Our Geothermal Advantage

Contact®

In a country rich in water resources and geothermal activity, New Zealand generates almost 80% of its electricity from renewables. By anyone's measure, that's significant.

80

Contact is one of the country's largest electricity generators, with five geothermal power stations, and a combined gross installed geothermal capacity of 431 megawatts (MW). To achieve that, you'd have to have some of the top geothermal minds in the world on your team. We do.

Tēnā koutou katoa, anei
te mihi maioha ki a koutou katoa.

Greetings, we warmly
welcome you all.

In Wairākei, in the Taupō region of the North Island, we have a team of 135 geothermal technical specialists supporting the development, operation and maintenance of our five geothermal plants. Their work here, and around the world, means their skills and experience are in demand.

Contact has been at the forefront of renewable energy generation for some time. We've been harnessing the geothermal power of the Wairākei steamfield for 57 years. The pioneering Wairākei power station, commissioned in 1958, was the second significant geothermal power station in the world to be built, and the first to utilise wells that produce a mixture of steam and water. Our newest power station, Te Mihi, was commissioned in May 2014.

Over these 57 years we've grown our skill and expertise in operating and maintaining geothermal power stations, and exploring and managing geothermal resources. But it doesn't stop there. We also operate hydro and thermal power stations and supply electricity, natural gas and LPG to residential and business customers across New Zealand.

Renewable energy generation is, rightly, a focus for countries around the globe. Contact has a proven track record in the successful consenting, development and commercial operation of renewable energy generation – and a constant drive for innovation to successfully harness and protect these valuable resources.

Awards

Energy Project of the Year (Wairākei bioreactor) – 2013 NZ Deloitte Energy Excellence Awards

Excellence in Health and Safety – 2013 NZ Deloitte Energy Excellence Awards

Over 57 years we've grown our skill and expertise in operating and maintaining geothermal power plants.

57

12

power stations across New Zealand

$3.5b

in net assets ($NZD)

$2.45b

of annual revenue ($NZD)

22%

share of the retail electricity market in New Zealand

1st

Wairākei was the first geothermal power station in the world to use steam and hot water

5

geothermal power stations in the Taupō region

1075

employees

562,500

electricity, natural gas and LPG customers

Our geothermal power stations

5

Wairākei power station
Commissioned 1958, and Wairākei binary plant (2005)
Gross output
132 MW

Ohaaki power station
Commissioned 1989
Gross output
50 MW

Poihipi Road power station
Commissioned 1997
Gross output
55 MW

Te Huka power station
Commissioned 2010
Gross output
28 MW

Te Mihi power station
Commissioned 2014
Gross output
166 MW

What would you call 135 of the world's leading geothermal experts clustered together in one place?

You'd have to call them one of the most experienced geothermal workforces in the world – and we're proud to say they're at the heart of our team at our Wairākei geothermal plant.

Our team is made up of reservoir, mechanical, drilling and electrical engineers, geothermal scientists, power station operators and maintenance experts. They support our geothermal development work, along with the operation and maintenance of our five geothermal power stations and the sustainable management of the geothermal resource. Their collective skills and expertise are rare and only a handful of public companies worldwide are large enough to have such a substantial, in-house, geothermal team.

Understanding the subsurface environment and managing the precious geothermal resource in a sustainable manner are key to the success of any geothermal development. We have a dedicated team of around 35 subsurface professionals based at Wairākei with international experience, having worked on geothermal projects in countries such as Chile, Indonesia, USA, the Philippines, and Papua New Guinea. It's an unparalleled depth of skill.

1. Mike Dunstall, GM Geothermal Resources and Development addresses the Contact team at the Te Mihi power station opening.
2. A marker (Pou) of the indigenous people of the land at the entrance to Te Mihi power station.

Geothermal from the beginning

1958

Wairākei power station commissioned

1989

Ohaaki power station commissioned

1995

Contact is created from the Electricity Corporation of New Zealand as a state-owned enterprise

1997

Contact takes over operation of Wairākei and Ohaaki power stations

1999

Contact is privatised

2000

Contact purchases Poihipi Road power station

2004

Origin Energy becomes Contact's majority shareholder

2005

The Wairākei binary plant is commissioned

2006

Tenon direct heat plant commissioned

2007

Wairākei power station consent renewed

2008

Te Mihi power station consent approved

2010

Contact receives consents to develop a 250 MW geothermal power station at Tauhara

Contact signs an agreement with Taheke 8C to jointly explore geothermal opportunities on land adjacent to the Okere and Kaituna Rivers; exploratory drilling begins

Te Huka power station is commissioned

2012

Wairākei bioreactor commissioned

2013

Ohaaki power station resource consent renewed

2014

Te Mihi power station commissioned

Can one energy company really do it all, from feasibility all the way to reliable operation?

