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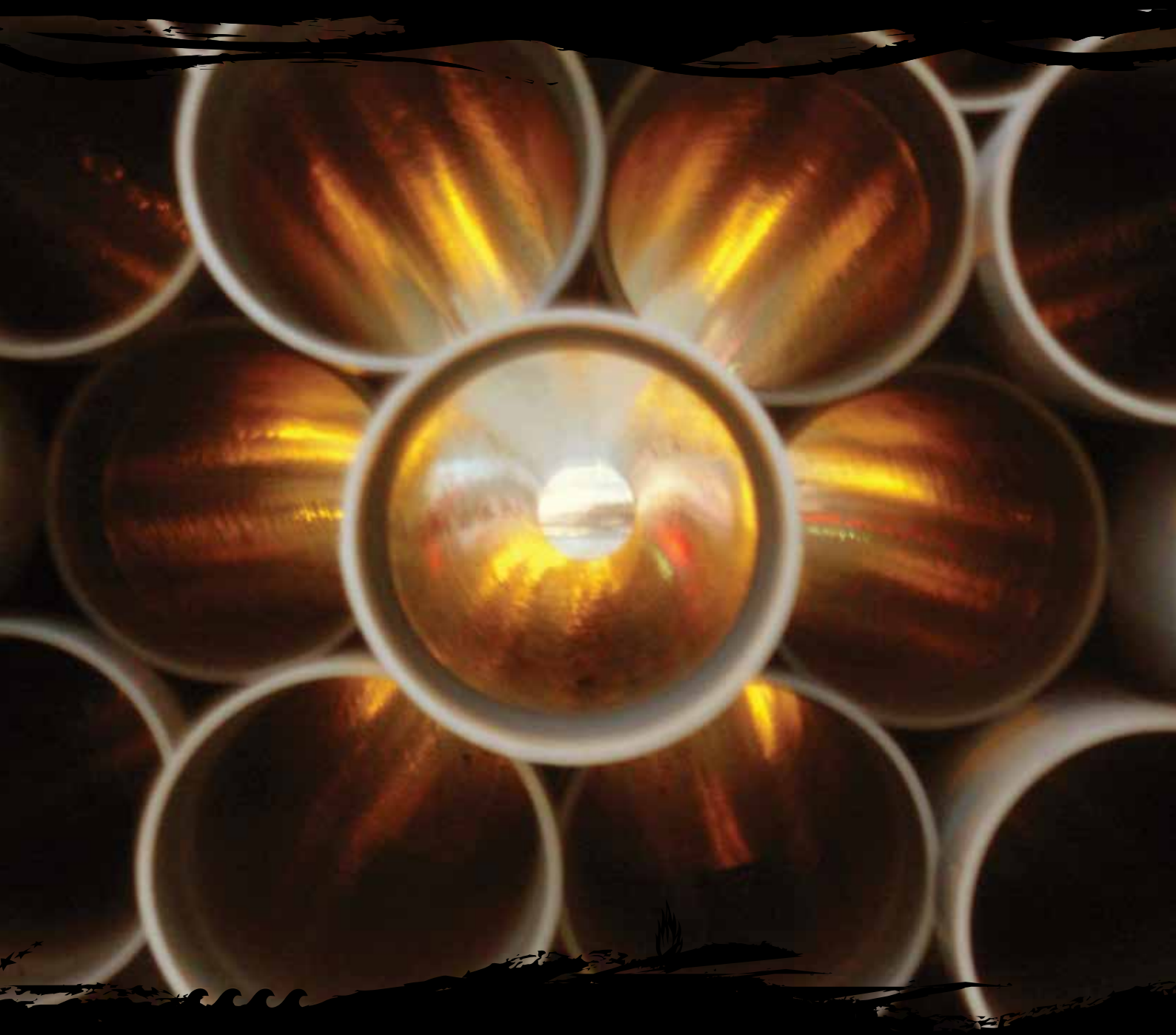

ECONOMIC IMPACT OF HYDRAULIC FRACTURING OF OIL AND GAS WELLS IN NEW ZEALAND

Venture TARANAKI
Te Puna Umanga

Foreword

The goal of economic transformation requires both the careful management of risks and the strategic optimisation of economic rewards.

That the oil and gas industry has risk associated with it, and that this risk largely sits with environmental and health and safety outcomes, is accepted. But what hasn't been fully explored is the flip side – the economic reward the industry can and could contribute.

In 2010 Venture Taranaki, the regional development agency for New Zealand's foremost energy province, released the *Wealth Beneath Our Feet* report, which went a long way towards quantifying the value of the industry in terms of employment, GDP and community economic impact. This report extends that economic analysis to the issue of hydraulic fracturing.

As an independent and apolitical agency, Venture Taranaki has initiated and driven this project under its regional mandate of leading Taranaki's economic growth. The report offers a robust and impartial analysis of the economics behind hydraulic fracturing, and how the outlook may be optimised to deliver maximum benefit to the New Zealand economy.

The Taranaki region's oil and gas reserves have brought global corporate citizens to the province. In doing so, the energy sector and its local supply chains have ensured the region's economic performance has been well ahead of the national curve. On a regional basis our communities understand the risks, and we understand the rewards that come with oil and gas.

We also understand how these rewards can align with national goals of economic transformation. In an industry where a single well strike can add $1 billion onto the nation's balance sheet, the value in optimising the productivity of existing wells cannot be underestimated.

Having hosted the industry in Taranaki for over 150 years, we too understand what it can mean for our ability to provide New Zealand's future generations with a means to have a great job, a great standard of living and that New Zealand remains a fantastic place to live, work and play.

There are perceptions that profits from oil and gas activity in New Zealand disappear offshore or into a central royalties fund, that it employs few New Zealanders, or that the nation does not benefit. Both this report and our earlier *Wealth Beneath Our Feet* have found that this simply isn't the case; both reports confront these perceptions with a balanced economic argument.

The economic rewards from oil and gas extend far beyond royalties. The value that could be added by hydraulic fracturing lies in jobs, innovation, added-value manufacturing, regional growth and greater energy security for our national economy.

Our nation's base load domestic energy demand is around 160-170 petajoules of energy a year. By 2018 New Zealand is forecast to experience a shortfall between demand and supply, which will require either increased imports, new

"In creating this report we have sought to provide a clear, concise and accurate resource to stimulate discussion, inform our nation's communities – both Māori and Pakeha - and our political leaders."

discoveries and/or embracing new technologies that enable the extension of existing fields.

Hydraulic fracturing is one of those technologies, and can help New Zealand meet the energy demands of current and future generations. It extends the economically recoverable levels of energy stored in existing wells and strengthens our ability to manage the potential shortfalls between demand and supply.

We face, and must prepare for an unknown energy future. Ensuring we maximise the efforts and results of existing wells, within a managed risk profile, is critical. In doing that we need to acknowledge that greater short term investment is required to ensure that regional New Zealand shares in the economic prosperity of the nation, and can meet the needs of this industry.

This report analyses three plausible scenarios for hydraulic fracturing in New Zealand; moratorium, expansion, and the status quo. It supports these scenarios with projections out to 2022. Balancing the risk of the current hydraulic fracturing regulatory model is a fiscal reward of $215 million in GDP and 2,000 jobs annually and up to $1.6 billion in royalties over the next decade.

A moratorium on the practice of hydraulic fracturing would minimise any risk, but would also see most of those rewards extinguished.

Conversely, were hydraulic fracturing to become a regulated, consented activity acceptable throughout other regions, then the economic gains could be even greater. On average, GDP could increase by $799 million and an additional 7,400 people would be employed each year. Around 65 percent of this GDP and employment could occur outside the Taranaki region, spreading the benefits across the nation. Royalties paid to central government over the next ten years could reach $4.4 billion.

Whatever our nation's future holds for the practice of hydraulic fracturing, it is critical that we take a view that balances risk and reward. Industry practice in New Zealand should be managed within one of the tightest health, safety and environmental regimes in the global oil and gas industry. The environmental risks need to be heavily assessed and actively managed.

This report informs the national debate and quantifies for the first time the economic benefits that new technologies can deliver in helping to unlock the wealth beneath our feet.

In doing so New Zealand will move closer to fully and safely optimising our natural resources to benefit not just current but future generations of all New Zealanders.

Stuart Trundle
Chief Executive, Venture Taranaki Trust
December 2012

"New Zealand's future will be underpinned by its natural resources. It is critical these resources are carefully managed for future, not just current generations. Economic resources are no different."

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Figures & Tables

Executive Summary

BERL was commissioned by Venture Taranaki to estimate the potential economic impact of hydraulic fracturing of oil and natural gas wells in Taranaki and New Zealand.

This report presents an estimate of future economic activity associated with the production of natural gas, oil and condensates that can be attributable to the ability to incorporate hydraulic fracturing treatments.

The scope of the report is on the economic activity enabled by hydraulic fracturing. The report does not take a position on hydraulic fracturing in relation to the environment.

Approach

The analysis uses a production scenario approach over a ten year period from 2013-2022. There are three scenarios that are compared:

- A low scenario, where a moratorium on hydraulic fracturing is put in place.
- A BAU scenario, where a resource consent is required to undertake hydraulic fracturing treatments as per the current environment but current activity is limited to conventional plays in the Taranaki region.
- A BAU+ scenario, where hydraulic fracturing is accepted as an integral part of oil and gas production throughout New Zealand and can be applied as needed to both conventional and unconventional plays.

All scenarios relate to onshore activity only, which currently accounts for around 28-30 percent of net gas produced in New Zealand.

Production levels under the three scenarios are based on current and historical activity and estimates of likely production under the scenario parameters. These have been developed in discussion with a majority of the oil and gas companies currently operating in New Zealand.

Economic activity

The difference in production between the BAU and the low scenario can be considered the additional activity that is generated as a result of the ability to undertake hydraulic fracturing. A further scenario (BAU+), which includes non-conventional activity (coal seam gas and shale oil), is also included to emphasise the potential benefits that hydraulic fracturing will enable.

This additional activity can be measured in terms of production, and can also be converted to revenues, royalties, GDP and employment.

BAU scenario

Under the BAU scenario, the ability to perform hydraulic fracturing activity could result in the production of an extra 773PJs of gas and an extra 277PJes of oil and condensate over the ten year period 2013 to 2022.[1]

Over ten years, additional production between the low and BAU scenario means extra:

- revenue of $10.5 billion;
- exports of $5.1 billion; and
- royalties of between $1.0 billion and $1.6 billion.

The expenditure required to achieve that extra production would have economic impacts at a national and a regional level.

- For New Zealand, additional expenditure of $190 million each year over the next ten years would contribute $86 million to GDP and employ 761 FTEs annually. Applying multipliers, GDP increases to $215 million and employment increases to 1,986 FTEs annually.
- For Taranaki, additional expenditure of $190 million each year over the next ten years would contribute $86 million to GDP and employ 760 FTEs annually. Applying multipliers, GDP increases to $133 million and

[1] PJe (equivalent).

employment increases to 1,190 FTEs annually.

You could argue that this is the likely GDP, employment, exports and royalties that would be lost if hydraulic fracturing is not allowed.

BAU+ scenario

Under the BAU+ scenario the ability to perform hydraulic fracturing activity could result in the production of an extra 809PJs of gas and an extra 1,293PJes of oil and condensate over the ten year period 2013 to 2022.

Over ten years, additional production between the low and BAU+ scenario means extra:

- revenue of $29 billion;
- exports of $23.7 billion; and
- royalties of between $2.9 billion and $4.4 billion.

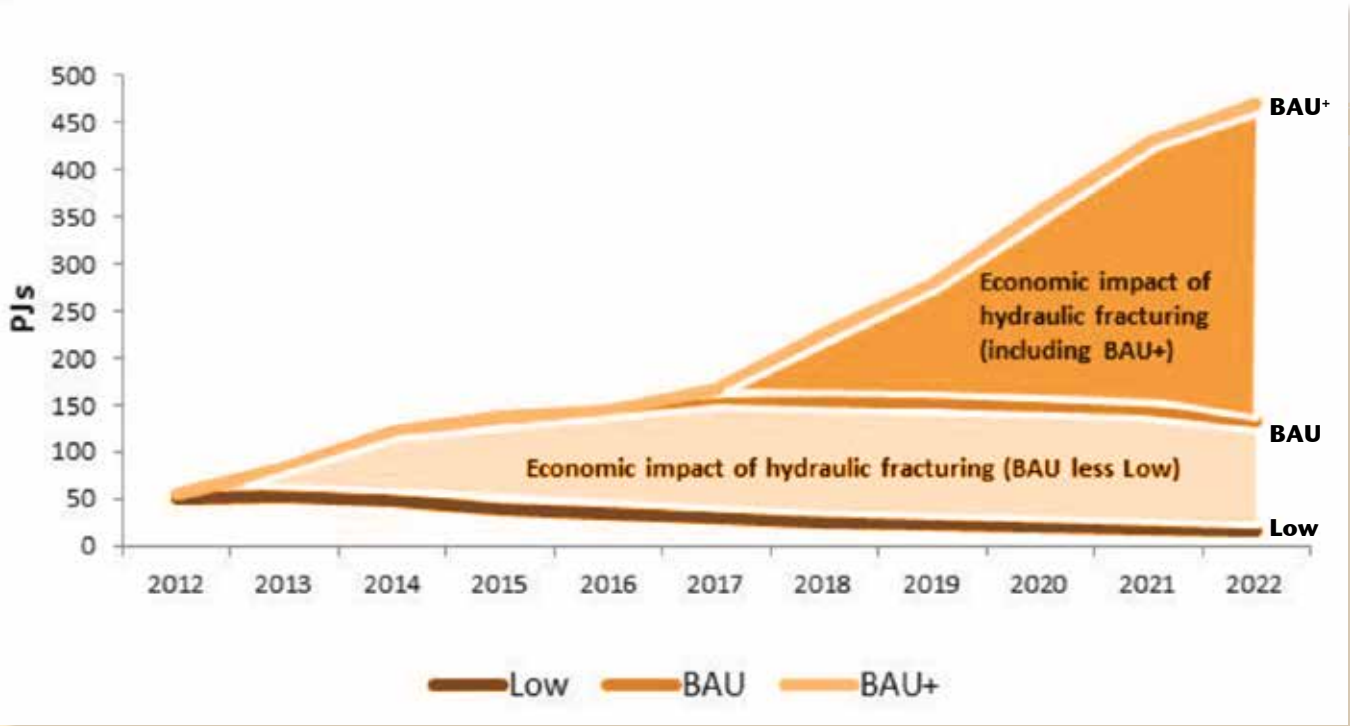
The expenditure required to achieve that extra production would have economic impacts at a national and a regional level.

