New Zealand Business Council
for Sustainable Development

Sustainable Energy Futures Project

Stage 1 Report

prepared by

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Timing of the Report

The first stage of the project Sustainable Energy Futures Project was carried out in March 2004. The report is therefore primarily based on the views of the participants at that time.

Due to some participants being unable to fully contribute in that period, there has been a delay in the reporting of the findings.

Where significant changes in the energy sector have occurred since March, these are highlighted in the report.

Executive Summary

The New Zealand Business Council for Sustainable Development (NZBCSD) in conjunction with a number of energy companies has established a Sustainable Energy Futures Project.

The project seeks to develop a long term energy industry perspective on what a sustainable energy sector might look like. This is important if the industry is to provide for New Zealand's long term energy futures and manage the transition from the existing asset base to the next generation of technology.

In the first stage of the project, carried out in March 2004, nine energy firms provided input to the development of energy demand and supply scenarios. The work focussed on the electricity sector and by nature of the participants on the considered opinion of the energy providers. The views of "users", the Energy Efficiency & Conservation Authority (EECA) and government departments have not been incorporated at this stage.

Although this first step in the Sustainable Energy Futures Project has been largely qualitative in approach some key conclusions could be drawn.

It is the project participants' view that electricity demand will rise significantly faster than that forecast in the Ministry of Economic Development's "New Zealand Energy Outlook to 2025".

Resulting from these rising demand forecasts it is clear that significant additional generation capacity is required in the short term with continued investment thereafter. Moreover, for the non renewable generation options, primary energy (fossil fuel) supply must be secured.

Four supply scenarios for future electricity generation were developed from the first step:

- Renewables, based mainly on wind, requiring a significant scale up from past wind power investment rates;
- Indigenous Gas, requiring an order of magnitude increase in exploration activity if short term requirements are to be met and other alternatives not implemented;
- LNG, a substitute for Indigenous Gas but with high capital cost and long term commercial implications; and
- Coal, the development of indigenous coal fields and installation of modern coal fired power stations.

All scenarios are believed to be feasible however there is also interaction between them that must be recognised. An example was the need for additional thermal generation to compensate for wind farm variability should the renewables scenario be realised.

An assessment of the existing generating mix and the four supply scenarios was made against the sustainable development criteria[1] of:

- security of supply;
- affordability; and
- environmental protection.

From the analysis it was clear that:

- a significant step change in supply security and affordability is occurring; and
- a combination of two or more of the supply scenario options would be required to achieve a balanced sustainable development outcome.

The Stage 1 Project participants all stressed that New Zealand was at a key point in energy policy yet there was an absence of coordinated thinking to ensure a sustainable balance of future energy supply. To address this, the next project steps will seek to involve government departments, EECA, user groups and other stakeholders.

[1] Per the International Implementing Agreement definition of sustainability

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1 Introduction

The New Zealand Business Council for Sustainable Development (NZBCSD) in conjunction with nine energy companies has established a Sustainable Energy Futures Project.

The project seeks to develop a long term industry perspective on what a sustainable energy sector might look like. This is important if the industry is to provide for New Zealand's long term energy futures and manage the transition from the existing asset base to the next generation of technology.

The project has been created against a backdrop of increasing concern that the New Zealand is drifting into an energy crisis with no strategy in place to address it.

The paper presents scenarios of what the future energy plan for New Zealand might look like based on input received from nine firms. The firms' operations cover the full spread of primary energy sources, electricity generation and distribution. They are:

BP NZ
(oil & gas)
Contact Energy
(50% gas, 14% geothermal, 33% hydro)
Meridian Energy
(hydro, wind)
Mighty River Power
(88% hydro, 2% geothermal, 10% cogen),
Orion NZ Ltd
(local distribution)

Shell NZ
(oil & gas)
Solid Energy
(coal)
Transpower
(national electricity grid)
Trustpower
(93% hydro, 7% wind)

Input for the scenarios was collated through questionnaire and interview covering:

- New Zealand & International Views on Fuel Types
- Energy Demand Growth
- Primary Energy Supply
- Electricity Generation / Transmission
- Scenario Interdependency/Conflict

The scenarios presented and the views expressed are not definitive. It is intended that the next stages of the project will include in depth assessment and modelling and will involve other stakeholders to ensure that the recommendations are robust. Where numbers are presented this is done to illustrate the magnitude of the challenge only.

The MED "Energy Outlook to 2025" Reference Case has been used as comparison basis where appropriate. The MED Energy Outlook contains a number of scenarios. However it gives strong prominence to the "Reference Case", which is clearly most closely aligned with other government policies such as NEECS and Climate Change. Furthermore, while the Minister has acknowledged other cases he has drawn upon the Reference Case almost exclusively in all his public communications and comments. Regardless of the professed intent to present numerous scenarios, it is therefore accepted widely that this is the government's "preferred scenario" and the government will use policy interventions to achieve this scenario if possible.

In this document energy demand scenarios are described first followed by energy supply scenarios. The scenarios are presented for electricity only however impacts on direct use and transport are highlighted where appropriate.

The scenarios highlight some of the key decisions facing New Zealand's energy sector and the long term consequences of them with respect to the sustainability criteria of:

- Security of Supply
- Affordability
- Environmental Protection

2 Background

2.1 Energy Use Categories

When considering the energy future of New Zealand, it is useful to break down its use into three categories: Direct Use, Transport and Electricity. The characteristics of these are described below.

2.1.1 Direct Use

In Direct Use, fuels are consumed at their end use location with no intermediate step. The most common example is the burning of coal, gas and biomass for process heat.

