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AN ECONOMIC AND STATISTICAL APPRAISAL OF PETROLEUM
EXPLORATION AND DEVELOPMENT IN AUSTRALIA



by

J.M. HENRY

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SETTING THE SCENE

In relation to the large areas still to be fully explored and the amount of work still to be done, petroleum exploration activity in Australia had reached an unsatisfactorily low level at the end of 1973. Onshore exploration drilling footage has fallen by 158,561 feet or 45.1 percent compared with 1972 and even more when compared with 1970 and 1971. Offshore exploration footage was down by 84,500 feet or 21.5 percent, but this can be traced largely to the effects of industrial unrest early in 1973 and more than average cyclonic activity. The number of exploration wells drilled onshore was down by 26 or 45 percent over 1972; offshore the position was down on 1973 by some 7 wells; again this can be traced to outside elements. The number of new field wildcats drilled in 1973 was 52 compared with 71 in 1972 and 98 in 1970. These 52 wells, onshore and offshore, resulted in only one new oil and 5 new gas discoveries, a very poor success ratio for oil and well below the average for Australia of 1 in 35.

Petroleum exploration expenditure in 1972, ((1) - the latest figures available), was \$118.25 million, or \$24.8 million more than the previous record of \$93.38 million in 1971. This mainly reflects rising costs of materials, services and money. It is expected that expenditure in 1973 will be less than in 1972 owing to the large fall-off in onshore operations. However, higher costs and the large amount of unproductive expenditure caused by the stoppage in offshore drilling due to strikes could minimize the difference in any analysis on a purely expenditure basis.

Tighter money markets, lack of Australian shareholder support, high interest rates, and borrowing restrictions on overseas funds will make financing by the private sector very difficult in 1974 and 1975. However, the Petroleum and Minerals Authority the Government proposes to establish and the funds it will have at its disposal will have an important bearing on the industry, particularly in the areas of exploration funds and equity.

Because of the poor success ratio and the completion of the current phase of the development work on the currently producing fields, the development activity picture is not encouraging. With the exception of the Cooper and Gippsland Basins and in the future the Northwest Shelf area, the exploration results do not indicate much development activity for some time to come.

With world-wide shortages of steel for tubulars and construction and of construction crews and equipment, especially offshore, any major development not already planned and initiated could be very difficult to mount in the immediate future.

FUEL CRISIS IMPACT

The threatened impact of the current world petroleum crisis on international trade and on the economies of individual countries is a stark reminder of the almost total reliance in our industries and living standards on petroleum or its by-products in one form or another.

Australia is fortunate in being one of the small number of industrialized nations that have a considerable degree of self-sufficiency in petroleum.

The effect of the world crisis on this country and on individuals in particular has not been really noticeable so far (no petrol rationing, no reduction in speed limits, no fuel or power cuts or major lay-offs). It is in this lack of impact and hence awareness that the danger lies. We must not become complacent if we are to maintain our high level of immunity from critical fuel shortage.

Australia relies almost wholly on imports for its supplies of exploration and production equipment such as drill pipe, rigs, casing, tubing, well heads and some line pipe, all of which are vital in maintaining or expanding our petroleum exploration or in development or production operations for developing fields already discovered. World shortages and price rises could make it difficult to obtain access to supplies of these commodities.

Thus any appraisal of Australia's current and future positions with regard to its petroleum exploration, development, and production industry must be made against the background of the world position for fuels and materials, not just local activity in terms of expenditure and wells drilled or surveys carried out.

EXPLORATION AND THE FUTURE

The future of petroleum exploration will obviously be affected by the availability of reserves to be discovered (drilling targets), the cost of discovery and development, available funds, demand, and the cost and availability of alternative energy sources.

Assuming the generally accepted rate of 8.0 percent as the annual increase in demand it appears that, calculated on current recovery factors, all existing

known world reserves of oil could be consumed by the mid 1980s and that by about 1990 the world will need to find new reserves of oil equal to those discovered to date. Projections beyond the year 2000 can quadruple our discovery needs on a world basis. However, we should not think of the 1980s as the doomsday for oil as it is inconceivable that further reserves will not be found and indeed, that other sources of energy will not, by that time, be decreasing our reliance on petroleum. At the end of 1972 Australia's proven and probable recoverable oil reserves had been depleted by 18%. (2)

Petroleum exploration involves spending large amounts of high risk capital. The development and production stages require access to further large amounts of finance. To reduce the overall financial and political risk it is desirable from a business point of view to spread the effort over a large number and variety of projects. It is these economies of scale, benefits of integration, and vast capital requirements that have resulted in the evolution of the large integrated companies; these are usually multi-national. With the increasing difficulties in finding exploration capital those oil companies with production activities would be well advised to set aside a large part of their earnings against this need. As shown later this is already being done in Australia to a considerable degree.