- For New Zealand, additional expenditure of $705 million each year over the next ten years would contribute $321 million to GDP and employ 2,829 FTEs annually. Applying multipliers, GDP increases to $799 million and employment increases to 7,386 FTEs annually.
- For Taranaki, additional expenditure of $248 million each year over the next ten years would contribute $112 million to GDP and employ 994 FTEs annually. Applying multipliers, GDP increases to $174 million and employment increases to 1,556 FTEs annually.

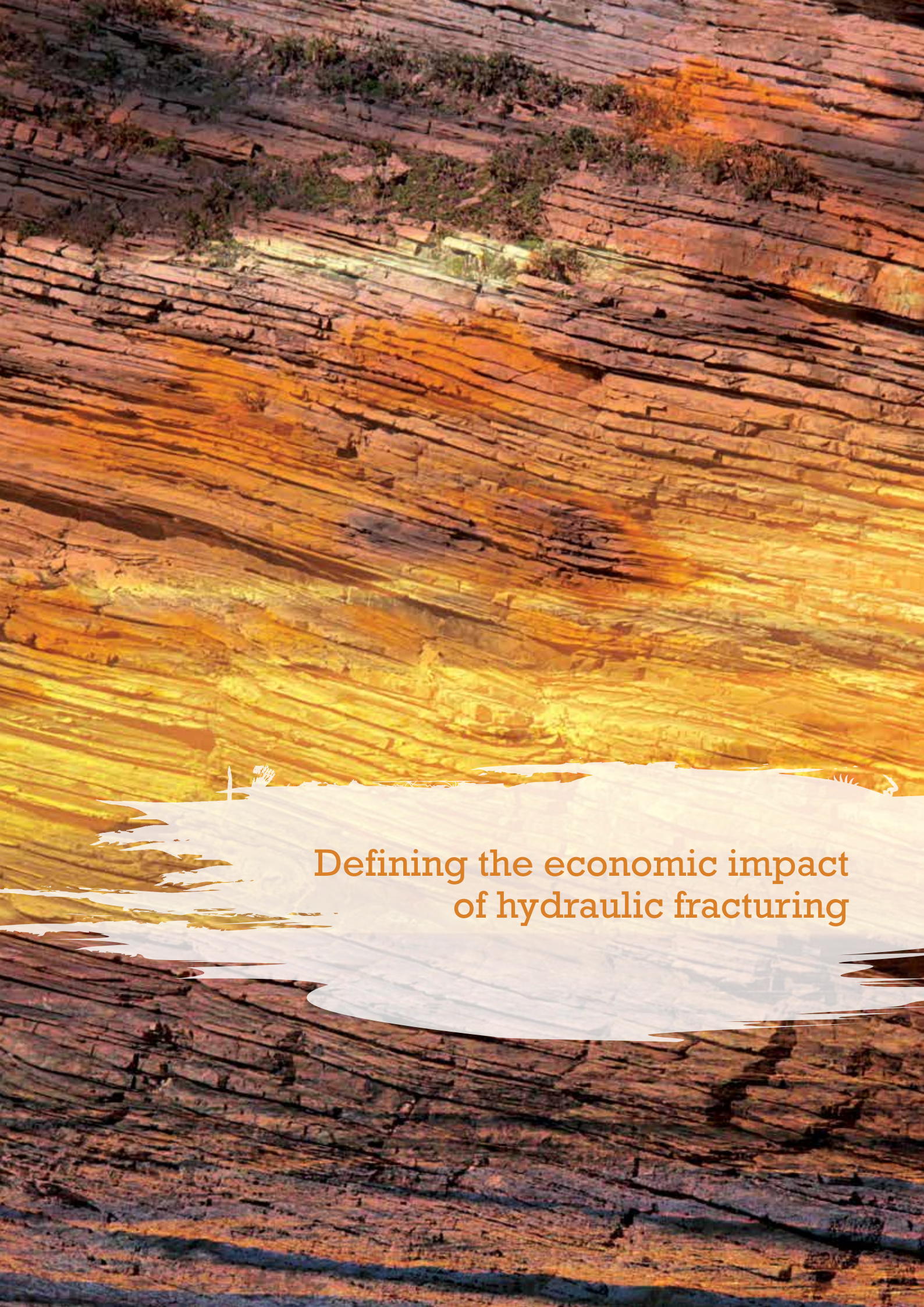
Additional activity and benefits of natural gas

Natural gas can be used as a feedstock to produce methanol, which makes a major contribution to economic activity in Taranaki and New Zealand. There is potential for methanol exports to exceed $1 billion.

Natural gas also plays a key role in ensuring the effective functioning of electricity supply and supporting the high level of renewable electricity generation in New Zealand.



Source: BERL



Defining the economic impact of hydraulic fracturing

Introduction

This report looks at the economic impact of hydraulic fracturing of oil and gas wells to the Taranaki and New Zealand economy. It focuses on two areas of economic impact, namely additional oil, condensate and gas generated as a result of hydraulic fracturing, and the economic activity (capital and operational expenditure) resulting from the ability to undertake hydraulic fracturing.

Between 1989 and mid-2011, 65 hydraulic fracturing procedures were undertaken on 39 wells across 13 onshore Taranaki fields. Hydraulic fracturing has been responsible for the viability, extension and improved yield of a number of onshore wells in the Taranaki region. Hydraulic fracturing has provided confidence in the supply of natural gas that has resulted in significant new investment in the Taranaki region. Indeed, an increasing proportion of natural gas production is as a result of hydraulic fracturing of existing wells in existing fields rather than the introduction of new production wells or fields.

Looking ahead, it is likely that hydraulic fracturing is critical to sustaining and growing natural gas and oil production in the Taranaki region and, indeed, in New Zealand.

This report shows the economic contribution of hydraulic fracturing to the New Zealand economy by comparing three future scenarios of production activity that reflect different policy settings in respect to hydraulic fracturing. These include a low, a business as usual (BAU), and a high activity (BAU+) scenario. The difference between the low and the BAU scenario is the economic impact that can be attributed to hydraulic fracturing. The BAU+ scenario includes major unconventional plays in South Taranaki and on the East Coast.

The economic impact is limited to the additional activity generated as a result of increased well construction, hydraulic fracturing activity, and natural gas, oil and condensate production. This impact can be identified in terms of GDP and employment as well as increased exports.

In addition, natural gas plays a crucial role in New Zealand's energy supply. While industry can substitute other forms of energy into their process (albeit likely at higher cost), ensuring continuous electricity generation is dependent upon the on-demand supply of peaking electricity that gas can provide. With current gas reserves falling, it is important that new sources of gas are developed to ensure that on-demand electricity can continue to be generated in periods of low renewable output.

Furthermore, the role of gas in terms of export growth and added-value manufacturing should not be underestimated. Natural gas is a feedstock into methanol production. Methanex is a major New Zealand exporter, contributing around $300 million to New Zealand's exports. With access to the necessary gas at the appropriate price, Methanex's exports can potentially exceed $1 billion.

Detailed Independent Analysis

Undertaken by BERL

Background

The process of hydraulic fracturing has been around since the 1940s. It has been applied a number of times in onshore fields in the Taranaki and Waikato regions since 1989.

The process of hydraulic fracturing has been around since the 1940s. It has been applied a number of times in onshore fields in the Taranaki and Waikato regions since 1989.

Hydraulic fracturing has extended the life and yield of a number of existing fields, and is responsible for an increasing proportion of gas production. As technology and techniques develop, hydraulic fracturing is increasingly considered an integral component of optimising any onshore field assessments in New Zealand.

There is currently considerable concern around hydraulic fracturing and its impacts on the environment. Public interest is high, with calls from some groups for a moratorium on hydraulic fracturing in New Zealand.

This report does not take a position on hydraulic fracturing in relation to the environment. The Parliamentary Commission for the Environment is currently investigating the effect of hydraulic fracturing on the environment in New Zealand and will provide an informed assessment of the process and its environmental impacts.

This report has been commissioned by Venture Taranaki, an independent economic development agency, who is interested in understanding the economic impacts of hydraulic fracturing on the New Zealand and Taranaki economies. These economic impacts are an important part of informing the debate around hydraulic fracturing by providing an assessment of the employment, GDP and exports enabled by the ability to include hydraulic fracturing in the oil and gas production process.

Hydraulic Fracturing

Hydraulic Fracturing is a well stimulation process used to maximise the extraction of underground resources; including oil, natural gas, geothermal energy, and even water.

The oil and gas industry uses hydraulic fracturing to enhance subsurface fracture systems to allow oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface.[2]

Hydraulic fracturing was first used to stimulate the flow of natural gas from the Hugotan field in Kansas in 1947. Halliburton, an oil services company, performed the first commercial fracturing treatment in 1949. Hydraulic fracturing has now been used for over 60 years, and in the US alone, over one million oil and gas wells have been hydraulically fractured.[3] In the United States it is estimated that 9 out of 10 wells require hydraulic fracturing treatments to remain or become viable.[4]

A visual example of hydraulic fracturing in Taranaki is available on the Petroleum Exploration and Production Association New Zealand (PEPANZ) website at http://www.pepanz.com/news-and-issues/issues/fracking/how-it-works-/.

Unconventional gas

Unconventional gas is differentiated from conventional gas on the basis of the nature of the geologic reservoirs it is found within and the types of technologies required to extract the gas.

Conventional natural gas deposits have a well-defined areal extent, the reservoirs are porous and permeable, the gas is produced easily through a wellbore, and reservoirs generally do not require well stimulation to produce.

Unconventional natural gas deposits are very diverse and difficult to characterise overall, but in general are often lower in resource concentration, more dispersed over large areas, and require well stimulation or some other extraction or conversion technology.

This includes gas extracted from shale formations, as well as coal seams.

[2] United States Environmental Protection Agency (EPA). Downloaded from the EPA website at http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydrowhat.cfm on 29 August 2012. Hydraulic fracturing in New Zealand is described in the Taranaki Regional Council report (pp 3-11).

[3] (Energy Institute, 2012).

Hydraulic Fracturing in New Zealand

The technique of hydraulic fracturing was first applied in New Zealand in 1989, when Petrocorp Exploration Ltd treated the Kaimiro-2 well on 11 May 1989.[5]

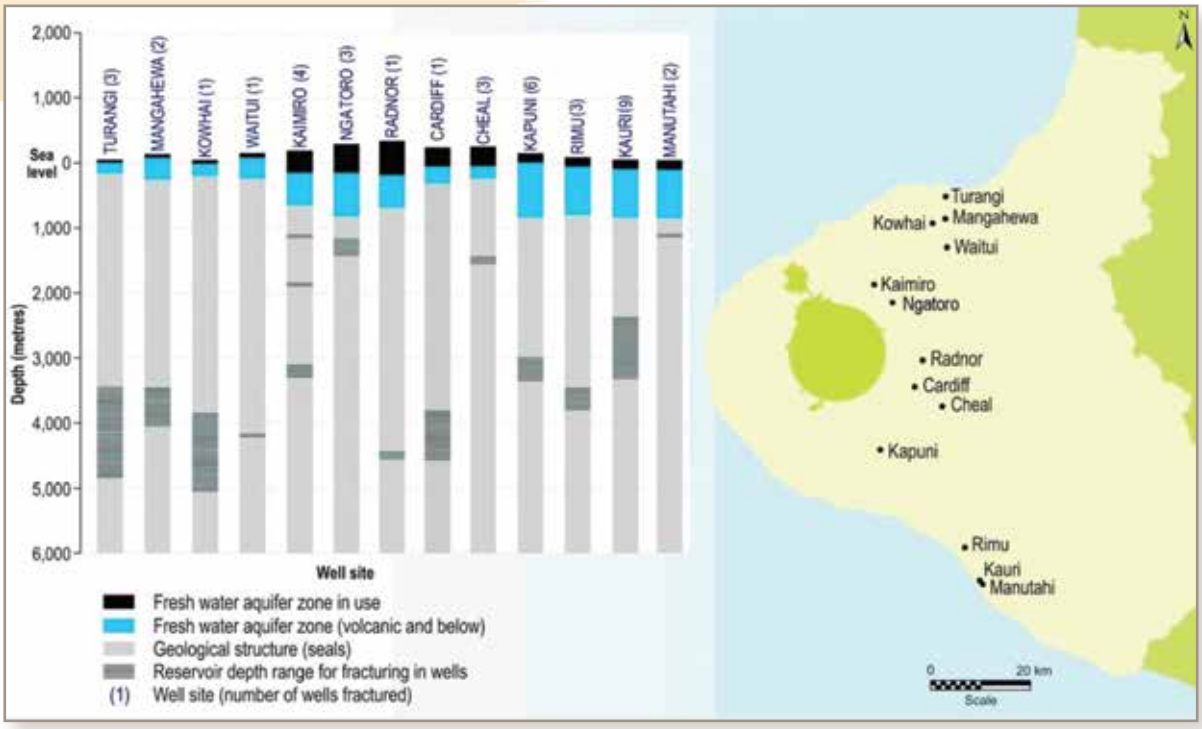
In the US, hydraulic fracturing is generally applied to coal or shale at shallow levels (<1km) to open up the reservoir. Unlike the US, hydraulic fracturing in New Zealand generally occurs at deeper levels (>3km) and into 'conventional' sandstone reservoirs to get better flowpaths.