Yes. Contact can because of our experience, the advantages of a renewables rich environment, and a serious depth of expertise right throughout the company.

Over time we've developed a depth and breadth of technical capability allowing us to manage projects from the identification and proving of a geothermal resource, through to operation, enhancement and protection.

Here's how we do it:

Proving a geothermal resource
We combine geoscience and exploratory drilling to quantify and scope the size of the energy resource, then determine its financial and technical viability for use in electricity generation or direct heat applications.

Consenting and stakeholder engagement
This is key to the way we work and a focus for all our projects. We engage with landowners and local communities to truly understand the impact of a proposed development. We work to avoid negative impacts and where this is not possible we develop agreements to mitigate the effects of our proposed construction and operational activities. We also seek opportunities to partner with stakeholders on our commercial development opportunities. Approval is then sought from the relevant local authority to proceed with the development.

Production and injection well drilling
We utilise subsurface modelling, geoscience and engineering expertise to determine the optimum number and positioning of production and injection wells to deliver to the required operating conditions, output or planned field expansion. Insights gathered about the subsurface conditions during drilling are integrated into our approach and modelling of the field.

Power station construction
We work with a range of suppliers and construction firms to prepare the site and build the power station, related plant and steamfield connections. Our clear focus is on ensuring a quality construction and engineering solution, with the highest levels of safety performance.

Power station operation
We manage systematic risk and ensure the appropriate maintenance and operation checks are in place to enable us to operate the power station safely, with high availability.

Enhancement and innovation
We constantly explore innovative ways to improve our operations, enhancing the output or operational flexibility – as well as reducing operating costs associated with steamfield management and well maintenance.

Community engagement and investment
Our philosophy is to be 'the neighbour you'd want to have'. We look for opportunities to partner with our key stakeholders, engage with our neighbours around our operations and to invest in local initiatives that support the social and economic goals of the community.

Mature or new technology – we have the experience
At Contact we're privileged to have comprehensive technical experience that spans operating, maintaining and enhancing older power stations – through to developing the very newest. Our experience at operating and maintaining the Wairākei (commissioned 1958) and Ohaaki (commissioned 1989) power stations provides us with a wealth of insight, experience and learning that we constantly use to solve operational and maintenance challenges.

Case study: Delivery of lower cost generation and added operational flexibility

Wairākei Investment Programme: 2011–2014

This major four-year programme targeted the delivery of a lower average cost of generation and additional flexibility in operating our fleet of geothermal power stations.

It was a busy year in 2014. We celebrated the completion of the Wairākei Investment Programme which included the construction of the $623 million Te Mihi power station and steamfield connections; development of the Wairākei bioreactor; drilling a number of new wells and the expansion of the Wairākei steamfield.

Contact now has a combined gross geothermal generation output of 431 MW and around 90 wells in service on the Wairākei field. The programme improved the resilience of our business and secured a strong, sustainable future.

Te Mihi proved our ability to develop and operate large, world-class geothermal power stations – it is one of the larger geothermal power stations constructed internationally in the past 10 years.

Te Mihi's development by our contract partners was a significant and complex challenge, with over 3.1 million hours worked and up to 600 people on site during the peak of construction – with civil, mechanical and electrical work often taking place simultaneously.

Safety is our first priority and a wide range of safety initiatives were implemented by Contact and our contract partners to instill the Zero Harm philosophy.

One of the unique aspects of Te Mihi was the need to build and integrate the new power station into a live steamfield environment that has been supporting the Wairākei plant since 1958 – and to do this with minimal disruption during construction.

The further development of the Wairākei steamfield provided for greater flexibility in the way we use our permitted daily take of geothermal fluid, enabling us to run our stations to better meet energy trading requirements.

The Wairākei Investment Programme has also allowed us greater ability to undertake planned maintenance without significantly disrupting output. Crucially, it's also provided a range of strategic options for the future (such as constructing a third unit at Te Mihi) as elements of the Wairākei power station reach the end of their intended life.