However, the local company with little or no indigenous or overseas production is unfortunately without sufficient income to support extensive exploration.

Against this background of ever increasing exploration expenditure, rising costs, tighter money markets, and the uncertainty of discovery, increasing demand and costs, and world shortages, the position in Australia appears to be critical.

Unless new discoveries of crude oil are made in increasing numbers and or size the future of the private sector of the exploration industry could become economically untenable if it does not receive adequate financial support.

The run-down in drilling rig availability and loss of exploration expertise and services that follow a slackening-off of activity will be hard to replace in the face of demands elsewhere. Companies must be assured of markets, economic rates of production and a reasonable and timely return on their investments in order to justify the present and future demand for exploration funds.

RESERVES

The position with respect to Australia's reserves of crude oil, natural gas, and natural gas liquids over the last three years is shown in the following table.

TABLE 1 - Australia - Initial Recoverable Reserves
and Their Depletion (3)

Year	Crude Oil		Natural Gas		N.G. Liquids	
	Bbl x 10 ⁶ (m ³ x 10 ⁶)		c.f x 10 ¹² (m ³ x 10 ¹²)		Bbl x 10 ⁶ (m ³ x 10 ¹²)	
	Initial	Current	Initial	Current	Initial	Current
1970	1861.086 (295.888)	1749.487 (278.145)	13.9407 (0.394)	13.8385 (0.392)	274.275 (43.606)	273.776 (43.527)
% Depletion	-	5.99	-	0.13	-	0.73
1971	2075.086 (329.912)	1854.036 (294.767)	14.1428 (0.400)	13.9543 (0.395)	302.500 (48.093)	300.083 (47.709)
% Depletion	-	10.65	-	1.33	-	0.80
1972	1889.151* (300.350)	1549.867* (246.408)	38.0584 (1.077)	37.7474 (1.068)	806.078 (128.156)	801.898 (127.491)
% Depletion	-	17.96	-	0.82	-	0.52

* Includes downward adjustment of Cooper Basin crude oil reserves.

The increase in the reserves of natural gas and natural gas liquids is encouraging. However, the position with respect to crude oil is not good, and the widening gap between the level of initial reserves and current reserves only highlights the worsening position for Australian crude oil, especially in view of the similar position throughout the world. Unless large or numerous commercial reserves of crude are found in the very near future Australia will be seeking overseas sources for crude at a time of increasing world demand for that commodity.

Which ever way the future is faced the obvious answer is an allout exploration drive to find more crude oil or other petroleum resources.

DISCOVERY RATE

Examination of Australian exploration drilling results (or the success-ratio) in the 1966 to 1973 period shows that 1 in 35 new field wildcats drilled resulted in an oil discovery and 1 in every 12.7 in a gas discovery. This could indicate that Australia has a higher potential as a gas province than as an oil province. The figures for each year from 1966 to 1973 are given in the following table.

TABLE 2 - DISCOVERY RATE - NEW FIELD WILDCATS - 1966 to 1973
(EXCLUDING PAPUA NEW GUINEA)

Year	1966	1967	1968	1969	1970	1971	1972	1973	Total
Total N.F.Ws	97	73	78	81	98	63	71	52 (Prelim.)	563
<u>Discoveries</u>									
Oil	2	3	3	4	1	1	2	1	16
Gas	3	5	3	7	9	11	6	5	44
<u>Ratio</u>									
Oil	1:48.5	1:24.3	1:26	1:20	1:98	1:63	1:35.5	1:52	1:35.2
Gas	1:32.3	1:14.6	1:26	1:11.5	1:10.8	1:5.7	1:11.8	1:10.4	1:12.8
Overall	1:19.4	1:9.1	1:13	1:7.4	1:9.8	1:5.3	1:8.8	1:8.6	1:9.4

It is interesting to note for comparison that figures published in International Petroleum Industry for the years 1963 to 1969 show ratios of 1:24 for gas and 1:7.6 for oil for what is termed "selected countries" throughout the world. The world figures given are the reverse of those for Australia in respect of gas and oil.

