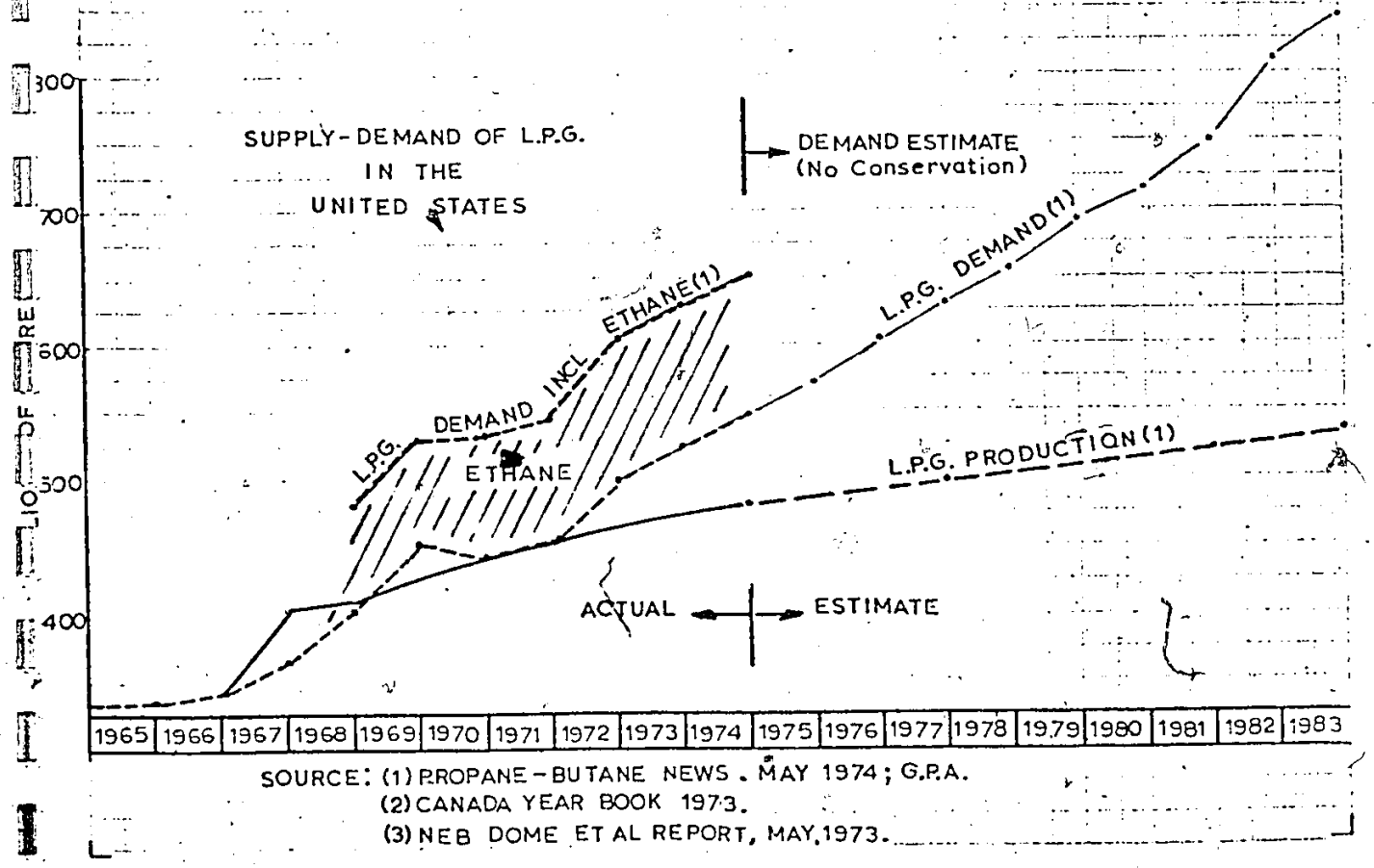
APPROVED





SOURCE: (1) PROPANE-BUTANE NEWS. MAY 1974; G.P.A.
(2) CANADA YEAR BOOK 1973.
(3) NEB DOME ET AL REPORT, MAY, 1973.

SUBJECT COAL SUPPLY-DEMAND, IMPORTS/EXPORTS, and REVENUES

PROJECT

LOCATION

SUPERSEDED

CALCULATION SHEET

SHEET 5 OF 5 SET 1.

DATE February, 1975

BY L. Zarysky

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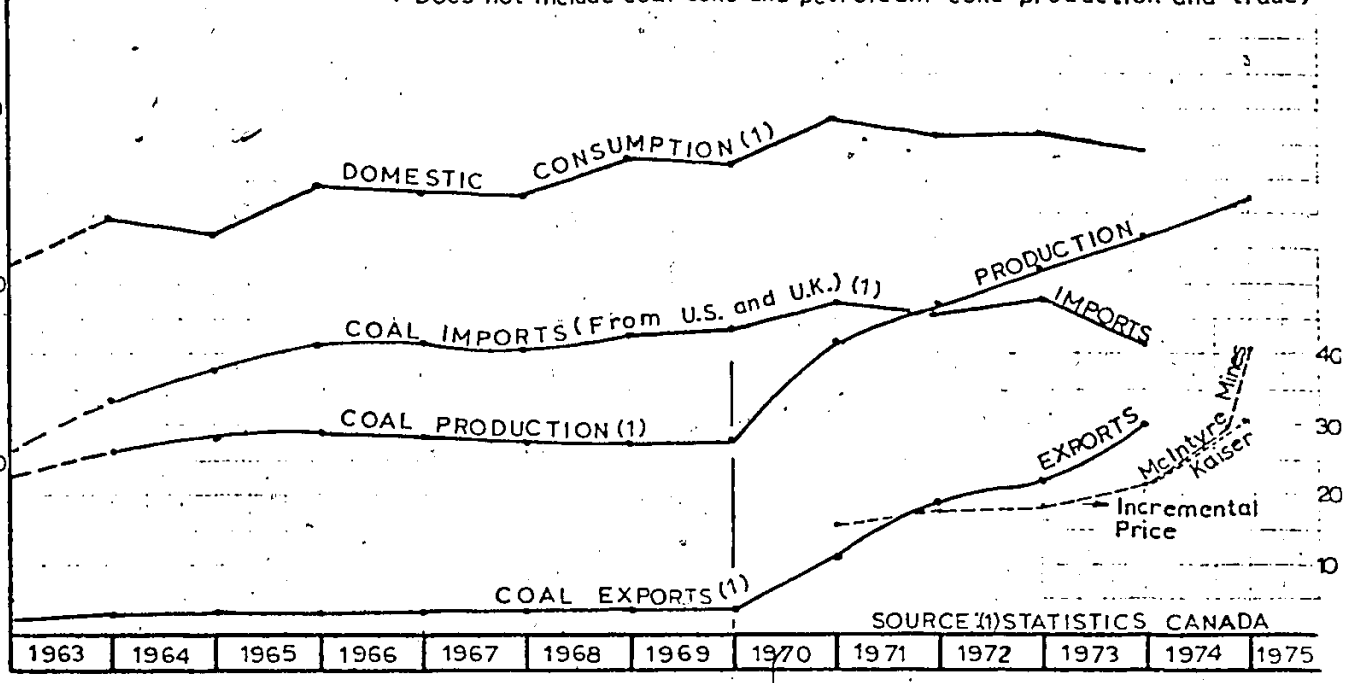
COAL PRODUCTION, DOMESTIC CONSUMPTION, IMPORTS and EXPORTS IN CANADA

(*Does not include coal coke and petroleum coke production and trade)

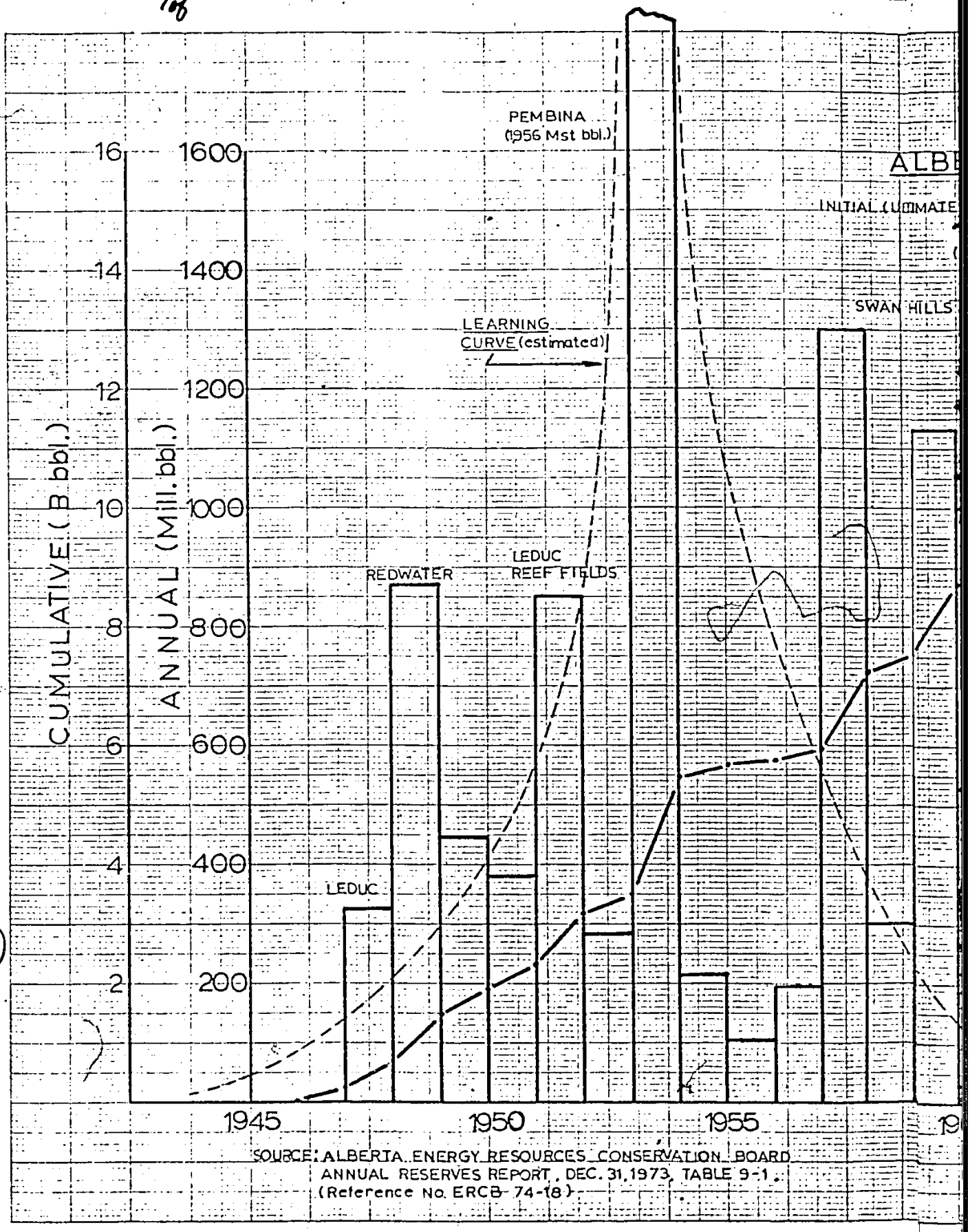


Canada, exports and imports of coal,* 1972-73

	1972		1973P	
	(short tons)	($)	(short tons)	($)
Exports				
Japan	8,322,937	103,835,000	11,712,105	160,046,000
Chile	101,099	1,260,000	114,980	1,369,000
Belgium-Luxembourg	77,827	716,000	–	–
United States	9,940	107,000	184,001	3,241,000
St. Pierre-Miquelon	1,585	35,000	854	19,000
United Kingdom	10	•	11,760	389,000
West Germany	5	•	–	–
Total	8,513,403	105,953,000	12,023,700	165,064,090
Imports (for consumption)				
Anthracite				
United States	379,344	5,945,704	460,599	5,625,000
Bituminous				
United States	18,885,546	172,341,144	16,014,841	160,824,000
Total	19,264,890	178,286,848	16,475,440	166,449,000

Source: Statistics Canada.
P Preliminary – Nil • Less than $1,000.

Source: Canadian Minerals Yearbook, 1973.



SOURCE: ALBERTA ENERGY RESOURCES CONSERVATION BOARD
ANNUAL RESERVES REPORT, DEC. 31, 1973, TABLE 9-1.
(Reference No. ERCB 74-18)

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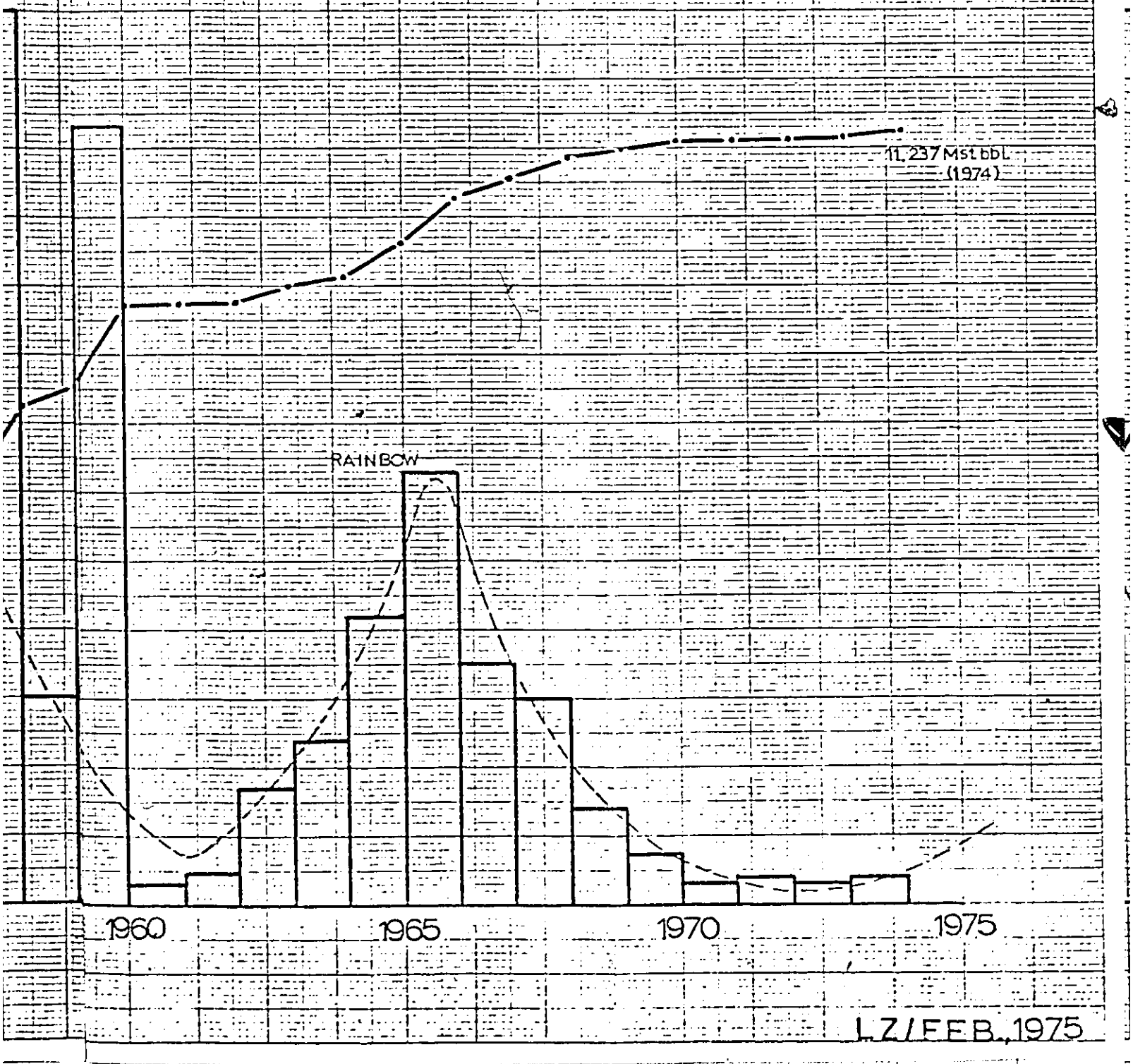
CHART 1

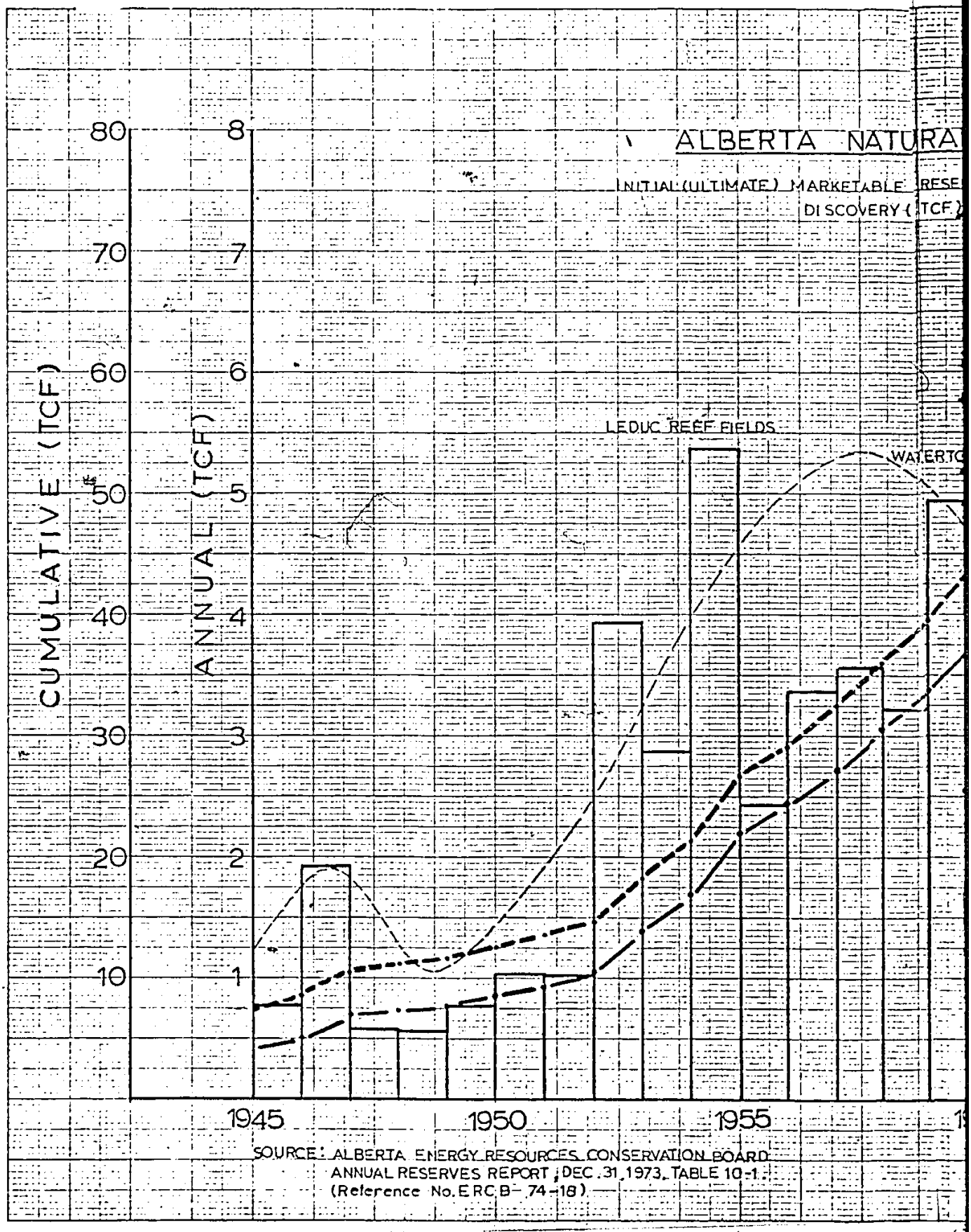
ALBERTA CRUDE OIL

AL (ULTIMATE) RECOVERABLE RESERVES BY YEAR OF DISCOVERY

(B st bbl. & M st bbl)



LZ/FEB., 1975

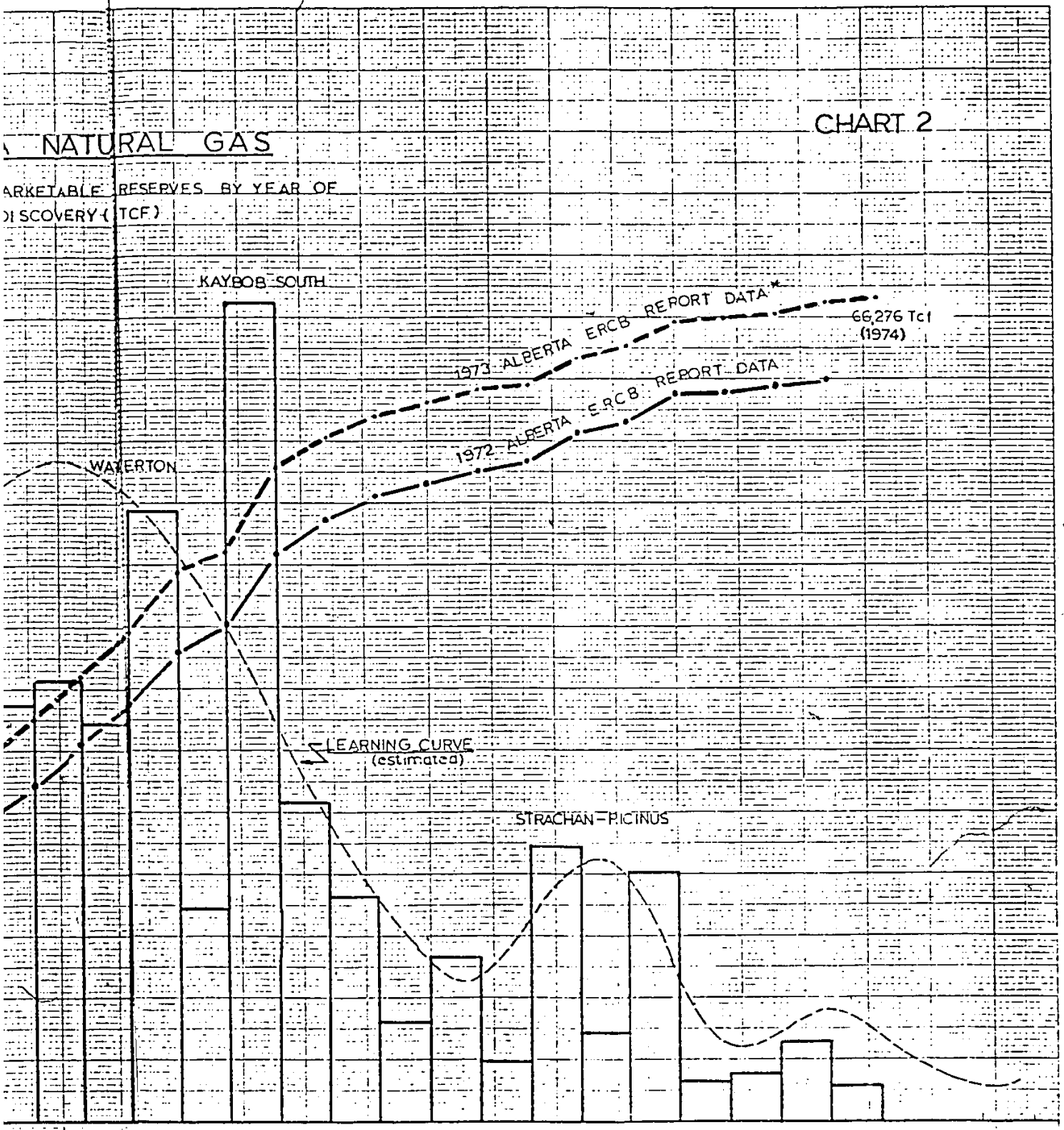


SOURCE: ALBERTA ENERGY RESOURCES CONSERVATION BOARD
ANNUAL RESERVES REPORT, DEC. 31, 1973, TABLE 10-1
(Reference No. ERCB-74-18)

CHART 2

NATURAL GAS

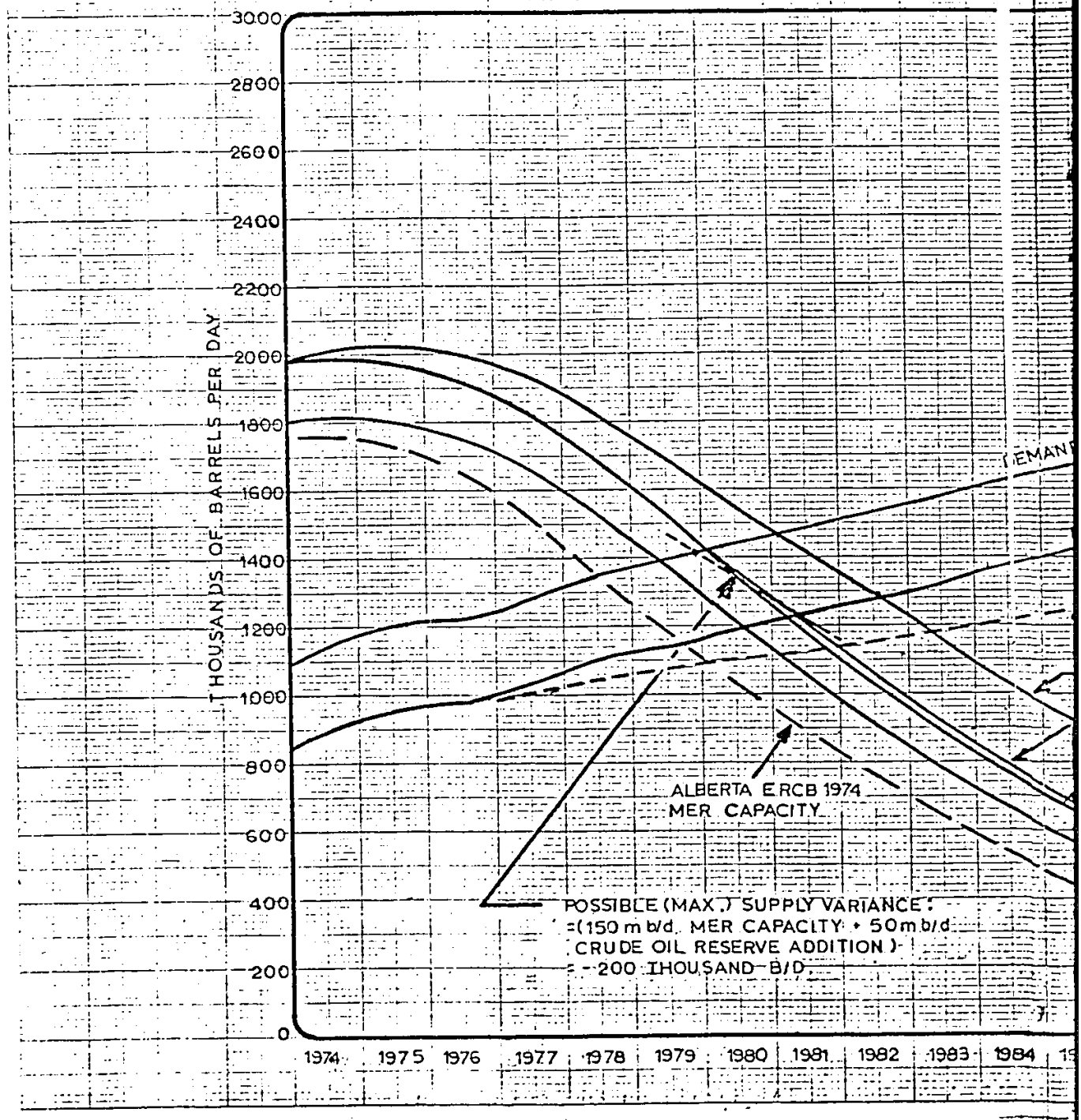
ARKETABLE RESERVES BY YEAR OF
)I SCOVERY (TCF)



* REVALUATION OF RESERVES DUE TO:
(i) addition of Suffield Block (marginal gas), and
(ii) lowering of abandonment pressures as a result of higher wellhead prices.

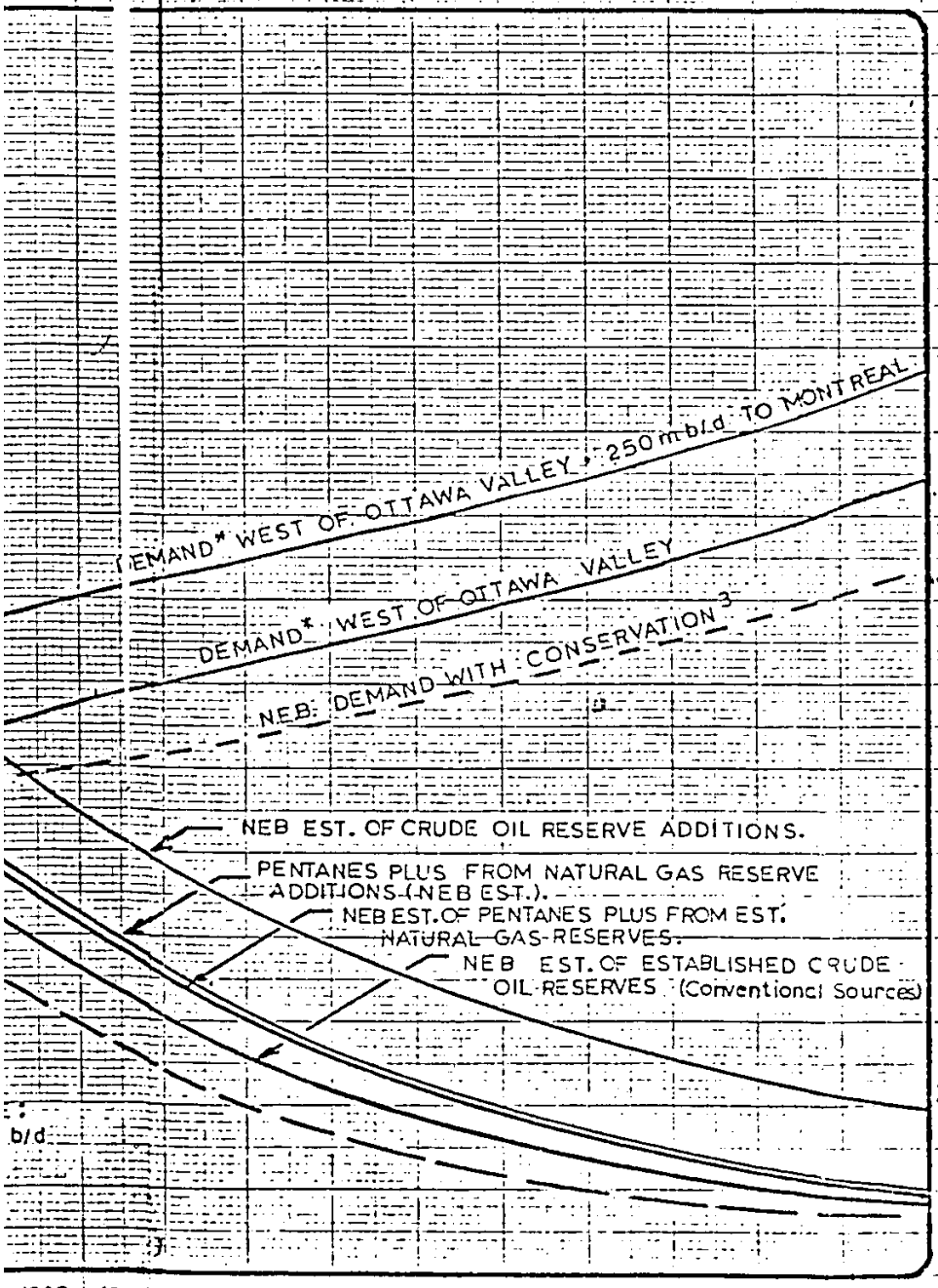
LZ/FEB., 1975

FORECAST OF CANADIAN CRUD
SUPPLY (ESTABLISHED RESERV
FOR INDIGENOUS FE



AN CRUDE OIL AND EQUIVALENT
ED. RESERVES) AND DEMAND[2]
NOUS FEEDSTOCKS

CHART 3



*NEB DOES NOT INCLUDE EFFECT OF CONSERVATION ON CANADIAN CONSUPTION (i.e. DEMAND SHIFT DUE TO MONETARY, PAYMENTS, OR SUPPLY CONSTRAINTS).