With Te Mihi using the latest steam turbine technology, it ensures minimal impact on the environment. Due to its close positioning to the geothermal resource, Te Mihi is 15–20% more efficient in its use of steam than the Wairākei power station.

Case study: Te Huka a strong, reliable performer

Contact's $100m Te Huka power station was commissioned in 2010, and is a 28 MW binary plant situated on the Tauhara geothermal field. The plant represents our first phase of generation development on the Tauhara field and is our first binary plant that uses both steam and separated geothermal water.

The plant was commissioned early and on budget with performance exceeding the design guarantee. Our well design and drilling practices have resulted in high productivity wells (the largest producing over 20 megawatts electrical) augmented with an antiscalant dosing system to control carbonate deposition. Since commissioning, the plant's availability has met or exceeded expectations, with two units exceeding 99% availability during 2014.

Contact has a combined gross geothermal generation output of 431 MW.

431

495,200
cubic metres of earthworks

2,600
tonnes of reinforcing steel

5,550
lineal metres of piles

1,400
tonnes of structural steel

20,000
cubic metres of concrete

3,880
lineal metres of electrical duct banks

5,800
lineal metres of underground mechanical pipe

5,000
lineal metres of carbon steel mechanical pipe

275,000
lineal metres of electrical and instrumental cable

1,300
lineal metres of fibre reinforced plastic condensate pipe work

Is it possible to innovate for the long term, protecting assets and the future of natural resources?

Contact believes the answer's 'yes'. Our experts take a sustainable, long-term view of innovation to enhance and protect operational activity and environmental resources.

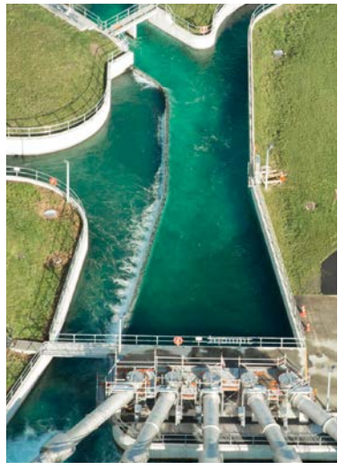
Case study: Improving environmental performance

Wairākei bioreactor – a world first

To prolong the life of the Wairākei power station we needed to find a solution to improve the environmental performance of the plant and reduce the impact on the Waikato River.

Hydrogen sulphide (H_2S) is present naturally in geothermal steam. As a result of the condensing process used by the Wairākei station, some H_2S dissolves into the station's cooling water, which is then returned to the Waikato River, impacting water quality. We corrected that by developing the Wairākei Bioreactor – a world first and an award winning solution.

The bioreactor harnesses the power of billions of naturally occurring bacteria endemic to the Waikato River to treat the water before it is returned to the river. The bioreactor is designed around a large network of 378 kilometres of underground pipes that create an environment for the bacteria to live and grow in. Cooling water from the power station flows into the bioreactor and passes through the pipe field where the bacteria naturally remove up to 90% of H_2S from the cooling water before it is returned back to the Waikato River. This is the first bioreactor in the world to be used in geothermal electricity production.



The Wairākei bioreactor

Case study: Adapting solutions to reduce costs

Contact is always seeking more cost effective solutions to traditional, disruptive and expensive methods of keeping geothermal wells in working order. Traditionally, this was achieved by cooling and shutting down a well, then completing a well workover with a drilling rig.

Our team approached things differently and adapted methods used in the oil and gas industry, by applying both broaching and live well workovers using coil tubing in the high temperature, abrasive environment in geothermal wells.

We worked with a contractor to be the first in New Zealand to utilise broaching, a wireline intervention technique to remove calcite and scale in drilling casing. Applying the technique to 14 geothermal wells allowed us to regain 22 MW of production for less than 5% of the typical cost of completing the 14 well workovers using a drilling rig. Broaching has allowed wells that have been uneconomic and dormant for years to contribute to our electricity generation once again.

We've also taken an innovative approach to undertaking live well workovers using coil tubing. It means the workover can be completed without the need to quench the well, at less than half the cost and with downtime of less than 10% of the traditional drilling rig method.

The process uses high temperature down hole motors powered by surface pumps, to drive a milling bit that cuts mineral scale from the well. Water is pumped through the two inch coil tubing at a rate of 300–400 litres a minute, while the well flows at around 2,500 litres a minute.

