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Article abstract

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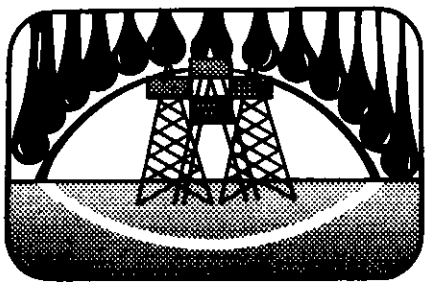

Canadian Petroleum

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Summary
Comparison of Canada's frontier petroleum provinces with the North Sea suggests that much less oil will be found in Canada. It is concluded that the present export pattern for oil cannot be long maintained and that increased investment in petroleum exploration is essential.

The strongly-stated views of Folinsbee and Leech (1974) and North (1974) in the first issue of *Geoscience Canada* were welcome contributions to a debate which prior to that date had been remarkably one-sided. Experience in public and private discussion suggests that the significance of hydrocarbon resource shortages in North America, and in Canada in particular, is being grossly underestimated. We have seen this winter how a marginal shortfall in supplies can disrupt industry and cause rocketing prices, not only for petroleum but also for all petroleum products. I have accordingly had a closer look at the issues raised by Folinsbee and Leech and by North as far as Canada is concerned and present some conclusions below.

A prime problem lies in the estimation of future hydrocarbon discoveries, present techniques for which are comprehensively derided by North. I would like to suggest that a more direct comparative method of predicting reserves in the Canadian frontier areas is to consider them in relation to the North Sea. The Arctic Islands, Mackenzie Delta and North Sea exploration programs began in the early 1960s (Fig. 1) and have evolved since then in areas of broadly comparable technological difficulty, using essentially the same exploration methods. The North Sea had to be explored purely geophysically at first, drilling (starting in 1964) was cheap in the south and expensive and hazardous in the north: in the Islands, geologic information indicated areas suitable for drilling from the beginning, but drilling is exceedingly expensive: and in the Delta, geophysical methods predominated in an area of intermediate technical difficulty for drilling. The present estimates show results per hole drilled (Fig. 1 and Table I). While the estimated reserves are subject to much uncertainty (compare North Sea oil reserve estimates from the British press and *Oilweek*) they show quite clearly that the rate of discovery of gas is broadly comparable in the three areas, but that North Sea oil discovered per hole drilled outstrips oil discovery in northern Canada by a factor of two or more, depending on which figures are preferred.

My own conclusion is that the oil potential of the Sverdrup Basin of the Arctic Islands is negligible, but that gas reserves are relatively large. Judging from relative current exploration rates, the next two years should suffice to show how our chances are for discovering major oil reserves in Northern Canada. My own feeling is that they may be reasonably large in the Delta (5 b.bbls) and will justify a pipline.

Table I *Comparison of drilling and results.*

	Years explored	Holes drilled	Gas Tcf	Oil b.bbl.
North Sea	14 (gas) 10 (oil)	610	50?	15 (?28)
Arctic Islands	12	80	15	trace
Delta	8	70	>7?	1?

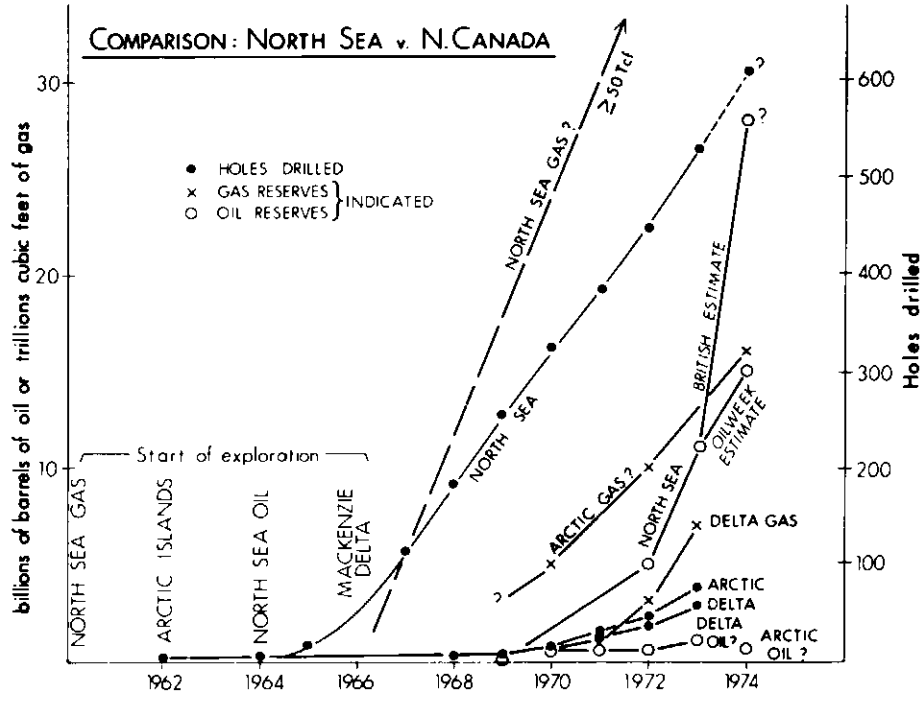

Figure 1
Comparison of numbers of holes drilled with estimated reserves in the North Sea, Arctic Islands and Mackenzie Delta. Drilling data for North Sea from Oil and Gas Journal annual tabulations and for Canada from Oilweek. Estimated reserves as published from time to time in the press, chiefly by industrial spokesmen.

