New Zealand's Energy Outlook 2009/2010

Hydrocarbon Harvest

What if New Zealand finds a lot of oil and gas?

Welcome

The *Reference Scenario* article released in September 2009 highlighted several challenges if we continue along a "business as usual" path. Among those challenges was New Zealand's continuing dependence on imported oil and the prospect of further electricity price rises.

In the *Reference Scenario* New Zealand's reliance on imported oil continues to increase due to a modest rate of new discoveries and ongoing increases in demand, particularly for transport. Oil prices are also on the rise, which exacerbates the economic burden of financing ever increasing oil bills.

New Zealand has historically had a more than sufficient gas supply from Taranaki fields, particularly Maui, which has seen gas grow to account for around a fifth of total electricity generation. A relatively cheap and flexible gas supply has helped to contain electricity prices and maintain security of supply. However, in recent years the gas supply outlook has deteriorated with the decline of the Maui gas field, causing gas prices to rise. The *Reference Scenario* assumes only modest new finds in the Taranaki Basin, resulting in the gas price increasing as supply tightens. This contributes to an increasing wholesale electricity price as more expensive renewable generation is built to meet electricity demand growth.

The alternative scenarios in this article focus on potential indigenous gas and oil resources and how development of these may help address the challenges set out in the Reference Scenario. The scenarios attempt to paint a balanced picture, noting that while there is potential to further develop our petroleum basins there is also considerable uncertainty in what quantities of oil and gas may be discovered, and the consequential price impacts.

This article considers three alternative "sub-scenarios" covering varying levels of future oil and gas discoveries, their location, and the associated impact on the domestic gas price:

- **Target Taranaki**: additional discoveries in the Taranaki basin suppress gas prices and enable more gas-fired electricity plant to be built compared with the *Reference Scenario.* The gas discoveries are too small to be exported but are large enough to meet domestic demand.
- **Southern Strike:** large quantities of oil and gas are found in the Great South Basin (GSB). The distance from existing infrastructure combined with the size of the finds results in all the gas and oil being exported and does not directly affect the domestic energy market. However, the associated royalties and tax revenues lead to an increase in GDP and the exchange rate, which have an indirect effect on energy demand and capital investment costs.
- **Gas Shortage:** lower levels of domestic gas production result in gas prices rising to a level reflecting the scarcity of the resource. This leads to a significant reduction in gas demand.

Key messages

> Additional gas finds in the Taranaki region could restrain wholesale electricity price increases for the next 20 years. Prices are up to 10% lower than in the *Reference Scenario* for most of the 2020s.

> Development of Deepwater Taranaki could see an extended period of lower electricity prices if the discoveries are not exported.

> Large oil discoveries in the Great South Basin could see New Zealand become a net exporter of oil for the 2020s as well as bringing in substantial royalty and tax revenues.

> To achieve a more permanent improvement in New Zealand's oil security, there needs to be ongoing investment in exploration of our petroleum basins, coupled with efforts to reduce oil demand.

> If there is a gas shortage, there would also be upward pressure on electricity prices. However, the availability of renewable generation options mitigates the potential electricity price rises.

Want a closer look?

For detailed data visit
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Net Oil Import Dependency is the ratio of net imports[1] to consumption. It is often used as an indicator of oil security as it shows how reliant a country is on oil imports to meet local demand. This ratio can be improved (i.e. made smaller) by either reducing demand or increasing local production.

Since 1990, New Zealand's Net Oil Import Dependency has experienced two periods of significant improvement. Firstly, in 1996 as production from the Maui field increased markedly and then from 2006 as production from the Tui, Pohokura and Maari fields began.

In the *Reference Scenario* New Zealand's Net Oil Import Dependency increases from record low levels back to record high levels post 2030 (>90% dependency). Production from the Tui, Pohokura, Maari and Kupe fields tapers off relatively quickly and there is modest production of 7 million (m) barrels per annum from "new" discoveries. Demand for oil, particularly diesel, also continues to grow strongly.

Under the *Target Taranaki* scenario we discover a further 100m barrels of recoverable oil reserves (additional to the 190m barrels in the *Reference Scenario*) in two fields around the sizes of Maari or Tui. Over 80% of the additional production is concentrated over the 2014-2024 period, which results in oil dependency improving to 40% in 2017. However, with ongoing demand increases, oil dependency would steadily increase thereafter, eventually rising to over 80% by 2030 (in line with the level seen in the *Reference Scenario*).

