



West Wind Makara wind farm near Wellington
(image courtesy of Meridian Energy)

How do we Model the future?



New Zealand's Energy Outlook

NEW ZEALAND'S ENERGY OUTLOOK
Electricity Insight

Exploring the uncertainty in future electricity demand and supply



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HIKINA WHAKATUTUKI



Preview of key insights:

-  Lower demand growth and excess supply should put strong downward pressure on prices for the next decade (see pages 7 and 10)
-  Electricity emissions likely to reach close to 1990 levels by the mid 2020s (see page 9)
-  Geothermal energy is key, potentially limiting price increases (see pages 8 and 10)

New Zealand's Energy Outlook | Electricity Insight

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New Zealand's Energy Outlook 2011
Reference Scenario and Sensitivity Analysis



Welcome

New Zealand's Energy Outlook 2011 presents updated projections of New Zealand's future energy supply, demand, prices and greenhouse gas emissions. These projections are intended to inform the energy debate.

This article updates the analysis presented in the Energy Outlook 2009, incorporating new and revised energy data as well as updated modelling assumptions and methods.

The **Reference Scenario** provides a benchmark for comparisons in the Sensitivity Analysis. The **Reference Scenario** is not our expectation of what

is going to happen. Rather, it assumes a continuation of the broad trends of key economic drivers and policy settings, as well as current technologies and fuel choices. The **Reference Scenario** assumes the continuation of enacted government policies, such as the emissions trading scheme. Detailed assumptions are discussed at the end of this article.

The **Sensitivity Analysis**, the second part of this article, explores the sensitivity of the **Reference Scenario** to the key macroeconomic variables of economic growth (GDP), exchange rate, emissions price and oil price.

This article is supported by detailed data tables available on the Ministry of Economic Development website and a technical reference document that details the methodology used.

Transport modelling for the Energy Outlook 2011 was a joint exercise between the Ministry of Economic Development and the Ministry of Transport.

Key messages from the Reference Scenario and Sensitivity Analysis

Reference Scenario

- New Zealand's energy intensity improves 21% by 2030.
- In 2030, renewable energy sources provide around 50% of New Zealand's primary energy supply.
- Consumer energy demand is projected to grow at around 1% per annum over the next decade, lower than the 1.4% p.a. seen from 1990.
- Transport remains reliant on oil. Electric vehicles and biofuels remain minor players, contributing less than 2% of total transport energy demand in 2030.
- Energy sector emissions stabilise but remain around 40% above 1990 levels out to 2030.
- Electricity demand increases more than 25% by 2030, but associated emissions are 7% lower than in 2010. Investment in new generation is dominated by geothermal and wind.
- Emissions from transport continue to grow but at a much slower rate than in the past.
- Wholesale electricity prices may need to increase around 1% above the rate of inflation out to 2030 in order to support investment in new electricity generation.

Sensitivity Analysis

- By 2030 the high economic growth sensitivity case sees energy intensity fall to just over half that of 1990.
- High oil prices improve the economics of oil and gas field development and this leads to increased gas supply in the 2020s.
- Sustained higher oil prices encourage the purchase of more fuel-efficient vehicles and a greater uptake of electric vehicles and locally produced biofuels.
- Emissions in 2030 are more than 50% higher than 1990 levels in the high economic growth case.
- Emissions pricing of \$500 per tonne CO₂e reduces coal fired electricity generation but total energy emissions are only marginally lower than in the Reference Scenario (with \$25 per tonne CO₂e).
- A higher valued New Zealand dollar improves the economics of imported technology (e.g. wind turbines) and results in lower wholesale electricity prices.



Want a closer look?
For detailed data visit
www.med.govt.nz/sectors-industries/energy/energy-modelling

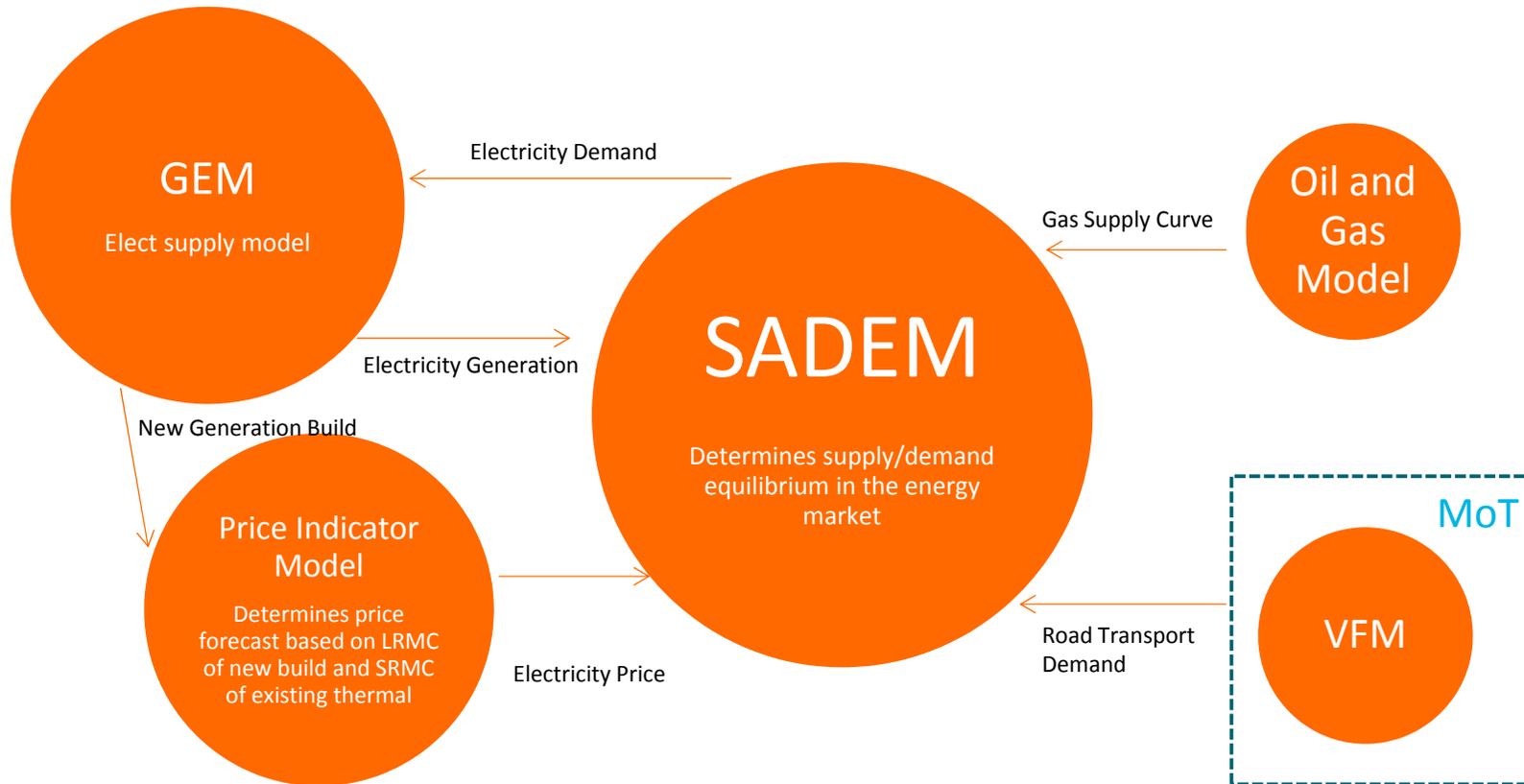
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Methodology Overview