Ⓐ Ⓒ

See next (CHART 3c)

SOURCE:

1. NEB OCT. 1974 REPORT: IN THE MATTER OF THE EXPLORATION OF OIL, APPENDIX 2-IV
2. NEB OCT. 1974 REPORT: IN THE MATTER OF THE EXPLORATION OF OIL, APPENDIX 4-I
3. NEB OCT. 1974 REPORT: APPENDIX 4-III (FOR ILLUSTRATIVE PURPOSE)

LZ/FEB. 1975

CALCULATION SHEET

SUBJECT CRUDE OIL SUPPLY-DEMAND SHORTFALL 1979-1993 (IN 100 m Bbl./Day TAR SANDS PLTS. OR EQUIVALENT)

SHEET ____ OF ____ CHART 3a

DATE FEBRUARY 1975

BY L. ZARYSKY

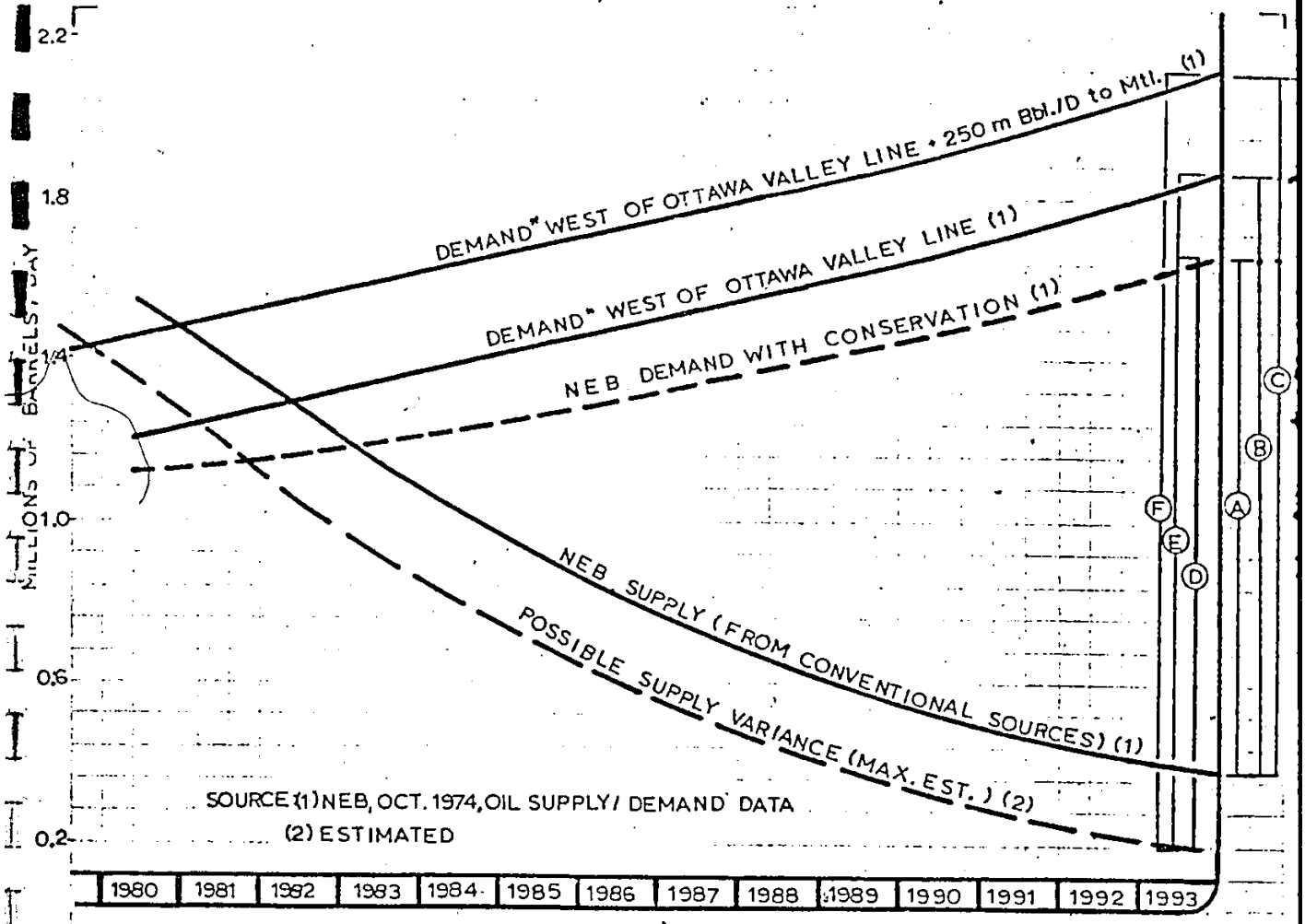
PROJECT

LOCATION

CHECKED

SUPERSEDED

APPROVED



SOURCE (1) NEB, OCT. 1974, OIL SUPPLY/ DEMAND DATA

(2) ESTIMATED

YRLY. SHORTFALL IN EQUIV. 100,000 bbl./d PLANTS UNDER VARIOUS SUPPLY-DEMAND SCENARIOS

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
A	-	-	-	-	(1)	(2)	(4)	(5)	(7)	(8)	(9)	(11)	(12)	(13)
B	-	-	-	1	2.5	4	6	7	9	10	11	13	14	15
C	-	-	1.5	3	5	6	8	9	11	12	14	15.5	17	17
D	-	-	0	2	4	5	7	8	9	10	12	13	14	15
E	-	-	1	3	5	7	9	10	11	12	14	14.5	16	17
F	-	[2]	[4]	[5]	[7.5]	[9]	[11]	[12]	[13]	[14]	[15.5]	[17.5]	[19]	[19]

MINIMUM PLTS. REQ'D (A) ; MAXIMUM = [F]

CALCULATION SHEET

CHART 3b

SUBJECT

PROJECT

LOCATION

SUPERSEDED

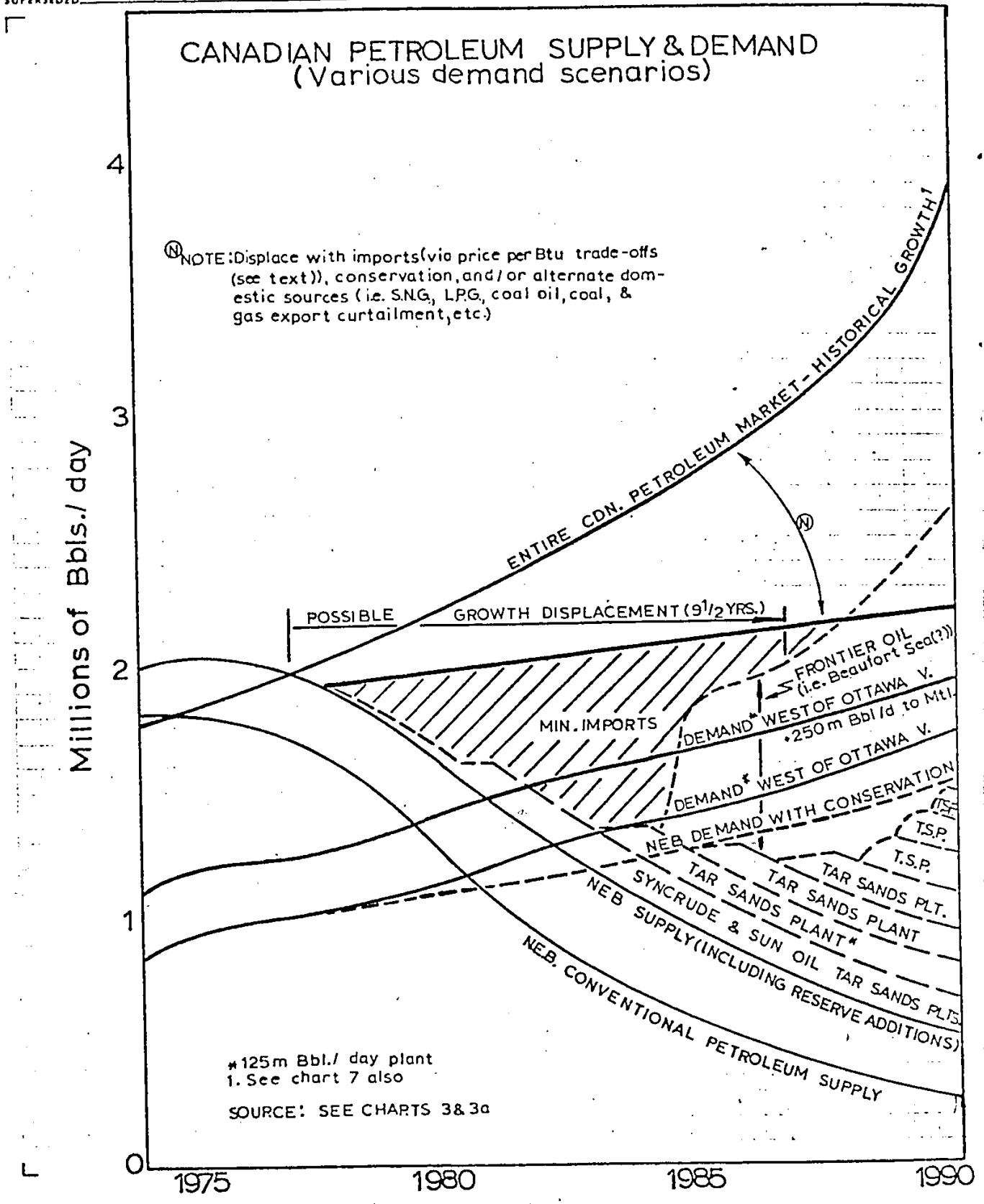
SHEET ___ OF ___

DATE FEBRUARY, 1975

BY L.ZARYSKY

CHECKED

APPROVED



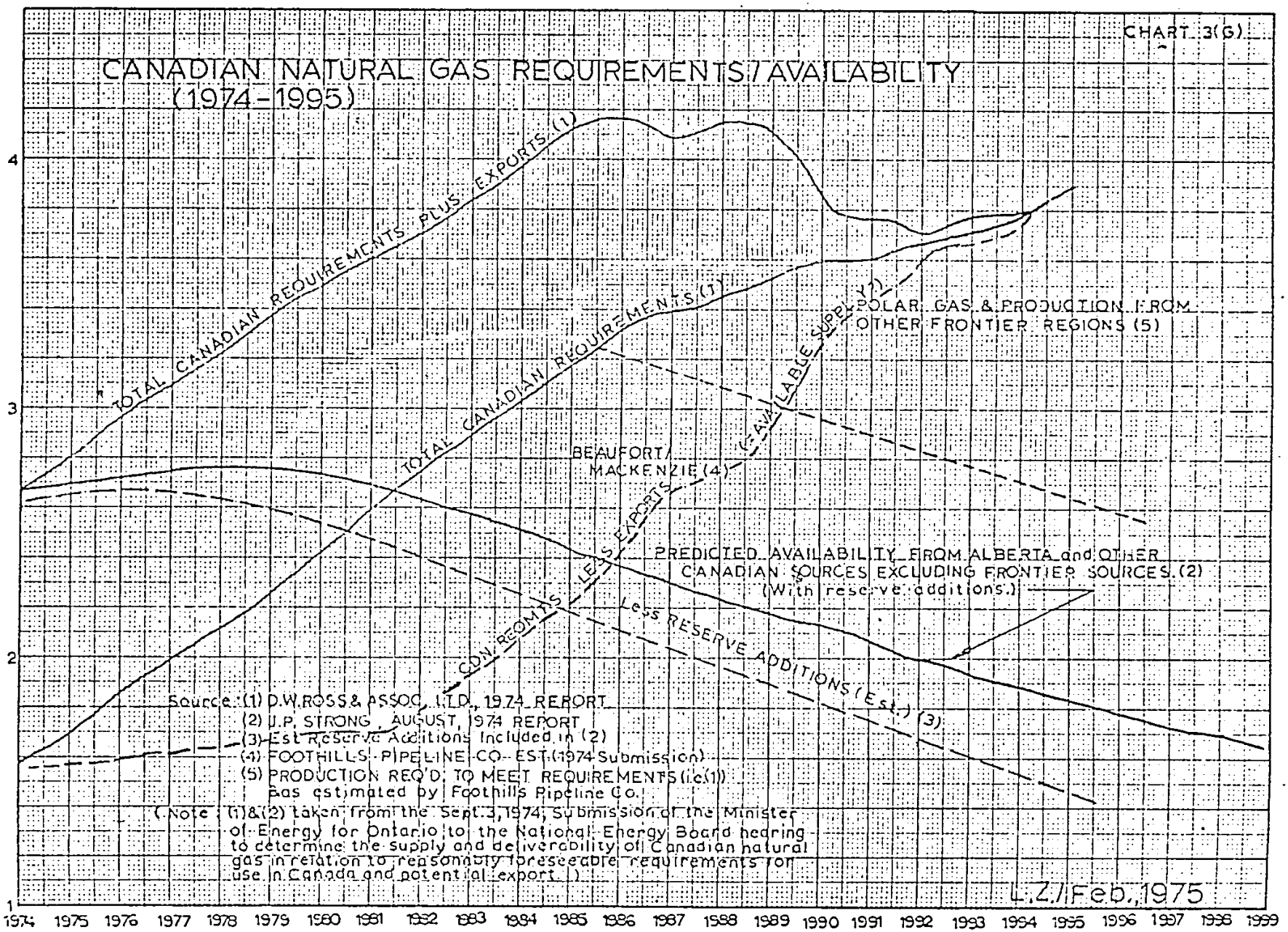
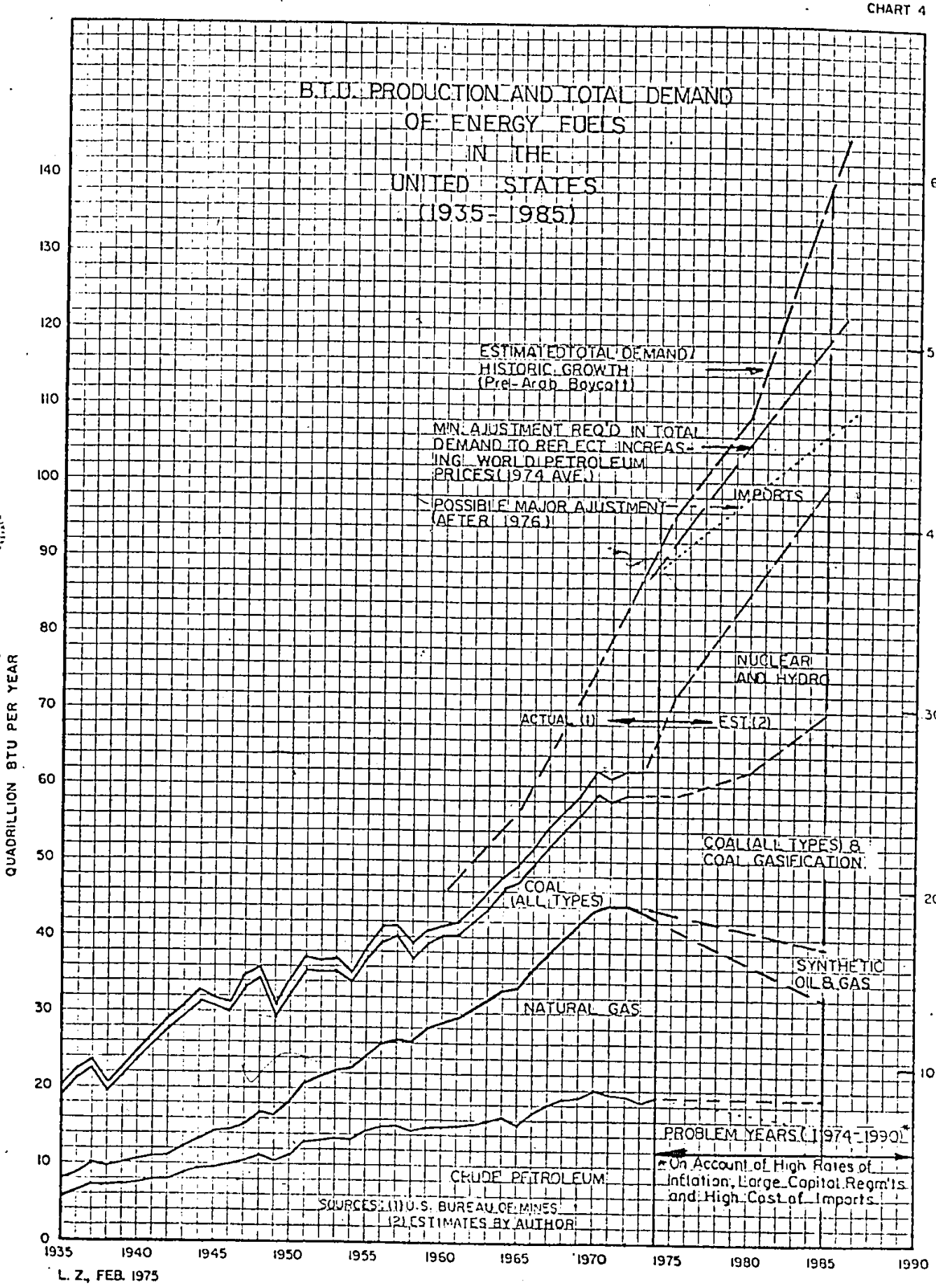


CHART 3(G)
CANADIAN NATURAL GAS REQUIREMENTS/AVAILABILITY
(1974-1995)
TRILLIONS OF CUBIC FEET
TOTAL CANADIAN REQUIREMENTS PLUS EXPORTS (1)
TOTAL CANADIAN REQUIREMENTS (1)
BEAUFORT/MACKENZIE (4)
POLAR GAS & PRODUCTION FROM OTHER FRONTIER REGIONS (5)
PREDICTED AVAILABILITY FROM ALBERTA and OTHER CANADIAN SOURCES EXCLUDING FRONTIER SOURCES. (2)
(With reserve additions.)
CDN. REQMTS. LESS EXPORTS
Less RESERVE ADDITIONS (Est.) (3)
Source: (1) D.W. ROSS & ASSOC. LTD., 1974 REPORT
(2) J.P. STRONG, AUGUST, 1974 REPORT
(3) Est Reserve Additions Included in (2)
(4) FOOTHILLS PIPELINE CO. EST. (1974 Submission)
(5) PRODUCTION REQ'D TO MEET REQUIREMENTS (i.e. (1)) Gas estimated by Foothills Pipeline Co.
(Note: (1) & (2) taken from the Sept. 3, 1974, Submission of the Minister of Energy for Ontario to the National Energy Board hearing to determine the supply and deliverability of Canadian natural gas in relation to reasonably foreseeable requirements for use in Canada and potential export.)
L.Z./Feb., 1975
1
2
3
4
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999

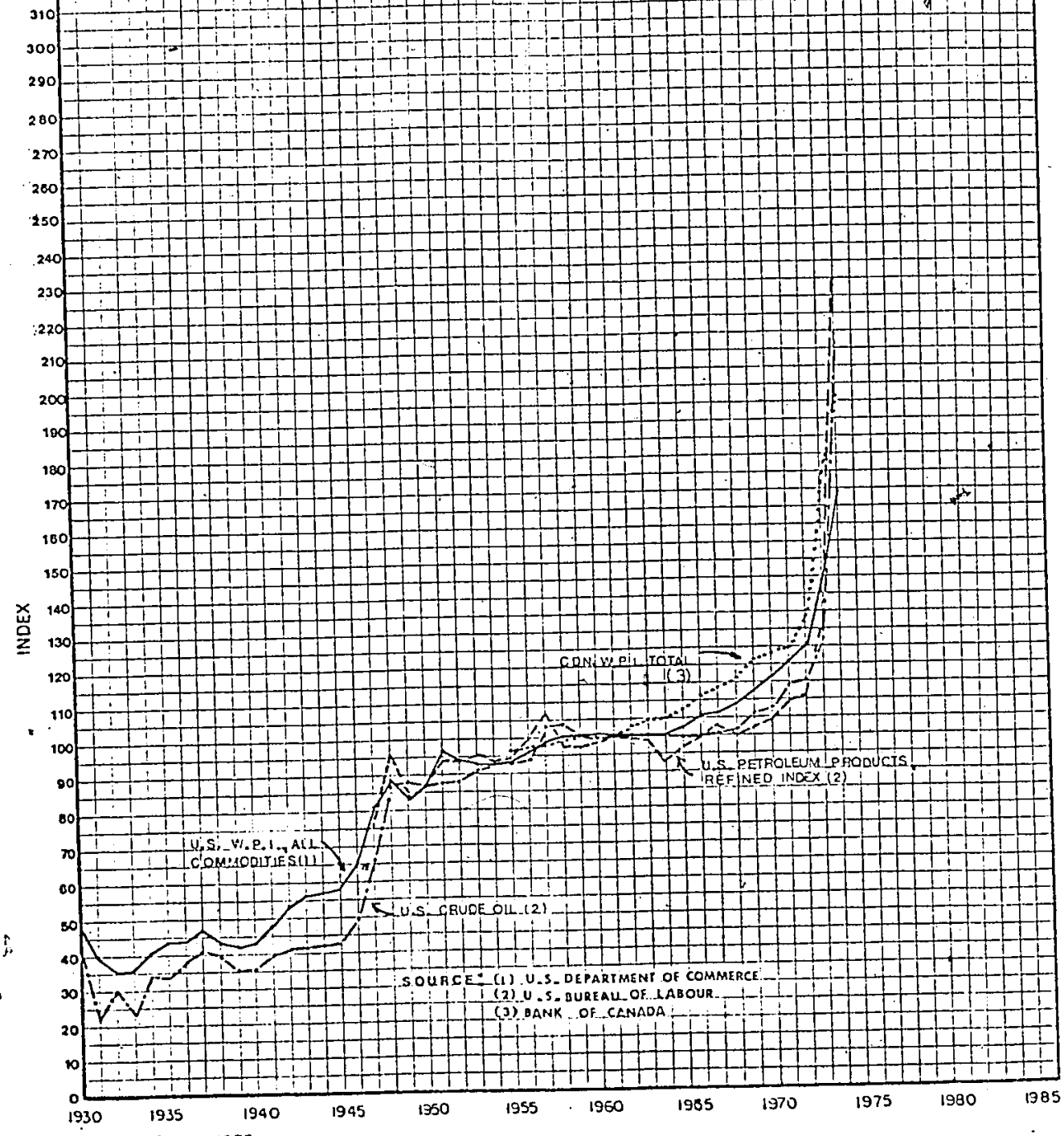
CHART 4



L. Z., FEB. 1975

CHART 5

WHOLESALE PRICE INDICES
(1961 = 100)



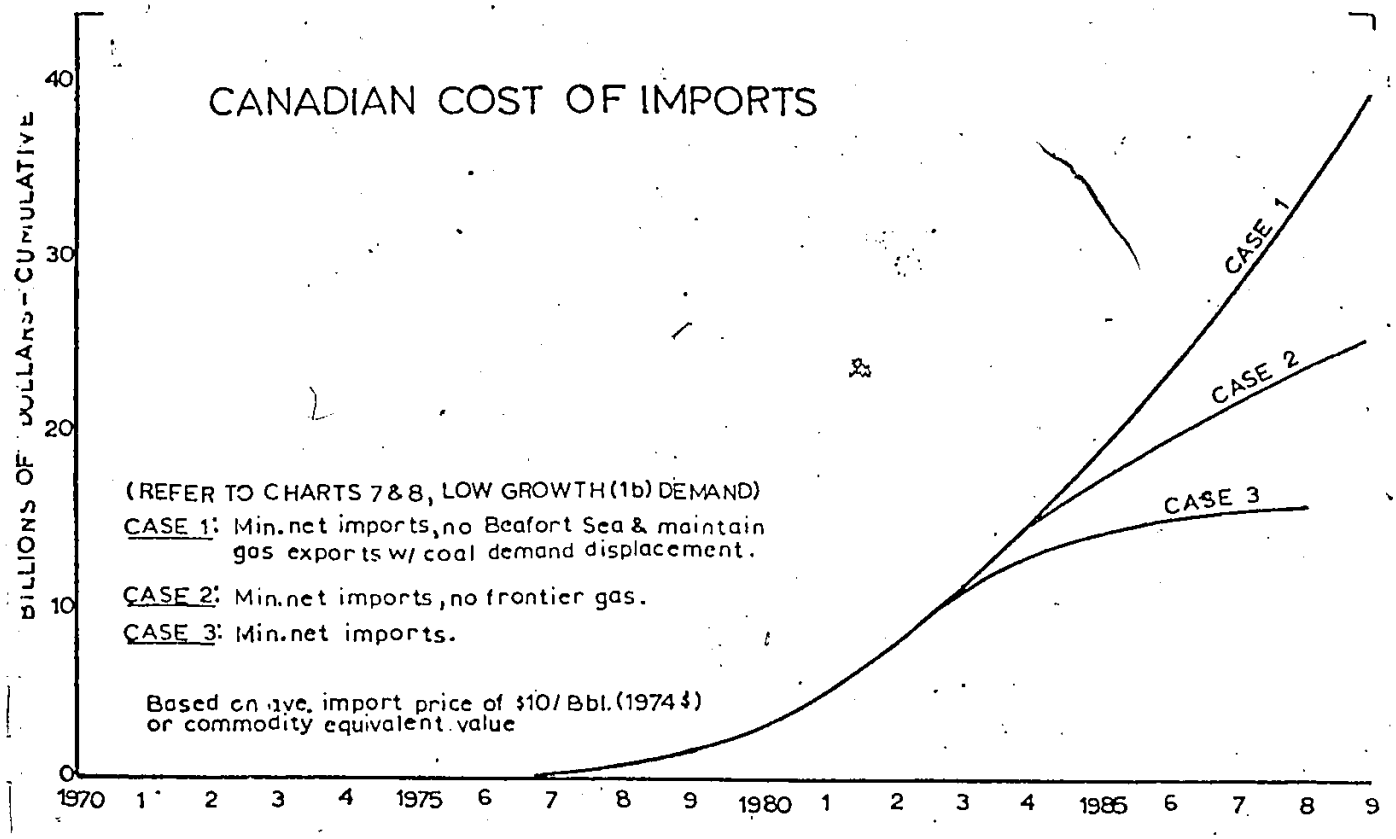
SOURCE: (1) U.S. DEPARTMENT OF COMMERCE
(2) U.S. BUREAU OF LABOUR
(3) BANK OF CANADA

LZ/ FEB. 1975

SUBJECT: COST OF IMPORTS
(VARIOUS SCENARIOS / ILLUSTRATIVE)
PROJECT
LOCATION
SUPERSEDED

CALCULATION SHEET
SHEET ___ OF ___ CHART 6
DATE Feb., 1975
BY L. Zarysky
CHECKED
APPROVED

CANADIAN COST OF IMPORTS



(REFER TO CHARTS 7 & 8, LOW GROWTH (1b) DEMAND)

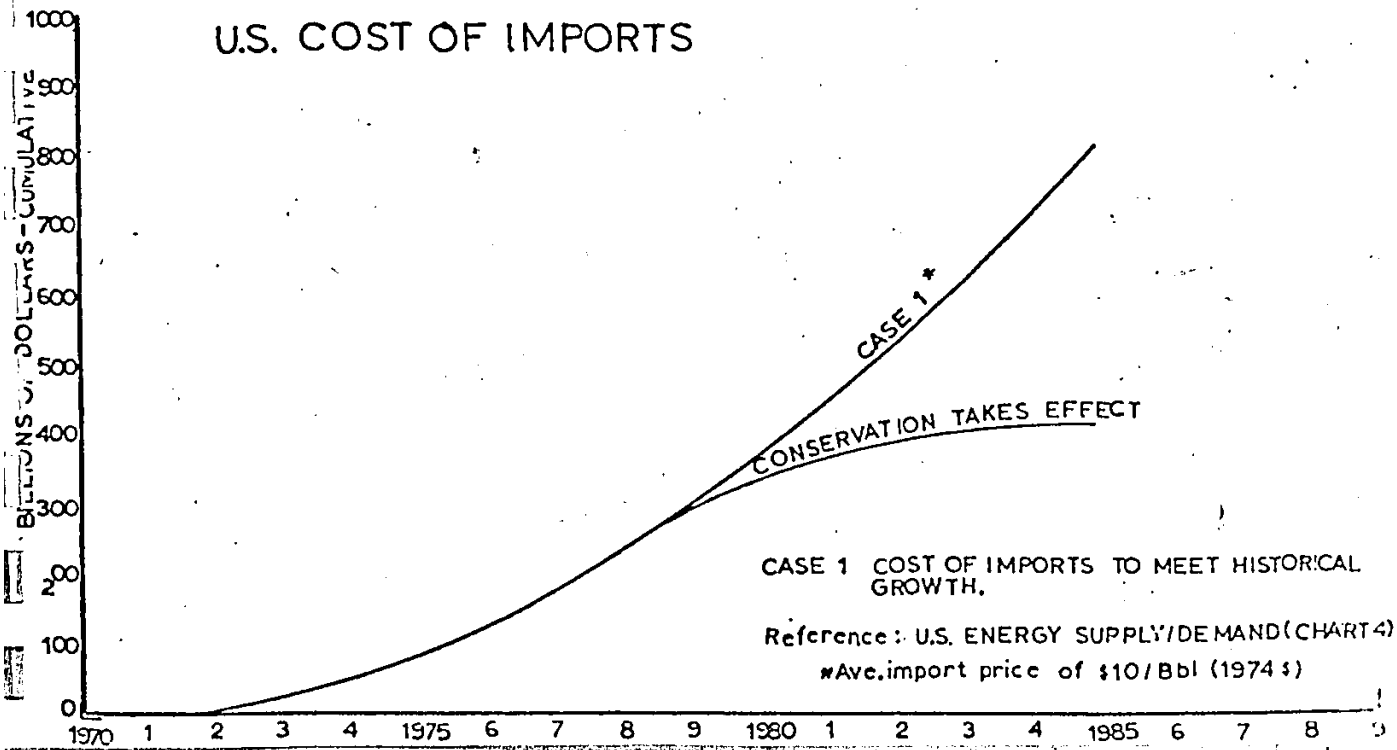
CASE 1: Min. net imports, no Beafort Sea & maintain gas exports w/ coal demand displacement.

CASE 2: Min. net imports, no frontier gas.

CASE 3: Min. net imports.

Based on ave. import price of $10/Bbl. (1974 $) or commodity equivalent value

U.S. COST OF IMPORTS



CASE 1 COST OF IMPORTS TO MEET HISTORICAL GROWTH.

Reference: U.S. ENERGY SUPPLY/DEMAND (CHART 4)

*Ave. import price of $10/Bbl (1974 $)

CHART 7

TOTAL DEMAND & B.T.U. PRODUCTION OF ENERGY FUELS IN CANADA (1945 - 1991)

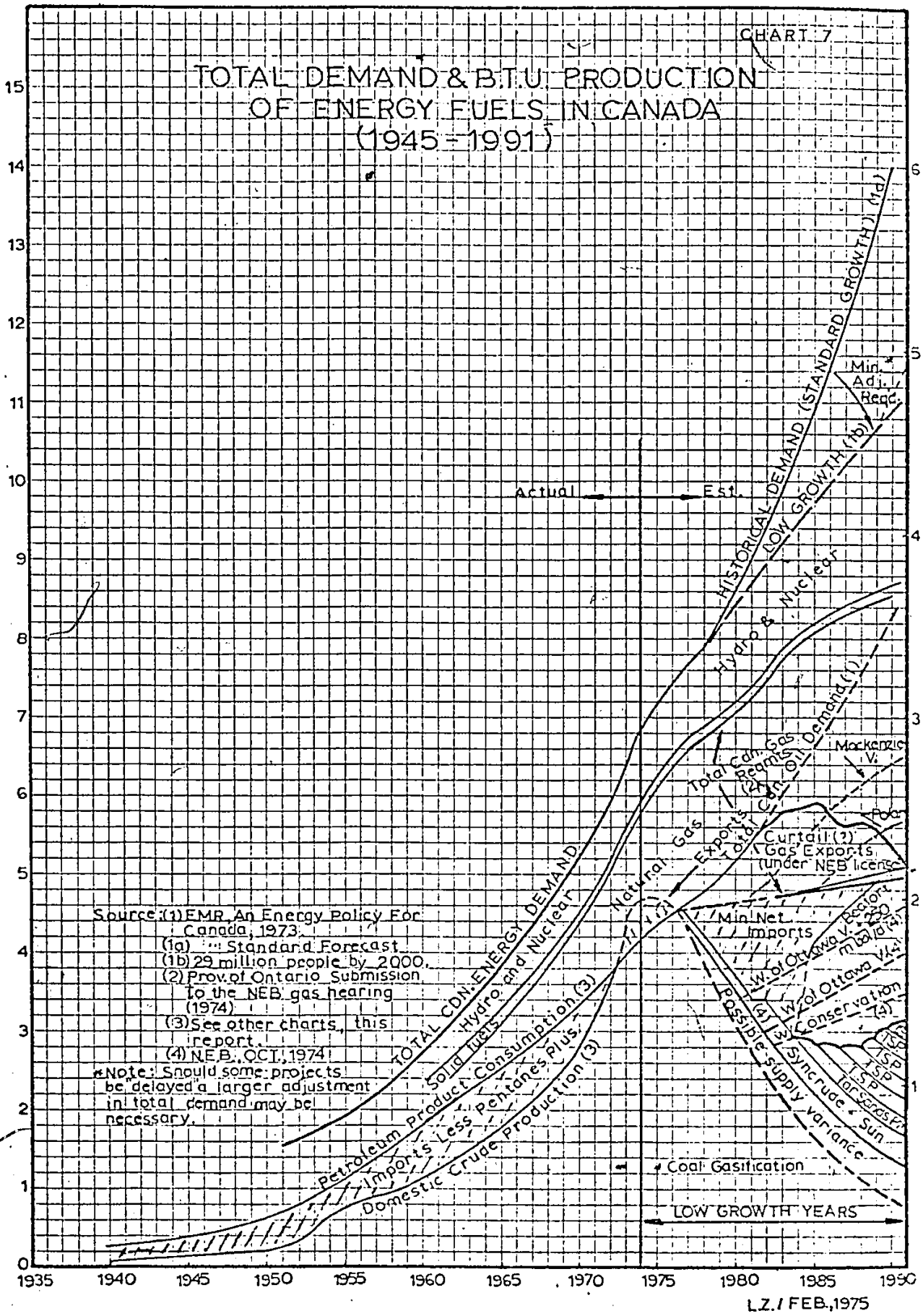
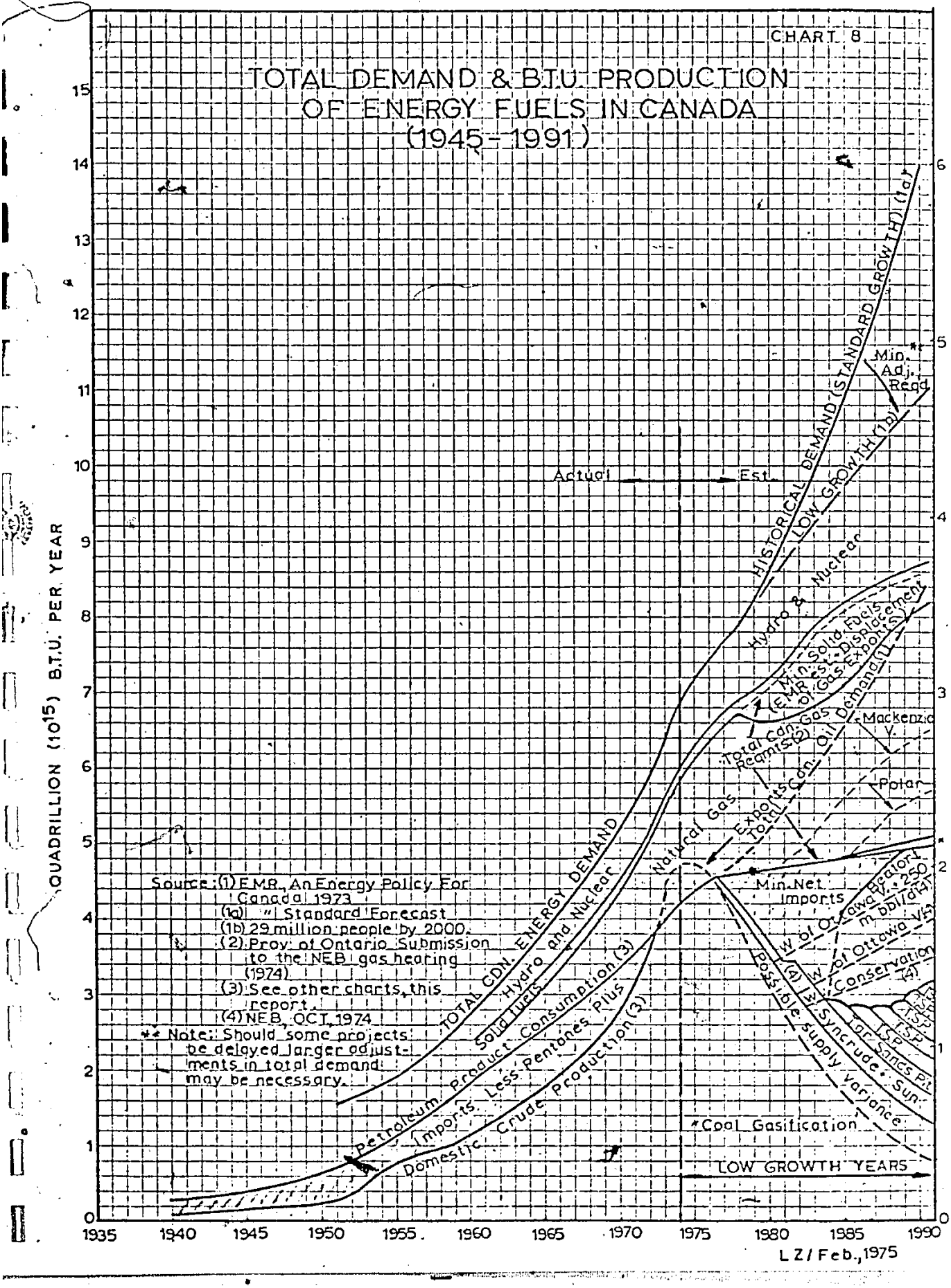


CHART 8

TOTAL DEMAND & B.T.U. PRODUCTION OF ENERGY FUELS IN CANADA (1945-1991)



