

FORECAST PETROLEUM AND GAS DEMANDS AND THE OPPORTUNITY FOR FURTHER PETROLEUM EXPLORATION TO MEET DEMAND

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Abstract

Historically, New Zealand is at an all-time high for petroleum self-sufficiency with only 30 % of oil and gas consumption being imported. While petroleum self-sufficiency has been high, the demand for gas and liquid petroleum in recent years has been only modest, following a strong growth in the 1979-87 period. This situation, coupled with changes in the petroleum exploration taxation regime, has resulted in explorers emphasising that the future gas market is rather soft and the risks associated with petroleum exploration are high, and therefore why explore for petroleum? The question of prospectivity is left for other speakers; this address examines existing and future oil and gas markets in New Zealand.

Petroleum and gas demand is firmly embedded in New Zealand's economy. One third of New Zealand's energy needs are for transport fuels. Approximately 40 % of energy for industrial non-transport end use, excluding Synfuels, is supplied by gas. Gas-fired electricity generation is expected to rise as the load factor of 1000 MW dual-fired Huntly Power Station increases. Proposals such as the Auckland Electric Power Board's gas-fired, combined-cycle power station also illustrate the likely new demands for gas. Another area where gas demand is likely to increase is cogeneration. This address examines where oil and gas is presently used, what the prime end users are, what policy changes have affected demand, and what alternatives, such as further hydro generation, are likely to compete for future oil and gas demands.

Indigenous petroleum supplies have peaked. Issues discussed in this paper include:

- decreasing Maui deliverability, and
- what happens after the year 2009.

The resulting gap between increasing oil and gas demands and diminishing known reserves provides an opportunity for further oil and gas exploration.

Introduction

In keeping with the theme of this conference (Meeting old challenges with new perspectives) I discuss the old challenge of meeting New Zealand's transport and thermal fuel market demands with the new perspectives for the 1990s of diminishing indigenous supply from Maui within the next 15 years, and the prospect of changing Government intervention and changing consumer-demand patterns.

New Zealand's oil markets: an historical overview (including the present situation)

Thirty years ago total oil consumption in New Zealand was approximately 65 PJ. By 1990 this demand had grown to 146PJ, an average growth rate of 2.7 % per annum. There are a number of contributing factors:

(i) Prices largely set in international markets. International crude oil prices (in nominal terms) over the last 30 years are illustrated in Figure 1. In the 1960s and early 1970s the international price of crude oil was in the US\$2 to US\$3/bbl range. In 1973 the first oil shock increased prices to US\$

11/bbl, with subsequent increases in the early 1980s seeing crude oil prices of US\$ 34/bbl. Crude oil prices have since decreased to around US\$ 18 to US\$ 20/bbl.

(ii) Cushioning and lag inefficiencies through price control and other high local costs, such as the high cost of coastal shipping. These inefficiencies have been removed over the last 5 years.

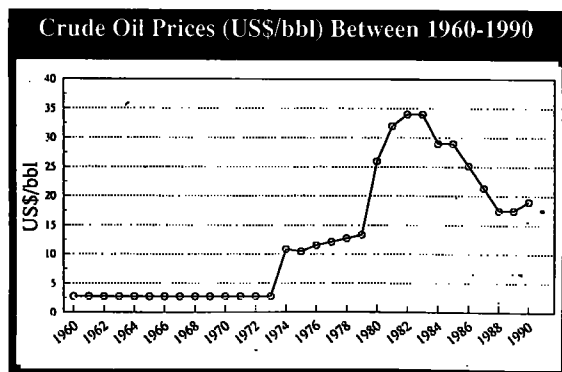


Figure 1: Crude oil prices between 1960 and 1990.

- (iii) Consistent 70 % market share for petrol of the total oil market over the last 30 years.
- (iv) Non-transport fuel substitution to gas in the 1970s and 1980s. This was spurred by the high prices for imported oil from 1973 onwards, and facilitated by the then recent discovery of the large Maui gas reserves in 1969 and 1970.
- (v) Local production of oil products since the commissioning of the Marsden Point Refinery in March 1964.

New Zealand's gas markets: historical overview including the present situation

Total gas demand increased from 5 PJ of manufactured gas demand in 1960 to 180 PJ of natural gas demand in 1990. This represents an average growth rate of 2.7 % per year over the 30 years. Over the 1980s, the growth rate of gas demand was 15 % per year.