The Australian success-ratio to date could be taken to indicate that Australia is likely to improve its gas reserves over the years but will have to rely on overseas sources for much of its requirement of crude oil.

However, with much of our petroleum resource potential untested, particularly offshore, present indications may not be reliable. Again the emphasis lies on accelerated exploration.

It is worth noting at this time that it is estimated that by 1985 we will have only used some 17% of our natural gas and natural gas liquids (4).

EXPLORATION EXPENDITURE

The amount of money needed for exploration is very large by any standard. This money must all be considered as high risk capital and as such is not generally available from many of the usual sources such as finance houses, institutional funds, insurance companies, etc.

To the end of 1972 in Australia, \$962,068,215 (5) had been spent on exploration. Of this sum \$773,982,613 had been provided by private enterprise and \$188,085,602 (5) as direct expenditure by Governments, of which \$119,349,404 (5) was in payments under the Petroleum Search Subsidy Act. To the total of just over \$962 million must be added some \$245 million provided as taxation and tariff concessions, making a grand total for Australia of \$1207 million.

TABLE 3 - EXPENDITURE ON PETROLEUM EXPLORATION
*Contains Estimated Figure

Year	Private Industry Exploration Only \$	Subsidy Payments \$	State and Fed. Govt. \$	Total \$
To 31.12.1965	64,906,470	nil	10,111,550*	75,018,020
1957	14,649,894	nil	1,132,200*	15,782,094*
1958	14,093,712	564,728	1,229,800*	12,888,240*
1959	11,771,184	1,197,854	1,486,600*	14,455,638*
1960	12,490,518	1,581,486	1,877,200*	15,949,204*
1961	12,969,756	2,695,800	2,369,400*	18,034,956*
1962	22,892,694	5,930,752	3,029,800*	31,853,246*
1963	26,979,700	10,519,208	3,357,600*	40,856,508*
1964	33,856,010	9,121,910	4,844,534	47,822,454
1965	50,606,566	10,412,832	4,534,936	65,554,334
1966	51,325,552	10,154,169	4,416,412	65,896,133
1967	56,519,965	10,326,475	4,974,238	71,820,677
1968	68,337,069	13,805,484	5,539,515	87,682,068
1969	73,834,898	14,911,351	5,069,879	93,816,128
1970	77,473,066	11,237,019	4,296,325	93,006,410
1971	79,755,095	8,468,176	5,154,595	93,377,866
1972	104,520,465	8,422,160	5 311,614	118,254,239
TOTALS	\$773,982,613	\$119,349,404	\$68,736,198	\$962,068,215
			\$188,085,602	

SOURCE OF FUNDS

The sources of the funds expended by private industry solely on exploration activities are not available for examination. However, data on the sources of private funds expended on exploration, development, and production are available and are probably indicative of the general trend.

Expenditure by private enterprise on the three activities of exploration, development, and production to the end of 1972 amounted to \$1,182,828,818 (6) of which \$475,348,646 (6) or 40 percent, was new capital of

Australian origin, \$184,441,671 (6) or 15 percent was "re-investment" or funds derived from the sale of indigenous petroleum production and \$523,038,501 (6) or 44 percent was new capital from overseas sources. In other words, the private enterprise funds from Australian sources were \$659.7 million or 56 percent of the total. As the major exploration companies are also the major producers it is reasonable to assume that the source for private enterprise exploration funds follows the above trend. The growth of "re-investment" funds as a source of money since 1964, when this type of funding was first introduced, is shown in Appendix A: In 1972, "re-investment" was the largest single source of funds.

Whether or not the rate of non-Governmental Australian finance can be maintained is open to some doubt as is illustrated by the many failures of shareholders to meet calls and the difficulty in raising capital being experienced by many local companies. However, as already stated the Australian Government has promised the injection of funds through the Petroleum and Mineral Authority and the petroleum industry can expect to benefit. It could well help local companies and improve Australia's equity in the industry as a whole.