It is important to note that treatments can vary from a production fracture, which is needed to carry gas through low porosity/permeability rock to the wellbore; to a 'skinfrac', which is a very short, usually high, fracture to provide a better connection between the wellbore and the reservoir. The amount of time, proppant and pressure applied varies significantly for different treatment types. Further, the same wells can be treated multiple times, and it is commonplace for hydraulic fracturing treatments to be repeated after a number of years.

Figure 1 provides a detailed snapshot of hydraulic fracturing treatments in the Taranaki region between 1989 and 2011.

Looking at Figure 1, the map on the right-hand side shows the fields where hydraulic fracturing has occurred. The bar

Figure 1 Hydraulic fracturing in Taranaki, 1989 - 2011



Source: Taranaki Regional Council

[4] Halliburton. Downloaded from their website at http://www.halliburton.com/public/projects/pubsdata/hydraulic_fracturing/fracturing_101.html on 29 August 2012.

[5] (Taranaki Regional Council, 2012, p. 3).

chart on the left shows the geological sub-surface structure of each field; the fresh water aquifer depth; and the depth where hydraulic fracturing has occurred. The number of well sites that have undergone hydraulic fracturing is in brackets above each field.[6]

As noted earlier, hydraulic fracturing has been applied in New Zealand since 1989, at the Kaimiro 2 and Kaimiro 3 wells. Between 1989 and mid-2011, there have been a total of 65 hydraulic fracturing procedures in 39 wells in 13 fields in the Taranaki region.[7] All hydraulic fracturing to date has occurred onshore.

Hydraulic fracturing was applied intermittently until around 2002, when a re-estimation of Maui reserves saw a significant reduction in recoverable gas reserves and a need to increase gas production. Since then, the level of hydraulic fracturing activity has gradually increased as shown Figure 2.

Activity peaked in 2005 at 13, with hydraulic fracturing occurring on wells at Kauri, Cardiff, Kapuni and Manutahi. In 2010, six wells at Kapuni, Mangahewa, Cheal and Radnor underwent 12 hydraulic fracturing treatments.[8]

Between 2001 and 2006 the hydraulic fracturing activity had an oil focus, while the more recent activities are primarily focused on gas.

Trends and Future Possibilities

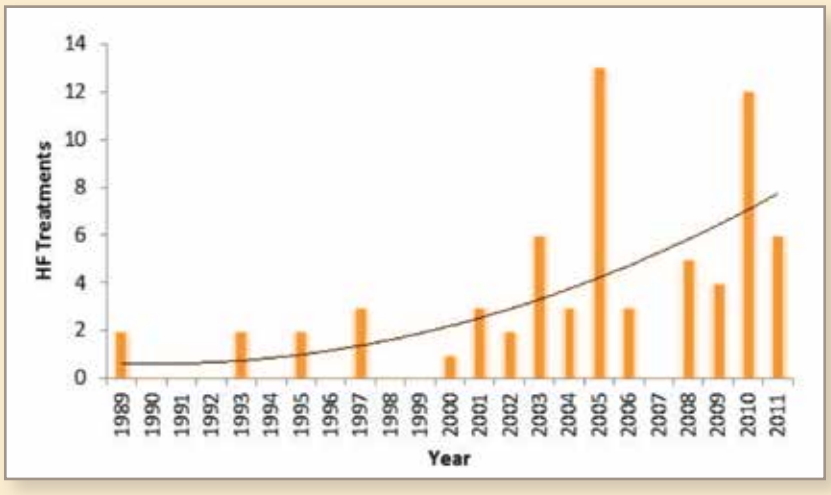
As technologies and techniques improve, the general trend is that hydraulic fracturing is becoming an increasingly accepted and integral process in optimising production flows in new fields rather than just extending the output of existing wells. For unconventional plays, such as shale gas and coal seam gas (CSG), hydraulic fracturing is often a necessary process.

Taranaki fields where hydraulic fracturing have occurred include Turangi, Mangahewa, Kowhai, Kaimiro, Ngatoro, Cardiff, Cheal, Kapuni, Rimu, Kauri and Manutahi.

All recent hydraulic fracturing treatments, apart from four procedures at Kaimiro and three at Cheal, have occurred in gas fields. As a result, increased output has largely been in relation to gas (although some increase in condensate has also occurred). Hydraulic fracturing is also likely to be applied to shale oil production on the east coast.

In the Taranaki region, Greymouth Petroleum, Shell Todd Oil Services, and Todd Energy have all commissioned hydraulic fracturing treatments, while Origin/Contact have purchased fields that have undergone hydraulic fracturing previously. All hydraulic fracturing services in the Taranaki region are provided by either BJ Services or Halliburton.[9]

Figure 2 Hydraulic fracturing in Taranaki by year, 1989 - 2011



Source: Taranaki Regional Council

[6] (Taranaki Regional Council, 2012). Hydrogeologic Risk Assessment of Hydraulic Fracturing for Gas recovery in the Taranaki Region.

[7] 2011 only includes activity up to March.

[8] Note that a well can be treated multiple times, so the amount of hydraulic fracturing treatments is not the same as the amount of wells that have received treatmen

[9] (Taranaki Regional Council, 2012, p. 16).

Solid Energy has undertaken hydraulic fracturing activity in the Waikato region near Huntly. In 2007, Solid Energy undertook four hydraulic treatments on four wells. In 2011, they undertook hydraulic fracturing on four wells, a total of six treatments.

Looking forward, it is expected that hydraulic fracturing activity will increase, as operators seek to extend and enhance productivity from existing wells. This is particularly the case in onshore Taranaki, where much of the growth in gas production is in existing or new fields where hydraulic fracturing treatments have been used or are likely to be required to improve economic viability.

It is less likely that hydraulic fracturing activity will extend offshore, particularly over the next 10 to 20 years, mainly due to the higher costs of offshore hydraulic fracturing procedures.

Unconventional Plays

As well as hydraulic fracturing to extend production from conventional wells, hydraulic fracturing potentially makes it possible to economically extract gas from coal seams and oil and gas from shale formations.

Coal Seam Gas (CSG)

With CSG, permeability enhancement may, or may not be required depending on the geological situation. If permeability enhancement is required, hydraulic fracturing is just one of the options available. All the options have limitations and situations when they work best. It is unlikely that any significant CSG production will eventuate in New Zealand without hydraulic fracturing being at least part of the operation.

In Eastern Taranaki, a contingent resource of 900PJ 2C of CSG has been identified by Solid Energy.

Hydraulic fracturing has been proven to allow extraction of CSG from the Huntly coal field, which has similar coal characteristics to Eastern Taranaki. Test wells have yielded high quality gas containing 98 percent methane and just 1 percent CO2.

It is highly unlikely that this CSG can be extracted economically without at least some hydraulic fracturing.

Solid Energy has applied to New Zealand Petroleum and Minerals for a seven-year extension of its Taranaki permit to allow the CSG project to move to appraisal/discovery phase.

What is Coal Seam Gas (CSG)?

Coal Seam Gas is another form of indigenous natural gas that can offset the declining production of New Zealand's Maui gas field.

- It creates fewer greenhouse emissions than any other thermal energy.
- It supports distributed generation by potentially contributing electricity to the national grid from multiple points around the country, possibly avoiding expensive transmission upgrades.
- Electricity from CSG would provide base load generation to support further renewable electricity generation projects.

CSG's significant potential is being recognised around the world — it already provides 15 percent of the USA's gas supply and close to 90 percent of Queensland's (Australia) gas supply.

Shale gas and oil

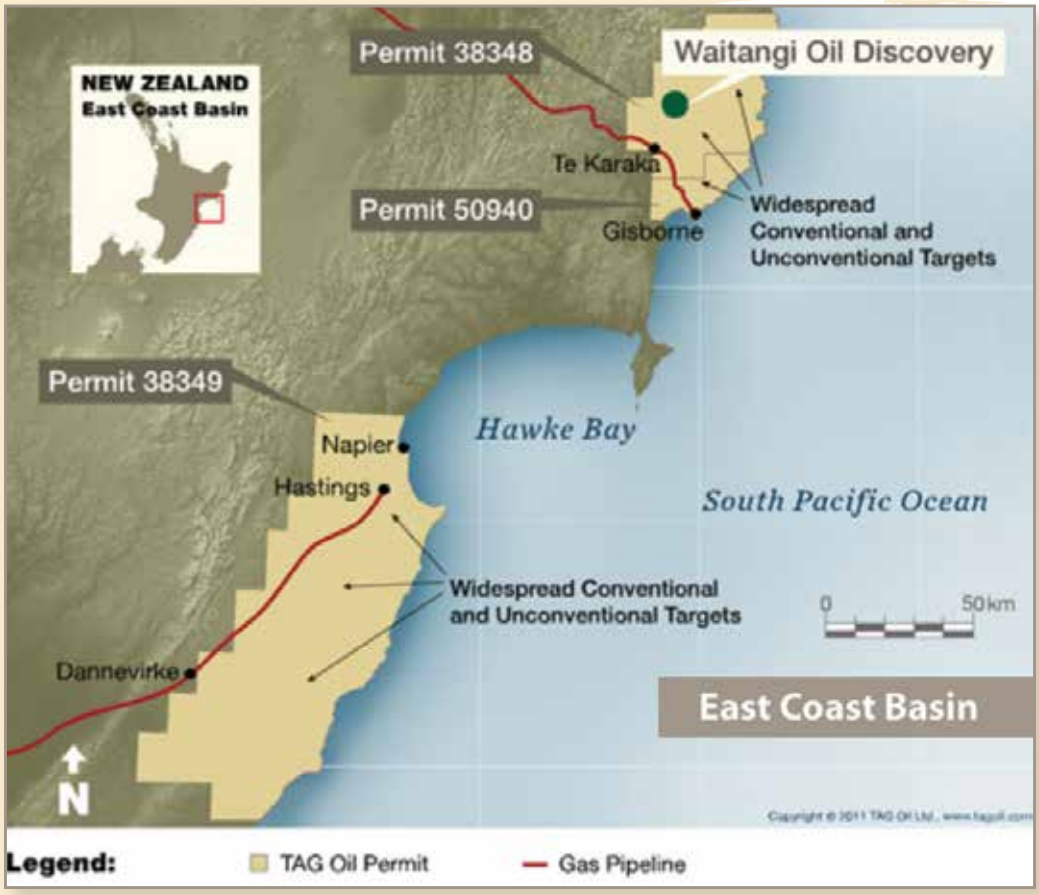
Shale gas and oil refers to natural gas and oil that is trapped within shale formations. Shales are fine-grained sedimentary rocks that can be rich sources of petroleum and natural gas.

The combination of horizontal drilling and hydraulic fracturing has made the extraction of shale gas and oil economically viable.

TAG Oil and New Zealand Energy Company (NZEC) are exploring oil-shale source rocks across the East Coast frontier. The initial target is fractured oil shale, with conventional prospects maintained as secondary targets.

The potential oil production from the East Coast frontier is very significant and will require high levels of capital investment.

East Coast Basin Permits
TAG Oil



Method

Hydraulic fracturing improves the viability and ability to extract gas and oil from new discoveries and existing wells.

Hydraulic fracturing enhances permeability, allowing fluids to flow to the well bore. The economic impacts are therefore the additional:

- gas and oil produced, which:
- increases tax and royalty payments to government
- enables increased downstream activity around feedstock, electricity generation and retail gas
- improves energy security
- reduces energy prices.
- jobs and GDP generated from
- hydraulic fracturing construction activity
- ongoing operations.

The approach in this analysis is to identify changes in production, construction and operational activity under a range of policy scenarios with regard to hydraulic fracturing activity. The analysis looks at three scenarios over a ten year period from 2013 to 2022.

1. Constrained (low) – Under this scenario, tighter restrictions are placed on hydraulic fracturing activity. This reduces the level of production as new activity is restricted to fields where hydraulic fracturing are not required and potential wells become less economic due to the inability to apply hydraulic fracturing treatments.