In the *Southern Strike* scenario a further 800m barrels of recoverable reserves are discovered in three large fields in the Great South Basin (GSB).[2] Around 90% of the resulting production is concentrated over the 2020–2035 period, which results in New Zealand becoming a net exporter of oil from 2021 to 2030. If there are no further large discoveries, then by 2040 oil dependency steadily rises towards 75%, approaching the *Reference Scenario*.

The *Southern Strike* scenario requires increased exploration activity in the GSB over the next few years. If this exploration activity could be maintained and expanded into other frontier basins, then it is possible that New Zealand could be a net exporter for several decades. Analysis by GNS Science suggests that there are perhaps another five frontier basins[3] with oil potential of a similar magnitude to GSB.

Trends in other countries would suggest that one major discovery will lead to increased interest (from oil companies) in that region. An individual gas or oil field is part of a wider "petroleum system" which often has several potential gas or oil fields. In New Zealand, the Taranaki region is a good example where there appears to be several petroleum systems.

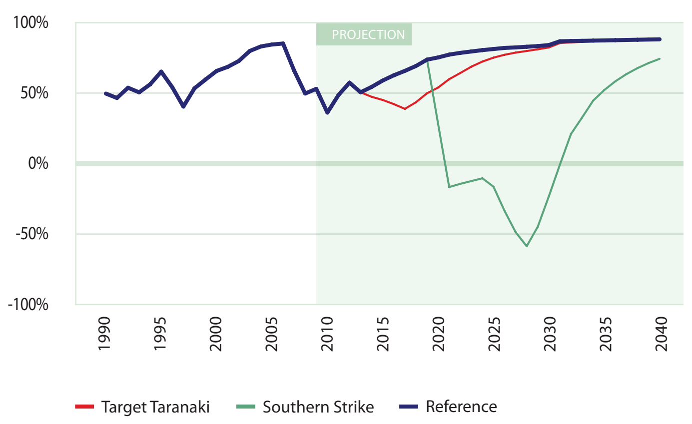
However, there are high risks surrounding oil exploration due to the uncertainty of discovering commercial quantities of oil and gas and the high costs associated with exploration. The large finds sought in the *Southern Strike* scenario are classified as "P10" by GNS Science, which means there is a 90% probability that the discoveries will be less than assumed.

Both the *Southern Strike* and *Target Taranaki* scenarios display the temporary nature of oil production and the associated royalties and tax revenues. These short–term rises in wealth provide an opportunity for government to invest in the long–term prosperity of the country. Many resource rich countries have set up investment funds as a way of managing this temporary wealth. One example is the Norwegian Government's Pension Fund, which currently has a value equivalent to around NZ$100,000 per capita.[4]

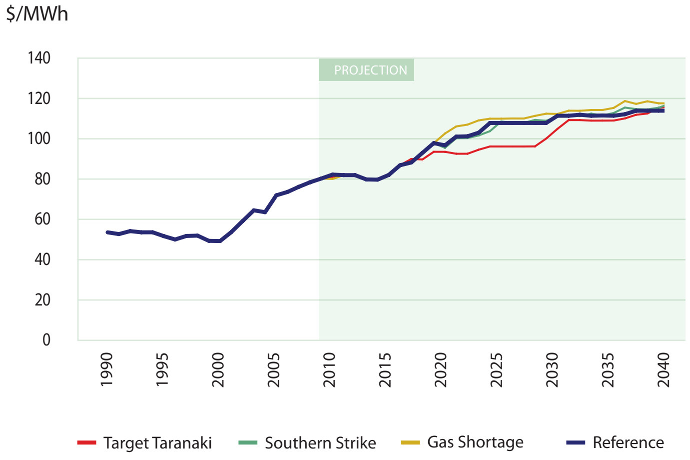
Wholesale Electricity Price forecasts reflect the long run marginal cost (LRMC) of new generation projects. The LRMC represents the return a generator must earn to cover the costs of building and running new power stations. In the *Reference Scenario* most new baseload generation[5] is forecast to be renewable (geothermal, wind and hydro).

Target Taranaki results in the lowest price trajectory with wholesale electricity prices around 10% lower than the *Reference Scenario* for most of the 2020s decade. This results from gas prices which are on average 14% lower than in the *Reference Scenario* over the 2020s

Net Oil Import Dependency



Wholesale Electricity Prices



1 Net imports = imports less exports. In New Zealand's case, although almost 95% of locally consumed oil is imported, our Net Oil Dependency is much lower because of local production, which is mostly exported as it fetches a premium price on the international market.

2 GSB is an offshore area south east of Invercargill. Refer to the Crown Minerals website for a map and further details about GSB and other frontier basins.