Direct use infrastructure is broken down into three steps:

Sourcing the fuel	Fuel is either imported or locally sourced (in some cases both e.g. Coal). The scale & nature of investment for this step is heavily fuel dependent.
Transporting the fuel	The fuel is transported to the end user. Infrastructure requirements are either pipeline (for gas and some oil products) or combinations of land and sea transport (road/rail/ship)
Combusting the fuel	The investment is relatively moderate, however typically only one fuel type can be combusted. Any fuel switching opportunities are therefore infrequent and only considered as part of an asset replacement or upgrade decision. An example of fuel switching is the switch to biomass in wood processing plant applications.

Another example of direct use is gas as a feedstock in chemical production (Methanex making methanol). This is highly capital intensive and inflexible.

Of the existing direct use fuels available, the fuel with the greatest exposure to supply security problems is viewed to be gas.

2.1.2 Transport

Transport fuel is dominated by oil products sourced from crude oil refined at Marsden Point refinery, or imported in finished form.

The balance between different fuel types (e.g. diesel and petrol) is dictated by the vehicle fleet, with shifts being linked to turnover rate.

Demand growth is met by increased import of finished product and/or crude. Infrastructure impacts of demand growth are incremental investment in the distribution network (pipeline, terminals and retail outlets).

The entrance of alternative fuels is limited by the nature of New Zealand's geography and the resulting extensive distribution network requirements.

2.1.3 Electricity

Electricity is referred to as a secondary energy, as it results from a transformation step ("generation") from its primary energy source.

Renewable electricity generation is located at the primary energy source (wind, hydro and geothermal). The electricity is then commonly transferred into the national grid.

Fossil Fuel or "Thermal" electricity generation (coal, gas and oil) is located taking into account two parameters:

Fuel Access:	At the original fuel source (e.g. Huntly coal) or at a location with access to the fuel through distribution infrastructure (e.g. gas pipeline)
Demand Location:	The electricity demand concentration, reducing transmission requirements.

As New Zealand's demand has increased, thermal generation has moved from being the balance generation for variations in hydro generation, to base load generation.

Electricity generation is characterised by being very capital intensive, with long payback times. The design of modern high efficiency thermal generation technology often precludes fuel switching. Confidence on the security of supply of a fuel is therefore paramount in making a decision to invest in such a plant.

New Zealand's geographical isolation precludes import of electricity, an option used by many countries to balance out own generation shortfalls. In addition our network is contained within one time zone with very narrow east-west spread (unlike North America, Australia or even Europe) so that there is no automatic geographic smoothing of peaks across the system

The New Zealand market is also relatively small but widely dispersed leading to high transmission infrastructure.

In summary, electricity supply with its high capital intensity and constraints on fuel switching has the most "inertia" of the energy categories and the least flexibility to adjust to compensate for any mismatch in the supply and demand balance.

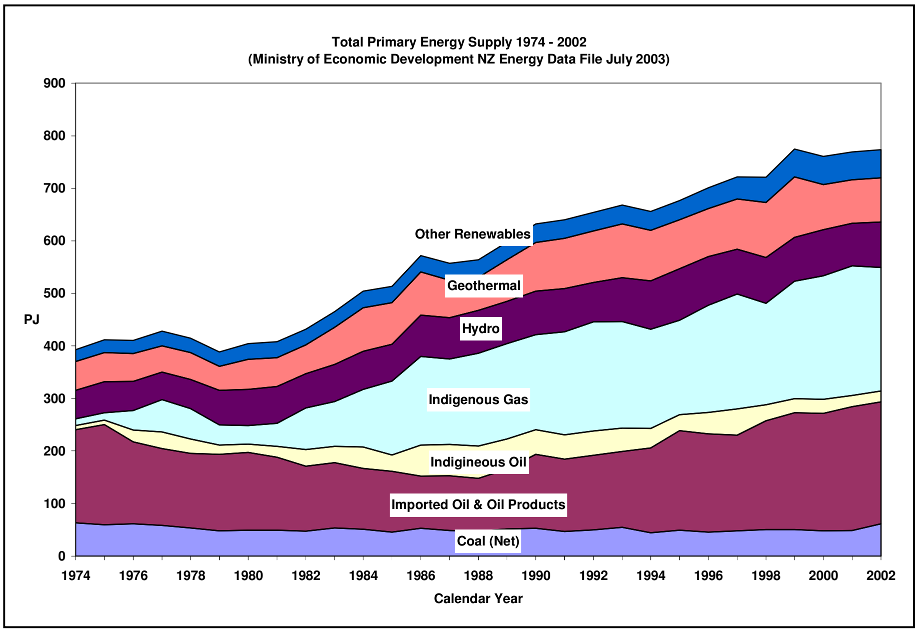
2.2 New Zealand's Current Energy Mix

The section provides a brief overview of the current situation. For more information please refer to the MED source publications[2].

2.2.1 Primary Energy

New Zealand's historical primary energy supply is shown in Figure 1 below:

Figure 1: New Zealand Primary Energy Supply 1974-2002



Note: Other renewables includes electricity generation from wind, biogas, industrial waste and wood.

Reviewing the application of these primary energy sources for the most recent data published covering the 12 months to end March 2003:

Coal: is primarily consumed in direct use for commercial and industrial applications including basic metals and cement, where process heat is required. Of the 59 PJ consumed in NZ only 19 PJ was used in electricity generation.

Oil & Oil Products: (indigenous and imported) 211 PJ was consumed as transport fuel (85% of total) with the remainder being spread over agriculture and industry.

Indigenous Gas: Of the 224 PJ of gas supplied, 40% was consumed by Petrochemicals (Methanex 36.9% and Ballance Agri-Nutrients 3.1%), 41% was used for electricity generation (including cogen plant) and the remainder was reticulated in the North Island. The soon depleted Maui field provided 74.6% of the gas.

Renewables: are primarily used for electricity generation. It should be noted however that of the 84 PJ of geothermal energy, only 10 PJ is realised for electricity generation.

[2] All energy data had been compiled from Energy Data File July 2003 and NZ Energy Outlook to 2025 published by The Ministry of Economic Development.