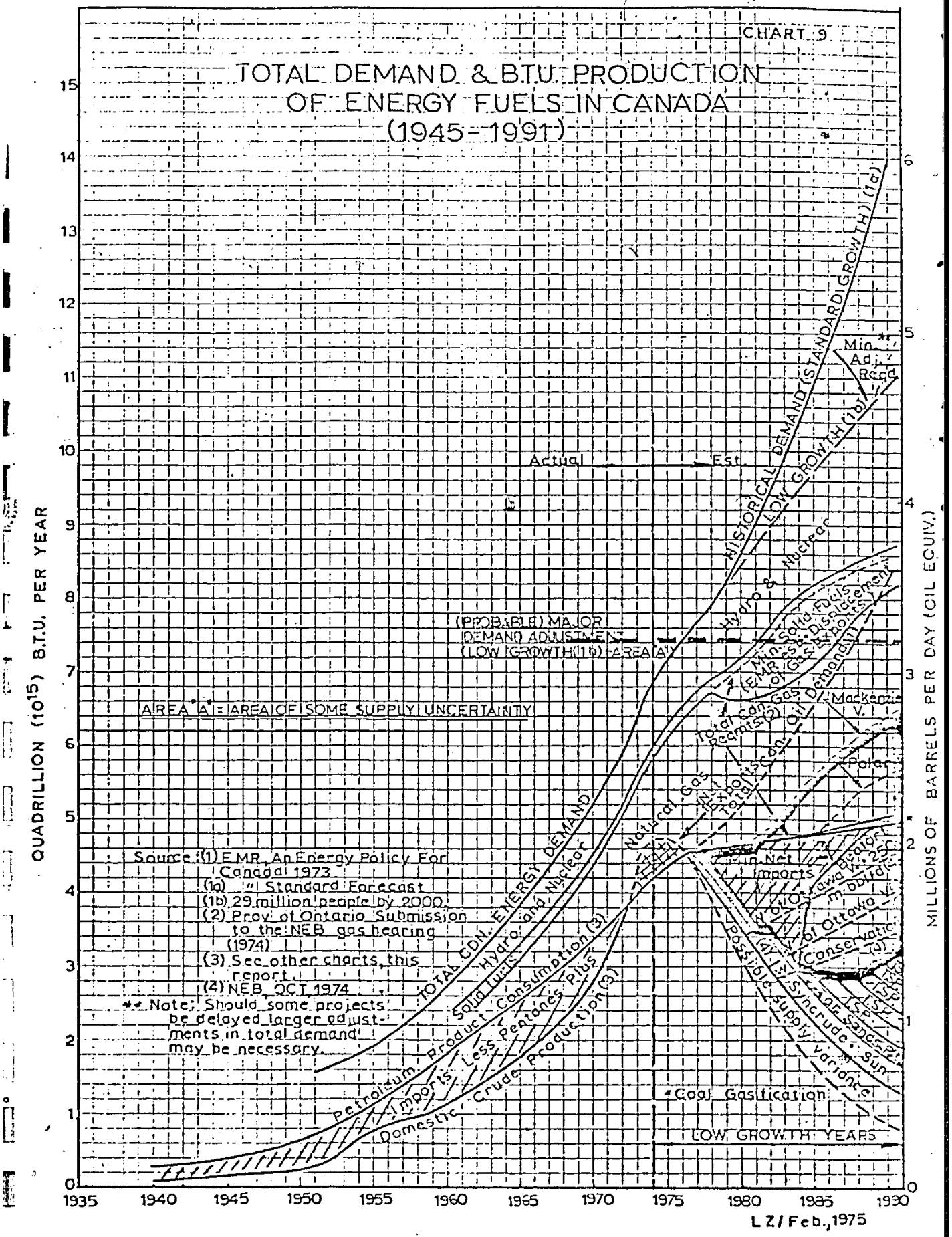
Source: (1) EMR, An Energy Policy For Canada 1973
(1a) " Standard Forecast
(1b) 29 million people by 2000.
(2) Prov. of Ontario Submission to the NEB gas hearing (1974)
(3) See other charts, this report.
(4) NEB, OCT. 1974

** Note: Should some projects be delayed larger adjustments in total demand may be necessary.

LZ/Feb., 1975

CHART 9

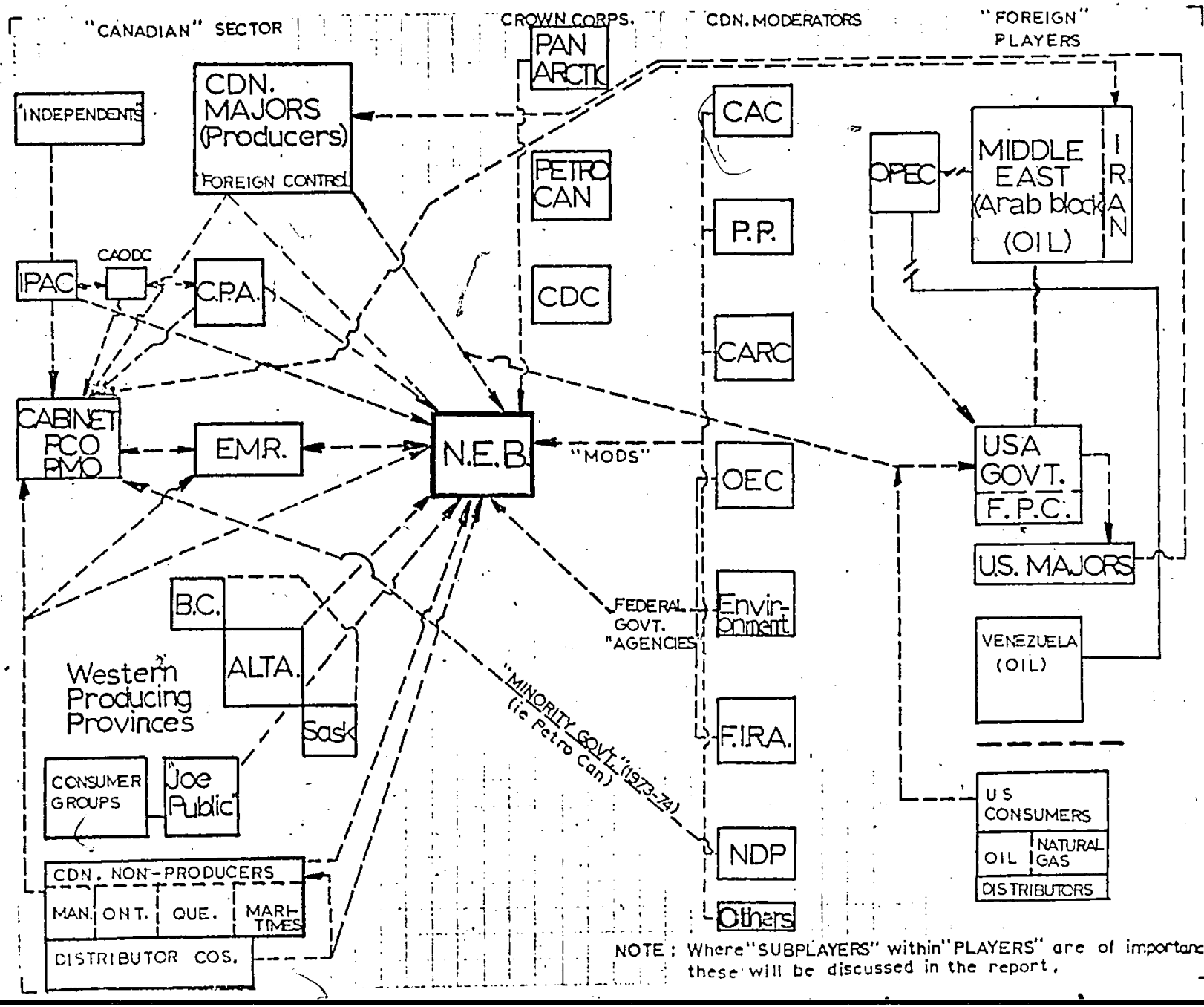
TOTAL DEMAND & B.T.U. PRODUCTION OF ENERGY FUELS IN CANADA (1945-1991)



Source: (1) EMR, An Energy Policy For Canada 1973
(1a) " Standard Forecast
(1b) 29 million people by 2000
(2) Prov. of Ontario Submission to the NEB gas hearing (1974)
(3) See other charts, this report
(4) NEB, QCI, 1974

** Note: Should some projects be delayed larger adjustments in total demand may be necessary.

LZ/Feb., 1975


"CANADIAN" SECTOR
CROWN CORPS.
CDN. MODERATORS
"FOREIGN" PLAYERS
INDEPENDENTS
CDN. MAJORS (Producers)
FOREIGN CONTROL
PAN ARCTIC
PETRO CAN
CDC
IPAC
CAODC
C.P.A.
CABINET PCO PMO
EMR.
N.E.B.
"MODS"
CAC
P.P.
CARC
OEC
F.I.R.A.
NDP
Others
OPEC
MIDDLE EAST (Arab block) (OIL)
IRAN
USA GOVT.
F.P.C.
U.S. MAJORS
VENEZUELA (OIL)
US CONSUMERS
OIL
NATURAL GAS
DISTRIBUTORS
FEDERAL GOVT. "AGENCIES"
Environment
B.C.
ALTA.
Sask
Western Producing Provinces
"MINORITY GOVT." (1973-74) (ie Petro Can)
CONSUMER GROUPS
Joe Public
CDN. NON-PRODUCERS
MAN.
ONT.
QUE.
MARITIMES
DISTRIBUTOR COS.
NOTE: Where "SUBPLAYERS" within "PLAYERS" are of importance, these will be discussed in the report.
SUBJECT The "PLAYERS"
PROJECT THE ENERGY GAME: Analysis of Options
LOCATION
SUPERSEDED
CALCULATION SHEET
SHEET 1 OF 2 CHART A
DATE Feb., 1975
BY L. Zarvsky
CHECKED
APPROVED

CALCULATION SHEET

SUBJECT

PROJECT The "Players" Defined

LOCATION

SUPERSEDED

SHEET 2 OF 2

DATE

BY

CHECKED

APPROVED LZ

Definitions/Abreviations:

IPAC	-	Independent Petroleum Association of Canada
CPA	-	Canadian Petroleum Association
PCO	-	Privy Council Office
PMO	-	Prime Minister's Office
EMR	-	Department of Energy, Mines and Resources
NEB	-	National Energy Board
CAODC	-	Canadian Assoc. of Oilweek Drilling Contractors
CDC	-	Canada Development Corporation
CAC	-	Canadian Association of Consumers
PP	-	Pollution Probe (and other 'like' orgs. i.e. C.S.P.)
CARC	-	Canadian Arctic Resources Committee
OEC	-	Office of Energy Conservation (reports to Min. of EMR)
ENVIR	-	Department of Environment
FIRA	-	Foreign Investment Review Agency
NDP	-	New Democratic Party
OPEC	-	Org. of Petroleum Exporting Countries
FPC	-	Federal Power Commission (U.S. equiv. of N.E.B.)
OPI	-	Ontario Petroleum Institute
Others	-	(University of B.C.
	-	(Canadians for Responsible Development
	-	(Canadian Arctic Resources Committee
	-	(Committee for an Indppendent Canada
	-	(Waffle
	-	(Voice of Women
	-	(Various Acedemics
	-	(Etc.

CALCULATION SHEET

SUBJECT

PROJECT

LOCATION

SUPERSEDED

SHEET 1 OF 5 CHART(S)

DATE

BY

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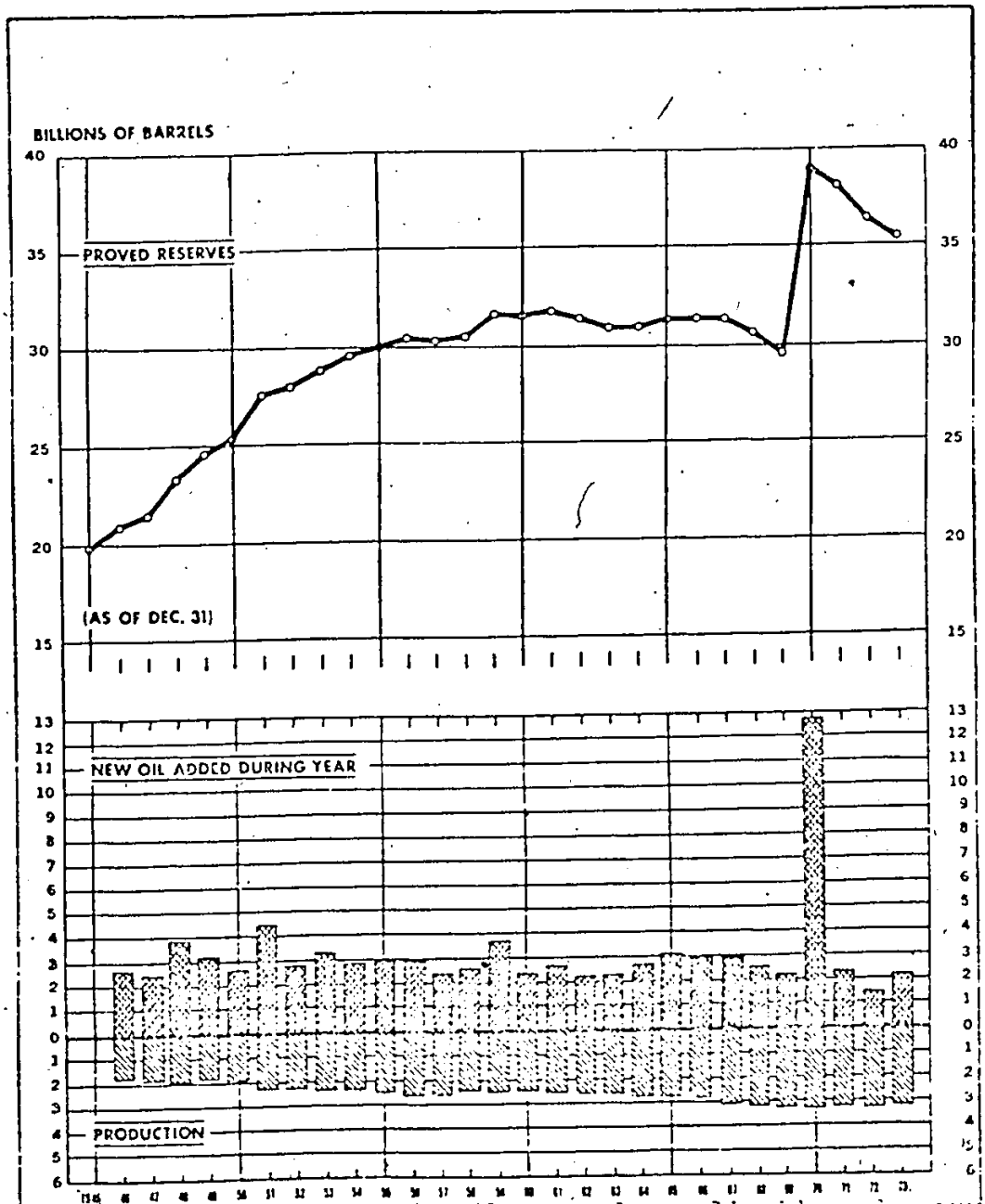
PROVED RESERVES OF CRUDE OIL IN THE UNITED STATES, 1945-1973



Source: Reserves of crude oil, natural gas liquids, and natural gas in the United States and Canada and United States productive capacity as of Dec. 31, 1973, Vol. 28, June 1974. Published jointly by the American Gas Association, American Petroleum Institute, and Canadian Petroleum Association.

CALCULATION SHEET

SUBJECT

SHEET 2 OF 5

DATE

PROJECT

BY

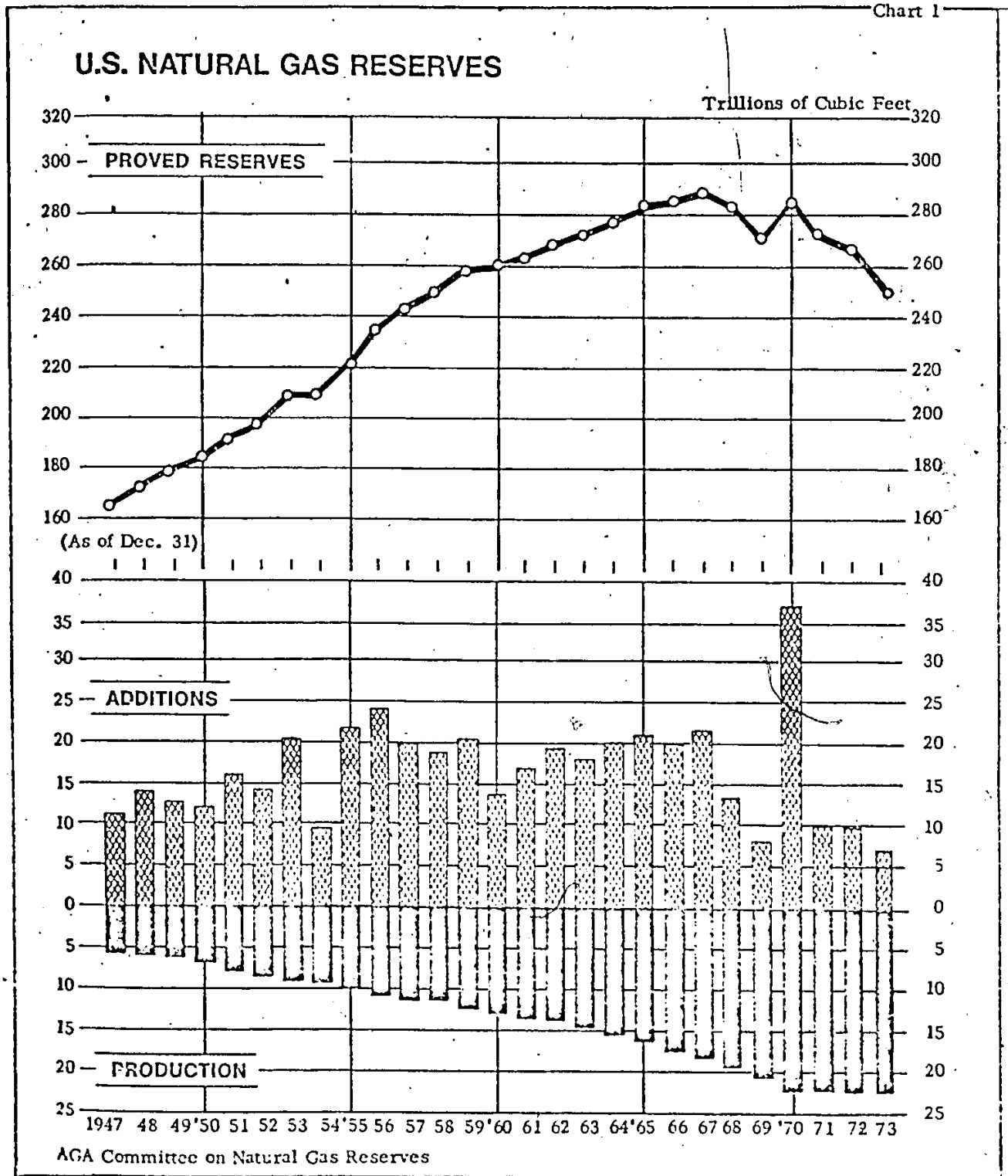
LOCATION

CHECKED

SUPERSEDED

APPROVED

Chart 1



Source: Reserves of crude oil, natural gas liquids, and natural gas in the United States and Canada and United States productive capacity as of Dec. 31, 1973, Vol. 28, June 1974. Published jointly by the A.G.A., A.P.I., & C.P.A.

CALCULATION SHEET

SUBJECT

PROJECT

LOCATION

SUPERSEDED

SHEET 3 OF 5

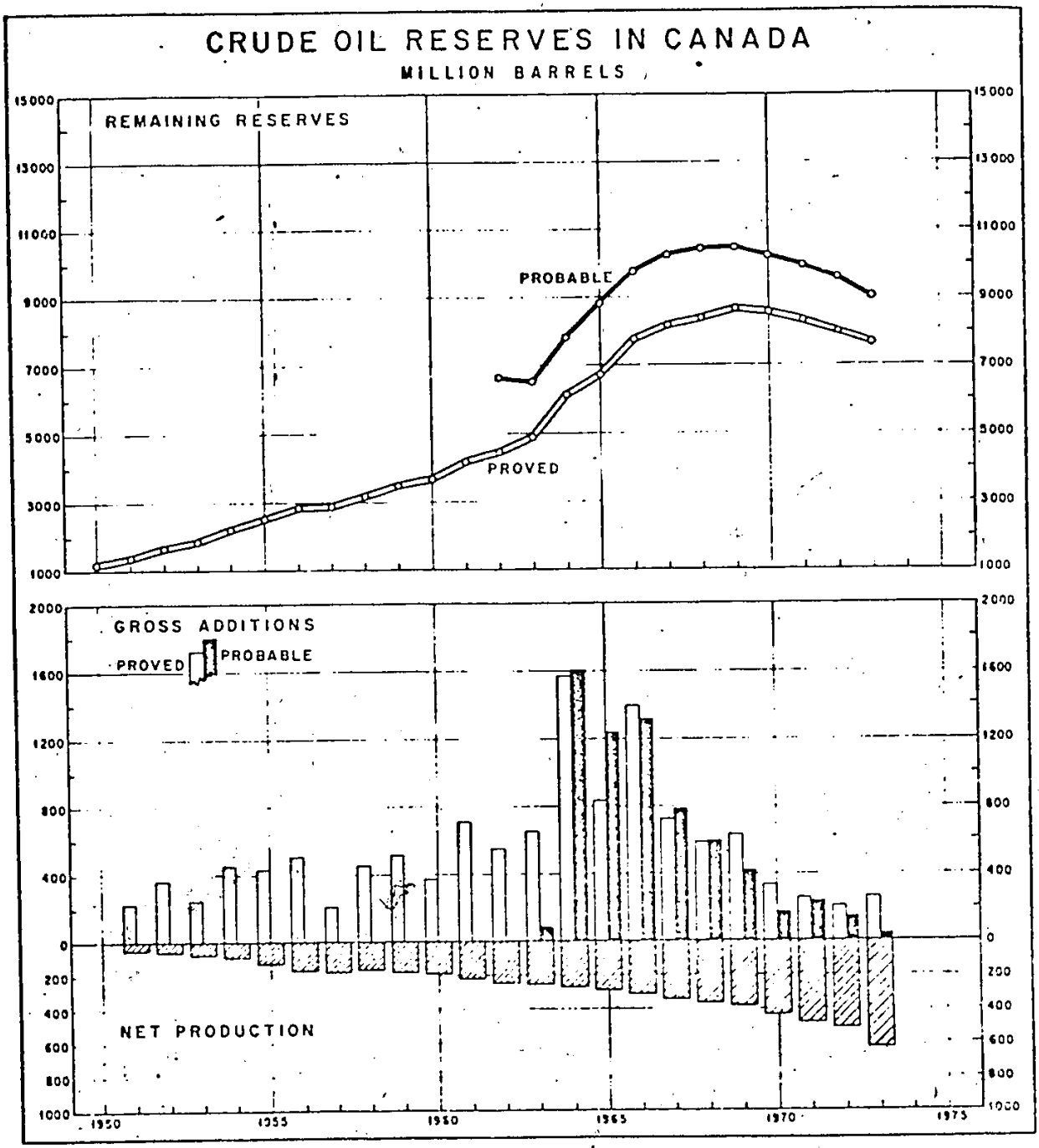
DATE

BY

CHECKED

APPROVED

CANADIAN PETROLEUM ASSOCIATION 1973 YEAR BOOK



RESERVES COMMITTEE

CALCULATION SHEET

SHEET 4 OF 5

SUBJECT

DATE

PROJECT

BY

LOCATION

CHECKED

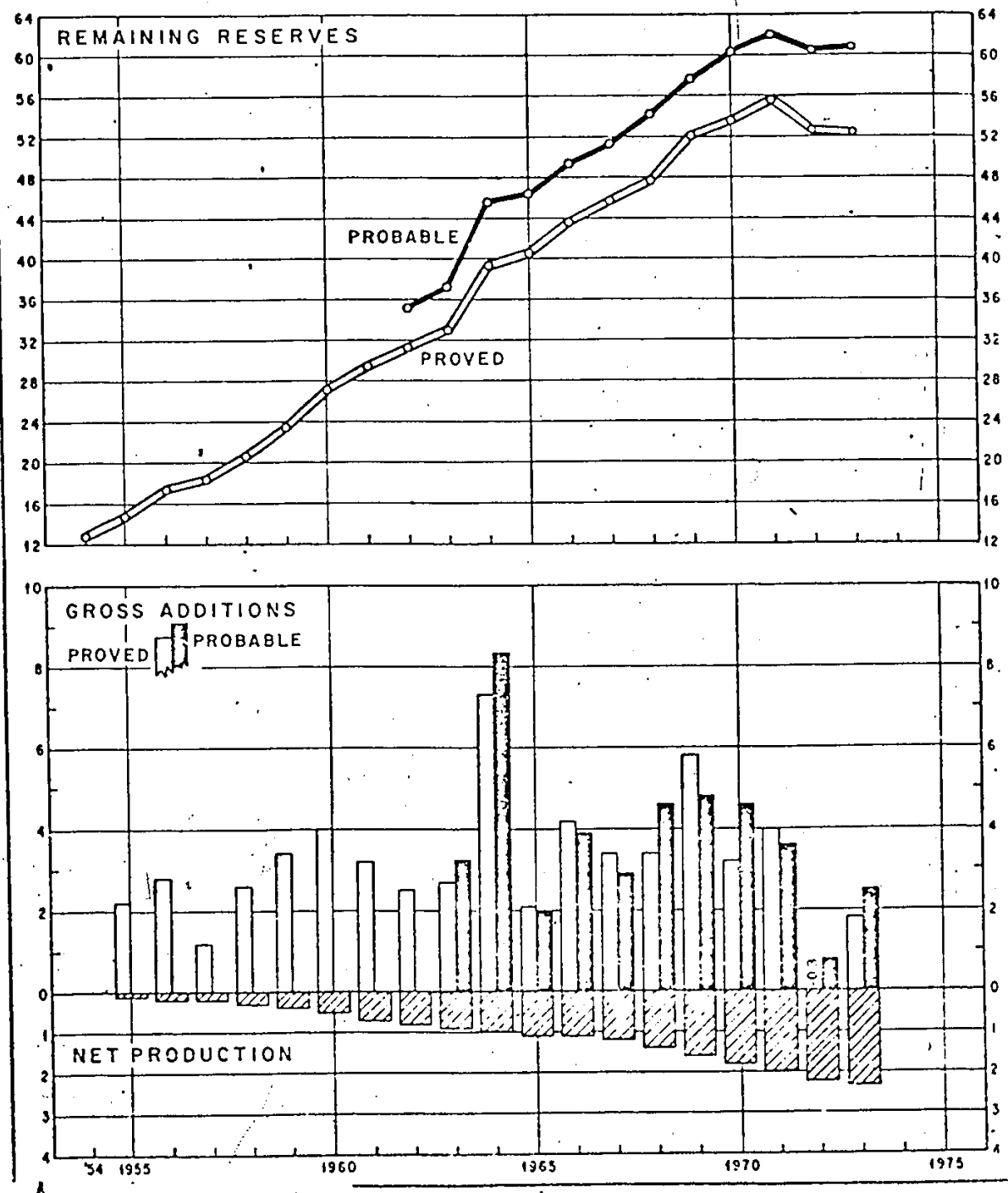
SUPERSEDED

APPROVED

CANADIAN PETROLEUM ASSOCIATION 1973 YEAR BOOK

MARKETABLE NATURAL GAS RESERVES IN CANADA

TRILLION CUBIC FEET



RESERVES COMMITTEE

CALCULATION SHEET

SHEET 5 OF 5

SUBJECT

PROJECT

LOCATION

SUPERSEDED

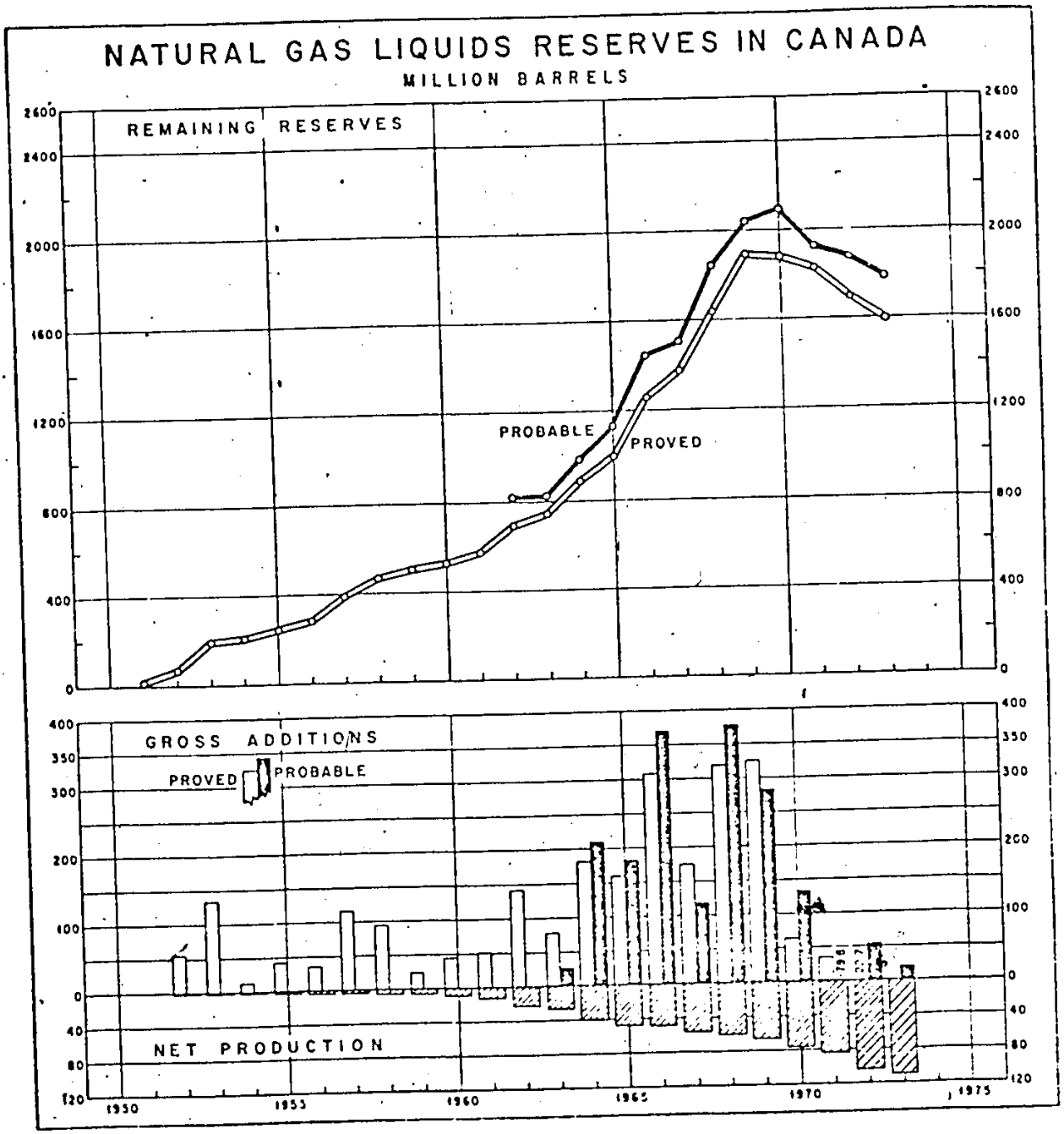
DATE

BY

CHECKED

APPROVED

CANADIAN PETROLEUM ASSOCIATION 1973 YEAR BOOK



RESERVES COMMITTEE

CHART C

CALCULATION SHEET

SUBJECT

PROJECT

LOCATION National Energy Board, Aug., 70, Report.

SUPERSEDED

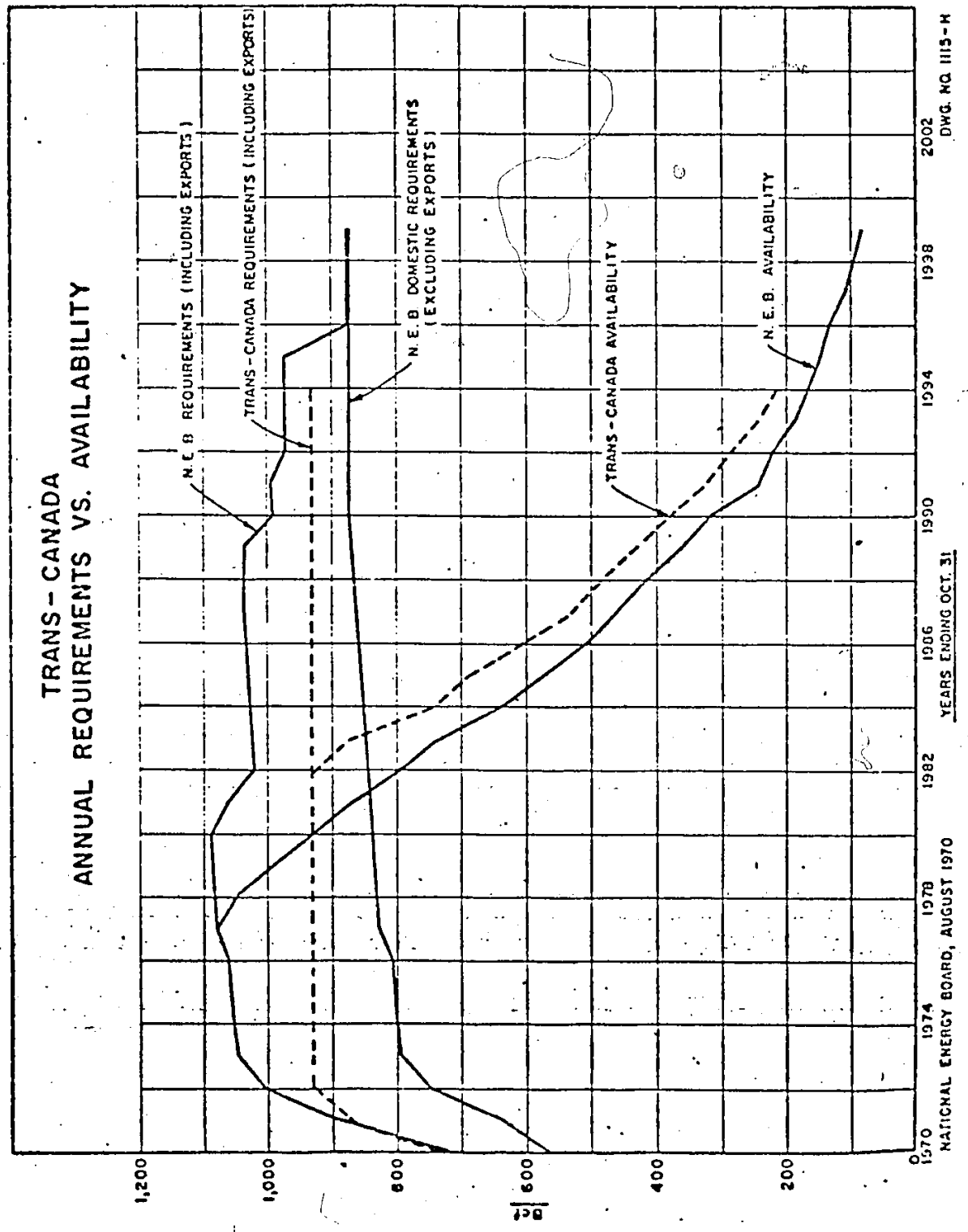
SHEET ____ OF ____

DATE

BY

CHECKED

APPROVED



CALCULATION SHEET

SUBJECT

SHEET 1 OF 3 CHART D

DATE

PROJECT

BY

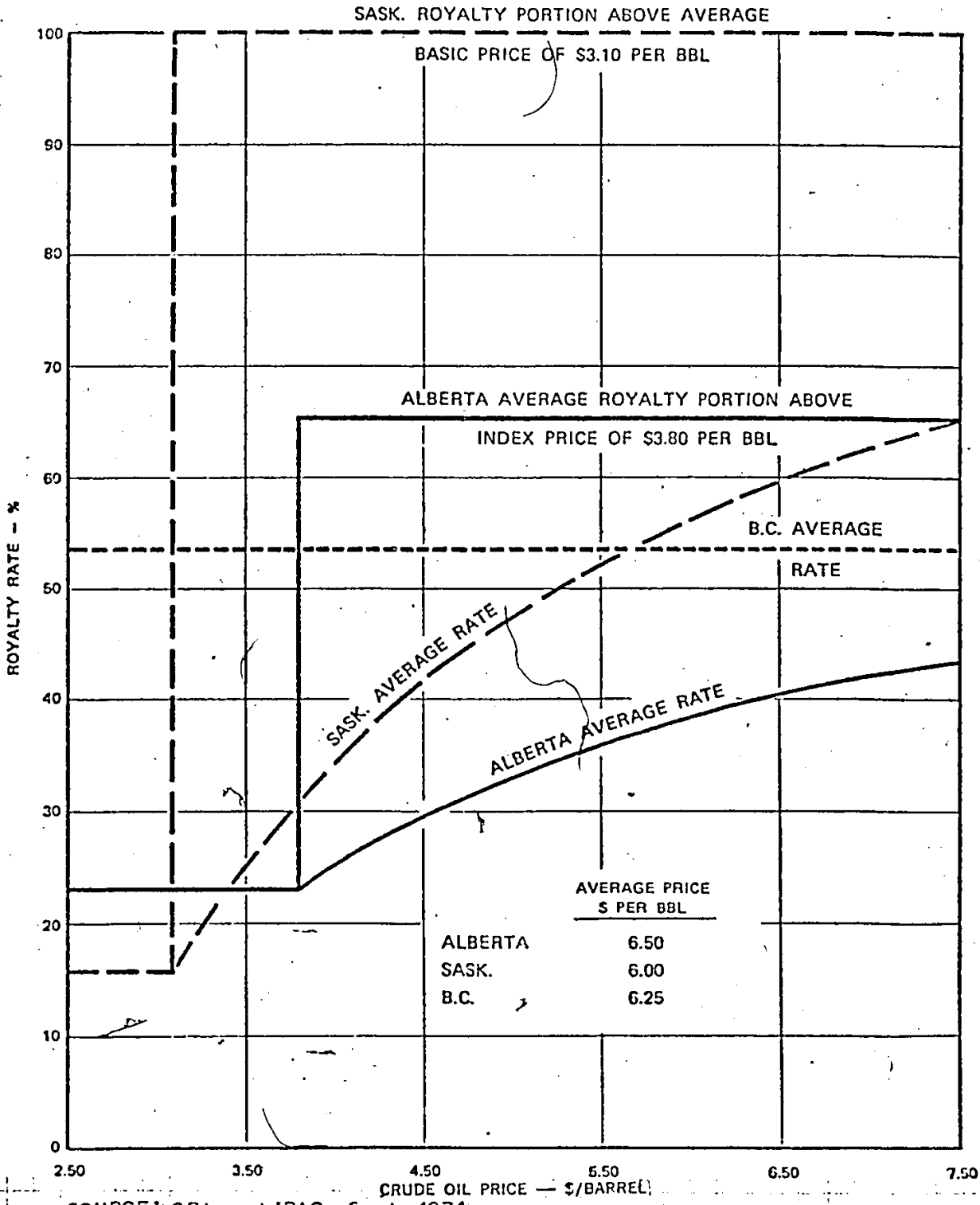
LOCATION

CHECKED

SUPERSEDED

APPROVED

CURRENT AVERAGE PROVINCIAL ROYALTY RATES ON OIL
PRODUCED FROM EXISTING RESERVES



SOURCE: C.P.A. and I.P.A.C., Sept., 1974.