Discussion of the Scotian Shelf has not been included in the above because of lack of space on Figure 1. However, for some 60 holes drilled, estimates of commercial oil and gas in late 1973 only ran to negligible and three Tcf respectively. Table I shows that this appears to be a singularly unpromising area at the present time: however, initial reports from the Labrador shelf are more promising.

These estimates are in general accord with what is rumoured about the state of hydrocarbon maturation in the three frontier areas mentioned: in particular it is understood that geochemical considerations are unfavourable for oil in the Scotian Shelf and the majority of the Arctic Island area. Perhaps the organic material in the Arctic Islands sediments has matured to gas plus heavy residues and not to petroleum, as a combined consequence of northerly latitudes and a comparatively thin sedimentary continental crust resting on basaltic crust at shallow depth together leading to low thermal gradients (Evans and Staplin, 1971; Sobczak and Weber, 1973; and Lambert, 1974).

With these pessimistic forecasts of oil reserves in mind and remembering the great time necessary between discovery and production in such remote areas, it is possible to estimate Canadian consumption, production and required imports for the next decade or so. Taking *Oilweek* data on past consumption and production, the 1973 Gulf and Imperial estimates of Albertan (~ Canadian) production of conventional crude in the future, a slightly higher version of Ryan's (1973) total Albertan recoverable reserves and some forecasts on the rate of bringing oil sands and Delta oil, Figure 2 has been constructed. The Hon. J. Yurko of the Albertan Provincial Government has said that it will be preferable to bring in oil sands plants slowly (*Edmonton Journal*, press release April 17, 1974), so I have allowed until 1982 to bring in four plants additional to GCOS (one every two years). There is some doubt as to whether more than five open pit