Contributing factors have been:

- (i) Fortuitous discovery of large gas reserves in 1969 with the discovery of the Maui reserves.
- (ii) Long-term Maui gas contract providing cash flow certainty to developers and price certainty to consumers. This was provided by the signing of the various Maui contracts in October 1973 between the Crown and the Maui JV partners.
- (iii) Base load customers for electricity generation and petrochemicals. In 1973 the prospect of large-scale gas-fired electricity generation with the development of up to 4,050 MW of capacity was expected. Subsequent events have seen the Auckland number 1 and number 2 thermal power stations lapse, and gas demands were initially met from New Plymouth (600 MW) and Huntly (1,000 MW) and only at very low volumes. The commencement of gas demands from the Ammonia-Urea plant in 1982, Petralgas chemical methanol plant in 1983 and the Synfuels gas to gasoline plant in 1985 have been substituted for those lapsed power stations.
- (iv) Reasonably widespread reticulation throughout the North Island has given industrial and commercial consumers access to competitively priced gas. Domestic consumption of gas has grown but, because of its relatively small size in comparison to the non-domestic markets, has not significantly affected overall growth rates. CNG use for transportation boosted gas demands over the early 1980s, but has since slipped back as the pressure on imported oil prices and perceptions of security of supply risks abated.
- (v) Oil substitution due to OPEC price shocks. There were two main influences here. Firstly consumers reacted to changing price signals by switching fuels either proactively or as capital replacement cycles forced decisions to be made. Secondly the Government had significant involvement in programmes and financial incentives to encourage substitution.

New Zealand's total energy market: historical overview including the present situation

I have examined only the transport and thermal fuels markets supplied by oil and gas over the last 30 years. I will now elaborate as to how these markets have performed relative to the total New Zealand energy scene. Demand for various fuel types has changed over the last 30 years (Figure 2).

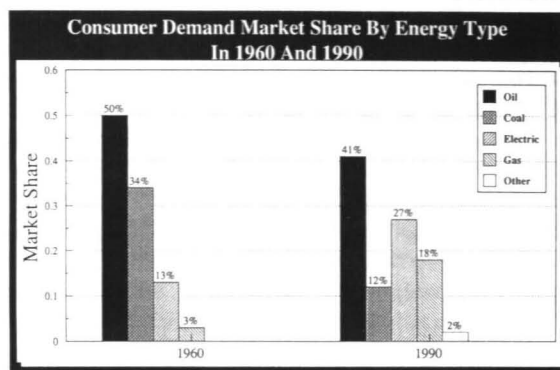


Figure 2: The consumer demand for uel types over the last 30 years.

Oil market overview

Oil has remained the largest energy type demanded by consumers over the last 30 years. This is based on the high proportion of transport fuels to New Zealand's total energy demand. For example, in 1990 transport fuels are estimated to have been 39 % of total end consumer energy demand.

Total Energy Market	1990
Non-Transport	61%
Transport	39%
	100%

Table 1: The proportion of transport fuel ddemand to New Zealand's total energy demand.

Coal market overview

Coal was the second largest energy type with 34 % of the energy demand market in 1960. We now estimate coal to have approximately 12 % of total end consumer energy demand. At first sight it appears the coal market has been decimated. However, after analysis it should be noted:

- (i) We estimate non-transport and non-electricity generation demand for coal to be at least twice as large as non-transport demand for oil. Over the last 30 years, large coal users such as hospitals have retained significant coal demands but switched to gas if previously oil users.
- (ii) Exports of coal are currently approximately half the size of actual coal demand by consumers (excluding coal-fired power stations).
- (iii) Coal for power stations is approximately half the volume of exports.

Overall coal volumes have not changed much over the last 30 years, but just under 50 % of their markets have moved from household, commercial and industrial demand in 1960 to coal exports and thermal power station demands in the 1990s.

Electricity market overview

The demand for electricity has doubled over the last 30 years. Since 1960 large electricity intensive industries such as Comalco, New Zealand Steel and some energy intensive pulp and paper industries have added to demand. In 1990, these sectors alone accounted for up to 30 % of total electricity demand.

Smaller industrial and commercial operations have become more electricity intensive. The development of

commercial buildings with air-conditioning, lighting and space-heating requirements, as well as electronic office equipment has boosted growth.

Household consumption of electricity has also increased as follows:

Household electricity demand	1960	1990
	kWh	kWh
Average demand per household	4464	7702

This increase can be attributed to:

- the increase in average disposable incomes;
- substitution from coal, in particular for space heating;
- increased average comfort levels for space heating, cooling and lighting; and
- a proliferation of electronic appliances and increased use (by households) of such items as refrigerators, freezers, dryers and televisions over the last 30 years.