SUBJECT

PROJECT

LOCATION

SUPERSEDED

CALCULATION SHEET

SHEET 2 OF 3

DATE

BY

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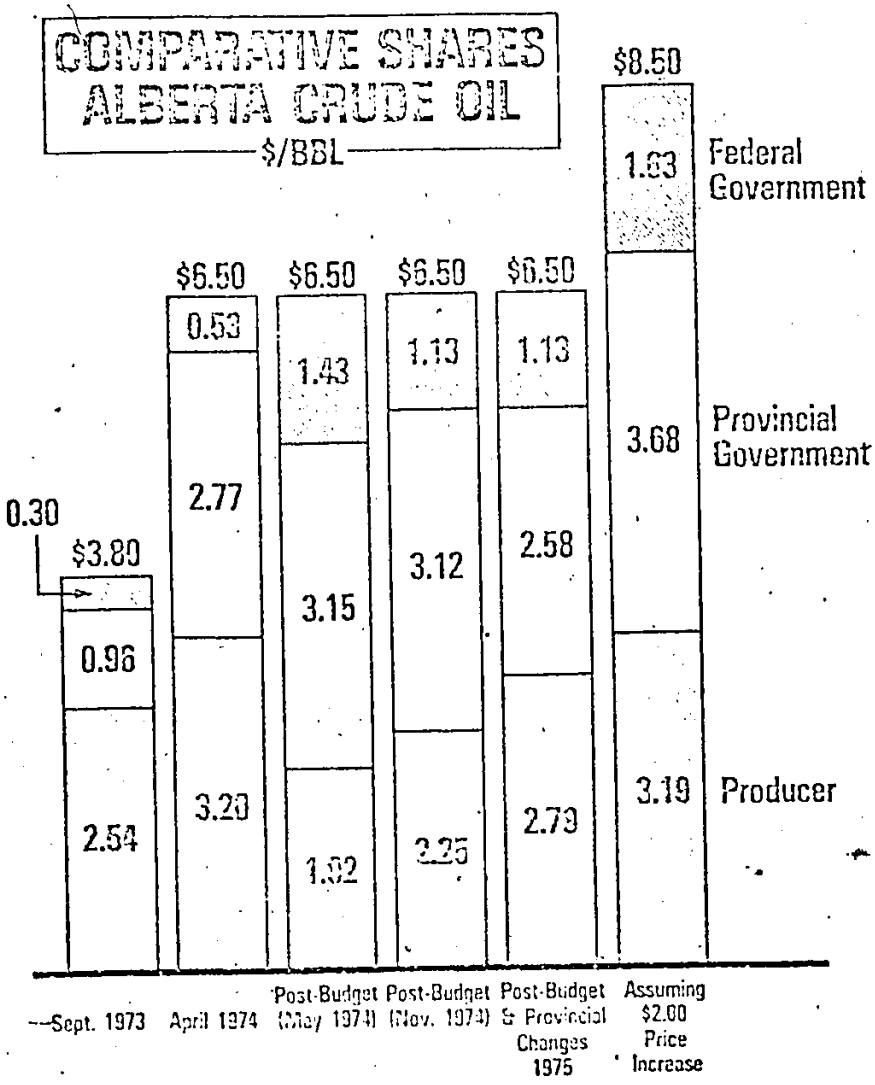


Source: Shell Canada Limited, Jan.,1975.

Prices and Tax Rates Applied to 34° API Arabian Light Crude ($/barrel)

	I	II	III
A - Posted price	11.651	11.651	11.251
B - Production cost	0.100	0.100	0.100
C - Royalty	1.456	1.942	2.250
D - Income tax	5.552	6.313	7.565
E - Government take (C + D)	7.008	8.255	9.815
F - Tax-paid cost (B + E)	7.108	8.355	9.915
G - Buy-back price (93% of A)	10.835	10.835	10.425
H - " " " (94.8% of A)	11.045	11.045	10.665

I - 12.5% royalty and 55% income tax.

II - 16.67% royalty and 65.7% income tax.

III - 20% royalty and 85% income tax from 1 November 1974.

As the above table indicates, the new decisions announced on 10 November by the three Arab Gulf countries have raised the government take on equity oil from $ 8.255 to $ 9.815 per barrel (+ $ 1.56) and the companies' tax-paid cost from $ 8.355 to $ 9.915 (+ $ 1.56). The buy-back price paid by the companies on part of the participation oil (currently 93% of the posting on the average) drops on the other hand from $ 10.835 to $ 10.425 per barrel (- 41 cents).

Source: Arab Oil & Gas, 16 November 1974.

HOW ALBERTA OIL PRODUCTION REVENUE IS NOW SPLIT: INDUSTRY GETS A PENNY FOR EVERY NICKEL

Expressed per average bbl of crude, all figures in dollars

	Pre-April 1/74	After April 1	Add'l tax (per budget)	Present total	% of net prod'n income ($6.00/bbl)
Av. gross price	3.50	6.50	—	$6.50	—
Alta. royalty	0.84	1.78	—	1.78	—
Alta. tax	0.18	0.25	0.41	0.66	—
Total Alta take	1.02	1.85	0.41	3.28	54.7
Federal take	0.62	0.85	0.65	1.50	25.0
Gross share to producer	2.16	2.28	—	1.72	—
Net share (-50¢/bbl costs)	1.66	2.28	—	1.22	20.33

Source: Energy Analects, November 22, 1974.

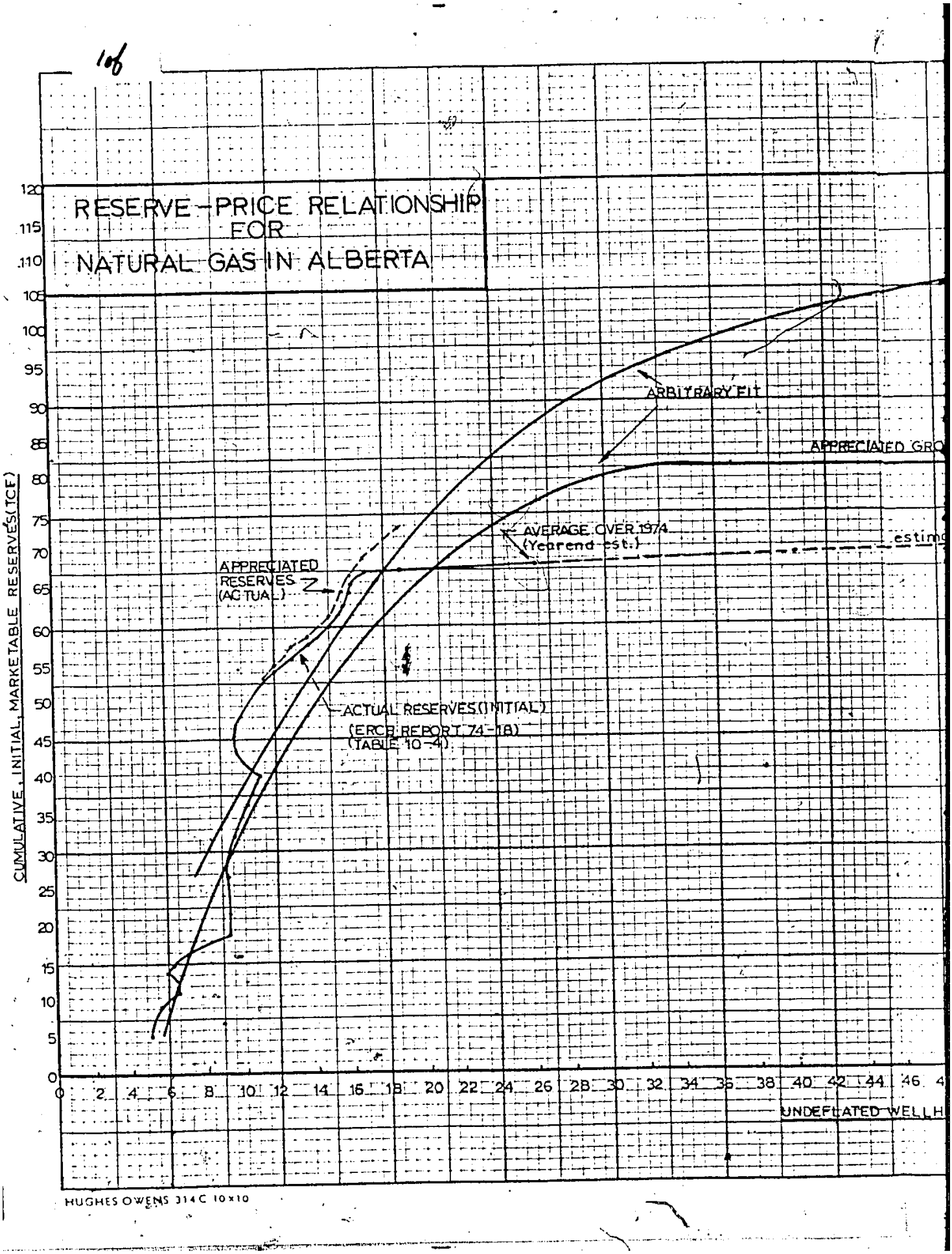

RESERVE-PRICE RELATIONSHIP
FOR
NATURAL GAS IN ALBERTA
CUMULATIVE, INITIAL, MARKETABLE RESERVES (TCF)
UNDEFLATED WELLH
ARBITRARY FIT
APPRECIATED GRO
AVERAGE OVER 1974
(Yearend est.)
estim
APPRECIATED
RESERVES
(ACTUAL)
ACTUAL RESERVES (INITIAL)
(ERCB REPORT 74-18)
(TABLE 10-4).
HUGHES OWENS 314 C 10x10

CHART E

A.E.R.C.B. EST. OF ULTIMATE INITIAL RECOVERABLE RESERVES - 110 Tcf[5] (ERCB REPORT 74-18)

(RANGE OF ULTIMATE RESERVES ACCORDING TO METHOD[4] USED & IN PARTICULAR THE INTERPOLATION OF DATA.)

RECIATED GROSS ULTIMATE RECOVERY - 80 TCF (ERCB 74-18 TABLE 10-4) per JOHN F. STRONG[3] AUG. 1974 STUDY[1] See APPENDIX DATA

ARCTIC GAS[2] PRICE TARGET (@ 2.00/Mcf, 75¢)

ALBERTA'S GOAL BY 1975-6 Ave. Wellhead price of 72¢/Mcf

estimated

* INITIAL RESERVES + A FORECAST APPRECIATION FACTOR BASED ON HISTORIC TRENDS ($A = 1.73434(1 - e^{-0.4466x})$)

LEGEND

1. BASED ON GOMPERTZ EQUATION (24-Year Trend Analysis)
   $\text{Log of GUR at } T_x = 1.912391 - 0.826720(0.870186^x)$
   where x = years from 1950
2. POINT AT WHICH ARCTIC GAS BEGINS TO ARRIVE IN ALTA. (1982)
   (Petroleum: Range between 5.2 - 6.3 million BTU's / Bbl.
   ∴ on the ave. $2.00/Mcf. gas ≈ $11.40/Bbl. oil equiv.
   $2.50/Mcf. gas ≈ $14.25/Bbl. oil equiv.
3. STUDY BY JOHN F. STRONG, PETROLEUM CONSULTANT, PREPARED FOR THE MINISTER OF ENERGY FOR ONTARIO, AUGUST, 1974, and SUBMITTED TO THE 1974 N.E.B. GAS HEARING.
4. ALSO ARPS MODEL RE. RESERVES-INVESTMENT RELATIONSHIP. Reference & CHART E(a)
5. THE AERCB DOES NOT INDICATE ITS CRITERIA.

2 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94

ATED WELLHEAD PRICE (CENTS/MCF)

LZ/FEB., 1975

CHART E(a)

ALTERNATE METHOD TO FINDING PRICE-RESERVE RELATIONSHIPS (A SIMPLE MODEL)

References:

(1) ARPS, J.J., M. Mortada, and A.E. Smith "Relationship Between Proved Reserves and Exploratory Effort", Journal of Petroleum Technology, June, 1971.

(2) Credit: G.T. McLoughlin and R.C. Richards, National Energy Board, for introducing the assumption that linear cumulative footage is a linear function of cumulative investment into Arps formula.

(3) Johnson, J., Econometric Methods, (1972), 2nd Edition, McGraw-Hill Publications.

(4) MASSAGER MANUAL - January, 1973, available through Statistics Canada, which is responsible for public dissemination. (The computer program described in this publication was developed initially in 1965 by M.C. McCracken at the Southern Methodist University Economics Department with the help of a Ford Foundation Fellowship. It was subsequently extended by McCracken and A. Leduc at the Economic Council of Canada).

Steps:

1. Use data on wellhead prices, Pj, (undeflated) and cumulative investment in exploration and development in the petroleum industry (CPA Statistical Yearbook) and the Massager Time Series Processor and find E and F in the following equation:

$$\ln Ij = E + F \ln Pj$$

Using multiple linear regression analysis this gives $\ln I = E + F \ln P$ which describes the trend between investment and prices in a linear approximation. (Note: Because of the nature of the petroleum industry, it is difficult to separate investment in exploration and development in gas from investment in oil and gas which the C.P.A. reports).

2. Find A, B, C and D in

$$Y = A\left[1 + C\,e^{-DI} - (1 + C)e^{-BI}\right]$$

where I = cumulative investment data and Y = cumulative, initial marketable gas reserves in Bcf, using the Time Series Processor (for non-linear least squares curve fitting regression analysis).

3. Find a series of investments from a series of prices from the fitted equation $\ln I = E + F \ln P$, and evaluate the corresponding cumulative, initial marketable reserves using the equation $Y = A\left[1 + C\,e^{-DI} - (1 + C)e^{-BI}\right]$. Plot Y versus the corresponding prices.

SUBJECT

PROJECT

LOCATION

SUPERSEDED

CALCULATION SHEET

SHEET ___ OF ___ CHART F

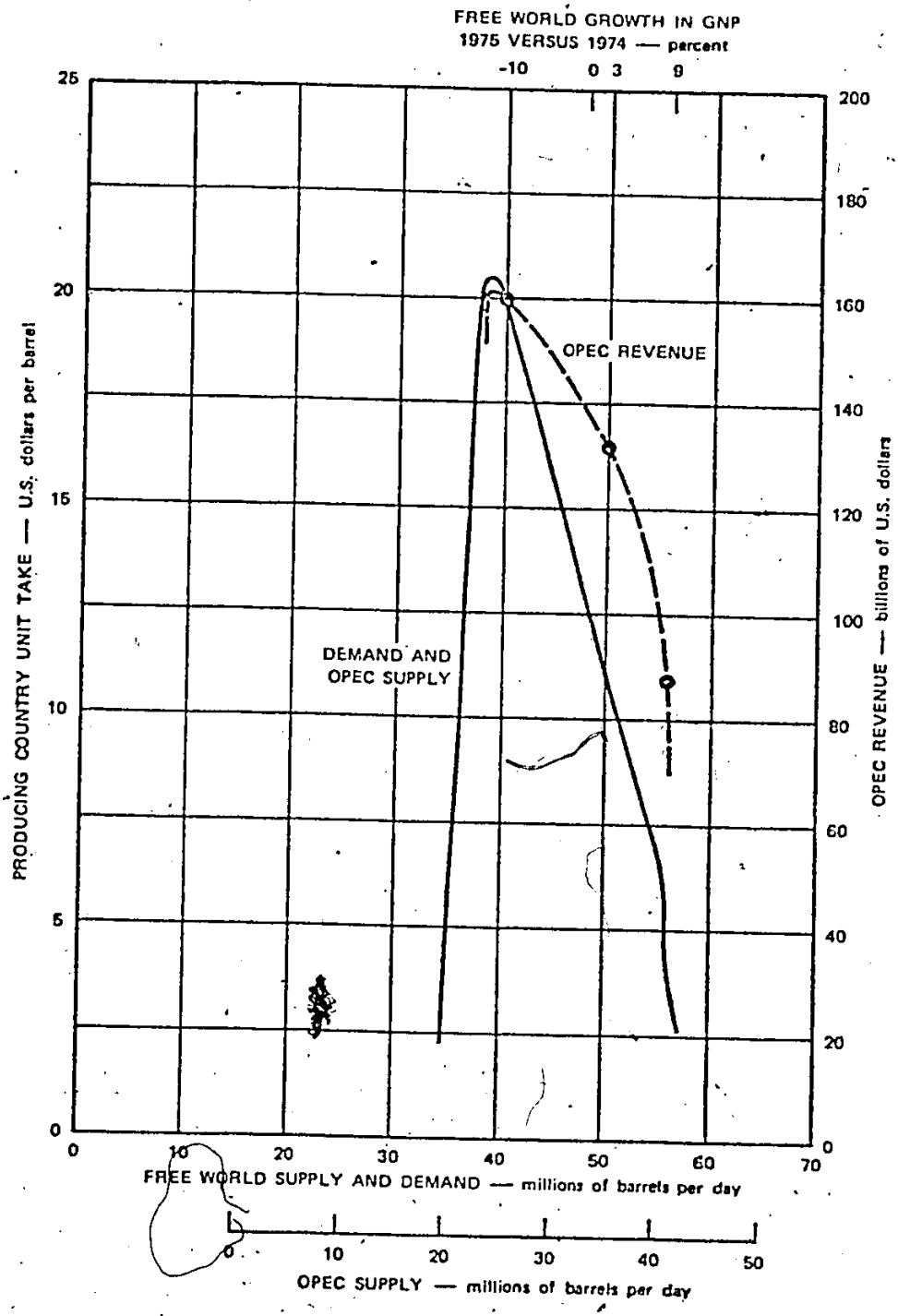
DATE Feb., 1975

BY

CHECKED L. Zarysky

APPROVED

FREE WORLD PETROLEUM DEMAND SCHEDULE FOR
1975 AND OPEC REVENUES



SUBJECT

PROJECT

LOCATION

SUPERSEDED

CALCULATION SHEET

SHEET ___ OF ___ CHART F(b)

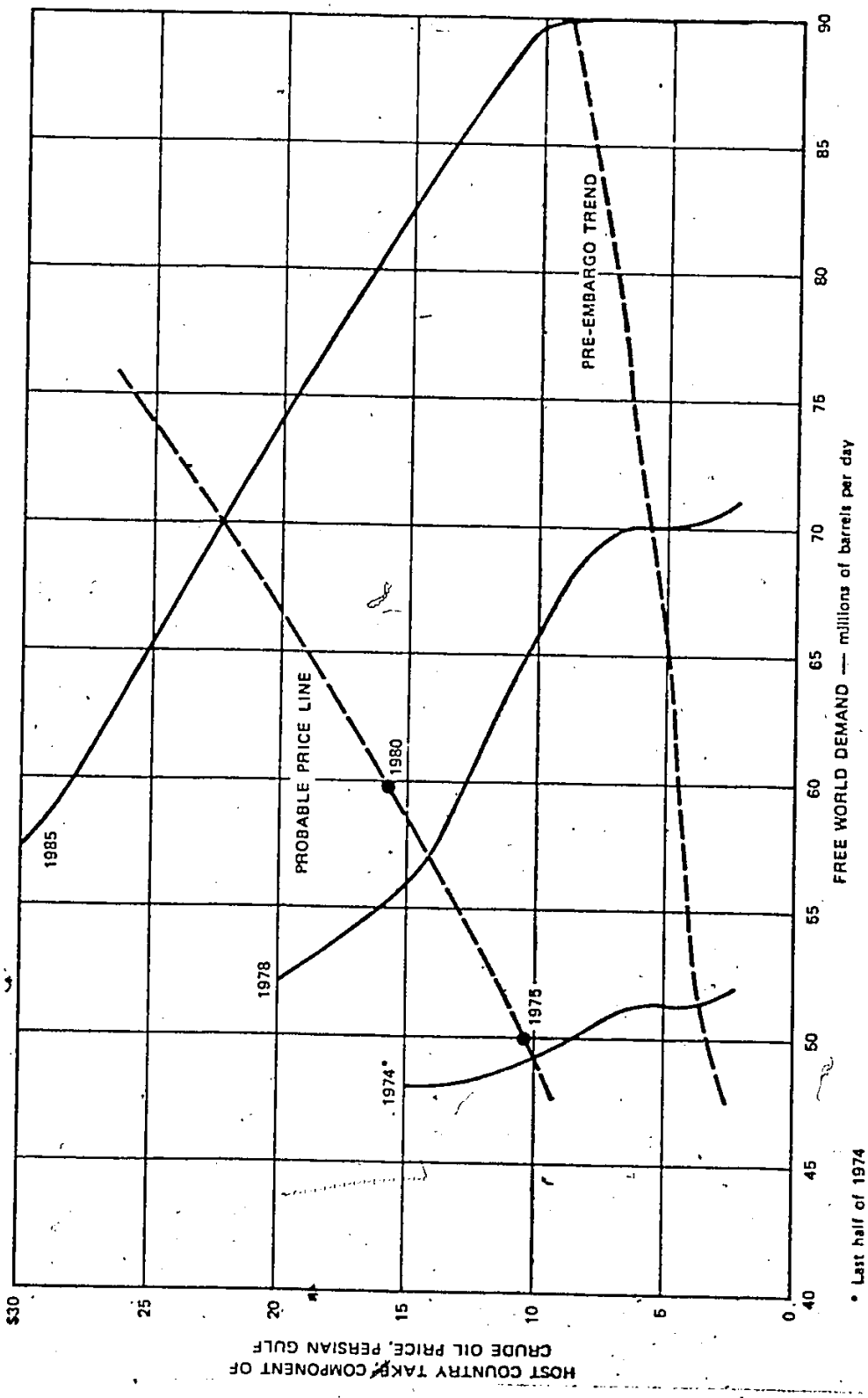
DATE Feb., 1975

BY

CHECKED L. Zarysky

APPROVED

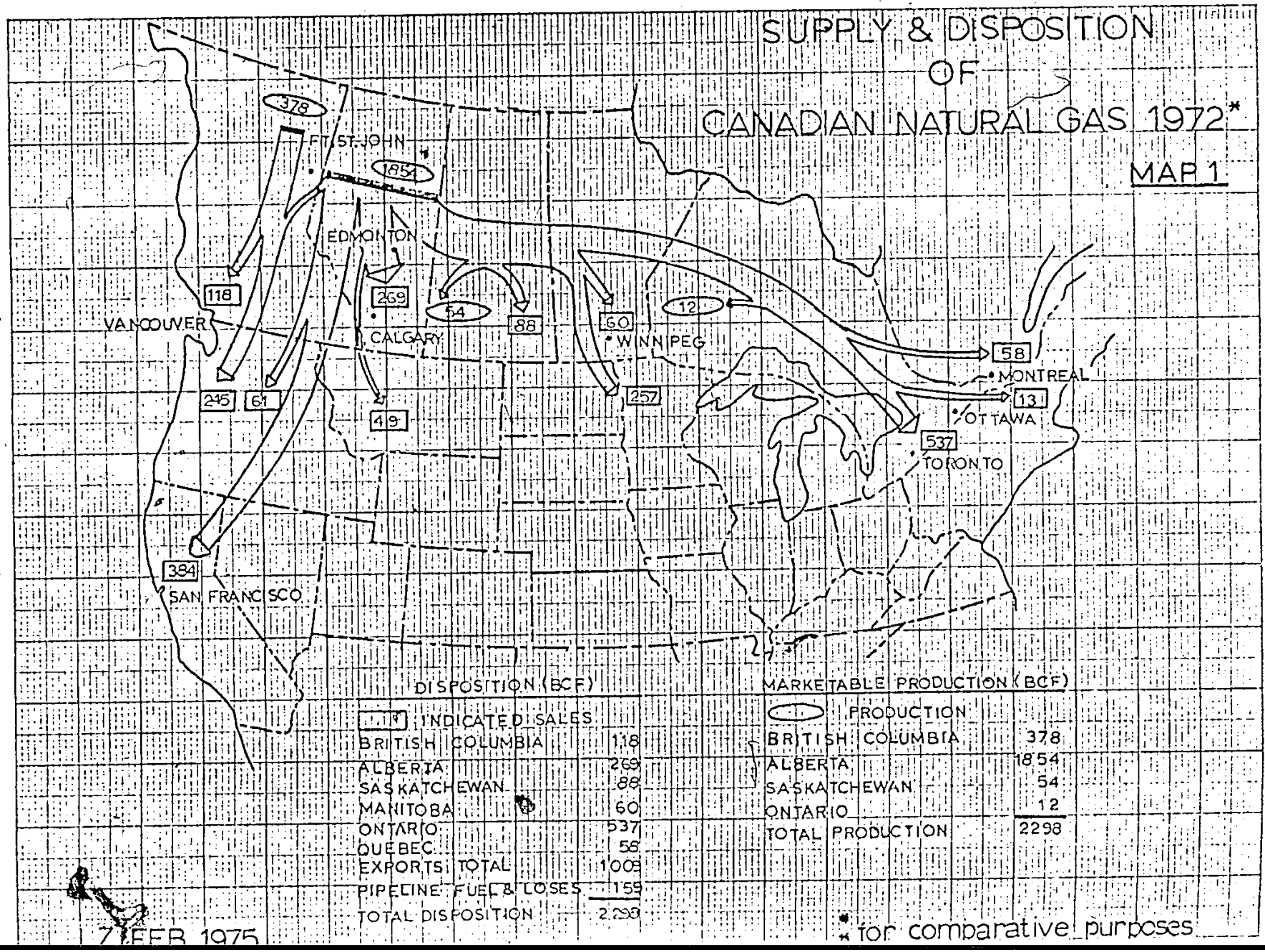
FIGURE DEMAND SCHEDULE FOR FREE WORLD PETROLEUM, 1974, 1978, AND 1985



* Last half of 1974

SUPPLY & DISPOSITION OF CANADIAN NATURAL GAS 1972*

MAP 1



DISPOSITION (BCF)

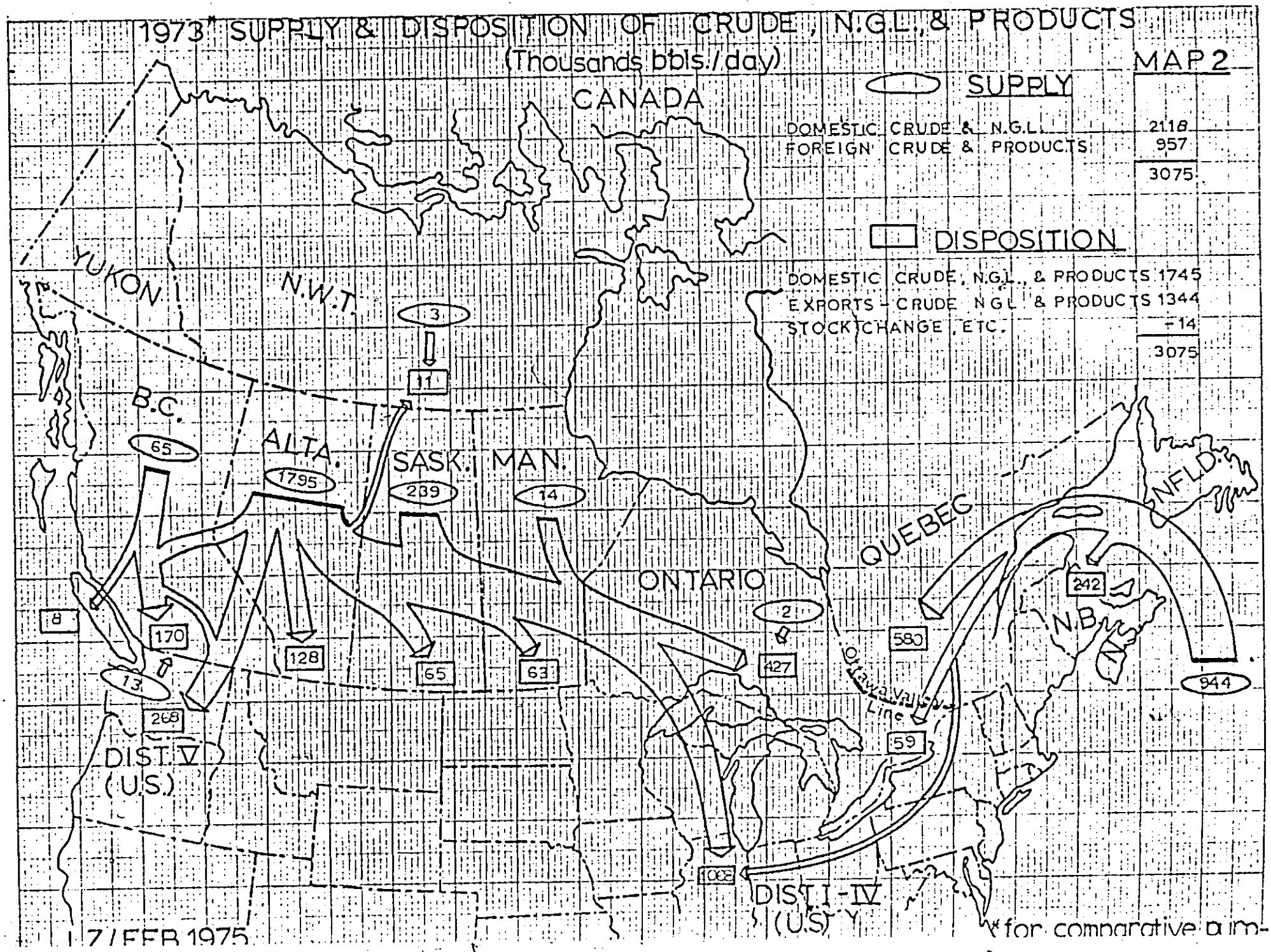
	INDICATED SALES
BRITISH COLUMBIA	118
ALBERTA	269
SASKATCHEWAN	88
MANITOBA	60
ONTARIO	537
QUEBEC	58
EXPORTS TOTAL	1008
PIPELINE FUEL & LOSES	159
TOTAL DISPOSITION	2298

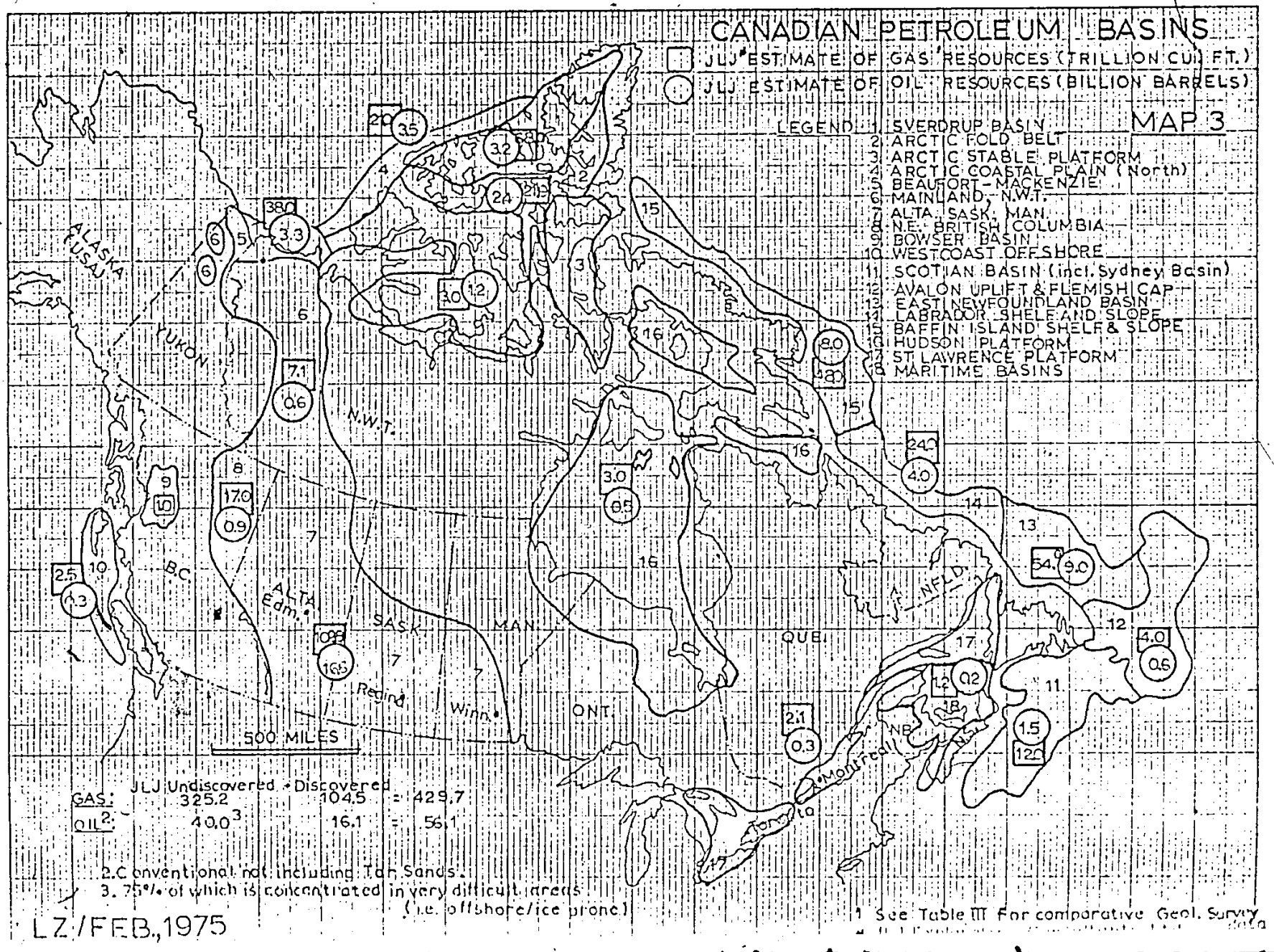
MARKETABLE PRODUCTION (BCF)