3 Deepwater Taranaki, Canterbury, Pegasus, Raukumara and Reinga. Refer to the GNS report available on the MED website.

4 Source: AUPEC report *Evaluation of the Petroleum Tax and Licensing Regime of New Zealand.*

5 Baseload generation refers to generation which runs continuously in order to meet the bulk of New Zealand's demand.

enabling three new (baseload) gas power stations to be built from 2017 to 2025 - two more than in the *Reference Scenario*.[6] The new gas power stations have an LRMC of around $95/MWh which keeps wholesale prices below the $100/MWh level until 2030.

Target Taranaki highlights the importance of having reasonably priced gas available in sufficient quantities and in the right location in order to restrain future electricity price increases. By 2031, wholesale electricity prices are virtually the same as in the *Reference Scenario* because the last gas plant is built in 2025, and thereafter more expensive renewables are required.

In the *Southern Strike* scenario all gas discovered in GSB is exported so there is no direct impact on New Zealand gas prices. Consequently, electricity prices are similar to the *Reference Scenario*, although there are two second order effects which tend to offset each other:

- higher demand stemming from higher GDP growth puts upward pressure on electricity prices (as more expensive renewable plant needs to be built to meet the higher demand), but
- a stronger exchange rate reduces the cost of building new generation plant, which puts downward pressure on prices.

The *Gas Shortage* scenario has only slightly higher wholesale electricity prices than the *Reference Scenario*, despite a very high long run gas price. Renewable generation (wind, hydro and geothermal) replaces much of the high–cost gas–fired generation, which mitigates potential electricity price rises. However, with greater penetration of intermittent wind generation, more flexible "peaking" generation[7] plant will be required to provide back–up when demand is high and the wind doesn't blow.

Primary Fossil Fuel Demand reflects the country's demand for oil, coal and gas.

Fossil fuel demand for *Target Taranaki* is higher than in the *Reference Scenario,* driven chiefly by the commissioning of an additional two gas power stations. The higher gas demand can be met since in this scenario we also discover additional gas near existing infrastructure. However, by 2040 gas production declines back to *Reference Scenario* levels which also reduces the use of gas for electricity generation.

Post 2020, fossil fuel demand for *Southern Strike* increases relative to the *Reference Scenario* due to the higher GDP growth assumption. Much of New Zealand's energy demand is closely linked to economic performance, and in this scenario higher tax and royalty revenues contribute to higher GDP growth.

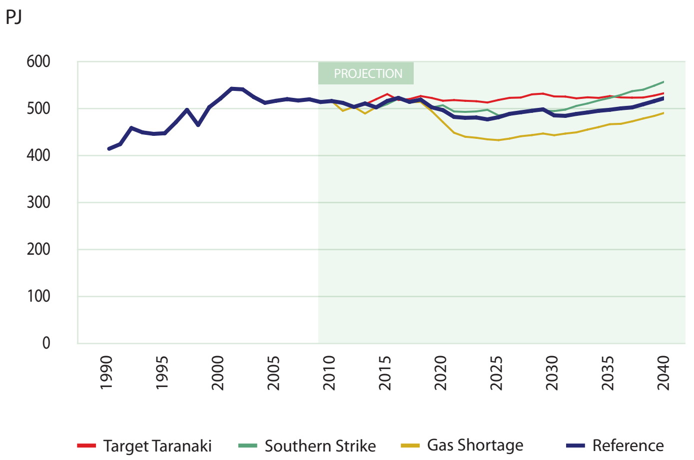
In the *Gas Shortage* scenario there is a steep decline in fossil fuel demand between 2018 and 2025 on the back of increasing gas prices. With higher prices gas–fired generation cannot compete with renewable alternatives, which results in the decommissioning of two gas fired power stations. There are also significant reductions in gas demand from most other sectors.[8]

For all scenarios a steady rise in oil demand continues throughout the forecast period.

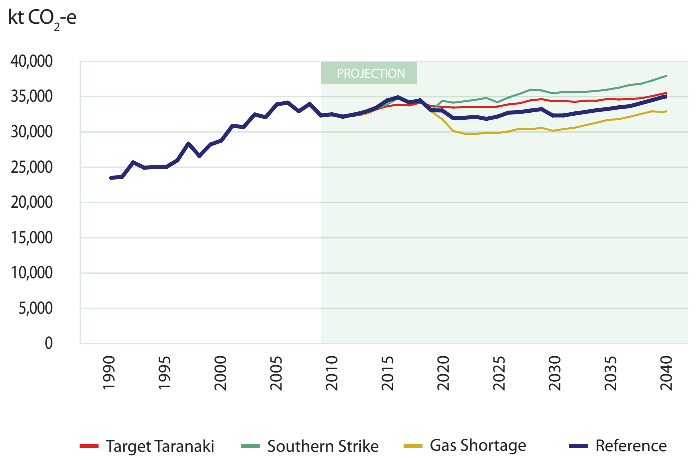
Trends in **Energy Sector Greenhouse Gas Emissions** for the *Gas Shortage* and *Target Taranaki* scenarios broadly follow the fossil fuel demand trends. However, in the *Southern Strike* scenario, emissions begin to increase from 2020 due to the extraction and processing of large quantities of oil and gas. Energy is required to extract and process oil and gas, so a portion of the oil or gas being extracted is consumed on–site and produces emissions. By 2030, *Southern Strike* emissions are around 10% (3m tonnes) higher than the *Reference Scenario*.

