Energy Supply and Demand Forecasts for New Zealand - an Update

presented by M Lear, Ministry of Commerce, PO Box 1473, Wellington.

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Abstract

The last decade has seen a dramatic change in the structure, ownership, and operating environment of the New Zealand energy sector, from one of government control to one of competition and privately funded investment. Recently, New Zealand has seen significant developments in government policy on the electricity sector, three companies announce entry to the petroleum retailing market in competition to the incumbent four, and the Kyoto protocol on climate change.

While the Government no longer undertakes centralised energy investment planning, the Ministry of Commerce carries out energy modelling to provide an objective outlook against which to make policy decisions. The resultant energy supply and demand scenarios are also published periodically to provide reference information to energy market participants. In keeping with its descriptive rather than predictive role, a national market clearing model is used, which balances supply and demand through prices.

This paper presents the Ministry of Commerce's latest energy supply and demand scenarios for New Zealand, looking beyond the draw-down of the large Maui gas field, to 2020.

The Current New Zealand Energy Sector

New Zealand's total primary energy supply was about 713 PJ pa in the year ending March 1997. Oil and gas currently dominate New Zealand's primary energy scene, accounting for about 63% of the total primary energy supply. Oil provides about 32%, gas about 30%, coal about 7%, hydro about 12%, geothermal about 13% and other renewables such as wind and wood the remainder.

New Zealand is well endowed with energy resources and is completely self sufficient in all but liquid fuels. New Zealand is currently about 89% self sufficient in its primary energy and 44% self sufficient in liquid fuels.

The large Maui gas/condensate field has dominated energy decision-making in New Zealand over the last 20 to 25 years. In order for the field to be developed, the Government of the day had to enter into long-term take-or-pay contracts. The Government then had to create a market for the large quantities of gas that would become available under the contracts, as early work had shown that reticulated demand was likely to be relatively small and able to be satisfied by the Kapuni Field.

Dramatic electricity demand growth was forecast in the late 1970s. When this did not eventuate, alternative markets were developed to take advantage of the cheap and abundant Maui resource. The synthetic petrol, methanol and ammonia/urea plants in Taranaki and the rapid

expansion of the reticulated gas market were the results. The production of synthetic petrol has been declining in recent years with production focussed on chemical methanol. While reticulated gas demand has increased slightly ahead of economic growth in recent years, significant increases in gas use has been witnessed in electricity generation using conventional, combined cycle and cogeneration technologies.

The New Zealand energy sector is still dominated by Maui gas, which provided around a third of New Zealand's total primary energy needs in 1996. The timing and profile of its.depletion and the timing and extent of new discoveries have important implications, particularly for the petrochemicals industry and electricity generation, but also for industrial, commercial and domestic consumers and for fuel shares.

