

# Energy Paper

This Energy Theme Paper has been prepared as part of the START – Sustaining the Auckland Region Together project. The paper reflects a range of views and does not represent official positions of the organisations involved.

## 1.0 Introduction

This paper presents a summary of the expert group's discussion about the energy dimensions of a sustainable future for the Auckland region. It proposes 'end state goals' for energy, identifies opportunities and challenges that we will need to meet, and proposes a series of actions that might help to get us closer to the goal.

The energy expert group met twice, on 19 July and 27 July 2006. Discussion was wide-ranging, covering electricity, transport fuel and other energy sources. Key points raised in discussion included:

Auckland's future is important to the prosperity of the whole country. Where Auckland goes, so goes New Zealand. Energy is a critical influence on this future.

In the foreseeable future, Auckland's energy systems will be integrally linked with New Zealand's. Auckland will not be a self-sufficient energy producer.

New Zealand's island status gives it a potentially different energy future from other countries. Do we want to be internationally dependent, or build on our island geography?

In turn, should Auckland have a regionally independent energy system?

Will Auckland and New Zealand pick up their performance regarding energy investment? The number 8 wire mentality can be extremely helpful: technologically savvy companies can help find solutions; but sometimes it means we look to do things 'on the cheap' rather than investing in longer-term solutions.

Energy infrastructure choices have a long life. Within a 100-year timeframe though, it is feasible to transition to more sustainable options.

What are our expectations for energy in the future? For example, should we develop different security requirements for different users?

We have always made energy choices based on opportunities (e.g. hydro). Different opportunities exist today.

## End State Goals

**Self-Reliance:** New Zealand has aligned its economic, climate change and renewables choices to become self-reliant in sustainable energy supply.

**Resilience:** The Auckland region's energy systems are resilient to change, featuring diversity of supply, multiple transmission pathways, end-users who are able to adjust to unpredicted shifts and shocks, and flexibility to adapt to new energy technologies and circumstances as they arise.

**Security of Supply:** The Auckland region has a secure energy supply that is able to meet the economic and quality-of-life needs of the population, and recognises the consequence of failure (with differentiation between different security needs).

**Efficiency:** Per capita demand for energy services, including reticulated electricity, gas, and transport fuel, is reduced while our quality of life is maintained.

**Maintained/enhanced environment:** The natural environment, including climate, is not degraded by our energy choices. Where possible, we have also remedied the effects of others' energy choices.

**Lowest fair cost:** Sustainable energy is provided at the lowest fair cost to consumers, the community and the environment.

**Early adopter of new technology:** New sustainable energy technologies are rapidly adopted by industry and end users.

**Renewables are a high proportion of energy generation:** Starting from an already-high base, a high proportion of renewable energy generation supplies the Auckland region.

## Seeds and Constraints

The Auckland region is fortunate to have a lot of 'seeds' for sustainable energy that could be grown. These include:

**Natural strengths:** The region has a good potential base of renewables for small-scale generation (e.g. wind, ocean current/tidal and solar). Auckland and New Zealand enjoy high sunshine hours (global radiation at ground level). Potential for wind generation in the Auckland region is not as strong as it is in areas further south. However, there are areas along the West Coast that are identified as having a generally good wind resource (see Appendix Three in the appendices section).

**Cultural strengths:** The number 8 wire, can-do mentality encourages flexibility to change and embrace new technology. Overseas experience exposes people to other lifestyle choices.

**Technological innovations:** More efficient technology is now available (e.g., Whispertech, smart meters). House retrofits and other incentive schemes are already underway. We know how to build new housing stock more efficiently. The Building Code Review (recommendations to be released end-2007) may help this.

**Drivers for change:** Shell and BP expect oil to last for 42 years, and gas for around 70 years worldwide: this is a good incentive to change. Rising petrol costs and winter power bills drive consumer interest in efficiency and are opportunities to encourage change.

At the same time, however, there are a number of constraints:

**Natural constraints:** Geography in the Auckland region is a limiting factor for large-scale renewable generation and presents challenges for the design of transport and energy transmission systems.

**Cultural constraints:** Although the drivers for change are becoming more immediate, we have had a complacent population. Capability and knowledge about sustainable energy options within the industry and trades is limited. The number 8 wire mentality can be a strength, but can also lead to 'quick fix' solutions. We also have a cultural resistance to rules and high expectations about our levels of mobility and flexibility – in other words, we like driving.

**Physical and technological constraints:** We are locked into existing systems, which will take time to change. The existing transmission grid is a major constraint. Infrastructure development has long lead times, so any transition to more sustainable systems could be slow. Supply systems have to be scaled to meet peaks, even though these are infrequent. Auckland tends to have seasonal rather than time-of-day electricity peaks, and even seasonal peaks may smooth out if summer cooling demand increases; these effects limit the benefits of demand side management. Our existing urban form and building stock is inefficiently designed from an energy perspective. For example, it's difficult to provide efficient public transport. Many new technologies (e.g. hybrid cars, solar generation) are economically unavailable to most consumers, especially when looking for short-term returns on investment.

**Institutional constraints:** There is a lack of regulatory baselines or boundaries to require more sustainable performance, especially if looking at plugging in increased distributed generation.<sup>1</sup> The region has only limited coordination of its energy systems, and weak links to other related strategies (e.g. the Regional Growth Strategy). There is a need for evidence, data and a compelling story, told with one (region-wide) voice.

## Impact of the Forces

Six 'Forces of Change for the 21<sup>st</sup> Century' have been identified as part of the START project, and presented in a series of working papers for debate. These forces have been identified as being likely to impact the Auckland region and its people over the next century.

Considering Auckland's energy future in light of the Forces, the following potential impacts emerge:

### Climate change

- a risk to hydro generation (lakes' size constraint will get worse if many catchments get drier as is predicted)

- possible change to wind generation potential (more westerly winds likely in some areas)

- changes to electricity maintenance planning (more frequent) due to extreme weather events

- increased temperature in summer leading to more air conditioning use

- additional population from climate refugees? Potentially more businesses locating here because of a secure energy supply.

Energy choices will affect our contribution to greenhouse gas emissions

Our response to Kyoto will affect energy choices and prices. Rising energy prices (especially for transport) could adversely affect NZ's global cost-competitiveness, which in turn might affect regional growth, the structure of our economy, and economic well-being. We will be exposed to an international price for carbon determined by global players. Also we have the potential to earn internationally tradable credits for renewable supply and sequestration.

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<sup>1</sup> Note that the Electricity Commission's purpose is, *inter alia*, to ensure that 'electricity is produced and delivered ... in an environmentally sustainable manner'.