Gas market overview

The gas share of the total New Zealand energy demand, excluding electricity generation and Synfuels, has increased from 3 % in 1960 to 18 % by 1990. As previously noted a significant share of this is due to the manufacture of methanol and ammonia-urea fertiliser. These two users consume 38 % of total end-user demand, excluding electricity generation and Synfuels.

Overview of other energy forms

Other forms of energy are mainly black liquor and wood-waste use, by pulp and paper plants. There is a wide range of other wood and wood-waste consumption, and minor uses of geothermal energy through to domestic solar water-heating panels and wind power.

Researchers are likely to agree that attempting to estimate the demand for "other" energy forms is very difficult, and our estimate of 2 % of the total demand must be viewed in that light. Research into "other" forms of energy demand and supply is difficult because a large proportion used are not traded, but are by-products reused; an example being boiler fuel.

Conclusion

Over the last 30 years energy demand in New Zealand has been characterised by growth in electricity and gas demands substituting for oil and coal in non-transport markets, with oil remaining the highest energy form used because of the high proportion of transport fuels used relative to total consumer demand. Given this summary of New Zealand's energy markets, what are the opportunities and new perspectives for oil and gas explorers and developers the 1990s?

New Zealand's total energy demand and supply: future prospects

To approach the question of where demand might go, a broad market-sector overview has been made in Table 2.

Over the next 10 to 15 years we expect the strongest growth in energy demand to be in the commercial and industrial sectors. This will arise as the reforms of the economy are consolidated, and developers undertake investments in the more competitive environment.

Ranked market share of total end demand 1990

Transport fuels	39%
Household demand	13%
Commercial sector demand	10%
Major metals	9%
Pulp and paper	8%
Methanol and Ammonia-Urea	7%
Dairy industry	4%
Remaining industrial sector	10%
	<hr/> 100%

Table 2: Total energy end-use in 1990.

The largest demands will be in the forestry sector as the rapidly maturing forestry resources are utilised. This is a significant opportunity for thermal energy suppliers. It should be noted that the wood-processing options available include those which would allow plants to be self-sufficient through to exporting unprocessed logs. What are the needs of the forestry owners and how might the oil and gas markets meet those energy needs competitively?

There is a possible increase in total energy demand by the major metals sector, with the primary fuel being electricity for additional aluminium smelting. This may result in an increase in gas-fired electricity demand.

Large changes have already occurred in the dairy industry with the concentration of processing into a few highly specialised plants. At the same time new technologies and large plants have been built, taking advantage of economies of scale. We believe this trend will continue; any increase in energy demand due to increased throughput will be offset by increasing efficiencies. Part of these efficiencies in the dairy and forestry sectors, in particular, is likely to be met by more cogeneration plants. Both of these sectors have heat requirements suitable for cogeneration. With the imminent posting by Trans Power of electricity transmission costs, the cost of electricity will be more clearly understood by possible cogenerators.

Oil and gas markets: future prospects

Our forecast of gas supply over the next 15 years is illustrated in Figure 3. The following key results should be noted:

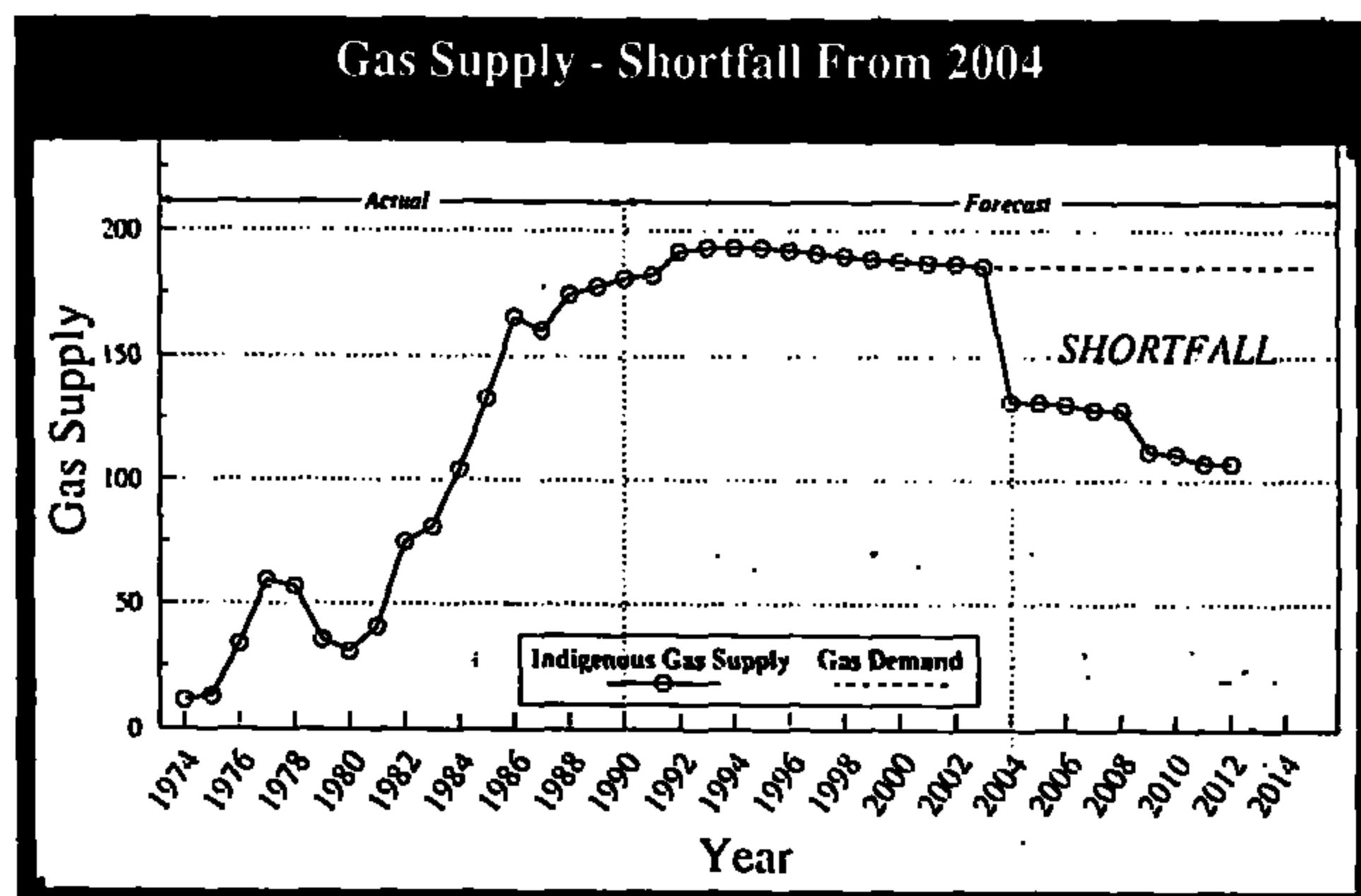


Figure 3: The gas supply forecast for the next 15 years.

- the current plateau of approximately 185 PJ per year will continue until the Synfuels, Ammonia-Urea and Petralgas demands cease in the year 2003;
- by 2008 the Kapuni gas reserves will be exhausted;
- by 2010 existing small onshore gas fields will be exhausted;
- the last Maui gas supply occurs in 2012; and
- from 2013 onwards there is a shortfall between demand and supply of 185 PJ per year.

These results are based on gas production maintaining high levels until complete exhaustion. In reality there will be a small decline in production capacity which will soften the drop-off in gas supply. Nevertheless, it is clear that some time after the year 2013 (given no further gas discoveries and development) New Zealand consumers will have to switch to imported oil or indigenous coal for their non-transport fuels.

By adding oil and gas demand and supply together, one can observe the shortfall in fuels to be imported (Figure 4).

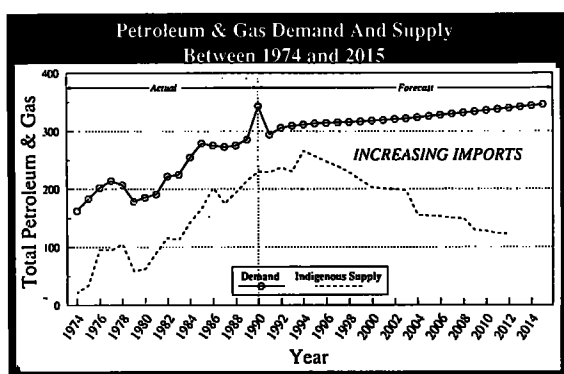


Figure 4: The gas supply forecast for the next 15 years.

From Figure 4 we see:

Year	Fraction of oil and gas demand imported
1975	81%
1985	40%
1995	18%
2005	53%
2015	100%

While we are currently at about the lowest fraction of imports to demand than we have ever had, the prospect is that within 15 years we will be importing more petroleum products than we produce locally. This gives rise to a number of opportunities for oil and gas explorers and marketers:

- With a fully developed gas infrastructure and established gas users, any new gas supplier will have an established market. Already we have seen new small gas fields, such as Waihapa, successfully selling to an existing consumer (the Stratford power station).
- Should new gas discoveries not be made, oil, coal and electricity marketers will all attempt to fill the breach. If the cost of imported oil rises high enough we may even see coal gasification as a contender!