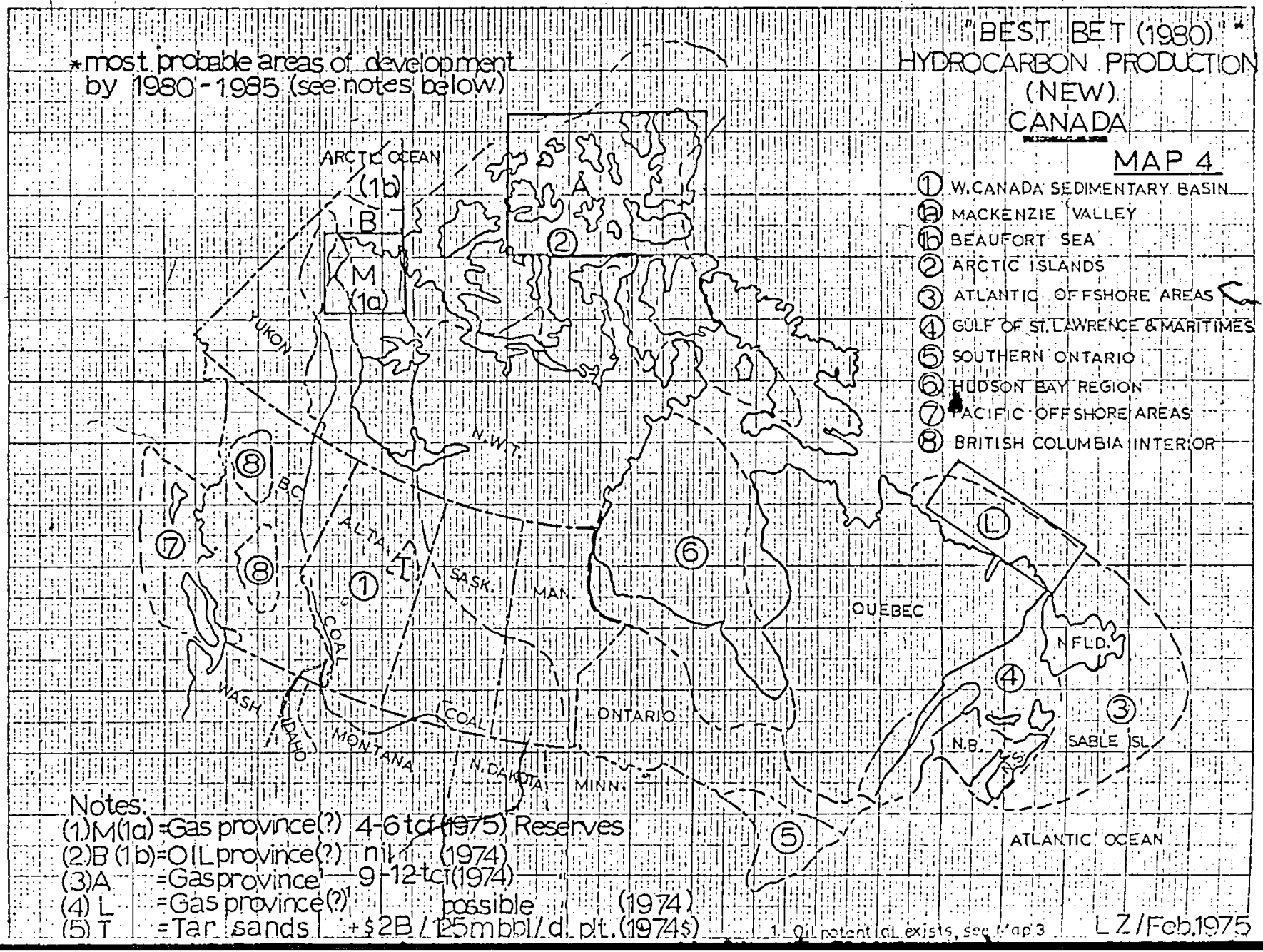
	PRODUCTION
BRITISH COLUMBIA	378
ALBERTA	1854
SASKATCHEWAN	54
ONTARIO	12
TOTAL PRODUCTION	2298

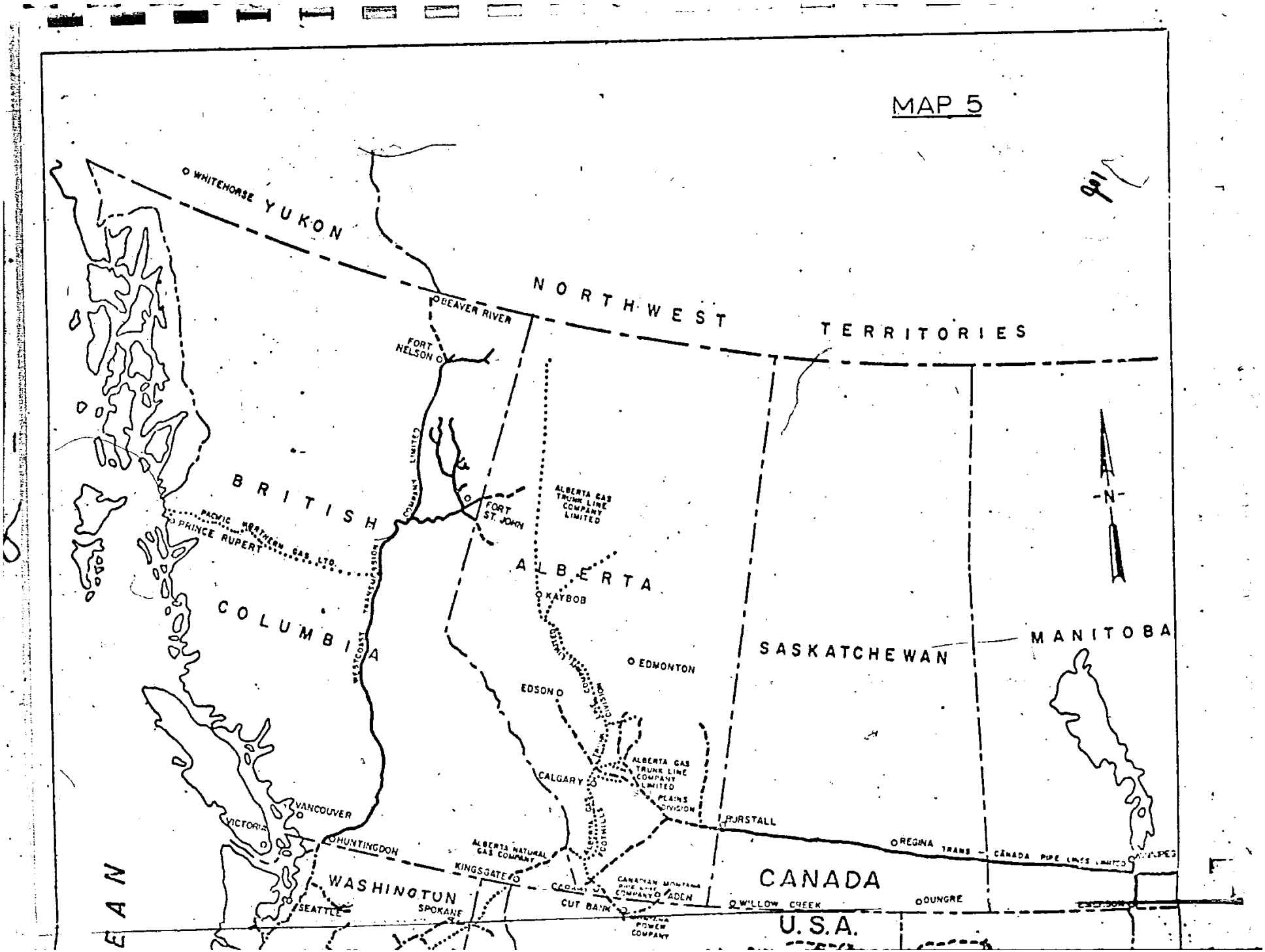
* for comparative purposes

7 FEB 1975

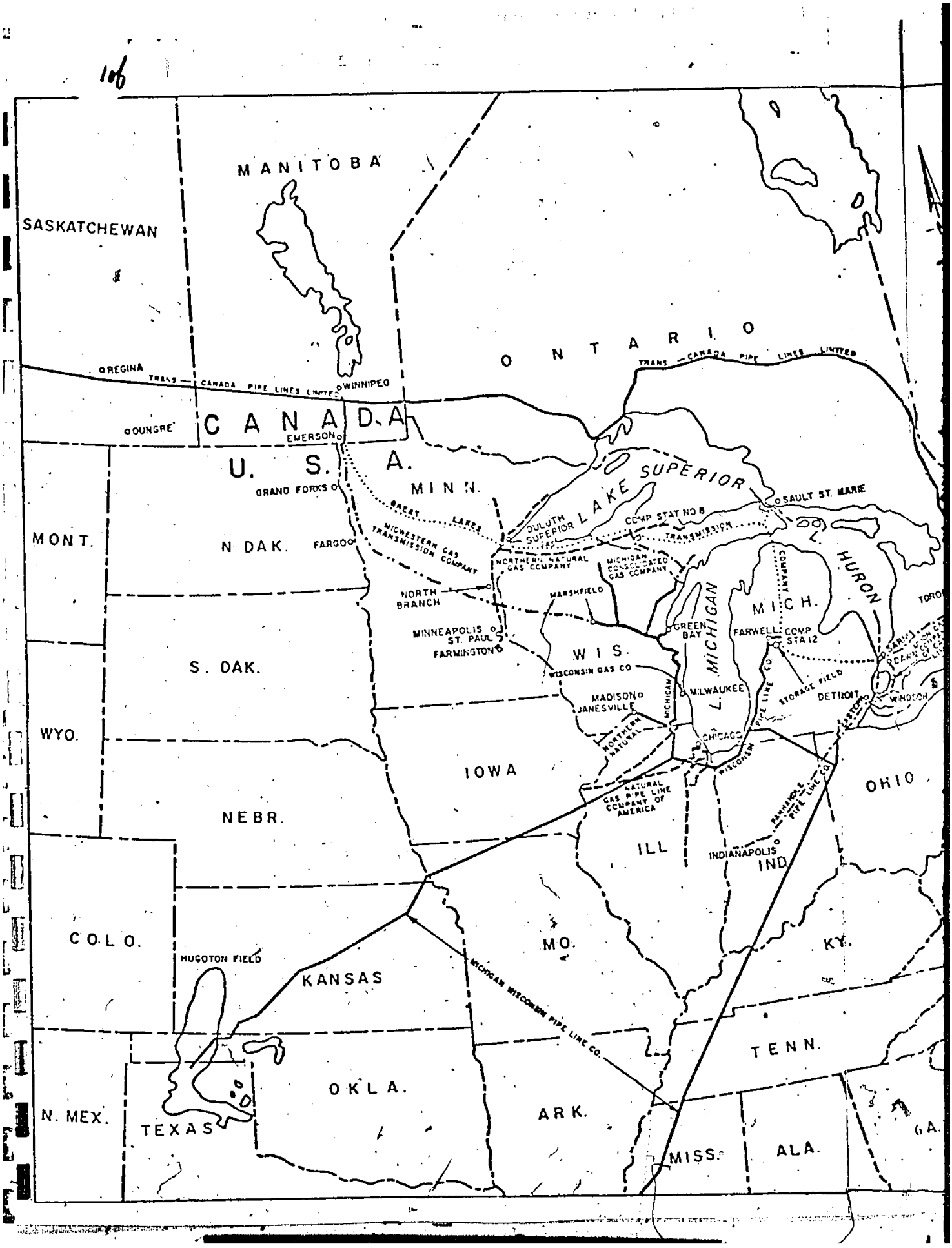

1973 SUPPLY & DISPOSITION OF CRUDE, N.G.L. & PRODUCTS
(Thousands bbls./day)
MAP 2
SUPPLY
DOMESTIC CRUDE & N.G.L. 2118
FOREIGN CRUDE & PRODUCTS 957
3075
DISPOSITION
DOMESTIC CRUDE, N.G.L., & PRODUCTS 1745
EXPORTS - CRUDE N.G.L. & PRODUCTS 1344
STOCK CHANGE, ETC. -14
3075
CANADA
YUKON
N.W.T.
B.C.
ALTA.
SASK.
MAN.
ONTARIO
QUEBEC
N.B.
NFLD.
3
11
65
1795
289
14
8
170
13
268
128
65
63
2
427
580
242
944
59
Ottawa Valley Line
DIST. V (U.S.)
DIST. I-IV (U.S.)
7/FEB 1975
* for comparative pur-

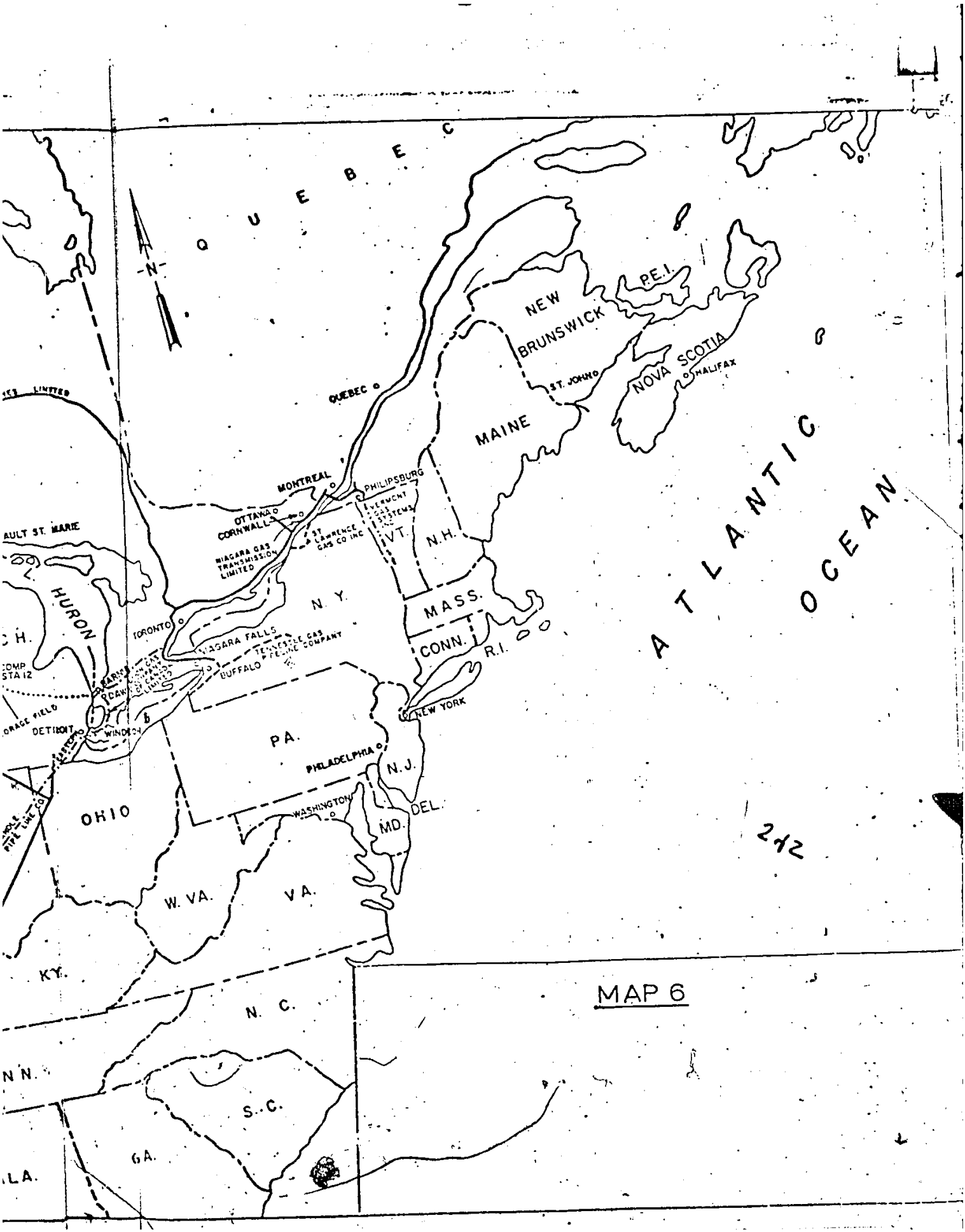

CANADIAN PETROLEUM BASINS
JLJ ESTIMATE OF GAS RESOURCES (TRILLION CU. FT.)
JLJ ESTIMATE OF OIL RESOURCES (BILLION BARRELS)
MAP 3
LEGEND
1 SVERDRUP BASIN
2 ARCTIC FOLD BELT
3 ARCTIC STABLE PLATFORM
4 ARCTIC COASTAL PLAIN (North)
5 BEAUFORT-MACKENZIE
6 MAINLAND, N.W.T.
7 ALTA, SASK, MAN.
8 N.E. BRITISH COLUMBIA
9 BOWSER BASIN
10 WEST COAST OFFSHORE
11 SCOTIAN BASIN (incl. Sydney Basin)
12 AVALON UPLIFT & FLEMISH CAP
13 EAST NEWFOUNDLAND BASIN
14 LABRADOR SHELF AND SLOPE
15 BAFFIN ISLAND SHELF & SLOPE
16 HUDSON PLATFORM
17 ST LAWRENCE PLATFORM
18 MARITIME BASINS
ALASKA (USA)
YUKON
N.W.T.
B.C.
ALTA
SASK.
MAN.
ONT.
QUE.
NFLD.
NB
Edm.
Regina
Winn.
Montreal
Toronto
500 MILES
GAS: JLJ Undiscovered 325.2 Discovered 104.5 = 429.7
OIL: 2. 40.0 3. 16.1 = 56.1
2. Conventional not including Tar Sands.
3. 75% of which is concentrated in very difficult areas (i.e. offshore/ice prone)
1 See Table III For comparative Geol. Survey
LZ/FEB., 1975

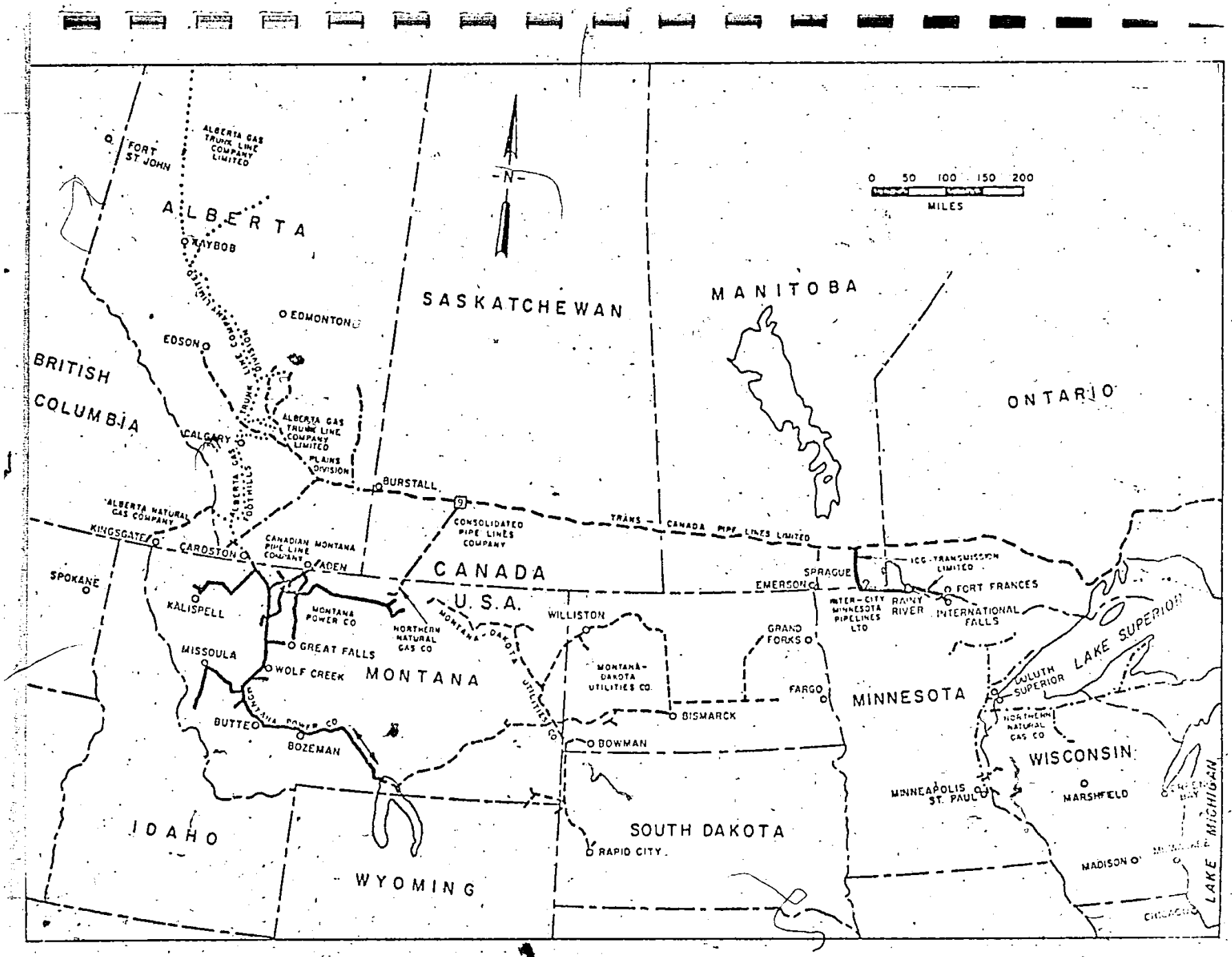

"BEST BET (1980)" *
HYDROCARBON PRODUCTION
(NEW)
CANADA
MAP 4
*most probable areas of development by 1980-1985 (see notes below)
① W. CANADA SEDIMENTARY BASIN
ⓐ MACKENZIE VALLEY
ⓑ BEAUFORT SEA
② ARCTIC ISLANDS
③ ATLANTIC OFFSHORE AREAS
④ GULF OF ST. LAWRENCE & MARITIMES
⑤ SOUTHERN ONTARIO
⑥ HUDSON BAY REGION
⑦ PACIFIC OFFSHORE AREAS
⑧ BRITISH COLUMBIA INTERIOR
ARCTIC OCEAN
(1b)
B
M
(1a)
A
②
YUKON
N.W.T.
⑧
B.C.
ALTA.
⑦
⑧
①
SASK.
MAN.
⑥
QUEBEC
L
COAL
WASH.
IDAHO
MONTANA
COAL
ONTARIO
N.DAKOTA
MINN.
N.B.
SABLE ISL.
N.FLD.
④
③
⑤
ATLANTIC OCEAN
Notes:
(1.) M(1a) = Gas province(?) 4-6 tcf (1975) Reserves
(2.) B (1b) = OIL province(?) nil (1974)
(3.) A = Gas province 9-12 tcf (1974)
(4.) L = Gas province(?) possible (1974)
(5.) T = Tar sands +$2B / 125 mbbl/d. plt. (1974$)
1 OIL potential exists, see Map 3
LZ/Feb. 1975


MAP 5
WHITEHORSE YUKON
NORTHWEST TERRITORIES
BEAVER RIVER
FORT NELSON
BRITISH COLUMBIA
PACIFIC NORTHERN GAS LTD.
PRINCE RUPERT
WESTCOAST TRANSMISSION COMPANY LIMITED
FORT ST. JOHN
ALBERTA GAS TRUNK LINE COMPANY LIMITED
ALBERTA
KAYBOB
EDMONTON
SASKATCHEWAN
MANITOBA
EDSON
CALGARY
ALBERTA GAS TRUNK LINE COMPANY LIMITED PLAINS DIVISION
BURSTALL
REGINA
TRANS-CANADA PIPE LINES LIMITED
VANCOUVER
VICTORIA
HUNTINGDON
ALBERTA NATURAL GAS COMPANY
KINGSGATE
WASHINGTON
SEATTLE
SPOKANE
CANADA
CUT BANK
CANADIAN MONTANA PIPE LINE COMPANY
ADEN
WILLOW CREEK
OUNGRE
MONTANA POWER COMPANY
U.S.A.
N


PACIFIC OCEAN
VICTORIA
HUNTINGDON
KINGSGATE
WASHINGTON
SEATTLE
SPOKANE
ALBERTA NATURAL GAS COMPANY
CANADA
PURSTALL
REGINA
TRANS - CANADA PIPE LINES LIMITED
CUT BANK
WILLOW CREEK
OUNGRE
U.S.A.
PORTLAND
EL PASO
MONTANA
MONTANA-DAKOTA UTILITIES CO.
N. DAK.
FARGO
OREGON
IDAHO
S. DAK.
WYOMING
NEBR.
COLORADO INTERSTATE GAS COMPANY
SOUTHWEST GAS CORP.
RENO
CARSON CITY
NEVADA
UTAH
COLO.
KANSAS
SAN FRANCISCO
ANTIOCH
MILPITAS
CALIFORNIA
ANADARKO BASIN
DURANGO
IGNACIO
SAN JUAN BASIN
GALLUP
NEW MEXICO
OKLA
TOPOCK
LOS ANGELES
ARIZONA
TEXAS
ROSWELL
PERMIAN BASIN


MANITOBA
SASKATCHEWAN
ONTARIO
REGINA
TRANS — CANADA PIPE LINES LIMITED
WINNIPEG
TRANS — CANADA PIPE LINES LIMITED
OUNGRE
CANADA
EMERSON
U. S. A.
GRAND FORKS
MINN.
LAKE SUPERIOR
SAULT ST. MARIE
MONT.
N DAK.
FARGO
GREAT LAKES
DULUTH SUPERIOR
COMP STAT NO 8
TRANSMISSION
NORTHERN NATURAL GAS COMPANY
MICHIGAN CONSOLIDATED GAS COMPANY
L. HURON
L. MICHIGAN
MICH.
NORTH BRANCH
MARSHFIELD
MINNEAPOLIS
ST. PAUL
FARMINGTON
GREEN BAY
FARWELL COMP STA 12
S. DAK.
WIS.
WISCONSIN GAS CO
MILWAUKEE
DETROIT
WINDSOR
MADISON
JANESVILLE
WYO.
CHICAGO
IOWA
OHIO
NEBR.
ILL
INDIANAPOLIS
IND
COLO.
HUGOTON FIELD
KANSAS
MO.
KY.
TENN.
OKLA.
N. MEX.
TEXAS
ARK.
MISS.
ALA.
GA.


QUEBEC
NEW BRUNSWICK
P.E.I.
NOVA SCOTIA
HALIFAX
ST. JOHN
QUEBEC
MAINE
MONTREAL
PHILIPSBURG
OTTAWA
CORNWALL
VERMONT GAS SYSTEMS INC.
ST. LAWRENCE GAS CO. INC
NIAGARA GAS TRANSMISSION LIMITED
VT.
N.H.
ATLANTIC OCEAN
SAULT ST. MARIE
L. HURON
TORONTO
N. Y.
MASS.
NIAGARA FALLS
TENNESSEE GAS PIPELINE COMPANY
BUFFALO
CONN.
R.I.
NEW YORK
DETROIT
WINDSOR
PA.
PHILADELPHIA
N.J.
OHIO
WASHINGTON
DEL.
MD.
W. VA.
VA.
KY.
N. C.
S. C.
GA.
MAP 6



SUBJECT

CALCULATION SHEET

SHEET ____ OF ____

DATE

MAP 7

CANADIAN NATURAL GAS FIELDS PRODUCING 10 MILLION MCF* OR MORE, 1970-73[1]

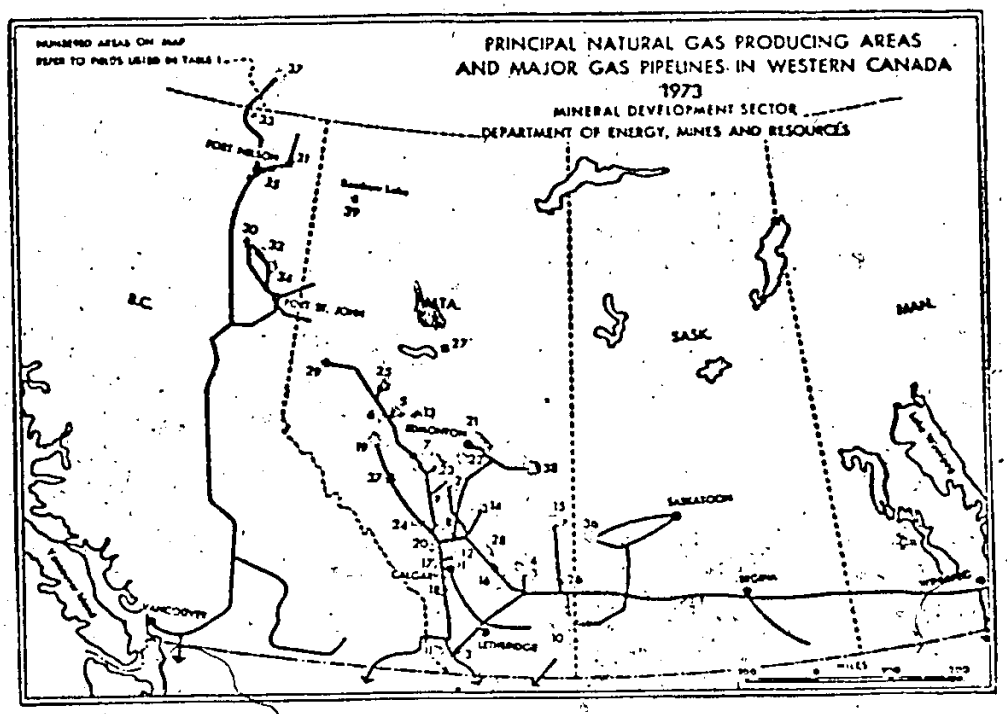


TABLE I

(Numbers in brackets refer to map locations.)	1970 (mcf)	1971 (mcf)	1972 (mcf)	1973 (mcf)
Alberta				
Kaybob South (25)	95,113,312	107,036,467	233,232,850	267,225,694
Crossfield (1)	154,367,756	159,710,434	158,464,089	154,279,622
Edson (19)	105,121,126	104,855,819	112,332,520	113,778,479
Waterton (11)	94,857,498	92,828,621	148,011,507	130,983,507
Westerose South (2)	93,296,817	92,446,598	88,294,063	82,745,152
Strachan (24)	421,838	70,973,782	112,166,610	107,699,917
Windfall (5)	76,051,777	61,749,368	68,506,660	55,586,490
Medicine Hat (10)	61,807,677	58,408,954	63,981,930	69,646,474
Harmattan-East (8)	50,911,678	54,190,550	53,851,992	63,178,812
Homeglen-Rimbey (9)	51,490,694	51,589,250	50,169,120	46,812,193
Harmattan-Elkton (8)	50,121,890	49,775,970	63,128,991	79,266,610
Pembina (7)	45,378,692	47,878,145	46,167,579	42,994,892
Cessford (4)	48,215,969	46,916,812	44,535,215	42,295,492
Marten Hills (27)	37,688,147	46,585,466	48,276,078	45,651,078
Brazeau River (37)	38,773,018	45,074,337	47,159,152	53,639,078
Carstairs (12)	48,805,481	45,515,514	49,296,115	49,000,161
Gilby (9)	45,218,834	44,653,479	46,854,919	48,162,805
Provost (15)	41,681,555	41,795,492	41,013,368	39,588,864
Nevis (14)	41,302,333	41,127,918	44,610,904	46,093,473
Jumping Pound West (17)	28,159,621	41,107,454	64,530,769	40,887,844
Wildcat Hills (20)	34,428,750	37,135,014	34,869,441	35,722,376
Ferrier (8)	32,348,996	34,159,999	34,212,335	34,756,330
Kaybob (25)	26,195,788	31,931,890	31,565,311	29,302,526
Carson Creek (13)	25,612,079	27,401,853	20,444,361	16,765,108
Ghost Pine (28)	28,529,412	26,742,698	26,575,010	25,203,076
Minnehik-Buck Lake (23)	22,513,798	25,381,260	28,592,820	31,528,694
Sylvan Lake (2)	23,433,959	22,178,062	23,493,926	23,409,458
Quirk Creek (18)	30,800	22,020,011	23,671,030	22,701,433
Lookout Butte (3)	24,509,944	21,770,492	20,584,867	18,674,348
Judy Creek (13)	20,406,621	21,316,793	21,992,600	34,887,249
[illegible] (29)	18,404,[illegible]	19,540,601	23,859,247	29,334,732

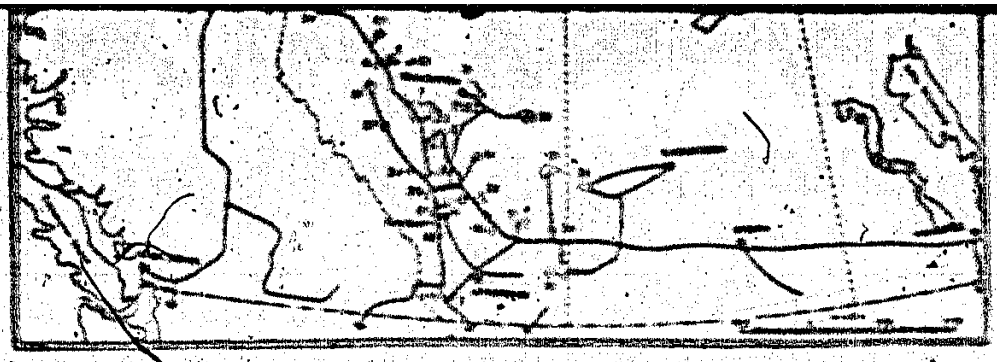


TABLE I

(Numbers in brackets refer to map locations.)	1970 (mcf)	1971 (mcf)	1972 (mcf)	1973 (mcf)
Alberta				
Kaybob South (22)	95,113,012	107,030,407	233,[illegible]32,850	247,225,694
Crossfield (1)	154,367,756	159,710,434	154,[illegible]64,089	136,279,622
Edson (19)	105,121,126	104,855,819	112,332,523	113,778,474
Waterton (11)	94,857,498	92,829,621	148,011,507	130,983,507
Westerose South (2)	93,296,817	92,444,596	88,294,083	82,749,[illegible]10
Strachan (24)	421,838	70,973,782	112,166,510	103,[illegible]06,91
Windfall (5)	76,051,777	61,749,[illegible]68	68,506,660	55,586,490
Medicine Hat (10)	61,807,677	58,408,9[illegible]	63,981,930	69,648,[illegible]74
Harmattan-East (6)	50,911,678	54,190,5[illegible]	5[illegible],851,[illegible]	63,176,812
Homeglen-Rimbey (9)	51,490,694	51,589,2[illegible]	50,166,120	48,812,193
Harmattan-Elkton (8)	50,121,890	49,775,970	63,128,991	79,216,610
Pembina (7)	45,376,692	47,878,143	46,167,[illegible]79	42,984,892
Ceasiord (4)	48,215,969	46,916,812	4[illegible],533,215	42,295,492
Marten Hills (27)	37,688,147	46,585,466	45,[illegible]76,028	45,651,078
Brazeau River (37)	38,773,018	45,074,337	47,159,152	51,639,078
Carstairs (12)	48,805,481	45,515,514	49,296,115	49,000,261
Gilby (9)	45,218,834	44,653,479	46,854,919	48,162,805
Provost (15)	41,681,555	41,795,492	41,013,366	39,588,866
Bevis (14)	41,302,333	41,127,918	44,610,904	46,093,473
Jumping Pound West (17)	28,159,621	41,107,454	64,330,769	40,887,844
Wildcat Hills (20)	34,428,750	37,135,014	34,869,641	35,702,574
Ferrier (8)	32,348,996	34,159,999	34,212,335	34,736,330
Kaybob (25)	26,195,788	31,931,890	31,565,311	29,302,524
Carson Creek (13)	25,612,079	27,401,853	20,464,361	16,765,109
Ghost Pine (28)	28,529,412	26,742,698	24,575,010	25,283,076
Minnehik-Buck Lake (23)	22,513,798	25,381,260	28,592,820	31,328,694
Sylvan Lake (2)	23,433,959	22,178,062	23,493,926	23,409,458
Quirk Creek (18)	30,800	22,020,011	23,671,030	22,701,433
Lookout Butte (3)	24,509,944	21,773,492	20,364,867	18,674,048
Judy Creek (13)	20,406,621	21,316,793	21,962,800	24,867,249
Rainbow (39)	18,404,128	19,540,601	23,859,247	29,334,732
Hussar (16)	20,880,820	18,715,968	17,829,790	18,611,439
Bigstone (25)	17,806,972	18,476,865	17,568,897	14,513,273
Bearlock (21)	16,233,419	18,474,273	21,371,589	24,583,526
Jumping Pound (17)	19,255,284	18,376,782	16,256,157	18,530,252
Swan Hills (13)	17,448,125	17,648,812	20,952,107	26,826,335
Pine Creek (5)	22,003,808	16,627,350	17,117,760	14,669,580

CANADIAN NATURAL GAS FIELDS PRODUCING 10 MILLION MCF* OR MORE, 1970-73 (cont'd)