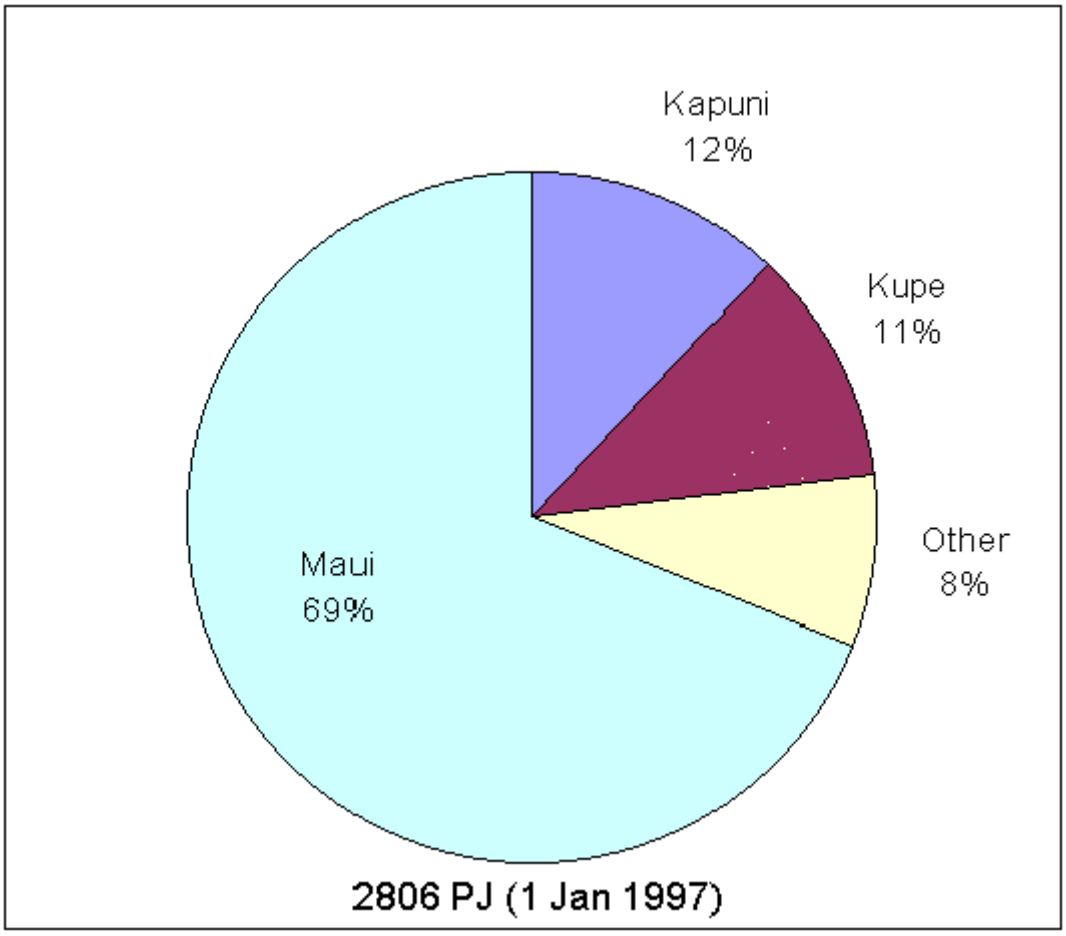

Figure 1. Estimated Gas Reserves

The Maui Field's importance to the New Zealand gas industry is highlighted in Figure 1, which shows the estimated remaining gas reserve shares of the New Zealand fields as at 1 January 1997. The Maui Field accounts for about 69% of New Zealand's total gas reserves of about 2800[1] PJ (net). The Kapuni Field is estimated to contain about 12% of New Zealand's total reserves, Kupe 11%, and the remaining fields about 8%.

Recent Ministry revisions to reserves have increased the estimated "proven and probable" reserves in the Maui Field by 500 PJ, an amount equivalent to around three years' demand. The recent discovery of the Taranaki onshore Mangahewa Field appears promising with a field size of 1000-2000 PJ being widely referred to. There is some speculation that the field could contain as much as 4000 PJ.

The Maui Field also dominates gas production, producing about 82% of New Zealand's net gas production[2] for the year ending December 1996. Kapuni produces about 10% of net production, McKee about 4%, Tariki/Ahuroa 3%, and the remaining fields a negligible amount.

About 39% of New Zealand's gas in the year ending March 1997 was used in electricity generation including cogeneration, 42% in the petrochemicals sector (comprising the Methanex methanol plants and the ammonia/urea plant), and about 19% was reticulated by Natural Gas Corporation (NGC) through its high pressure pipeline system direct to major users, and to gas utilities.

New Zealand's estimated remaining crude oil and condensate reserve shares as at 1 January 1997 are estimated at around 800 PJ and are presented in Figure 2. Oil reserves too are dominated by the Maui Field which contains about 70% of New Zealand's reserves. The Kupe Field contains about 12%, Kapuni contains about a further 5%, M^{c}Kee about 7%, and the remaining fields about 6%.

New Zealand's production of crude oil and condensate was about 91 PJ in 1996. Oil production is also dominated by the Maui field, supplying about 69% of the total, with 8% from the Kapuni Field, 5% from the Waihapa Field, 13% from the McKee Field, 2% from the Ngatoro, and 4% from the remaining fields.