## Demographics

- more overall energy demand with population increase but opportunities for more efficient use (e.g. with higher density housing, public transport, industry growth using efficient technology)
- aging population may mean less money is available for infrastructure investment
- changing household structure and energy use patterns, e.g. people home all day may use more energy<sup>2</sup>
- increasing hospital demand: good options for co-generation

## Resource availability

- electricity generation is reliant on water and hydro lakes. This could be affected by changing rainfall patterns, and increasing competition for water resources.  
loss of topsoil and productive land could limit biomass generation potential  
increased pressure for efficiency of use
- increased pressure on different resources (e.g. other heating sources, agricultural production for fuel rather than food)  
energy imports (oil and possibly gas): NZ is a price taker – changes in availability will lead to major economic impacts e.g. on exports, could drive the economy to smaller more valuable production
- Potential transition away from some major energy using industries towards activities that produce more value per unit of energy (economic transformation)

## Globalisation

- ◆ Potential increasing global instability increases the risk of reliance on international energy
- ◆ Possible emergence of global or regional trading blocs for energy
- ◆ Economic impacts of large-scale shifts to renewables (e.g. US) could set up cyclical effect, with OPEC decreasing oil prices in response. This could in turn affect the cost-benefit of investing in renewables
- ◆ Energy prices might influence NZ's place in international markets (e.g. tourism, exports)
- ◆ Kyoto and subsequent international commitments will shape energy futures
- ◆ Food miles vulnerability ... or the sustainable food basket of the world?

## Technology

- ◆ Could solve all our energy problems, but we can't rely on it. Future is uncertain.
- ◆ Increasing technology use can lead to increasing energy demand (e.g. computers).

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<sup>2</sup> It was noted that elderly people tend to use less energy in their homes, but this may change with the baby boomers. Rest homes can be high energy consumers. Warm homes contribute to health and quality of life.

- ◆ Rebound effects (e.g. once houses are insulated, people heat more of their homes).
- ◆ At same time, technology can improve efficiency (same devices using less energy, or substitution of different devices)
- ◆ Potential for greater interaction and substitution between energy forms for the same purpose (e.g. hybrid cars).
- ◆ In combination with increased energy prices, technology could lead to innovation in the end use of existing energy supplies, and to expansion of alternatives. It could change demand patterns (e.g. transport demand patterns could be altered by maturing of virtual technologies such as teleconferencing and telecommuting).

### **World views**

- ◆ Current view of energy abundance, but some consciousness of energy saving, e.g. periodic awareness over cold winters, particularly when they are also dry (which constrains electricity supply).
- ◆ Clash of civilisations (east-west) directly affects energy prices

### **Actions**

A number of the solutions to move towards the desired end state goals are already present in Auckland's energy system. Some, such as installation of medium scale renewables generation, are already being developed, others need to be further up-scaled or supported. Actions focus on incentivising change and lifting bottom-line performance.

It was noted that decisions about supply are primarily made by a small group of actors, whilst multiple consumers make decisions about demand. This could lead to quite different actions in these two spaces. Supply decisions are generally at the national-level, whereas consumption and demand management has great potential for regional leadership.

### **Overarching actions**

- Develop a shared understanding of the Auckland region's energy future, including the energy levels of service needed and performance benchmarks. Communicate clearly with providers, regulators and policy makers.
- Open dialogue with Wellington on the development of the National Energy Strategy.
- Manage risk and volatility to help set the investment climate (a central government action). For example, the business case for large-scale investment in renewable energy generation is vulnerable to volatility of rising and falling oil costs. Government could introduce measures to help to moderate this volatility and reward desired behaviour (i.e. investment in renewable options).
- Strengthen EECA's capability via the review of the National Energy Efficiency and Conservation Strategy.
- The public sector should be a market leader, making energy efficient choices in location, building design, vehicle fleet, and options for flexible working arrangements (e.g. teleworking).

- Work to advocate diversity of supply and to promote other end-state goals.
- Should the Auckland region make a Kyoto-style commitment to match the levels of commitment undertaken by European and North American cities?<sup>3</sup>

## Electricity/non-transport fuels

### Generation

- On right track with renewables generation (at the modest scale, not micro). Could be increased (acknowledging intermittency and system stability challenges).
- Remove barriers and provide incentives for small-scale cogeneration and distributed generation.
- Improve proportion of renewables to non-renewables, with individual PJ targets for hydro, wind, photovoltaics. A 100% renewable goal could be an international attraction for companies to use NZ as a secure and reliable business location and it would polish our international 'clean and green' image.
- Develop local bio-fuels and solid waste as potential reserve thermal fuel.
- Encourage energy supply companies to use renewables by selling energy services (e.g. hot water) instead of electricity or gas only.
- Create legal basis for investors in renewables to secure feed-in conditions over life time period (see: Germany's Feed-In Law). This could be piloted in the Auckland region.
- Explore potential for deep geothermal energy generation.
- Recognise lignite/coal as a current bridging step but acknowledge the significant challenges (e.g. greenhouse gases) that this source poses. Consider whether imported CNG/LPG would be a more sustainable option.
- Secure areas for wind generators in plans for long term development
- Identify areas (industry/commercial) with high demand/consumption to be targeted with individual energy concepts (e.g.:medium term plans including energy monitoring /controlling,+ micro cogeneration,+ large scale solar water heating and storage,+ demand reducing scheme,etc).

### Transmission

- Need adequate transmission networks for renewables.
- Look at trenching in roads for combined service delivery (gas, fibre optic etc.).
- Make a choice about transmission (overhead or underground). Aim for no overhead (transmission or distribution) lines in 100 years.

### Consumption and demand management

- Increase uptake of neighbourhood (and house) level interventions: heat pumps, back venting fires, passive design, insulation, solar hot water systems.

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<sup>3</sup> Note that ARC, Auckland City, North Shore City, Rodney District and Waitakere City Councils are already signatories to Communities for Climate Protection.

- Promote and enlarge storage capacity at the house level (i.e. hot water cylinders)
- Work on changing behaviour: smart metering, incentivising efficiency, make it possible to buy 'green' energy (as is possible currently by purchasing from Meridian).
- Improve streetlighting – dimming, solar technologies
- Promote direct use of gas as more efficient, and conversely, avoid gas use for electricity production when possible.
- Promote new concepts through pilot projects (e.g. green subdivisions, low energy apartments, commercial buildings using renewables and micro cogeneration systems)

## Transport

Improve public transport and urban planning

- ♦ ARTA to take into account energy futures in its PT procurement decisions
- ♦ Improve the convenience of PT relative to cars. Continue investment in rail: electrify and ensure power is from renewables (Kyoto commitment)<sup>4</sup>. (Relative efficiencies need to be explored. Maintain existing system, including double tracking)
- ♦ Investment in PT in general e.g. busway. Improve service features and marketing
- ♦ Improve urban form for walkability, accessibility. Nodal development. Queen St as pedestrian mall?
- ♦ Promote cycling and cycle networks
- ♦ Review balance of investment between roads and PT
- ♦ Encourage communications technology as an alternative to travel (IT, teleworking, unbundling local loop network)

Make cars more efficient

- ♦ Auckland to determine what kind of car fleet it wants
- ♦ Set minimum car efficiency standards
- ♦ Find a way to link air quality benchmarks to cars. Emission testing, catalytic converters, import standards (what benchmark?) – staircase introduction
- ♦ Encourage lighter weight cars
- ♦ Registration costs linked to vehicle efficiency (with provision for equity)
- ♦ Incentives to scrap undesirable cars?
- ♦ Recognise generally we're a taker of automobile technology → be a faster follower
- ♦ Explore how to ensure efficient freight movement

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<sup>4</sup> Note that the ambition for renewable supply may not be possible within the short term. Current supply constraints mean that any increased demand will be most likely met with thermal generation. The issue points to the need to reverse the trend towards non-renewable energy generation, noted elsewhere in this paper.