2.2.2 Electricity

The breakdown of primary energy for generation of electricity for the year ending March 2003 is shown in Table 1 below.

Table 1: Electricity Generation & Primary Energy Used (2003)

12 months to March 2003	Primary Energy PJ	Electricity PJ	Electricity GWh	Electricity %
Coal	19.1	6.5	1,806	4.5%
Oil	0.0	0.0	-	
Gas	71.2	34.6	9,620	24.1%
Hydro	88.7	88.7	24,636	61.6%
Geothermal	9.9	9.9	2,744	6.9%
Biogas	0.3	0.3	92	0.2%
Waste Heat	2.1	2.1	592	1.5%
Wood	1.2	1.2	327	0.8%
Wind	0.6	0.6	153	0.4%
Total	193.1	143.9	39,970	100%

From the table it is seen that while hydro provided over 60% of generation, the major "variable" generation is gas fired, this including some 735 MW of large scale modern Combined Cycle Gas Turbine (CCGT) capacity.

The balance of generation varies from year to year due to changes hydro in flows as well as supply and demand scenario shifts.

2.3 Future Primary Energy Availability

It has been widely reported that New Zealand is coming to the end of an era of "cheap Maui gas" being available.

The impeding depletion of the Maui field increases the dependency on other existing and potential gas fields.

The impact of this sharp decline in gas availability impacts on existing assets and future investment plans. For existing assets, the energy use category most significantly hit will be electricity generation due to the capital intensive installed capacity. Until recently it had been widely assumed that much of the future demand driven generation capacity would also be gas fired.

With uncertainty over future primary energy availability, deferral of decisions to invest may lead to the country becoming supply constrained. The scenarios presented in the next section present a series of "alternative futures" for New Zealand's energy supply.

3 New Zealand's Future Energy Demand

In developing the demand scenarios, the greatest disparity between the views of the firms and the Energy Outlook was in energy efficiency uptake. This obviously has a major impact on energy demand and is factored into the scenarios as described below.

Two demand scenarios could be identified from the Project participants' views. These are described below and compared against the Energy Outlook reference case. The demand scenarios assume no supply constraints.

3.1 Scenario 1 – High Demand

New Zealand's electricity demand grows at the historical average of ~2% per annum[3].

Underlying views given were:

- GDP growth continues at 2.5% rising to 4% beyond 2010, increased primary production and immigration offsetting the impact of an aging workforce.
  - As primary production continues to drive growth, energy is still inexorably linked to GDP.
  - The primary sector increases in energy intensity e.g. through increased irrigation and increased processing requirements.
  - In the short term Industry holds back on efficiency projects pending certainty on fuel supply security, carbon tax treatment and Negotiated Greenhouse Agreement negotiation outcomes. Subsequently improvements made offset intensity increases
  - In the longer term energy efficiency gains start to be seen offsetting increase in longer term growth
- The commercial sector of the economy continues to drive energy demand at a high rate (up to 4% pa).
- Residential use continues to grow as "comfort" is favoured over energy saving.
  - Energy demand increases with larger homes, proliferation of more electrical "stand-by" gadgets more than offsetting efficiency gains as major appliances are replaced.
  - Air-conditioning in homes becomes increasingly common this also displacing direct use fuels for home heating further increasing electricity demand.
- The National Energy Efficiency & Conservation Strategy (NEECS) is effective to some extent in producing energy efficiency gains that counterbalance increased energy intensity.

[3] Some firms believe that this would be the mid range case, with a high case at more than 2.5% pa.

3.2 Scenario 2 – Moderate Demand

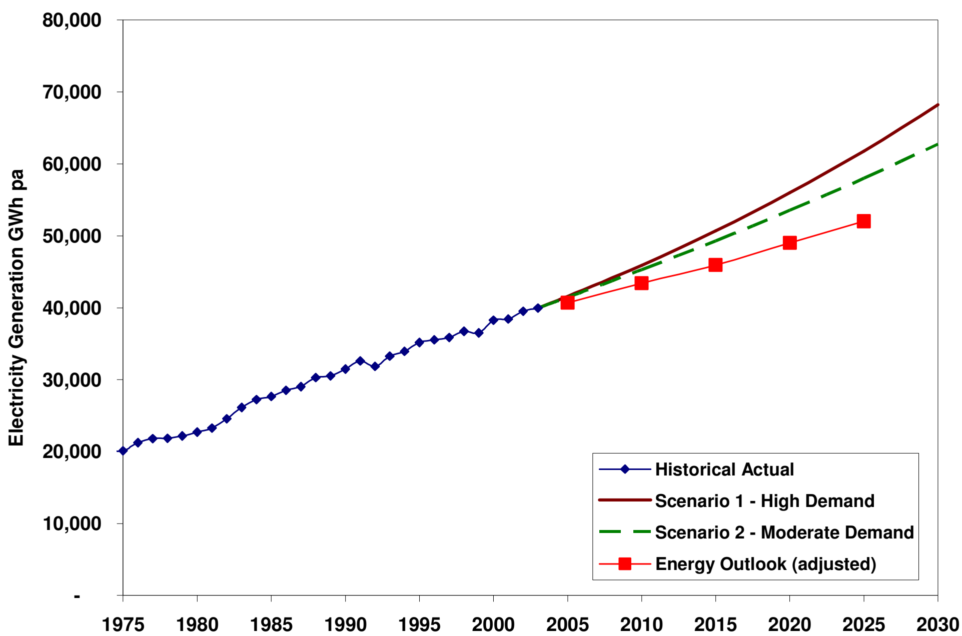
New Zealand's electricity demand grows at 1.8% pa through to 2010, at 1.7% pa through to 2020 and subsequently reducing to 1.5% pa thereafter.

