Medium Term Vulnerabilities within the New Zealand Gas Market

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Abstract

This paper presents an analysis of the New Zealand thermal fuels outlook in the medium term and discusses some of the infrastructural issues that could well influence future energy directions in this country. The discussion in the paper is primarily motivated by the "gas gap" that has emerged with the depletion of the Maui gas field and examines the challenges and opportunities that thus present themselves. In bringing an overview of these issues together, the paper covers:

- An update of key developments in the last year or so and a "stocktake" of where we are;
- A brief survey of a number of solutions that have been canvassed in the recent past; and;
- What the BAU implications, risks and opportunities of the current situation might be.

New Zealand faces some very important energy decisions in the next several years. Decisions taken now are likely to set supply directions for at least the forward 15 to 20 years. The options considered in this paper present different risk profiles and, ultimately, price implications for New Zealand industry. Each option must be fully assessed and risks identified and appropriately managed if we are to achieve an optimal supply strategy for the country. The challenge is to balance security, risk and economic competitiveness so as to deliver the best macro-economic outcome for New Zealand.

Introduction

CAE's commentary paper "Thermal Fuels in the Post-Maui Era" completed in November 2004[1], was one of the first to take an in-depth look at the energy situation in New Zealand in the wake of the Maui gas field re-determination and to consider a number of alternative scenarios on how the natural gas sector might develop in order to meet future demand.

The study's major conclusion was that there remained good prospects for restoring New Zealand's gas inventories to a level that would improve national energy security and certainty. However, this assessment of continuing self-sufficiency was conditional on the undeveloped reserves in the Pohokura and Kupe fields being brought on-stream according to plan, and anticipated new discoveries being made early and brought on-stream promptly.

Energy security is based on the knowledge that an adequate and continuous supply of energy at reasonable prices can be maintained whilst also maintaining the incentives for further discovery and production. After a period of considerable uncertainty, it now appears that both the thermal fuels and electricity sectors have adjusted to the run down of the Maui gas field and a more ordered market response is emerging with changing energy use patterns. In particular we have seen the dual-fired Huntly power station switch from natural gas to coal-firing, producer gas prices more reflective of international energy prices, and a resulting major retraction in methanol manufacture and other lower-value demand.

But, perhaps, most importantly, the CAE study reinforced the view that because of New Zealand's small and remote energy markets and the impediments to investments in upstream activity, in an internationally competitive setting, we are unlikely to ever see a purely commercial decision related to future supply infrastructure. The inherent difficulty faced by the NZ energy market is one of scale and the high risk hurdle that needs to be overcome before new production capacity can be made available to the market.

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[1] *Energy Supply in the Post-Maui Era – An Investigation into Thermal Fuel Options and their Contribution to Energy Security*, Centre for Advanced Engineering, November 2004.

An additional factor remains, that in a shrinking gas market, New Zealand's gas infrastructure is insufficient to support new discovery. For major energy users the price of gas will be critical.

CAE has previously characterised the country's failure to address supply issues as a lost opportunity, leaving New Zealand exposed to economic risk and the vagaries of global energy markets. Despite wholesale contract prices that are thought to be in the region of $6-7/GJ, a more favorable royalties regime and increased Government promotion, there has not been a stampede to further explore in what are considered to be under-explored and prospective theatres such as Taranaki, the East Coast and the Great South Basin.

The degradation of New Zealand's energy security over the recent past has been severe. As of today, overall primary energy self-sufficiency has fallen from 85.6% in 2001 (March year) to 75.7% in 2005. An LNG importation project would reduce self-sufficiency by around another ten percentage points. In addition to falling gas supplies, self-sufficiency in liquid fuels has fallen from over 50% in the late 1980s to less than 20% today.

Recent estimates give the country's total residual gas reserves at approximately 1740PJ; representing around 12 years of production at current production rates of 150 PJ per year, the lowest production level since 1985.

One must conclude, therefore, that as yet there appears insufficient incentive for increased gas exploration. Despite some increased exploration activity, a lack of success in the last year or so has meant that the window of opportunity for indigenous supplies to plug the gas gap is becoming more urgent. The question thus remains - where to from here?