Produce bio-fuels in NZ, for example from waste biomass. May require some risk mitigation for investors if market failures exist.

## **Actions the Auckland region can take**

- ◆ Clarify who has authority/ability to determine future actions and choices.
- ◆ Set standards (e.g. overhead transmission, require new buildings to install solar hot water systems)
- ◆ Advocacy with Wellington, working with a coherent regional voice (current regional failure in coherence)
- ◆ Offer administrative cost incentives (e.g. via development contribution rebates and rates differentials, and/or free building consents) for energy-related improvements (e.g. solar hot water installation).
- ◆ Scale up existing programmes, e.g. EcoWise West home retrofits, HNZC retrofits. Migrate such schemes to the private sector, or look at how Councils can invest in retrofit programmes, on the basis of return of savings.
- ◆ Set local/regional targets to get houses insulated.
- ◆ Create a Warrant of Fitness for houses – energy labelling.
- ◆ Lead by example, with programs from Auckland region councils (such as energy saving and efficiency program in public buildings and infrastructure (schools, libraries, street lights, etc.))

## **Expert Group Membership**

The Energy Paper expert group consisted of the following people

- ◆ Bart van Campen, Auckland Energy Centre, University of Auckland
- ◆ Carolyn Judd, Mighty River Power
- ◆ Gerard Willis, Enfocuss
- ◆ John Small, COVEC
- ◆ Kaylene Cocker, Vector
- ◆ Robert Kirkpatrick, Auckland Energy Centre, University of Auckland
- ◆ Walter Breustedt, Eco Management Group Ltd

The group Convenors were:

- Gareth Wilson, Ministry of Economic Development
- Graeme Campbell, Waitakere City Council

The group Navigators were:

- Megan Howell, Auckland Regional Council
- Rose Leonard, Waitakere City Council
- Simon North, Ministry of Economic Development

## Appendix One: Historical Background

*Supplied by the Ministry of Economic Development*

10 July 2006

Gareth Wilson

Manager, Electricity Group

The following notes are intended as input to the START Working Group on the Energy Theme.

### *100 Year Backcast*

Ultimately, we are looking forward. However our direction is partly determined by where we have come from and the path we are currently on. Not all that we have left behind is bad, and some old elements may be picked up again<sup>5</sup>.

### *International Travel*

100 years ago, all international travel was by ship, whether passenger or freight. These were either wind-powered or steam powered with coal or diesel fuel options. Dual-fuel transport options were available. The harbour front was active with loading and unloading.

### *Domestic Travel*

100 years ago, the harbour was also the centre for domestic travel. Fleets of sail- and steam-vessels carried freight and passengers around the country.

Rail did serve a limited function. In 1909, the main trunk line was completed between Auckland and Wellington, enabling an alternative means for transporting passengers and freight. Initially these were steam trains fuelled by coal. By 1910 there was already some discussion about 'possible electrification of suburban and ultimately of the main trunk railways.' Diesel power followed much later. This was finally followed by electric units in some suburban networks of other cities (e.g. parts of Wellington in 1938) over much of the main trunk by 1988, but still not in Auckland.

100 years ago Auckland was already a commuter city. The harbour was the highway bringing commuters by ferry from the North Shore and the Eastern Bays. Ferries continued to serve a valuable function until the commissioning of the Harbour Bridge in the early 1960s, followed by extensive motorway networks in the 1960s and 70s when private petrol/diesel vehicles took over the commuting function from these parts.

Mass Rapid Transit arrived in Auckland at the turn of the 19<sup>th</sup> century. Between 1899 and 1902 the privately owned Auckland Electric Tramway Company established a full electrified tramway network, replacing the older horse tramway. This was the largest

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<sup>5</sup> A significant portion of the historical information has been taken from:

E A Rose (2006) *Heritage Walks – The Engineering Heritage of Auckland*. A booklet produced by Tourism Auckland on the initiative of the Auckland Engineering Heritage Committee of IPENZ.

J E Martin (1998) *People, Politics and Power Stations Electric Power Generation in New Zealand 1880-1998*

municipal engineering project in New Zealand at the time, and meant that a significant portion of Auckland's transport was electrified. A condition of construction imposed by the Auckland City Council was that some electricity be supplied for Queen Street lighting. Trams were essential to early life in Auckland and their extensive patronage promoted the expansion of 'tramway suburbs', such as Mt Eden and Mt Albert, all over the Auckland isthmus. They were replaced by the electric trolley bus system in 1949 which operated until 1980.

Cars and trucks were a novelty initially. The Model T Ford was on the road after 1908, with car numbers increasing to the present day.

### *Coal and Gas Use*

Coal was brought in from the Huntly mines for domestic heating and boiler operation.

Coal was gasified, and the gas was used in Auckland from the 1860s, initially for street lighting. Full reticulation of gas began in the 1870s in a 20km radius around the Chief Post Office through the Auckland Gasworks Company. The 'golden years' for the company were from 1908-1910 before electricity started to take over and wartime coal shortages affected supply. In the 1970s, natural gas was transmitted from the gas fields of Taranaki and the coal gasification plant was finally closed down.

### *Electricity Generation*

Initially all generation was distributed generation. Frequently small diesel generators powered individual sites, commonly for lighting. The Auckland City Council actively tried to control generation through the Auckland Electric Lighting Act 1900 which gave itself exclusive generating rights. Larger scale generation began with the Auckland Electric Tramway Company, including a coal-fired power station on Lower Hobson Street from which waste heat was reticulated for use in the newly built Tepid Baths in 1914. As mentioned earlier, some of the company's electricity was used for Queen Street lighting.

Fear of bubonic plague led to the establishment of the Freemans Bay city waste destructor commissioned in 1905, built by the Auckland City Council. This was converted to electricity generation (450kW) in 1908, with electricity being reticulated to 12 customers. Within four months of commissioning, this waste-to-energy project was faced with inadequate waste supplies so coal supplemented supplies.

By 1913 the city council had built a new and larger coal-fired power station on Kings Wharf, so closed the Freemans Bay waste-to-energy plant. The Kings Wharf included the largest steam unit in New Zealand until the commissioning of Meremere in 1958. By 1920 Kings Wharf had a capacity of 3.4MW DC and 7.1MW AC. Kings Wharf station remained in operation until 1968 when it was finally shut down, despite being reduced to a standby and peaking function at a much earlier date.