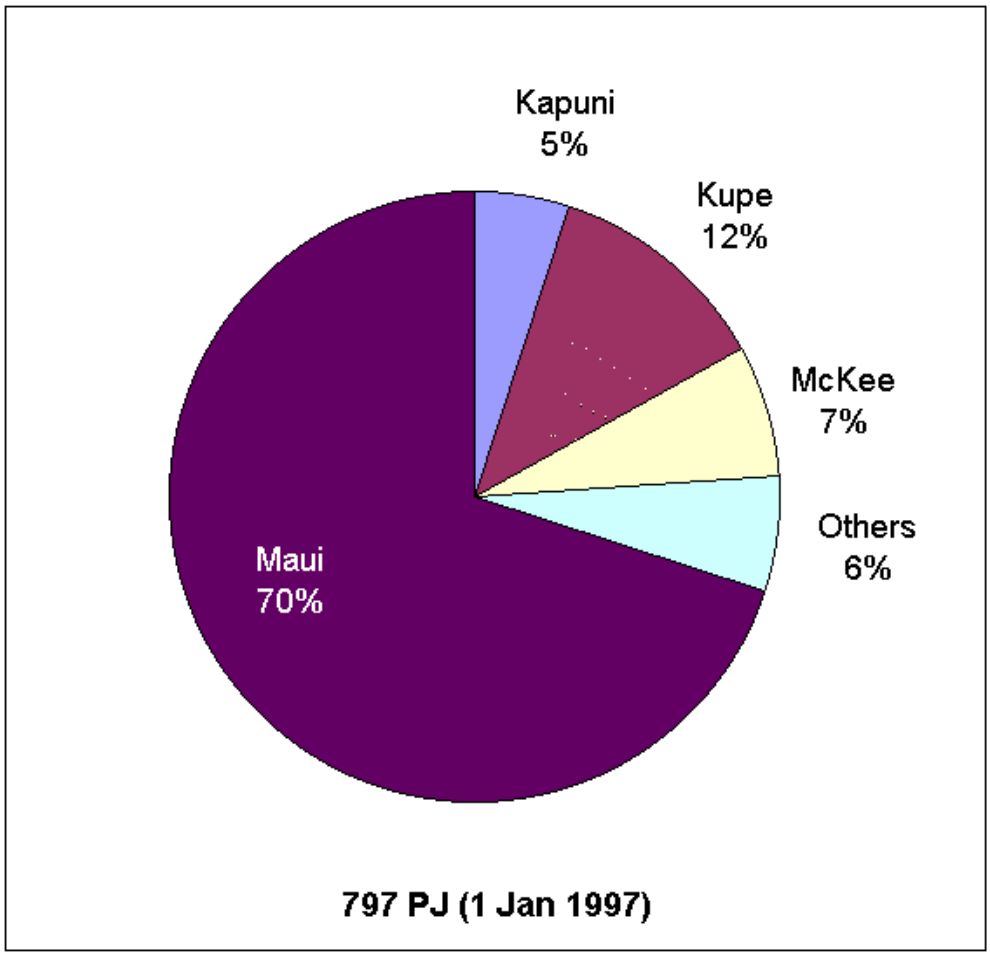

Figure 2. Estimated Oil Reserves

New Zealand's consumer energy is dominated by oil, comprising about 47% or 197 PJ pa of a total consumer energy consumption of about 439 PJ pa for the year ended March 1997. Most of this (about 80%) was used in the transport sector. Electricity accounted for about 27% of consumer energy, coal about 8%, and gas about 9% and direct use of renewables such as geothermal and wood about 10%.

The Ministry of Commerce Modelling Programme

The Government is no longer a provider of energy supplies or services, but sets the regulatory framework to ensure the efficient operation of those markets. Instead of centralised, government planning, the responsibility for planning and investment in the energy sector has been placed with those individuals and organisations which face the correct set of incentives. However, the Government still needs to be able to understand and analyse likely future patterns of energy demand and supply, in order to identify and examine key policy issues, and promote the efficient operation of the market.

The Ministry of Commerce modelling programme has developed a set of tools that can be used to examine in a formal way the complex interactions between the supply of, and demand for, energy in the New Zealand economy. This enables the Government to make informed decisions regarding the future of the New Zealand energy sector.

The SADEM integrated energy supply and demand model has been developed to be descriptive rather than prescriptive. The model explores the market clearing pattern of energy demand and supply. Demands are projected for a given set of prices and the costs of supply for those demands determined: if different, the model is then re-run until the prices match the costs and supply, thus balancing supply and demand.

The model utilises a series of quantitative and qualitative methods to project New Zealand's energy demand and supply by fuel and by sector out to 2020. To explore further the possible future patterns of energy supply and demand, scenarios can be analysed by varying a wide range of input assumptions.

The key assumptions used for the 1998 baseline scenario examined here are:

- Future GDP growth of about 3% pa.
- A future exchange rate of NZ$1 = US$0.58.

- Oil prices are based, in part, on the IEA's World Energy Outlook price scenarios. Current prices are taken to be around US$19 (~NZ$33) per barrel rising to around US$26 (~NZ$45) per barrel by 2005 and stable thereafter.
- In the Baseline scenario the gas price is assumed to be $3.25/GJ in 2010. The price is escalated from around $2.60/GJ now and rises to around $3.70/GJ in 2020.
- New gas discoveries of about 60 PJ pa. This is an expected average new discovery rate based on the assumption of a major find, in this case, the Mangahewa field with an assumed size of 1000 PJ plus a series of small finds averaging 10 PJ pa.
- The coal price is taken to be $2.66/GJ rising to $3/GJ by 2010 and constant thereafter.
- The methanol plants cease production at the expiration of their Maui take-or-pay gas contracts in 2003 and 2005.

The oil price assumptions are similar to our previous assumptions. Current crude prices have already moved below these assumptions and the outlook is tending to be lower rather than higher. However, crude prices comprise around only 20-25% of the final price of petrol and diesel. Also from a modelling point of view, petrol and diesel demand does not face significant inter-fuel competition from other fuel types and so slightly lower prices will simply lead to slightly higher demand.

The gas price profile is significantly lower than previously assessed prices of around $3/GJ now, rising to over $4/GJ by 2010 and to $5.32/GJ in 2020. This is more consistent with observed market and contract prices and also takes into account our re-estimation upwards of reserves from the Maui Field of 500 PJ and the addition of an assumed 1000 PJ Mangahewa Field to reserves around the turn of the century.

The projected coal price profile is significantly below our previous long run price assumption of $3.74/GJ. It is in line with the current neutral to negative view on coal prices internationally together with declines in costs of production and observed falls in contract prices domestically and internationally.