- As for scenario 1 but with the following differences
  - GDP does not increase above 2.5% pa
  - Demand side activities are stepped up leading to reduced demand growth
  - Industry and government coordinate their efforts to support a much more active NEECS with focussed approach on asset replacement opportunities, building standards etc. Energy efficiency uptake is still well below Energy Outlook reference case of 19.6% by 2012.

3.3 Comparison against Energy Outlook

Figure 2 below shows the generation requirement in GWh per annum on a historical and look ahead basis. Scenarios 1 and 2 are as outlined above. The Energy Outlook data has been increased upwards to reflect the offset of actual and forecast 2003 generation.

Figure 2 : Electricity Demand Scenarios – Generation Required



It can be seen that both the Moderate and High demand scenarios are significantly higher than the MED Energy Outlook reference case.

Reviewing all the core assumptions to the Energy Outlook forecast, the one key difference in views is the rate of uptake of energy efficiency measures. Participants fundamentally do not believe that the Energy Outlook view based on NEECS is realistic based on the current implementation approach. It was highlighted by some that the NEECS targets were aspirational in nature however they have subsequently been locked into policy development and analysis. This may result in an underestimation of the risk of under supplying the economy's energy demand.

3.4 Nominal New Generation Capacity Required

A simplistic approach to establish the scale of generation investment required has been carried out.

From the demand forecasts, the additional generation requirement for each 5 year period has been calculated (refer Figure 3)[4].

The required installed capacity can then be calculated based on the assumed Potential Average Load for each generation type. To illustrate the magnitude, the approximate additional installed capacity for the period 2006-2010 is shown in Table 2 below. Note that each generation type is meeting the full additional demand in isolation. In reality a mix of generation types is likely.

Figure 3 : Additional Generation Capacity Required in each 5 year period at 100% load factor

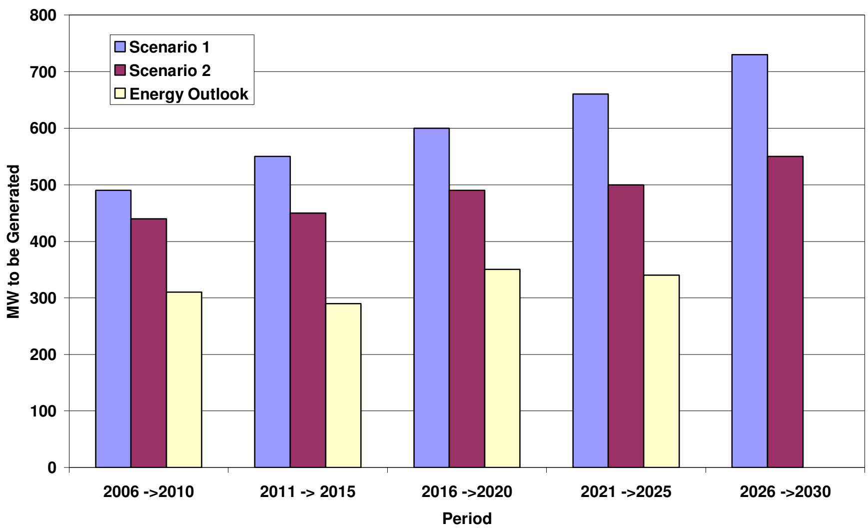


Table 2: Additional Generating Capacity Required to Meet 2006-10 Demand.

Generation Type (in isolation)	Potential Average Load	Scenario 1	Scenario 2	Outlook
Wind	45%	1090 MW	980 MW	690 MW
Hydro	55%	890 MW	800 MW	560 MW
Geothermal	90%	540 MW	490 MW	340 MW
Gas CCGT	85%	580 MW	520 MW	360 MW
Coal	85%	580 MW	520 MW	360 MW

[4] This is net electricity generated – not potential or installed capacity.

4 New Zealand's Future Energy Supply Scenarios

4.1 Background

In order to meet the increased demand for electricity outlined in the demand scenarios, it is clear that generation assets need to be built and their sources of primary energy secured. Furthermore increased efforts need to be made to encourage users to reduce their consumption and therefore reduce demand towards the NEECS targets.

Based on the Project participants input, scenarios have been developed to describe a possible "alternate world" future with key decisions and where appropriate timelines identified. As they are based on largely qualitative input, with no modelling carried out, they do not purport to be an accurate representation of real alternatives.

The scenarios presented are each focussed on using a dominant fuel type to meet the additional demand. The potential for synergy or conflict with other scenarios is highlighted. For simplicity, the existing generation assets are assumed to remain unchanged although in fact some aging generation assets may reach the end of the useful lives and will need replacement during the 30 year period

Project participants raised a number of common concerns which have impacted on energy supply planning to date and will be significant in the future unless addressed:

1. Resource Management Act (RMA)

   The RMA was frequently stated to be a significant source of uncertainty in investment decision making.

   Where projects extended across Territorial Authority boundaries additional uncertainty was highlighted. This would be particularly true of transmission and gas pipeline infrastructure upgrades to facilitate additional generation.[5]

   Allocation & management of water rights is a major concern for hydro generation options.

2. Kyoto Policy – Carbon Tax Design

   Two elements were raised that increased the uncertainty for projects. The first relates to whether the Kyoto Protocol would come into effect and what New Zealand's fall back position and policy framework would be should Russia not ratify. The second aspect relates to the design of the carbon tax and how this will flow into the electricity generation sector.

3. Electricity Commission Establishment

   It was highlighted that the establishment of the Electricity Commission had introduced another regulatory body, whose powers are as yet not fully defined.[6]

Where appropriate these are highlighted in the scenarios.

[5] Refer www.nzbcsd.org.nz for Business Council's submission to government on the RMA review

[6] NB. The project group has not discussed the scenarios with the Commission at this stage

4.2 Renewables Scenario

4.2.1 Hydro

With Project Aqua stopped, a shortfall of 570 MW of planned installed capacity from 2009-12 onwards arises. Other energy firms viewed Aqua to be the test case for large scale Hydro generation so focus is shifted away from developing these plans further in the short to medium term. Even with government support through changes to legislation to ease large scale hydro, there is opposition from local interest groups and stakeholders affected.