The Place of Thermal Fuels in the Economy

New Zealand's primary energy supply is roughly 750 PJ/year. Natural gas, three-quarters of it historically from Maui, contributed approximately 30% of this in 2002, dropping to about 20% now. At its peak Maui produced a quarter of New Zealand's energy requirements. The sheer size and production capacity of the Maui field relative to the size of the New Zealand gas market has, until recently, delivered plentiful gas to reticulated users, electricity generators and petrochemicals feedstock industries at prices essentially fixed in the mid-1970s.

Depletion of supply from the Maui field has thus had an immediate and material effect on the future availability of thermal fuels, both for direct use to supply process and low-grade heat in the industrial, commercial and domestic sectors, and for electricity generation. As a legacy of the Maui era, about a quarter of New Zealand's electricity is produced from gas, with gas-fired power stations (including cogeneration) consuming about 40% of natural gas production.

When hydro electricity is constrained, thermal fuels generate up to a third of our electricity. New Zealand's thermal generation system is anchored by power stations at Huntly (1000 MW), Stratford (355 MW) and Otahuhu B (380 MW). While other gas-fired and oil-fired plants are generally only used in hydro-firming, demand peaking, and other back-up roles, the capacity shortage caused, in part, by uncertainty over gas supplies means that there is increasing pressure on them to supply base load.

Beyond electricity generation, about one-third of New Zealand's total energy use is associated with producing heat by various means using a range of thermal fuels. Major industry sectors that require some form of process heat include forestry, basic metals, fertiliser, dairy and meat processing. Because many industries require both heat and electricity, the drive for efficiency has resulted in a growing uptake of cogeneration, using thermal fuels to produce both forms of energy from the same source.

Despite tighter supply and rising prices, gas remains the preferred fuel for new electricity generation plant and, until the re-determination of the Maui field, gas demand had been increasing as new combined-cycle and gas-fired cogeneration plant came on stream. As New Zealand's developed gas reserves dwindle, our capacity to meet this level of demand has only been possible because the dual-fuel Huntly power station has switched from gas to coal, underlining our dependence on thermal fuels.

The difficulty for New Zealand is that it's past history of dependence on Maui gas and historical reliance on hydro for electricity generation has significantly constrained incentives for the development of alternative fuel sources. In the absence of sufficient indigenous supplies, the importation of LNG has been touted as the most apparent solution to plug the gas gap.

Announcements made over the recent period show, however, that those involved in the delivery of energy services to New Zealand are beginning to offer alternatives to LNG for meeting this country's thermal fuels requirements. Competition between these alternatives has the potential to incentivise least-cost solutions, whilst also managing long-term supply risk.

LNG in the New Zealand Context

The starting point for considering LNG importation to New Zealand is an estimate of project scale. CAE analysis of the upstream supply chain suggests that an import scheme of around 80 PJ pa, representing over 50% of the retrenched NZ gas market, would be a likely minimum scale project. Pricing estimates for such a scheme show an LNG price of around NZ$8.70/GJ assuming an oil price of US$30 per barrel and an exchange rate of 60c.

While LNG markets, the technology emplyed and its supply chain are well established, LNG has the disadvantage of being large scale and would appear to be an inflexible option that risks foreclosing other alternatives. In short, the NZ natural gas market is small when considering an LNG option. It is even smaller when there is at least some capability of indigenous supplies to serve the market.

CAE analysis suggests, therefore, that it is unlikely that a conventional LNG importation scheme could proceed in the New Zealand context without significant adverse competition effects or impacts on the domestic E&P sector. An additional adverse factor is the likely requirement for long-term contracts to secure LNG, and this will have the largest potential impact on the size of the contestable gas market.

CAE also investigated a regasification vessel option that is more flexible than a conventional project in that the NZ-based storage and regasification hardware could be deployed here on a more as-and-when-required or contracted basis. This would appear to be a more attractive LNG implementation. However, this type of operation is in its infancy.

The importation of CNG could also be another source of significant supplies of natural gas. While the manufacture and use of CNG is established, the (long distance) marine transportation of it is not. Shipping is the costliest and least developed segment of the CNG supply chain. Tankers are still in the R&D phase and no commercial applications are considered likely before 2010 at the earliest. On the plus side, CNG has more potential for smaller scale application than LNG and has easier scalability.