A small private gas engine had been installed in Devonport in 1915 and was subsequently expanded with growing demand.

Elsewhere around the country there was growing interest in hydro generation. Peter Hay wrote a classic comprehensive report on New Zealand hydro potential in 1904. In 1906 Joseph Ward became Prime Minister, and was to be an early advocate of renewable energy having visited a hydro power station at Niagara. There were many supportive officials.

Of most significance for Auckland in the early years was the Waihi Gold-mining Company which developing a range of generation types to meet the demand of its

mining operations (one of the largest in the world at the time). By 1913, the company generated power from coal-fired steam turbines, a power station based on coal-gasification technology, a small hydro station and the larger 6.3MW Horahora hydro station on the Waikato River. The Horahora station was purchased by the Government in 1919 and extended to 10.3MW.

Many other stations have followed. In 1920 thermal power stations accounted for nearly 50% of national capacity and 28% of generation but by 1930 this had fallen to 18% and 8% respectively.

### *Electricity Transmission and Distribution*

At the turn of the 19<sup>th</sup> century, the greatest distance electricity had been transmitted anywhere in the world was about 250km.

There was very little distribution of electricity around Auckland. In 1917, there were 2,500 consumers in Auckland, but 12,000 in Wellington, more than 4,000 in Christchurch and nearly 6,000 in Dunedin. The situation changed when the Auckland Electric Power Board was formed in 1921, and an agreement was reached to take bulk power from Arapuni hydro station. In 1923, the Waitemata Electric Power Board was formed helping to accelerate North Shore electricity uptake.

In 1925 power was transmitted to Auckland from the Horahora hydro station following completion of a 110kV transmission line (other lines were extended to the Bay of Plenty), but power was not available from Arapuni until 1929. In 1930 the Kings Wharf station was ceremonially closed (but retained for standby duty) so Auckland was then supplied by renewable hydro electricity only.

Generally through the late 1920s there was rapid growth in transmission lines. All of the North Island was interconnected by 1934 when a link between the lower North Island network through Stratford to Arapuni was completed.

### *Electricity Demand*

Initially electricity demand was focussed on transport (trams) then extended to street lighting. Industry (both urban and rural – particularly dairy industry) followed along with household lighting. Demand accelerated greatly after homes were rewired to allow greater use of electricity for wide-ranging domestic use.

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Senior Advisor  
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## **Appendix Two: New Zealand's Energy Outlook to 2030**

*Supplied by the Ministry of Economic Development*

The following discussion and projections shown are drawn from the modelling work completed for the (soon to be published) Ministry of Economic Development's New Zealand Energy Outlook to 2030.

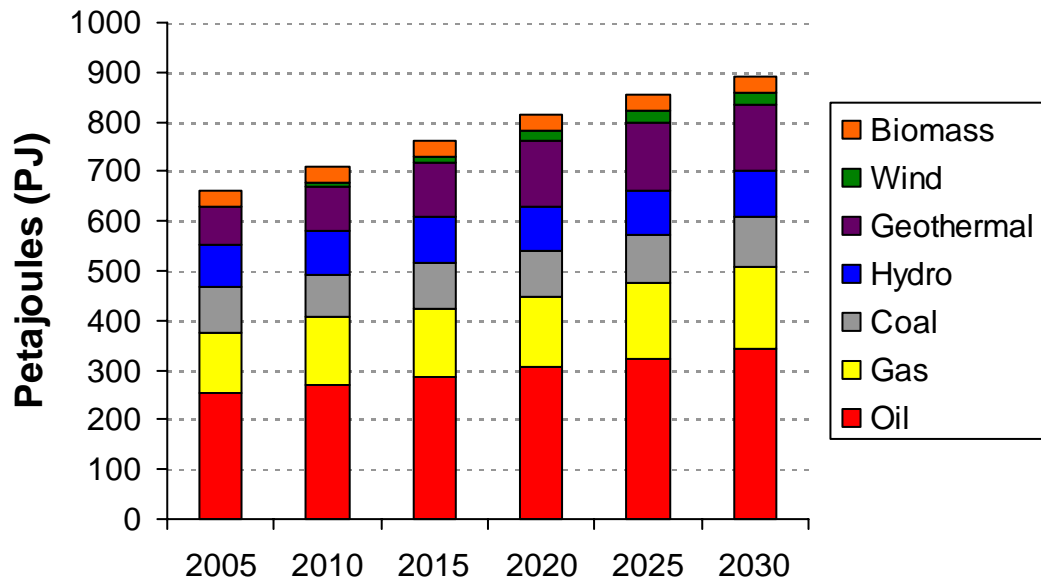
All projections have been made at national level. Regional splits are not modelled for Energy Outlook and thus specific Auckland projections are not immediately available. In the absence of regional models, it may be appropriate to assume the national growth rate will apply at regional level, or it may be that regional growth is better estimated pro-rata with population and/or economic growth.

The projections detailed are the Base Case view for which the following are key assumptions

- *GDP growth follows New Zealand Treasury's assumptions, of 3.25% growth in 2007, dropping slowly over time, reflecting an aging population.*
- *Exchange rates to 2009 are based on New Zealand Institute of Economic Research (NZIER) projections. For 2010 and thereafter, the exchange rate is assumed to be 0.60 US\$/NZ.*
- *Oil prices are assumed to remain at US\$60/barrel throughout the model time horizon.*
- *New gas discoveries are assumed to average 60 PJ/year, with production from new discoveries starting in 2012. This number represents the historical average (excluding the Maui field).*
- *Energy efficiency improvements are assumed to proceed at historical rates.*
- *No carbon tax.*