2. Business as usual (BAU) – Under this scenario, the policy settings stay the same. Oil and gas companies are able to undertake hydraulic fracturing activity through the current consenting process. However, non-conventional plays, which are dependent upon hydraulic fracturing, do not occur because of uncertainty around the regulatory environment.

3. Non-conventional plays (BAU+) – This scenario includes activity from non-conventional plays including coal seam gas in South Taranaki and shale oil in the East Coast.

Scenarios

A number of oil and gas companies were asked to provide their assessment of activity under each of the three scenarios. This included production, capital expenditure and operational expenditure. These figures were extrapolated out to provide aggregate production and expenditure flows over the next ten years. Where the associated condensate volumes produced alongside gas production has not been provided by the operators the volume is calculated based on historical ratios for that field.[10]

All hydraulic fracturing activity to date has been onshore. It is unlikely that offshore hydraulic fracturing will occur within the scenario timeframe. While the majority of hydraulic fracturing activity has focused on gas fields, there are associated condensates extracted as well. Further, non-conventional plays on the East Coast are targeting oil. The analysis does not consider offshore activity.

Economic impact

The economic impact analysis is based on the earlier framework developed for the Wealth beneath our Feet report. In particular, this report is used for the level of expenditure that occurs in New Zealand and the split of that expenditure across industries.[11]

Export revenue is based on production levels for oil and gas. Natural gas and oil prices for the scenario are $7 per GJ of natural gas and NZ$110 (US$90) per barrel of oil equivalent (BOE) out to 2022. These prices are consistent with current oil and gas prices.

Because there are different royalty regimes for when different fields were developed, and the application of either accounting profit of 20 percent or five percent of revenues (whichever is greater), it is difficult to identify exactly the likely royalties on a particular scenario. The analysis provides a high and low projection based on historical levels of production and royalties paid and likely activity going forward. The high projection is based on

[11] (Venture Taranaki, 2010).

[12] This is consistent with the estimated breakdown of expenditure identified in Wealth Beneath our Feet (Venture Taranaki, 2010).

[10] Condensate is also referred to as 'wet gas' and is a mixture of light hydrocarbons that exist as a gas in underground reservoirs which condense to form a liquid at atmospheric conditions. Condensates are used to make chemicals and other high-value oil products.

royalties of 15 percent of revenue, while the low projection assumes royalties of 10 percent of revenues.

All prices and dollar values are in New Zealand dollars and are nominal. Historical prices and production activity are taken from New Zealand Petroleum and Minerals data.

For the economic impact analysis for Taranaki fields, 60 percent of capital expenditure is used, as it is considered that 40 percent of expenditure goes directly offshore.[12] However, in relation to East Coast production, the analysis is based on 80 percent of capital expenditure and 40 percent of operational expenditure occurring in Taranaki, which is where the production capability and many of the resources reside. This is relevant for the Taranaki economic impacts under the BAU+ scenario.

From the economic activity (expenditure) each year, direct, indirect and induced GDP and employment measures are calculated using multiplier analysis. These measures of activity are aggregated and then presented as an average annual impact over the next decade. In reality, much of the activity, particularly in the BAU+ scenario, is likely to occur in the latter half of the decade.

Context

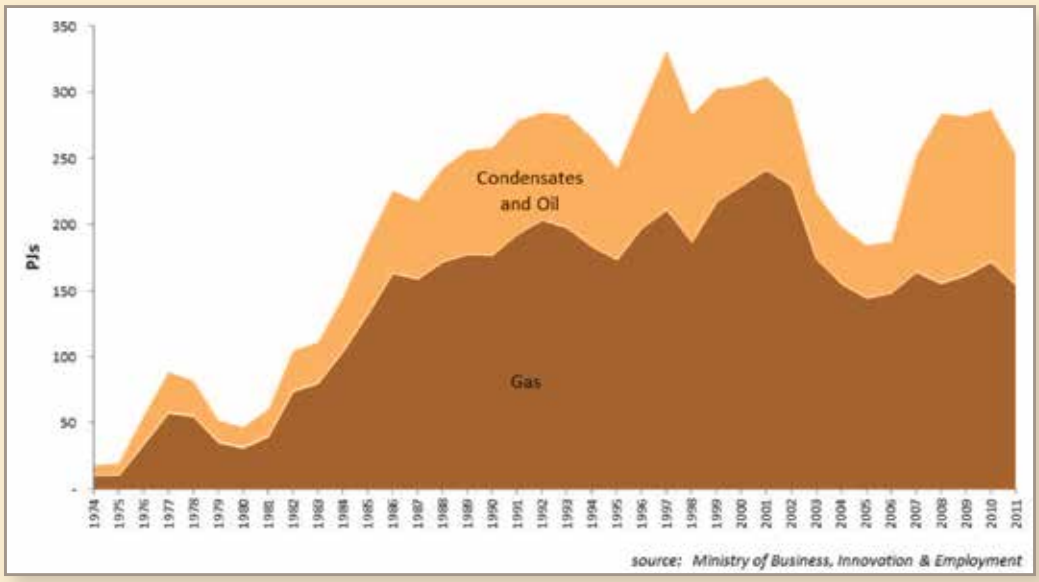
Most of the hydraulic fracturing treatments have occurred on onshore gas fields. This section discusses historical production of oil and gas and puts the level of activity from those fields where hydraulic fracturing has occurred into perspective.

Oil and Gas production in New Zealand

To compare oil and gas production they are both presented in term of petajoules (PJs), which is a measure of energy. Oil and gas production from 1974 to 2011 are shown in Figure 3.

In relation to oil and gas production, gas accounted for around 60 percent (in terms of energy produced in PJs) in 2011. However, oil production has increased significantly since 2007. In 2006, gas accounted for close to 80 percent of oil and gas produced in New Zealand.

Figure 3 Net national oil and gas production (PJs), 1974 - 2011



Source: Ministry of Business, Innovation & Employment

Gas Production

Gas production peaked in 2001, which was the height of Maui production. Production then declined, as Maui output declined. Production by field is shown in Figure 4.

A number of smaller fields have also been producing over that time although there has been a marked increase from the early 2000s. In terms of larger contributions, Pohokura came on-stream in 2006, ramping up from 2007, and then Kupe started contributing from 2010.

However, the majority of gas produced comes from offshore fields as shown in Figure 5.[13]

From 2007 to 2011, onshore fields have accounted for around 28 to 30 percent of total gas production. Offshore gas initially came from the Maui field and, more recently, Pohokura and Kupe.

Onshore, Kapuni is the largest gas field, followed by Mangahewa and Turangi. A number of smaller fields, including McKee, Kaimiro, Ngatoro, Kowhai, Rimu/Kauri, Tariki, Waihapa, Ngaere, Cheal, Sidewinder, Surrey and Manutahi contribute to onshore gas production.

The first hydraulic fracturing treatment occurred in Kaimiro in 1989, followed by Kapuni in 1993. Figure 6 shows production from fields where wells have undergone treatment against fields where treatment has not occurred.

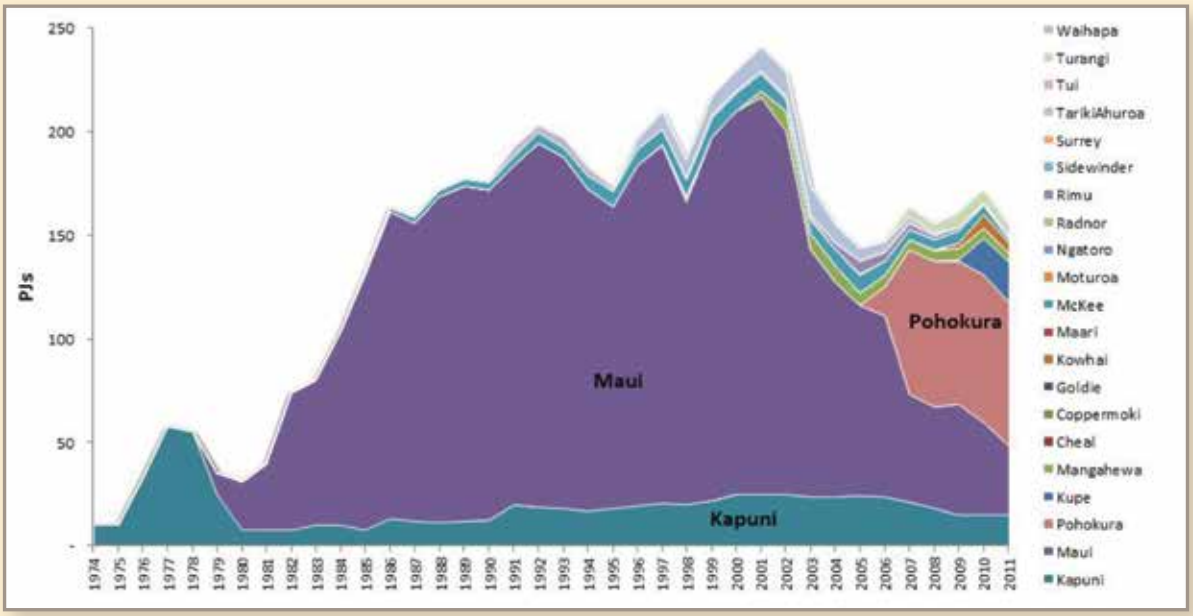
Note that the graphic does not suggest that hydraulic fracturing was responsible for the total production from those fields but rather represents the contribution of fields where hydraulic fracturing has occurred. For example, only part of Kapuni and Kaimiro production came from treated wells, whereas all production from Mangahewa, Turangi and Kowhai can be attributed to hydraulic fracturing.

Between 2006 and 2011, fields where wells have received hydraulic fracturing treatments accounted for between 23 and 27 percent of total net gas produced.

However, when considering gas production, fields where hydraulic fracturing has occurred account for almost all onshore production in 2011. This is shown in Figure 7.

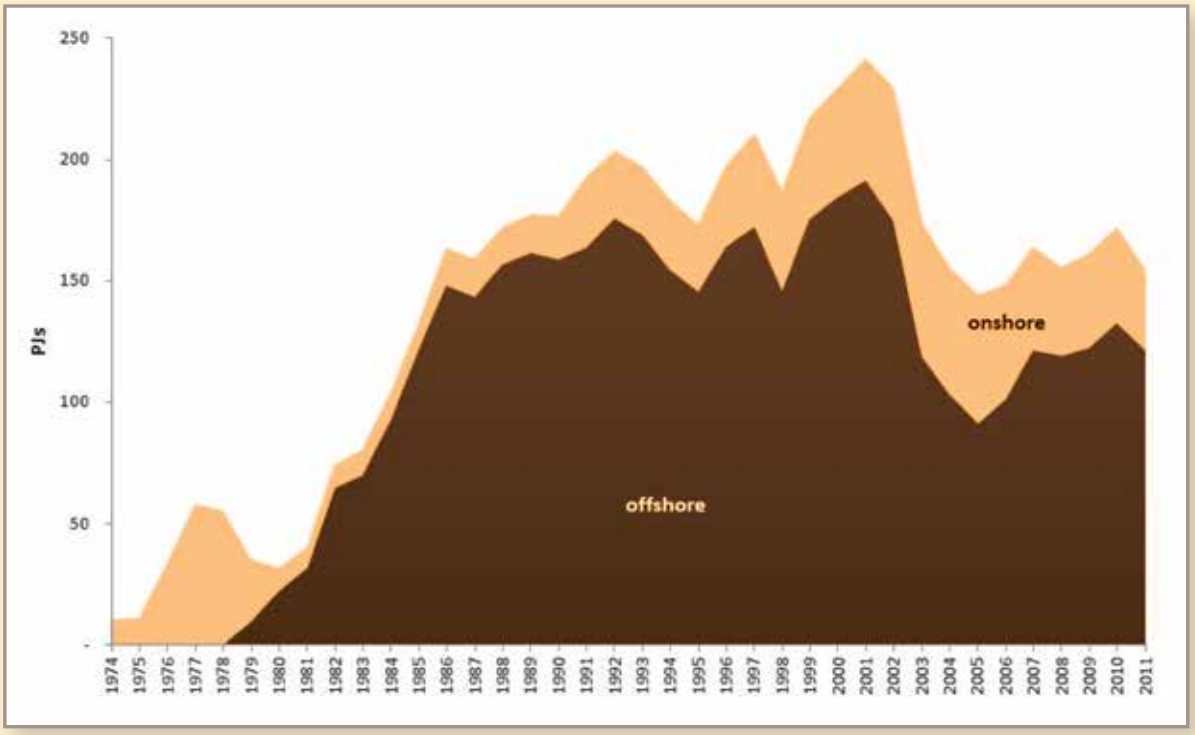
[13] Pohokura has been classed as an offshore field, although half of the wells and processing of gas occurs onshore.