During the process, the well flow is diverted from the power station to an atmospheric silencer. Material removed from the well is flushed to the surface and improvements in stream flow can be monitored in real time. Costing less than 50% of a traditional drilling rig approach, the live well workover method also enables the well to be returned to service within just four days – avoiding the usual outage of up to six weeks.

Live well workovers using coil tubing can be completed at less than half the cost and with less than 10% of the downtime of the traditional drilling rig method.

50%

The Ohaaki wetlands

When it comes to innovating for local conditions, just how local do we get?

We'll always go to the core of local conditions and issues to create innovative, breakthrough solutions. We build a detailed picture of the characteristics of the subsurface geothermal resource, enhancing the long-term management of the steamfield and enabling more efficient drilling activity. It's all about the innovative use of data to monitor and model for optimum operation and performance.

Case study: Underground monitoring using the Wairākei micro seismic network

Using technology from the US, we positioned an array of ultra-sensitive geophones deep within the steamfield to accurately detect and record ground movement from natural and induced events – often so faint they're unable to be detected without the use of technology.

It takes years to build a thorough picture of the positioning of underground faults and fluid movement. This leading technology allows us to monitor even the smallest changes and use the information to inform our long-term approach to managing the field.

Case study: Interpreting reinjection data to better understand drivers of well performance

Understanding well performance is critical, so we undertook a thorough statistical comparison between test data gathered as geothermal wells were completed, with performance of in-service wells across a range of operating conditions. The outcomes are helping to advance the science of reservoir engineering.

Our work focused on the effect varying the temperature of fluid had on our capacity to reinject it, and the associated impact on the field. The key benefit is enhanced economy of effort in the management of the steamfield.

At the well design phase, the information enables us to more accurately predict well drilling specifications, including more accurate prediction of the number of wells needed to effectively reinject the volume of fluid involved. This reduces both effort and costs and allows us to predict and plan for the outcome of changing operating conditions and pressures prior to them occurring, and to better understand the interaction between the well and the reservoir.

Case study: Developing innovative methods for examining, visualising and analysing reservoir parameters

Recognising an opportunity to utilise multiple data sets to build a deeper understanding of the Wairākei subsurface environment, we took the innovative approach of partnering with a software provider to support the development of beta test software.

The developed software integrates our subsurface 3D geological model of the Wairākei field with the reservoir model of the environment. The result is a new product that provides a more detailed view of the subsurface environment, enabling us to more efficiently test scenarios and improve the way we manage the resource.

What's the key to working positively with local communities to form true partnerships?

We always start with the philosophy of being 'the neighbour you'd want to have'. It's a positive, solution-minded approach that encourages true partnerships from the outset.

We've developed strong partnerships with a broad range of local groups and invested in a number of initiatives providing social and economic support to our communities. Our partnerships with indigenous communities are meaningful and mutually beneficial.

The indigenous people of Aotearoa/New Zealand have a unique place in the fabric of our country. Through the country's founding document, the Te Tiriti o Waitangi/The Treaty of Waitangi, the joining of two peoples began the nation that is Aotearoa/New Zealand today.

Contact recognises the special status that tangata whenua (first people of the land) hold and the aspirations that they have to protect and sustainably develop their taonga tuku iho (inherited treasures) which include water and geothermal resources. Contact strives to be partners in relationships with tangata whenua which grow both of our organisations, that grow our collective knowledge and experience, and contribute to our country. We are proud of our relationships with tangata whenua and we seek to continue to improve them over the years to come.

Case study: Partnering to address long-standing issues

Ngāti Tahu is an indigenous tribe and is a landowner in New Zealand's central North Island. Contact developed a genuine partnership with Ngāti Tahu, reaching agreement on how to work towards positive resolution of 17 years of conflict relating to the operation of the Ohaaki power station and the damage caused to tribal treasures and resources.

Over the years, the operation of the Ohaaki power station had caused ground level subsidence of up to 3.7 metres, putting the Ohaaki marae (traditional meeting house) at risk of being flooded. We negotiated with the three entities that manage the land on behalf of the Ngāti Tahu landowners – the Ngāti Tahu Tribal Trust, the Marae Reservation Trust and A1 Section 30. Collectively we worked through historical differences and found a positive approach to resolution.

Through our partnership agreement we are working with the iwi to protect the marae from future flood risk and have set protocols around use of the land to protect and monitor culturally significant sites. The agreement provides compensation for and acknowledges the damage caused by geothermal development to their tribal community and treasures.