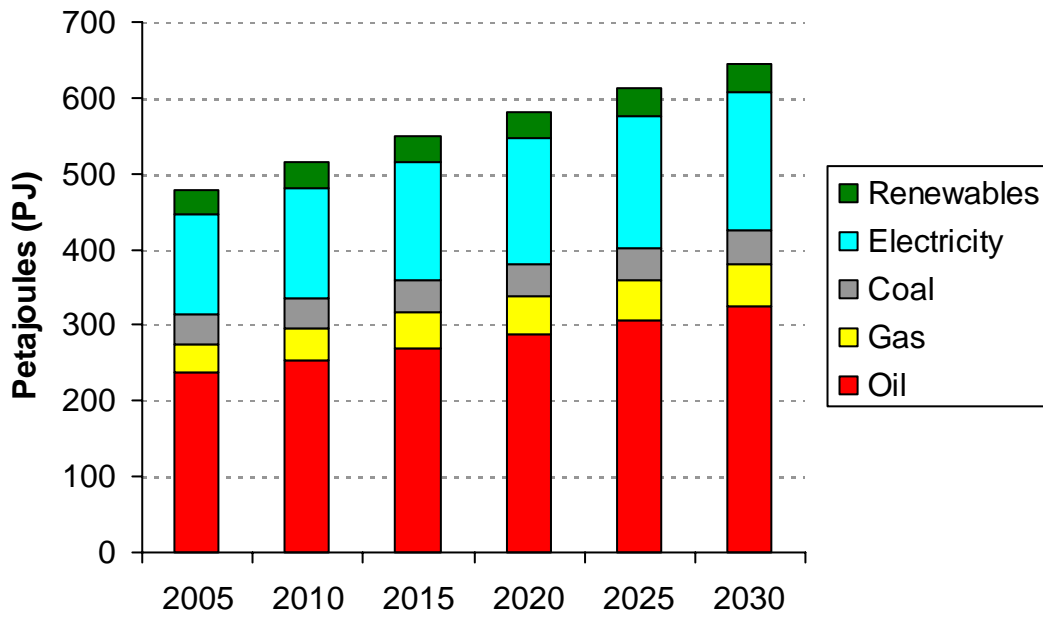
## Total Energy

- New Zealand's Primary Energy supply is projected to grow at rates averaging 1.5% from 2005 to 2010 reducing gradually to 0.9% for 2025 to 2030. The lower growth is in line with lower population and economic growth rates in the latter years.



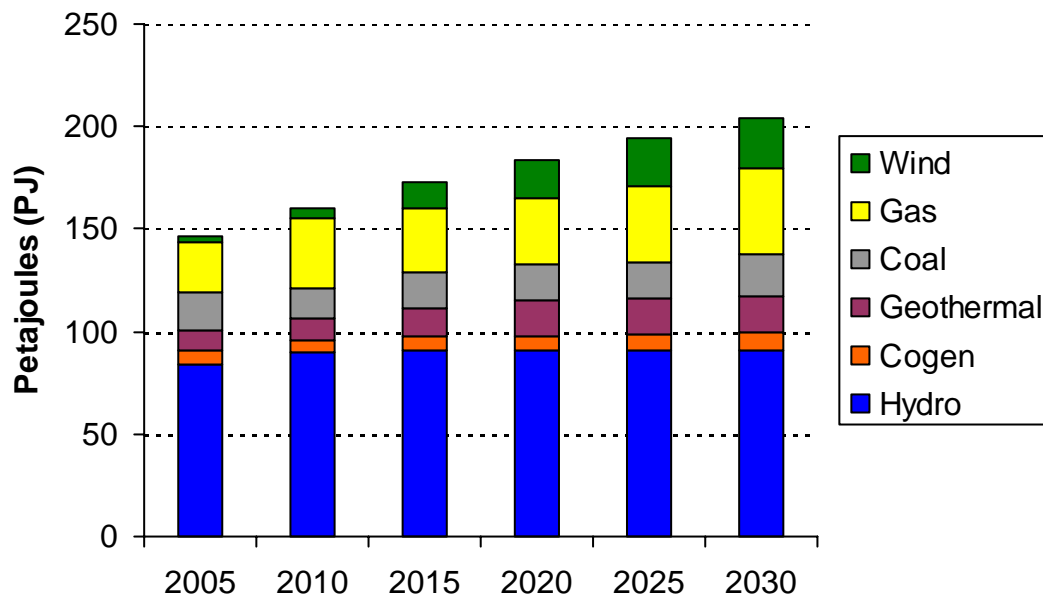
## Primary Energy Supply by Fuel Type

- This growth is shared principally between Oil; and Gas, Geothermal and Wind used in Electricity generation.
- Similar growth rates are seen in the Energy as used by Consumers with the majority of this growth seen in Oil and Electricity.



**Consumer Energy Supply by Fuel Type**

**Electricity**



**Electricity Supply by Fuel Type**

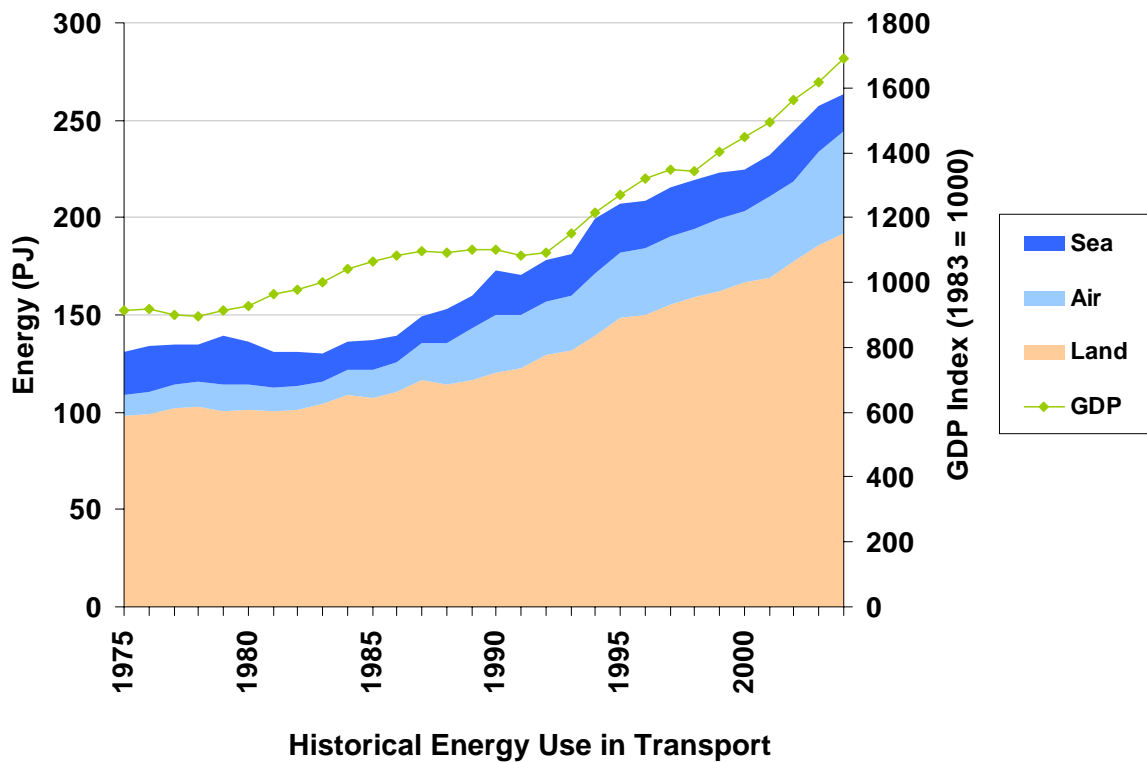
- New Zealand's Electricity supply is expected to grow at rates averaging 1.6% from 2005 to 2010 reducing gradually to 1.0% for 2025 to 2030. Again it is the expected lower population and economic growth that leads to the lower projected growth in electricity demand.
- The following table shows the Electricity Supply projection split between generation sources. It can be seen that thermal sources are expected to hold

their current market share despite the projected growth in wind generation. In our base case projection little additional Hydro generation is foreseen and its relative proportion diminishes as a result.