Figure 4 Net national gas production by field, 1974 - 2011



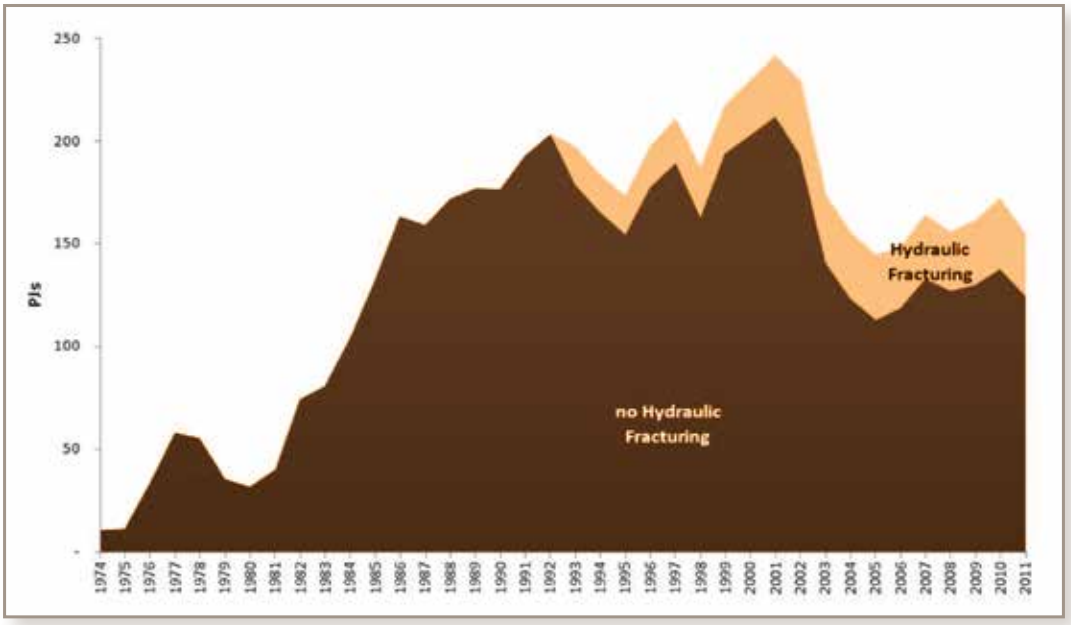
Source: Ministry of Business, Innovation & Employment

Figure 5 Net national gas production, onshore and offshore, 1974 - 2011



Source: Ministry of Business, Innovation & Employment

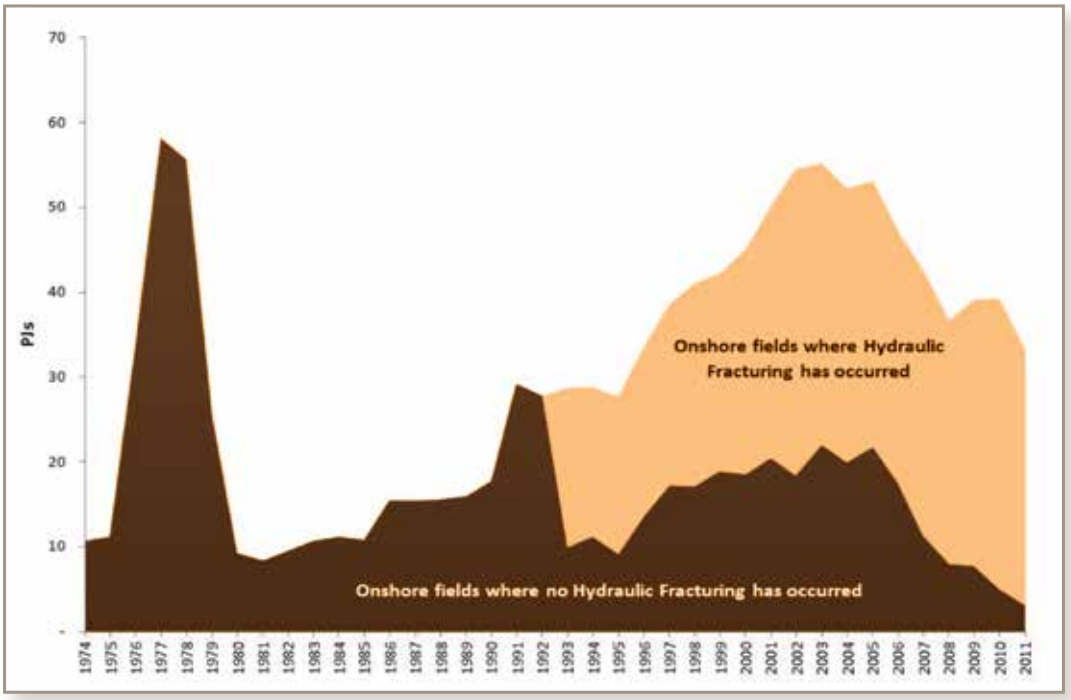
Figure 6 Net National Gas Production, treated vs. non-treated fields, 1974 - 2011



Source: BERL

* Production relates to fields where a well has received treatments as apposed to production from wells within fields that have received treatments. The graphic does not present production dure to hydraulic fracturing.

Figure 7 Onshore net national gas production, treated vs. non treated fields, 1974 - 2011



Source: BERL

* Production relates to fields where a well has received treatments as apposed to production from wells within fields that have received treatments. The graphic does not present production dure to hydraulic fracturing.

Gas Production continued...

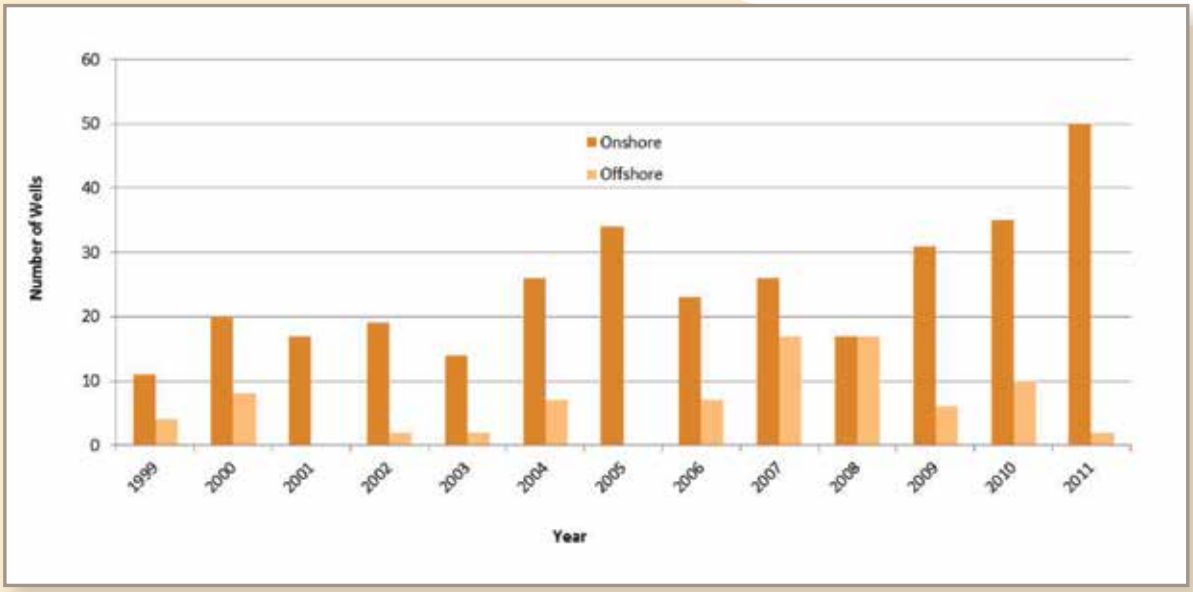
As a result of the majority of activity occurring onshore, combined with the unlikely prospect of offshore hydraulic fracturing occurring in the short to medium term (the scenario timeframe), the focus of the analysis is on onshore fields.

Wells drilled

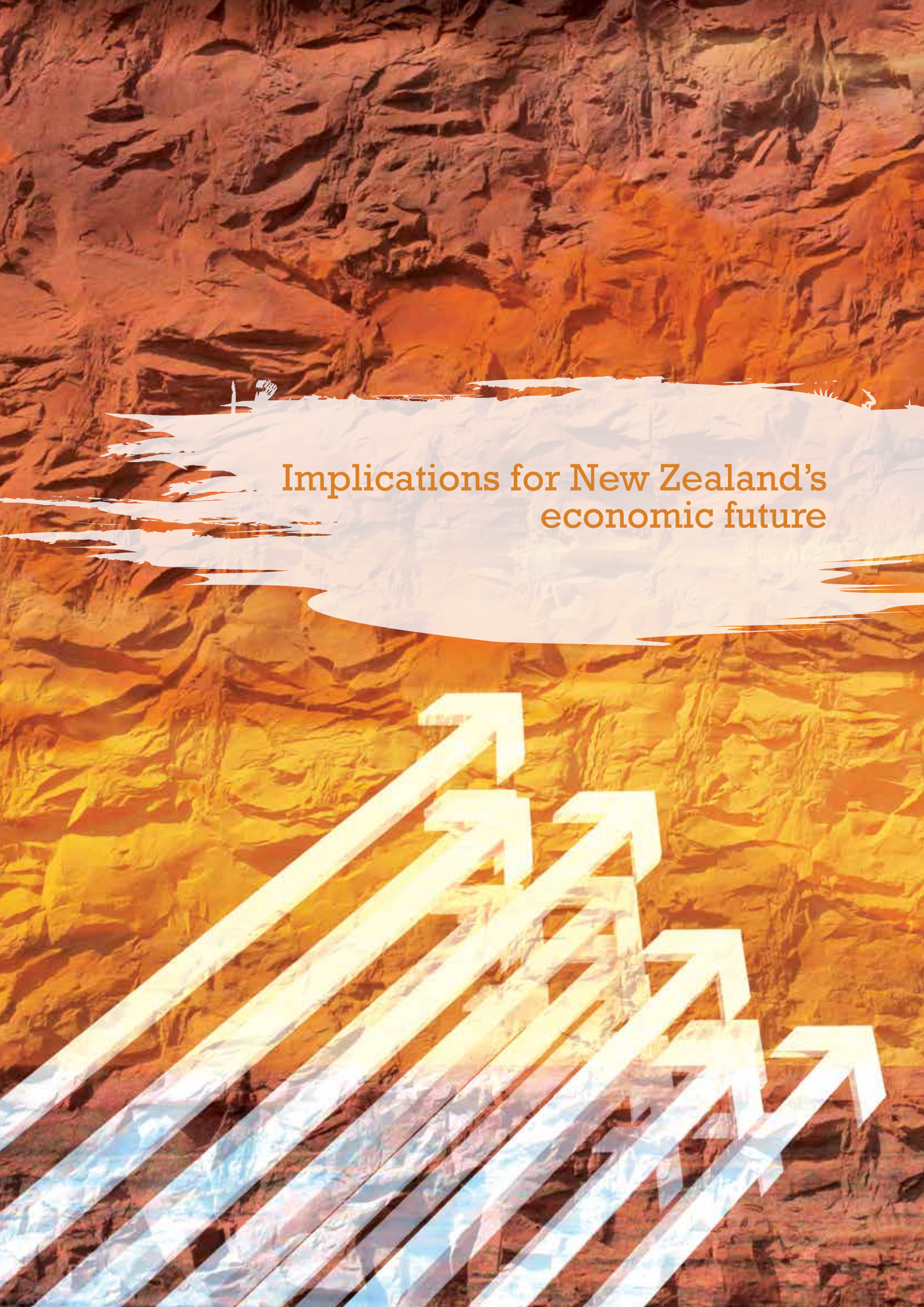
A significant proportion of well drilling in recent times has been onshore targeting gas. While the dwindling supply has been a major driver of this additional activity, the economics due to hydraulic fracturing has enabled further production from these existing fields.

A total of 405 wells have been drilled between 1999 and 2011. Of these, around 80 percent have been drilled onshore. In 2011, 52 wells were drilled, of which 96 percent were drilled onshore.

Figure 8 Wells drilled 1999 - 2011, onshore vs. offshore



Source: New Zealand Petroleum & Minerals



Implications for New Zealand's economic future

Scenarios

This analysis uses a scenario approach, which allows us to compare the future onshore activity of the New Zealand oil and gas sector under contrasting environments. Two environments incorporate hydraulic fracturing into its activity (BAU and BAU+) and one that does not (low).

Multiplier analysis shows the direct and total economic impact of activity in the oil and gas sector in terms of expenditure, GDP and employment. The difference between the low and high scenarios reflects the economic value of hydraulic fracturing to the economy. The analysis looks at the impact on New Zealand and Taranaki.

Summary

In 2011, onshore gas production was around 33 PJs. Under each of the three scenarios, onshore production changed as shown in Figure 9.