Small scale and micro hydro do however continue to be developed and non-environmentally intrusive upgrades of existing hydro assets are implemented. However the contribution of them meeting additional demand is relatively small. The distributed nature of such generation eases grid problems. Storage hydro is used to balance wind generation variability.

In summary Hydro has an ongoing contributing role in meeting demand but with the obvious hydro generation schemes already in place, it is constrained by the availability of suitable sites.

4.2.2 Geothermal

Significant additional geothermal energy could be sourced with MED forecasts detailing 700 MW available through to 2025 although this quantity is uncertain. To realise this, relaxation of existing restrictions on land use are made and local interest on land use such as tourism and concerns on subsidence over ruled. Upgrades of existing geothermal plants provide some increased capacity.

In summary geothermal has the potential to make a significant contribution but as with Hydro is constrained by the number of sites available.

4.2.3 Wind

Wind power investment has increased rapidly in the past years this must be continued in order to realise the potential generation capacity of 1500 MW or more.

Lessons from successful rapid and intensive wind farm development in Europe are implemented & resources are secured.

Public concerns relating to visual impacts and noise continue to be overcome through consultation and discussion, and well considered and located sites have few issues gaining consent.

The ability to maintain wind power growth is limited by the number of suitable sites; however this is offset to an extent by new technology making marginal sites economic. Over time, “re-powering” of older sites through installation of new turbines increases capacity at low risk.

As a “renewable” wind power receives strong government support as it contributes to its Kyoto commitments. Incentives used include the introduction of a carbon tax to increase alternative fuel power costs and Projects Mechanism (carbon credit) funding. Transmission upgrades to sites are fast tracked through the RMA and Electricity Commission steps.

With government support as outlined, wind generation projects are brought on-stream in less than 5 years. They are therefore a suitable short term solution to meet demand and will continue to make a significant contribution in the longer term.

4.2.4 Other Renewables

Other renewable energy sources may contribute to either meeting generation demand; solar photovoltaic and tidal power, or inhibit demand; solar water heating.

The generation options may make a significant contribution in the longer term, this depending on the rate of technological development of cost effective options. Solar water heating is already cost competitive for low grade heat application however its take up rate is currently low.

4.2.5 Relationship with Other Supply Scenarios

With the major additional generation component in the Renewables Scenario being wind, variability of generation is managed through:

- wind power generation sites being distributed more widely across the country to provide greater geographic cover;
- hydro providing short to medium term backup; and
- new thermal generation investment, perhaps in a peaking mode.

Higher pricing of fossil fuel alternatives increases project viability of wind farms.

4.3 Indigenous Gas Scenario

4.3.1 Background

As has been widely reported, short term security of supply of indigenous gas is a major concern. As Maui field declines Pohakura comes on stream in 2008 and Kupe in 2008-9. Even then a shortfall is foreseen at the end of this decade, even sooner if Methanex continues to operate beyond 2004.

Already existing generation assets that can switch fuels have done so (Huntly to Coal, New Plymouth to Oil) with the remaining CCGT stations facing an uncertain future.

New fields are therefore required however the MED Energy Outlook forecast of new gas available of 35 PJ pa for 2011-13 and 60 PJ pa for 2014-2025 is uncertain.

Demand scenarios require 360 – 580 MW of new generation in the period to 2010. Planned CCGT generation (E3P[7] and Otahu C projects each 400 MW) are on hold pending certainty of gas supply. Each 400 MW station requires approximately 25 PJ pa of gas.

Gas fired stations typically have a 3-5 year project timeline, assuming they are located on the existing gas pipeline network.

4.3.2 The Scenario – Short Term

An immediate order of magnitude increase in exploration activity is achieved, this having required substantive government and energy industry initiatives to increase the attractiveness of New Zealand as an exploration target. Even with such measures the

[7] E3P go ahead was announced in August 2004, subsequent to the completion of the Stage 1 work.

oil majors do not enter as the market is too small to be on their radar screen. If a substantive find is made, an oil major may however assist in the low risk stage of bringing the gas to market.

The minimum time required to find and bring gas to market is viewed to be 5-6 years, however the outlook is uncertain until 2-3 years into the project(s).

If exploration is successful, availability of gas does not constrain CCGT based electricity generation demand and does not leave generators (and direct users) with stranded assets.

4.3.3 The Scenario – Medium to Long Term

Despite short term uncertainty the medium to long term future of gas as a fuel is positive.

Through the intensive exploration effort, gas is found in significant quantities in the Taranaki and Northland basins. The former material is brought on shore into the existing Maui/NGC pipelines, while the latter requires a new pipeline connecting into Northland (and interconnecting with pipelines put in under a Marsden Point LNG scenario).

Gas is favoured as the fossil fuel of choice by generators due to the availability of efficient moderate capital cost plant.

The lower carbon dioxide emission associated with the low carbon content fuel and high efficiency provide an advantage over coal in a Kyoto environment.

4.3.4 Relationship with Other Supply Scenarios

It is highly likely that this short term scenario is invalid in isolation from other fossil fuel based scenarios:

- If unsuccessful in bringing gas to market, the country faces an energy supply shortage;
- A fall back position for generation therefore has to be in place to ensure supply security;
- Even with the renewables scenario, in the long term more fossil fuel generation is required to firm supply.

There is little doubt that New Zealand has significant reserves of gas. The question is whether there is a fall back option that does not preclude the ongoing exploration and development of this resource.

4.4 LNG Scenario

4.4.1 Background

LNG, the Liquid form of Natural Gas, could be a fall back option for indigenous gas. LNG is imported by ship and stored in a tank before being revaporised and distributed through the reticulation pipeline to users.