In this setting, a revisit of recent developments in world LNG markets is pertinent. The following points are worthy of consideration:

- The "buyer's market" of the last couple of years seems to be closing;
- Prices are higher, not necessarily because of increased supply/demand tensions, but because of the linkage to (higher) oil prices;
- Price resistance from China may be counterbalanced by higher than expected demand growth in the USA and Europe;
- The recent histrionics in regard of pipeline natural gas supply from Russia to Europe strengthens the case for diversification with LNG, notwithstanding reliability being compromised with an increasing number of missed shipments in recent times;
- As fabrication metals' prices have increased so have supply chain costs increased. For example, a 150,000t standard LNG tanker now costs around US$200m as compared to US$150m for a 135,000t standard tanker of 2 years ago;
- Not only have materials costs risen but labour and expertise has become scarcer and therefore more expensive;
- There have been delays in the commissioning of some projects, perhaps indicating the increasingly ambitious targets of the industry to a large degree;
- Significant cost overruns and other delays in projects such as Sakhalin 2, also Sakhalin 1 and others

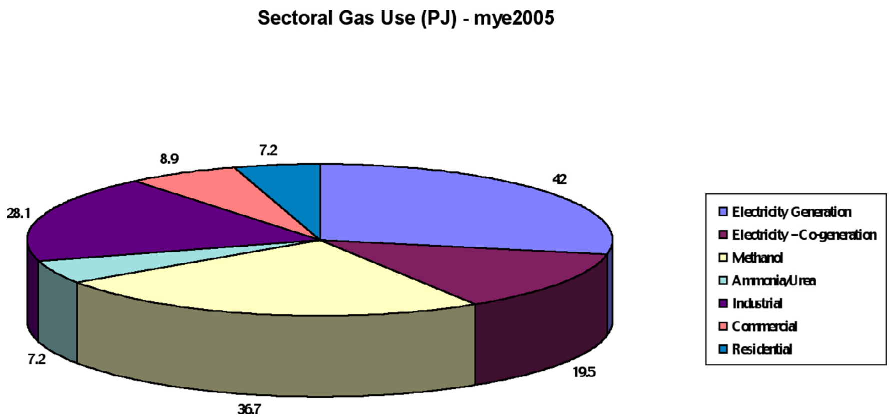
show the uncertainties and difficulties of operating in climatically challenging and environmentally sensitive theatres.

The final point is pertinent to both oil and gas operations and may well cause participants to reassess their risk-reward tolerances in considering frontier regions.

In summary, the above developments have made an LNG project for NZ somewhat less attractive than was the case a year or two ago. Equivalently, the case for increased investment to ensure an adequate supply of indigenous natural gas or alternative(s) is stronger.

The Demand Side Perspective

An examination of energy use patterns in New Zealand can only act to reinforce how much the gas market has retracted over the last several years. The figure below shows sectoral gas use for the year ending March 2005.



The total demand of around 149 PJ is considerably down from the peak of around 240 PJ in 2001. The two sectors where there has been significant consumption attrition has been (i) methanol production which has used up to 90 PJ pa but the plants will be mothballed indefinitely soon after Methanex's remaining gas entitlements have been used up, and (ii) electricity generation where the Huntly station is now running solely on coal and New Plymouth's switch to fuel oil.

Other higher value (direct) uses have not yet shown the same degree of demand destruction. However, this is partly because, in many cases, consumers have limited fuel-switching capabilities in the short term. Of note, however, are announced plans by Fonterra to commission combined coal-firing plants to meet increased thermal fuels load, in preference to other energy forms. With modern combustion technologies coal has the potential to reassert itself in the thermal fuels markets generally, for both electricity generation and industrial use. An indication of this is Fonterra's energy strategy as exemplified by their proposed Whareora dual coal/gas plant.

With the likely complete cessation of methanol production during 2006, annual gas consumption is likely to fall to around 115 PJ pa. Allowing for an additional annual demand increment of around 20 PJ when Huntly e3p is commissioned, the size of the NZ natural gas market is thus, at best, around 135 PJ pa or less, assuming all three ccgt power stations are continuously operated on base load. This is, by no means a certainty, as the two older ccgts will, at times, likely be at the margin especially as other generation capacity is commissioned.