GDP, Pop, Households, Oil Price, X-Rate, \$CO₂



SADEMS areas of strength

- Supply and demand interactions between the natural gas and electricity market.
- Transport – Implications of changes in vehicle fleet on transport energy demand.
- Electricity specific
- Economic structure and energy demand

SADEM is:

- National level
- Aggregate fuels (not technology specific)
- Grounded on historical trends



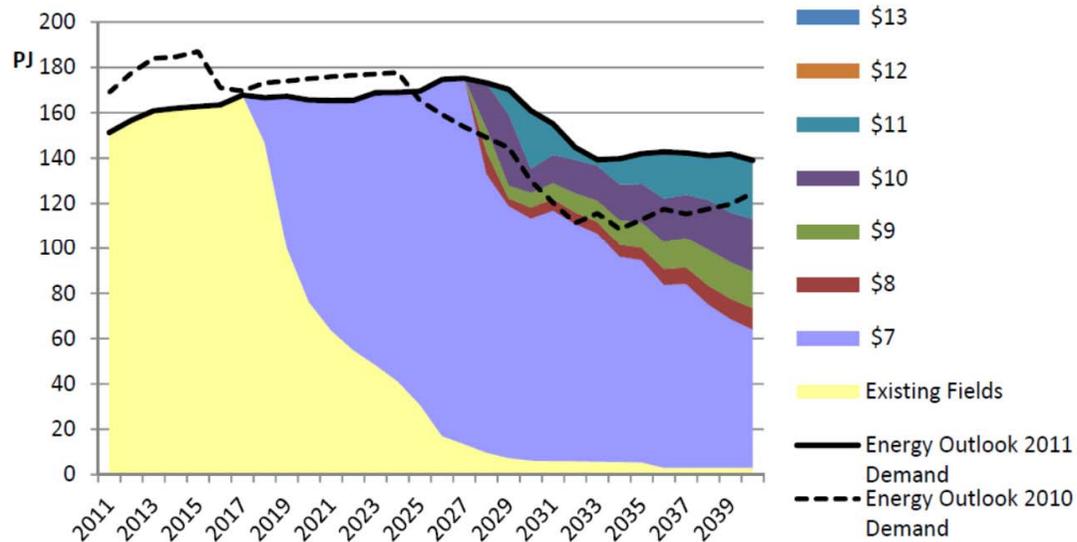
Electricity Supply - Electricity Authority's GEM

- Generation Expansion Model
- What technology, when, how much (MW), where (NI/SI)?
- Optimal solution – finds lowest cost combination of new plant to meets energy and peak demand needs
 - Considers technology characteristics (e.g. wind can't be relied on to meet peak demand requirements, but thermals can)
- Before using GEM we must assume:
 - What projects could be built - tech specs & location.
 - From SADEM - Fuel Availability, & energy/carbon costs
 - Point estimate of capital and O&M (non-fuel) costs for every possible plant. NZ Generation Data Update 2011.



Output of our gas supply model

Figure 12 Smoothed P50 production profiles and break even gas prices (Reference scenario, prices exclude Carbon cost)



The model:

- Estimates the probability of 'technical finds' of oil and gas in NZ's sedimentary basins
- Uses a financial model to assess the commercial viability of these finds using estimates of production costs in each basin



Transport Modelling

- We use the VFM maintained by Ministry of Transport.
 - Incorporates top down projections of travel and composition of the fleet with “bottom” up models that reflect road and traffic conditions.
 - Uses detailed fuel factors calibrated with recent vehicle test cycle data



Large industry/Specific Industry

- Projections = future production * energy intensity



More info and other approaches

- More information
 - Technical guide
 - Contact us.
- Other approaches to energy modelling in government
 - OPENZ @ EECA
 - Interest in General Equilibrium modelling.





West Wind Makara wind farm near Wellington
(image courtesy of Meridian Energy)

Some insights from recent Energy Outlook modelling



Energy Outlook results

- Results of Energy Outlook modelling
 - Demand
 - Supply
 - Emissions
 - Energy intensity
 - wholesale price indicators





NZEO Electricity Insight



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Introduction

- Electricity Supply Scenarios
- Electricity Demand Sensitivities
- No one scenario can be used to predict the future. But...
- by considering the scenarios and sensitivities together, we can make general conclusions about the future ('key insights')



The Supply Scenarios...