	1970 (mcf)	1971 (mcf)	1972 (mcf)	1973 (mcf)
Viking-Kinsella (28)	14,435,436	16,093,557	13,917,053	22,477,067
Come First Creek (1)	14,476,038	15,250,404	22,297,208	23,552,816
Pemberton (12)	14,914,607	15,761,814	15,786,604	16,634,039
Bindloss (26)	13,814,042	14,733,799	13,482,224	13,589,702
Alderson (14)	13,188,021	14,071,950	18,041,611	22,087,214
Olds (11)	13,615,791	13,442,167	12,862,065	11,667,332
Fort Saskatchewan (21)	14,151,466	13,398,910	13,608,705	13,729,399
Wayne-Rosedale (3)	13,021,798	12,411,535	11,469,091	12,117,379
Turner Valley (18)	12,685,042	12,350,423	10,370,982	9,351,449
Countess (16)	12,135,735	12,103,510	13,482,369	13,552,944
Pincher Creek (3)	13,611,416	11,336,328	9,827,204	8,911,915
Gold Creek (29)	7,459,936	10,974,035	5,433,098	5,641,799
Bonnie Glen (22)	9,202,189	10,858,128	13,185,243	19,787,803
Atlee Buffalo (23)	5,192,861	10,604,212	10,004,611	9,106,180
Swan Hills South (13)	8,161,170	10,472,103	13,307,253	13,792,937
Okotoks (15)	9,162,357	10,186,366	8,975,121	9,044,617
Richmond West (24)	302,167	317,235	55,646,371	98,203,952
Dunnegan	--	--	--	32,566,544
Carson Creek North (13)	10,003,714	8,504,826	11,377,728	14,412,826
Richlands	549,148	642,541	1,169,184	14,189,377
Garrett Timber (25)	2,799,095	9,680,635	12,674,381	13,749,591
Wizard Lake	6,332,193	6,446,139	9,087,217	13,721,735
Ladder-Woodbend (22)	8,480,469	9,427,341	11,909,264	13,444,312
Craigend (27)	8,898,519	9,559,217	12,659,891	12,634,625
Beaverhill Lake	8,423,368	8,274,183	8,583,027	12,020,369
Whitecourt	10,670,342	9,715,287	10,990,039	11,197,435
Bruce	--	--	734,787	10,438,670
Medicine River	6,771,810	6,651,545	8,936,117	10,370,107
Mitsue	5,931,217	7,248,011	8,533,755	10,198,170
Pend Oreille	9,632,156	9,245,951	8,338,009	10,041,715
British Columbia				
Clark Lake (35)	104,278,387	94,112,798	104,204,239	124,289,024
Yo Yo (31)	48,064,498	37,462,939	68,259,702	71,990,208
Laprise Creek (30)	25,908,115	24,175,857	23,267,368	24,802,043
Rigel (34)	16,791,212	22,805,490	24,471,087	22,137,141
Big Creek (32)	16,584,423	17,756,522	15,123,824	14,177,853
Jedney (30)	17,311,108	16,764,879	14,485,528	14,605,196
Sierra (31)	9,886,456	15,969,175	16,811,280	22,676,669
Stoddart (34)	12,635,773	15,602,264	13,943,636	12,192,767
Beaver River (33)	--	12,520,830	68,251,540	58,151,696
Buick Creek (32)	10,768,622	11,246,207	9,767,941	12,400,690
Siphon	--	--	--	13,315,732
Saskatchewan				
Coleville-Smiley (36)	12,339,918	11,662,481	7,342,189	6,930,320
Northwest Territories				
Pointed Mountain (37)	--	---	---	34,261,563

Source: Canadian Minerals Yearbook, 1973; Provincial Government reports

* 14.65 psia

* mcf - 1,000 cubic feet

-- Nil

Fort Saskatchewan	[illegible]	[illegible]	[illegible]	[illegible]
Wayne-Rosedale (1)	13,021,798	12,411,531	11,469,091	11,217,379
Turner Valley (16)	12,885,042	12,350,423	10,370,962	9,551,449
Countess (14)	12,175,735	12,103,310	12,482,369	13,552,944
Pincher Creek (3)	13,611,416	11,336,328	9,627,204	8,911,915
Cold Creek (29)	7,459,936	10,474,035	5,433,098	5,641,799
Jumping Pound (2)	9,202,187	10,838,421	10,181,042	19,761,670
Acton Buffalo (25)	5,192,861	10,434,212	10,004,811	9,100,180
Swan Hills South (33)	8,161,170	10,472,101	10,177,253	15,797,631
Okotoks (18)	9,162,353	10,166,568	8,975,121	9,044,640
Elkton West (24)	302,167	117,233	55,648,371	98,209,952
Dunnegan	--	--	--	32,566,564
Carson Creek North (13)	10,903,716	8,304,826	11,377,728	16,412,824
Elkton	349,148	642,541	1,169,164	14,189,377
Burnt Timber (20)	2,799,093	9,680,635	12,474,3[illegible]	13,749,591
Wizard Lake	6,332,193	8,441,139	9,087,11[illegible]	13,721,735
Leduc-Woodbend (12)	8,480,469	9,427,341	10,900,264	13,444,312
Craigend (27)	8,898,319	9,559,217	12,639,891	12,634,115
Beaverhill Lake	8,423,364	8,174,183	8,593,027	12,020,364
Whitecourt	10,670,342	9,715,287	10,990,039	11,197,431
Bruce	--	--	334,781	10,458,670
Medicine River	6,771,810	6,631,545	8,936,117	10,370,107
Nitsua	5,931,217	7,246,011	8,533,715	10,194,170
Pembina	9,632,156	9,243,951	8,338,009	10,041,715
British Columbia				
Clark Lake (35)	104,228,387	94,112,764	104,204,239	124,289,824
Ya Ya (31)	48,064,491	37,442,955	66,259,702	71,999,[illegible]
Laprise Creek (36)	25,908,111	24,175,557	23,917,243	24,802,043
Rigel (34)	16,791,212	22,805,490	24,471,087	22,137,[illegible]
Big Creek (32)	16,584,423	17,756,522	15,123,824	14,177,[illegible]
Jedney (30)	17,311,108	16,764,879	14,485,228	14,608,[illegible]
Sierra (31)	9,866,456	13,[illegible]9,175	16,811,260	22,671,[illegible]
Stoddart (34)	12,635,771	15,622,2[illegible]	13,943,[illegible]	12,192,767
Beaver River (33)	--	12,520,830	18,231,5[illegible]	58,151,[illegible]
Buick Creek (32)	10,768,623	11,246,207	9,767,941	12,400,690
Siphon	--	--	--	13,313,732
Saskatchewan				
Colonville-Smiley (36)	12,339,916	11,662,481	7,342,189	6,930,[illegible]
Northwest Territories				
Pointed Mountain (37)	--	---	---	34,251,[illegible]

Source: Canadian Minerals Yearbook, 1973; Provincial Government reports

1 14.65 psia

mcf - 1,000 cubic feet

-- Nil

L.Z./Feb.,1975.

PRODUCTION OF CRUDE OIL AND CONDENSATE BY PROVINCE AND FIELD, 1971-73

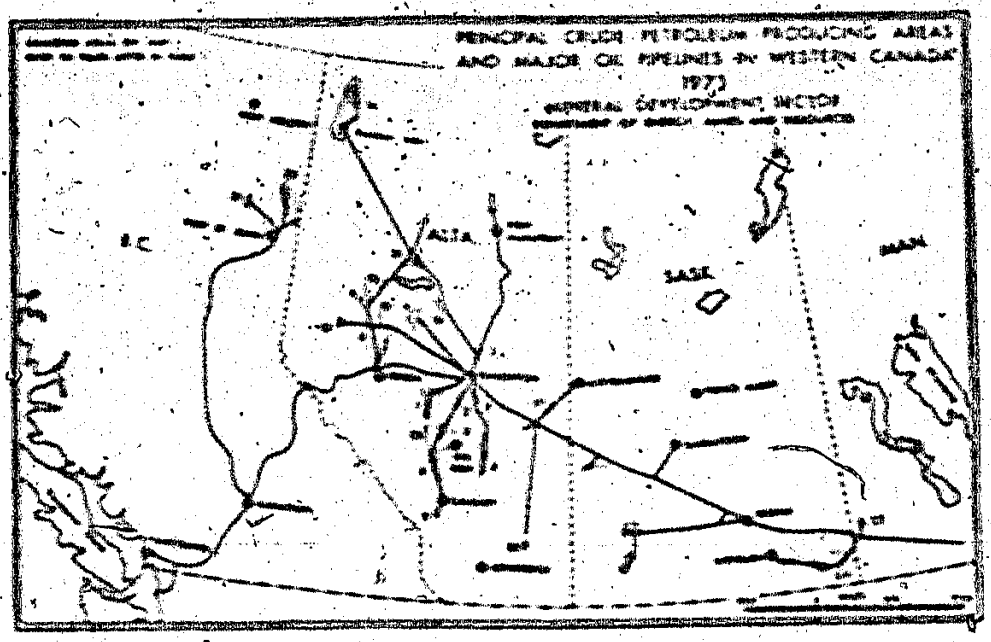


TABLE II

(Numbers in parentheses gives location of field on accompanying map.)

	1971 (barrels)	1972 (barrels)	1973 (barrels)	1974* (barrels)
Alberta				
Pembina (1)	53,872,369	50,680,729	46,688,219	
Swan Hills(4)	32,975,072	38,478,226	42,058,089	
Redwater(3)	23,077,286	31,420,047	45,250,954	
Rainbow(14)	24,185,186	29,380,584	35,908,669	
Judy Creek	17,702,358	22,571,208	33,700,842	
Bonnie Glen(2)	14,328,615	18,718,954	27,034,322	
Swan Hills South(4)	14,334,794	17,667,206	18,127,579	
Wizard Lake(2)	11,547,117	17,482,568	22,931,225	
Mitsue(16)	13,506,248	15,480,751	18,163,616	
Nipisi(19)	10,740,108	14,800,762	19,016,297	
Golden Spike(2)	12,994,331	13,159,318	17,647,408	
Penn Big Valley(8)	7,769,951	9,926,906	11,266,238	
Leduc Woodbend(2)	6,228,327	7,453,623	8,981,388	
Carson Creek North(4)	5,242,478	6,996,730	9,369,317	
Zama(14)	4,095,681	5,924,888	6,062,504	
Sturgeon Lake South	4,507,315	5,724,469	5,442,336	
Westerose(2)	3,231,017	5,588,629	7,462,662	
Willesden Green(13)	5,093,679	5,520,209	5,384,423	
Kaybob(10)	4,410,848	5,181,156	5,900,234	
Acheson(2)	3,620,791	4,243,502	4,800,729	
Harmattan East(6)	2,672,928	3,274,400	4,315,807	
Joffre(5)	2,588,423	3,168,864	1,825,405	
Virgo(14)	2,574,231	3,160,251	3,592,584	
Snipe Lake	2,827,630	3,148,139	3,162,823	
Kaybob South(10)	2,521,979	3,136,215	4,370,904	
Simonette(15)	1,552,384	3,026,657	2,351,353	
Rainbow South(14)	3,172,882	2,938,790	3,813,402	

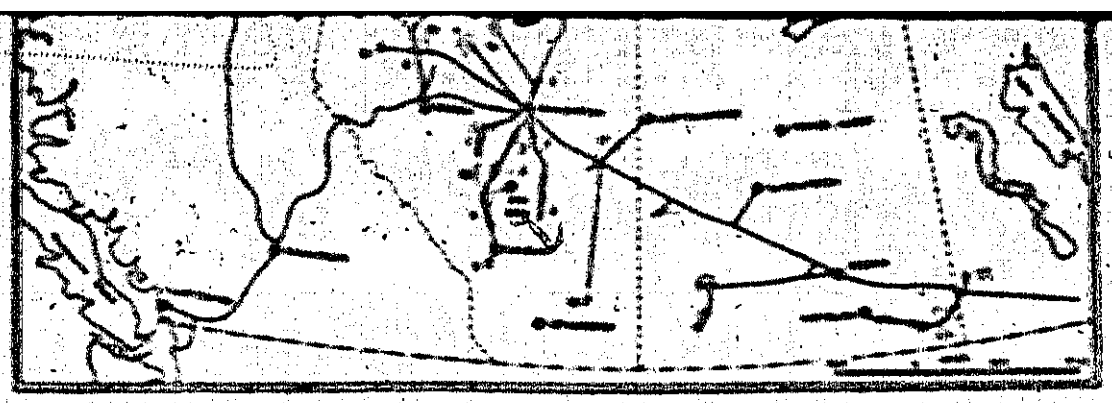


TABLE II

(Numbers in parenthesis gives location of field on accompanying map.)

	1971 (barrels)	1972 (barrels)	1973p (barrels)	1974e (barrels)
Alberta				
Pembina (1)	53,872,369	50,380,729	46,688,219	
Swan Hills(4)	32,975,072	38,478,226	47,058,089	
Redwater(3)	23,077,286	31,420,047	45,250,954	
Rainbow(14)	24,185,186	29,380,584	35,908,669	
Judy Creek	17,702,358	22,571,208	33,700,842	
Bonnie Glen(2)	14,328,615	18,718,954	27,034,322	
Swan Hills South(4)	14,334,794	17,667,206	18,127,579	
Wizard Lake(2)	11,547,117	17,482,568	22,931,225	
Mitsue(16)	13,504,248	15,480,751	18,163,616	
Nipisi(19)	10,740,108	14,800,762	19,016,297	
Golden Spike(2)	11,994,551	13,159,318	17,647,408	
Fenn Big Valley(8)	7,769,951	9,926,906	11,266,238	
Leduc Woodbend(2)	6,228,327	7,453,623	8,981,388	
Carson Creek North(4)	5,242,678	6,996,730	9,369,317	
Zama(14)	4,095,681	5,924,888	6,062,504	
Sturgeon Lake South	4,507,375	5,724,469	5,442,336	
Westerose(2)	3,231,017	5,588,629	7,462,662	
Willesden Green(13)	5,093,679	5,520,209	5,384,423	
Kaybob(10)	4,410,848	5,181,156	5,900,234	
Acheson(2)	3,620,791	4,243,502	4,800,729	
Harmattan East(6)	2,672,928	3,274,400	4,315,807	
Joffre(5)	2,588,423	3,168,864	1,825,405	
Virgo(14)	2,574,232	3,160,251	3,592,584	
Snipe Lake	2,827,630	3,148,130	3,162,825	
Kaybob South(10)	2,521,979	3,136,213	4,370,904	
Simonette(15)	1,552,384	3,026,657	2,351,353	
Rainbow South(14)	3,172,882	2,938,790	3,813,472	
Innisfail(6)	2,383,100	2,938,123	3,427,349	
Jocarcam (7)	2,348,232	2,804,369	3,370,962	
Medicine River(13)	2,090,663	2,547,827	2,988,744	
Clive	2,326,404	2,473,196	2,105,714	
Wainwright(17)	2,402,600	2,427,875	2,427,824	

.../cont'd.

PRODUCTION OF CRUDE OIL (Cont'd.)

	1971 (barrels)	1972 (barrels)	1973 (barrels)	1974* (barrels)
Countess	1,065,457	2,406,433	4,796,181	
Provost	1,967,032	2,569,391	2,648,566	
Goose River	1,938,208	2,332,087	2,242,803	
Harmattan Elkton(6)	1,777,909	2,321,189	2,763,480	
Gilby(5)	1,761,096	2,178,930	2,100,898	
Bantry(18)	2,376,645	2,086,656	2,381,649	
Bellshill Lake	1,735,739	2,003,337	3,095,836	
Stettler	1,258,183	1,606,624	1,671,080	
Grand Forks	539,696	1,300,040	1,391,209	
Ferrier	1,178,221	1,283,668	1,447,091	
Sundre	1,132,326	1,274,010	1,525,398	
Sylvan Lake	1,038,074	1,180,885	1,301,214	
Taber South	1,356,414	1,149,252	1,422,342	
Cessford	1,018,990	1,067,658	1,130,934	
Munson	885,261	1,058,628	1,299,301	
West Drumheller	817,004	1,028,642	1,400,166	
Turner Valley (11)	1,069,745	1,012,308	1,092,830	
Other fields and pools	46,661,414	55,659,191	74,003,856	
Total	371,500,922	444,984,164	541,686,850	
Saskatchewan[1] Total	88,458,641	66,787,209	85,889,079	
British Columbia				
Boundary Lake(20)	9,703,989	9,426,811	8,643,244	
Peejay(20)	4,425,895	3,789,160	3,118,148	
Inga(21)	3,269,940	3,693,241	3,087,267	
Milligan Creek(20)	3,152,309	2,443,156	2,115,934	
Other fields	4,710,997	4,583,607	4,351,674	
Total	25,263,130	23,935,975	21,316,267	
Manitoba				
North Virden Scallion(22)	2,775,062	2,819,531	2,442,489	
Virden-Roselea(22)	1,388,623	1,345,361	1,289,758	
Other Fields	1,440,886	1,292,047	1,351,652	
Total	5,604,571	5,256,939	5,083,899	
Ontario Total	958,104	877,965	808,323	
Northwest Territories Total	944,083	890,067	962,733	
New Brunswick Total	9,598	8,714	9,920	
Canada Total	492,739,049 (1,349,9703/D)	561,736,934 (1,535,4563/D)	655,757,071 (1,796,5943/D)	

Source: EMR, Provincial government reports, and Statistics Canada,

formation rather than by field

Stettler	1,258,183	1,606,124	1,871,080
Grand Forks	559,696	1,500,040	1,391,209
Ferrier	1,178,221	1,283,668	1,447,091
Sundre	1,132,326	1,274,010	1,525,398
Sylvan Lake	1,038,074	1,180,883	1,301,254
Taber South	1,356,414	1,149,252	1,422,342
Cessford	1,018,990	1,067,651	1,130,934
Bussor	885,261	1,058,628	1,299,301
West Drumheller	817,004	1,028,642	1,400,168
Turner Valley (11)	1,069,745	1,012,368	1,092,830
Other fields and pools	46,661,414	53,639,191	74,003,856
Total	371,900,922	444,984,104	541,686,850
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Inga(21)	3,269,940	3,693,241	3,087,267
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Other fields	4,710,997	4,583,607	4,351,674
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Manitoba			
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Total	5,604,571	5,256,939	5,083,899
Ontario			
Total	958,104	877,965	808,323
Northwest Territories			
Total	944,083	890,067	962,733
New Brunswick			
Total	9,598	8,714	9,920
Canada			
Total	492,739,049 (1,349,970B/D)	561,796,934 (1,535,456B/D)	655,757,071 (1,796,594B/D)

Source: ERCB; Provincial government reports, and Statistics Canada.
1 Saskatchewan lists production by formation rather than by field
* 1974 data not available at the time of writing
p Preliminary.

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TABLE III

COMPARISON OF G.S.C. 1973 and JLJ 1974[1]

CONVENTIONALLY PRODUCTIBLE GAS RESOURCES ESTIMATES

	Basin	Est. Ultimate Recoverable Marketable Gas Resources, TCF		'Most Likely' Reserves TCF
		G.S.C. 1973	JLJ 1974	JLJ 1974
1.	Sverdrup Basin			
	Land	118.8	28.0	8.3 JLJ 1974*
	Offshore	79.2	40.0	
2.	Arctic Fold Belt			
	Land	15.2	14.0	
	Offshore	6.8	7.0	
3.	Arctic Stable Platform			
	Land	0.6	1.0	
	Offshore	0.6	2.0	
4.	Arctic Coastal Plain (North)	20.8	21.0	
5.	Beaufort - MacKenzie			
	Land	50.0	10.5	4.7 JLJ 1974*
	Offshore	43.5	27.5	1.5 JLJ 1974
6.	Mainland N.W.T.	7.5	7.1	1.2 CPA 1973
7.	Alberta, Saskatchewan & Manitoba	82.2	102.8	75.3 ERCB & CPA 19
8.	N.E. British Columbia	21.4	17.0	12.0 CPA 1973
9.	Bowser Basin	5.6	1.0	
10.	Westcoast Offshore	3.6	2.5	
11.	Scotia Basin (inc. Sydney Basin)			
	Shelf	28.0	6.0	0.4?JLJ 1974
	Slope	42.1	6.0	
12.	Avalon Uplift & Flemish Cap			
	Shelf	1.9	1.0	
	Slope	12.9	3.0	
13.	East Newfoundland Basin			
	Shelf	60.9	21.0	
	Slope	31.3	33.0	
14.	Labrador Shelf & Slope	38.7	24.0	
15.	Baffin Island Shelf & Slope	91.3	48.0	
16.	Hudson Platform	7.3	3.0	
17.	St. Lawrence Platform	3.6	2.1	0.9 CPA 1973
18.	Maritime Basins	9.1	1.2	
	TOTALS	782.9	429.7	104.5

LIQUIDS TOTAL 2.661 Billion Barrels

* Figures compare with statements made by J.C. Sproule & Associates

1 JLJ Exploration Consultants Ltd.
G.S.C. - Geological Survey of Canada

SOURCE: Foothills Pipelines Ltd., Calgary, September, 1974
Submission (p.24) to the N.E.B. 1974--75 Gas Hearing

TABLE IV

NATURAL GAS DATA[1] - ALBERTA

lhead Price ural Gas ted c/Mcf)	Net Natural Gas Production (Mcf)	Natural Gas Revenues[2] ($ 000)	Cumulative Natural Gas Revenues ($000)	Investment[3] in Exploration & Development in Alberta ($Million)	Cumulative Investment[3] in Exploration & Development in Alberta ($Million)	Cumulative Initial Marketable Natural Gas Reserves in Alberta (Bcf)[4]
		0.0	0.0	25.5	0.00	0.00
5	37,696	2,648.	4,653.	60.5	86.00	11,701.00
3	40,810	2,559.	7,212.	112.	198.00	12,490.00
8	50,576	2,930.	10,142.	159.	357.00	13,340.00
1	57,028	3,494.	13,636.	180.	537.00	14,543.00
4	63,356	5,936.	19,572.	218.5	755.50	18,476.00
3	72,530	6,724.	26,296.	224.	979.50	21,354.00
2	87,075	8,038.	34,334.	260.5	1,240.00	26,728.00
4	106,539	9,976.	44,310.	315.5	1,555.50	29,151.00
6	113,875	10,960.	55,270.	376.	1,931.50	32,514.00
2	134,214	13,735.	69,005.	327.	2,258.50	36,087.00
8	186,048	20,080.	89,085.	340.5	2,599.00	39,315.00
6	251,071	24,010.	113,095.	342.5	2,941.50	44,251.00
7	321,487	31,300.	144,395.	353.5	3,295.00	45,992.00
0	421,239.	50,908.	195,303.	393.	3,688.00	52,613.00
7	621,274	78,869.	274,172.	321.1	4,009.10	55,182.00
9	693,277	90,563.	370,735.	356.7	4,365.80	57,007.00
6	777,412	113,193.	483,928.	410.8	4,776.60	57,821.00
4	853,235	122,514.	606,442.	497.7	5,274.30	59,200.00
0	901,856	135,465.	741,907.	492.6	5,766.90	59,679.00
5	972,540	150,562.	892,469.	584.9	6,351.80	61,896.00
5	1,101,660	170,961.	1,063,430.	[redacted]	6,947.30	62,624.00
4	1,303,848	200,408.	1,263,838.	[redacted]	7,573.70	64,652.00
0	1,521,751	243,877.	1,507,715.	608.4	8,182.10	64,972.00
8	1,686,997	266,289.	1,774,004.	648.3	8,830.40	65,359.00
6	1,852,399	307,471.	2,081,475.	680.7	9,461.10	65,999.00
7	1,970,634	367,680.	2,449,155.	688.2	10,149.30	66,276.00
		518,000.(P)	2,967,000.(P)			

s to this year rather than the actual figures should not
lot or time series calculations significantly.

l 60°F.
ide by-product revenues
nt in oil and gas.
.A.

L.E. Feb. 1979

TABLE IV

NATURAL GAS DATA[1] - ALBERTA

	Ave. Wellhead Price of Natural Gas (undeflated c/Mcf)	Net Natural Gas Production (Mcf)	Natural Gas Revenues[2] ($'000)	Cumulative Natural Gas Revenues ($000)	Investment[3] in Exploration & Development in Alberta ($Million)	Cumulative Investment Exploration Development Alberta
1947*			0.0	0.0	25.5	
1948	6.5	37,696	2,448.	4,653.	60.5	
1949	6.3	40,810	2,559.	7,212.	112.	
1950	5.8	50,576	2,930.	10,142.	159.	
1951	6.1	57,028	3,494.	13,636.	180.	
1952	9.4	63,356	5,936.	19,572.	218.5	
1953	9.3	72,530	6,724.	26,296.	224.	
1954	9.2	87,075	8,038.	34,334.	260.5	1.
1955	9.4	106,539	9,976.	44,310.	315.5	1.
1956	9.6	113,875	10,960.	55,270.	376.	1.
1957	10.2	134,214	13,735.	69,005.	327.	2.
1958	10.8	186,048	20,080.	89,085.	340.5	2.
1959	9.6	251,071	24,010.	113,095.	342.5	2.
1960	9.7	321,487	31,300.	144,395.	353.5	3.
1961	12.0	421,239	50,908.	195,303.	393.	3.
1962	12.7	621,274	78,869.	274,172.	321.1	4.
1963	13.9	693,277	96,563.	370,735.	356.7	4.
1964	14.6	777,412	113,193.	483,928.	410.8	4.
1965	14.4	853,235	122,514.	606,442.	497.7	5.
1966	15.0	901,856	135,465.	741,907.	492.6	5.
1967	15.5	972,540	150,562.	892,469.	584.9	6.
1968	15.5	1,101,660	170,961.	1,063,430.	595.5	6.
1969	15.4	1,303,848	200,408.	1,263,838.	626.4	7.
1970	16.0	1,521,751	243,877.	1,507,715.	608.4	8.
1971	15.8	1,686,997	266,289.	1,774,004.	648.3	8.
1972	16.6	1,852,399	307,471.	2,081,475.	630.7	9.
1973	18.7	1,970,634	367,680.	2,449,155.	688.2	10.
1974			518,000.(P)	2,967,000.(P)		

* Assigning zeros to this year rather than the actual figures should not affect the plot or time series calculations significantly.

P Preliminary

1 14.65psia and 60°F.

2 Does not include by-product revenues

3 Total investment in oil and gas.

SOURCE: C.P.A.

TABLE V

CRUDE OIL DATA - ALTA. & CDN.

DN. AD PRICE DE OIL LATED $/Bbl) (1)	ALTA. OIL PRODUCTION (BARRELS) (1)	CDN. CRUDE OIL PRODUCTION (BARRELS) (1)	NET CDN. PRODUCTION (M BARRELS) (1)	ALTA. CRUDE OIL & CONDENSATE REVENUES ($000) (1)	REMAINING CRUDE OIL RESERVES IN ALTA. (MMscb) (2)	REMAINING CRUDE OIL RESERVES IN CANADA (Mst BARRELS) (1)
	75,793,679	109,560,970				
.54	6,382,065	7,289,152		17,099		
.01	10,504,928	11,896,107		33,578	88	
.82	19,767,845	21,011,014		57,403	357	
.88	27,149,369	28,645,903		80,568	960	1,202,607
.49	45,836,143	47,535,067	47,318	115,809	1195	1,376,600
.33	58,836,653	61,161,442	60,500	139,658	1529	1,679,509
.46	76,702,091	80,780,345	80,910	193,118	1871	1,845,422
.55	87,593,065	95,959,826	95,616	228,012	2133	2,207,614
.35	112,853,132	129,259,866	127,507	274,708	2450	2,509,534
.36	143,682,076	171,757,574	169,321	355,682	2822	2,849,370
.50	136,766,453	181,126,516	181,753	358,554	2936	2,874,454
.41	112,471,393	164,677,785	166,045	285,922	2833	3,165,904
.31	128,801,649	183,602,170	183,739	312,295	3129	3,497,124
.27	130,601,127	189,615,106	191,104	318,418	3304	3,678,542
.28	157,640,801	220,647,208	221,028	379,984	3509	4,173,569
.23	165,187,031	244,202,958	244,883	388,483	3622	4,480,702
.38	168,671,330	258,098,253	256,487	424,785	3810	4,881,492
.45	175,370,560	274,577,617	270,799	450,322	5828	6,[illegible],646
.41	183,746,090	291,880,341	291,592	472,311	6077	6,711,237
.39	202,500,091	319,667,614	316,053	522,688	6760	7,791,751
.38	230,482,518	350,190,841	344,156	588,771	7129	8,168,924
.40	250,793,232	372,948,767	371,468	644,742	7632	8,381,613
.42	279,113,213	400,003,644	393,403	712,577	7695	8,619,805
.49	325,439,731	448,101,929	438,023	844,066	7601	8,558,980
.75	355,176,909	476,337,161	480,126	1,011,793	7385	8,330,08[illegible]
.77	424,431,230	542,005,208	518,020	1,210,465	7086	8,020,141
.41	522,240,857	636,039,982	625,659	1,822,517	6620	7,674,150
				3,300,000(P)	6300(P)	
	4,614,535,261	6318,579,766		12,244,328(Alta)*		
				16,024,531(Cdn.)*		

g 1974 preliminary figures.

1) C.P.A.
2) E.R.C.B.

L.Z./ Feb. 1975

TABLE V

CRUDE OIL DATA - ALTA. & CDN.

		AVE. CDN. WELLHEAD PRICE OF CRUDE OIL (UNDEFLATED $/Bbl) (1)	ALTA. OIL PRODUCTION (BARRELS) (1)	CDN. CRUDE OIL PRODUCTION (BARRELS) (1)	NET CDN. PRODUCTION (M BARRELS) (1)	ALTA. CRUDE OIL & CONDENSATE REVENUES ($000) (1)	REMAINING CRUDE OIL RESERVES IN ALTA. (MMstb) (2)
CUM to	1947		75,793,679	109,560,370		17,099	
	1947	2.54	6,382,065	7,289,152		33,578	88
	1948	3.01	10,504,928	11,896,107		57,403	357
	1949	2.82	19,767,845	21,011,014		80,568	960
	1950	2.80	27,149,369	28,645,903		115,809	1195
	1951	2.49	45,836,143	47,535,067	47,318	139,658	1529
	1952	2.33	58,836,653	61,161,442	60,500	193,118	1871
	1953	2.46	76,702,091	80,780,345	80,910	228,012	2133
	1954	2.53	87,593,065	95,959,826	95,616	274,708	2450
	1955	2.35	112,853,132	129,259,866	127,507	355,682	2822
	1956	2.36	143,682,076	171,757,574	169,321	358,554	2936
	1957	2.50	136,766,453	181,126,516	181,753	285,922	2833
	1958	2.41	112,471,393	164,677,785	166,045	312,295	3129
	1959	2.31	128,801,649	183,602,170	183,739	318,418	3304
	1960	2.27	130,601,127	189,615,106	191,104	379,984	3509
	1961	2.28	157,640,801	220,647,208	221,028	388,483	3622
	1962	2.23	165,187,031	244,202,958	244,883	424,785	3810
	1963	2.38	168,671,330	258,098,253	256,487	450,322	3828
	1964	2.43	175,370,560	274,577,617	270,799	472,311	6077
	1965	2.41	183,746,090	291,880,341	291,592	522,688	6760
	1966	2.39	202,500,091	319,667,614	316,053	588,771	7129
	1967	2.38	230,402,518	350,190,841	344,156	644,742	7632
	1968	2.40	250,793,232	372,948,767	371,468	712,577	7695
	1969	2.42	279,113,213	400,003,644	393,403	844,066	7601
	1970	2.49	325,439,731	448,101,929	438,023	1,011,793	7385
	1971	2.75	355,176,909	476,337,161	480,126	1,210,465	7086
	1972	2.77	424,431,230	542,005,208	518,020	1,822,517	6620
	1973	3.41	522,240,857	636,039,982	625,659	3,300,000(P)	6300(P)
	1974					12,244,328(Alta)*	
	TOTAL		4,614,535,261	6318,579,766		16,024,531(Cdn.)*	

* Not including 1974 preliminary figures.
P Preliminary
M Thousands
SOURCE: (1) C.P.A.
(2) E.R.C.B.