Dennis Barnes and Whaimutu Dewes at the celebration of the Ngāti Tahu partnership

Leo Rika and James Kilty hongi at Ohaaki Marae

To help future proof the agreement, several layers of engagement have been established between Ngāti Tahu and Contact, from the chair or CEO level, to management level, as well as on the ground within operational processes. This truly collaborative approach was acknowledged by the industry when the landowners and Contact were jointly selected as finalists in the 2014 Deloitte Energy Excellence Awards in the Environmental category.

Case study: Commercial geothermal exploration with indigenous landowners

In 2009 Contact was chosen by the Proprietors of Taheke 8C and Adjoining Blocks Incorporation (Taheke 8C) to partner in a proposed geothermal power development on Taheke 8C's land near Lake Rotoiti, north east of Rotorua.

The joint venture involved equal representation, shared risk and effort, and mutual commitment to sustainable development, capturing Taheke 8C's requirements for the future of its people and the geothermal taonga (treasures).

In February 2010, a project agreement between Taheke 8C and Contact was signed and field investigations and exploratory drilling began on site in September 2010. The project awaits a change to market conditions before proceeding further; however the partnership continues with opportunities for Taheke 8C members to undertake internships with Contact.

Since 2010 the Swim Well Taupō programme has provided free swimming and water safety lessons to around 3,000 students each year.

3,000

Case study: Supporting community aspirations

As a proud member of the local Taupō community, with a significant operational presence, we support and invest in a number of key local initiatives where our involvement can make a true difference.

Swim Well Taupō

In 2010 we went directly to the people of Taupō and asked them which community organisation they believed needed our support. Swim Well Taupō was the winner of our 'What does Taupō need?' promotion and we've continued to support it ever since.

Since 2010 the Swim Well programme has provided free 'learn to swim' and water safety lessons to around 3,000 school-aged students each year. Taupō is situated beside a major lake and river, popular for swimming, fishing and recreational water sports. By providing free access for children to develop their confidence and independence in the water, Contact is playing a key role in ensuring families can safely enjoy this treasured local resource.

Lake Taupō Cycle Challenge

Contact has been principal partner of New Zealand's largest cycling event for the past six years. The Contact Lake Taupō Cycle Challenge attracts around 8,000 participants and delivers over $6 million into the Taupō community each year.

The picturesque course takes riders around Lake Taupō, and the Contact Huka mountain biking course includes our Wairākei steamfield site. Our special focus with this event is our partnership with approximately 800 volunteers, essential to the event's safety and smooth running. The Contact Lake Taupō Cycle Challenge is also keenly supported by Contact employees, particularly those working at the nearby Wairākei, Te Mihi, Ohaaki, and Poihipi Road geothermal power stations.

'Behind the Plug' geothermal schools' programme

Looking to find a new and innovative way to help local children learn more about the Wairākei power station and geothermal resource on their doorstep, we partnered with education curriculum specialists Ministry of Done to create a series of interactive classroom resources for primary school children.

Six Taupō and Wairākei schools, comprising 450 students across 15 classrooms, took part in the initial pilot of the 'Behind the Plug' programme in 2014, with further roll out of the programme planned for 2015. Members of the local Contact geothermal team visited classrooms as part of the programme and teachers utilised a range of specially developed print and online resources to lead students through interactive lessons. The Behind the Plug school kit is now widely available via Apple's iTunes U app.

Tumblr:
http://behindtheplug.tumblr.com/

iTunes U:
Search for 'school kit' within the iTunes U app, then select the Behind the Plug collection.

Bringing Te Mihi to life within Minecraft

In 2014, we created and launched a Contact Te Mihi custom map for popular children's computer game Minecraft.

The interactive world enables players to take a journey to Taupō for an exclusive look into the Te Mihi power station, exploring dark production wells deep within the earth or mighty turbines that turn geothermal steam into electricity. The world of Te Mihi in Minecraft offers endless exploration, hidden treasures and unique discoveries, giving players a unique way to learn more about renewable energy and how it's harnessed to power our cities.

How can you achieve operational excellence across the board?

It's about having high levels of operational expertise at every step and the ability to apply it in innovative and smart ways – from creating flexibility to support trading outcomes, to adopting new drilling approaches, through to robust maintenance to achieve high plant availability.