The minimum economic size of the receiving and regasification facilities is 60 PJ pa, representing some 1000 MW of CCGT generating capacity, with facilities up to 100 PJ pa not costing much more. Phased investment to accommodate increased demand is an option.

Location options for the receiving terminal are:

- Marsden Point, with CCGT located next door and new pipeline to Auckland;
- Taranaki, with connection into existing NGC/Maui network; or
- Greater Auckland Area (offshore facility either floating or resting on sea bed).

The commercial nature of LNG is:

- High capital cost for receiving facilities – approximately NZ$220 million; and
- Long term 15 (or longer) year supply agreement with price linkage

A joint industry study is underway on the feasibility of LNG by Genesis and Contact Energy.

4.4.2 The Scenario

With existing gas fired generation assets and new projects at an advanced stage of planning, the generators' need for security of supply outweighs other considerations.

A decision is made to import LNG and a receiving facility is established at Marsden Point, together with a new 400 MW CCGT generation plant, next door to the refinery.

The project timeline is a minimum of 5 years based on a fast tracked process through the RMA. The greatest hurdles to be overcome are the consenting of a new gas pipeline and public concerns about the safety of the concentration of energy infrastructure in a single location.

While other scenarios are incremental investment in nature, LNG requires a long term commitment. The scale of the investment and long term commercial arrangements lead generators to seek government support to offset the financial risk of being locked into LNG prices should indigenous gas be found in large quantities and brought to market at low cost.

The government underwrites the LNG project based on its Kyoto commitments and increasing concerns that its net carbon credit position will be severely eroded by alternative fossil fuel scenarios, exposing New Zealand to greater costs of ratification than forecast.

Beyond the initial 15 year "take or pay" contract further supply contracts are secured.

4.4.3 Relationship with Other Supply Scenarios

Although 60 PJ pa represents 1000 MW of installed CCGT generation, this quantity of gas is less than the 70 PJ of indigenous gas used for existing generation in the 12 months to March 2003.

LNG can only be considered to be a part of the solution. It provides security of supply for existing CCGT and fuel for additional CCGT generation. The quantity of additional generation is dependent on the LNG import rate (up to 100 PJ pa) and indigenous gas production.

With LNG in the generation mix, the price of electricity (based on current market model) will rise, leading to further investment interest in all alternatives.

4.5 Coal Scenario

4.5.1 Background

New Zealand has extensive coal reserves but little is currently used for electricity generation. Huntly power station, co-located with coal reserves, ran on gas for many years but has now switched back to coal due to gas supply constraints. Initially up to half this increase in coal is being imported (from Indonesia) but Waikato coal field operations will be scaled up to meet demand.

The magnitude of the indigenous coal reserves (1000 PJ in N Island, 9000 PJ on S Island West Coast, and some 150,000 PJ of lignite in Southland) is such that the potential for coal fired electricity generation is not fuel supply constrained.

The timeline for coal fired generation is 4-5 years, where coal handling and rail/barging requirements would add to project complexity if generation is not co-located at the source.

While capital costs for coal fired generation are higher than those for CCGT, this may be countered by the lower price of the primary energy.

Coal generation technology is advancing internationally as more countries are increasing their dependency on coal as gas and nuclear phase out. This is leading to significant improvements in efficiency.

Stack emissions are now addressed through proven control systems. The remaining environmental concern is the higher carbon dioxide emissions in the context of climate change. In the longer term geo-sequestration of carbon dioxide and offset projects may alleviate this.

4.5.2 The Scenario

With unconstrained availability of fuel supply, coal fired generation is rapidly implemented at strategic locations in the country e.g. Marsden Point[8], Huntly and on the West Coast.

The relatively short project timeline for investments is such that they can be phased in response to demand, with typical generation capacity increments of 400 MW.

The low cost of South Island lignite presents an additional generation (co-located) opportunity but requires an upgrade of the HVDC link to transfer electricity north, or the development of demand e.g. an energy intensive industry centre close to the generation site.

Under current climate change policy, coal is disadvantaged when compared to gas due to its higher carbon content and hence carbon-tax impact.

With the need for additional thermal generation and being the only thermal generation option with a secure fuel source, coal fired generation is supported by government and the carbon tax impact is alleviated through policy changes or offset activities in some way. In parallel, studies to identify suitable locations for long term geo-sequestration of carbon dioxide emissions are carried out. In the long term, with suitable locations identified cost effective geo-sequestration technology is developed and adopted.

[8] In August 2004, Mighty River Power announced their intention to seek resource consents for the operation of Marsden B as a coal fired power station.

4.5.3 Relationship with Other Supply Scenarios

Coal fired generation can coexist with the other supply scenarios largely unconstrained. Physical location of plant is viewed to be the only issue on which conflict may occur e.g. LNG (with associated CCGT) and coal both being seen as options at Marsden Point.

4.6 Oil

Due to its high price other generation options are significantly lower cost, eliminating oil as a base load generation option. Oil is only viewed to be an option for specific short term needs such as dry year reserve generation (Whirinaki) or for fuel switching from a constrained fuel source (New Plymouth).

4.7 Nuclear

Despite perceived good security of supply and moderate to high affordability, a largely consistent view was expressed that nuclear is untenable in New Zealand due to cultural/political opinion. It is recognised that this is a New Zealand specific issue and that in other countries Nuclear continues to play a vital role in electricity generation.

Should the other scenario options raised above not be acceptable for any reason, nuclear should be revisited.