With higher levels of gas–fired electricity generation, emissions in *Target Taranaki* are slightly higher (~4%) than in the *Reference Scenario.* The *Gas Shortage* scenario has the lowest level of emissions due to much lower gas consumption (3% lower emissions than the *Reference Scenario*).

Primary Fossil Fuel Demand



Energy Sector Greenhouse Gas Emissions



[6] The three plant built are. Otahuhu C (407MW, which is also built in the *Reference Scenario* in 2025 to replace Stratford), Rodney (240MW) and Taranaki (200MW).

[7] Peaking generation can be called on at short notice to meet sudden increases in demand (or reductions in supply). Examples are hydro, the Whirinaki diesel station and Contacts new gas–fired peaker in Taranaki.

[8] Refer to assumptions section for further details.

Electricity demand for *Target Taranaki* is slightly lower than in the *Reference Scenario* despite electricity prices being substantially lower over the 2020-2030 period. The main influence here is the relatively lower gas price, which encourages some demand switching from electricity to gas. Over this period *Target Taranaki* gas prices are around 14% lower than in the *Reference Scenario*, while electricity prices are around 9% lower.

As expected, there is a substantial increase in gas-fired generation for *Target Taranaki* with an additional two (baseload) gas power stations built compared with the *Reference Scenario*. Gas-fired generation in 2025 is over 50% higher than in the *Reference Scenario*, making up around a quarter of total generation. There are corresponding decreases in generation from geothermal, wind, hydro and some coal. However, by 2040 gas generation is only 20% higher as wholesale gas prices rise to $13/GJ, which reduces the usage of gas in the existing generation stations and increases renewable generation.

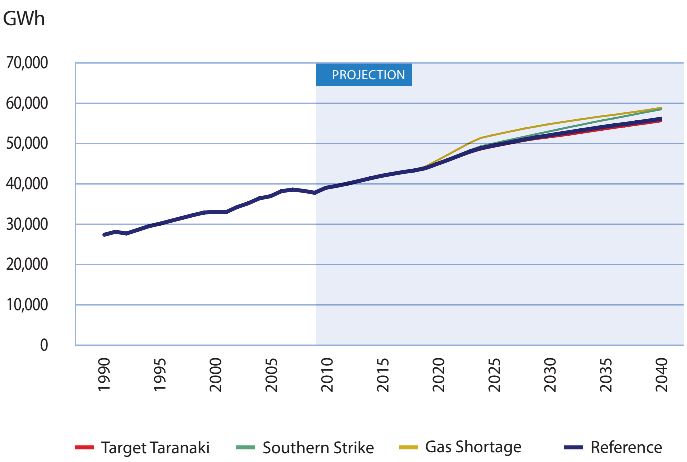
Electricity demand for *Southern Strike* is just over 4% higher than the *Reference Scenario* by 2040, reflecting the higher GDP growth assumption.

The exchange rate is also assumed to appreciate by 10% in *Southern Strike*, which reduces the cost of building new power stations (as most materials are sourced from overseas). This improves the relative economics of renewable projects since they have a greater upfront capital cost than gas turbines. The key result is that the 407MW gas-fired power station built in 2025 in the *Reference Scenario* is not built in *Southern Strike*. This is an interesting outcome given that in this scenario New Zealand has an abundance of gas and oil but is not using it domestically, i.e. New Zealand is better off exporting gas and taking advantage of the strong exchange rate to invest in renewable generation projects.