Case study: A successful nine year geothermal drilling programme

Our ambitious operational drilling programme over the nine years to 2014 has seen significant growth in our in-house team and expertise. The programme delivered the wells for the Te Huka and Te Mihi power stations, ongoing maintenance, as well as greenfields exploration.

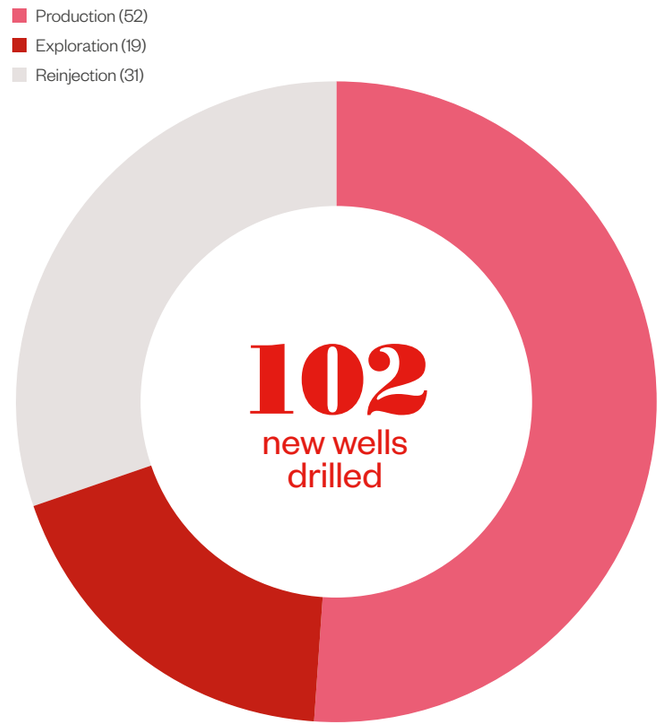
The continuous drilling programme saw over 100 wells and more than 150,000 metres drilled, with up to three drilling rigs operating concurrently and 922 drill bit runs completed.

A focus on well quality, the adoption of new technology, new approaches and lessons learned along the way saw us achieve significant results. As a company, we invested in our well design process, designing more flexibility and contingency into our drilling operations.

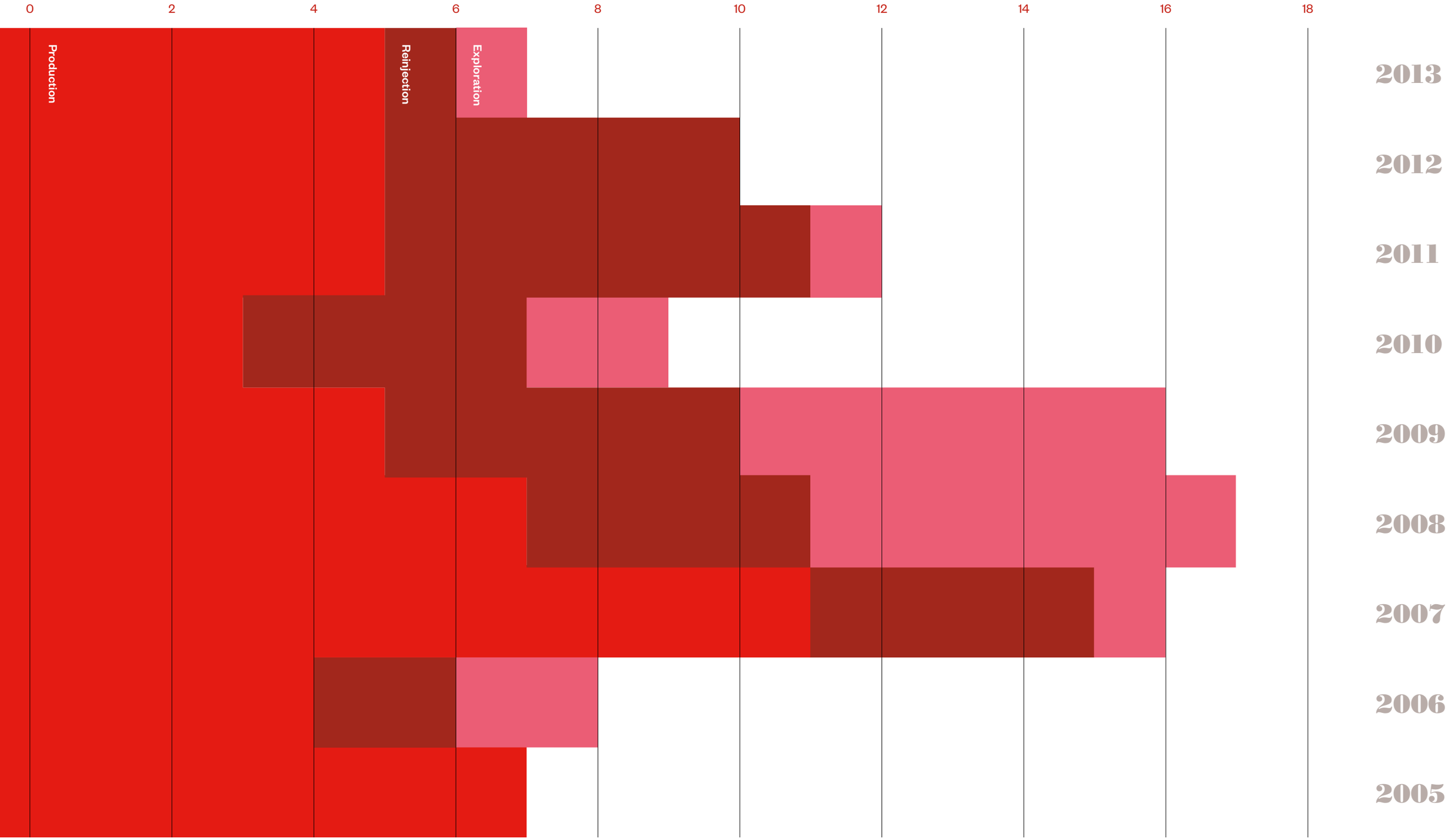
We were one of the first operators to undertake geothermal drilling using reaming and drilling with casing and have continued to evolve our well construction capability using aerated drilling. The aerated drilling method offers better control, markedly reducing the risk of the drilling bit becoming stuck.