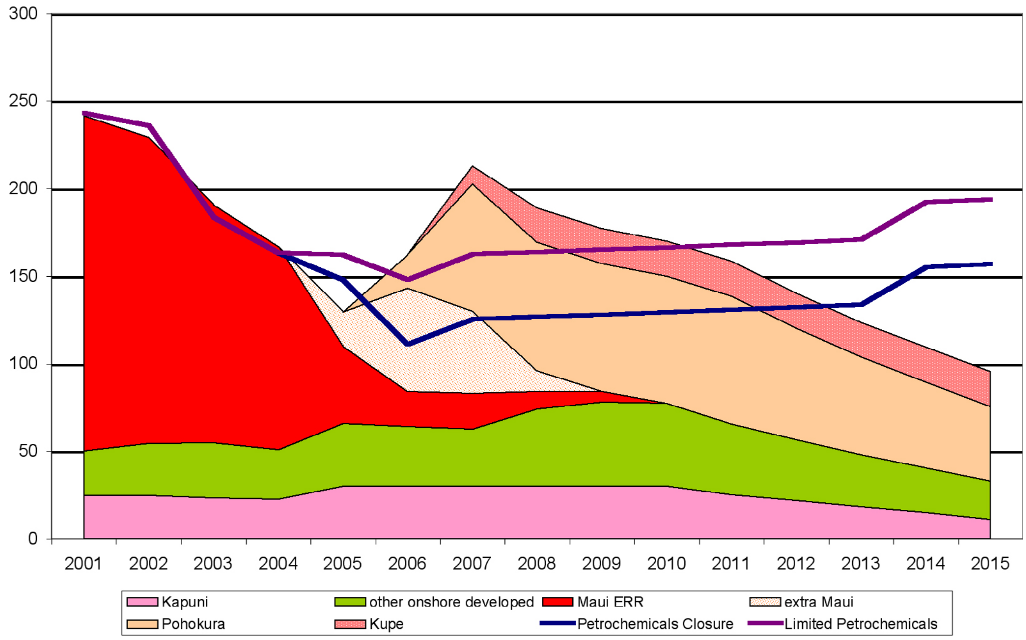
In the short term, this may be seen as a positive as it conserves gas for later use.

In the medium term, however, part of the co-generation tranche is also at risk. This tranche peaked at 25PJ in the March year ending 2004 at 18.8 PJ for 2005 March year is back to pre-Maui re-determination levels. Higher gas costs are impacting the gas-fueled co-generation option, not only as future investment but also in the abandonment of existing plant. Further reductions in the co-generation tranche seem likely. In the medium term (1-5 years), industrial direct use and cogeneration could attrite by around 10 PJ pa.

From an industry perspective, therefore, decisions on our future thermal fuels supply pathways are becoming time critical. In respect of natural gas and oil, industry players are having to grapple with both price risk and supply risk. The comparative certainty that attaches to coal in this regard far outweighs the potential risks presented by carbon charges etc.

Possible Pathways

The following graph provides a perspective of the outlook for indigenous natural gas (in New Zealand). With the swift decline in output from Maui, we are now dependent on the timely commissioning of the Pohokura Field, and shortly thereafter, the Kupe Field, to meet anticipated demand.



The outlook for indigenous natural gas from CAE (2004)

The key point here is obvious, should there be any delay or worse, failure, to supply gas as anticipated the consequences are serious. Notwithstanding commendable tranches of wind capacity and geothermal coming on stream soon, electricity generation is still relatively constrained and depends on the fueling of both existing, and with increasing demand, more than two, of the ccgt stations (including e3p).

What therefore of the period beyond 2009 when gas supply may be insufficient to supply reticulated demand and fuel the 1120MW or so of anticipated ccgt capacity? Will some of this plant be stranded? Will there be sufficient alternative generation capacity, such as the New Plymouth gas/fuel oil station, to make up the shortfall?

Given the urgency of the situation, if New Zealand does not find new indigenous sources of natural gas within the next year or so that can be brought on-stream early next decade, then alternative sources of gas-based fuel or alternative energy capacity such as coal-fired power stations need to be planned for.

The basis of our consideration of alternative (thermal) energy options is the idea that we should seek to postpone the LNG decision. In other words, we should, perhaps, seek a “bridge” to a future where more suitable alternatives might present themselves[2].

For example, alternatives to conventional LNG that we have already investigated are the regasification vessel for LNG and the importation of CNG. Both of these are only emerging technologies but have the potential to be commercial within the next few years. Other options that also may emerge include coal gasification and coal bed methane. These options are technically well understood but not yet economic (in NZ), and may be subject to development lead-time over the medium term.

[2] CAE assessment of an additional 350PJ of Maui Gas included in the figure above and recent confirmation of at least 200PJ above Maui ERR by STOS does buy some time to secure additional domestic discoveries.