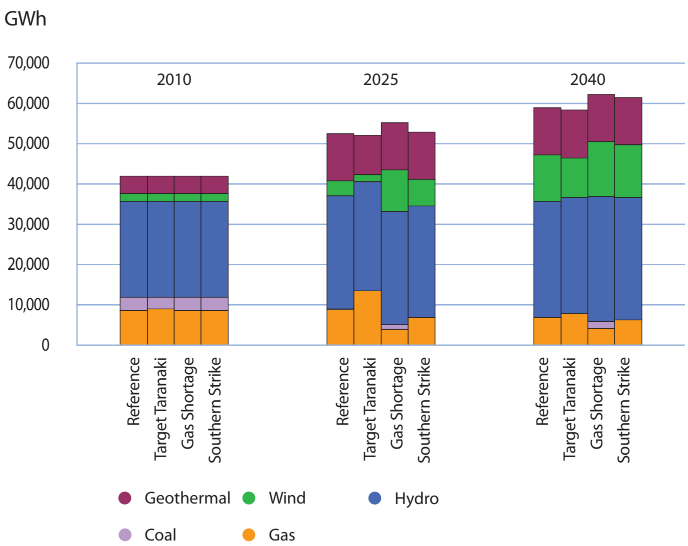
In the *Gas Shortage* scenario there is an increase in electricity demand from 2020, which reflects the switching of some direct use gas customers to electricity (and some to coal). Gas demand decreases over this period as current domestic gas sources are depleted and new gas contracts begin to be written at much higher prices. By 2040, electricity demand is 4% higher than in the *Reference Scenario*.

The *Gas Shortage* scenario also sees a nearly 60% decline in gas-fired generation by 2025 with two power stations decommissioned five years earlier than we assume in the Reference scenario.[9] The fall in gas-fired generation, in combination with the overall electricity demand increase, sees substantial increases in wind and hydro generation, as well as a CCS (Carbon Capture and Storage) coal plant built in 2040. By 2025 this scenario achieves a 90% renewable generation mix.

Electricity Demand



Electricity Generation by Fuel



% Renewable Electricity Generation

Scenario	2010	2025	2040
Reference	71%	82%	87%
Target Taranaki	71%	73%	85%
Gas Shortage	71%	90%	90%
Southern Strike	71%	86%	89%

[9] There is only one baseload gas station operating in 2025 in the *Gas Shortage* scenario compared with three in the *Reference Scenario*. No changes to cogeneration plant assumptions were made in this scenario.

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This section covers the direct use of energy by final consumers. It does not include gas used for "transformation" into other energy sources (e.g. electricity generation or methanol production).

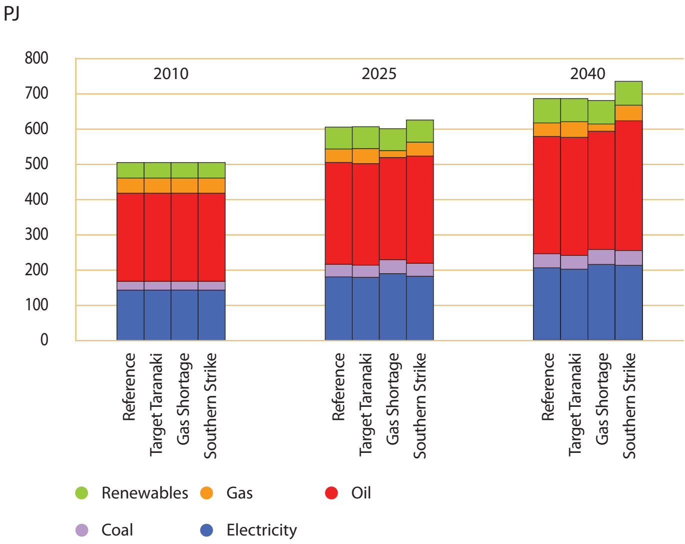
Under *Target Taranaki* there is more local gas available from 2017 and lower gas prices (relative to the *Reference Scenario*), which results in an increase in the direct use of gas by residential, commercial and industrial customers. The direct use of gas in *Target Taranaki* is around 10% (~4PJ) higher than in the *Reference Scenario* in both 2025 and 2040, offsetting some electricity and coal demand.

Southern Strike total energy demand is 7% greater than in the *Reference Scenario* by 2040, reflecting the higher GDP growth assumption. The increased demand has been distributed across all fuel types although most of the growth comes from oil.

With the higher GDP growth in *Southern Strike*, diesel use in land transport is 18% higher than the *Reference Scenario*. This is because most diesel used for transport is in commercial sectors which are closely aligned to the economy. The increased diesel demand accounts for just over half of the total consumer demand increase by 2040.

The demand for gas by residential, commercial and industrial customers in *Gas Shortage* is nearly 50% lower than the Reference Scenario in 2025 and 2040. The decline is largely offset by increases in electricity and coal demand, with total consumer demand around 1% lower in 2040.

Total Consumer Energy Demand by Fuel



Explaining Oil Reserves

Oil or gas reserves are the amount estimated to be commercially recoverable by current technology.