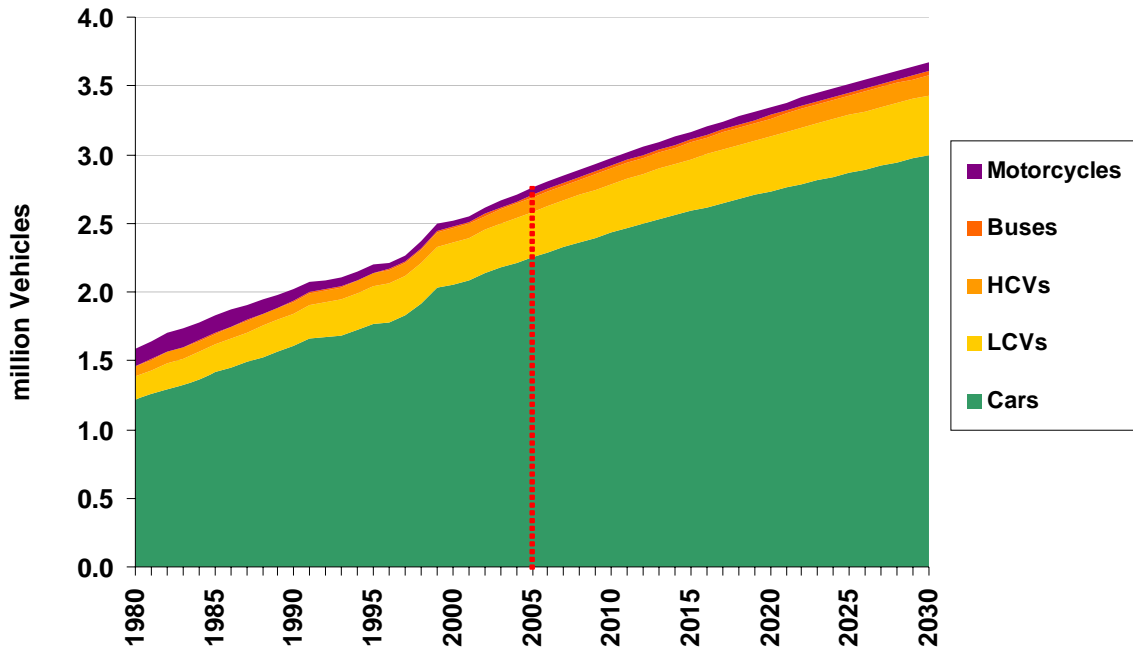
Projected Electricity Supply (by Energy source)						
	2005	2010	2015	2020	2025	2030
Hydro	61%	56%	52%	49%	47%	45%
Cogen	3%	4%	4%	4%	4%	4%
Geothermal	6%	8%	9%	9%	10%	9%
Coal	9%	12%	11%	10%	9%	10%
Gas	18%	17%	18%	17%	18%	20%
Oil	0%	0%	0%	0%	0%	0%
Wind	2%	3%	7%	10%	12%	12%

## Transport

- The energy use by transport has shown strong growth since 1992. This is compared on the graph with the higher level of economic growth recorded over this period. Currently Oil products provide some 99% of New Zealand's transport energy



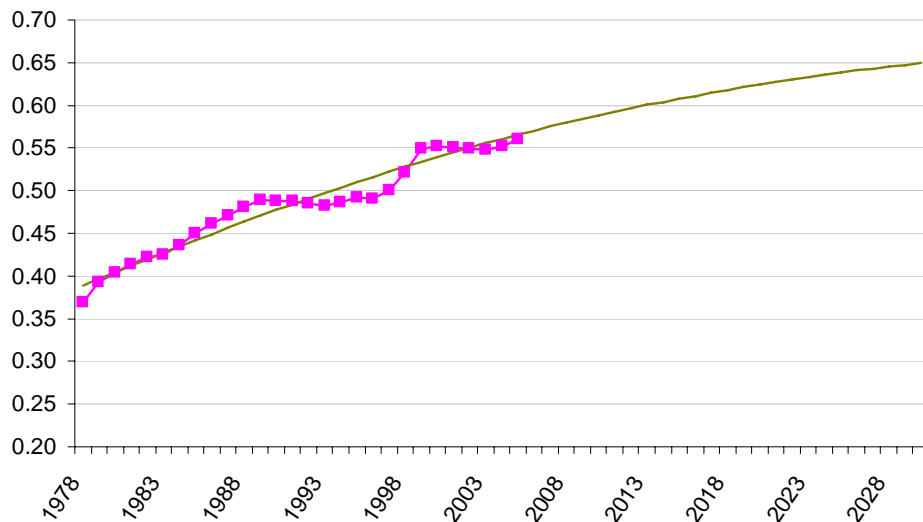
- There has been associated strong growth in the number of licensed motor vehicles in New Zealand. Car numbers have increased at levels well above population growth as households have added additional vehicles.



**New Zealand Licensed Vehicle Fleet**

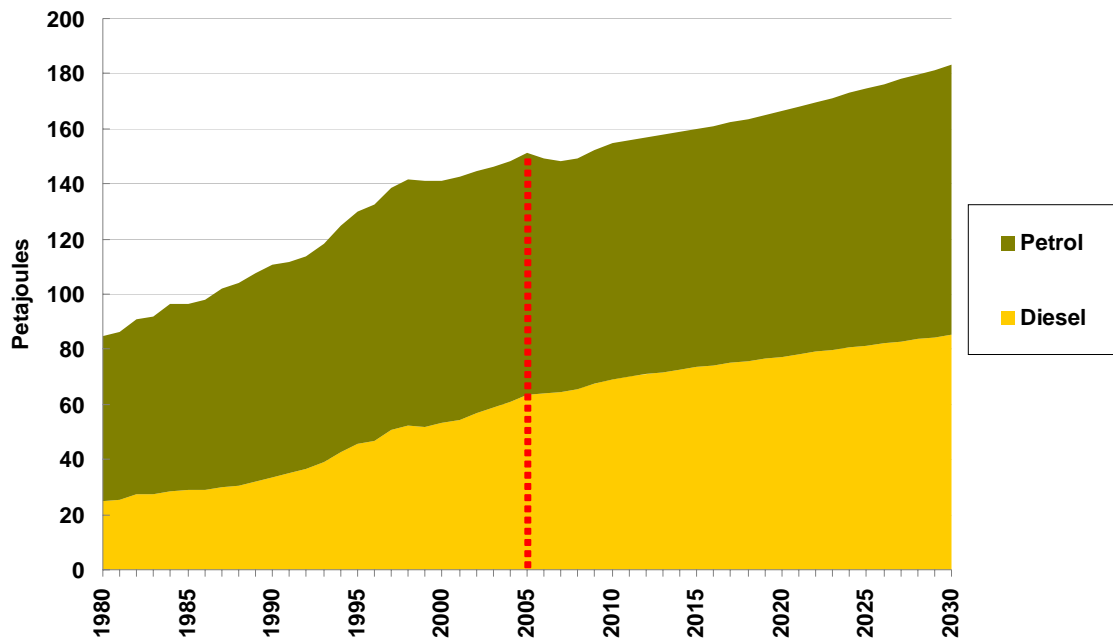
- Modelling now points to an estimated “long-run saturation level” of 700 cars per thousand people.