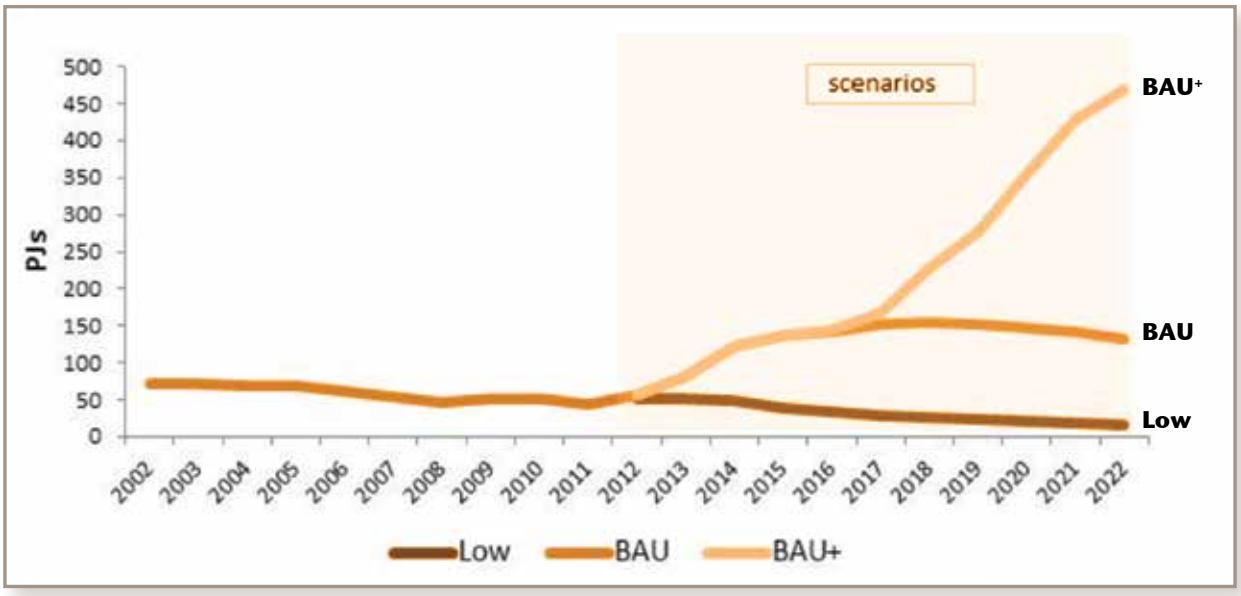
Under the BAU scenario, production remains on a relatively consistent path, with production peaking in 2018 at 154 PJs. Onshore production then eases, with 133 PJs expected to be produced in 2022.

The low scenario sees production rise slightly to 2013 as existing activity flows through to production. Production then falls consistently to 16PJ by 2022.

The BAU+ scenario sees solid growth as development projects, such as coal seam gas, get underway in Taranaki. This ramps up from 2018 as oil production starts on the East Coast.

The breakdown between oil and gas production is shown in Figure 10 and Figure 11.

Figure 9 Onshore oil and gas production scenarios to 2022, PJs



Source: BERL

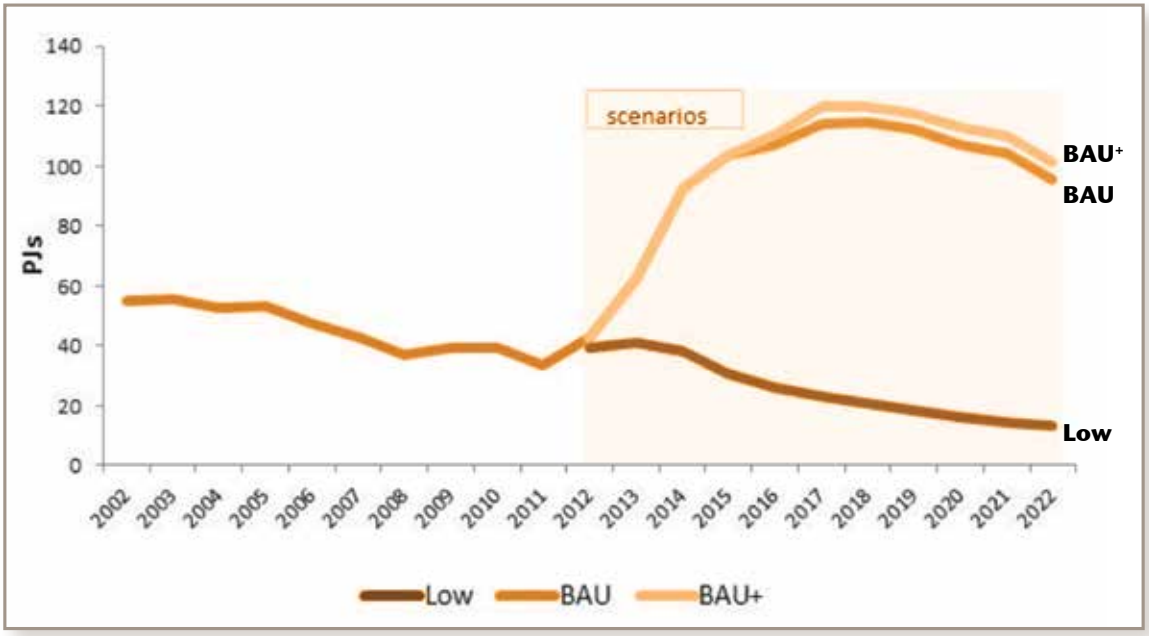
There are relatively consistent projections for onshore gas production under the BAU and BAU+ scenarios. Both the BAU and the BAU+ scenarios see rapid growth to 2018 and then an easing after that. The BAU scenario sees onshore gas production at a slightly lower level than the BAU+ scenario from 2016. Under the low scenario there is lumpy movement to 2014 before a consistent easing out to 2022.

Oil production activity, on the other hand is largely represented by the BAU+ scenario, as shown in Figure 11.

Currently, much of the onshore oil production is a result of condensate gathered as a result of gas production. The change in condensate is therefore directly related to the change in gas production. However, under the BAU+ scenario, the development of the oil shale fields in the East Coast over the period to 2017 sees production ramp up significantly independent of gas production from 2018.

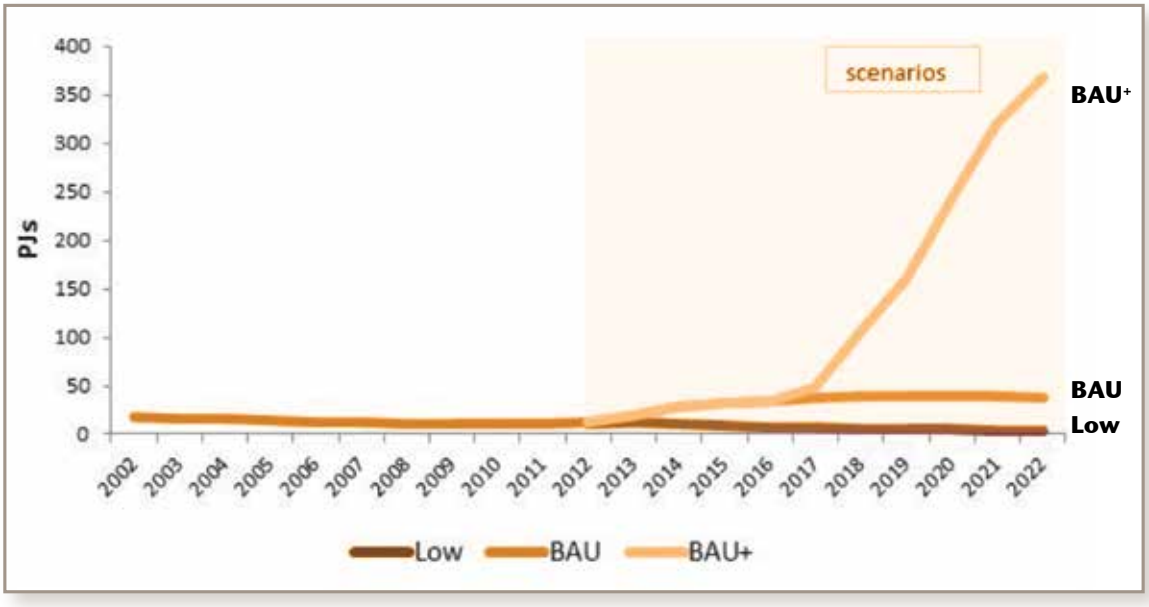
The economic impact of these production scenarios are presented individually in the next sections.

Figure 10 Onshore gas production scenarios to 2022, PJs



Source: BERL

Figure 11 Onshore oil production scenarios to 2022, PJs



Source: BERL

Scenario 1 – Low activity

A hydraulic fracturing moratorium is put in place, which bans all future hydraulic fracturing activity. As a result no existing wells receive further hydraulic fracturing treatments and few new wells are drilled onshore due to uncertainty around viability. Oil and gas from current fields are extracted at 90 percent of the previous year until they are exhausted. Fields where hydraulic fracturing is not required are developed as per normal.

Activity

Table 1 shows the production, revenue, royalties and expenditure generated under the low activity scenario.

Onshore natural gas production drops from 41PJs in 2013 to 13PJs in 2022. Over the same period, onshore oil production drops from 12PJs to 3PJs.

This results in a drop in revenue from just over $500 million in 2013 to $155 million in 2022. Royalties fall from between $50 and $75 million to between $15 million and $23 million. Oil and condensate exports average $125 million each year, although they drop from $217 million in 2013 to $63 million in 2022. Expenditure drops from $149 million to $88 million, largely due to a fall in operating expenditure (OPEX).

Economic Impact

Economic impact analysis is based on the proportion of capital expenditure (CAPEX) spent nationally and the total OPEX, which equates to $980 million. The economic impact on New Zealand is shown in Table 2.

Direct expenditure of $980 million over the ten year period results in direct annual GDP of $45 million and directly employs 392 FTEs. Adding indirect and induced effects results in total annual GDP of $111 million and the employment of 1,025 FTEs.

Table 3 shows the economic impact of the low scenario on the Taranaki region.

Direct expenditure of $980 million over the ten year period results in direct annual GDP of $44 million and directly employs 392 FTEs. Adding indirect and induced effects results in total annual GDP of $68 million and the employment of 614 FTEs.

Table 1 Summary of activity – scenario (Low)

Scenario (Low)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2013-2022	ann ave
Production (PJ)												
Gas	41	38	30	26	23	21	18	16	15	13	241	24
Oil & Condensates	12	11	9	8	7	6	5	4	4	3	68	7
Revenue ($m)												
Gas	285	265	213	183	162	144	127	114	102	92	1,688	169
Oil & Condensates	217	200	161	138	120	106	93	82	73	63	1,254	125
Royalties ($m)												
low	50.2	46.5	37.4	32.1	28.2	25.0	22.1	19.6	17.5	15.5	294.2	29.4
high	75.4	69.7	56.1	48.1	42.3	37.5	33.1	29.5	26.3	23.3	441.3	44.1
Expenditure ($m)												
CAPEX	30	30	30	30	30	30	30	30	30	30	300	30
OPEX	119	106	90	82	77	72	68	64	61	58	798	80

Source: BERL

Table 2 New Zealand annual average economic activity 2013 - 2022

Scenario: Low	Direct	Total
Expenditure ($m)	98	240
GDP ($m)	45	111
Employment (FTEs)	392	1,025

Source: BERL

Table 3 Taranaki annual average economic activity 2013 - 2022

Scenario: Low	Direct	Total
Expenditure ($m)	98	149
GDP ($m)	44	68
Employment (FTEs)	392	614

Source: BERL

Scenario 2 – Business as usual (BAU)

Oil and gas exploration and activity continues along the current pathway. However, developments outside of Taranaki that will likely require hydraulic fracturing do not occur due to uncertainty around the consenting process. Similarly, non-conventional plays, such as shale oil and coal seam gas are put on hold due to uncertainty.

Activity

Table 4 shows the production, revenue, royalties and expenditure generated under the BAU scenario.

Onshore natural gas production increases from 62PJs in 2013 to 112 PJs in 2018. Production then eases to 96PJs in 2022. Over the same period onshore oil and condensate production increases from 19PJs in 2013 to 40PJs in 2019 before easing to 37 PJs in 2022.

This results in total revenue of $785 million in 2013, increasing to $1,520 million in 2019and easing to $1,341 million by 2022.

Royalties over the ten years are expected to be between $1.3 billion and $2.0 billion. Exports of oil and condensates are $6.3 billion.

Expenditure as a result of activity averages $325 million over the ten years.

Economic Impact

Economic impact analysis is based on the proportion of CAPEX spent nationally and the total OPEX, which equates to $2,875 million. The economic impact on New Zealand is shown in Table 5.

Direct expenditure of $2,875 million over the ten year period results in direct annual GDP of $131 million and directly employs 1,153 FTEs. Adding indirect and induced effects results in total annual GDP of $326 million and the employment of 3,011 FTEs.

Table 6 shows the economic impact of the BAU scenario on the Taranaki region.

Direct expenditure of $2,875 million over the ten year period results in direct annual GDP of $130 million and directly employs 1,152 FTEs. Adding indirect and induced effects results in total annual GDP of $201 million and the employment of 1,804 FTEs.