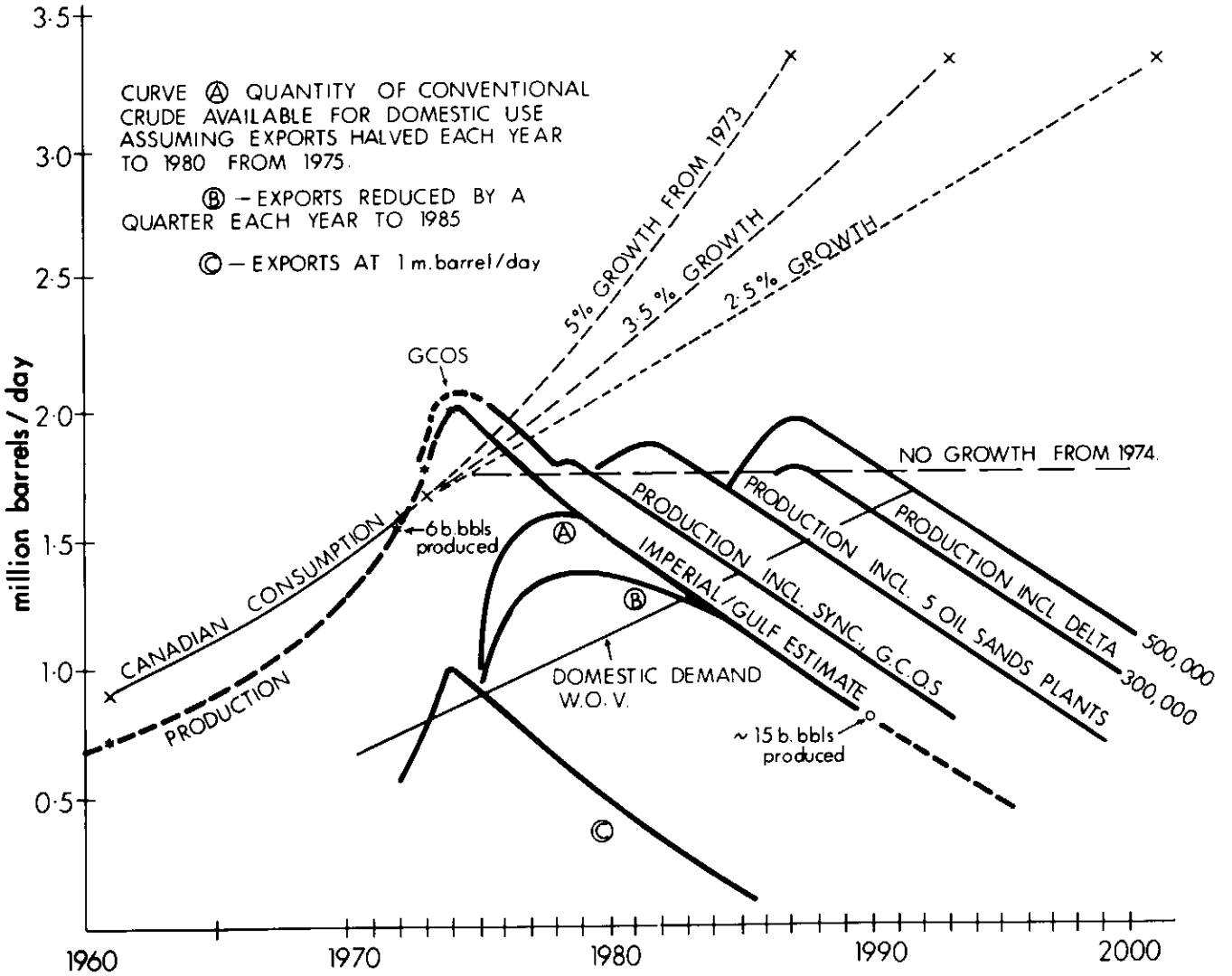

Figure 2

Canadian petroleum production and consumption extrapolated to end of century. The linear domestic demand West of Ottawa Valley curve is roughly equivalent to 4 per cent growth. The three curves, A, B, C show conventional crude available for domestic use at export rates noted on figure.

plants are feasible, and subsurface recovery methods may take a decade to develop. A Delta pipeline is shown as bringing in 300,000 or 500,000 barrels/day from 1985. Growth curves for consumption are based on the well-documented 5 per cent p.a. increase over the last decade. Curves for two lower growth rates and zero growth are shown. Canada's population increases by 1.4 per cent p.a. with little change in the pattern in the last decade (Statistics Canada quarterly estimates of population), so zero growth in petroleum consumption seems unlikely: increased prices may slow growth to 3.5 per cent (Fig. 3).

Superimposed on the total production/consumption pattern is the export pattern. Curves are shown indicating effects of maintaining present rates (~1 m barrels/day), of halving that rate every year to zero in 1980 (curve A) and reducing it by quarter every year to zero in 1985 (curve B). Figure 3 shows net imports required on the basis of all assumptions on Figure 2, with curves for the three export patterns, zero exports from now, and one curve indicating the situation post-1984 if the oil sands plant construction rate is roughly doubled.

It is easy to conclude: (a) that the present export pattern cannot be maintained for long, (b) even if exports are rapidly reduced, Canada will be a net importer of petroleum for all the foreseeable future, (c) export pattern B seems to give the closest approach to a uniform import pattern, and (d) that increased investment in petroleum exploration is essential even in Canada, ignoring pressures from the U.S.A.

I would like to conclude with a plea for more facts to be made available to those of us who discuss these matters with students and the public. A misinformed public is as bad as, or worse than a public ignorant of the facts. Finally, I wish to acknowledge, with many thanks, guidance from R. E. Folinsbee in the subject matter of this report.

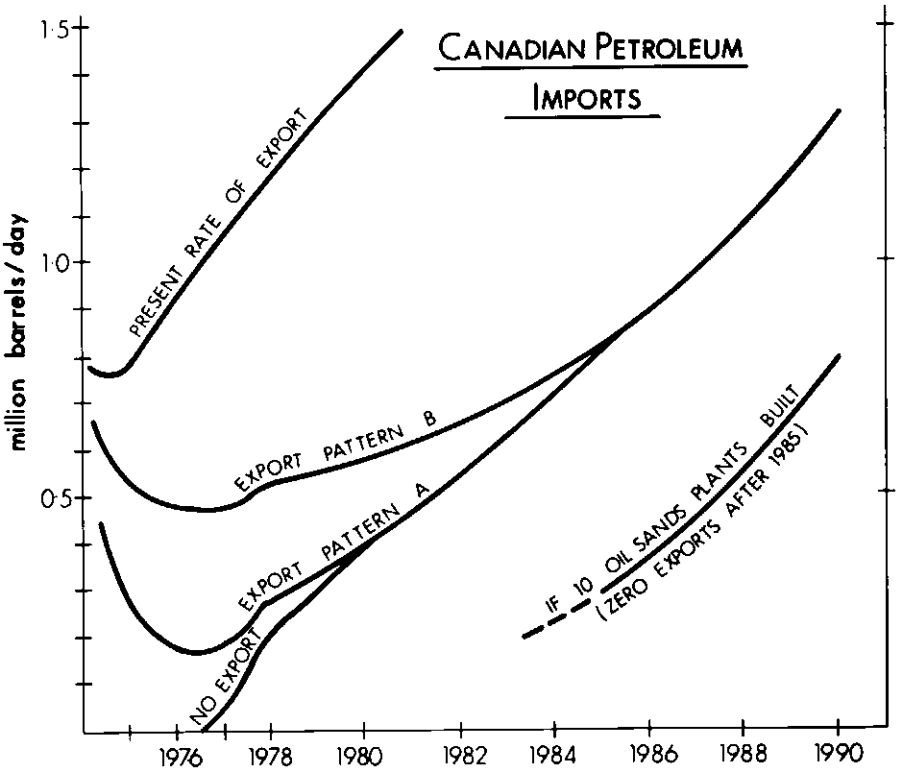

Figure 3
Canadian petroleum imports required, given the various export patterns and production rates shown on Figure 2.

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