5 Assessment of Fuel Types against Sustainable Development Criteria

5.1 Background

The main existing electricity generation fuel types (Coal, Indigenous Gas, Hydro and Geothermal) and the main future scenario fuel types for additional electricity generation, (Renewables - primarily wind, Indigenous Gas, LNG and Coal) have been assessed

Applying the International Energy Agency sustainable development criteria of:

- Security of Supply;
- Affordability; and
- Environmental Protection,

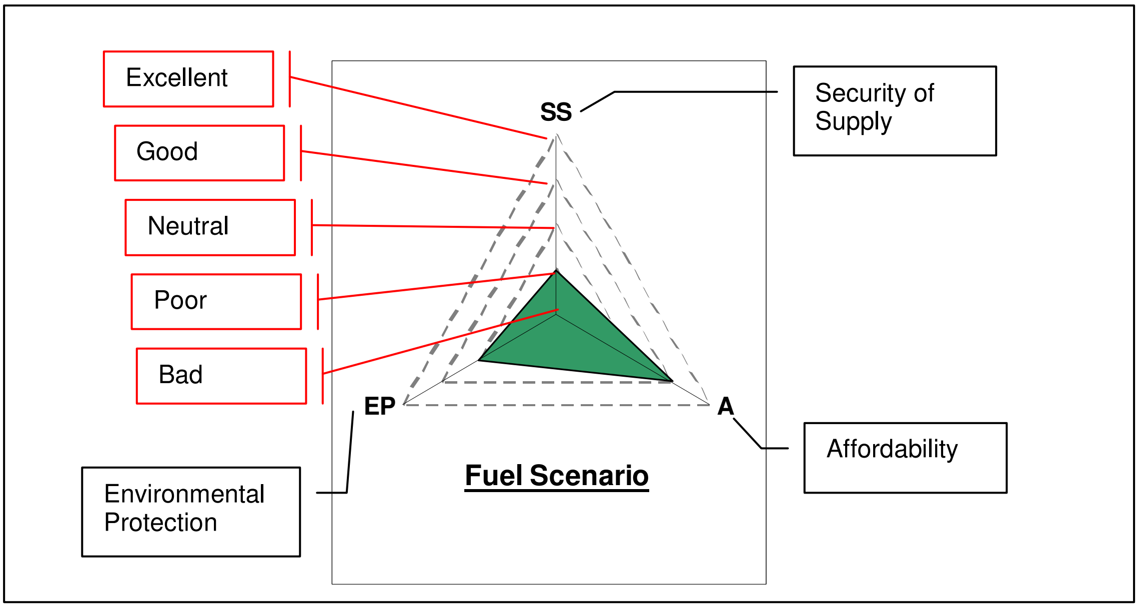
an assessment has been made of the existing main electricity generation fuel types and those identified as the main scenarios for future generation.

The assessments presented are based solely on the input from the Project participants namely energy providers not users or other stakeholders.

The existing generation base is judged on the current status, while future generation options are based on the average future ratings covering the period 5 to 30 years from now.

An example showing how the results, presented graphically, should be interpreted is shown in Figure 4 below:

Figure 4: Interpreting the results:



In this example the scenario rates poor on supply security, neutral on environmental protection and good on affordability.

5.2 Results

Figures 5 & 6 show the assessment results. Any significant changes in assessment with time and divisions of Project Participants' views are highlighted in the accompanying text.

Figure 5: Existing Generation Type Assessment Results

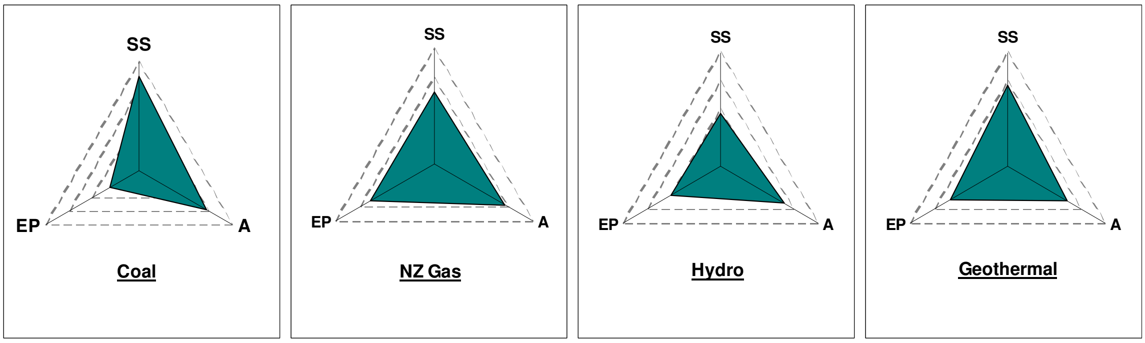
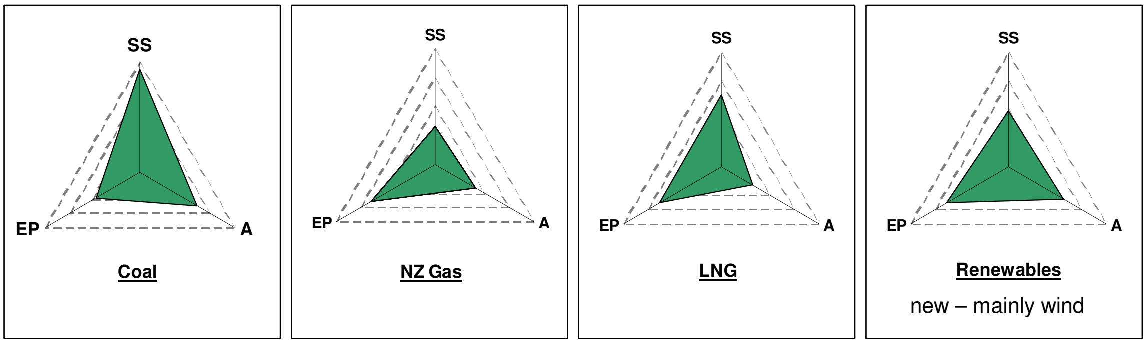


Figure 6: Future Generation Type Assessment Results



Coal

Supply security is ranked high now and improving in the future due to its availability from indigenous mines or imports.

Its affordability for electricity generation is viewed positively but declining with time – in some cases due to participants factoring in a carbon tax or cost of geo-sequestration.