Table 4 Summary of activity – scenario (BAU)

Scenario (BAU)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2013-2022	ann ave
Production (PJ)												
Gas	62	93	104	107	114	115	112	107	104	96	1,014	101
Oil & Condensates	19	28	33	34	37	39	40	39	39	37	345	35
Revenue ($m)												
low	437	648	725	750	800	803	786	750	729	669	7,097	710
high	348	521	599	628	685	717	734	716	706	672	6,326	633
Royalties ($m)												
Gas	78.5	116.9	132.5	137.8	148.5	151.9	151.9	146.7	143.5	134.2	1,342.4	134.2
Oil & Condensates	117.7	175.3	198.7	206.7	222.7	227.9	227.9	220.0	215.3	201.3	2,013.6	201.4
Expenditure ($m)												
CAPEX	135	138	116	145	129	114	58	40	40	40	955	95
OPEX	187	224	225	229	251	255	248	235	227	220	2,302	230

Source: BERL

Table 5 New Zealand annual average economic activity 2013 - 2022

Scenario: BAU	Direct	Total
Expenditure ($m)	287	704
GDP ($m)	131	326
Employment (FTEs)	1,153	3,011

Source: BERL

Table 6 Taranaki annual average economic activity 2013 - 2022

Scenario: BAU	Direct	Total
Expenditure ($m)	287	437
GDP ($m)	130	201
Employment (FTEs)	1,152	1,804

Source: BERL

Scenario 3 – Non conventional plays (BAU+)

Hydraulic fracturing is accepted politically and publicly as a safe technique to extract gas from conventional and unconventional plays. Hydraulic fracturing activity follows strict guidelines and monitoring to ensure it is done appropriately. As a result, unconventional plays, such as CSG and shale oil, are developed.

Activity

Table 7 shows the production, revenue, royalties and expenditure generated under the BAU+ scenario.

Onshore natural gas production increases from 63PJs in 2013 to 120 PJs in 2018. Production then eases to 101PJs in 2022. Over the same period onshore oil and condensate production increases from 19PJs in 2013 to 369 PJs in 2022.

This results in revenue of just under $790 million in 2013, increasing to almost $7.5 billion in 2022.

Royalties over the ten years are expected to be between $3.2 billion and $4.8 billion. Exports of oil and condensates are worth $25 billion.

Expenditure as a result of activity averages $1.05 billion over the ten years.

Economic Impact

Economic impact analysis is based on the proportion of CAPEX spent nationally and the total OPEX, which equates to $8,029 million for New Zealand and $3,459 million for Taranaki. The economic impact on New Zealand is shown in Table 8.

Direct expenditure of $8,029 million over the ten year period results in direct annual GDP of $365 million and directly employs 3,221 FTEs. Adding indirect and induced effects results in total annual GDP of $910 million and the employment of 8,410 FTEs.

Table 9 shows the economic impact of the BAU+ scenario on the Taranaki region.

Direct expenditure of $3,459 million over the ten year period results in direct annual GDP of $156 million and directly employs 1,387 FTEs. Adding indirect and induced effects results in total annual GDP of $242 million and the employment of 2,170 FTEs.

Table 7 Summary of activity – scenario (Low)

Scenario (BAU+)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2013-2022	ann ave
Production (PJ)												
Gas	63	93	104	110	119	120	118	113	110	101	1050	105
Oil & Condensates	19	29	33	35	48	106	161	243	319	369	1362	136
Revenue ($m)												
Gas	438	649	726	772	836	840	823	789	768	709	7,351	735
Oil & Condensates	349	523	603	633	886	1,951	2,949	4,457	5,848	6,761	24,962	2,496
Royalties ($m)												
low	78.7	117.2	132.9	140.5	172.2	279.1	377.3	524.6	661.7	747.0	3,231.3	323.1
high	118.0	175.8	199.4	210.8	258.3	418.7	565.9	786.9	992.5	1,120.5	4,846.9	484.7
Expenditure ($m)												
CAPEX	177	174	180	177	704	802	1,016	998	998	998	6,225	622
OPEX	189	226	230	238	263	357	460	755	776	801	4,295	429

Source: BERL

Table 8 New Zealand annual average economic activity 2013 - 2022

Scenario: BAU+	Direct	Total
Expenditure ($m)	803	1,966
GDP ($m)	365	910
Employment (FTEs)	3,221	8,410

Source: BERL

Table 9 Taranaki annual average economic activity 2013 - 2022

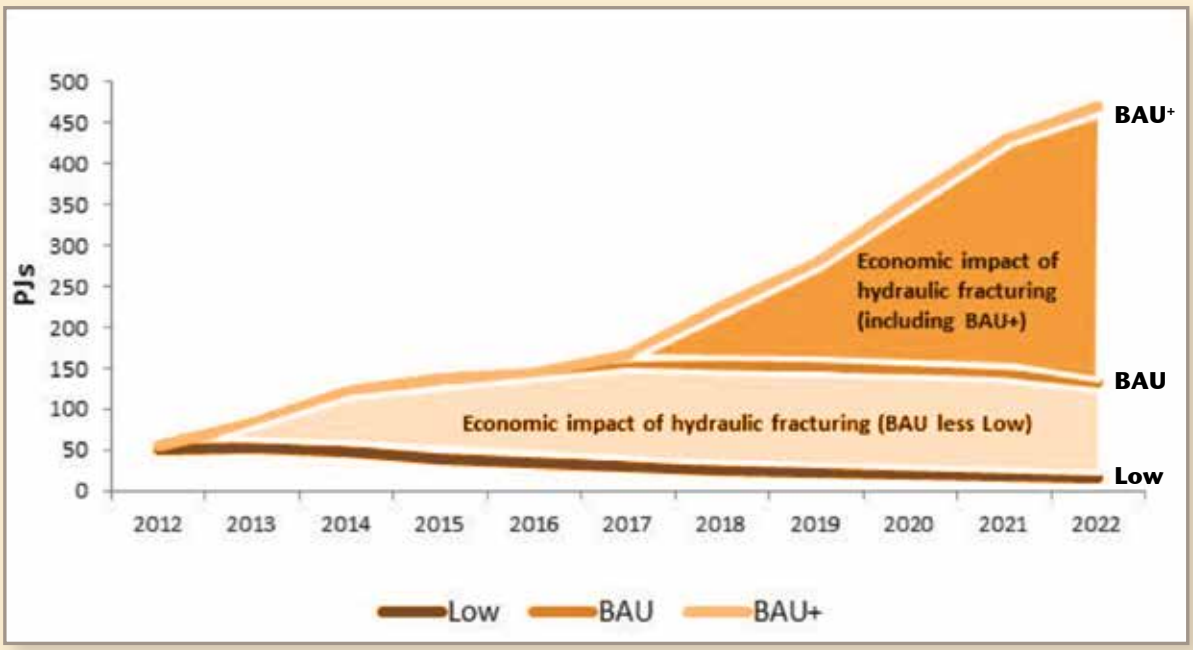
Scenario: BAU+	Direct	Total
Expenditure ($m)	346	526
GDP ($m)	156	242
Employment (FTEs)	1,387	2,170

Source: BERL

Economic Impact of Hydraulic Fracturing

The economic impact of hydraulic fracturing over the 10 years to 2022 is represented by the difference between the low scenario, where there is no hydraulic fracturing allowed; and the BAU scenario, where activity continues within the current environment. The BAU+ scenario is a potential impact, where unconventional activity including CSG and oil shales are included. The additional activity is represented by the shaded areas in Figure 12.

Figure 12 Economic impact of hydraulic fracturing



Source: BERL

BAU scenario

The activity generated by hydraulic fracturing is shown in Table 10.

Over the ten year period 2013 to 2022, the ability to perform hydraulic fracturing activity could result in the production of an extra 773PJs of gas and an extra 277PJs of oil and condensate.

Over the ten year period, this additional production converts to additional:

- revenue of $10.5 billion; and
- royalties of between $1.0 billion and $1.6 billion.

The expenditure required to achieve that extra production would have economic impacts at a national and regional level. These are shown in Table 11 and Table 12.

For New Zealand, additional expenditure of $190 million each year over the next ten years would contribute $86 million to GDP and directly employ 761 FTEs annually.

Applying indirect and induced effects, GDP increases to $215 million and employment increases to 1,986 FTEs annually.

For Taranaki, additional expenditure of $190 million each year over the next ten years would contribute $86 million to GDP and directly employ 760 FTEs annually.

Applying multipliers, GDP increases to $133 million and employment increases to 1,190 FTEs annually.

Table 10 Activity generated by hydraulic fracturing (BAU Scenario)

Diff (Low vs. BAU)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2013-2022	ann ave
Production (PJ)												
Gas	22	55	73	81	91	94	94	91	90	82	773	77
Oil & Condensates	7	18	24	27	31	33	35	35	35	33	277	28
Revenue ($m)												
Gas	152	383	512	567	638	659	658	637	627	577	5,409	541
Oil & Condensates	130	321	438	490	565	611	640	634	633	610	5,073	507
Royalties ($m)												
low	28.2	70.4	95.0	105.7	120.3	126.9	129.9	127.0	126.0	118.7	1,048.2	104.8
high	42.4	105.6	142.6	158.5	180.4	190.4	194.8	190.5	189.0	178.0	1,572.3	157.2
Expenditure ($m)												
CAPEX	105	108	86	115	99	84	28	10	10	10	655	65
OPEX	68	117	135	147	174	182	180	171	166	162	1503	150

Source: BERL

Table 11 Economic impact of hydraulic fracturing on New Zealand

Difference (low to BAU)	Direct	Total
Expenditure ($m)	190	464
GDP ($m)	86	215
Employment (FTEs)	761	1,986

Source: BERL

Table 12 Economic impact of hydraulic fracturing on Taranaki

Difference (low to BAU)	Direct	Total
Expenditure ($m)	190	288
GDP ($m)	86	133
Employment (FTEs)	760	1,190

Source: BERL

BAU+ scenario

A second scenario, where non-conventional activity occurs onshore suggests a significant upside to the economic impacts of hydraulic fracturing. The difference between the low and BAU+ scenarios are presented in Figure 13.

Over the ten year period 2013 to 2022, the ability to perform hydraulic fracturing activity could result in the production of an extra 809PJs of gas and an extra 1,293PJs of oil.

Over the ten year period, this additional production converts to additional:

- revenue of $29.4 billion; and
- royalties of between $2.9 billion and $4.4 billion.

The expenditure required to achieve that extra production would have economic impacts at a national and a regional level. These are shown in Table 13 and Table 14.

For New Zealand, additional expenditure of $705 million each year over the next ten years would contribute $321 million to GDP and employ 2,829 FTEs annually.

Applying multipliers, GDP increases to $799 million and employment increases to 7,386 FTEs annually.

For Taranaki, additional expenditure of $248 million each year over the next ten years would contribute $112 million to GDP and employ 994 FTEs annually.

Applying multipliers, GDP increases to $174 million and employment increases to 1,556 FTEs annually.

Figure 13 Activity generated by hydraulic fracturing (BAU+ scenario)

Diff (Low vs. BAU+)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2013-2022	ann ave
Production (PJ)												
Gas	22	55	73	84	96	99	99	96	95	88	809	81
Oil & Condensates	7	18	24	27	42	101	156	239	315	365	1,293	129
Revenue ($m)												
Gas	153	384	513	589	675	696	696	675	666	617	5,662	566
Oil & Condensates	132	324	442	495	765	1,845	2,856	4,375	5,775	6,698	23,708	2,371
Royalties ($m)												
low	28.4	70.7	95.5	108.4	144.0	254.1	355.2	505.0	644.1	731.5	2,937.0	293.7
high	42.7	106.1	143.3	162.6	216.0	381.2	532.8	757.5	966.2	1,097.3	4,405.6	440.6
Expenditure ($m)												
CAPEX	147	144	150	147	674	772	986	968	968	968	5925	592
OPEX	69	120	140	156	186	284	392	691	715	744	3496	350

Source: BERL

Table 13 Economic impact of hydraulic fracturing on New Zealand

Difference (low to BAU+)	Direct	Total
Expenditure ($m)	705	1,726
GDP ($m)	321	799
Employment (FTEs)	2,829	7,386

Source: BERL

Table 14 Economic impact of hydraulic fracturing on Taranaki

Difference (low to BAU+)	Direct	Total
Expenditure ($m)	248	377
GDP ($m)	112	174
Employment (FTEs)	994	1,556

Source: BERL

Other impacts

The economic impact analysis does not consider downstream activity that is enabled as a result of access to gas. These include its use as feedstock in the production of methanol, and the role gas plays in electricity generation.

Mangahewa Developments

Todd Energy is expected to have spent a total of $760 million over the seven year period to 2018 developing the Mangahewa field. Hydraulic fracturing has occurred at a number of wells in its Mangahewa field, which has resulted in major improvements in well productivity and extended the life of the field to 23 years.

Improved performance at this and other fields (Pohokura) has supported a $75 million investment in a new LPG plant at the McKee production station. The LPG plant has a production capacity of 27,000 tonnes per year, which is equivalent to around 15 percent of New Zealand's LPG needs. LPG is exported out of Taranaki to the rest of the North Island and parts of the South Island.

Additional gas has also enabled Todd Energy to sign a 10 year security of supply agreement with Methanex, which is one of New Zealand's largest exporters. This agreement has enabled Methanex to expand its own activity; with the potential of increasing production by 100 percent (the 2nd Motonui train was refurbished to accommodate the gas from Todd Energy). Methanex is looking at investing even further in increased production capacity and re-commissioning the Waitara Valley plant.

According to an earlier BERL report capital expenditure by Todd energy over the seven-year development process is expected to contribute $274 million to the Taranaki economy and employ 1,064 FTEs.[14] Once fully operational, Mangahewa will contribute $9 million to GDP and create employment for 60 people annually. At a national level, capital expenditure would contribute $403 million and employ 1,356 FTEs, while operational activity would contribute $14 million to GDP and employ 83 FTEs annually.