It may be worth pausing here to consider two old perspectives on this issue:

(i) With a large gas infrastructure, the value to New Zealand of new gas discoveries is great. The cost of having to develop new oil or coal infrastructures to meet existing gas users needs (once the gas runs out) plus the international

pegged pricing, which will arise, will indeed be large. We should be encouraging gas exploration and development to take advantage of this infrastructure. Equally, petroleum explorers should be actively seeking new niche markets for their product, now, and making plans to supply large undersupplied potential markets.

(ii) Self-sufficiency will certainly decline. I note this only. As you are probably all aware, self-sufficiency at any cost is definitely not to be advocated. However, a strategic view of limiting supplies to imports only would not provide enough flexibility for the uncertainties of the future.

The crunch facing New Zealand is that in the next 15 to 25 years we will have lost the advantage as a nation of a large and predictably priced, thermal-fuel source. While that may seem some distance away, I note the comments of Murray Kennedy, group planning Manager of Electricorp Marketing who in a paper recently presented at the Power Industry Conference in Wellington noted two key points:

“At current volume growth rates of about 2% a year (for electricity demand) the existing industry generating capacity will be utilised by about 1997”. This immediately gives rise to a potential new gas-fired power station demand within the next decade. Not only is Electricorp a possible candidate for additional gas supplies for power station generation, but also Auckland Electric Power Board, Hutt Valley Energy Board and CRA have signalled their interest in being the next developer of a power station.

“A large thermal station takes about six years from Environmental Impact Report to production. On this basis decisions will be required in about another 2-3 years if shortages (of electricity) are to be avoided at the end of the decade”. If such a lead time (plus the lead time between discovery and production) is taken into place, then the window of opportunity for petroleum explorers to place gas into new thermal power stations is beginning to open now.

Important factors affecting future oil and gas markets

The following three main factors are interrelated and affect demand and supplier responses.

Macro demand variables versus understanding each sector

The traditional methods of forecasting energy demand take into account energy to GDP relationship, plus population growth and pricing relativities. While such models are useful guides to the future, I believe that an additional perspective must be taken by oil and gas explorers and wholesalers. There are significant uncertainties in terms of technology changes, consumer preferences and government policies that need to be understood. Only in this way can niche markets and whole new markets be identified and opened up.

The prospect of consumers switching their mode of operation to energy efficient products and processes has recently been offered as a possible means of dampening and even changing the direction of energy demand growth. Several commentators have pointed to our increasing energy use per unit GDP compared to the rest of the OEDC (which has been decreasing). Two areas to consider are:

- To what extent has growth in the large industrial energy intensive users (such as Comalco, New Zealand Steel and pulp and paper processing) contributed to this?

- Compared to most OECD countries, New Zealand still has a per head energy use, excluding major energy intensive industries, which is favourable. I would caution country by country comparisons of such data without a careful analysis of whether the database is similar, and other environmental factors, such as climate and density of housing.

The new perspective I suggest you adopt is not to aim *only* at the market share you expect (using historic data), but rather to understand your potential clients needs and develop these directly.

Government interaction

The prospect of carbon taxes, tradeable permits, and a whole raft of economic instruments and new processes under the Resource Management Act provides ongoing uncertainty to the energy sector. Not only will any changes affect oil and gas marketers, but also their competitors in the coal and electricity generating industries. This issue is the forerunner of a continuing perceived need by the Government for targeted intervention where market forces do not provide competitive or equitable outcomes. Such a role for Government we applaud. What the mechanics of those interventions are though requires consultation and surveillance by the industry.

For the gas industry, important decisions are being made in the form of competing electricity price tariffs. Similar comments on consultation and surveillance by the gas industry apply. A solution is needed, equitable from both an economic and political perspective, to ensure the gas industry continues without the dominance of a high fixed-cost electricity distribution system. An important outcome of this process will be the impact on cogeneration options in the future.

The last government intervention to note is in the area of licensing exploration acreage and developments. I am sure this is an area of lively debate throughout this Conference, so I will not add to it!

Propensity of explorers to explore

Whether petroleum explorers invest exploration monies in New Zealand is decided upon a mixture of:

- the prospectivity of New Zealand;
- the licensing and royalty regime compared to alternative countries; and
- the potential markets for downstream products.

I hope that this address will encourage you to consider the latter factor, given the history of New Zealand's oil and gas markets and the key uncertainties facing the future.

Author

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Govind Saha has a B.Sc. Engineering (First Class with Distinction) from India, an M.E. (Distinction), a Ph. D from the University of Auckland, and an MBA from Victoria University of Wellington.