The modelling here assumes that the methanol plants cease production at the expiration of their Maui "take-or-pay" gas contracts in 2003 and 2005. In reality the situation appears quite fluid with Methanex's intentions of mothballing the smaller of the two plants last year being overtaken by the continuation of methanol production at both plants subsequent to a much more optimistic view of gas availability. Production from these plants in the future is principally dependent upon gas availability, its price, the price of methanol, competing uses for available gas and competing supply sources of methanol. Thus the methanol plants could close earlier (or later) than assumed depending on developments in both the gas and methanol markets.

Based on these assumptions, the Ministry of Commerce modelling projects consumer energy to grow by about 1% pa between 1997 and 2020 from 494 PJ pa to 626 PJ, for GDP growth of about 3% pa. This results in a decline in New Zealand's energy intensity over the next 23 years. This is in contrast to New Zealand's historical energy intensity which, unlike that for most other OECD countries, has risen over the past 10 to 15 years.

The main driver of this relatively slow growth in consumer energy is the current high use of gas for methanol production instead of synthetic petrol production. The use of gas for methanol production is counted as consumer energy whereas, in contrast, the use gas for synthetic petrol production provides input into the liquid fuels energy component. The former is a consumer of energy whereas the latter had a neutral effect through the replacement of other sources of petrol. Leaving out the methanol component means that (commercial) consumer energy grows from around 407 PJ[3] now to the 626 PJ mentioned above, a growth rate of 1.9% pa.

Figure 3 shows the historical and projected GDP growth and consumer energy growth between 1970 and 2020. As consumer energy growth outstripped GDP growth between 1970 and 1990, New Zealand's aggregate energy intensity grew, as presented in Figure 4

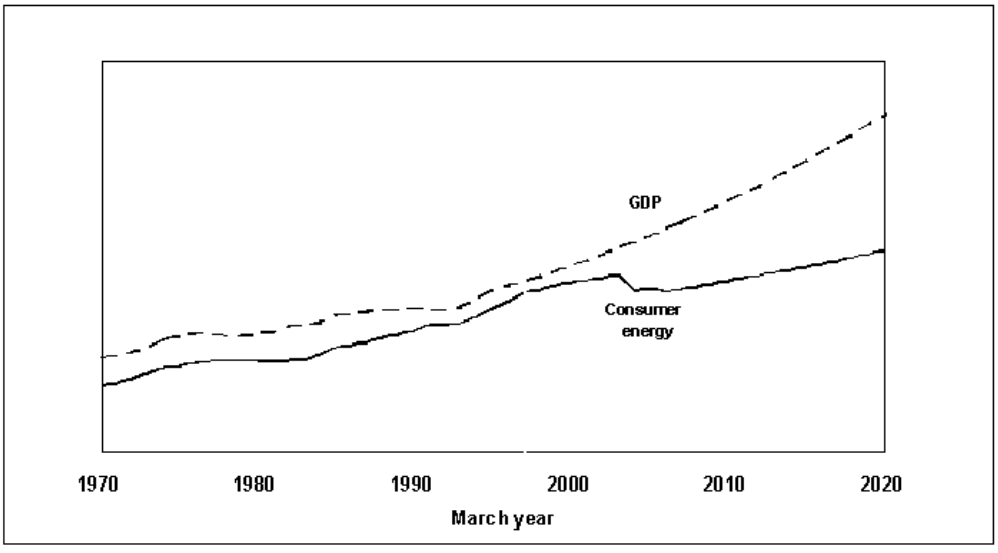

Figure 3. Consumer Energy and GDP Growth

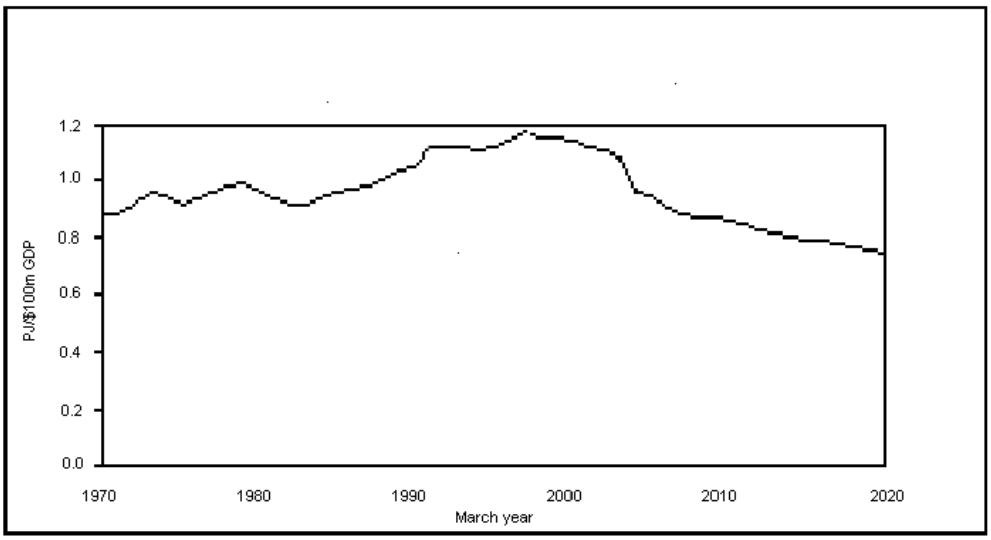

Figure 4. New Zealand's Consumer Energy Intensity

The recent increased use of gas, especially for methanol production, results in an upwards blip in energy intensity. Adjusting for this, consumer energy intensity is expected to continue declining. Figure 3 shows that between 1997 and 2020 a growing divergence between GDP and consumer energy occurs, which translates into the projected decline in energy intensity shown in Figure 4 over the same period.