If Methanex were to run at full capacity, it would contribute a further $646 million in GDP and employ 4,100 people in New Zealand annually. The export value of methanol would increase by 300 percent to over $1 billion.[15]

This additional activity would have flow-on effects to Port Taranaki, which is a key strategic asset in the Taranaki region. Methanol is currently the second largest product exported out of Port Taranaki and at full capacity would potentially be the largest single product exported. This supports the viability and ability of Port Taranaki to provide a full range of port services to businesses in the Taranaki region and support the national transport infrastructure system.

[14] (BERL, 2012). Todd Energy: Economic Impact of Oil and Gas Investment in Taranaki and Nationally.

[15] (BERL, 2012). Economic Impact Analysis of Methanex 2012.

Natural Gas as an energy source

Natural Gas is used for a variety of purposes – electricity generation, industry, residential and feedstock. This is in contrast to Hydro and Geothermal. For Hydro, 100 percent of supply is used to generate electricity. For Geothermal, 93 percent of supply goes into generating electricity. Similarly, 100 percent of renewables energy is converted into electricity.

The majority of natural gas (one-third) is used to generate electricity. Industry is the second largest user, with 28 percent (and 12 percent which goes into co-generation). Non-energy use, or feedstock accounts for around 15 percent of natural gas used, while residential, commercial and agriculture each account for less than five percent of natural gas used.[16]

The role of natural gas in supporting industry was highlighted with the disruption to the Maui Pipeline in 2011, where supply was interrupted to all businesses north of Waikato, including a number of major businesses, forcing them to close or significantly limit their operation for a number of days.[17]

Increased supply of natural gas can also result in lower-priced energy for New Zealand industries and consumers making it less expensive to produce goods, heat homes and generate electricity.

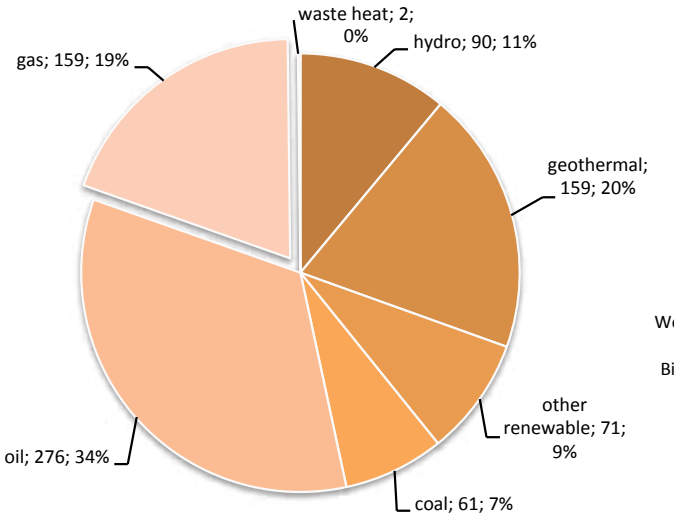
Role of Gas in electricity generation

Gas is an important energy source within New Zealand accounting for around 19 percent of energy supplied in 2011 as shown in Figure 14.

Gas is New Zealand's third largest energy source behind oil and geothermal.

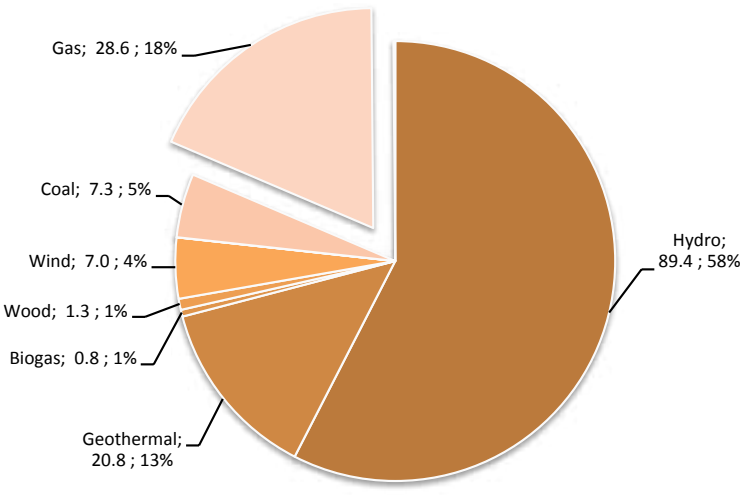
As well as being used directly by industry and residential customers, gas is a key source of energy into electricity generation. In 2011, 29 PJs of gas went into electricity generation, accounting for around 18 percent of electricity generated.

Figure 14 Total primary energy supply, 2011



Source: New Zealand Petroleum & Minerals

Figure 15 Electricity generated by fuel type, 2011



Source: Energy Data File 2012

[16] (Ministry of Economic Development, 2012). New Zealand Energy Data File 2012.

[17] Such as the Chelsea sugar refinery, Tip Top Ice-cream Factory and Goodman Fielder bakeries, Fonterra, Sanitarium, Lion Breweries.

While 18 percent appears relatively low, gas is the main source of non-periodic electricity generation and has a critical role to play in providing peaking electricity during dry periods. For example, if we took a dry year such as 2008, the contribution from Hydro drops to 52 percent. The difference in supply is provided by gas and coal as shown in Figure 16.

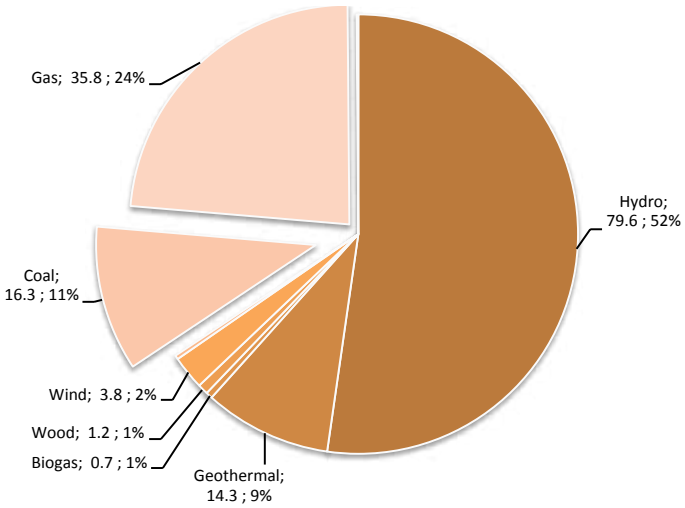
Electricity generated by gas was 33 percent higher in 2008 than in 2011, and contributed close to a quarter of total electricity generated. As well, coal generation was three times higher than in 2011, accounting for over 10 percent of total electricity generated.

This suggests the value of gas toward ensuring security of electricity supply in a system where the majority of supply is subject to weather.

Further, in terms of providing peaking or continuity of supply, it is a better environmental option than coal, which is the other alternative currently.

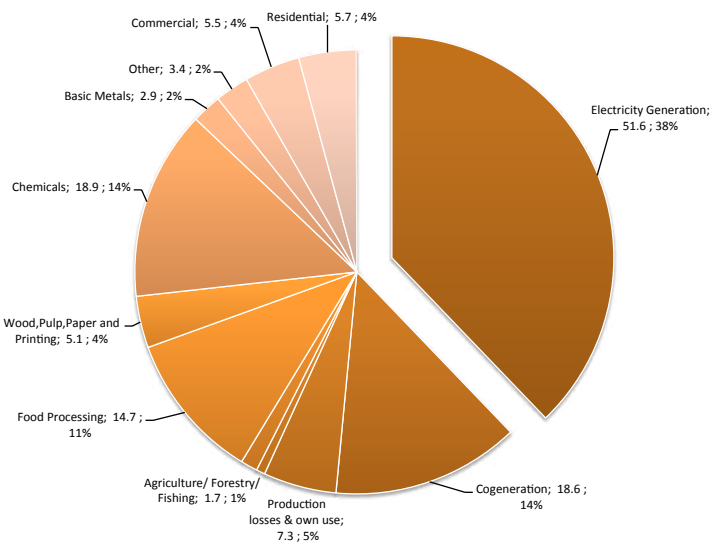
An efficient energy source, natural gas is the cleanest-burning conventional fuel, producing lower levels of greenhouse gas emissions than heavier hydrocarbon fuels such as coal and oil.

Figure 16 Electricity generation by fuel type in a dry year, 2008



Source: Energy Data File 2012

Figure 17 Natural gas use by sector, 2011



Source: Energy Data File 2012

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About Venture Taranaki

Venture Taranaki Trust is the region's development agency. We help grow the region.

Incorporated as a charitable trust, Venture Taranaki is a dynamic organisation which has facilitated business success from enterprise inception through to sustainable growth based on international competitiveness.

Venture Taranaki is an initiative founded by the New Plymouth District Council. In addition to the New Plymouth District Council, Venture Taranaki is supported by: South Taranaki District Council, Stratford District Council, Taranaki Electricity Trust, Ministry of Business Innovation and Enterprise, Business in the Community and numerous other organisations.

Venture Taranaki commissioned BERL to independently undertake an analysis of the economic impact on New Zealand of changes to policies concerning hydraulic fracturing in New Zealand.

BERL is a privately owned New Zealand company providing economic analysis and advice to both public and private sector clients. Independent and authoritative, BERL specialises in strategic economic development regionally and nationally.

Project Director: Dr Anne Probert
Email: anne@venture.org.nz

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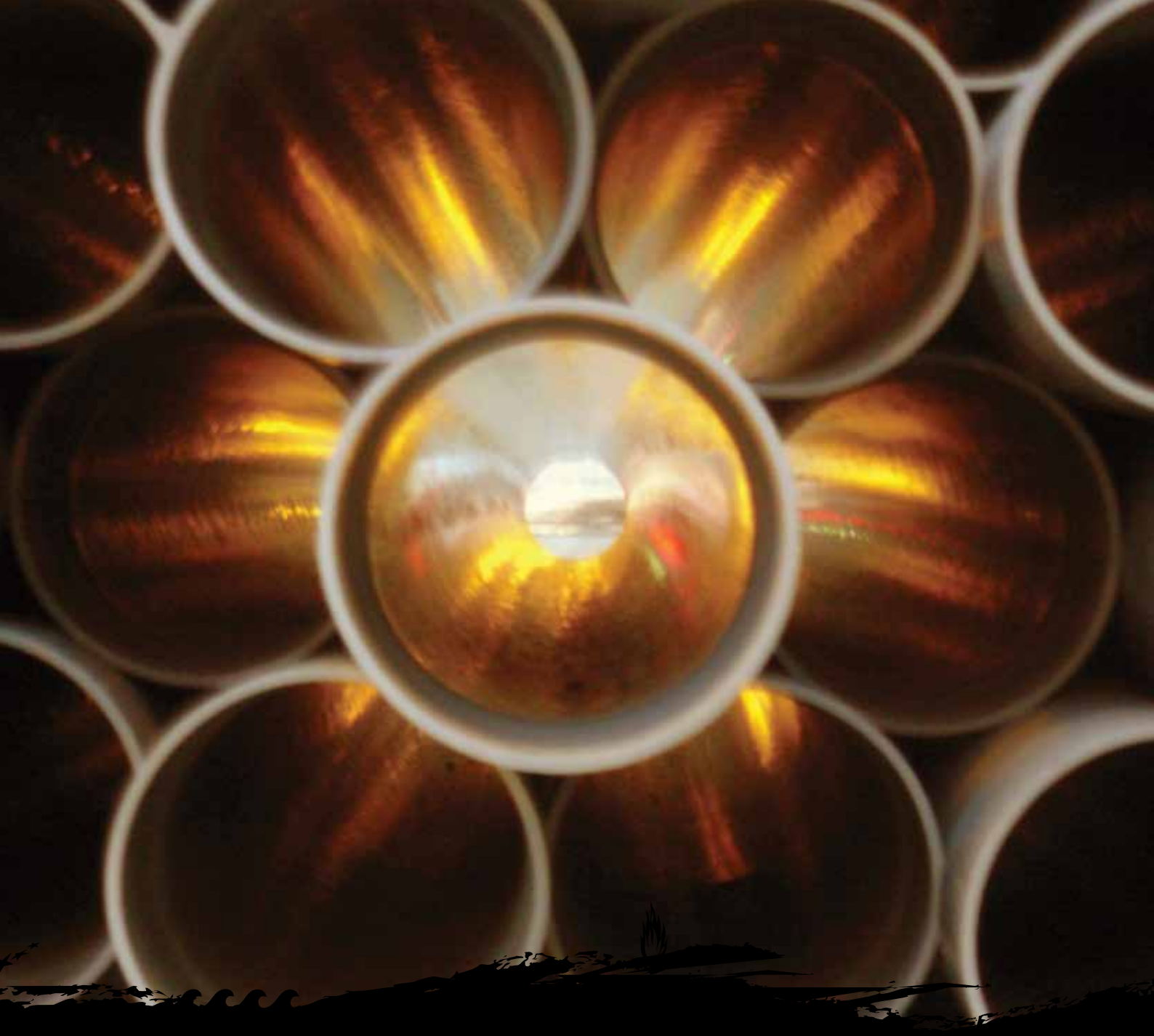

Venture TARANAKI
Te Puna Umanga

Taranaki's Regional Development Agency

9 Robe Street | PO Box 670 | New Plymouth
P. (06) 759 5150 | F. (06) 759 5154
E. info@taranaki.info

www.taranaki.info

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