Mixed renewables

- IEA WEO 'current policies' scenario assumptions for oil and carbon price
- Mid case population and GDP growth

High geothermal access

- Same as mixed renewables but with higher availability of geothermal resources

Low cost fossil fuels

- No global agreement(s) on climate change, carbon price low
- High oil price encourages oil exploration – gas price stays lower for longer

Global clean energy

- IEA WEO '2 degrees' scenario assumptions for oil and carbon price
- Global agreement on climate change
- R&D lowers the cost of renewable generation technologies



The Demand Sensitivities to the MRS...

Mixed renewables

- IEA WEO 'current policies' scenario assumptions for oil and carbon price
- Mid case population and GDP growth

High growth

- What if economic and population growth are higher than expected?

Low Growth

- What if economic and population growth are lower than expected?

Tiwai Closure

- Mid-case - but...
- What if the Tiwai Point aluminium smelter (13% of 2012 demand) was to close, gradually declining over 2016–2018?



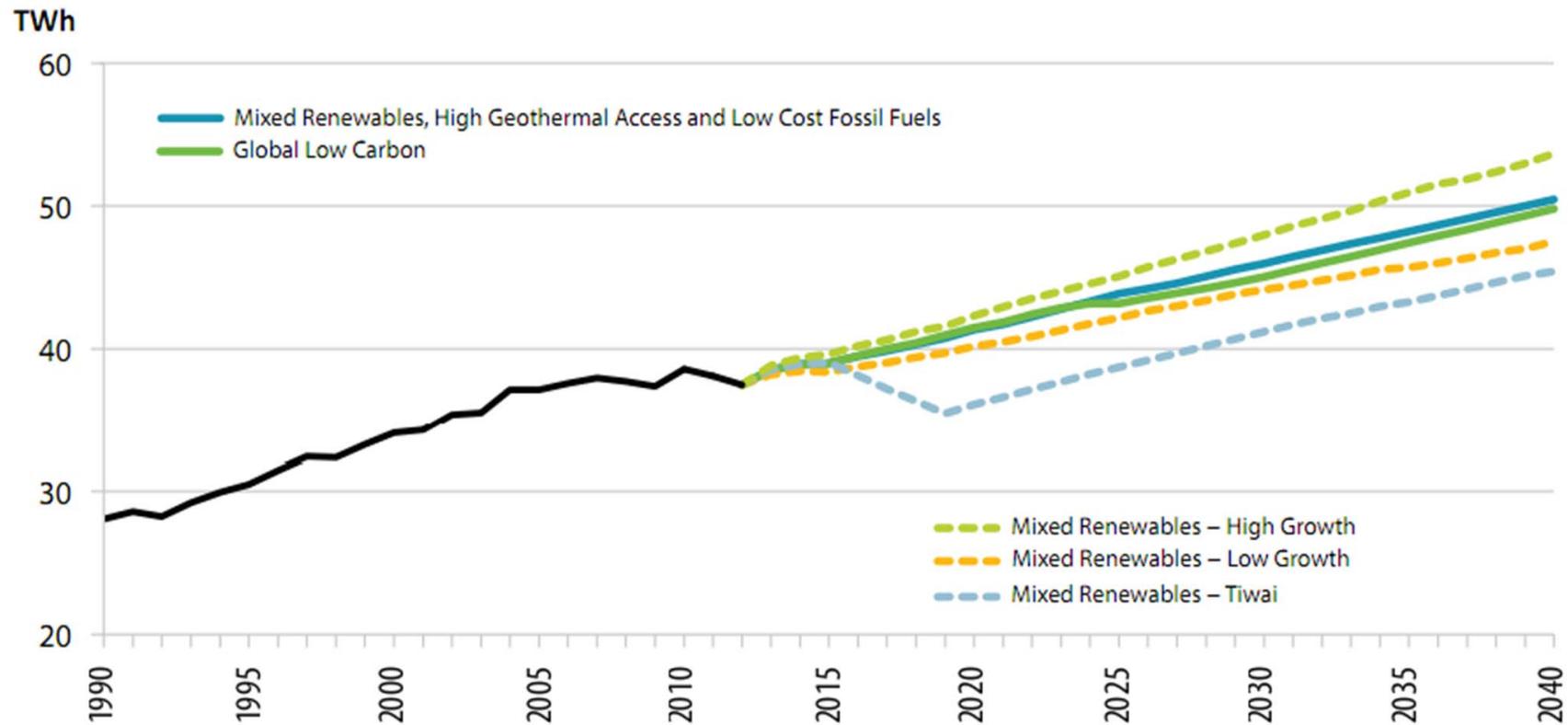
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Outlook → Demand