We've also improved our reinjection capacity while reducing the environmental impact of our older plants, by drilling a significant number of reinjection wells to take water previously returned to the river. The use of MB Century's Rig 32, which is custom specced for geothermal drilling, introduced significant automation, boosting safety, with only one worker required to operate the rig from an enclosed operator's console, compared with four people on the drilling rig floor previously.

Through analysis and making adjustments to our process, we've also been able to greatly reduce the time taken to overcome a well hole collapse from 12–46 days to 0–5 days since 2011.



Geothermal wells drilled per year



Case study: Delivering strong availability over long periods of time

The performance of the Wairākei power station illustrates Contact's ability to successfully maintain and operate geothermal power stations to achieve high levels of generation availability over decades.

Commissioned in 1958, Wairākei continues to achieve impressive availability performance – testament to the way the plant has been rigorously maintained.

See page 33 for the availability performance of Wairākei power station over the past 20 years.

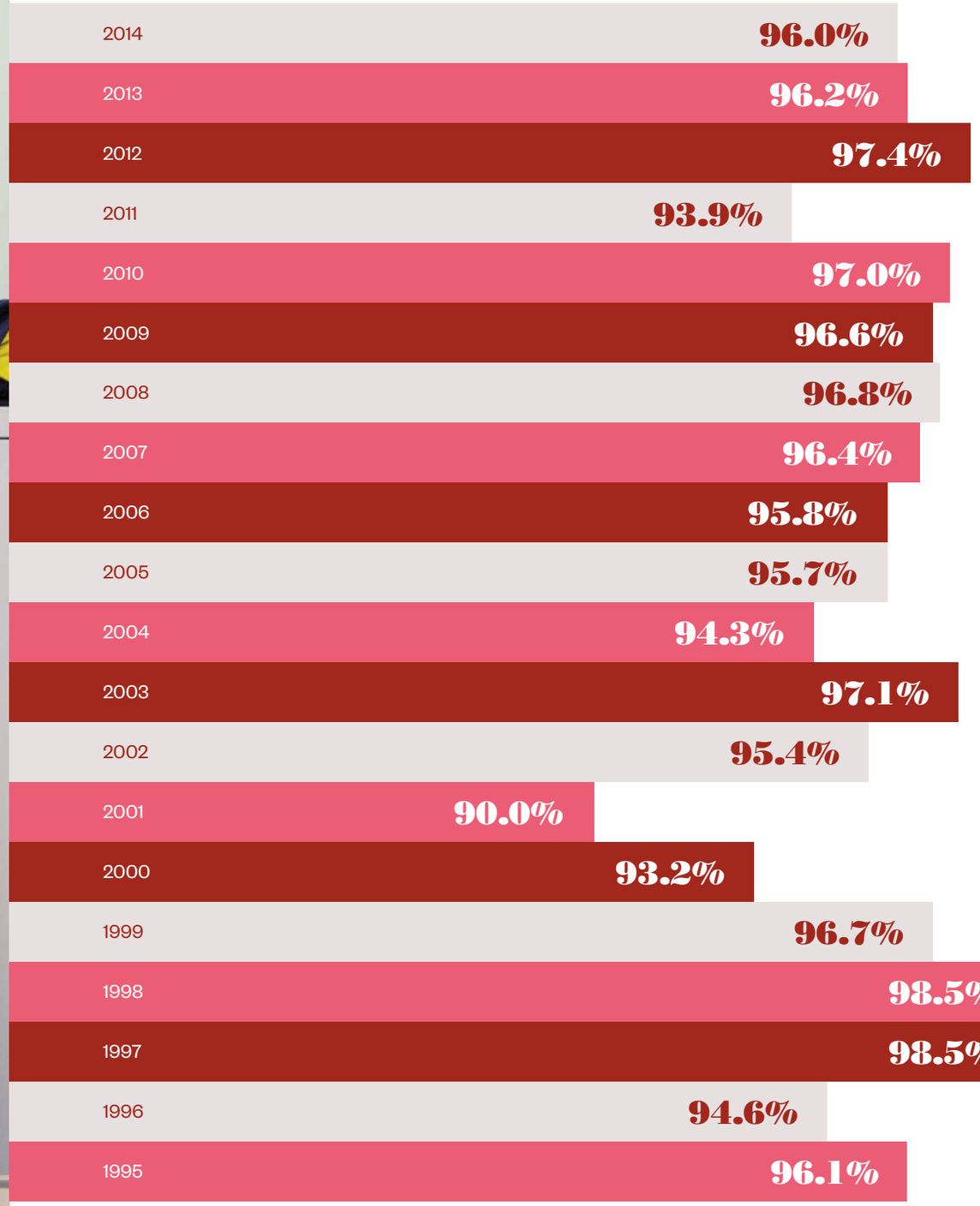
Case study: Wairākei Investment Programme

This major four-year programme targeted the delivery of a lower average cost of generation and additional flexibility in operating our fleet of geothermal plants.

The Wairākei Investment Programme included the construction of the $623 million Te Mihi power station and steamfield connections; development of the Wairākei bioreactor; drilling a number of new wells and the expansion of the Wairākei steamfield.

(For the complete story on this programme and the significant operational improvements, please see page 14.)