***Proved reserves** have a reasonable certainty of being recovered under existing economic and political conditions, with existing technology. Proved reserves are commonly referred to as P90 (i.e. having a 90% certainty of at least that volume being recovered) or 1P.*

***Unproved reserves** have technical uncertainties which prevent them from being classified as proved. They provide an "upside" on the P90 proved reserves, and are sub–classified as **probable** and **possible**.*

***Probable reserves** have a 50% certainty of at least the specified volume being recovered, and are commonly referred to as P50 or 2P. New Zealand's current oil and gas reserves, quoted in the MED's Energy Data File (Section H), are Proved and Probable reserves (P50 or 2P).*

***Possible reserves** have a less likely chance of being recovered than probable reserves. Usually referred to as P10 (or 3P), these reserves are claimed to have at least a 10% certainty of being produced.*

Refer to the Society of Petroleum Engineers' website for a more technical definition of these terms: www.spe.org/industry/reserves/docs/Petroleum_Resources_Management_System_2007.pdf

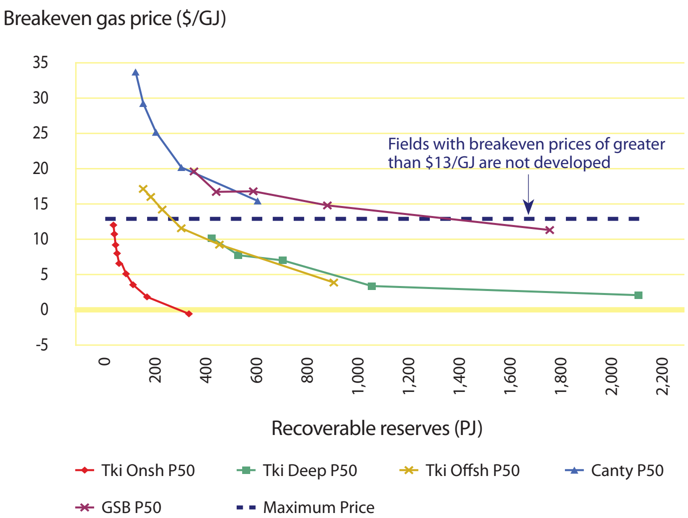
This section outlines some of the background analysis performed to help develop these scenarios. It uses data from 3 reports produced as part of the government's work programme on Maximising New Zealand's Petroleum Potential:[10]

- GNS Science: *Potential Undiscovered Oil and Gas Resources of New Zealand*
- Michael Adams Reservoir Engineering: *Production and Cost Estimates for New Zealand's Petroleum Resources.*
- AUPEC: *Evaluation of the Petroleum Tax and Licensing Regime of New Zealand.*

Using the data from these reports, we have developed a gas field cost model, which estimates the "break–even" gas price that would be required in order for a particular gas field to be economic. This model then uses the GNS estimates of potential resource and associated probabilities to calculate a distribution of gas prices for various sized fields.

The model has been used to help develop our scenario assumptions around discovery levels. To date we have only modelled the three Taranaki basins (Onshore, Offshore and Deepwater), Canterbury and GSB. The model will be extended to other basins as information becomes available.

An example of the cost model output is provided in the chart below, which shows the results when using the "P50" GNS estimates. Taking the Deepwater Taranaki basin as an example, we can see there are 5 potential fields (i.e. the 5 points on the line). The smallest field, at just under 500PJ, has a break even gas price of just over $10/GJ. The largest field, at just over 2000PJ, has a break even gas price of around $2/GJ. It is also interesting to note that in Onshore Taranaki, where capital development costs are much lower than the offshore areas, the largest field actually has a negative break–even gas price, i.e. the field makes an economic return based solely on the oil revenue.



The following table sums the reserves for all the fields where the break–even gas price is below $13/GJ. For example, at the P50 level, we estimate there is 970PJ available in 10 Onshore Taranaki fields, and 1656PJ available in three Offshore Taranaki fields.[11]

Estimated Recoverable Gas Reserves (PJ) by Basin*

(only includes fields with a breakeven gas price of less than $13/GJ)

	Tki Onsh	Tki Offsh	Tki Deep	Canty	GSB
P90	431	489	959	0	0
P50	970	1656	4811	0	1756
P10	2278	3574	15981	2007	11497

The levels of exploration activity are also a key factor to consider. Using AUPEC's 10% success rate (oil or gas) for exploratory wells in Offshore Taranaki, and a 50% probability of gas (versus oil), then you would need to drill on average 21 wells in Offshore Taranaki before a successful gas find.

The more exploratory wells that are drilled each year, the sooner you can expect to find the potential resource. For example, if you drilled one hole per year in Offshore Taranaki, it would take 125 years to find the entire P50 resource (of 1656PJ). However, if you drilled 5 wells per year it would take only 25 years.