Figure 1 – Grid level electricity demand by scenario and sensitivity

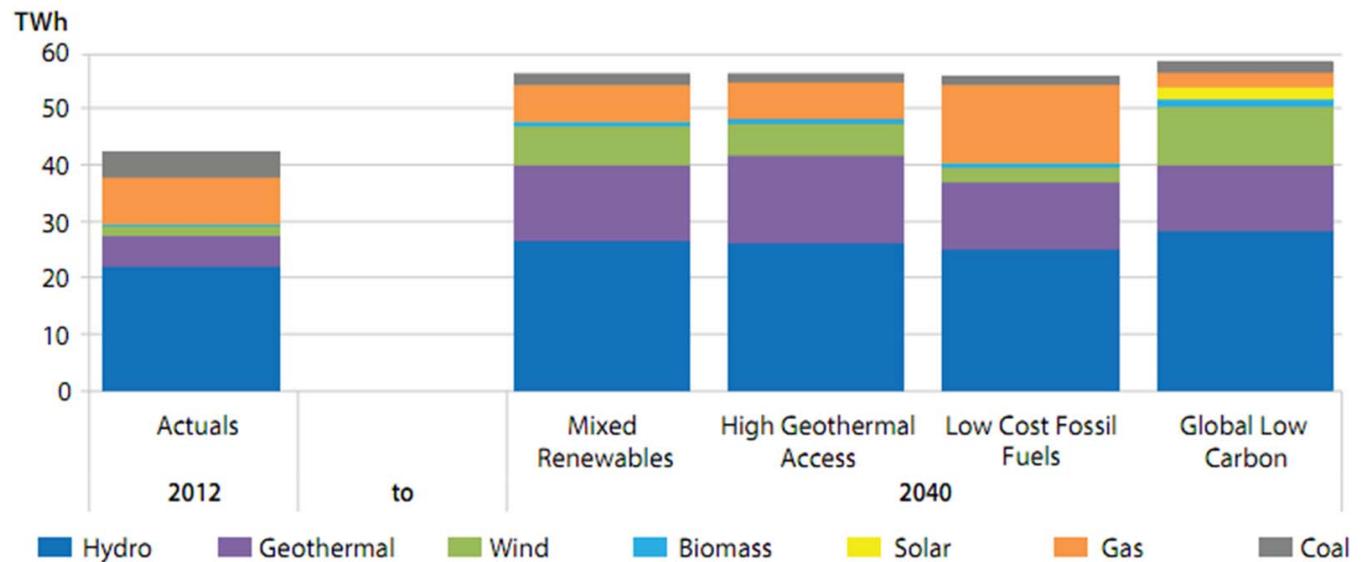




Outlook → Supply

- Regardless of scenario, wind and geothermal generation expected to grow strongly
- Current assumption is that gas will play a part in all scenarios in 2040

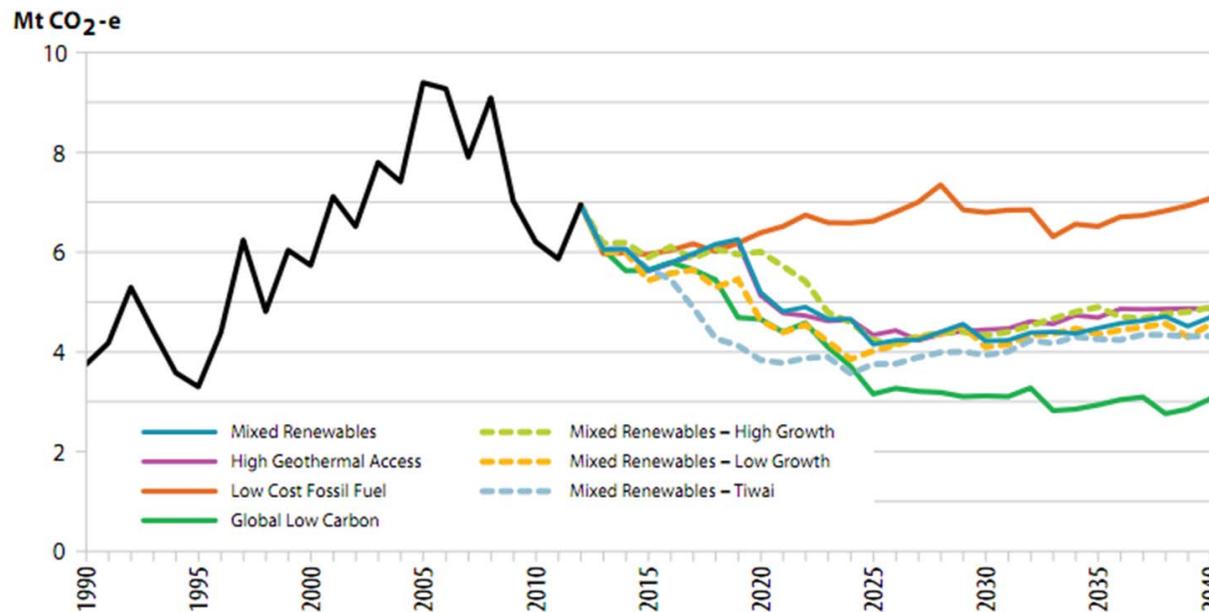
Figure 2 – Electricity generation by scenario