Environmental protection increases with time. This is in line with implementation of next generation plant with higher efficiency and new emission control technologies.

There was a clear divide in views on coal's impact on the environment, reflecting the concerns of some parties on the climate change impact of coal.

Indigenous Gas

A sharp drop in security of supply is seen between now and the future case, together with a commensurate drop in affordability as supply constraints drive the price up.

The extent to which these factors will be true beyond 10 years is heavily dependent on the level of exploration activity. Uncertainty on this issue led to the pessimistic view continuing.

Gas rated well on environmental protection due to it being clean burning with low carbon content.

Hydro

As an existing generation base, hydro scored close to good on affordability while it only scored neutral on supply security and environmental protection. [Future Hydro is captured in Renewables below]

Geothermal

As an existing generation base, geothermal was rated positively in all criteria. Views were however divided on the environmental protection with some giving lower ratings due to localised ground damage.
[Future Geothermal is captured in Renewables below]

LNG

The future import of LNG rated positively on security of supply. Concerns about the reliability of shipments precluded a higher rating. Affordability is rated poor, however this is viewed to improve marginally over time.

Environmental protection, as expected, rates the same as indigenous gas.

Renewables

In assessing future renewables, a weighting has been given to wind over hydro and geothermal to reflect the balance of where new renewable generation will come from.

Supply security is rated neutral due to the inherent variability of wind.

Affordability was also neutral. Over time improvements would be seen but these may be offset by the need to use more marginal sites.

On environmental protection wind's "zero emissions" was countered by concerns over visual impact and noise leading to a positive but perhaps lower than expected environmental protection rating. There was a division of views on the significance of visual impact.

5.3 Analysis

Overall it can be seen that no individual fuel type achieves the goal of rating good or better on all three sustainable development criteria.

As expected the most significant shift looking forward is the severe decline in security of supply and affordability of indigenous gas. As indicated in the scenario section, this could be rectified should exploration activity be stepped up and be successful.

In the short term the direct substitute of LNG carries an affordability penalty, however its use may avoid stranded CCGT generation assets.

Coal is an attractive future option based on supply security and affordability and is neutral on environmental protection. There are however split views on its environmental profile in relation to climate change.

Renewables present a balanced option but as also reflected in the scenarios section, supply security is no more than neutral and requires thermal generation in support to improve on this.

In conclusion, to meet the additional generation requirements while also achieving a balanced outcome against the sustainable development criteria, it is likely that a mix of fuel types will be required.

Further analysis based on the graphical approach to assess the sustainability of different fuel options is recommended for future stages in the Project. One approach would be to systematically fix two out of three of the sustainability criteria at a required level and then assess the impact on the third on the different scenarios or combinations of them. This would illustrate the required trade offs between the three parameters.

6 Conclusions

Although this first step in the Sustainable Energy Futures Project has been largely qualitative in approach, some key conclusions can be drawn.

It is the project participants' view that electricity demand will rise significantly faster than that forecast in the MED Energy Outlook. Reviewing all the core assumptions to the Energy Outlook forecast the one key difference in views is the rate of uptake of energy efficiency measures. Participants fundamentally do not believe that the Energy Outlook view based on NEECS is realistic.

Resulting from these demand forecasts the participants are consistent in their view that significant additional generation capacity is required in the short term, with continued investment thereafter. Moreover, for the non renewable generation options, primary energy (fossil fuel) supply must be secured.

A common theme raised was the need to address concerns about the Resource Management Act to enable primary energy and generation projects to proceed in a reasonable timeframe, and the need for certainty on Kyoto policy implications and carbon tax design.

Four supply scenarios for future electricity generation were developed:

1. Renewables, based mainly on wind, requiring a significant scale up from past investment rates;
2. Indigenous Gas, requiring an order of magnitude increase in exploration activity if short term requirements are to be met and other alternatives not implemented;
3. LNG, a substitute for Indigenous gas but with high capital cost and long term commercial implications; and
4. Coal, the development of indigenous coal fields and installation of modern coal fired power stations.

All scenarios are believed to be feasible however there is also interaction between them that must be recognised. An example was the need for additional thermal generation to firm wind farm variability should the renewables scenario be realised.

An assessment of the existing generating mix and the four supply scenarios was made against the sustainable development criteria of:

- Security of Supply;
- Affordability; and
- Environmental Protection.

From the analysis it was clear that:

- a significant step change in supply security and affordability is occurring; and
- a combination of two or more of the supply scenario options would be required to achieve a balanced sustainable development outcome.

Since March 2004, the month in which the project participants provided their substantive input, there have been significant developments in the energy sector. These include:

- The opening of Trustpower's Tararua Stage 2 36 MW and Meridian Energy's Te Apiti 90 MW wind farms;
- Genesis Power's 16th August announcement that it will proceed with its "E3P" 385 MW CCGT power station at Huntley under a risk sharing agreement with the government to address the issue surrounding uncertainty of gas supply; and
- Mighty River Power's 18th August announcement that it would seek consents to refit the Marsden B power non-commissioned oil fired station to coal firing, generating up to 320 MW.

It is notable that the new generation highlighted above covers three energy sources, coal, gas and wind.

However, even with these and other smaller projects announced, noting that 570 MW of planned generating capacity was lost with the cancellation of Project Aqua stage 1 at the end of March 2004, a clear shortfall is still there.

In July, Contact Energy launched a large scale publicity campaign titled “New Zealand’s Energy Future: It’s just a question of balance”. This campaign also reflects the trade-offs between security of supply, price and the environment that different generation options present.

The urgency to find a sustainable balance of future generation solutions therefore remains.

The Stage 1 Project participants all stressed that New Zealand was at a key point in energy policy yet there was an absence of coordinated thinking to ensure a sustainable balance of future energy supply. To address this, the next project steps will seek to involve government departments, EECA, user groups and other stakeholders.