Impact of Exploration Activity on Gas Discoveries

	Tki Onsh	Tki Offsh
Average # of wells drilled before technical success	7	21

# of years to discover entire P50 resource	Tki Onsh	Tki Offsh
1 wells per year per basin	71	125
3 wells per year per basin	24	42
5 wells per year per basin	14	25

In order to discover 2,400PJ for the Reference Scenario before 2040, you would need to drill around 8 exploratory wells per year (5 in Onshore and three in Offshore Taranaki). In the *Target Taranaki* scenario you would probably need to drill a further 4 wells each year up until 2030 (5 Onshore and 7 Offshore until 2030 when the focus shifts to Deepwater). Over the last 5 years there have been an average of 12 exploration wells drilled each year in the Taranaki region.

The following observations relate to the scenarios:

- There is sufficient "P50" potential in Onshore and Offshore Taranaki to meet the 2,400PJ of new gas discoveries required in the Reference Scenario.
- At the P50 level, the 3,400PJ required for *Target Taranaki* relies on increased offshore drilling activity, leading to the development of Deepwater Taranaki sometime around 2030.
- Once the Deepwater Taranaki region is accessed, there may be 4,811PJ of economic reserves at the P50 level. This suggests that even more gas–fired electricity stations could be built in the *Target Taranaki* scenario (post 2025), which would enable electricity prices to be restrained for longer.
- An alternative path for the *Target Taranaki* scenario is P10 discovery levels in Onshore and Offshore Taranaki, which hold potential reserves of 2,278PJ and 3,574PJ respectively. This would not then require any further discoveries from Deepwater Taranaki prior to 2040.
- The *Southern Strike* scenario requires at least P10 discovery levels in the GSB in order to find an LNG sized field (recoverable reserves greater than 5,000PJ).

[10] Refer to: www.med.govt.nz/petroleum-strategy/

[11] Note that these numbers cannot be summed to get a P50 estimate for NZ since probabilities are not additive.

The information included in this article is based on an integrated approach combining modelling from the Supply and Demand Energy Model (SADEM), the Generation Expansion Model (GEM) and the Vehicle Fleet Model (VFM).

This section describes each of the scenarios and summarises the key changes to assumptions from the *Reference Scenario*.

The *Reference Scenario* assumes there is a 100PJ increase in annual gas production from 2017 to 2040. This requires 2,400PJ of new reserves to be discovered between now and the mid–2030s (the equivalent of two Pohokura sized fields). Gas prices are assumed to rise steadily towards a cap of $13/GJ by 2035, with the cap determined by the opportunity cost faced by electricity generators.

The *Reference Scenario* also assumes there is an increase of 6.7 million (m) barrels in annual oil production (due to new discoveries) from 2013. This requires a total of 187m barrels to be discovered between now and the mid–2030s. To put this into context, historical average oil discoveries are 8.7m barrels per annum including Maui, or 5.5m excluding Maui.

The section on Modelling Gas Discoveries provides more information on the analysis used to help establish assumptions around discoveries in each of the cases below.

Target Taranaki

A further 1,000PJ of gas (nearly the size of Pohokura) is discovered in the Taranaki basins, which allows annual production to be 40PJ higher than in the *Reference Scenario* from 2017 to 2040.

In the *Reference Scenario* it is assumed that only one more gas station can be built (407MW at Contact's Otahuhu C site) due to gas supply constraints. In *Target Taranaki* another two stations can be built: 240MW at Rodney (Genesis) and 200MW in Taranaki (Todd). There is also a nearly 10% increase (~4PJ) in the direct use of gas by residential, commercial and industrial customers (from 2020), which is offset by decreases in electricity and coal demand.[12] Methanol production is extended two years further than in the *Reference Scenario*, with production now ceasing in 2016.

Gas prices are suppressed for a while longer with the peak price of $13/GJ achieved in 2040 (2035 in the *Reference Scenario*).

In this scenario we also discover a further 100m barrels of oil (additional to the 190m in the Reference Scenario) in two fields around the sizes of Maari or Tui. The first 50m barrel discovery begins production in 2014, and the second in 2016. Production begins at a relatively high level then tapers off, with over 80% of the production concentrated over the 2014–2024 period.

The oil and gas discovery levels can be considered as 'P50' providing that Deepwater Taranaki is also developed.

Greater levels of exploration activity are also required in this scenario, especially over the next few years given the long lead–in times to develop offshore gas and oil fields.

We assume there are no substantial (economic) oil or gas finds in other frontier basins such as Great South Basin (GSB) or offshore Canterbury.