Outlook → Emissions

Figure 3 – Greenhouse gas emissions in the electricity sector*



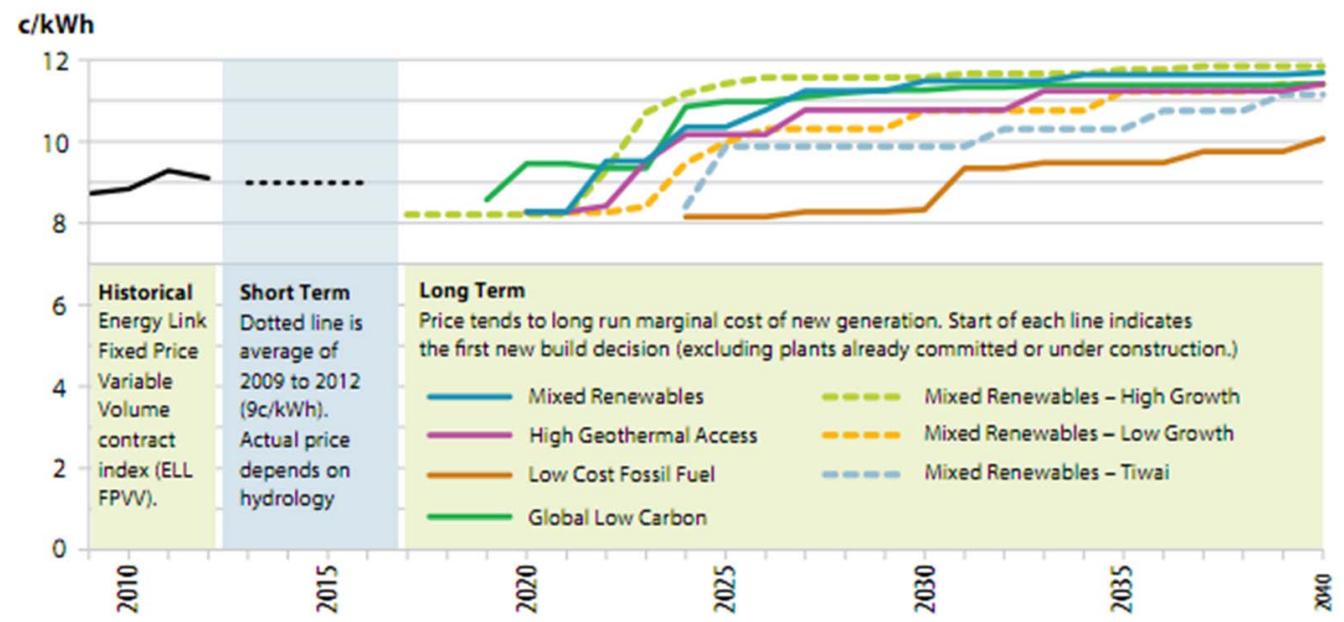
- 1990 levels in MR
- Further reductions requires further retirement
- Risky to invest in new fossil fuel baseload plants
- But... must not forget transport.





Outlook → Wholesale Prices

Figure 4 – Wholesale electricity price indicator (real \$2011)



Access to low cost geothermal is very important

Renewables - New Zealand's competitive advantage in a low carbon world?



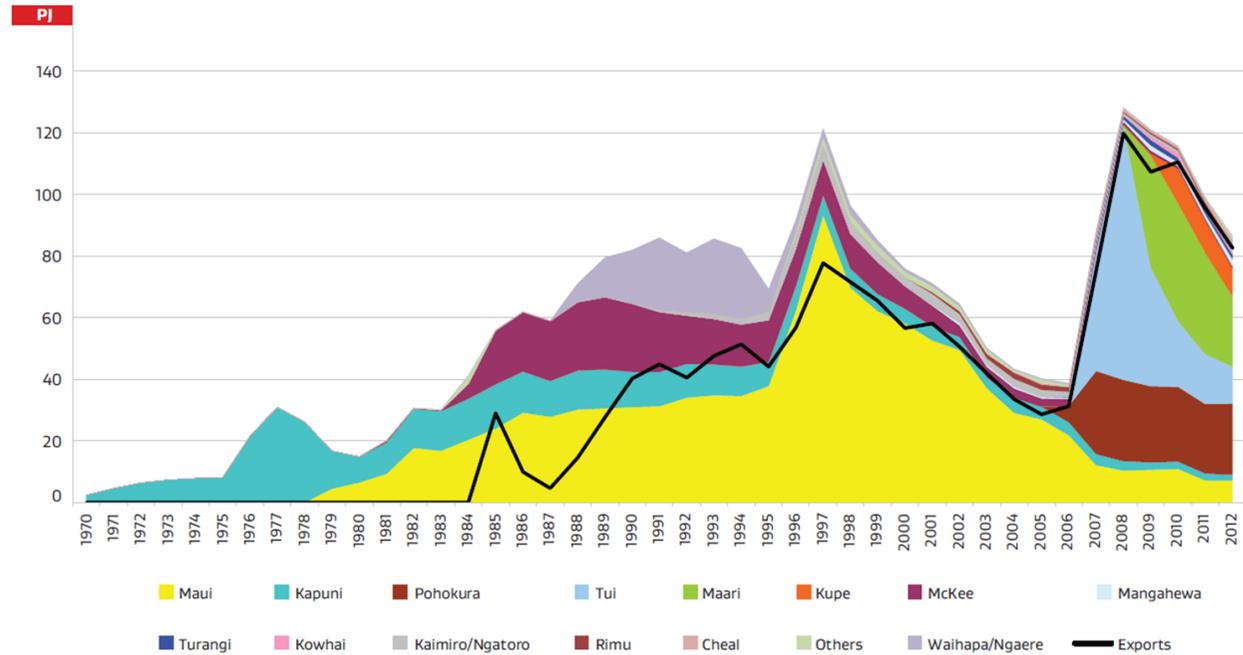
Gas Supply Outlook



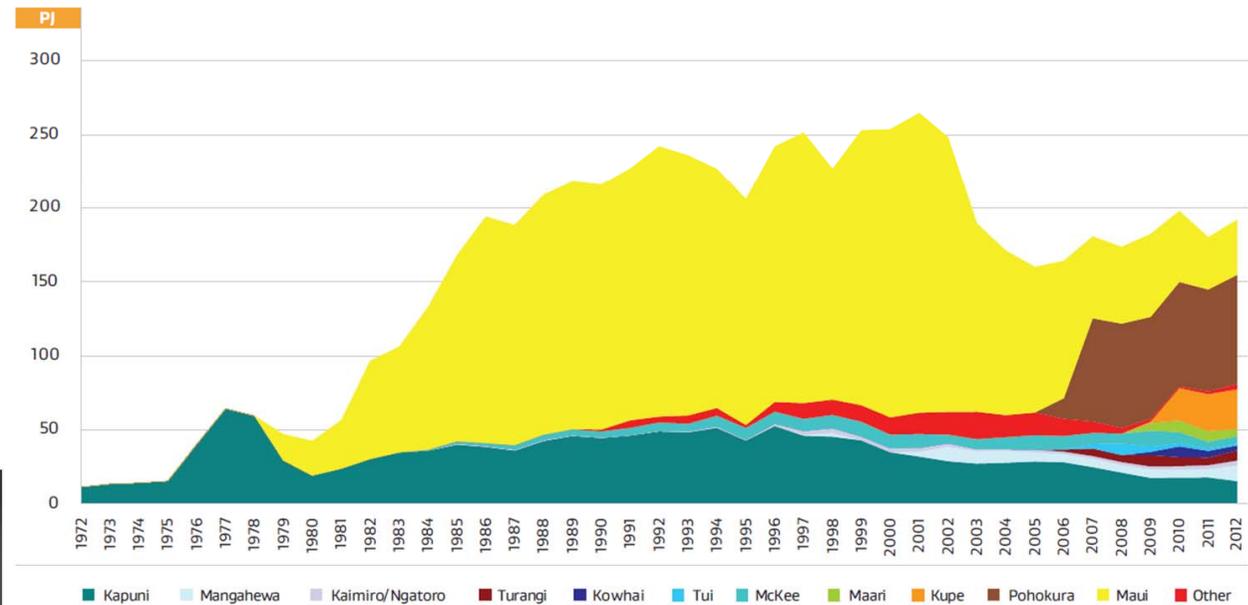
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Looking back...