Both coal bed methane (cbm) and in-situ coal gasification have achieved significant commercial application in countries such as Australia and the USA, and are now attracting considerable interest in New Zealand. It is worth reflecting that in terms of measured energy reserves, the lignites of the South Island are by far and away New Zealand's most important strategic energy resource.

The work undertaken by the Liquid Fuels Trust Board during the 1980s provides a sound basis for examining future utilisation of these resources. The deposits are well defined, the lignite properties known and mining costs reasonably established. Most important is their suitability as a feedstock for thermo-chemical conversion to liquid fuels and related chemicals, coupled with their overall low energy costs. Recent work confirms that at existing crude oil prices commercial development of the lignite is potentially attractive. Development of this resource thus offers NZ a potential significant hedge against the volatility of world oil markets

The view being expressed then, is while efforts are made to commercialise these emergent options, we should consider the use of so-called "bridge" fuels until alternatives more appropriate than LNG are available. This is similar to the notion of natural gas often being viewed as a "bridge" to a low-carbon world.

Fuels that can be thought of as bridge fuels in our circumstances include conventional coal and oil-based fuels such as LPG, fuel oil, diesel, avtur and naphtha. The switch of the Huntly to coal-firing due to the low availability and higher price of natural gas and the re-firing of New Plymouth due lack of investment in power generation, in turn, due to uncertainty over thermal fuels, are examples of this occurring already. It could well be that coal plays a greater part in industrial applications, as for example, in the case of Fonterra.

Geothermal energy now appears a more attractive option for the forestry sector and related industries given the coincidental location of geothermal fields and forestry resources. Beyond this, of course, geothermal offers a significant low-grade heat source for direct use in primary processing and horticulture.

As far as electricity generation is concerned, coal remains under consideration as the "backstop" option due to resource availability and price. Analysis undertaken for the Ministry of Economic Development[3] indicates that, in the absence of a carbon tax, various coal-fired generation options may well be more economic than the assessed cost of LNG-fired generation by CAE. Less attractive options lie in the use of oil based feedstocks – fuel oil, diesel and naphtha.

The use oil at New Plymouth and diesel at the "backup" plant at Whirinaki, is already well established in NZ. The table below provides some updated indicative cost estimates for a range of thermal fuels.

Fuel	**Location**	**Price** ($/GJ)	**Outlook – changes in real prices**
Natural Gas	NZ-wide	>$6	Rising at 4% pa until 2015
LNG	NZ-wide	>$9	Constant in real terms
Coal	Huntly Marsden Southland West Coast	$3.50 $2.62 $0.79 $2.50	Rising to $4/GJ by 2013 Constant Constant Constant
Oil	Whirinaki New Plymouth Avtur Naptha	$25 $19 $21 $18	? ? ? ?

It can be seen that the oil-based fuels are considerably more expensive than coal or gas. Of these, naphtha could well be the cheapest. However its price and price formation is more complicated due to its wide range of uses including being a component of petrol or avtur, a major precursor of plastics, a fertiliser feedstock (as is natural gas), and able to be converted into "towngas".

3 *Fossil Fuel Electricity Generation Costs*, East Harbour Management Services, June 2004.

The high cost of oil-based fuels is obviously directly related to the current high prices of crude oil. Similarly, since the price of LNG for New Zealand is likely to be linked to oil prices, the oil price outlook, amongst other factors lead us to believe that LNG prices are likely to be somewhat higher than we had originally estimated a year ago. Previous CAE analysis suggested that if the price margin over domestic gas as shown in the above table was passed onto the electricity generator, LNG is likely to add around $10-20/MWh onto the long run marginal cost of electricity.