Consumer Energy by Sector

Total consumer energy is projected to grow by about 1% pa between 1997 and 2020, from about 494 PJ pa to 626 PJ pa, on the assumption that GDP growth is 3% pa. This is presented in Figure 5 which shows consumer energy growth by sector between 1970 and 2020.

Of the main sectors, transport demand is projected to grow at about 2% pa, from about 207 PJ pa in 1997 to about 323 PJ pa in 2020. Air transport (domestic and international) is projected to grow the fastest at about 2.3% pa, from about 30 PJ pa in 1997 to 51 PJ pa in 2020. Land transport is projected to grow at about 1.9% pa, from about 155 PJ pa in 1997 to 242 PJ pa in 2020. Sea transport is not projected to experience such strong growth, growing at about 1% pa, from about 24 PJ pa in 1997 to about 29 PJ pa in 2020

Industrial and commercial consumer energy actually falls from around 244 PJ in 1997 to 231 PJ in 2020 which, excluding the dominating effect of methanol production results in a growth rate of around 1.8% pa. The assumed closure of the petrochemicals plants, largely balances strong growth in the "other industrial and commercial" and forestry sectors, which grow at about 1.9% pa and 1.8% pa respectively.

The forestry sector is expected to see considerable growth in its energy requirements over the outlook period, as an approximate doubling in the available wood resource occurs through to 2020. Under the baseline scenario, although the percentage of the forestry harvest going to the energy intensive pulp and paper industry is expected to decline, the absolute quantity of wood processed in New Zealand is projected to grow strongly. Note here that the modelling accounts for commercial energy only and, for example, nets out the potentially significant increases in wood residue use for energy production in the forestry sector.

Projected Growth in Primary Energy Supply

The growth in consumer energy and changes in the consumer energy fuel shares that result mask dramatic changes in the composition of New Zealand's primary energy supply, as the Maui gas field depletes and the diversity of the fuel sources of new electricity generation projects increases. The view presented here is only indicative of the possible changes, as in the forecast horizon to 2020, both the availability of fuels and their relative prices can easily be very different from the assumptions and projections. Further only commercially traded fuels are modelled and fuels such as direct geothermal and wood use are excluded from the analysis.

The reduction in gas consumption has the most dramatic effect on the composition of primary energy supply. Gas consumption is projected to peak between now and 2003, at about 210 PJ pa, and with the assumed closure of the Methanex plants then decline to between 120 and 150 PJ pa to 2020. The peak in the next few years until the first of the Methanex's Maui contracts expire is underpinned by strong demand for gas in

electricity generation from conventional thermal, combined cycle and cogeneration technologies. The new Taranaki Combined Cycle (TCC) is likely to be run as a baseload plant from the outset as will Contact Energy's Otahuhu station.

The coal industry is the most notable beneficiary from any decline in New Zealand's gas reserves and/or rise in gas prices, with the primary energy supply of coal projected to grow dramatically, from about 54 PJ pa now, to about 95 PJ pa in 2020. There is moderate growth in coal for industrial and commercial use, as the gas price rises and fuel switching occurs. However, the dramatic growth in coal use is mostly attributable to electricity generation. From 2000, upwards of 23 PJ pa is projected to be used by the Huntly Power Station, as it switches increasingly to coal-fired generation. While Huntly's continued operation may be open to conjecture its full switching to coal could consume some 60-65 PJ of coal pa. This would require significant increases in New Zealand's current coal production if demand is to be satisfied from domestic sources alone. With essentially limitless supplies, coal is the backstop fuel for electricity generation, and the projected use of 41 PJ for this purpose in 2020 could be more or less depending on the continued availability of gas at competitive prices.

The primary energy supply of oil is also projected to grow strongly from about 218 PJ pa in 1997, to about 335 PJ pa in 2020, in line with the growth in demand for transport fuels.

The primary energy supplies of geothermal and hydro experience quite different patterns of growth as electricity demand exceeds the current economic capacity of the existing system. About 400 MW of new geothermal capacity becomes economic over the period. At an assumed efficiency of only about 10%, this has a dramatic effect on geothermal primary energy supply in electricity generation, which grows from about 72 PJ pa in 1997 to about 187 PJ pa in 2020, a growth rate of around 4.1% pa. Hydro experiences much more modest growth rates, as the hydro base is considerably larger than geothermal and is assumed to be close to 100% efficient. The primary energy supply of hydro is projected to grow from about 88 PJ pa in 1996 to 95 PJ pa in 2020, as the result of an additional 560 MW of capacity.