FYI:
Oil



Natural Gas (a.k.a. Gas)



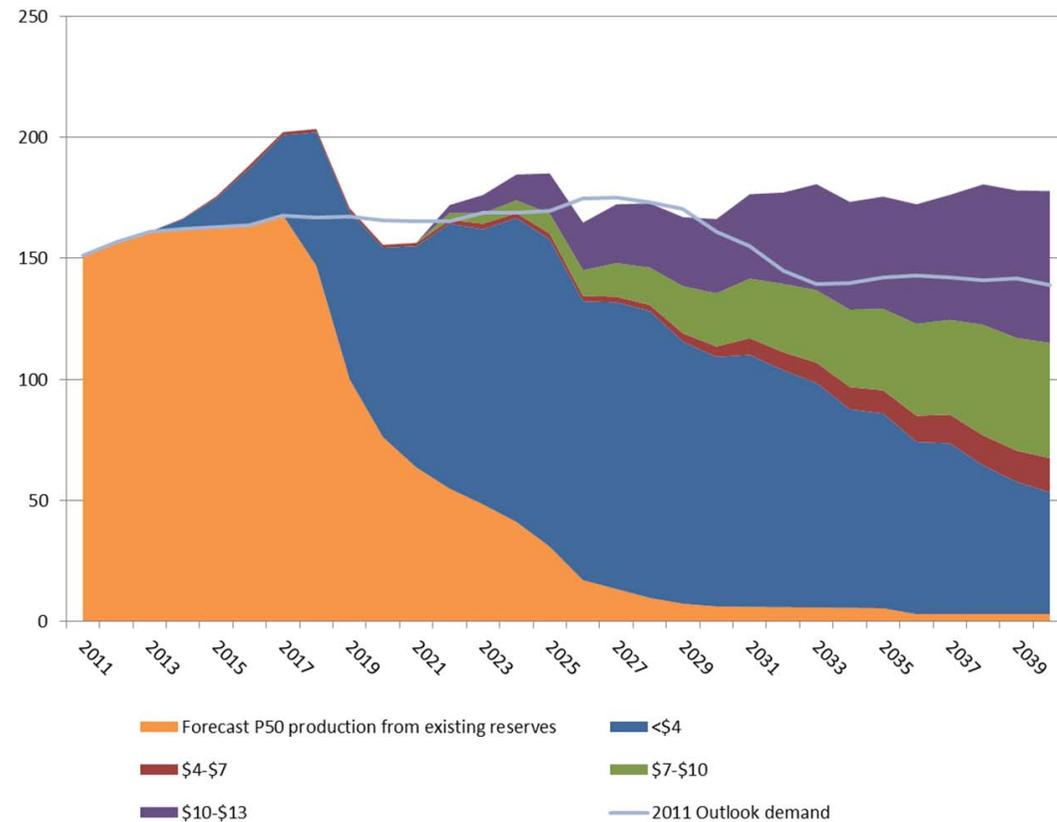
GAS

P50 resource estimates balance potential supply and demand...

Balanced scenario (P50) for gas production:

- Supply and demand well balanced
- Gas prices stay near current levels until the mid 2020s
- Energy Outlook assumes methanol production ceases in the late 2020s because of more expensive gas

P50 Potential Gas Production(PJ)