Wairākei power station Availability performance



Data: Wairākei A and B stations. Contact financial years ended June 30.

What gives us an innate understanding of the importance of sustainable operation?

We come from a country that is rich with natural beauty and renewable resources. A desire to add value to the resources we develop, to protect and care for the environment, and respect people's values, cultures and beliefs are central to the sustainable philosophy of New Zealanders.

The vision of our forefathers, with their early commitment to renewable generation, is something that we continue to benefit from today with almost 80% of New Zealand's electricity produced from renewable sources in 2014. Hydro, geothermal and wind generation all play a part in powering households and businesses and we understand the need to care for the natural resources that fuel the production of energy.

Contact's Wairākei power station was commissioned in 1958 and sits alongside a fleet of geothermal and hydro plants that, after decades of operation, continue to reliably produce environmentally friendly energy. As an organisation we generated close to 70% of our energy from geothermal and hydro power in our 2014 financial year, meaning the care of natural resources is critical to the ongoing operation of our business.

Renewable generation by country

Data sources:
NZ – 2014 MED NZ Quarterly Energy Survey Dec 2014.
Sweden – 2013 IEA. Chile – 2013 Empresas.
United Kingdom – 2013 Gov UK statistics.
Australia – 2013 BREE, Clean Energy Council AU.
Indonesia – 2012 EIA. USA – 2014 EIA.

Get in touch to talk to us about our geothermal operations, expertise or potential opportunities.

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Ngā mihi,
Nā matou katoa
o Contact.

Yours with thanks,
from all of us here
at Contact.

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