DEVELOPMENT AND PRODUCTION EXPENDITURE

Expenditure by private enterprise on Development and Production activities to the end of 1972 has been \$229,710,603 or 19 percent of the total private expenditure. The overseas and Australian content of this expenditure is assumed to be on the same basis as that for the overall expenditure, namely some 56 percent Australian.

EQUITY OR BENEFIT

Overseas interests have played and continue to play a major role in the exploration and development of Australia's natural resources including petroleum.

Although Australia's equity in the petroleum industry is currently low, Australia has full legislative powers over its petroleum resources. The issue of petroleum exploration and production titles, terms and conditions of tenure, expenditure and work requirements, conservation and production of resources are all provided for under the relevant legislation and regulations:-

- The export of petroleum and its products is controlled.
- The price of indigenous crude is controlled and is also one of the lowest in the world.
- The price of petrol is also one of the lowest in the world.
- From June 1949 to June 1973 the price of petrol has only risen 69.0% (7) whereas wages have risen 470.4% (7) and the excise on petrol has risen some 214.0% (7).
- The requirement to refine within Australia is also covered by legislation.

With only some 30 percent of its petroleum needs having to be met by imports, the position is favourable, especially in respect of the current world crisis. However, the corollary to the price benefit is the low to very low economic benefit to the producer in return for his investment in a country that has high exploration and development costs due mainly to logistic problems, size and remoteness, and low level of activity and support services.

The export of petroleum and products is currently restricted to those for which we have no immediate market and which are produced as a result of refining crude oil or processing natural gas to satisfy Australia's current needs; that is, they are products over and above the needs of the local market or which because of logistics it is more advantageous to export from one area and offset this with imports into another area.

Because of its indigenous production, Australia is in a good position in respect of its savings on overseas exchange and freight costs on crude imports. It is subject to minimal influence by outside sources, for example the countries of the O.P.E.C. group, which can exert political pressure through price changes or production cut-backs when it feels the moment is opportune.

Also of considerable benefit to Australia are royalty and other charges levied on producers and the employment and back-up industry generated by these operations. The stability and continuity of supply of a major share of our petroleum needs is beneficial and also has considerable strategic importance. It is not easy to obtain figures on Australian equity in a given field or reservoir because of the frequent and sometime obscure changes in share holdings, particularly where nominees are concerned. However, a general idea can be obtained if an analysis of major shareholders, etc., is made at a specific time.

Based on figures available to June 1973, the Australian share (equity) of the production of hydrocarbon liquids (crude, natural gas liquids and condensate) was 40.0% and for natural gas 39.0%; similar figures for June 1972 are 39.0% and 39.0% respectively. The small

differences in these figures are mainly due to production rate changes and revision of the Australian holding in one company. See Appendix B for details.

The figures for Australian equity in petroleum reserves at June 1973 are 40.0% for hydrocarbon liquids and 31.0% for natural gas. These are based on the published reserves at June 1973 and while presently indicative, could be easily changed by new discoveries and the nationality of, or share holding within, the discoverer.

In the case of the reserves still to be developed, the ultimate equity will rest with the ownership of the production licence which could differ greatly from the equity in the exploration permit within which the discovery is made. It is in participation in the production stage that Australian companies could find the vehicle for a major share of the benefits.

APPRAISAL (CONCLUSION)

(a) If Australia is to maintain or improve its degree of self sufficiency in petroleum resources it is essential that an active and expanding program of exploration be reintroduced immediately or the back log or gap between discoveries and needs will reach unbridgeable proportions.

(b) The current world shortages of materials needed for exploration and development especially steel products, and the rising costs could make it feasible to produce some items locally. However, to be economic such production must be sustained by continuing demand from an active exploration and production industry.

(c) Every encouragement in terms of finance and reasonable returns should be made to the industry especially in maintaining or improving Australian equity.

(d) The establishment and operations of the Petroleum and Minerals Authority should provide a useful impetus to the industry as a whole and to the smaller Australian company in particular.

(e) The general public must realise that petroleum is a wasting asset and that if Australia is to remain in the fortunate position of having sufficient fuel for our everyday needs more and more money will be needed to discover and develop new petroleum reserves. Investment by the public in the support of local companies or overseas companies raising funds in Australia for use here should be encouraged. This should be considered as an investment in Australia's future, not as a means of rapid profit taking due to share price moves.