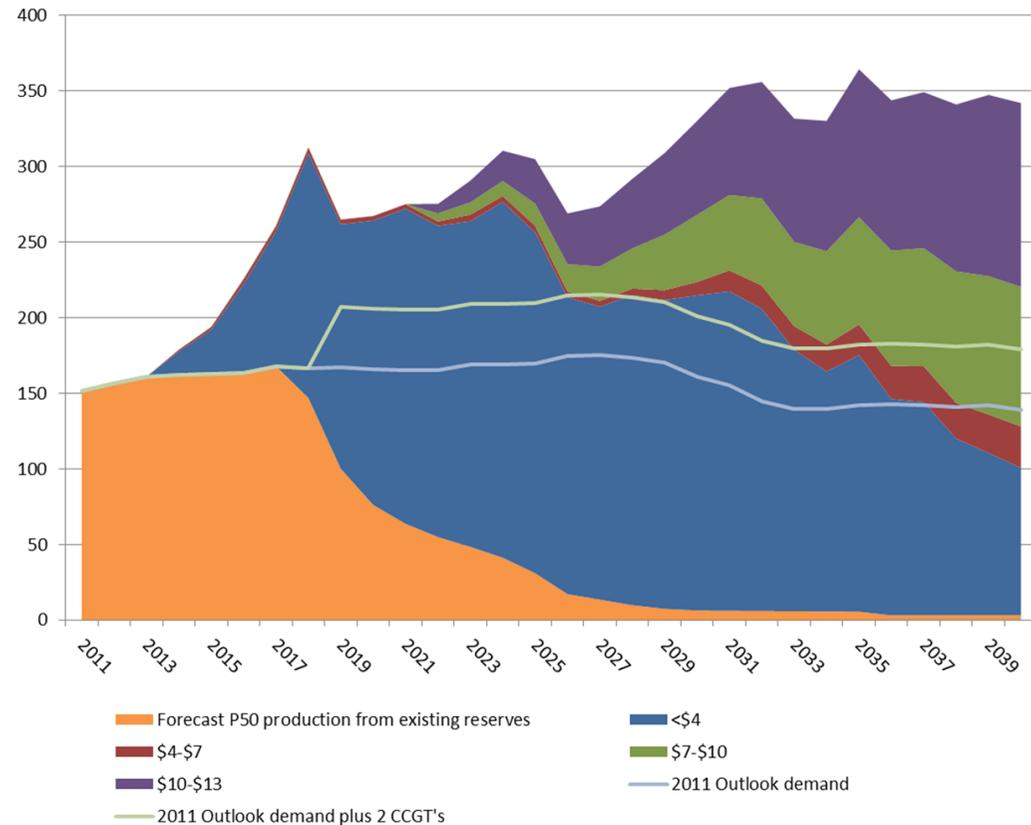


P10 resource estimates could mean LNG exports...

Optimistic scenario (P10) for gas production:

- Potential supply exceeds demand
- Plenty of gas available with a break-even price lower than current wholesale price
- Economics of CCGTs look favourable
- Note chart excludes 'LNG' size discoveries

P10 Potential Gas Production - Excludes Exports (PJ)