As existing reserves, particularly of the Maui Field, decline, gas is likely to be traded to its highest value uses (price control on gas having been removed from 1 April 1993). As a result, the wholesale price of gas is expected to rise over time to the long-run cost of new discoveries.

We have attempted to illustrate the impact on the energy sector of two alternative gas (discovery) scenarios to the baseline.

A pessimistic scenario of discoveries of, say, an average of 20 PJ pa, a "no major find(s)" scenario, means that gas prices will increase faster than otherwise with the increasingly scarce resource being traded to higher value uses, possibly muted by established contracts. In essence, this means that reticulated demand will continue to be supplied, the methanol plants will close sooner than otherwise and somewhat less gas will be used for electricity generation than indicated in the baseline.

Conversely, a more optimistic view of gas discoveries and/or reserves than in the baseline should result in lower prices. The methanol plants may find it advantageous to continue operating beyond the expiration of their Maui contracts and there may be more gas available for electricity generation resulting in the postponement of more expensive technologies such as coal-fired and the higher cost hydro and geothermal options.

New Zealand's electricity generation system is predominantly hydro (around 70% of generation mainly depending on inflows), thermal (gas, coal and oil contributing 24% of generation) and geothermal (6% of generation). The variability of hydro inflows and the small storage capacity of the hydro system mean that significant thermal capacity is required to manage the system through peak winter demands. The system has been operated to a 1-in-60-year security standard, so that the system could meet expected demand even if inflows into the hydro system hit a 1-in-60-year low. In the reformed competitive industry, security of supply will be agreed through commercial contracts.

New Zealand's current thermal system is primarily dependent on gas to fuel the Huntly (1000 MW) and New Plymouth (580 MW) power stations, with Stratford (198 MW) and Otahuhu (90 MW) being used in back-up mode only. Huntly is dual-fuel capable on coal and gas and has run increasingly on coal in the last year or so and is likely to continue to do so in the next few years.

The last three or so years has seen a rapid evolution of the New Zealand electricity generation sector. A diverse myriad of new generation projects have been either commissioned in the two years, is under construction, been confirmed or under active investigation. Most of this new capacity has at least some significant involvement from supply companies, with Maori interests and onsite cogeneration developments comprising the balance. The commissioned, committed or confirmed total of new projects to April 2001 amounts to around 1400 MW with an estimated output of slightly over 9000 GWh (32.4 PJ) pa. Table 1 is a summary of these projects.

Of the above, some 904 MW (65%) are gas fueled. All this gas capacity will essentially operate in baseload mode generating an estimated 6227 GWh pa - 68% of the estimated new generation. Together with the Huntly and New Plymouth stations, this means that total gas demand for electricity generation purposes could be over 110 PJ pa. In reality the actual figure for these stations will be somewhat less as Contact Energy has indicated that New Plymouth will be progressively mothballed as Otahuhu is commissioned and Huntly, currently owned by Electricity Corporation of New Zealand (ECNZ), is being increasingly run on coal. By way of comparison, current gas use for electricity generation is around 70-75 PJ pa.

This new capacity is being widely referred to as a "supply bubble" and in the absence of decommissionings (other than of New Plymouth) and/or increases in demand in excess of that projected, will provide sufficient capacity well into the next decade and result in downwards pressure on wholesale prices. Our modelling indicates that little new capacity beyond that already committed will be economic before 2010.

As demand grows and the economic capacity of the system is reached, it will be economic to build new increments of capacity. Competition in electricity generation and the development of a wholesale electricity market will ensure that decisions about the needs for new power stations will be made on a commercial basis.

Location	Type	MW	GWh	Promoter(s)	When
	Commissioned or commissioning				
Haunui	wind	3.5	13	Wairarapa Elec/Merrill Int'l	Jun 1996
Te Awamutu	gas cogen	26	219	NZ Dairy/ECNZ	Aug 1995
Edgecumbe	gas cogen	10	70	BoP Elec/Bay Milk Products	Oct 1996
Southdown	gcc/cogen	114	930	Mercury/TransAlta/Enerco	Dec 1996
McLachlan	geothermal	55	458	Mercury Geotherm Ltd	Jun 1997
Kinleith	wood waste cogen	34	274	Carter Holt/ECNZ	mid 1997
Rotokawa 1	geothermal	24	189	Power NZ/Ngati Tahu	Oct 1997
Glenbrook/ Waiuku	kiln waste cogen	72	470	BHP NZ Steel	Jan 1998
TCC (Stratford)	gas combined cycle	379	2,500	FCL/Mercury/TransAlta	Apr 1998
	Subtotal	718	5,123		
Committed					
Tararua Ranges	wind	30	130	CentralPower	Apr 1999
Ngawha	geothermal	10	80	Top Energy/Tai Tokerau	? 1999
Waitaki	hydro efficiencies	36	250	ECNZ	Jun 1999
Otahuhu	gas combined cycle	350	2,300	Contact	Jan 1999
Kapuni	gas cogen	25	208	Bay of Plenty Electricity	Jan 1998
Mokai	geothermal	55	390	Tuaropaki Power Co/ECNZ	Dec 2000
Manapouri	hydro	175	640	ECNZ	Apr 2001
	Subtotal	681	3,998		
	Cumulative total	1,399	9,121		

Table 1. Summary of new generation capacity (estimated).