Canadian Price Indices

(1961=100 (seasonally adjusted))

U.S. Price Indices

(1961=100)

YEAR	(1) G.N.E. PRICE INDEX (D40514)	(1) (2) CONSUMER PRICE INDEX (EXCL. FOOD)	(3) WHOLESALE PRICE INDEX, TOTAL	(1) WHOLESALE PRICE INDEX, NON-FARM (D601010)	(4) WHOLESALE PRICE INDEX, ALL COMMODITIES*	(5) CRUDE OIL PRICE INDEX (0561)	(5) PETROLEUM PRODUCTS REFINED INDEX (057)
1953	87.8			93.4	92.5	90.7	95.3
1954	89.2	89.7 (2)		91.8	92.7	93.3	92.8
1955	89.7	90.1		94.5	92.9	93.4	94.7
1956	93.0	91.5	96.7	98.6	96.0	93.9	100.0
1957	95.0	93.8	97.4	98.7	98.7	103.5	107.1
1958	96.3	96.2	97.7	97.5	100.1	103.7	97.6
1959	98.3	98.1	98.8	98.7	100.3	100.3	97.1
1960	99.5	99.5	99.0	99.1	100.4	99.7	98.3
1961	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1962	101.4	101.0	102.9	102.4	100.3	100.2	98.9
1963	103.2	102.2 (1)	104.8	103.7	100.0	99.8	97.8
1964	105.8	104.1	105.2	105.5	100.2	99.4	93.3
1965	109.2	106.6	107.3	107.6	102.2	99.3	96.5
1966	114.1	109.6	111.2	109.7	105.6	100.0	100.2
1967	118.6	114.4	113.2	112.5	105.8	101.1	102.9
1968	122.4	119.4	115.7	116.4	108.5	101.9	100.9
1969	127.8	124.9	121.0	120.7	112.7	106.4	102.5
1970	133.9	129.6	122.8	123.1	116.8	107.3	104.0
1971	138.1	134.1	124.2	125.6	120.5	114.5	109.9
1972	144.7	139.1	133.0	132.7	126.0	115.1	112.0
1973	155.7	146.1	168.3	152.4	143.4	127.4	152.4
1974	176.0(EST.)	159.0	196.5	185.2	169,4	214.2	229.8

*Incl. Farm

SOURCE:
(1) BANK OF CANADA REVIEW, JANUARY 1975
(2) BANK OF CANADA ANNUAL REVIEW, 1969
(3) BANK OF CANADA, OTTAWA,
(4) U.S. DEPARTMENT OF COMMERCE
(5) U.S. BUREAU OF LABOUR

SUBJECT CAN./MEX. AND U.S. PRICE INDICES (1953/74)
PROJECT
LOCATION
DISCIPLINE
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DATE Dec 5, 1975
BY L. JARVSKY
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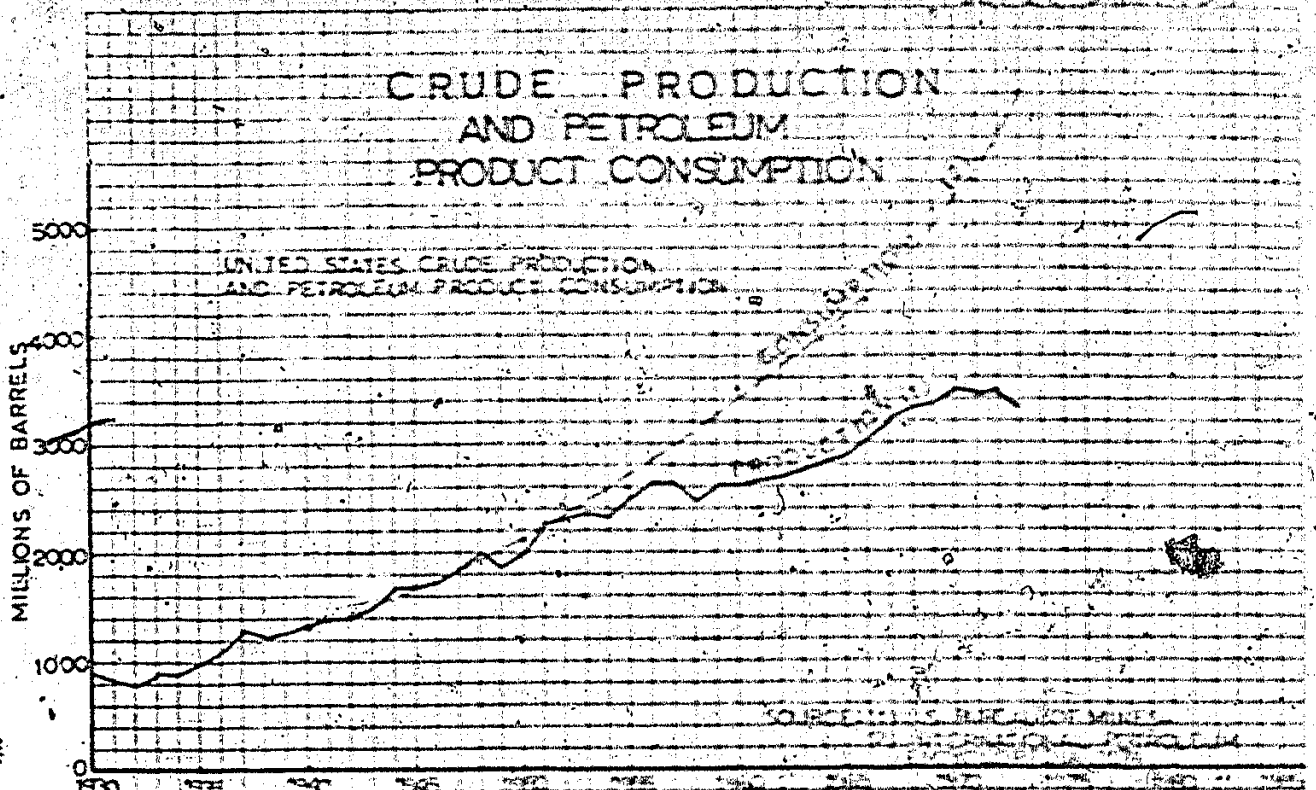
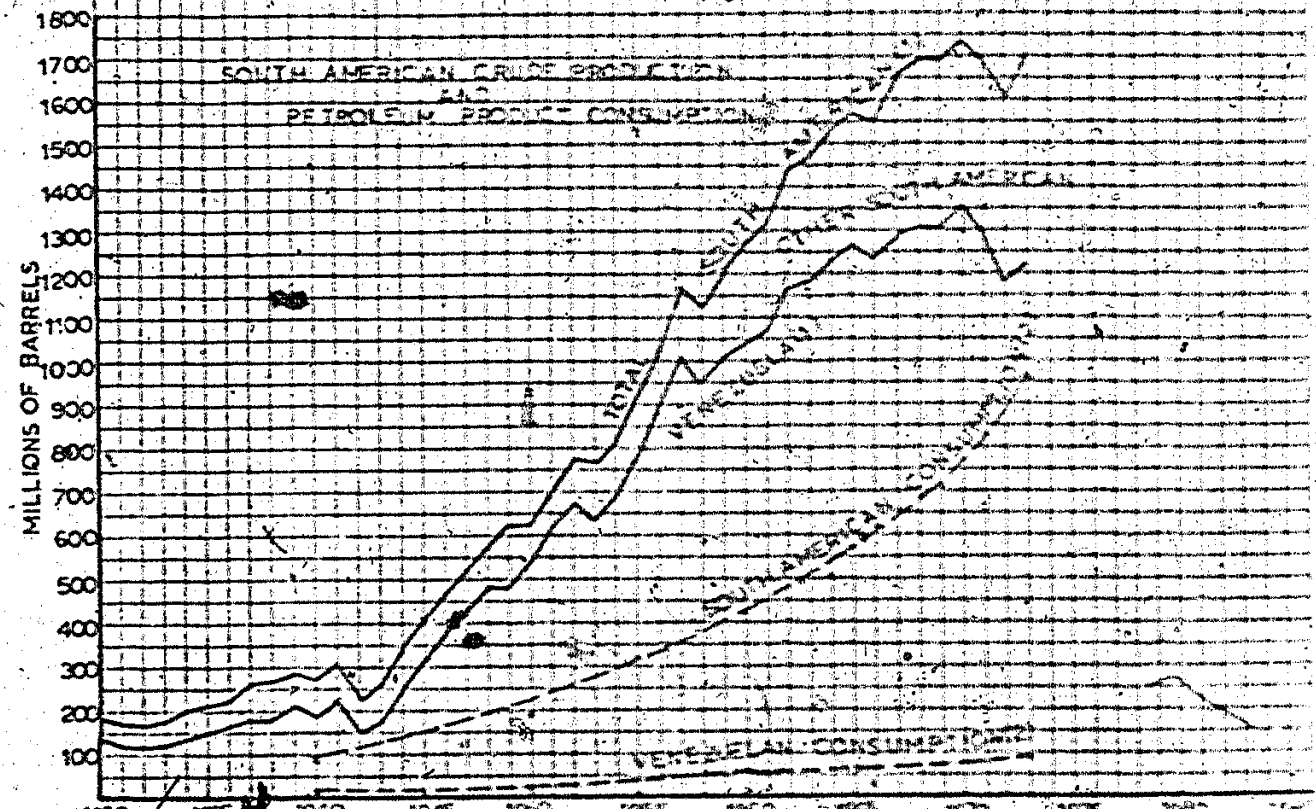
TABLE VI

CRUDE PRODUCTION AND PETROLEUM PRODUCT CONSUMPTION





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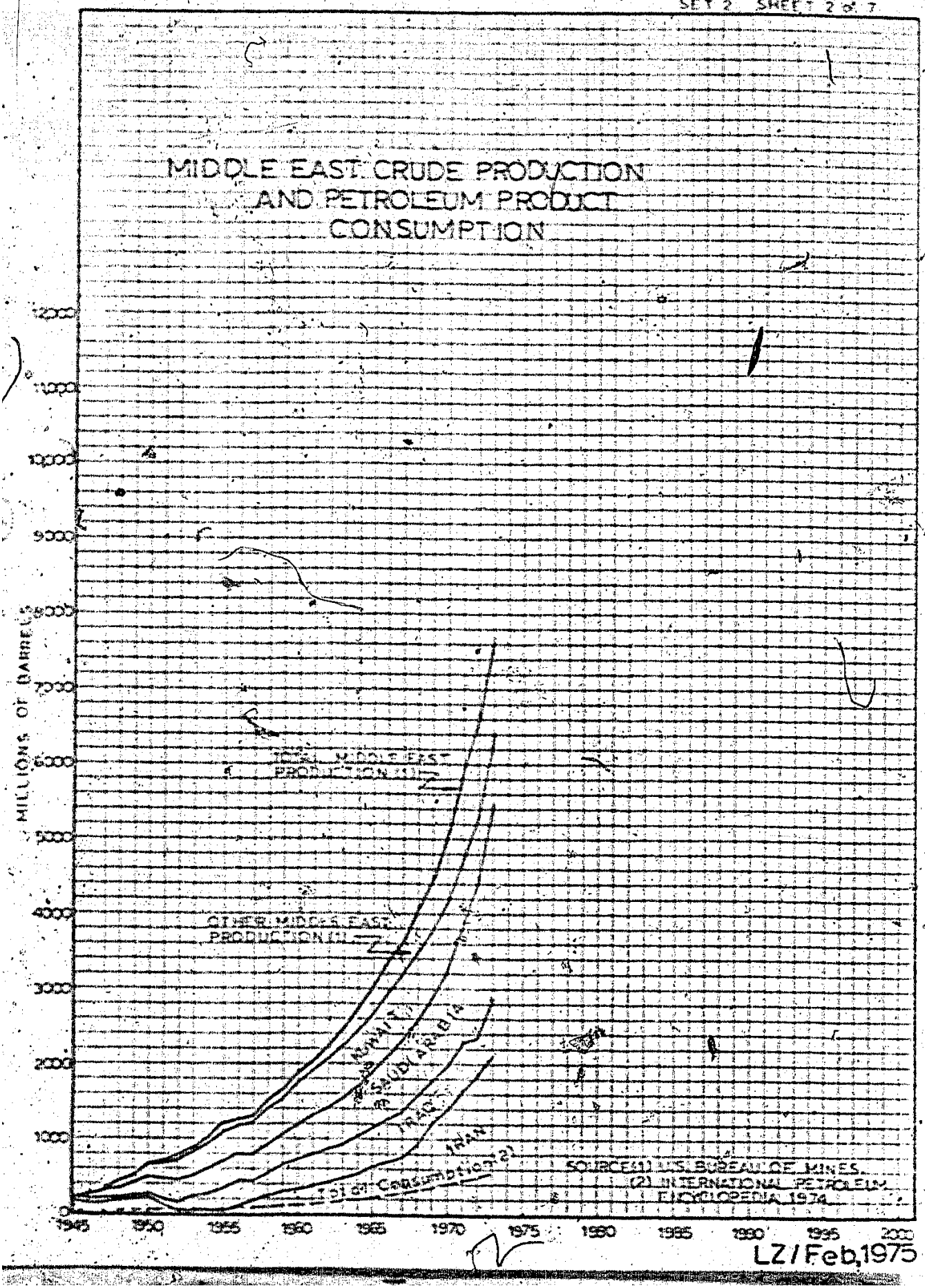
MIDDLE EAST CRUDE PRODUCTION AND PETROLEUM PRODUCT CONSUMPTION



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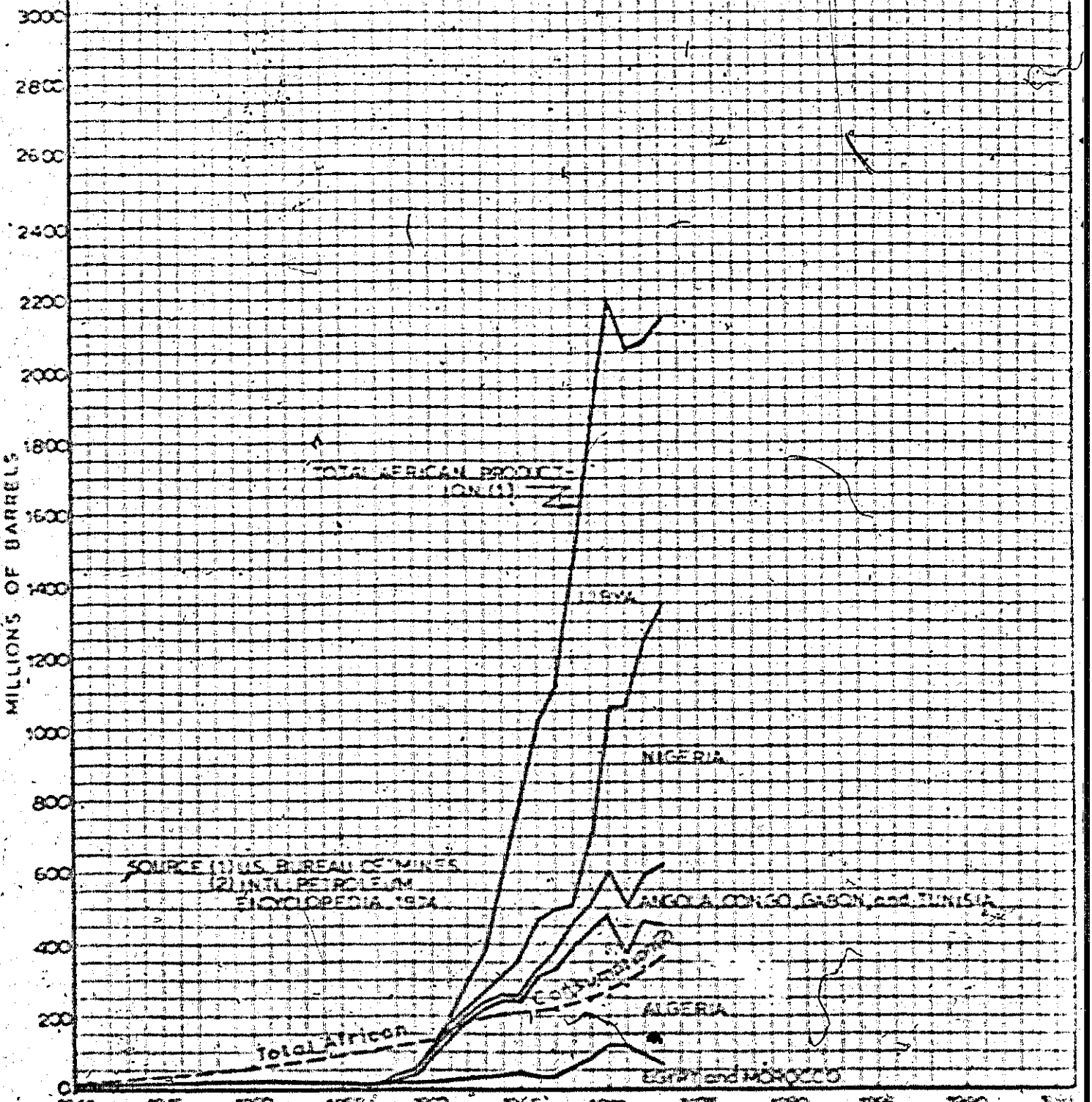
AFRICAN CRUDE PRODUCTION and PETROLEUM PRODUCT CONSUMPTION



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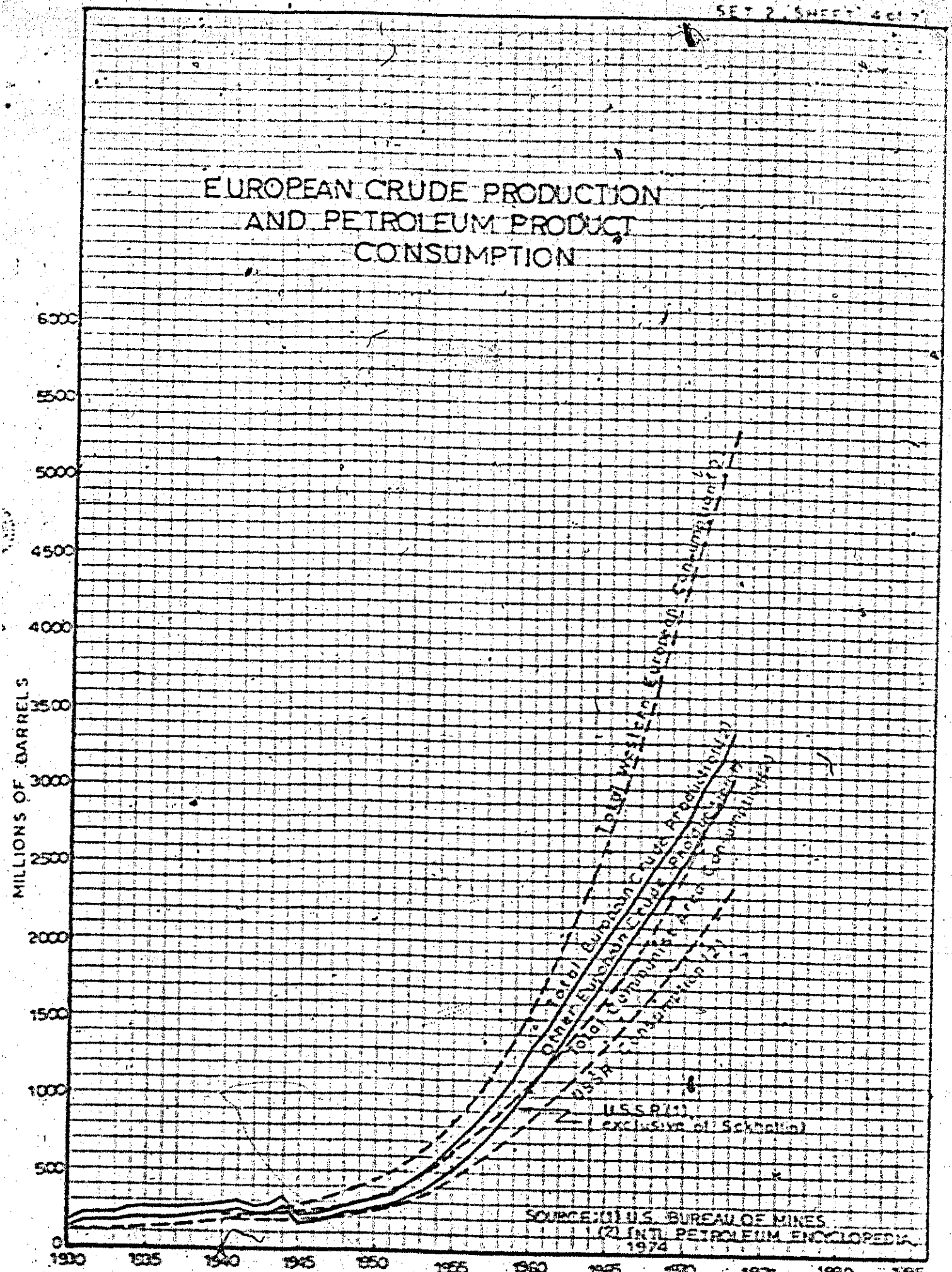
EUROPEAN CRUDE PRODUCTION AND PETROLEUM PRODUCT CONSUMPTION



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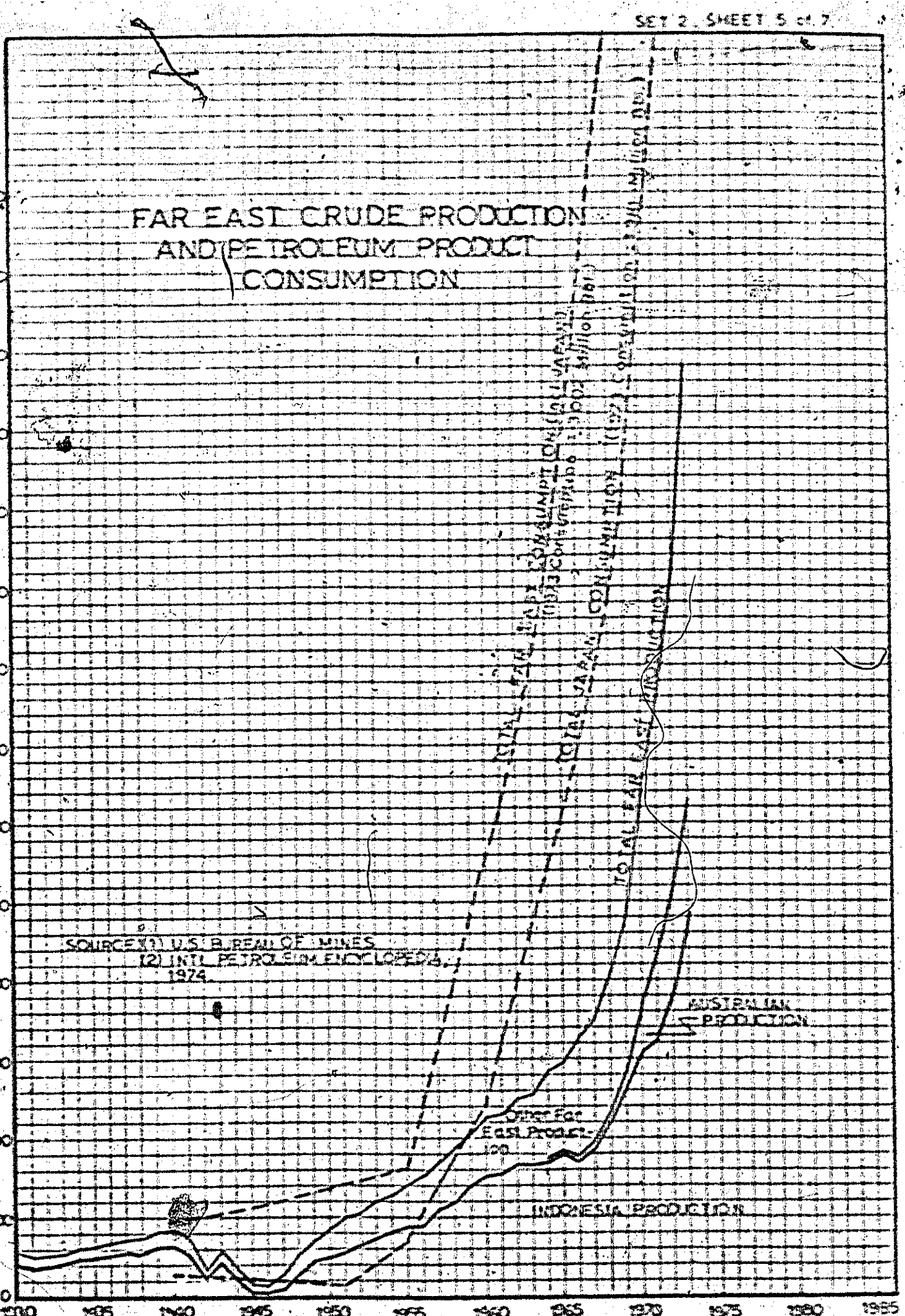
FAR EAST CRUDE PRODUCTION AND PETROLEUM PRODUCT CONSUMPTION



SOURCE: (1) U.S. BUREAU OF MINES
(2) INTL PETROLEUM ENCYCLOPEDIA 1974

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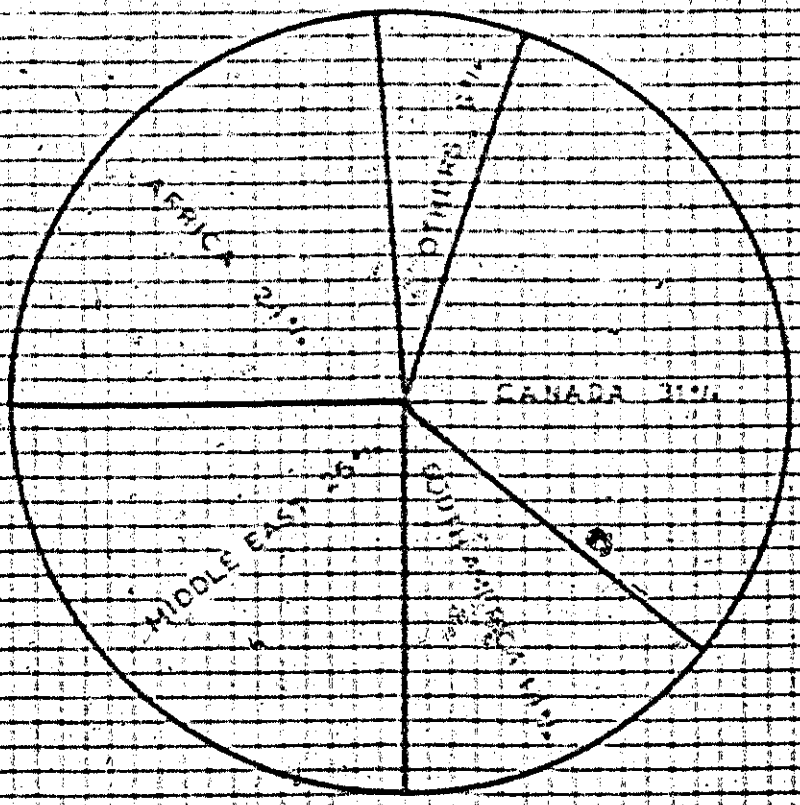
UNITED STATES IMPORTS OF CRUDE OIL BY SOURCE



TOTAL 1 BILLION BARRELS
FOR THE YEAR 1973

SOURCE: US BUREAU OF MINES;
DeGOLYER and MACNAUGHTON, 1974

MILLIONS OF BARRELS

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500

1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980

TOTAL CRUDE OIL IMPORTS

INDONESIA & OTHERS

AFRICA

MIDDLE EAST

SOUTH AMERICA

CANADA

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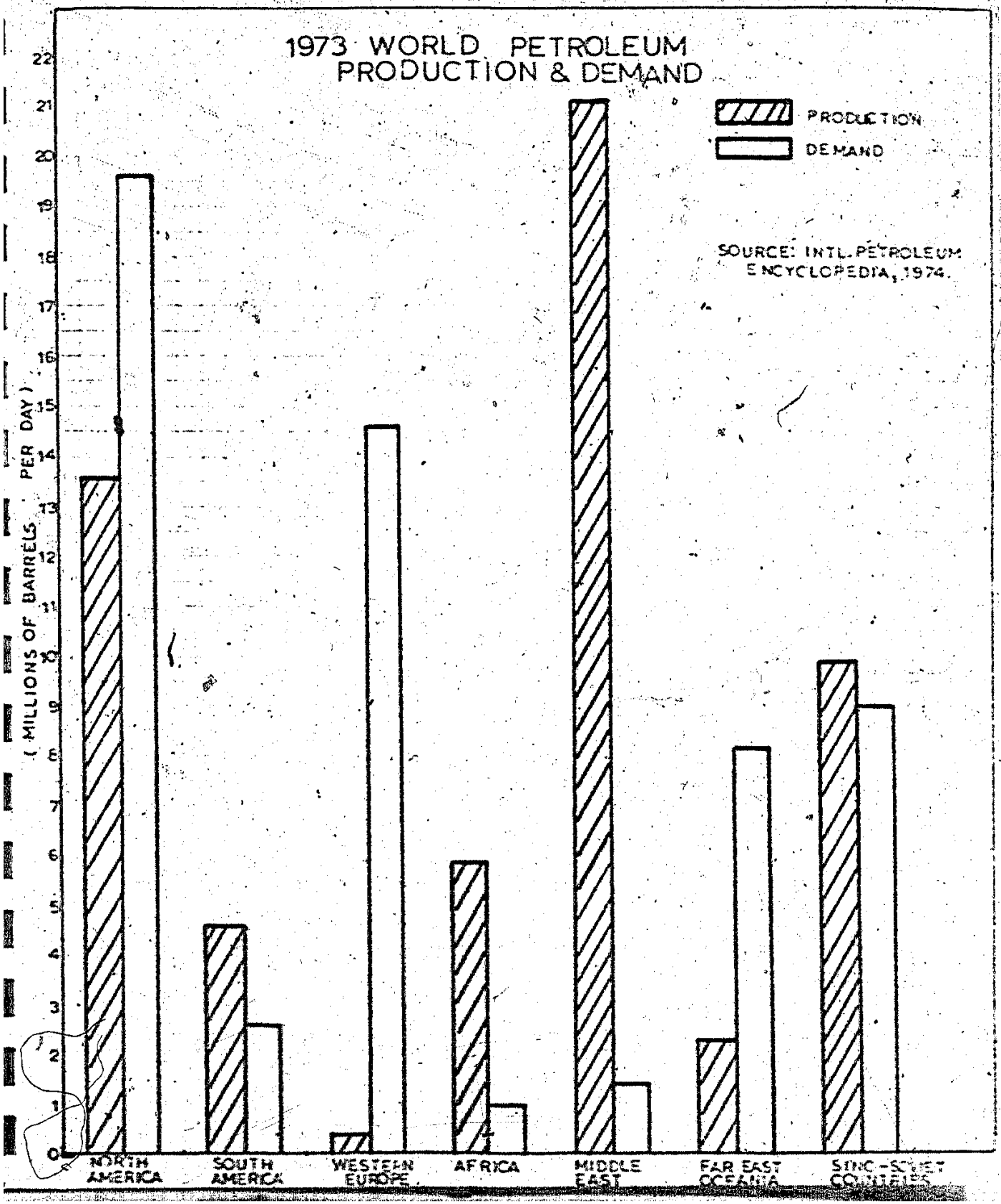

CONVERSION FACTORS

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ENERGY

WORLD PRIMARY ENERGY CONSUMPTION

COUNTRY/AREA	1973						1972					
	Oil	Natural Gas	Solid Fuels	Water Power	Nuclear	Total	Oil	Natural Gas	Solid Fuels	Water Power	Nuclear	Total
	MILLION TONS OIL EQUIVALENT											
U.S.A.	816.7	548.5	307.6	23.8	13.2	1,709.8	775.8	533.4	301.5	23.1	4.8	1,638.6
Canada	83.6	43.3	16.7	12.3	1.6	157.1	79.3	44.1	16.0	11.8	0.6	152.3
Other Western Hemisphere	139.9	47.5	13.8	9.8	-	210.1	139.6	43.8	13.2	9.8	-	226.4
TOTAL WESTERN HEMISPHERE	1,040.2	639.3	336.1	45.1	14.2	2,175.4	994.9	621.3	330.7	42.9	5.4	2,041.5
Belgium & Luxembourg	22.5	7.2	12.4	0.2	-	52.3	21.1	6.3	12.5	0.1	-	50.0
Netherlands	43.3	22.2	2.6	-	0.1	78.2	42.1	22.6	2.6	-	-	70.7
France	125.2	14.1	23.0	4.4	2.2	173.4	114.1	12.6	20.8	3.5	1.1	162.1
W. Germany	140.5	25.7	76.6	2.1	1.1	255.2	140.9	23.5	77.6	1.9	0.7	241.6
Italy	104.5	13.3	10.8	3.9	0.3	132.8	98.2	11.7	10.8	3.9	0.2	124.9
U.K.	112.6	28.5	72.7	0.4	2.1	216.3	103.7	24.0	71.7	0.4	2.1	202.9
Scandinavia	56.0	-	0.1	8.8	0.4	72.3	54.6	-	5.4	8.1	0.1	77.2
Spain	35.7	1.0	11.1	2.8	0.4	51.0	29.8	1.0	11.0	2.8	0.4	45.1
Other Western Europe	83.9	5.0	28.2	7.5	0.4	141.0	80.5	4.5	28.8	7.8	0.3	129.9
TOTAL WESTERN EUROPE	747.7	127.0	256.3	31.1	6.5	1,172.6	691.2	122.2	245.4	28.5	5.0	1,112.6
Japan	257.2	5.3	31.2	7.3	1.2	302.2	234.3	4.8	43.7	7.2	0.8	290.8
Australasia	22.2	3.5	25.5	2.2	-	53.4	20.6	3.0	23.6	2.2	-	49.4
U.S.S.R. & Europe & China	424.9	227.5	949.6	17.4	9.8	1,629.2	393.7	218.2	923.1	15.3	6.7	1,557.0
Other Eastern Hemisphere	215.5	27.2	121.1	6.3	0.3	370.5	203.7	23.7	118.5	5.4	0.2	351.4
TOTAL EASTERN HEMISPHERE	1,597.6	403.8	1,405.1	64.2	18.0	3,576.9	1,543.3	357.8	1,374.8	68.3	16.7	3,367.2
WORLD	2,785.5	1,063.3	1,741.2	109.4	32.5	5,752.3	2,537.2	1,005.7	1,705.7	111.2	12.1	5,421.7

APPROXIMATE CALORIFIC EQUIVALENTS

One million tons of oil equals approximately:

Heat Units

41	million million BTUs
415	million therms
10,500	Teracalories

Solid Fuels

1·5	million tons of coal
4·9	million tons of lignite
3·3	million tons of peat

Natural Gas (1 cub. ft = 1,000 BTUs) (1 cub. metre = 9,000 kcals)

1·157	thousand million cub. metres
41·2	thousand million cub. ft.
113	million cub. ft./day for a year

Town Gas (1 cub. ft. = 470 BTUs) (1 cub. metre = 4,200 kcals)

2·5	thousand million cub. metres
88·3	thousand million cub. ft.
242	million cub. ft./day for a year

Electricity (1 kWh = 3,412 BTUs) (1 kWh = 860 kcals)

12	thousand million kWh

Heat units and Other fuels expressed in terms of million tons of oil.

		million tons of oil
10	million million BTUs approximates to	0·24
100	million therms approximates to	0·24
10,000	Teracalories approximates to	0·95
1	million tons of coal approximates to	0·67
1	million tons of lignite approximates to	0·20
1	million tons of peat approximates to	0·30
1	thousand million cub. metres approximates to	0·85
10	thousand million cub. ft. approximates to	0·24
100	million cub. ft./day for a year approximates to	0·82
1	thousand million cub. metres approximates to	0·40
10	thousand million cub. ft. approximates to	0·11
100	million cub. ft./day for a year approximates to	0·41
10	thousand million kWh approximates to	0·82

One million tons of oil produces about 4,000 million units (kWh) of electricity in a modern power station.

Source: BP Statistical Review of the World Oil Industry, 1973.

CALCULATION SHEET

SUBJECT

PROJECT THE ENERGY GAME: Analysis of Options

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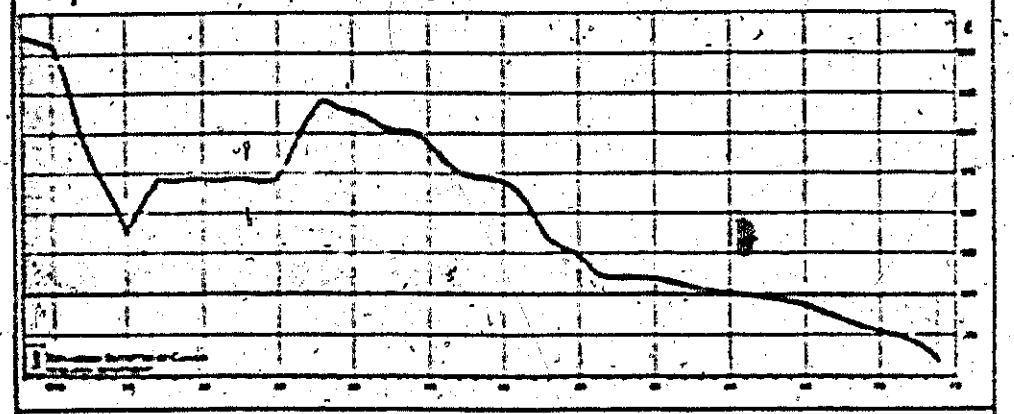
PURCHASING POWER OF THE CANADIAN DOLLAR



	Cents		Cents		Cents
		1931	130.48	1951	113.54
		1932	139.64	1952	110.85
1913	261.13	1933	220.25	1953	111.55
1914	259.74	1934	214.92	1954	111.23
1915	255.19	1935	215.52	1955	110.99
1916	235.29	1936	211.42	1956	108.41
1917	198.81	1937	204.92	1957	106.04
1918	175.75	1938	202.84	1958	103.31
1919	160.00	1939	204.50	1959	102.15
1920	138.12	1940	196.65	1960	100.91
1921	156.74	1941	185.53	1961	100.00
1922	171.23	1942	177.50	1962	98.85
1923	170.96	1943	174.22	1963	97.59
1924	173.91	1944	173.31	1964	95.42
1925	172.41	1945	172.41	1965	93.11
1926	170.26	1946	168.57	1966	89.77
1927	172.31	1947	152.44	1967	88.66
1928	172.71	1948	133.15	1968	83.25
1929	170.85	1949	124.20	1969	79.58
1930	171.52	1950	125.53	1970	77.10
				1971	74.86
				1972	71.50
				1973	68.48
				1974	60.97

These figures represent monthly annual averages, as applicable, and are based on 1961 = 100. If 1940 = 100 had been used, 1974 would be 61.62.

December, 1974 figure is 58.83

Source: Recipient of Statistics Canada Consumer Price Index.