**Cars per Head of Population**



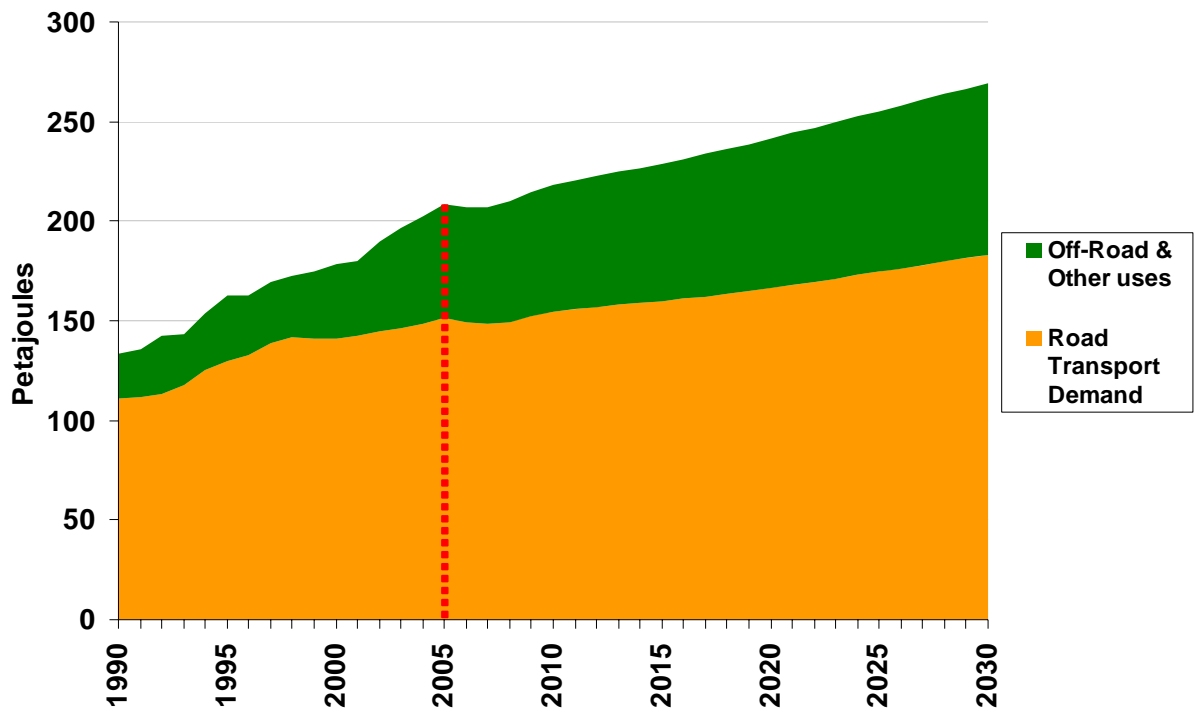
- The higher level of car ownership has led to some reduction in the average kilometres travelled per vehicle. This coupled with the continuing improvement in the fuel efficiency of newer vehicles leads to lower projected growth rates (than vehicle numbers) in the energy required by the fleet. (n.b. the relatively small number of LPG powered vehicles are included as Petrol in

this graphic. The smaller number of fully Electric powered vehicles are not included)



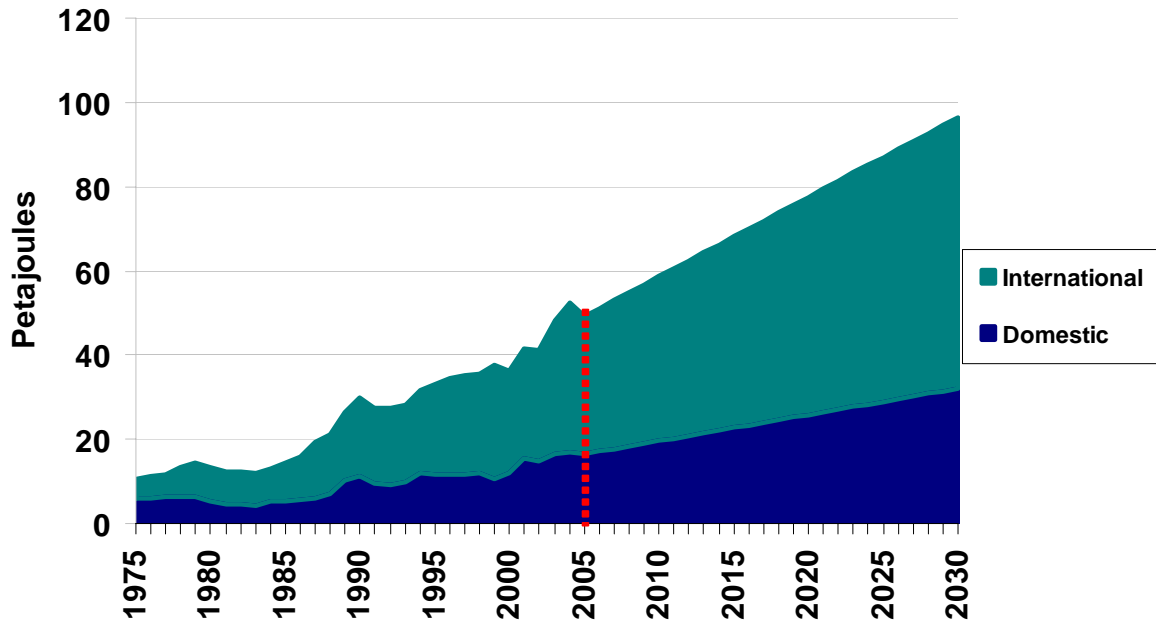
### NZ On-road Vehicle Fleet – Energy Demand (PJ)

- Combining the On-road demand with projections of other land based uses of petrol and diesel, gives