Southern Strike

A gas field with recoverable reserves of at least 5,000PJ is discovered in the Great South Basin (GSB). All gas produced is exported as LNG from an onshore LNG terminal somewhere near Invercargill. The distance between the export terminal and existing North Island gas infrastructure means that only Taranaki gas fields continue to supply the New Zealand market.

This scenario also requires greater levels of exploration activity, but with resources focused on developing the GSB, the Taranaki region is not developed to the same extent as we assume in *Target Taranaki*. The result is that gas available for domestic usage, and the domestic price, is unchanged from the *Reference Scenario*.

Three large oil fields with combined recoverable reserves of at least 800m barrels are also discovered in the GSB. The largest field has reserves of nearly 450m barrels (about nine times the size of Tui) and begins production in 2020. Two smaller fields begin production in 2025 and 2027 respectively. Around 90% of the resulting production is concentrated over the 2020–2035 period. These discoveries reduce New Zealand's net oil dependency, but have no *direct* effect on the domestic energy market.

These four large gas and oil discoveries could earn New Zealand royalties and tax revenues in excess of $60billion over the life of the fields. As a result, we assume that annual GDP growth is 0.75% higher than the Reference Scenario from 2020 onwards, and that the US/NZ exchange rate appreciates by 10%. These are assumptions and are not the results of any macroeconomic modelling[13].

This scenario represents "P10" quantities of oil and gas based on analysis by GNS.

Explaining the $13/GJ Price Cap

Electricity companies have a range of potential generation projects to choose from, each with their own unique characteristics and risks. After 2020, it is assumed that the LRMC (long run marginal cost) of renewable projects, primarily wind, are in the $100/MWh to $120/MWh range. The implication is that any company running a gas–fired station would only be willing to pay up to $13/GJ for gas, because at higher gas prices investment in renewable generation is more economic.

[12] In the *Reference Scenario* the direct use of gas was reduced (and substituted with electricity and coal) in order for demand to be less than or equal to the constrained gas supply. With more gas available in the *Target Taranaki* scenario we are able to partially reverse this adjustment

[13] Other export focused sectors such as dairy, forestry and agriculture may be adversely affected by the exchange rate appreciation, but this has not been incorporated into these energy demand forecasts.

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Gas Shortage

In this scenario there is a 40PJ reduction in annual gas production when compared to the Reference Scenario. This implies new discoveries of around 1,400PJ between now and the mid 2030s. The reduced discovery rate could be caused by either:

- lower levels of exploration activity which result in potential gas resources being developed at a slower rate than assumed in the *Reference Scenario*, or
- the discovery of only 'P90' quantities of gas in the Taranaki Basins (the *Reference Scenario* assumes 'P50' quantities).

The gas shortage will result in gas prices rising to a level reflecting the scarcity of the resource. A long run domestic gas price of around $26/GJ is assumed to be reached by 2030, double the *Reference Scenario* price cap of $13/GJ (which is reached in 2035). At gas prices greater than $13/GJ, baseload gas-fired power stations are replaced by more economic renewable alternatives such as wind. Two gas stations are decommissioned five years earlier than in the *Reference Scenario:* Stratford in 2020, and Otahuhu B in 2025. However, gas "peaking" stations will pay higher gas prices since other alternatives such as diesel and hydro are also costly.

There is also a ~50% decrease in the direct use of gas by residential, commercial and industrial customers by 2024 which is mostly offset by increases in electricity (and some coal) demand. Methanol production ceases from 2013 and Urea from 2019 (both one year earlier than assumed in the *Reference Scenario*).

Oil production volumes have not been altered in the *Gas Shortage* scenario. GDP and exchange rate impacts have also been ignored.

Whilst domestic gas shortage could be addressed by importing LNG into New Zealand, the future LNG price could be well in excess of the long run *Reference Scenario* gas price of $13/GJ [14]. Given the current views around LNG prices and the cost and availability of renewable projects, investment in an LNG import terminal seems an unlikely proposition.

Average Gas Price ($/GJ incl carbon cost)

Scenario	2010–2020	2020–2030	2030–2040	2040+
Reference	8.10	9.80	12.60	13.10
Target Taranaki	7.80	8.40	10.60	13.10
Gas Shortage	8.80	17.00	26.30	26.30
Southern Strike	8.10	9.90	13.00	13.60

[14] The LNG price forecast in the 2009 World Energy Outlook (www.worldenergyoutlook.org/) is US$15/GJ for imports into Japan. The price faced by NZ consumers would also need to factor in re-gasification facility costs, additional shipping costs, and of course exchange rates.

Authorship
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