The current average North Island wholesale price is about 4.5 c/kWh which is above the average short-run marginal cost (SRMC) of about 2-3 c/kWh (depending on demand, inflows and lake levels). The developing wholesale electricity market is seeing a diverse range of new contracts and financial instruments that will ensure that consumers' and suppliers' needs are met. Electric power companies, wholesale buying groups, and retailers will be able to purchase electricity from a variety of sources. They will be able to manage a portfolio of electricity contracts and exposure to the spot market, in order to maximise their expected benefits, taking into account both the risk to which they are exposed and the cost of insurance.

Electricity consumption is projected to grow from about 113 PJ pa in the year to 31 March 1997 to about 173 PJ pa in 2020, or a rate of about 1.9% pa. Projected demand will exceed the economic capacity of the current generating system including recently commissioned and committed capacity around 2010. New Zealand has utilised much of its low cost electricity generating options, so the long-run supply curve for electricity is upward sloping and the wholesale electricity price is expected to rise over time to the long-run cost of generation.

The cheapest forms of new generation in the shorter term are cogeneration and gas combined cycle. With the improved outlook for gas availability, the prospects for these two technologies appear reasonable. Under an assumption of constant relative prices of alternative generation technologies, the long-run cost of electricity generation seems likely to be set by coal-fired generation, given its current economics and essentially unlimited supply in the New Zealand context. In the interim however, the supply curve is dominated by renewable options, with a number of geothermal sites being the most competitive, while some wind and hydro appears economic at around 5-6.5 c/kWh. Given current projections, non-traditional renewable energy's technology and costs will have to improve faster than coal's in order to gain a larger share of new generation beyond 2010. Pricing effects, such as economic instruments for climate change mitigation, could improve the competitiveness of renewables technologies.

Figure 7 shows the quantity, composition and timing of the new generation capacity requirements from the economic optimisation of the Ministry of Commerce model. Over the next 25 years around 2150 MW of new generating capacity over and above that recently commissioned or committed, a total of around 3550 MW, is projected to become economic in order to satisfy demand growth. This is a net amount of just under 3000 MW as the decommissioning of the 580 MW New Plymouth station is modelled. The addition to capacity is some 400 MW more

than the amount presented to this conference two years ago.

Between 2010 and 2015, around 300 MW of gas combined cycle, 40 MW of geothermal, 80 MW of cogeneration and 65 MW of wind become economic to satisfy demand growth. By 2020 the SRMC of generation has reached the cost of coal-fired generation and about 165 MW becomes economic as a baseload plant, along with 250 MW of gas combined cycle, 200 MW of hydro, 150 MW of geothermal, 75 MW of wind, 80 MW of cogeneration and 100 MW of distillate. All except the distillate capacity is baseload plant. It is needed to serve growing peak demand.

The effect this expansion profile and the Huntly switch to coal-fired generation has on electricity generated from different fuel sources is significant. Coal's share of electricity generation grows from about 3% now to about 8% in 2020. Geothermal's share grows from about 5% currently to 10% in 2020, cogeneraton from about 1% to 8%, and wind from virtually nothing now to about 3% in 2020. With continued availability, gas's share declines marginally from about 20% now to 19% in 2020, and hydro declines from about 70% currently to about 51% in 2020. Obviously, gas's share is somewhat dependent upon the amount of economic gas available and its share can easily be more or less through the displacement of or replacement with coal.

The incorporation of the "supply bubble" in the modelling means that wholesale electricity prices fall below long-run marginal costs (LRMC) and towards SRMC and do not rise to LRMC until around 2015. This capacity expansion profile produces a wholesale price profile initially approaching SRMC of generation that grows from about 3.4 c/kWh[4] in 2000 to 4.8 c/kWh in 2010, to the LRMC of about 6.6 c/kWh in 2020. This increase in the wholesale price is muted at the retail level by transmission and distribution costs, which are not projected to grow as strongly on a per unit basis.

Conclusions

The New Zealand Government has set the scene for a highly deregulated economy and energy sector with further reform of the electricity sector under active consideration. New Zealand's energy sector is set to continue to undergo significant change in the next 25 years as the demand for energy grows, the Maui gas field declines, and energy sector companies adapt, evolve and grow in the new "light-handed" regulatory environment.