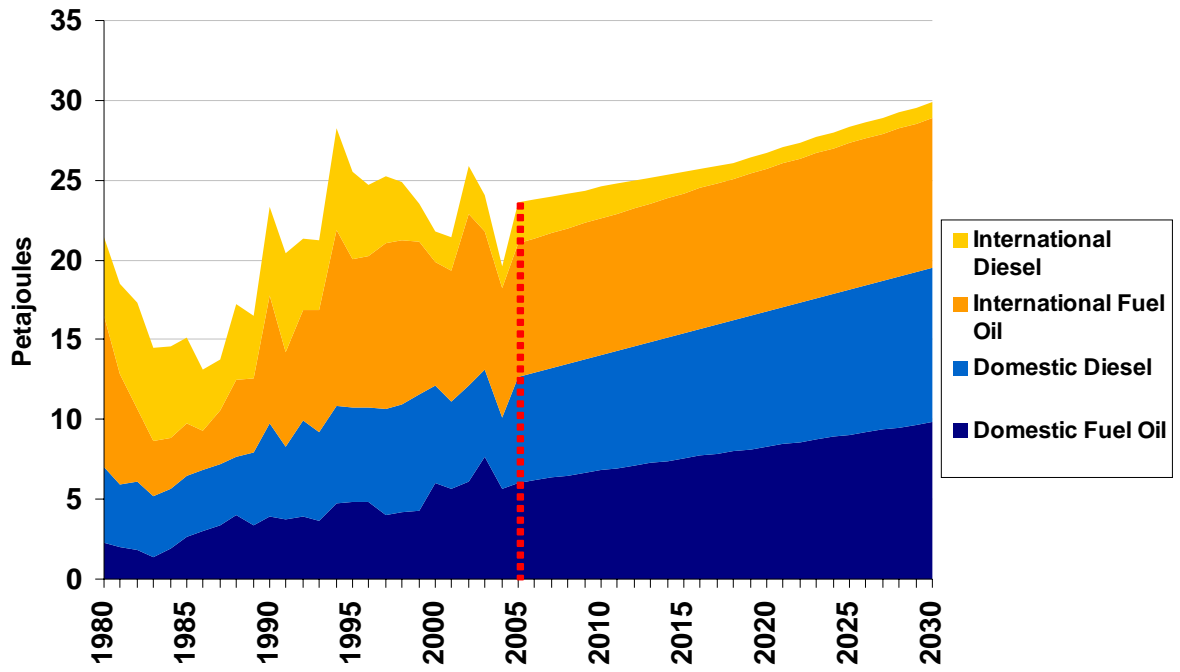
Historical and Projected Land Transport Energy Demand

- Air transport and its use of fuel are projected to continue on recent strong growth taking an increasing percentage of total petroleum fuel use.



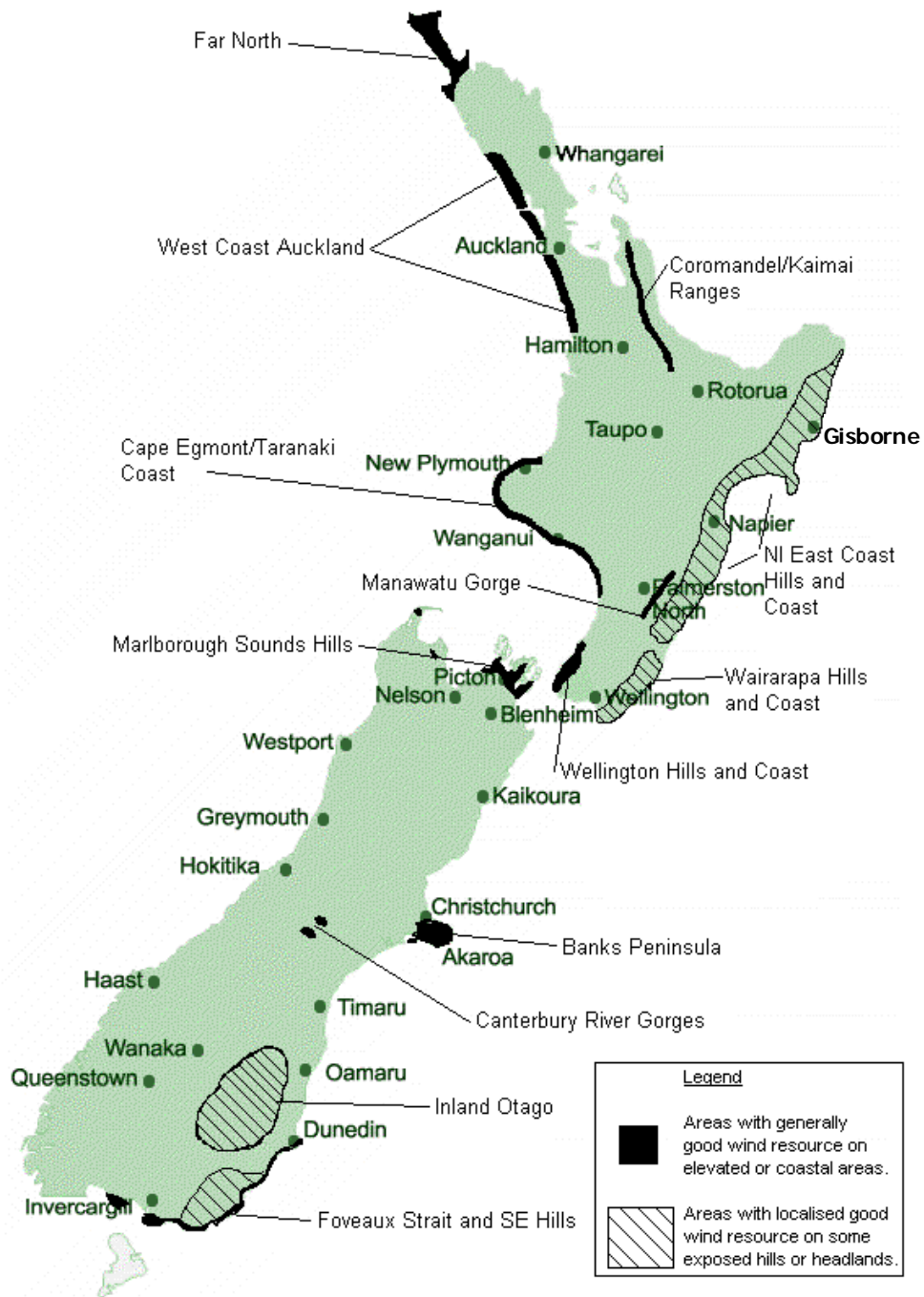
Historical and Projected Air Transport Energy Demand

➤ Sea transport growth is projected to continue at a lower level



Historical and Projected Sea Transport Energy Demand

### Appendix Three: Wind Zones map



## Appendix Four The potential for renewable energy generation in NZ – some international comparisons

*Analysis supplied by Walter Breustedt, Eco Management Ltd.*

<b>NZ</b>	<b>GWh</b>
total electricity generated in 2004	42000
produced by Gas + Coal	10000
produce by wind in 2004	190
Status Report EECA 2005 estimated potential wind	8500
<b>Germany in 2005</b>	
electricity by wind	27000
<b>Denmark in 2004</b>	
electricity by wind	6200
Denmark's goal for 2030	12000
<b>Spain electricity generated by wind</b>	
similar to Denmark	
<b>Solar Hot Water production</b>	
NZ in 2004 for 4Mill inhabitants	60
Austria for 8 Mill inhabitants	1000