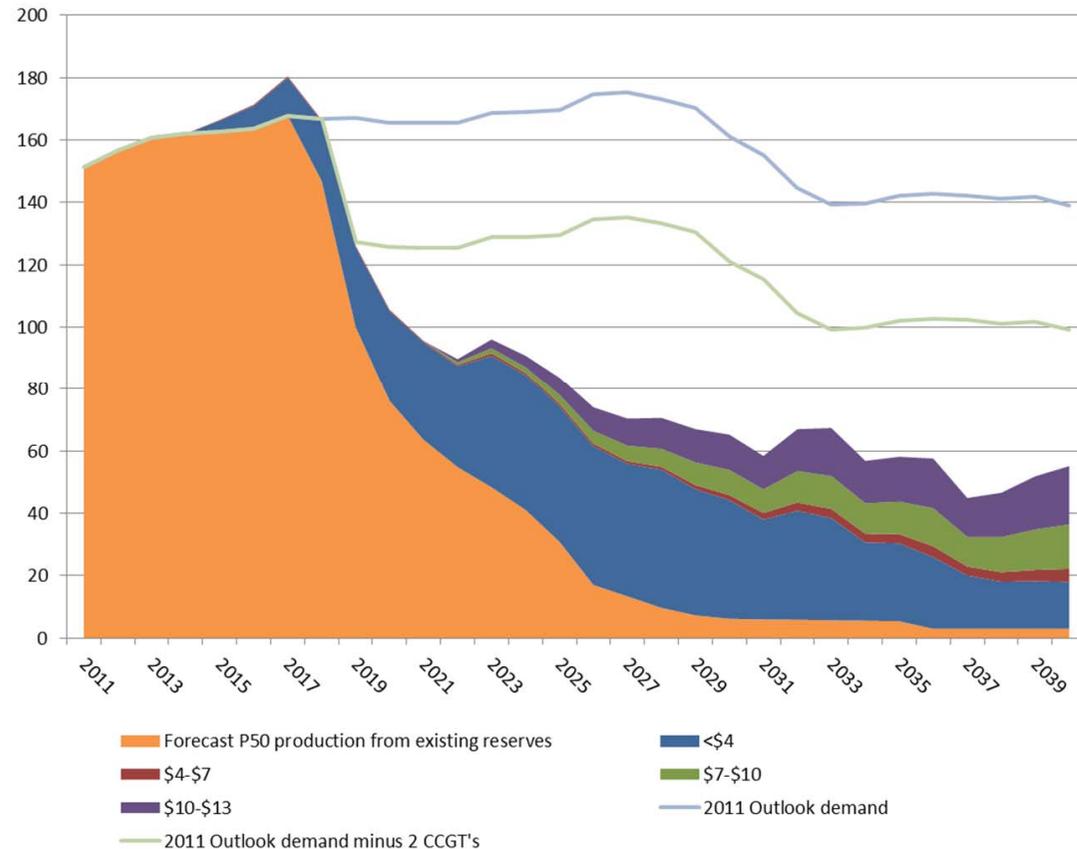


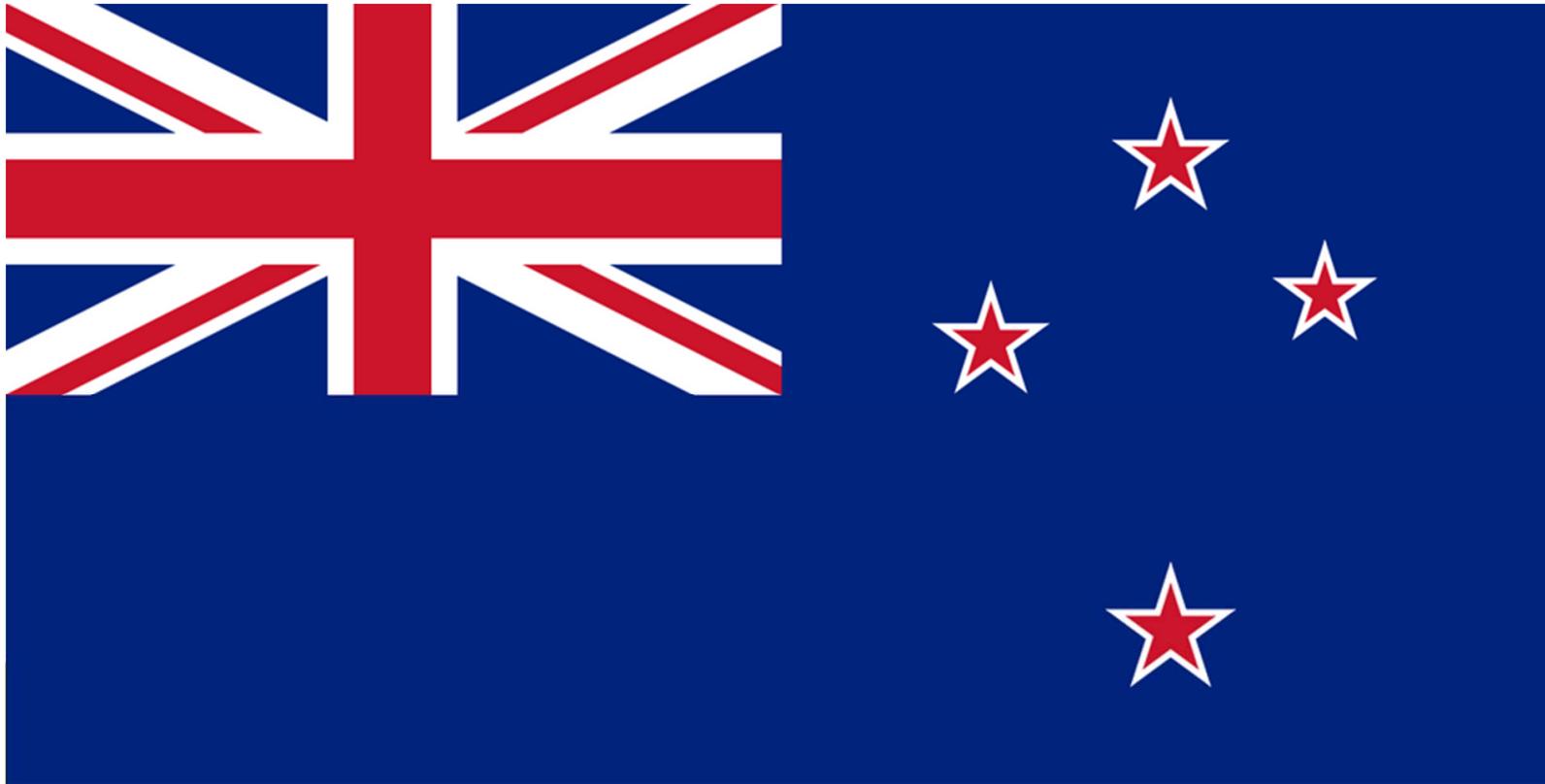
P90 resource estimates would mean big changes for gas...

Pessimistic scenario (P90) for gas production:

- Supply not enough to meet demand
- Would mean retirement of gas-fired electricity plant
- Methanol production no longer possible

P90 Potential Gas Production (PJ)





Working for the state



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Being a public servant

The public service is politically neutral



What is "political neutrality"?

- Political neutrality is about public servants doing their jobs professionally and without favouring one political party over another. This is important for the maintenance of trust in the institutions of government, and it allows government business to continue regardless of which party is in power.
- The political neutrality principle does not mean you can't take a personal interest in politics. It does mean that you must "keep your job out of politics and politics out of your job".

Can a public servant be politically active?

- Outside work, you are free to take an active interest in political matters. In the great majority of cases, it is acceptable for you to belong to, and to play an active role in, a political party. But remember to "keep your job out of politics and politics out of your job".
- Although public servants have the same rights of political expression outside the workplace as ordinary members of the public, they need to be politically neutral at work.
- It is not appropriate to use work premises or resources for party political purposes.
- Public servants are entitled to stand for election to Parliament but must let their managers, chief executive or board chair know as soon as the decision is made to stand.

<http://www.ssc.govt.nz/election-guidance-2014>



What's it like to work for Central Government



- Get to deal with big picture issues:
 - Grow New Zealand for all
 - Addressing Climate Change – New Zealand's contribution to a global problem.
 - Strategic whole of energy market analysis (rather than looking at the regulatory detail).
- Most 'Policy Advisors' have training in things like:
 - Economics
 - Law
 - Politics
- But don't let that stop you! 'Energy Analysts' get to do the fun work anyway!



That's all folks!

For more info:

- Visit our webpage

<http://www.med.govt.nz/sectors-industries/energy/energy-modelling>

- Email

energyinfo@med.govt.nz

The screenshot displays the website for the Ministry of Business, Innovation & Employment (Med.govt.nz). The header includes the ministry's name in English and Māori, the tagline 'Economic Development Information', a search bar, and social media links. The main navigation menu features 'Sectors & Industries', 'Business', 'Have your say', and 'News & media centre'. The current page is 'Energy data and modelling', with a breadcrumb trail: 'Home > Sectors & industries > Energy > Energy data and modelling'. A left-hand sidebar lists navigation options: 'Energy data and modelling', 'Data', 'Modelling', 'Energy publications', 'Technical papers', 'Questionnaires', and 'Contact energy information and modelling team'. The main content area is titled 'Energy data and modelling' and features a large graphic for 'ENERGY MODELLING' with the subtitle 'Modelling of energy supply demand information'. Below this are six category tiles: 'COAL', 'OIL', 'GAS', 'RENEWABLES', 'ELECTRICITY', and 'GREENHOUSE GAS EMISSIONS', each with a 'Read more...' link. A 'GET THE LATEST' section highlights 'Fuel price information'. At the bottom, there is a 'Latest publications' section for the 'New Zealand Energy Quarterly' dated 19 June 2014, and a 'Technical papers' section.



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