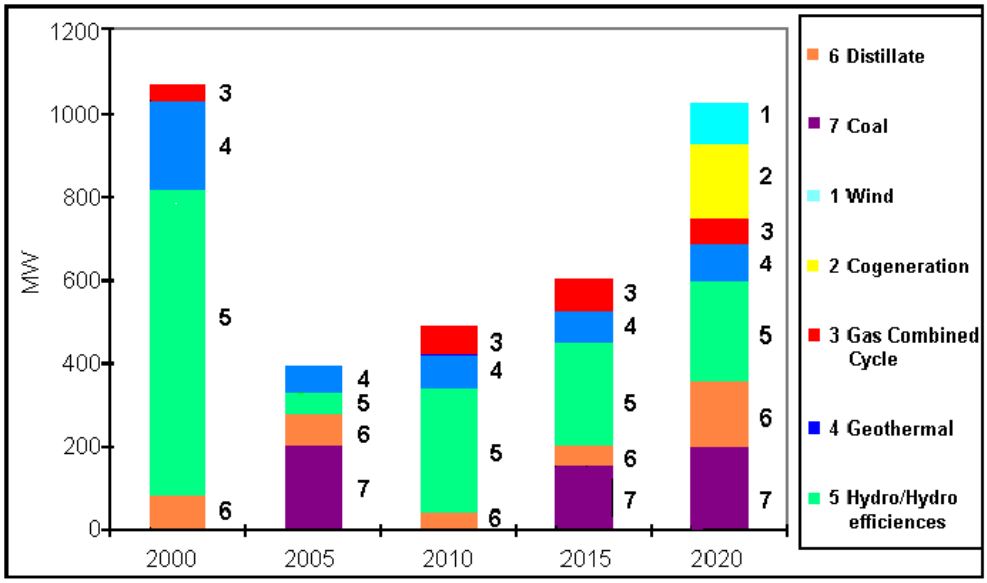

Figure 7. New electricity generation plant (commissioned or committed to 2005 and projected thereafter). New Plymouth (580 MW) assumed decommisssioned around 2000.

The Ministry of Commerce projects, for 3% pa GDP growth between 1997 and 2020, that consumer energy will grow by about 1% pa although this is partly an artifact of the decline in gas use from the assumed closure of the methanol plants when their "take-or-pay" contracts expire. This represents a significant decline in the ratio of energy growth to GDP growth from about 1.2 to 1 in the past 25 years, to about 0.33 to 1 in the next 23 years. If methanol gas consumption is filtered out from consideration the growth rate is around 1.9% pa, an energy to GDP ratio which is still almost half that of the past quarter century.

Residential sector consumer energy is projected to grow at about 2% pa between 1997 and 2020, the industrial and commercial sector excluding methanol grows by around 1.8% pa, and the transport sector by about 2% pa.

The consumer energy of electricity is projected to grow by about 1.9% pa, coal by 1.4% pa, oil by 1.9% pa, and gas to decline by about an average of 2.9% pa under the assumption that the petrochemicals plants close at the end of their contracts.

Assuming there are no capacity reductions in existing plant other than New Plymouth, about 2150 MW of new electricity generating capacity is projected to become economic between 2010 and 2020 with the current "supply bubble" of around 1400 MW possibly providing sufficient

capacity until around 2010. The surplus in the shorter term drives wholesale electricity prices below their LRMC towards SRMC.

The current tranche of new capacity is dominated by gas technologies of about 900 MW with some geothermal, non-gas cogeneration, the Manapouri second tunnel and notably some wind capacity. The increments between 2010 and 2020 are projected to be dominated by more gas combined cycle plant (850 MW), with smaller amounts of hydro (350 MW), geothermal (240 MW), cogeneration (230 MW), wind (215 MW), coal (165 MW) and distillate (100 MW). The fuel share of electricity generation is likely to change significantly as these new increments are installed, and as Huntly switches increasingly to coal. Hydro's share of electricity generation is expected to decline from about three-quarters now to little over half in 2020, and gas's share marginally from about 20% now to about 19% in 2020. The electricity generated from coal experiences the most rapid fuel share growth, from about 3% currently to about 8% in 2020 as it becomes the backstop technology.

Compared to the picture painted at the previous conference two years ago, the outlook for gas is much more favourable, even without taking into account the Mangahewa Field, with a significant upwards revision of reserves of 580 PJ in the Maui Field. All energy prices' outlooks, including that for gas, have been revised downwards to a greater or lesser degree. Given its projected price and reasonable assumptions as to reserves and continuing availability, gas remains the pivotal fuel of the future in New Zealand. Its availability and price impacts upon whether the methanol plants continue to operate in New Zealand and as recent events indicate, it is the major fuel of choice for electricity generation.

Footnotes

1 The figures for reserves presented here differ from those presented in the Ministry's January 1998 Energy Data File in that 85 PJ of Maui LPGs have been reassigned from gas reserves to oil reserves.

2 Gross production less flaring, reinjection, own use, losses and LPG extracted.

3 These figures do not completely reconcile with those published in the Energy Balance tables in the Ministry's Energy Data File as the SADEM model considers commercially traded energy only, includes international transport and treats gas for methanol production as an energy use.

4 This is the ex-power station gate SRMC and is lower than the nodal prices which may be more usually referred to in wholesale pricing.

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