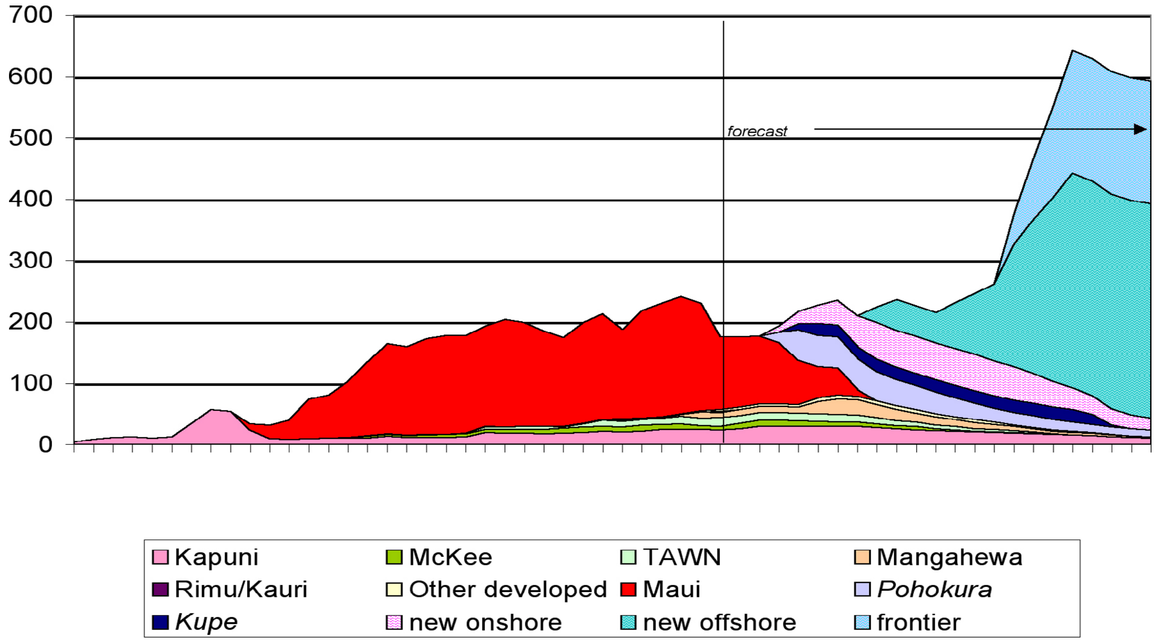
While the impact of increasing natural gas scarcity and higher prices is most widely felt by electricity consumers, the major direct users of natural gas feel the largest direct impacts. A critical issue for these, and other firms, is the fuel price at which exports become non-competitive in international markets and thus force reductions in domestic capacity and production. It should be remembered that with demand attrition comes the potential for further supply uncertainty in an increasingly small and declining market.

Prospects for the Future

The two main tenets of economic energy security are diversity of energy types and diversity of energy sources, neither of which are necessarily easy to attain in a small economy, distant from all but domestic supplies. It is not hard to see, but worth re-iterating, that the high proportion of hydro generation in our electricity system and the dominance of the Maui gasfield in thermal fuels have been at times blessings for the NZ economy, but of recent times the legacy of these arrangements have been more of a curse.

Some domestic supply of oil (especially) and gas is clearly good for energy security. It is no accident that many import dependent countries actively seek to improve their domestic supply capabilities where endowments exist.

In this respect, the long vision on NZ's gas prospectivity is well presented in the CAE Thermal Fuels commentary. The following figure is a depiction of that vision. The authors of that report suggest that the fundamentals for further gas exploration success in New Zealand are good and that there is a need to encourage investment in NZ's under-explored, long lead-time exploration prospects. New Zealand has the fundamentals to achieve the requisite reserves levels to, at least, supply domestic demand.



A future scenario for New Zealand gas production given successful and aggressive exploration investment

The lack of success in oil and gas exploration in the last year should not (yet) be seen as detracting from the prospectivity of New Zealand exploration theatres. Rather, the disappointment exists primarily because of the unique situation that New Zealand finds itself in of having both exploration success and production development on a critical path.

The uncertain outlook for natural gas is impacting the production and investment decisions of both direct users of thermal fuels, electricity generation and users of electricity. That is, all energy consumers have been affected to a greater or lesser degree.

This uncertainty is not just about a lack of (economic) energy security but a certainty of rising energy prices. Rising prices have not only as a result of increasing scarcity (as perceived with oil resources) but also as a result of shortages of energy and energy producing and delivery capability (although the two are not independent of one another) as has occurred in the NZ economy.

If one accepts the premise of continuing exploration success, the challenge, then, is for New Zealand to restore gas reserves to levels that allow for a more orderly market than has been in existence since the Maui re-determination. Recent exploration failures has created both pressure and a sense of urgency for New Zealand to arrive at a "solution" for meeting its thermal fuels needs.

Our analysis suggests that a range of alternatives is available and that depending on any single one option may well increase this country's vulnerability. Instead, we should give closer attention to current less "attractive" options as a bridge to the future. So doing will allow this country to extend current supply horizons and act to encourage investment in development of our indigenous energy resources.

This challenge is here and now.

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