(f) The exploration and development potential in terms of geological and geophysical services, especially contractor services, drilling capacity in numbers and depth ranges of rigs, material and special imports must be maintained by providing adequate work and incentives. Once contractor services are lost to other areas e.g. the North Sea or Indonesia, then it will be very difficult to replace them. Much of the equipment and material needed has to be ordered up to 12 to 18 months ahead and unless an intensive exploration program can be justified and maintained such forward planning and ordering cannot be carried out.

(g) If Australia is to retain it's favourable position with respect to the petroleum resources the time of intensive exploration activity is now.

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- (5) Australian Mineral Industry 1972 Review, Petroleum chapter Pre-Print, page 41, Table 22.
- (6) B.M.R. Record 1966/205 Expenditures on Petroleum Exploration and Development to 31 December 1965, Table 9(a) and Petroleum Newsletter Nos 30, 34, 38, 42, 46, 50 and 54.
- (7) Petroleum Information Bureau Australia, Oil and Australia 1973 (Pre-Print).

SOURCE OF PRIVATE ENTERPRISE FUNDS (6) - APPENDIX 'A'
Australian and Papua New Guinea 1964-1972

Year	AUSTRALIA				N. AMERICA		OTHER		TOTAL
	New Capital		Reinvestment		\$	% of total	\$	% of total	\$
	\$	% of total	\$	% of total					
1964	17,874,144	50	1,526,300	4	12,899,036	36	3,806,030	10	36,106,101
1965	17,180,452	31	4,426,900	8	30,043,968	54	4,254,880	7	55,906,200
1966	15,934,309	27	3,617,356	6	31,836,202	54	7,431,640	9	58,819,507
1967	25,030,352	28	12,658,851	14	45,515,210	52	5,511,580	6	88,715,993
1968	51,880,039	42	19,300,124	16	40,667,235	33	11,152,011	9	122,999,409
1969	94,443,393	57	14,160,909	9	50,011,473	30	6,194,679	4	164,810,454
1970	49,533,296	36	24,737,963	18	56,652,465	42	5,557,051	4	136,480,775
1971	84,034,843	54	41,101,850	27	28,182,085	18	1,716,802	1	155,035,580
1972	41,450,980	26	62,860,918	39	41,478,142	25	16,347,352	10	162,137,392
Totals	397,361,808	39	184,441,671	18	337,285,816	34	61,972,025	9	981,061,320

AUSTRALIAN EQUITY IN PETROLEUM PRODUCTION - APPENDIX 'B'

*Hydrocarbon Liquids = crude oil, natural gas liquids and condensate where applicable

ANNUAL PRODUCTION										
		July 1971 - June 1972				July 1972 - June 1973				
Basin Field(s) Area(s)	Australian Equity In Field(s) %	*Hydrocarbon Liquids		Natural Gas		Australian Equity (if changed)	*Hydrocarbon Liquids		Natural Gas	
		Total	Aust.Share	Total	Aust.Share		Total	Aust.Share	Total	Aust.Share
		10 ⁶ bbl	10 ⁶ bbl	10 ¹² cu ft	10 ¹² cu ft		10 ⁶ bbl	10 ⁶ bbl	10 ¹² cu ft	10 ¹² cu ft
Gippsland Basin Barracouta, Marlin, Kingfish, Halibut	42%	103.4948	43.4678	0.0379	0.0159	same	114.3395	48.6226	0.0521	0.0219
Perth Basin Dongara, Mondarra, Gingin, Yardarino, Walyering	14%	nil	nil	0.0101	0.0014	same	0.0652	0.0091	0.0295	0.0041
Carnarvon Basin Barrow Island	14%	15.9757	2.2366	0.0067	0.0009	same	14.7393	2.0635	0.0063	0.0008
Cooper Basin Gidgealpa, Moomba, Big Lake	37%	0.2275	0.0813	0.0347	0.0127	same	0.1486	0.0542	0.0358	0.0131
Bowen-Surat Basins Moonie-Alton- Bennett	95%	0.9004	0.8527	nil	nil	same	0.7449	0.7054	nil	nil
Roma Area Gas Fields	94.0%	0.0199	0.0187	0.0082	0.0077	same	0.0340	0.0319	0.0141	0.0132
TOTALS		120.6183	46,6571	0.0976	0.0386		130.0715	51.4862	0.1378	0.0531
% of GRAND TOTAL			39.0%		40.0%			40.0%		39.0%