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Calculations Based on Gompertz Equation

(24-Year Trend Analysis)

Equations

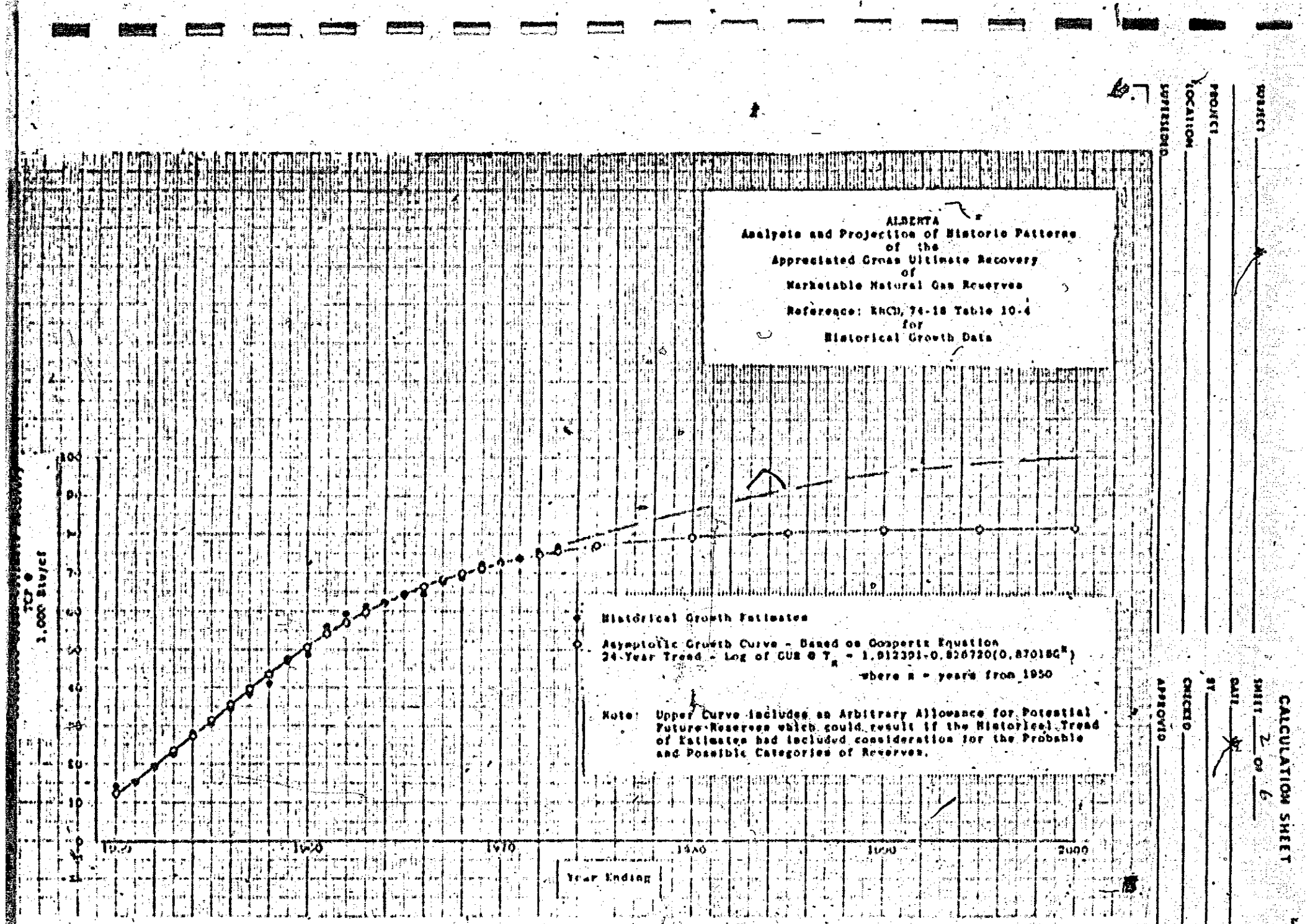
$$\log Yc = \log k + (\log a)(b^x)$$

$$\text{Where } b^n = \frac{\Sigma_3 \log Y - \Sigma_2 \log Y}{\Sigma_2 \log Y - \Sigma_1 \log Y}$$

$$\log a = (\Sigma_2 \log Y - \Sigma_1 \log Y) \frac{b-1}{(b^n-1)^2}$$

$$\log k = \frac{1}{n} \{\Sigma_1 \log Y - (\frac{b^n-1}{b-1})(\log a)\}$$

Source: Study by John F. Strong, Petroleum Consultant. Prepared for the Minister of Energy For Ontario, August, 1974, and submitted to the 1974-75 N.E.B. gas hearing.



Source: From study by John F. Strong, August, 1974.

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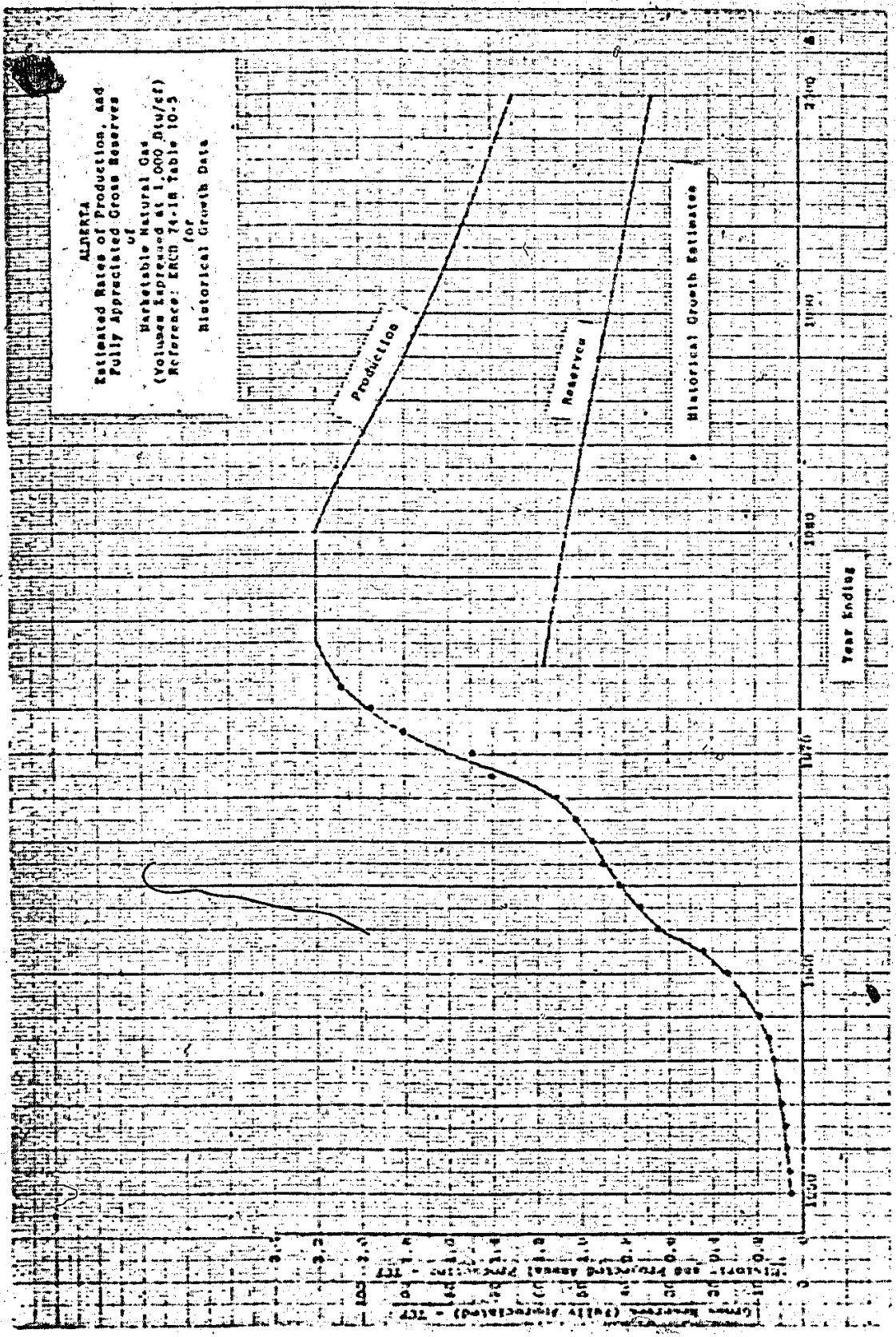
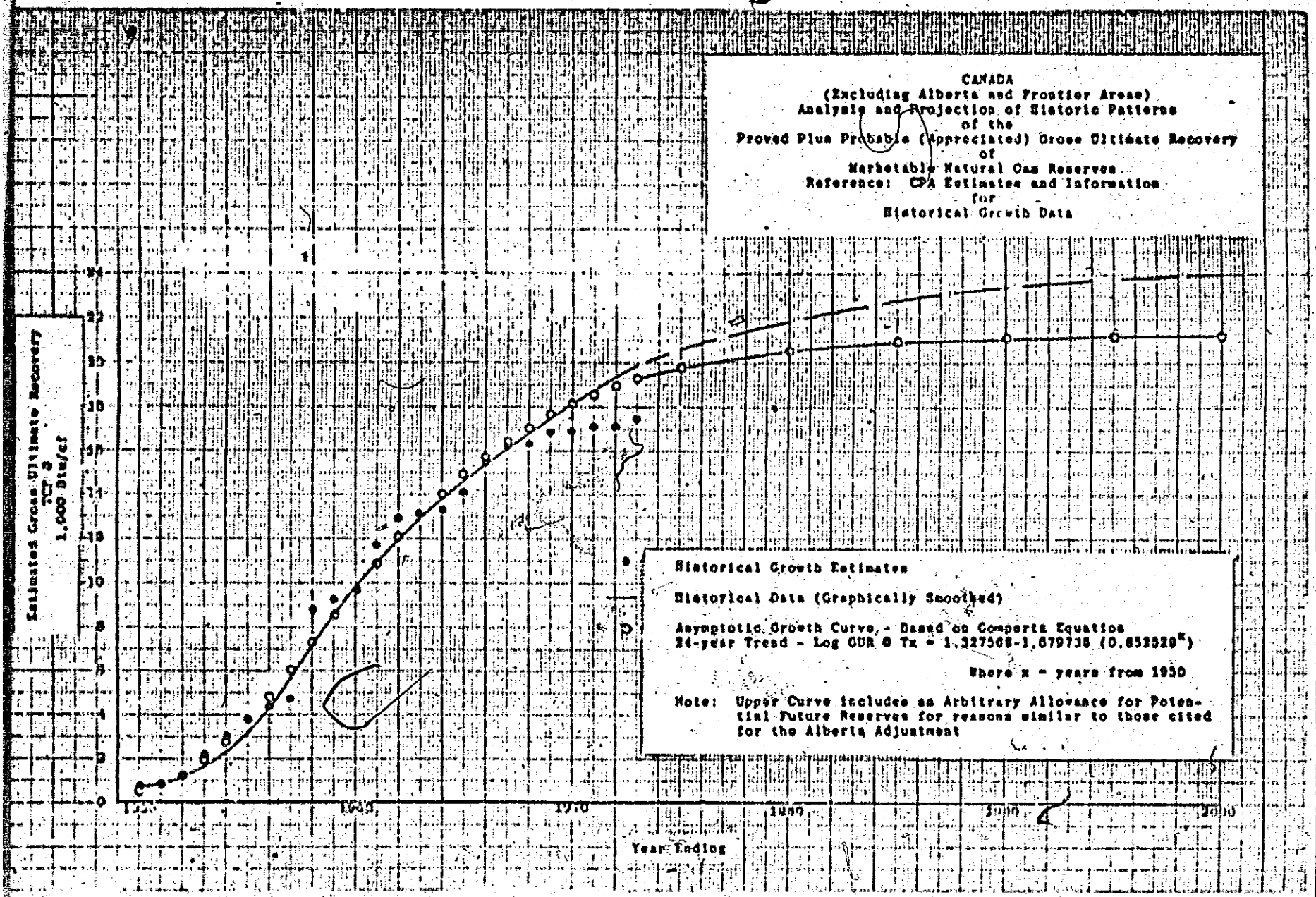


Source: From the study of John F. Strong August;1974.



Source: From the study of John F.Strong, August, 1974.

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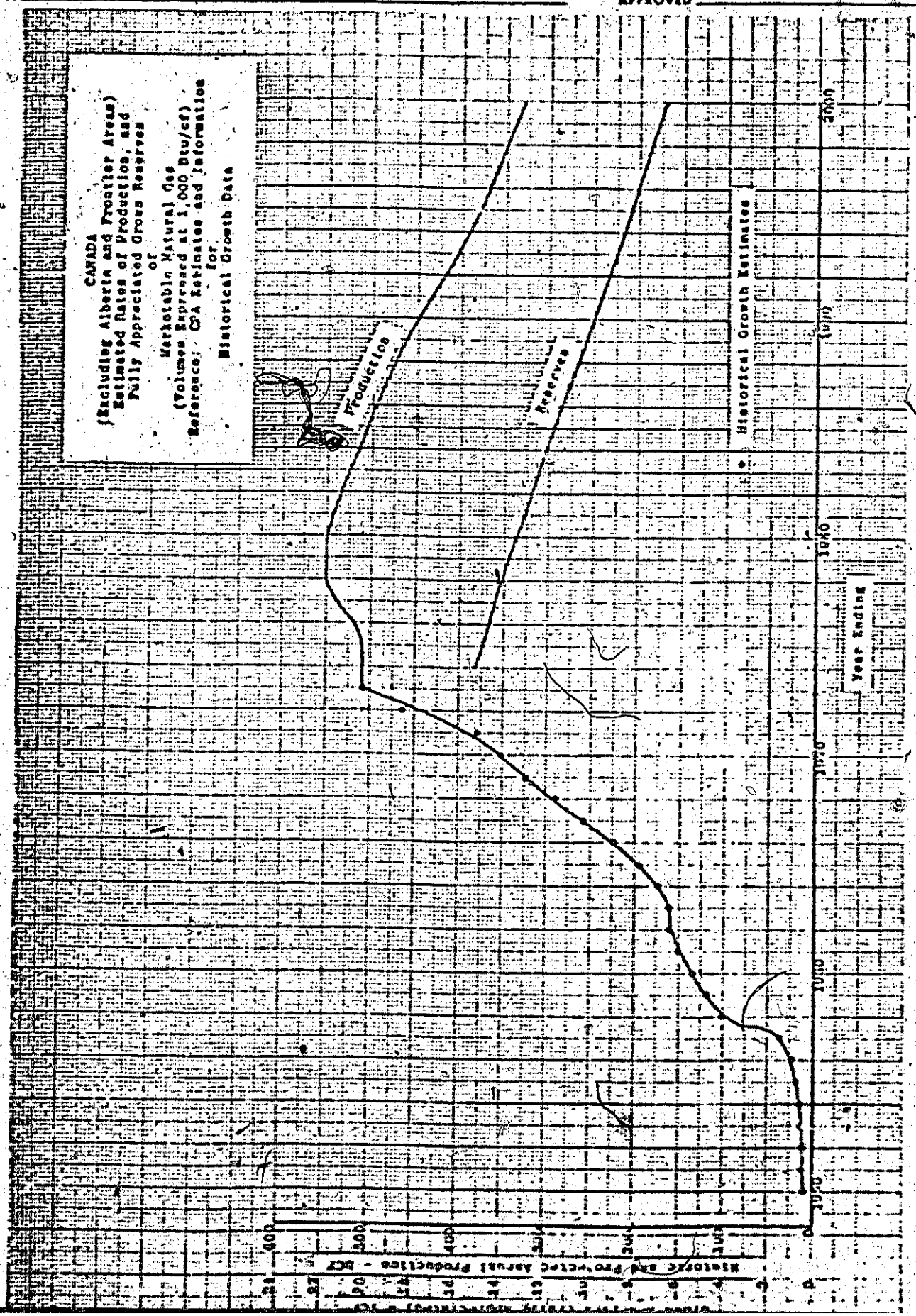

Source: From the study of John F. Strong, August, 1971.

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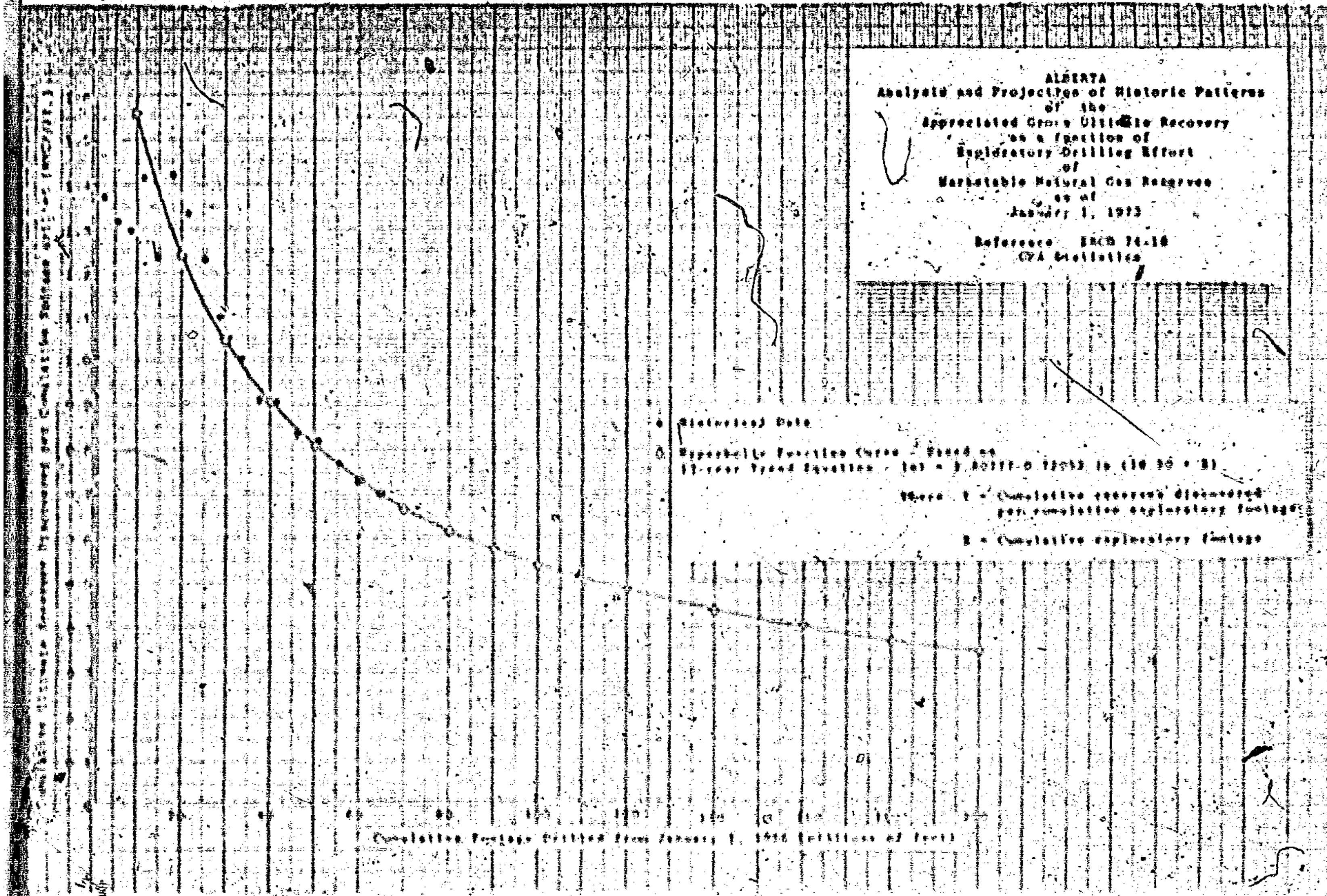

Source: From the study of John F. Strong, August, 1974.

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DELIVERABILITY

Explanatory

The deliverability of natural gas from Alberta and Saskatchewan sources to meet TransCanada's requirements during the period November 1, 1974 through October 31, 1995 are illustrated in Figures 1 and 2.

In Figure 1, three deliverability profiles A, B and C are presented. These profiles have been prepared by field by field analyses of reserves committed to TransCanada and depict the following:

Profile A: represents TransCanada's best estimate of the deliverability pattern from TransCanada's gas supply existing as of July 1, 1974.

Profile B: represents the maximum deliverability potential from TransCanada's gas supply existing as of July 1, 1974. This profile assumes that producers will make a concerted effort to increase and maintain deliverability at a high level by drilling wells, installing compression and tying-in currently non-producing wells in existing pools. It was further assumed that all producers will deliver at a minimum daily rate of take of 1 MMCFD for every 7,300 MMCF of initial marketable reserves where physically possible, i.e., no significant plant expansion would be required. It also assumes pipe, compressors and other materials and supplies are readily available.

Source: TCPL Sept. 1974 Submission to the 1974-75 N.E.B. Gas Hearing. (Vol. 1).

Profile C represents the minimum deliverability available from TransCanada's gas supply existing as of July 1, 1974. This profile assumes that producers will maintain deliverability from only those wells which are currently delivering and would not commit future funds to drilling, compression and gathering system to enhance or maintain deliverability.

Superimposed on the deliverability profiles are TransCanada's Requirements. The requirements from November 1, 1974 through October 31, 1978 reflect those necessary to meet TransCanada's contractual obligation. The 1977-78 requirements have been held level through 1995. The increases in requirements in the first few years depicts increases in Alberta requirements.

Figure 2 depicts deliverability Profile A from Figure 1. Supplementary to Profile A are Curves 1 and 2 which represent the deliverability schedule from Profile A plus the addition of the deliverability that can be anticipated from 100% to 50%, respectively, of the future Alberta gas surplus as shown on the bottom portion of Figure 2. The calculation of that surplus is shown on Table 1 under this Tab.

Source: TCPL Sept.1974 Submission to the 1974-75 N.E.B. Gas Hearing (Vol.1).

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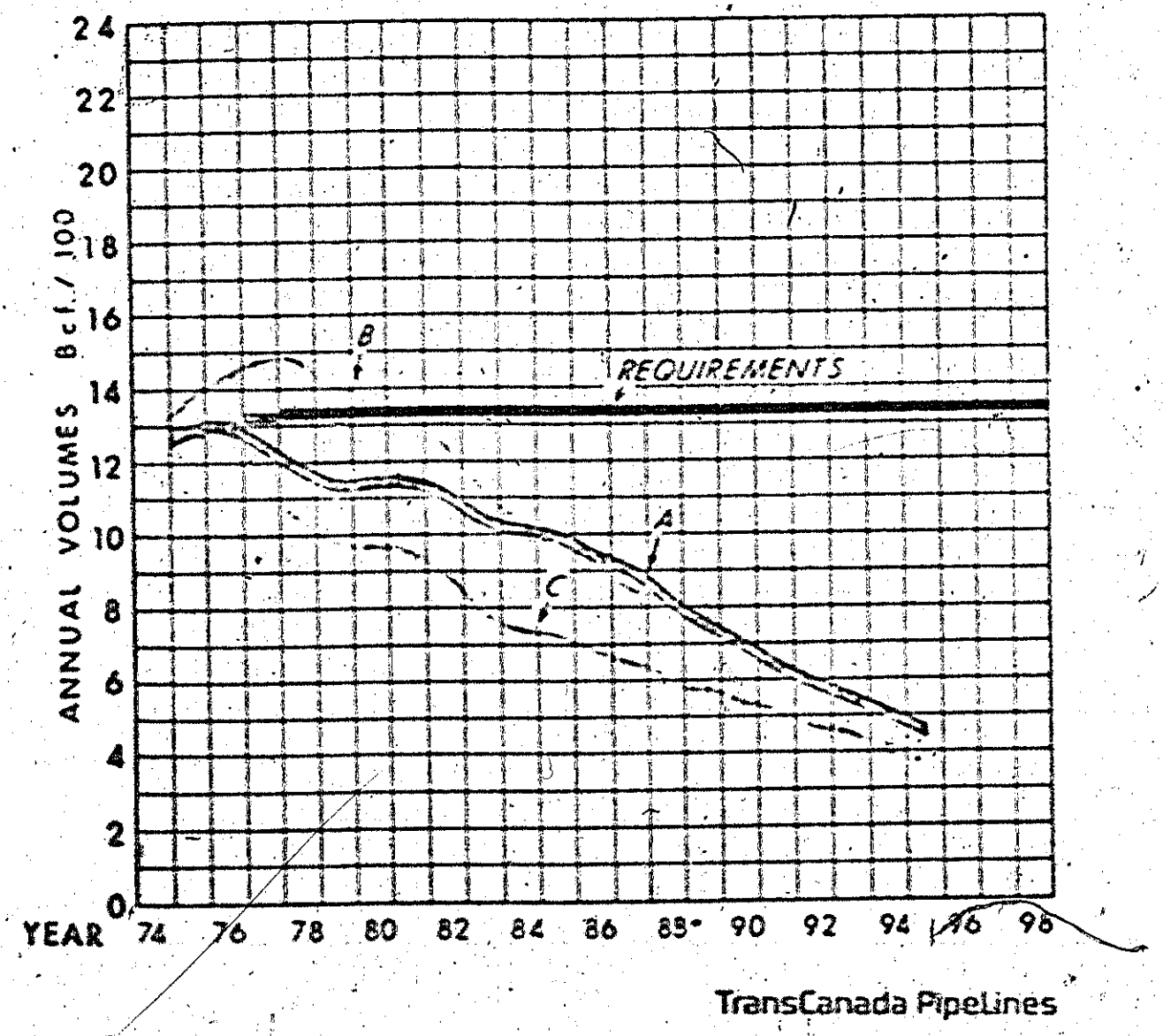
FIGURE 1

TRANS-CANADA PIPE LINES
FUTURE REQUIREMENTS vs FUTURE GAS SUPPLY



TransCanada Pipelines

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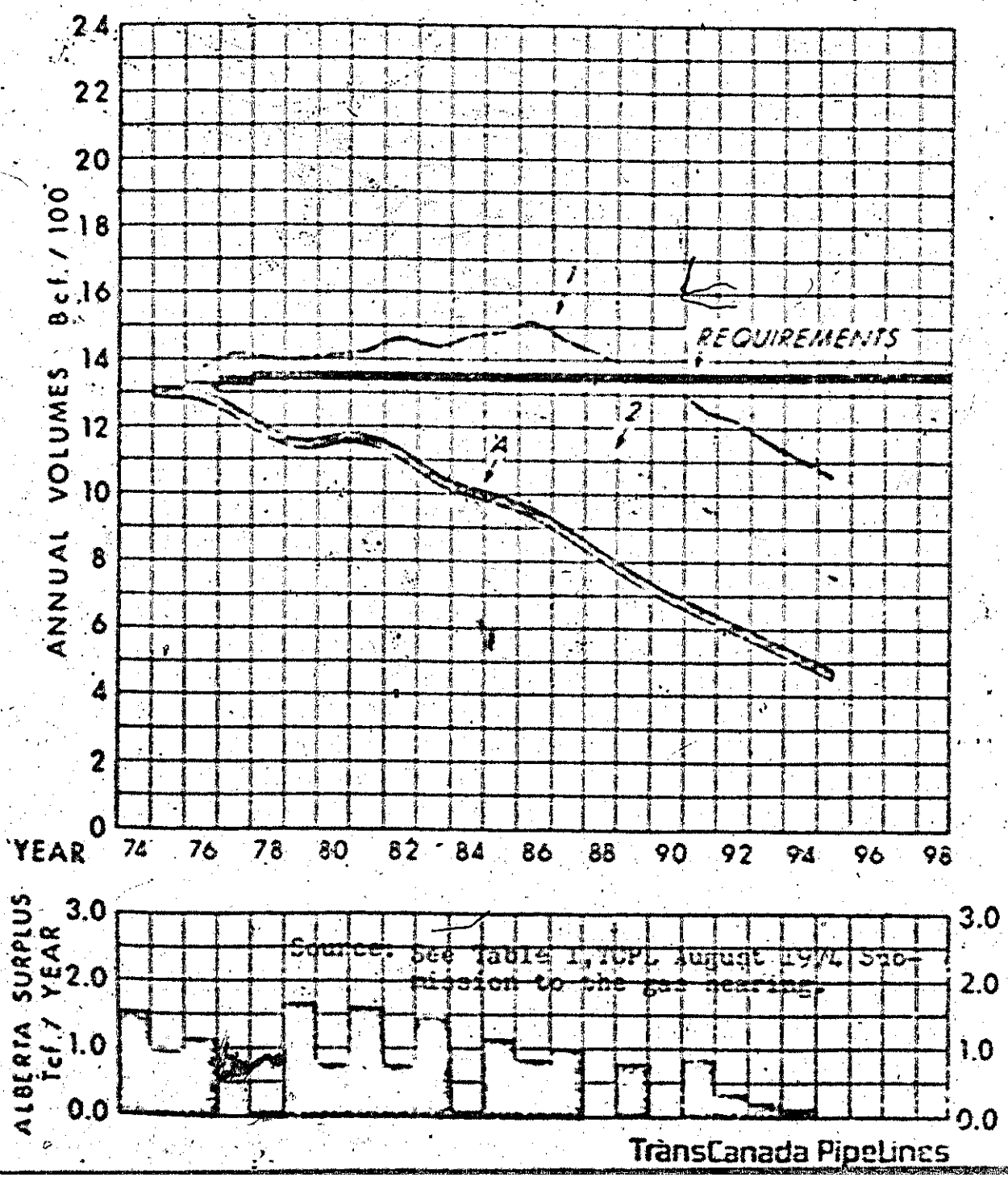
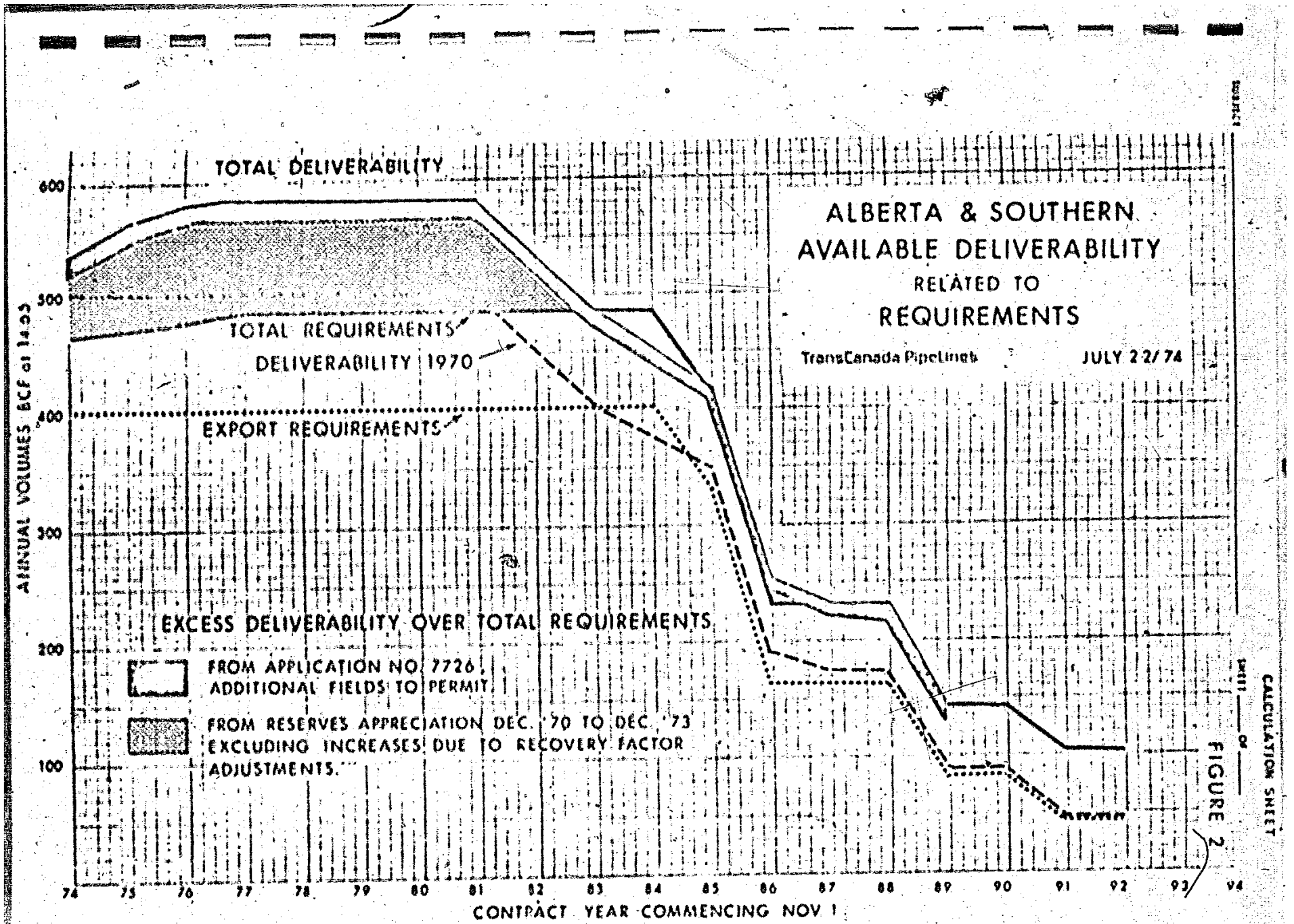
FIGURE 2

TRANS-CANADA PIPE LINES
FUTURE REQUIREMENTS vs FUTURE GAS SUPPLY



TransCanada PipeLines



Source: TCPL Sept.1974 Submission to the 1974-75 N.E.B. Gas Hearing (Vol.1).

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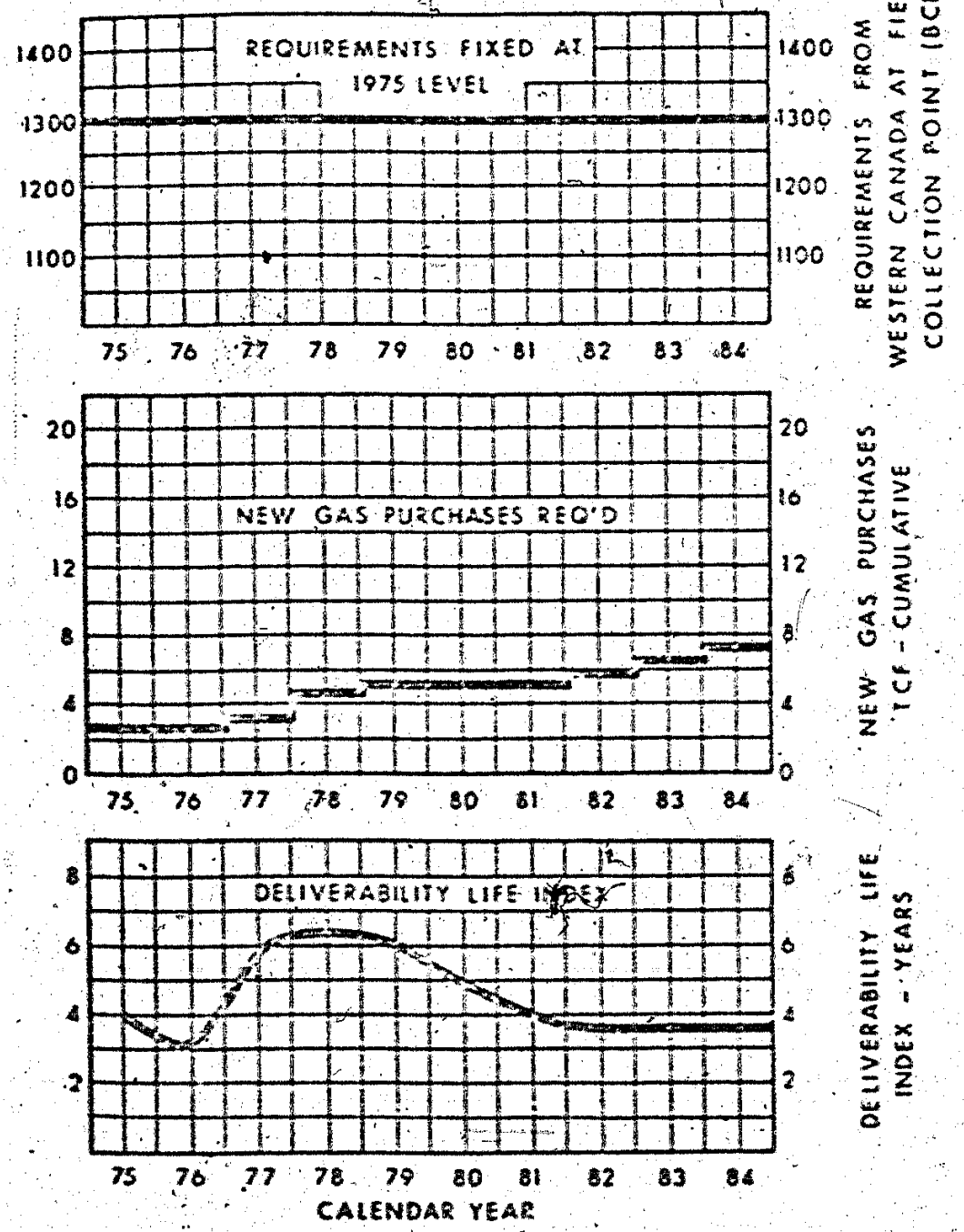
PROJECT _____ BY _____

TRANS-CANADA PIPE LINES

GRAPH SHOWING DELIVERABILITY LIFE INDEX BASED UPON CURRENT YEAR (A1) LEVEL OF REQUIREMENTS AND CURRENT AVAILABLE GAS SUPPLY (REF FIG.1 TAB 4) PLUS NEW GAS PURCHASES UP TO A TAKE OR PAY LEVEL



TransCanada Pipelines Sept.1974.

CALCULATION SHEET

SUBJECT _____ SHEET ____ OF ____

DATE _____

PROJECT _____ BY _____

LOCATION _____ CHECKED _____

TRANS-CANADA PIPE LINES

GRAPH SHOWING DELIVERABILITY-LIFE INDEX BASED UPON GROWTH LEVEL OF REQUIREMENTS AND CURRENT AVAILABLE (A1) GAS SUPPLIES (REF. FIG. 1 TAB. 4) PLUS NEW GAS PURCHASES UP TO A TAKE OR PAY LEVEL